



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



Long Range Management Plan
Border Management Unit
Averill Mountain Wildlife Management Area
Bill Sladyk Wildlife Management Area
Black Turn Brook State Forest



Norton, Holland, and Averill, Vermont
10,596 acres

Prepared by: St Johnsbury District Stewardship Team

Approved by: _____
_____, Commissioner
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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

The 10,596 acre Border Management Unit is composed of Bill Sladyk WMA, Black Turn Brook State Forest, and Averill Mountain WMA, in the towns of Norton, Holland, and Averill.

Natural Communities and Wildlife

Twenty-three natural community types have been mapped in the BMU. Forested natural communities are, broadly, spruce-fir forests at the lowest elevations and on rocky ridges, and hardwood forests on slopes at middle elevations. Spruce-fir-tamarack swamps and northern white cedar swamps are abundant, and many of these show signs of beaver influence.

Wildlife present on the parcels are typical of the Northeastern Highlands of Vermont. Features of particular importance on the Unit include the presence (or potential for) “boreal” wildlife like moose, snowshoe hare, American marten, and black-backed woodpecker; ten species of rare or very rare plants; large areas of potential deer wintering area; numerous high-quality wetland communities; and large areas of undeveloped forests.

Planned management for wildlife and plants will focus on maintaining important natural communities and habitats, while creating some areas of both younger and older forests, managing upland openings, and actively restoring degraded aquatic habitats.

Timber Resource

The forests of the BMU are approximately 20% Northern Hardwood, 33% Spruce-Fir, and 33% Red Spruce-Yellow Birch. All of these forests have been substantially altered due to a long legacy of timber harvest.

Planned vegetation management will focus on enhancing the diversity of age classes and species in many areas of the forests, maintaining or enhancing the softwood component of many stands which has been reduced by past logging, and providing high quality wildlife habitat.

Fisheries and Water

The of the BMU exhibit many features that are unique in Vermont, particularly a rare undeveloped, remote character.

The BMU’s small ponds (Beaver, Duck, Round, Turtle, Halfway, Line) have varying fisheries including some that support native brook trout and bullhead, historical accounts of rare round whitefish in Beaver Pond, introduced chain pickerel, and some with conditions that are likely too warm and acidic for substantial fish communities. Holland Pond supports white suckers, introduced chain pickerel, brown bullheads, stocked rainbow trout, and brook trout. The extensive streams of the BMU support native, wild-reproducing brook trout.

Planned management will focus on restoration of degraded aquatic habitats due to failing infrastructure (roads and culverts), and management of fisheries for the most appropriate species.

Invasive Exotic Species

Few invasive exotic pests and plants are known from the BMU.

Planned management will focus on eradicating a small number of known occurrences of common reed. Monitoring will occur to identify any future occurrences early.

Historic Resources

While both native American and early Europeans likely used the lands now encompassing the BMU, it is likely that most uses were ephemeral (such as travel routes and logging), and few historic resources are known from the properties.

Planned management activities will be evaluated for possible historic resources impacts as projects are planned.

Recreation

Dispersed uses including wildlife observation, hunting, and snowshoeing are the predominant uses across most of the BMU. Recreational trails exist for snowmobiling and for hiking to ponds in the northern area of Bill Sladyk WMA and up Averill Mountain. In addition, an extensive road network on Bill Sladyk WMA provides vehicular access to large areas of the WMA.

Planned management will continue the general uses and pattern of activities on the landscape. As part of this, a Remote Forest Reserve has been designated around the ponds of Bill Sladyk WMA, as an area where users can continue to find remote, “wild” experiences, where no additional intensive recreational infrastructure will be developed.

Infrastructure and Access

While Black Turn SF and Averill Mountain WMA contain no permanent road infrastructure, the roads on Bill Sladyk WMA are extensive and will require substantial management. These roads, many of which have not been maintained for decades, are creating the most significant known problems on the BMU. They are degrading water quality, impacting fish habitat, limiting public access for many users.

Planned management will focus on maintaining key access roads on Bill Sladyk WMA, while fixing problem areas, and reducing access to some secondary roads which do not have appropriate condition for continued public use.

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 categories based upon knowledge and understanding of resources and appropriate levels of management. The four categories as applied to the BMU are Highly Sensitive (36%), Special Management (23%), General Management (40%), and Intensive Management (0%). 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 to occur in particular areas.

Management goals for the BMU include strategies to:

- Maintain and enhance forest ecosystem health, the condition of natural communities, and water quality.
- Protect and enhance rare, threatened, and endangered species and their habitat;
- Provide dispersed recreational opportunities and trail systems where appropriate and compatible with other goals.

- Maintain and enhance wildlife habitat through creation of balanced 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.
- Promote an ethic of respect for the land, sustainable use, and exemplary management.
- Enhance opportunities for wildlife-based recreation, particularly hunting, trapping, and wildlife viewing;

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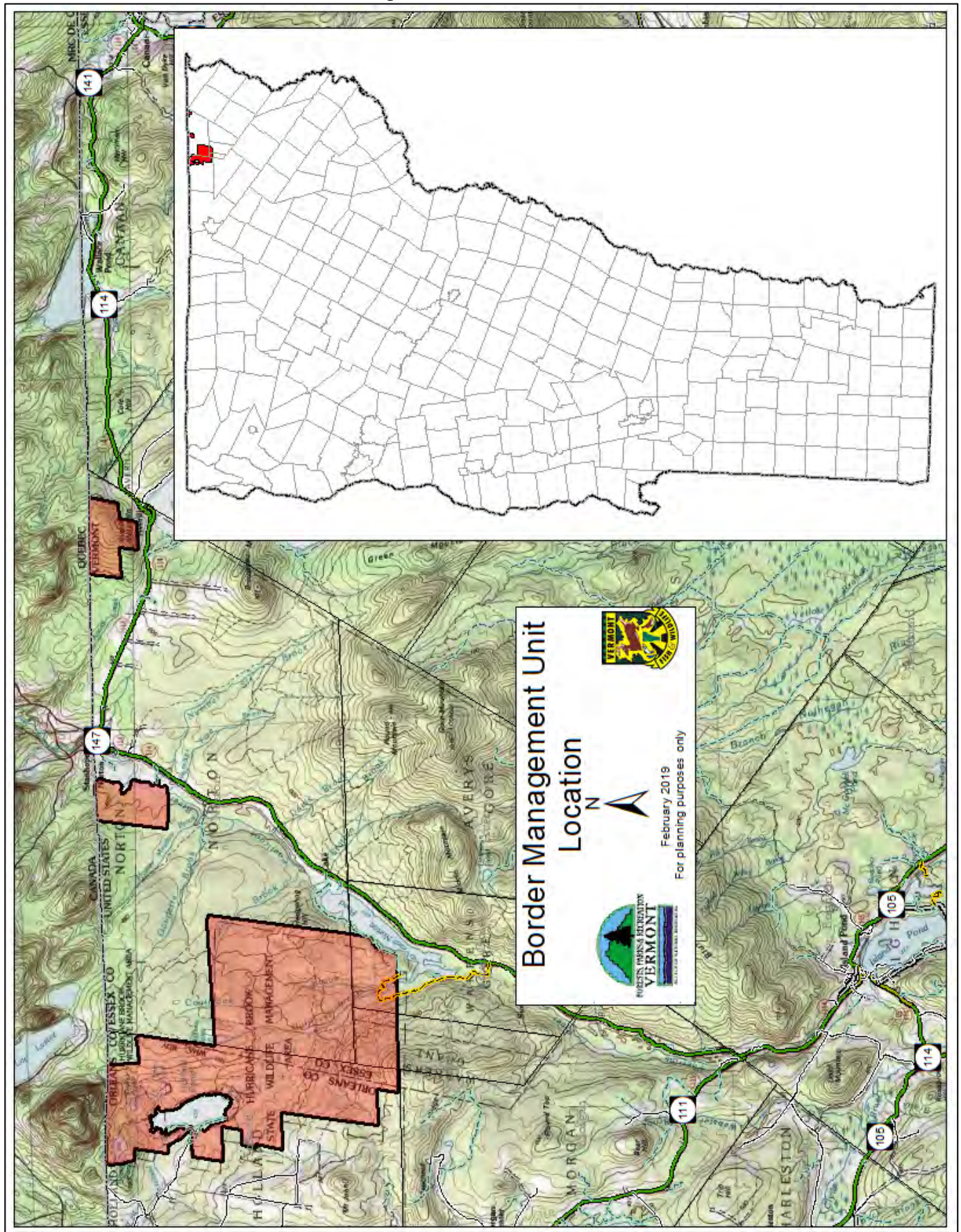
I. PARCEL DESCRIPTION

A. Parcel Description and Location

Bill Sladyk Wildlife Management Area (WMA) is 9,493 acres, largely in the east part of Holland and southwest part of Norton, with small parts in Morgan and Warren's Gore. Averill Mountain WMA is 510 acres in the northeast of Norton. Black Turn Brook is 593 acres in north-central Norton. All three parcels have their northern borders at the US-Canada border.

All three parcels lie at the northern extreme of the Northeastern Highlands biophysical region, and connect to a large area of conserved land to the south, including both publicly-owned land and land under conservation easements.

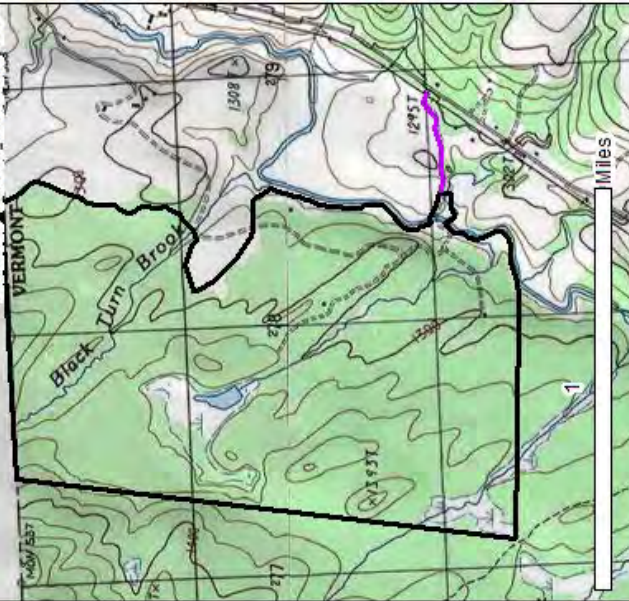
Map 1 – Location



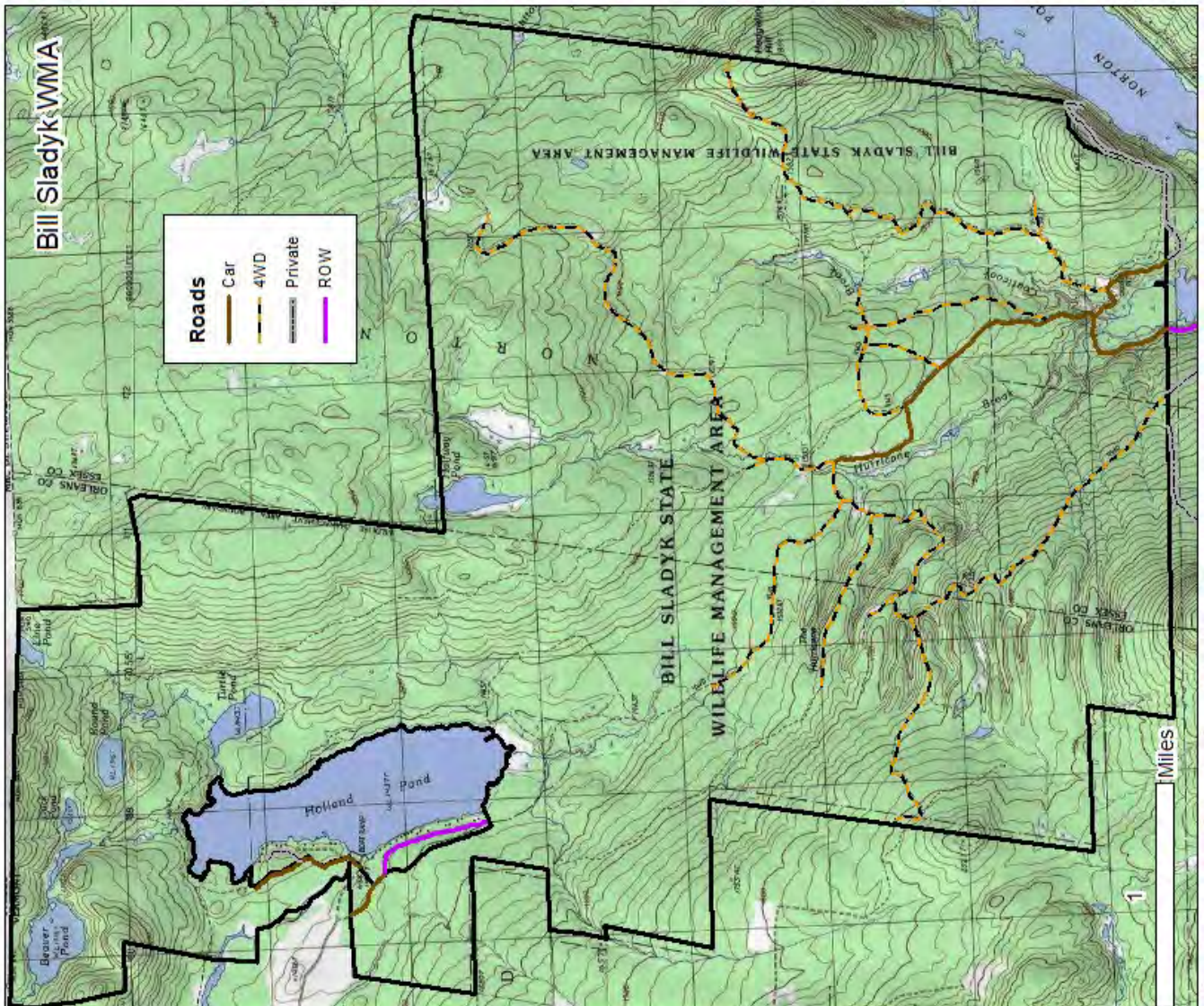
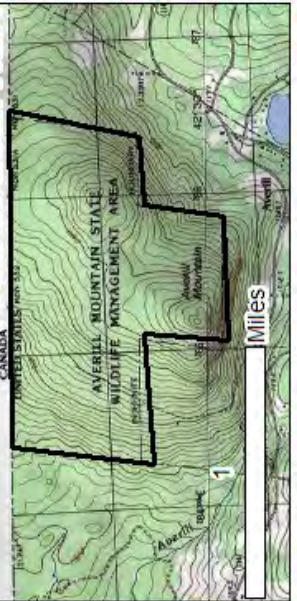


February 2019
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BlackcTurn Brook, SF



Averill Mountain WMA



B. Purpose of Ownership

The Border Management Unit (BMU) is composed of two different ownership types—Bill Sladyk Wildlife Management Area and Averill Mountain Wildlife Management Area are managed by the Department of Fish and Wildlife (FW). Black Turn Brook State Forest is managed by the Department of Forests, Parks, and Recreation (FPR).

These parcels, as with the missions of FW and FPR, share much in common and will often be managed as a single unit. At the same time, each department does have its own distinct mission (as shown on page __) each acquisition came with its own mandate, and funding sources used by each department come with various requirements – so the priority of different goals may vary between parcels. More specific details on how the purposes of the BMU will be accomplished are provided in the Management Actions section.

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

- Maintain and enhance forest ecosystem health.
- Provide dispersed recreational opportunities and trail systems where appropriate and compatible with other goals.
- Produce a diversity of wood products through sustainable management and harvest practices.
- Promote an ethic of respect for the land, sustainable use, and exemplary management.
- Enhance wildlife habitat through creation of balanced vegetative stages (age classes), protection and enhancement of critical wildlife habitat such as deer wintering areas, and protection of unique habitat.

Wildlife Management Areas are managed by the Vermont Department of Fish and Wildlife to meet a variety of conservation and management goals, generally including

- 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;
- Enhance opportunities for wildlife-based recreation, particularly hunting, trapping, and wildlife viewing;

C. History of Acquisition

Averill Mountain WMA

1. The Averill Mountain WMA was established in 1971 when the Vermont Department of Fish and Wildlife received 510 acres in the Town of Norton on the Canadian border from Jean Carttier, of New York.

Bill Sladyk WMA

1. In 1959 the Vermont Fish and Game Department purchased 1620 acres of land and timber rights from Arnold Jackson in the Town of Holland.
2. In the same year the Department purchased 3066 acres in the Town of Holland, 3664 acres in the Town of Norton, 497 acres in the Town of Warner's Grant, and 644 acres in the Town of Warren Gore from Florence Davis. This purchase of 7891 acres from Florence Davis did not include the timber rights.
3. In 1966 the timber rights on some of the land of the Davis tract were purchased from the Fillmore Lumber Company of Quebec in the Towns of Holland and Norton.
4. The remainder of the timber rights in Holland, Norton, Warner's Grant, and Warren Gore was purchased from the Fillmore Lumber Company of Quebec in 1970 with Pittman-Robertson Funds.
5. In 1972 the State of Vermont exchanged a Right of Way with then adjoining landowner, Brown Company. This R.O.W. allowed the State to have legal access across Brown Company Land from VT. 114 on the "Hurricane Road" to state land. In exchange the State gave Brown Company legal access to some of its land across state land.
6. In 1976 the State exchanged 88 acres in the Town of Holland with adjoining landowner Byron Stookey. The state owned 88 acres that was not contiguous with the WMA. The state exchanged this lot with Stookey for land of his adjacent to the WMA near the Holland/Morgan/Warner's Grant town lines.
7. When Arnold Jackson sold land to the state in 1959 he reserved 8.43 acres of land on the south end of Turtle Pond in the town of Holland. In 1996 the state purchased this land from Elmont Jackson.
8. The most recent acquisition at the Bill Sladyk WMA was in 1998 when the state purchased 115 acres on the east and south shore of Holland Pond from the Holland Pond Trust of the Rothschild Family. This land was purchased with Pittman-Robertson Funds.

Black Turn Brook State Forest

1. Black Turn Brook State Forest was established in 1994 when the state received 592 acres of land in the Town of Norton from the United States Government, U.S. Marshalls. This parcel of land formerly known as Earth People's Park had been seized by the U.S. Government.

D. Land Use History

Land use in the region has been mostly limited to logging, dating back to the mid-1800s. Settlements in Holland, Norton, and nearby Canada were based around historical transportation routes and the Grand Trunk Railway. Logging was the predominant use for these lands, which were owned generally in large blocks by commercial timber companies. With good softwood resources, the lands of the BMU would have been valuable areas for logging, while their terrain, poor soils, and distance to settlements made them unfavorable for agriculture. With a shared history of commercial logging extending from the mid-1800s through the mid-/late-1900s, the more recent history for each parcel is described below.

Averill Mountain WMA

Averill Mountain has historically been forest, and was likely harvested multiple times since European settlement. No records exist of infrastructure ever being built on the parcel.

Bill Sladyk WMA

DFW's interest in the Bill Sladyk WMA (then known as "Hurricane Brook WMA") began for its value as deer wintering area, upland hunting and wildlife habitat, and as large areas of undeveloped land. After the State of Vermont acquired the first land (without timber rights) for Bill Sladyk WMA in 1959, a Canadian lumber company purchased the timber rights in 1962 and began extensive road-building and timber harvests. Vandalism of logging equipment led the company to restrict public access, which led to public outcry. Large areas of the parcel were clearcut in the 1960s -1970s, eliminating their former value as deer wintering habitat. In 1970, the FW acquired the outstanding timber and mineral rights. Over time, the State acquired more of the land piece-by-piece and began managing it for wildlife habitat, forestry, and public access. FW practices have included softwood thinning, wildlife opening maintenance, clearcuts for early-successional aspen habitat, firewood harvests, road and trail maintenance, public access management, and many more activities.

In 1983, the "Hurricane Brook Wildlife Management Area" was renamed the "Bill Sladyk Wildlife Management Area" in honor of William F. Sladyk. Bill Sladyk developed an outstanding reputation over 18 years as a Wildlife Forester for FW, until his untimely passing in 1983 at the age of 42. Hurricane Brook WMA—his favorite of the Department's lands—was renamed in his honor.

Black Turn Brook WMA

While still in private ownership, approximately 300 acres of Black Turn Brook State Forest was logged very heavily around 1969 (and an additional 80 acres were cut in 1900). Once part of a large deer wintering area in the region, these harvests reduced or eliminated the quality of the deer wintering habitat on the parcel for a time.

In 1972 a group seeking a place where people regardless of financial, socials, and religious beliefs go live communally bought the parcel sight-unseen. Over the next decade the land supported numerous people camping and up to two-dozen roughly-built cabins as inhabitants came and went. By the late 1970s, the founders of the group had left and the number of

inhabitants dwindled. In 1990, the US Marshals seized the property, having found marijuana growing there. After years of legal limbo, an agreement in 1994 between the State of Vermont, the US Government, the group that had been inhabiting the parcel, and the Vermont Land Trust allowed for a transfer of the parcel to the State of Vermont, to be managed for wildlife, public access, and natural resources. In 1995, the State removed 29 tons of garbage and 12 tons of metal trash, including the remains of all structures on the property. Since acquisition, Black Turn Brook has been managed by the Department of Forests, Parks, and Recreation for the purposes of wildlife, forestry, public use, and other natural resource values.

E. Resource Highlights

Natural Communities and Wildlife

Twenty-three natural community types have been mapped in the BMU. Forested natural communities could broadly be divided into spruce-fir forests at the lowest elevations and on rocky ridges, and hardwood forests on slopes at middle elevations. Spruce-fir-tamarack swamps and northern white cedar swamps are abundant, and many of these show signs of beaver influence.

Wildlife present on the parcels are typical of the Northeastern Highlands of Vermont. Features of particular importance on the Unit include the presence (or potential for) “boreal” wildlife like moose, snowshoe hare, American marten, and black-backed woodpecker; ten species of rare or very rare plants; large areas of potential deer wintering area; numerous high-quality wetland communities; and large areas of undeveloped forests.

Timber Resource

The forests of the BMU are approximately 20% Northern Hardwood, 33% Spruce-Fir, and 33% Red Spruce-Yellow Birch. All of these types have been substantially altered due to a long legacy of timber harvest.

Fisheries and Water

The of the BMU exhibit many features that are unique in Vermont, particularly a rare undeveloped, remote character. The BMU’s small ponds (Beaver, Duck, Round, Turtle, Halfway, Line) have varying fisheries including some that support native brook trout and bullhead, historical accounts of rare round whitefish in Beaver Pond, introduced chain pickerel, and some with conditions that are likely too warm and acidic for substantial fish communities. Holland Pond supports white suckers, introduced chain pickerel, brown bullheads, stocked rainbow trout, and brook trout. The extensive streams of the BMU support native, wild-reproducing brook trout.

Historic Resources

While both native American and early Europeans likely used the lands now encompassing the BMU, it is likely that most uses were ephemeral (such as travel routes and logging), and few historic resources are known from the properties.

Recreational Uses

Dispersed uses including wildlife observation, hunting, and snowshoeing are the predominant uses across most of the BMU. Recreational trail exist for snowmobiling, and hiking to ponds in the northern area of Bill Sladyk WMA and up Averill Mountain. In addition, an extensive road network on Bill Sladyk WMA provides vehicular access to large areas of the WMA.

Infrastructure and Access

While Black Turn SF and Averill Mountain WMA contain no permanent road infrastructure, the roads on Bill Sladyk WMA are extensive and will require substantial management. These roads, many of which have not been maintained for decades, are creating the most significant known problems on the BMU. They are degrading water quality, impacting fish habitat, limiting public access, and limiting access for users.

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

This LRMP is compatible with all known regional and town plans, including:

- The *Regional Plan for the Northeast Kingdom* (2015)
- The *Holland Town Plan* (2012)
- The *Norton Town Plan* (2014)
- The *Unified Towns & Gores of Essex County, Vermont Local Development Plan* (2011, amended 2014).

Specifically, the Border Management Unit furthers town and regional goals including those related to maintaining traditional ways of life and land use patterns, conserving and utilizing natural resources, protecting water quality and open space, and encouraging public access and outdoor recreation.

II. PUBLIC INPUT

The citizen participation process for the BMU Long Range Management Plan was 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 Management Unit has been considered in the preparation of this plan.

An open-house style informational public meeting was held on August 19, 2009 at the Brighton Town Hall in Island Pond, Vermont to present inventory and assessment information and to receive comments.

When ANR renewed efforts to create the LRMP after a long delay, another open-house meeting was held on March 30, 2018 at Brighton Elementary School. Thirty-seven members of the public attended.

Themes from public comments during meetings and comment periods are included in Appendix A.

III. RESOURCE ANALYSIS

G. Legal Constraints Assessment

There are a number of legal constraints that affect the stewardship of the Border Management Unit. They include:

Averill Mountain WMA

No special constraints.

Bill Sladyk WMA

1. Timber rights purchased on 7871 acres in the Towns of Holland, Norton, Warner's Grant and Warren Gore in 1970 with funds provided by the Pittman-Robertson Wildlife Restoration Act. Management activities and land uses on parcels funded with Pittman-Robertson Funds must be consistent with the objectives of protecting, restoring, or improving habitat for wildlife.
2. Also purchased with Pittman-Robertson funds was the 115 acre Rothschild parcel on Holland Pond in the Town of Holland. This purchase is subject to the Pittman Robertson Wildlife Restoration Act also.
3. The State of Vermont received a R.O.W. in 1972 from the Brown Co. from Route 114 to the state boundary on the "Hurricane Road".
4. At the same time, the State of Vermont granted a R.O.W. to Brown Co. across state land to access Brown Company land, at the southeast corner of the WMA. This R.O.W has since been litigated based on modern camp owners desiring access (*Berge v State*) with the finding that a legal R.O.W. does exist for camp owners entitled to it, but such R.O.W. is from Holland along a route that is not currently a road.
5. The International Water Company of Derby Line/Stanstead P.Q. has a R.O.W. for a water line at the Northwest corner of Holland Pond. This water line provides drinking water to the communities of Derby Line, VT and Stanstead, Quebec.
6. Citizens Utility Co. of Newport, VT has a 10 year License for a 30 foot wide R.O.W. for electric transmission line in the vicinity of the Holland Pond Fishing Access in the Town of Holland.
7. Hunting camp lease to Robert Tice of Derby, VT. Life lease. When the State acquired the land in 1959 there were 3 hunting camps leases on the property with the previous owner. The state extended the leases to the life of the current leasee. This is the only remaining camp lease on the WMA.
8. While not part of Bill Sladyk WMA, Fish and Wildlife has the authority to manage specified wildlife habitats on a private parcel, adjacent to the southwestern corner of the WMA. The parcel has a conservation easement held by the Vermont Land Trust which assigns Fish and Wildlife habitat management authority as well as public access protections.

Black Turn Brook S.F.

1. The State of Vermont has a Restricted Right-Of-Way for vehicles in excess of 24,000 pounds to pass through the historical Bauman farm to the northern half of the property ("Poutre & Campbell").

2. The State of Vermont has a Right-Of-Way extending “50 feet from the easterly bank of the Coaticook River...and running...to the westerly side of Route 114 in the Town of Norton.” (“Thibault”). This access currently has a kiosk and public parking area at 114.
3. Vermont Housing and Conservation Board Grant and Agreement # 93-049 (VHCB # 93-049). The agreement specifies the primary purpose “is to conserve and protect the scenic, wildlife, forestry, recreational, open space, and natural resources of the protected property...” and a secondary objective “to ensure public access” including educational activities and trails. The Agreement specifies other requirements, including that the Agency shall conduct and report to VHCB annually with monitoring of the property and shall provide VHCB with copies of updated management plans.

H. Wildlife and Natural Community Assessment

Ecological summary

The BMU is a northern landscape, comprising natural communities with boreal affinities and supporting some species near their southern range limits. As part of a network of intact forest blocks, the BMU is part of a connected and ecologically functional landscape. Twenty-three natural community types and variants were identified and mapped in the BMU. Forested natural communities could broadly be divided into spruce-fir forests at the lowest elevations and on rocky ridges, and hardwood forests on slopes at middle elevations. Most of these forests are relatively young due to past timber harvesting. Spruce-fir-tamarack swamps and northern white cedar swamps are abundant, and many of these show signs of beaver influence. Those swamps that do not have beaver influence may represent some very high quality examples of these wetland communities, particularly the cedar swamps. Open wetlands, including beaver-influenced bogs and fens, offer habitat diversity and support rare plants. These open peatland habitats also may support rare invertebrates, but these species have not been inventoried in the BMU.

Wildlife summary

Wildlife species known from the BMU reflect the habitats discussed in-detail below. The most common species on the BMU are those that rely on forests for some or all of their needs (e.g., fisher, bear, ruffed grouse, and scarlet tanager). Also common are many species that rely on wetlands (e.g., otters, beaver, dragonflies, and numerous birds). In addition, the BMU supports a variety of species that use young forest habitats for at least part of their annual needs (e.g., moose, bobcat, snowshoe hare, American woodcock, and ruffed grouse), while species associated with human development (e.g., starlings and house sparrows) are rare. Importantly, many species found on the BMU are common to boreal communities, north of the United States, but uncommon in Vermont (e.g., black-backed woodpecker and American marten).

The following are summaries of wildlife known from the BMU organized by major species groups. See the following sections for more details on listed species (Special Concern, Threatened, and Endangered) and focal species (those featured in management of the BMU).

Birds

The BMU provides habitat for more than 100 species of birds. Most of these species breed on the BMU, while others use the area during migration or wintering.

Numerous species of birds that are known to or may occur on the BMU are of conservation concern including the Special Concern black-backed woodpecker, gray jay, and boreal chickadee; and the Rusty Blackbird, which was recently listed as Threatened. Most of these rare species are “boreal birds” that occur mostly in the spruce-fir forests of Canada. The lowland spruce-fir and mixed forests of the BMU provide a rare habitat for these birds.

Game birds likely find acceptable habitats in the BMU. Turkey likely inhabit the extensive forests at low densities, waterfowl breed in the numerous wetlands, and ruffed grouse and American woodcock make use of the shrubby floodplain habitats and young forest areas.

Mammals

The BMU supports at least 30 species of mammals.

The fifteen species of small mammals known to occur in or around the BMU, including the Special Concern rock vole, generally rely on forested and riparian environments and make use of habitat elements including uncompacted soils, ground cover, rocky areas, herbaceous understory vegetation, downed logs, and tree cavities.

Most of Vermont’s nine bat species have been found in the region and may occur on the BMU, though specific survey have not been conducted in the area. Bats are a high conservation concern given recent dramatic population declines, but likely find good habitats across the Unit’s forests, wetlands, and other habitats.

Numerous mid-sized mammals are known from the BMU, including coyote, fisher, beaver, otter, raccoon, snowshoe hare, American marten, and Canada lynx. These species tend to use a variety of habitats. Many find their greatest success in areas of forest interspersed with regular openings (coyote, red fox), while other prefer continuous forest cover (fisher), and others still rely on streams and wetlands (otter, mink). Beaver are common on the BMU in the extensive wetland communities, and are particularly important for their role in creating open water, wetland, and successional habitats. In addition, American Marten (state Endangered) and Canada lynx (federally Threatened, state Endangered) have both begun to naturally recolonize northeastern Vermont and may be present. These two species specialize more in their habitat choices, with marten preferring structurally diverse mature forests and lynx preferring dense, young softwood forests.

The three big game mammals likely find good habitats across the BMU. Bear and moose thrive in the extensive, contiguous forests of northeastern Vermont. The BMU’s large softwood areas provide critical, and regionally-significant, wintering areas for deer, and wetlands provide feeding areas for bear and moose. Soft and hard mast plants throughout the forest and openings provide important food sources for bears, and the remoteness of the region allows generally shy moose and bear to largely avoid human contact.

Reptiles and Amphibians

Twenty or more species of reptiles and amphibians may occur on the BMU. The BMU itself contains at least two species of turtles, three species of snakes, six species of salamanders, and eight species of frogs and toads (including the uncommon mink frog). Generally, these species rely on wetlands including vernal pools, streams, and ponds, and adjacent uplands. Many also

require or prefer the cool, moist conditions offered by a full forest canopy and downed woody material to provide cover, moisture, and thermal moderation.

Invertebrates

Invertebrates are very poorly surveyed across the BMU, as with much of the state. The biophysical region supports at least fifteen species of rare and uncommon odonates, a rare noctuid moth, and three rare or uncommon mussels (one of which is state Threatened). Many of these species rely on high-quality wetland, stream, and river ecosystems. Our knowledge, however, of invertebrate biology is generally poor.

Coarse-filter

Biophysical Region and Climate

Vermont's biological landscapes are divided into eight regions that share features of climate, topography, geology, human history, and natural communities. These regions are continuous in adjacent states, and are related to regional and national classifications of ecological systems in North America. Almost all of the BMU is located in the Northeastern Highlands biophysical region (the northwest corner of Bill Sladyk WMA just barely reaches into the Northern Vermont Piedmont). The Northeastern Highlands region, known to many people as the "Northeast Kingdom" or simply the "north country," is characterized by its cool summers and extremely cold winter weather. This mostly forested region includes the far northern portion Vermont's Connecticut River Valley, and the rugged hills to the west. Bedrock in the highlands is typically erosion-resistant granite or schist, with the latter sometimes contributing to mineral enrichment of the soil. Glacial till covers much of the landscape, and glacio-fluvial features such as eskers, kettleholes, and kame deposits are common in this region (though relatively uncommon in the BMU; see below). The Northeastern Highlands generally receive more annual precipitation than the adjacent piedmont, though not as much as the wettest areas in the Green Mountains.

Bedrock and Surficial Geology and Soils

The geologic history of an area can have a strong influence on the distribution of natural communities. Almost all of the BMU is located on top of a large igneous intrusion known as the Averill Pluton. This Devonian-era granitic rock formed from molten underground rock, that was pushed up into (or "intruded" into) the older sedimentary rocks of the region. Millions of years of erosion have worn down the overlying layers of sedimentary rock, exposing the granite. This strong rock resists weathering, and granite plutons are responsible for the relatively high elevations throughout the Northeastern Highlands. Because this acidic rock weathers slowly, it does not contribute substantially to the development or mineral enrichment of soils. In addition, the western portion of Averill Mountain WMA is underlain by the Gile Mountain Formation, a sedimentary rock that is sometimes calcium-rich. This rock weathers faster than the granite, and has resulted in slight enrichment in the soils of that part of the WMA.

The degree to which this bedrock affects growing conditions at the BMU is mediated by the depth of the surficial materials deposited at the end of the last glaciation, some 15,000-12,000 years ago. As the glacier ice melted, rock fragments of all sizes, from boulders to clay, fell in an unsorted jumble known as glacial till, and most areas of the BMU feature a layer of this over the bedrock. Glacial till can be many feet deep, but is often substantially shallower. In many portions of the BMU the bedrock is found beneath just a few inches of till soil.

While till is almost ubiquitous, other glacial deposits are less common in the BMU. A kame moraine, created from sediments deposited by water flowing along the edge of a melting valley glacier, is mapped along the southeastern edge of Bill Sladyk WMA, along the slope above Norton Pond. These deep gravelly and sandy sediments are exposed in a borrow pit not far from the south entrance to the WMA. An interesting set of parallel ridges south of “The Hurricane” may be of glacial origin, but no mention of this feature was found in any geologic reports. Black Turn Brook State Forest also has an interesting series of parallel ridges, lower than the ones found at Sladyk WMA and apparently composed of coarse sand and gravel. Both sets of ridges would be worthy of further study, as they seem to be an uncommon feature even in the Northeastern Highlands region. Post-glacial accumulations of muck and peat are found in most of the wetlands. These are organic materials deposited in very acidic and anaerobic environments that consequently decay more slowly than they are produced.

The soils of the BMU are primarily products of these surficial deposits. Till-derived soils are the most widely distributed, followed by peat and muck soils. The most widespread NRCS series mapped in the western portion of Sladyk WMA include the till-derived and very rocky Tunbridge-Lyman and Tunbridge-Dixfield complexes. Other mapped till series include the Cabot, Dixfield, and Monadnock silt or sand loams. Bucksport, Peachum, and Wonsqueak and Pondicherry mucks are found in wetland areas. Field observations and sampling found much variation, even within a small area. Of particular note, many lowland environments within the BMU defy easy classification as either wetlands or uplands. In places with flat topography and shallow soil underlain by impervious granite, a thin soil (approximately 6”) develops with several inches of peat on top of an inch or two of mineral soil. A slight rise in the bedrock topography (on the order of inches), however, can suddenly create well-drained conditions. These sites host communities that mix upland and wetland characteristics; many of these are a mix of lowland spruce-fir forest and spruce-fir-tamarack swamp.

Hydrology/Streams/Rivers/Ponds

The BMU receives around 43-47” of precipitation annually, which is average in the state.

The BMU is located primarily within the watershed of the Coaticook River, which begins at Norton Pond and parallels Route 114 to drain north into Canada, eventually reaching to Saint Lawrence River. Bill Sladyk WMA has several headwater streams of the Coaticook River, including Hurricane Brook (which begins in the large wetland complex south of Holland Pond), and Coaticook Brook (which begins at Halfway Pond and Cranberry Bog). Several other small streams in the southeastern portion of Bill Sladyk WMA also drain into the Coaticook River; as do all the streams of Black Turn Brook SF. Most of Averill Mountain WMA also eventually drains into the Coaticook River, though it lacks any substantial streams.

The northwestern portion of Bill Sladyk WMA (including the remote ponds such as Beaver Pond and Turtle Pond) drains into Holland Pond, and then north into Canada via Holland Brook. These waters also eventually reach the Saint Lawrence River, but are not part of the Coaticook River watershed. Finally, a very small portion of hillside in the far northeast corner of Averill Mountain WMA drains east and eventually reaches the Connecticut River.

Wetlands and small streams are abundant within the BMU, but the most prominent hydrologic features are the ponds of Bill Sladyk WMA. Holland Pond and Norton Pond, to the north and south, are the two largest bodies of water. These have extensive shoreline outside the WMA boundary, and have many private camps. The smaller ponds, including Beaver Pond, Round Pond, Line Pond, Halfway Pond, and Turtle Pond are all undeveloped and may be some of the most remote ponds in the state. Many have a pristine wilderness feel, even if the land around them has a history of timber harvesting.

Landscape-scale land cover/land use

Bill Sladyk WMA and Black Turn Brook State Forest are both within a large, intact forest block bounded by Routes 114 and 111 to the east and south, respectively; roads and agricultural lands to the west in Holland; and the International Border to the north. At approximately 35,000 acres in size, this forest block provides interior forest functions, and is part of connectivity corridors extending across the state. It also provides for ecological connectivity into Canada, but roads, development, and agriculture likely limit connectivity not far north of the border. Averill Mountain WMA is part of a much smaller forest block bounded by Route 114 and the border. This block also provides some interior forest functions and contributes to connectivity.

The Northeastern Highlands Biophysical Region, in which the BMU occurs, is largely forested. To the east and south of the BMU are even larger forest blocks.

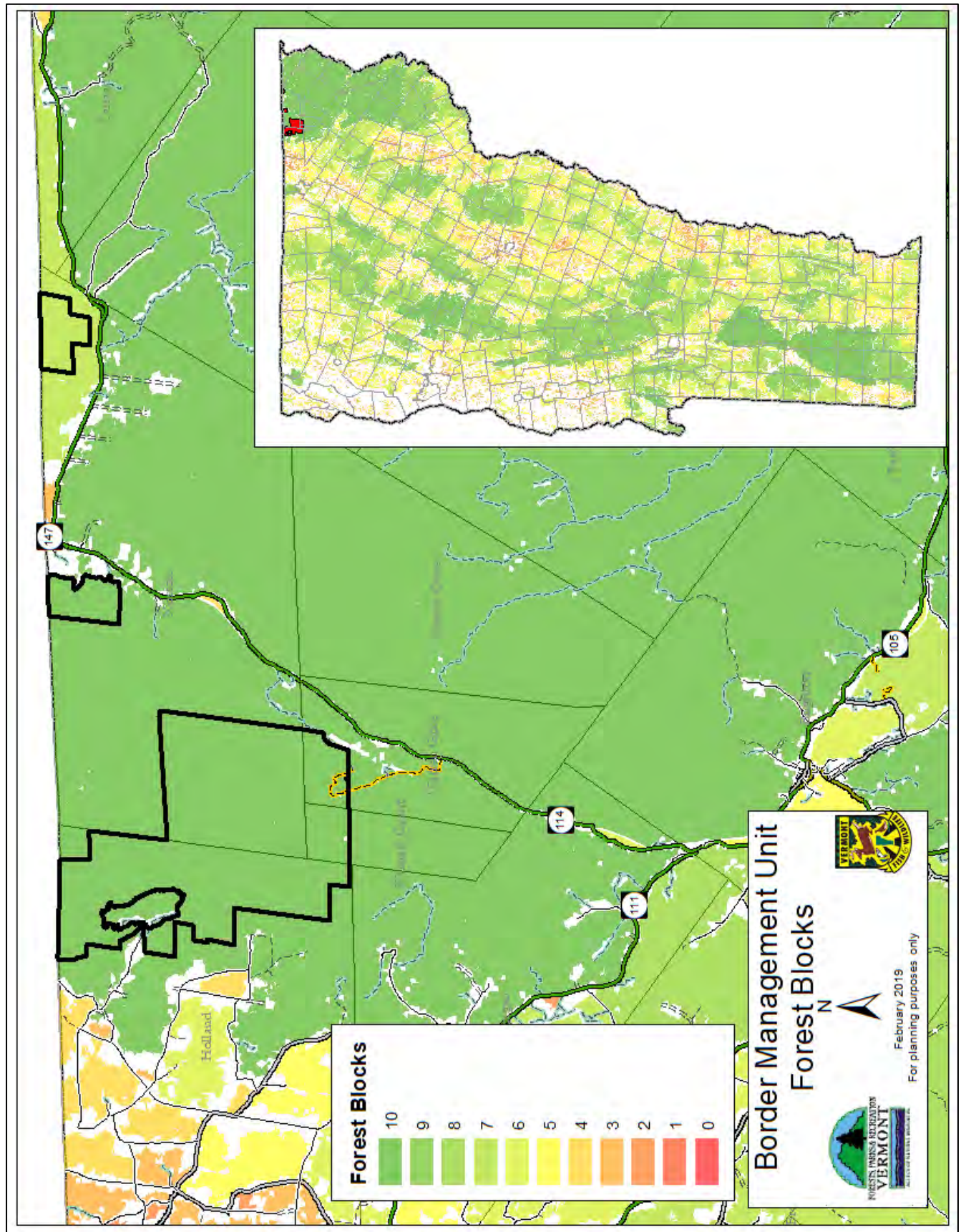
Natural and human disturbance

Natural and human disturbances have both played a role in shaping the natural communities of the BMU. Natural disturbance regimes vary based on the natural community affected. In upland hardwood forests, natural disturbance is primarily the result of wind, ice, or insect damage to individual trees or small patches, resulting in small canopy gaps. Large-scale blowdown or ice storm events are normal processes, but very infrequent – occurring on the order of every 1,000 years for a large blowdown (Lorimer and White, 2003). Spruce-fir forests in the BMU experience similar disturbance regimes, but large-scale wind events are slightly more frequent in these forest types. Fire is an infrequent natural disturbance in any of the communities in the BMU.

The most common natural disturbance in wetlands is by beaver activity. Many wetlands in the BMU have been modified by beavers, resulting in a diverse landscape mosaic of open water ponds, grass- and sedge-dominated meadows, shrublands, and young forest. These areas support many wildlife species not found in the closed canopy woods.

The primary human disturbance in the BMU is timber harvesting. Past timber harvests are still evident in the forest structure—most of the forest in the BMU is relatively young, regrowing after past harvesting. Older forests, with large trees, large dead and downed wood, and tip-up mounds, are lacking. In addition, past timber harvesting appears to have pushed the species composition in places away from spruce-fir forests that would naturally occur, to hardwood forests.

Map 3 – Forest Blocks



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 (Thompson and Sorenson 2000). More than a simple collection of species, a natural community is characterized by complex webs of mutualism, predation, and other forms of interaction. The 89 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. Natural community occurrences vary greatly in their size. Matrix communities, such as lowland spruce-fir forest, occur in broad expanses across the landscape, and form the context in which other, smaller communities are found. Large patch communities, such as spruce-fir-tamarack swamp or northern hardwood forest, typically occur at scales of 10-100 acres. Small patch communities, such as red spruce-heath-rocky ridge forest or black spruce woodland bog, are usually less than 10 acres in size, and owe their existence to highly localized site and disturbance characteristics.

Natural communities in the BMU were identified through aerial photograph interpretation and field surveys. Field data were collected using a Trimble GeoXM global positioning system (G.P.S.) unit, compass, binoculars, soil augur, Cornell pH kit, and a variety of reference manuals for identification of plants, animals, fungi, etc. Many plant specimens were collected for identification in the lab. A Geographic Information System (G.I.S.) map of natural communities was produced using ArcView software from ESRI, Inc. 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 BMU; instead, it should be treated as a first attempt at describing natural communities in this area. Land managers and members of the public should be aware that additional examples of small patch natural communities (such as seeps and vernal pools) 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 Natural Heritage Inventory, 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.

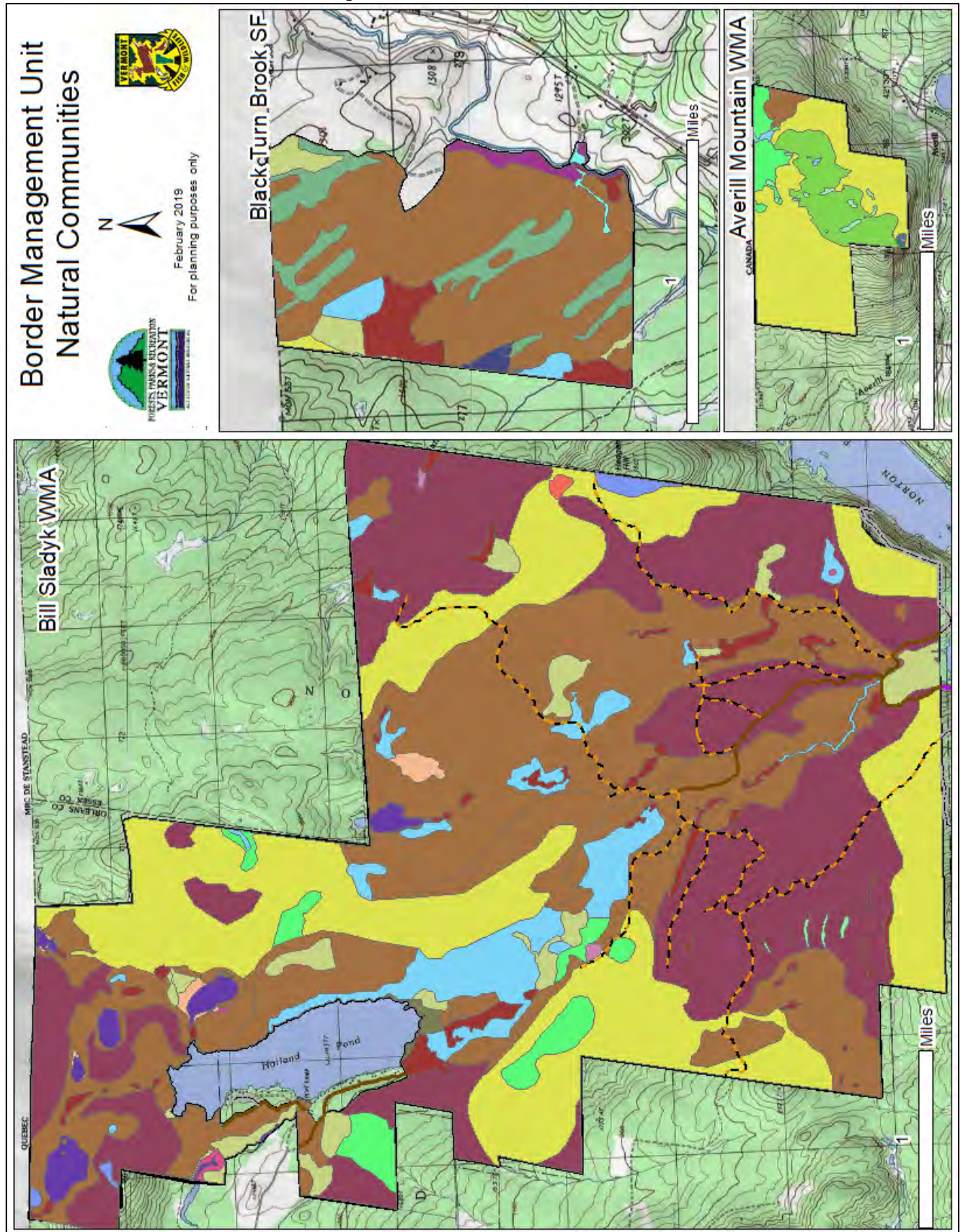
Eighty-one occurrences of 23 natural community types and variants were identified and mapped in the BMU (see table below). A total of 213 natural community polygons were mapped. Some broad patterns emerged from this mapping effort. Forested natural communities could broadly be divided into spruce-fir forests at the lowest elevations and on rocky ridges, and hardwood forests on slopes at middle elevations. Spruce-fir-tamarack swamps and northern white cedar swamps are abundant, and many of these show signs of beaver influence. Those swamps that do not have beaver influence may represent some very high quality examples of these wetland communities, particularly the cedar swamps. This report describes several natural community types or variants not currently recognized by the Vermont Natural Heritage Inventory; these are presented provisionally in this report. One community type, granite pavement pondshore, may be the first observation of its sort from Vermont.

The topography, soils, vegetation, and wildlife associations of each natural community in the Border Management Unit are described in Appendix B.

Natural Communities (Legend)

| | |
|---|--|
|  | Alder Swamp |
|  | Beaver Wetland |
|  | Black Spruce Swamp |
|  | Black Spruce Woodland Bog |
|  | Boreal Outcrop |
|  | Boreal Talus Woodland |
|  | Dwarf Shrub Bog |
|  | Hardwood-Softwood Seepage Forest |
|  | Lowland Spruce-Fir Forest |
|  | Montane Yellow Birch-Red Spruce Forest |
|  | Northern Conifer Floodplain Forest |
|  | Northern Hardwood Forest |
|  | Northern Hardwood Talus Woodland |
|  | Northern White Cedar Swamp |
|  | Open Land |
|  | Open Water |
|  | Red Spruce-Heath Rocky Ridge Forest |
|  | Red Spruce-Northern Hardwood Forest |
|  | Rich Northern Hardwood Forest |
|  | Seep |
|  | Spruce-Fir-Tamarack Swamp |
|  | Sugar Maple-Ostrich Fern Floodplain Forest |
|  | Sweet Gale Shoreline Swamp |
|  | Temperate Acidic Outcrop |
|  | Vernal Pool |

Map 4 - Natural Communities



| Natural Communities of the Border Management Unit | | | | |
|--|--|-------|----------------------|----------------------------|
| Natural Community | | Acres | Vermont Distribution | State Significant Example? |
| Uplands | Boreal Outcrop | 1 | common | yes |
| | Boreal Talus Woodland | 0.4 | uncommon | no |
| | Lowland Spruce-Fir Forest | 3261 | uncommon | yes |
| | Montane Yellow Birch-Red Spruce Forest | 132 | uncommon | yes |
| | Northern Hardwood Forest | 2594 | very common | yes |
| | Northern Hardwood Talus Woodland | 3 | uncommon | no |
| | Red Spruce-Heath Rocky Ridge Forest | 33 | uncommon | yes |
| | Red Spruce-Northern Hardwood Forest | 2737 | common | yes |
| | Rich Northern Hardwood Forest | 8 | common | yes |
| | Temperate Acidic Outcrop | <0.1 | common | no |
| Wetlands | Alder Swamp | 84 | very common | no |
| | Beaver Wetland | 249 | very common | n/a |
| | Black Spruce Swamp | 7 | rare | yes |
| | Black Spruce Woodland Bog | 9 | rare | yes |
| | Dwarf Shrub Bog | 34 | rare | yes |
| | Hardwood-Softwood Seepage Forest | 224 | unknown | unknown |
| | Northern Conifer Floodplain Forest | 13 | rare | yes |
| | Northern White Cedar Swamp | 292 | uncommon | yes |
| | Seep | 14 | common | yes |
| | Spruce-Fir-Tamarack Swamp | 466 | uncommon | yes |
| | Sugar Maple-Ostrich Fern Floodplain Forest | 7 | uncommon | yes |
| | Sweet Gale Shoreline Shrub Swamp | 30 | uncommon | yes |
| | Vernal Pool | <0.1 | Uncommon | unknown |
| <p>For more information on these and other natural communities, see <i>Wetland, Woodland, Wildland: a Guide to the Natural Communities of Vermont</i>, by Elizabeth Thompson and Eric Sorenson. Information may also be found online at: http://www.vtfishandwildlife.com/books.cfm?libbase_=Wetland,Woodland,Wildland</p> | | | | |

Special Habitats

Forest Structural Diversity

The BMU is dominated by a mix of three forest types, in generally even-aged stands of 6-12 inches dbh, with relatively little age/size class diversity. Forests cover the vast majority of the management unit. Lowland Spruce-Fir forests are most common, covering about 3200 acres, while Red Spruce-Northern Hardwood forests cover about 2700 acres, and Northern Hardwood cover about 2600 acres.

Although vegetation age/size diversity are generally lacking, the variety of structures provided within these forest communities supports a diverse array of wildlife—from leaf litter and ground cover, through the low herbaceous layer, the smaller shrub layer, and the taller-still mid-story, each level of vegetation provides nesting, foraging, and cover for a range of forest wildlife. Generally, the variety of plants and conditions observed across the BMU will provide adequate habitat for most species. These structures are naturally patchy and uneven in their distribution, so areas will favor different wildlife species based on their structures (for instance, dense shrub layers will favor wood thrush compared to open shrub layers that favor spruce grouse). Lowland spruce-fir communities have herbaceous cover including three-leaved goldthread, Canada mayflower, and numerous bryophytes, and shrub layers composed of dense spruce-fir saplings and native shrubs covering up to one-third of the area in places. Northern hardwood communities have herb layers with ferns and clubmosses, and shrub layers dominated by hobblebush, with striped maple. Red spruce-northern hardwood communities include Canada mayflower and woodferns as herbaceous growth with hobblebush and striped maple as shrub layers, and red spruce, American beech, and balsam fir in the tree canopy.

Early successional / young forest/ shrubland habitat

Early successional or young forest areas are important habitats for some species, including ruffed grouse, chestnut-sided warbler, American woodcock, and snowshoe hare. These habitats are created following forest disturbances by natural forces (wind, ice, beavers, insects) or human activities (forestry). Dense seedlings and saplings quickly grow into disturbed sites, providing cover, browse, soft mast, and other resources uncommon in closed forests. Within 15 years, however, trees typically have grown enough to create a closed canopy, shading the understory, and reducing their value for young forest wildlife.

On the BMU, young forest patches cover about 200 acres of the landscape, due to past forest management and openings from the natural blowdown of trees.

In addition, more than 600 acres of the BMU are composed of naturally-occurring swamps dominated by alders and other woody shrubs (these are also categorized as wetlands). Parts of these communities are high-quality habitats for a variety of species including American woodcock and snowshoe hare.

Late successional habitat /old forest

The majority of the forest in the BMU is regrowing after past timber harvest. The unique habitat features associated with large trees and natural disturbances of old forests are largely absent. The oldest upland forests that are closest to developing these characteristics appear to be on Averill

Border Management Unit – DRAFT Long-Range Management Plan

Mountain WMA. On Bill Sladyk WMA, some Northern White Cedar Swamps show minimal evidence of past harvest. These sites have large trees and the dead and downed wood providing habitat diversity.

Managed openings

Herbaceous and shrub communities are important wildlife habitats for many species, including deer, snowshoe hare, and dozens of birds. These habitats, however, are rare in the northeast and many species that rely on them are declining in this region, largely due to loss of habitat. Additionally, these communities are ephemeral in nature, as they develop into forest without repeated disturbance.

No grasslands occur on the BMU, but the management unit does support a range of forb and shrub cover. Across the management unit, about 9.5 acres are maintained as permanent openings. BSWMA hosts all 9.5 acres of maintained openings, the largest of which is about 2.8 acres, and all of which are mowed on a three-year rotation.

The majority of these openings is composed of forbs (herbaceous, non-grammanoid plants) such as purple vetch, goldenrod, and asters, woody shrubs including meadowsweet and *rubus* species, with grasses, saplings, and taller trees only uncommonly mixed in. Although small in size, these openings provide herbaceous forage, seeds, insects, berries, small rodents (prey for carnivores and raptors), and nesting materials in much higher concentrations than within the forest, so they contribute significantly to the abundance and diversity of wildlife at BSWMA.

Deer Wintering Areas

Deer wintering areas provide critical habitat where deer can survive harsh winter conditions. They tend to occur at lower elevations, southern exposures, and have dense softwood canopies that reduce ground-level snow depths and minimize wind-chill effects. Ideally, an ample supply of food near the softwood cover is also available, typically in the form of hardwood shoot growth and cedar or hemlock foliage.

The BMU contains a number of deer wintering areas. Essentially all of Black Turn Brook SF (569 acres) is mapped deer wintering area. This is a portion of a large (3897 ac) wintering area extending from Black Turn Brook SF south and west, almost to Bill Sladyk WMA. Bill Sladyk WMA contains 359 acres of mapped DWA between Turtle and Holland Ponds including wetlands to south, and 318 ac along Hurricane Brook and its tributaries. In addition, there are more than 1000 acres of additional lowland spruce fir forest in Bill Sladyk WMA, which are not mapped as DWA on FW's state-wide map because they may not be functional cover currently. Averill Mountain WMA contains no mapped deer winter habitat.

Interior forest habitat

Interior habitats are areas of forests, wetlands, and natural openings that are greater than 200 meters from a permanent human-created disturbance zone, such as a road, farm field, or residential area. While these human land uses support a variety of wildlife (such as bluebirds and grey squirrels), they alter the environment of the surrounding forest and cause negative "edge effects" for many other species, including increased predation on forest birds; decreased habitat quality for amphibians due to increased light and wind in the forest; increased nonnative invasive species such as honeysuckle and buckthorn; and disturbance of sensitive wildlife such as bears.

The vast majority of the BMU is more than 100 meters from developed land uses. With few municipal roads, only a couple of agriculture fields, and essentially no residential development around the BMU, negative edge effects are likely less severe than those often found in more developed land areas. The international border corridor is maintained in natural shrub cover as a narrow linear opening, minimizing these negative effects on the north margin of the BMU. These large core habitats provide excellent areas for most of Vermont's forest wildlife to meet their needs.

Riparian areas

Riparian areas are upland communities adjacent to waterbodies. These areas are often the most biodiverse on the landscape because they support both terrestrial and aquatic species and many species make use of both upland and wetland habitats. Riparian habitats are particularly important for amphibians, mink, beaver, otter, wood duck, and common loon.

Much of the Management Unit is within 100 meters of a wetland or waterbody. These areas are concentrated around the ponds and streams of Bill Sladyk WMA and Black Turn Brook SF.

Hard mast concentrations

Many species of wildlife consume hard mast (in Vermont, beechnuts and acorns), including deer, ruffed grouse, turkey, blue jay, fisher, squirrel, and mice. Hard mast is particularly important to bears, and its availability affects both their reproduction and cub survival. With few oaks, beech nuts are the main source of hard mast in northeastern Vermont. In years of good beechnut production, these stands are heavily used by bears and are known as "key mast areas."

ANR has information on stands with high concentrations of beech and reports of bear-scarred beech from forest inventory data collection. Stands demonstrating both of these qualities may be important mast areas. Assessed in 2010, 16 stands covering almost 2000 acres of Bill Sladyk WMA were noted as having high concentrations of beech trees and evidence of bear scarring. None are known from Black Turn Brook SF or Averill Mountain WMA. Additional field inspection is needed to determine the status and condition of potential stands identified from inventory data.

Soft mast concentrations

Soft mast are fleshy fruits like those from mountain-ash, pin-cherry, apples, *rubus*, and *vaccinium* species. These fruits are consumed by a variety of wildlife including wood turtle, bear, wild turkey, mice, coyote, and many songbirds.

Soft mast occurs commonly in managed and natural openings that are able to develop *rubus* and shrubby vegetation. In addition, natural shrub and floodplain communities often contain many soft mast species including *rubus*, viburnum, and cherry.

Dead and dying wood features / Forest structure components

Overall, about one-third of New England's forest wildlife makes use of dead and dying wood features, including cavity trees, snags, and downed wood. Often these are critical elements, affecting the distribution, behavior, and survival of wildlife.

Cavity trees are standing trees, typically alive, that have sections of decay or damage creating openings within the tree. Cavities in small trees are used by both boreal and black-capped chickadees, while cavities in larger trees may be used by species including pileated woodpecker, wood duck, fisher, raccoon, grey fox, American marten, and multiple bats. Standing dead trees, called snags, serve as perches for birds, cavity trees for birds and mammals, and will eventually fall to the ground, becoming downed wood. Downed wood of small diameters is used by species including white-throated sparrows for nesting and American marten for access to subnivean (under snow) areas, while larger downed wood is used by salamanders and snakes for cover and temperature/moisture moderation, by ruffed grouse for drumming sites, and by species including black bear, smoky shrew, and ovenbird for access to invertebrates living in the wood. Downed wood is also important for germination sites of trees including red spruce and hemlock, and for nutrient cycling in forested ecosystems. Finally, large trees are required to produce large cavities and large downed wood, which receive disproportionately more use compared to smaller cavities and downed wood. For example, bear and grey fox will use large, but not small, downed wood for foraging and cover.

The history of intensive forest management across the BMU has limited the presence of dead and dying wood, particularly in the important large size classes. The BMU's forests, however, have begun to generate dead wood through natural forest development, and some areas provide excellent sources of these habitat features. The even-aged nature of the forests, especially spruce-fir, also poses a risk for the long term supply of these features, as the forest may produce high levels of dead wood for a short time then little more for many decades as the next cohort matures.

Overstory inclusions

The presence of softwood trees within a hardwood stand or hardwood trees within a softwood stand, can add valuable feeding, nesting, and sheltering resources not otherwise available. These inclusions can be as small as a group of just a few trees or as large as a few acres. At least 50 species of birds and 8 species of mammals will make use of such features, including porcupine, southern red-back vole, broad-winged hawk, and golden-crowned kinglet.

Overstory inclusions are common in the BMU. The large area of red-spruce northern hardwood forest provides an excellent mix of this habitat feature. In addition, while both the lowland spruce-fir and northern hardwood forests are more homogeneous than the mixed forest, each does contain inclusions of the other tree types.

Amphibian Breeding Pools

Vernal pools are small (usually less than one acre), seasonal wetlands that lack perennial inlet or outlet streams, have no permanent fish populations, and can be critical for breeding amphibians. During the wettest seasons of the year (*e.g.*, spring or fall) they hold standing water. When the pools dry out they may only be recognizable as an isolated depression in the forest floor, often with a mat of moist or dry leaf litter. Some beaver ponds and other fishless wetlands provide some of the same functions.

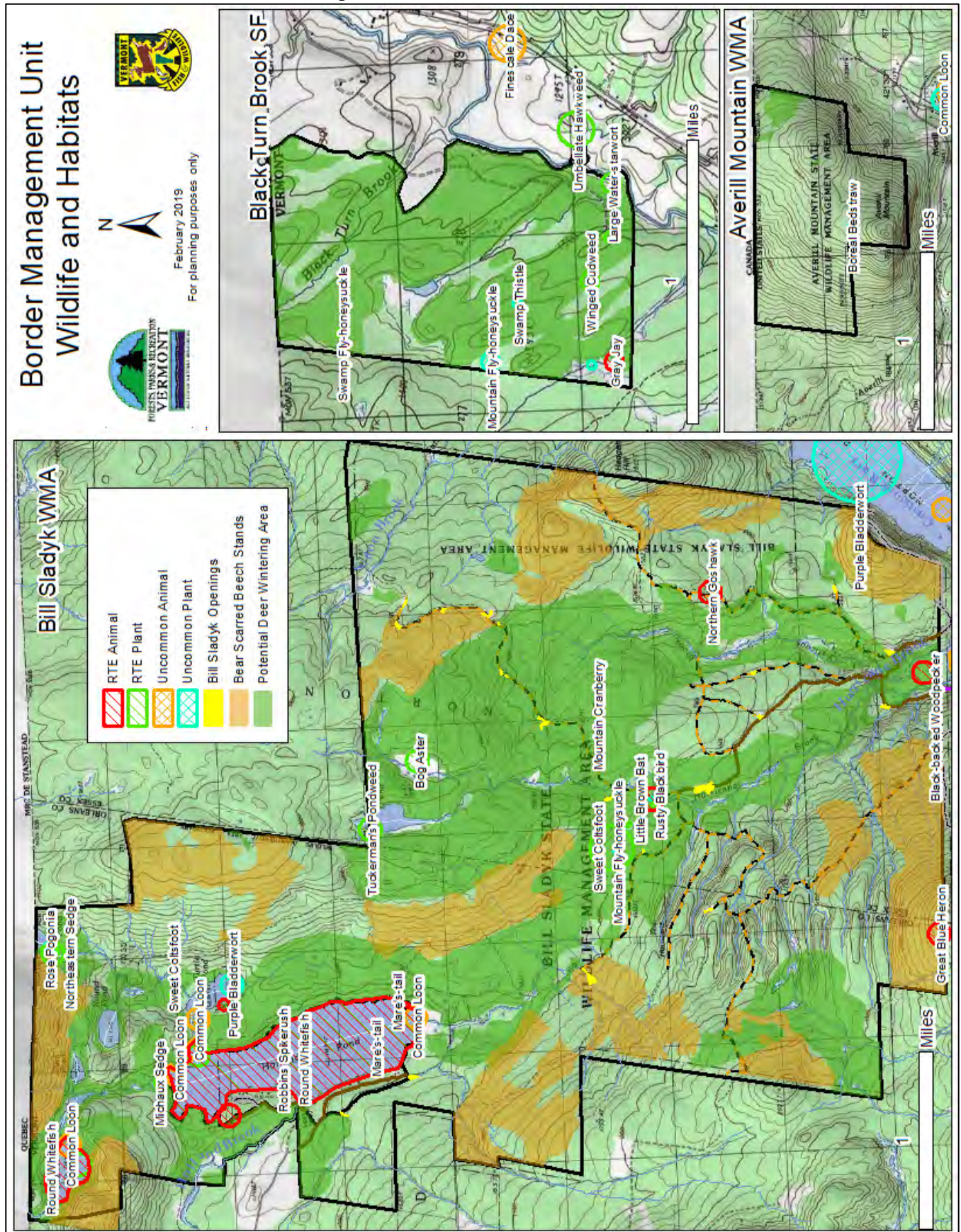
The area adjacent to a vernal pool is important as the species that breed in the pool require uncompacted, deep litter; coarse woody debris; and canopy cover that helps to maintain a suitable forest floor environment that enables dispersal, migration, foraging and hibernation.

Vernal pools known on the BMU are described as Natural Communities above.

Anthropogenic/highly modified areas (e.g., developed)

Developed land uses are limited to the roads and parking areas of the BMU. Overall, these land uses occupy less than 1% of the area of the BMU. These areas may support adaptable generalist species such as raccoons and blue jays to the detriment of more sensitive native forest wildlife.

Map 5 – Wildlife and Habitats



Fine-filter

The BMU is home to a number of rare, threatened, and endangered species of animals and plants.

Rare, Threatened, and Endangered Plants

Ten species of rare or very rare plants have been located with the BMU. Three of these are listed as “threatened” by Vermont state endangered species statute (10 V.S.A. 123). Their occurrence in the BMU is thus very important on a statewide basis. The rare species all are known from wetland or aquatic habitats, though these vary from large open beaver meadows to small montane seeps. Five other plants that are uncommon in the state have also been found in the BMU. These species also generally occur in wetland habitat. Protecting the ecologic and hydrologic integrity of the wetlands within the BMU will maintain the habitat necessary to protect these rare and uncommon species.

Given the size and remoteness of much of the BMU, it is possible that additional rare species are present, but have not yet been detected. Many natural community types—especially wetlands—that are rare or uncommon in the state are abundant within the BMU. These would be likely locations to search for additional rare species.

| Rare, Threatened, and Endangered Plants of the Border Management Unit | | | | | |
|---|----------------------------|--------------------------|--------------------------|----------------|---------------------|
| Species Name | Common Name | Sites Where Found | State Rarity Rank | Rarity* | Legal Status |
| <i>Utricularia resupinata</i> | Northeastern bladderwort | ponds | S1 | very rare | threatened |
| <i>Xyris montana</i> | Northern yellow-eyed grass | Line Pond | S1 | very rare | threatened |
| <i>Oclemena nemoralis</i> | Bog aster | boggy wetlands | S2 | rare | |
| <i>Lonicera oblongifolia</i> | Swamp fly-honeysuckle | forested wetland | S2 | rare | |
| <i>Peteasites frigidus</i> var. <i>palmatus</i> | Arctic sweet coltsfoot | forested wetlands | S2 | rare | threatened |
| <i>Potamogeton confervoides</i> | Tuckerman's pondweed | ponds | S2 | rare | |
| <i>Splachnum ampullaceum</i> | Moose dung moss | boggy wetlands | S2 | rare | |
| <i>Carex cryptolepis</i> | Northeastern sedge | Line Pond | S2S3 | rare | |
| <i>Carex michauxiana</i> | Michaux's sedge | beaver wetland | S2S3 | rare | |
| <i>Galium kamtschaticum</i> | Boreal bedstraw | montane seeps | S2S3 | rare | |
| <i>Alopecurus aequalis</i> | Short-awn foxtail | boggy wetlands | S3 | uncommon | |
| <i>Cirsium muticum</i> | Swamp thistle | wetlands | S3 | uncommon | |
| <i>Lonicera villosa</i> | Mountain fly-honeysuckle | wetland | S3 | uncommon | |
| <i>Pogonia ophioglossoides</i> | Rose pogonia | bog mats | S3 | uncommon | |
| <i>Utricularia purpurea</i> | Purple bladderwort | ponds | S3 | uncommon | |
| | | | | | |
| *for an explanation of these rarity ranks, visit the Vermont Natural Heritage Inventory's website: http://www.vtfishandwildlife.com/wildlife_nongame.cfm | | | | | |

Rare, Threatened, and Endangered Animals

Fifty-one wildlife species known from the BMU are considered as Species of Greatest Conservation Need in Vermont. Of these, fifteen are listed as Special Concern, Threatened, or

Endangered by Vermont, including two which are listed as Threatened by the US Fish and Wildlife Service.

| Common Name | SGCN Rank | RSGCN? | State Rank | Global Rank | SPROT | FPROT |
|-------------------------|-----------|--------|-------------|-------------|-------|-------|
| Bald Eagle | High | No | S1B,S2N | G5 | E | |
| Rusty Blackbird | High | Yes | S3B | G5 | E | |
| American Marten | High | Yes | S1 | G5 | E | |
| Canada Lynx | High | No | S1 | G5 | E | T |
| Little Brown Bat/Myotis | High | Yes | S1 | G3 | E | |
| Northern Long-eared Bat | High | Yes | S1 | G2G3 | E | T |
| Tri-colored Bat | High | Yes | S1 | G3 | E | |
| Black-backed Woodpecker | Medium | No | S2B,S2N | G5 | SC | |
| Gray Jay | High | No | S1S2B,S1S2N | G5 | SC | |
| Northern Harrier | High | Yes | S2B,S3S4N | G5 | SC | |
| Pied-billed Grebe | High | Yes | S2B,S3N | G5 | SC | |
| Wood Turtle | High | Yes | S3 | G4 | SC | |
| Rock Vole | High | No | S2 | G4 | SC | |
| Small-footed Bat | High | Yes | S1 | G1G3 | T | |
| Canada Warbler | High | Yes | S4B | G5 | SC | |

Abbreviations

| | |
|--|--|
| Global Status and State Status: 1 = very rare or critically imperiled 2 = rare or imperiled 3 = uncommon or vulnerable 4 = common to uncommon or apparently secure 5 = common or secure U = unrankable, due to lack of information B = breeding status N = nonbreeding status | Federal Listing and State Listing E = E T = Threatened SC = Special Concern P = Proposed SGCN = Species of Greatest Conservation Need, Vermont Wildlife Action Plan |
|--|--|

Due to their conservation importance, a brief description of the habitat and potential management opportunities for each is included here, though specific management activities that will be undertaken as part of this plan are laid out in Section IV:

Black-backed Woodpecker

see Focal Species accounts, below

Rusty Blackbird

see Focal Species accounts, below

Northern Harrier

Northern harrier have been sighted in the area of the BMU, though no information on breeding or abundance is known. It is likely that the BMU's extensive forests present only marginal habitat for this bird of open lands.

Habitat: Harriers prefer open, and often wet, areas such as meadows, swamps, and fields, where they hunt for small mammals.

Potential management:

- Maintain large open areas.

Gray Jay

The gray jay is an inhabitant of boreal spruce-fir forests, residing here year-round. They are known for their curious and bold behavior around people, earning the nickname “camp robber.”

Habitat: Spruce-fir and mixed conifer-hardwood forests.

Potential management:

- Monitor effect of climate warming on gray jay productivity, which may decrease as a result of lost food supplies.

Bald Eagle

Bald eagles have been reported around the large ponds of the BMU. Eagles breed near large bodies of water, nesting in tall trees. Extensive use of the pesticide DDT caused nest failures and bald eagle declines in the early and mid-1900s. Since the banning of DDT and enhanced protections for eagles, they have begun recovering. Successful eagle nesting in Vermont only began again in the 2000s, but now they have rebounded dramatically.

Habitat: Eagles need large bodies of open water and tall, undisturbed trees for nesting.

Potential management:

- Maintain healthy ponds and fish populations.
- Maintain trees around ponds.
- Where nests are known, implement buffers to prevent disturbance.

Pied-billed Grebe

Grebes are known from a small number of locations in Vermont, typically around large marsh wetlands.

Habitat: Pied-billed grebes inhabit shallow, permanent marshlands that have deep open water nearby. They seek areas with permanent water levels and build inconspicuous floating nests.

Potential management:

- Where breeding, minimize human disturbance or changing of water levels.
- Maintain ponds and marshes free of invasive plants.

Canada Lynx

Canada lynx were extirpated from Vermont. From 2012 to 2014, however, USFWS documented evidence of a family group breeding in the Nulhegan Basin. Presumably, these individuals dispersed from populations in New Hampshire or Maine. The Bill Sladyk-Black Turn Brook area has been identified as one of a small number of potential habitats for lynx in Vermont.

Habitat: Lynx rely on snowshoe hare as the staple of their diet, so they are strongly associated with forests with dense understories, especially sapling/small pole-sized coniferous forests that

support high hare densities. They thrive in northern climates, where deep snow allows them to outcompete bobcats, coyotes, and fishers. They also make use of swamps, bogs, and rocky areas, and create dens in rocky openings, large tree cavities, or fallen trees.

Potential management:

- Create or maintain regenerating conifer or mixed forest mixed with mature forest.
- Create or maintain large diameter snags and woody material.
- Protect rocky and talus areas from disturbance.
- Manage snowshoe hare populations to provide sufficient prey base.
- Maintain landscape connectivity between the BMU and Nulhegan habitat block.
- Survey abundance and distribution of snowshoe hare to determine suitability of prey base.

American Marten

see Focal Species accounts, below

Rock Vole

Within Vermont, rock voles are found only in the Northeast Kingdom. Records indicate this species is present in the area, though specific locations are unknown. Based on its habitat preferences, it may occur on the multiple talus and rocky slopes present.

Habitat: Rock voles rely on cool, moist talus slopes and rocky areas. They prefer sites near surface water, with coniferous or mixed forest cover, and herbaceous ground cover.

Potential management:

- Maintain forest cover in and around rocky and talus sites, to preserve moist conditions.
- Assess distribution across BMU and corridors for dispersal and genetic exchange.

Bats

Four species of state-listed bats may occur on the BMU. In recent decades, non-migratory bats have faced some of the steepest declines of any species in North America. These bats use caves to hibernate through the winter, and have been declining from an introduced fungal disease known as White Nose Syndrome (WNS). The BMU may host four species of state-listed, non-migratory bats: the little brown bat, tri-colored bat, the northern long-eared bat, and the small-footed bat. Of these, the northern long-eared is proposed for federal Endangered listing, while the small-footed bat is of particular importance in this area because the northeast supports a large portion of its global population.

Habitat: These species of bats have a variety of habitat requirements, but generally use forested landscapes with wetland/water and upland openings. They forage both in the forest canopy and over openings, with northern long-eared bats specializing in interior forests with low edge-to-interior ratios, and tri-colored bats avoiding dense forest. These species may use barns and attics for maternity colonies, but may also use forest stands, or (as in the case of the small-footed bat) crevices in cliff faces. Roost areas tend to have greater standing wood volumes, larger trees, and more dead wood than average forest stands, and cavity trees may be important sites. Finally, these species all rely on caves that maintain a stable temperature over the winter for hibernation.

Potential management:

- Create or maintain an adequate supply of dead and dying trees, especially large trees, complex forest structure, and extensively forested areas.
- Maintain stream, pond, and wetland buffers for travel and access to aquatic insects.
- Maintain openings in forested habitats for foraging.
- Assess species present, abundance, and distribution across BMU.

Wood Turtle

Wood turtles are a long-lived species requiring a long time to mature, and reproductive success is often low. This makes them susceptible to significant population declines and slow to rebound even if threats are mitigated.

Habitat: Slow-moving streams with riparian vegetation, shrub swamps, meadows and woods near streams. They also require sandy sites for egg-laying.

Potential Management:

- Maintain high-quality streams and riparian habitats.
- Mow fields in October and mow more than six inches high, to reduce direct mortality.
- Prevent the creation of trails or roads near streams that may support wood turtles, to minimize loss to collection.
- Assess distribution and abundance across BMU.

Focal Wildlife Species

Focal species are a subset of all the species known (or likely) to occur on the BMU, which will be the focus of the most management and research efforts over the lifetime of this plan. These species were chosen based on their conservation need, importance in ecological relationships, and/or human value for wildlife observation or hunting.

| Common Name | VT Rank* | Global Rank* | Legal Status* |
|---|----------|--------------|---------------|
| American Woodcock | S5B | G5 | None |
| Ruffed Grouse | S5B | G5 | None |
| <p>American woodcock and ruffed grouse prefer a mix of mature forest, young forest, and open areas. Both species have declined with the maturation of forests across their ranges, though populations in Vermont appear relatively stable in recent decades. Both species are popular game birds in addition to being well-known by wildlife watchers.</p> <p><u>Habitat:</u> Mixed areas of mature forest, young forest, and fields provide good habitat for grouse and woodcock. Grouse particularly benefit from aspen stands, which are well-represented on Black Turn Brook SF. Both species, but woodcock particularly, rely on alder floodplains.</p> <p><u>Threats:</u> The regrowth of forests from past uses into relatively homogenous, middle-aged forests is thought to be the primary driver of population decreases. High harvest rates by hunters may be additive mortality in some situations, however the large landscape of the BMU likely means harvest rates are relatively low across the broad area.</p> <p><u>Potential Management Options:</u></p> <ul style="list-style-type: none"> • Retain and enhance aspen-birch stands where possible. • Retain and enhance soft mast plants. | | | |

- Maintain and increase managed openings and early-successional forest areas.
- Retain conifer inclusions for winter cover.

Potential Research and Monitoring Options:

- Assess populations across BMU.
- Census Bill Sladyk WMA and Black Turn Brook SF for hunting participation and success.

| | | | |
|---|-----------|-------------|----------------------|
| Black-backed woodpecker | S2 (rare) | G5 (common) | Special Concern (VT) |
| <p>Black-backed woodpeckers are residents year-round in northeastern Vermont. The BMU is one of few in the state where one can find these typically boreal birds.</p> <p><u>Habitat:</u> Black-backed woodpeckers are habitat specialists, preferring mature spruce-fir-tamarack forests with numerous dead or dying trees. Black-backed woodpeckers forage for beetle larvae in loose bark and nest in decaying trees. Fires, boggy areas, beetle-infestations, and logging operations may all favor this species, if significant amounts of dead and dying wood result.</p> <p><u>Threats:</u> State-wide habitat loss from development is likely the primary threat. In addition, forest management practices may adversely impact this species if mature spruce-fir and dead/dying wood habitats are not maintained. Finally, climate change may pose a threat to this species and its habitats, which are at the southern extent of their ranges.</p> <p><u>Potential Management Options:</u></p> <ul style="list-style-type: none"> • Continue surveys of potential habitats before timber harvests. • Create or maintain areas with high levels of snags and coarse woody debris. • Allow an area of spruce-fir to reach biological maturity and undergo natural disturbances. <p><u>Potential Research and Monitoring Options:</u></p> <ul style="list-style-type: none"> • Map areas of suitable breeding habitat (mature spruce-fir forests greater than 250 acres in size) on the BMU. | | | |

| | | | |
|---|---|---|--|
| Rusty blackbird Canada warbler | S3B (uncommon) S4B (uncommon- common) | G4 (uncommon- common) G5 (common) | Special Concern (VT) Special Concern (VT) |
| <p>Rusty blackbirds and Canada warblers are both experiencing range-wide population declines. Rusty blackbirds have decreased as much as 95% across their range. These birds are little-known and understudied due to the difficulty of accessing their breeding territories.</p> <p><u>Habitat:</u> Rusty blackbirds rely on dense coniferous cover in and around forested wetlands, marshes, bogs, and ponds. Canada warblers seek dense sub-canopy vegetation, particularly mixed stands, which naturally occur around wetlands and waterbodies, but may also be created by forest management.</p> | | | |

Threats: Threats range-wide may include development on lakeshores in breeding habitats, degradation and loss of wintering habitat, and mortality from pesticides. Locally, disturbance and alteration of riparian areas may have the most significant impact. Timber harvesting may improve habitat for Canada warbler, but if done near to wetlands may decrease habitat value for Rusty blackbird – which seem to be attracted to such habitats, but to attain lower productivity there.

Potential Management Options:

- Maintain coniferous vegetation throughout riparian areas.
- Maintain active populations of beavers, which create additional wetland habitat and regenerating riparian vegetation.
- In areas away from wetlands and waterbodies, create forest openings with dense vegetation and some emergent mature trees for Canada warbler.

Potential Research and Monitoring Options:

- Assess the abundance and distribution of rusty blackbirds and Canada warblers across the BMU. Also, consider such an effort across all state land in northeastern Vermont.

| American marten | S1 (very rare) | G5 (common) | Endangered (VT) |
|--|----------------|-------------|-----------------|
| <p>American marten were extirpated from Vermont in the nineteenth century. In recent decades, however, marten sightings have been confirmed, primarily in northeastern Vermont. These individuals are likely a natural recolonization from populations in New Hampshire and Maine. Habitat modeling indicates that the BMU is a likely location for marten in Vermont, and marten have been sighted on Bill Sladyk WMA.</p> <p><u>Habitat:</u> Marten are opportunistic carnivores, and forage in trees and forest understories. They are associated with dense forest, especially softwood, and prefer mature, undisturbed forests with complex structure, but may use forests as young as 30 years. They rely on large cavities in trees for resting and denning, and extensively use coarse woody material and its associated subnivean tunnels for accessing prey in winter.</p> <p><u>Threats:</u> Incidental mortality due to capture in traps set for common species during legal, regulated trapping seasons may be a problem in some locations. In recent decades a small number of marten have been taken in this way in Essex County. In addition, plowed roads in winter may allow competitor species such as coyotes increased access to marten habitat. Finally, climate change may pose a threat to this species and its habitats, which are at the southern extent of their ranges.</p> <p><u>Potential Management Options:</u></p> <ul style="list-style-type: none"> • Create or maintain extensive areas of mature forest with complex structure, including large diameter live and dead trees. • Limit young forest to a minority of the forested landscape. • Minimize incidental trapping mortality through outreach and collaboration with local trappers. | | | |

Potential Research and Monitoring Options:

- Assess abundance and distribution in BMU and northeastern Vermont.
- Monitor trapping mortality.

| Moose | S5 (common) | G5 (common) | none |
|---|-------------|-------------|------|
| <p>Moose were virtually extirpated from Vermont by the mid 1800's, due to conversion of forests to agricultural uses and unregulated hunting. Moose returned to Essex County in the 1970's, and dramatic population growth led to densities of 4-5 moose/mi² in the county by 2005. Vermont began regulated hunting seasons for moose in 1993, and, harvests were accelerated through 2008 in an attempt to reduce moose densities which had overbrowsed their range and were causing damage to forest regeneration. From 2000 to 2012, 2745 moose were harvested in WMU E. Presently, moose density in the area is substantially down from its peak, and now believed to be in balance with the habitat. In recent years, however, increased mortality have been observed due to winter tick outbreaks and warming temperatures.</p> <p><u>Habitat:</u> Coniferous and mixed forests with semi-open areas and wetlands. Young regenerating forest provides important woody browse and open water provides aquatic plants consumed in summer.</p> <p><u>Threats:</u> Increased winter tick populations may be impacting moose populations across the northern United States. In addition, warming weather due to climate change may lead to lower productivity due to thermal stress and warm springs may allow winter tick populations to expand. Locally, overbrowsing due to moose overabundance may have reduced habitat quality for moose and deer in northeastern Vermont.</p> <p><u>Potential Management Options:</u></p> <ul style="list-style-type: none"> • Maintain and enhance coniferous and mixed forest cover. • Create and maintain young regenerating forest stands for browse. • Protect wetland feed habitats. <p><u>Potential Research and Monitoring Options:</u></p> <ul style="list-style-type: none"> • Monitor moose abundance across BMU. • Monitor impact of moose herbivory on forest regeneration. | | | |

| Snowshoe hare | S5 (common) | G5 (common) | none |
|--|-------------|-------------|------|
| <p>Snowshoe hare have a key place in local food webs, as the obligate food source for Canada lynx, and a preferred food source for coyote, bobcat, fisher, and raptors. Simultaneously, hare are hunted through a regulated season. Snowshoe hare are common throughout the younger, dense coniferous forests and alder swamps of the BMU.</p> <p><u>Habitat:</u> Snowshoe hare prefer dense understories of coniferous, mixed, or deciduous vegetation for both browse and cover. They will use a variety of natural habitats including swamps, but also make extensive use of young forest (approximately 7-15 years).</p> | | | |

Threats:

- Climate change may pose a threat to this species and its habitats, which are at the southern extent of their ranges.

Potential Management Options:

- Create and maintain dense regenerating forest patches, especially softwood.

Potential Research and Monitoring Options:

- Assess abundance across BMU and monitor over time.

I. Forest Health Assessment

Primary causes of mortality to trees of the BMU include Spruce Budworm, Beech Bark Disease, and environmental events. Typically, declines occur from multiple years of a combination of stressors – i.e. drought, insect and disease outbreaks, and poor growing conditions. Future forest health may be compromised by the spread of invasive plants – though the BMU is remarkably free of these pests for now.

Spruce Budworm: (*Choristoneura fumiferana*) - In 1974, a massive blow-in of adult moths occurred. In 1975, light defoliation was widespread in northern Vermont. Acres of defoliation increased annually with Essex and Orleans Counties hardest hit. Holland, Norton and Canaan were among the towns with the heaviest damage.

The peak of the outbreak was in 1983 when 178,086 acres of defoliation was mapped in Essex, Orleans, Caledonia, Lamoille and Washington Counties. In Essex County, 64,876 acres of defoliation was mapped. Of those acres, 32,093 acres of mortality was mapped. The estimated number of dead spruce and fir trees in Essex county was 888,000 with a total volume loss of 66,754 cords. Mortality in Essex County continued to be mapped for the next several years.

SBW populations in Vermont have remained low since 1983. However, populations have been increasing in eastern Canada in recent years. In 2010, Nova Scotia saw the highest moth counts since 1994. In Quebec, 1.7 million acres were defoliated. In Vermont, FPR resumed the pheromone trapping program after 20 years (1983-2003). Trap locations include Essex County sites at Black Turn Brook State Forest in Norton and Silvio Conte Wildlife Refuge in Lewis and in Orleans County at Holland Pond in Holland. Since 2010, spruce budworm moths trapped are well below historic highs from the outbreak of the early 1980's.

Beech Bark Disease: Beech scale-Nectria Complex (*Cryptococcus fagi* – *Nectria coccinea* var. *faginata*) - In the early 1970's heavy beech mortality was mapped during annual aerial surveys. More than 250,000 acres were mapped in northern Vermont in 1973 including northern Essex county. At this time, beech bark disease was Vermont's number one tree killer. By the late 1970's, trees resistant to the fatal aspects of the disease were starting to be observed and beech scale populations were declining. Mortality continued to be mapped through the 1980's but to a lesser degree.

Over the years, it has been noted that a decrease in acres mapped occurs following cold winters and an increase was observed following drought years. Mild winters and dry conditions in the fall of 1999 were ideal for the survival of beech scale. The 2001 drought made bark more susceptible to *Nectria* infection which increased foliar symptoms. Both beech scale and chlorosis were reported to be the heaviest ever seen.

Low acreage of beech bark disease was mapped through the 1990's. A sharp uptick began in 2001 averaging almost 2,500 acres of dieback and decline from BBD. In 2015, over 7,000 acres were mapped in Essex County. The last two years have seen a drastic drop. BBB is likely to continue to cause dieback, decline and mortality although resistant trees have become noticeable in some areas of high beech scale.

Paper birch decline - In 2006, 28,358 acres of defoliation in Essex county was caused by septoria leaf spot. This disease in conjunction with birch leafminers and birch skeletonizer may continue to challenge birches in the area. Birch decline and mortality increase statewide in 2006 (326 acres mapped in Essex county) due to drought and successive years of defoliation.

Balsam Woolly Adelgid - BWA is a non-native adelgid that feeds on firs. Infestations can lead to mortality, which is often exacerbated during years of stress such as drought. Damage is often spotty, because BWA does not disperse well.

Emerald Ash Borer - Emerald ash borer was discovered in multiple locations of Vermont in 2018 and has been known in Quebec since 2008. This non-native insect has the potential to kill the majority of ash trees in infested areas.

Weather Events – non-living environmental factors may cause significant effects on forests in the area. Wind, ice and snow, drought, and excessive rain all cause tree mortality. In 2007, wind damage from a strong storm on April 16 was mapped on 3262 acres in Essex county with some light damage south of the Canadian border and near the Orleans/Essex county border. In 2004, a wet summer contributed to an increase in dieback and mortality in Essex county, 3,447 acres mapped.

Invasive Exotic Plants - Invasive plants appear to be very limited on the BMU. Bill Sladyk WMA has three known patches of *phragmites* (common reed). These sites are being assessed and treated by ANR staff.

J. Timber Resource Assessment

History

The current condition of timber resources on the Borderline Management Unit (BMU) is a product of time, in combination with natural and human influences. Environmental conditions

like soils, climate and elevation have combined with human disturbances like agriculture and logging to create the current forest mosaic.

Throughout the Northeast, sawmills were often the first manufacturing plant established in a town (Dinsdale 1965). This pattern holds true for the lands within the BMU – the first well-documented European settlement activity was the construction of a saw mill along Holland Brook in 1850 (Scharoun and Cowie 2009). The earliest timber extraction likely focused on the best-formed softwood trees, which could easily be floated to a mill. Later cutting would have removed hardwoods of sawlog quality; by the turn of the century the timber industry had transitioned to pulpwood production (Whitney 1996).

The largest tract of land, Bill Sladyk WMA, experienced the most recent and large-scale timber extraction. The State purchased much of the land in 1959; however, the legal rights to the timber remained with the Fillemore Lumber Company of Stanstead, Quebec. Between 1959 and 1970, when the State purchased the timber rights, Fillemore Lumber Company heavily cut the majority of the ownership. In areas dominated by hardwood trees, this harvesting focused on the larger and more valuable trees, leaving the individual poor quality trees that remain on the landscape today. This is in contrast to areas that supported softwood tree species which were clear-cut. The development of these areas post-harvest has largely depended on the tree species involved and past cutting practices. In areas where environmental conditions favor softwood species the forest has regenerated to a current condition characterized by tightly spaced trees of the same age, usually Balsam Fir (*Abies balsamea*) and Red Spruce (*Picea rubens*). Areas where conditions favor hardwood trees are largely in a “two-aged” state where older, widely scattered, poor-quality trees are interspersed with a younger group of trees that arose from the heavy cutting.

The most recent land use on the remaining two parcels in the BMU is quite different. Black Turn Brook State Forest was originally purchased in 1970 by a non-profit trust named Earth Peoples Park, Inc. Over the next twenty years the land saw sporadic timber harvests. While there are no records of the specific harvests, evidence on the ground suggests logging activities removed larger diameter trees in areas heavy to Red Spruce and Balsam Fir; these have since regenerated to young softwood species with scattered hardwood species. The Department of Forests, Parks, and Recreation took ownership of the parcel in 1994 and began an active timber management program.

Of the three parcels that comprised the BMU, Averill Mountain WMA has experienced the least extensive timber harvesting. Averill Mountain was donated to the Fish and Game Department in 1971 by John Cattier. Records of harvest activities prior to State ownership do not exist. However, current forest conditions suggest that some forest products may have been removed. The State has allowed natural disturbances like the 1998 ice storm, to shape the current forest composition.

Existing Conditions

Forest Inventory

Forests can be described by their composition, function, and structure (Franklin et al. 1981; Smith et al. 1996; Hunter Jr. 1990). Composition is the assemblage of organisms (living and non-living) that exist within a forest. It is frequently described by the presence and/or dominance of species. Function refers to the types and rates of processes and interactions among

plant and animal species and environmental forest components. Finally, structure is the physical arrangement and characteristics of the forest. Managing these complex interactions requires a sound understanding of each component. To assist land managers, large parcels of land are often divided into stands – a spatially continuous group of trees and associated vegetation having similar structures and growing under similar soil and climatic conditions (Oliver and Larson 1996). The following discussion refers to the timber resources portion of the quantitative effort to describe the BMU's composition, function and structure.

The assessment of the timber resources on the BMU was conducted over a period of two years beginning in the fall of 2007. Foresters used a sampling system known as double point sampling (Bruce 1961; Oderwald and Jones 1992; Marshall, Iles, and Bell 2004) to quantify the existing timber resource. Species composition, tree density, timber volume and cavity tree density, among other metrics, were calculated from the information collected. This timber inventory is used for timber harvest planning across the Management Unit and, more specifically, for the development of stand-level prescriptions. Timber inventories are conducted during the long-range management planning process and are generally applicable for a period of ten years. In the case of double point sampling, individual tree measurements are collected on a predetermined grid and used to calculate a variety of summary statistics for a given forest stand. The data collected during the BMU cruise included tree species, stem diameter (DBH), stand basal area, height of the merchantable products within a tree and qualitative metrics of the general stand condition, including size class, operability and risk. Analysis of the inventory data provides statistical estimates of forest stand composition and structure.

The inventory was designed to identify: (i) the species present on the landscape and their relative abundance; and (ii) an approximation of their size and density. Measurements determined: (i) tree species present; (ii) tree diameter at 4.5 feet above the ground; (iii) the quality and size of any merchantable product within a tree stem; and (iv) basal area.

Individual stands were stratified prior to sampling using ArcGIS, which allowed consideration of multiple variables including, soil type, past timber harvests, aspect, elevation, and orthophotography. After stratification a sampling grid was overlain on the stand map. The grid design was chosen to maximize efficiency while providing appropriate landscape representation. The grid orientation (25.25° from true north) was designed to remove sampling bias from natural patterns on the landscape (e.g. valley and ridgetop).

Measurements were taken using variable plot sampling (also called point, horizontal point, angle-count, prism, or Bitterlich sampling). A 20 basal area factor (BAF) prism was used to estimate basal area per unit of land area and a horizontal angle gauge, designed to represent a much larger BAF, was used to sub-sample the initial basal area count trees (Oderwald and Jones 1992, Marshall et al. 2004, Brooks 2006). This second sample selected trees to be measured for calculation of the volume to basal area ratio (VBAR). Tree diameters were measured using Biltmore sticks and merchantable heights were estimated ocularly. Qualitative assessments of existing regeneration, season of operability, and stocking were made at each point. This information was captured in a “notes” section on each plot sheet. Wildlife signs were noted in certain instances by certain cruisers.

Cover Types

Forest trees in nature may be aggregated into certain groupings or associations such as the Beech-Birch-Maple forests of the northeastern United States and Canada, and the loblolly pine-shortleaf forests of the South; or they may occur in essentially pure stands such as black spruce in the colder lowlands of the Northeast (Eyre 1980). These aggregations and pure stands, called forest cover types, may be either stable or transitory. Some have occupied the same area for long periods. Others are temporary occupants of disturbed sites and through ecological succession gradually give way to a more stable cover type.

Described here are the forest cover types of the BMU. The classification is based on existing tree cover. These are the forests as they are today – what the land manager finds on the ground and must deal with. The descriptions give recognition, however, to the human and ecological factors that helped to create the types and will continue to influence their development. The information presented was derived from the inventory described above, management records, and interpretation of aerial photography.

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

Northern hardwoods are found on approximately 20% of the BMU. This association is a widespread matrix forest in central New England and at lower elevations in northern New England. This type occurs most commonly on acidic, moderate to well-drained soils generally below 2500 feet. In the BMU, they cover mid-elevation ridges and associated slopes. The canopy is dominated by sugar maple (*Acer saccharum*) mixed with variable amounts of American beech (*Fagus grandifolia*) and/or yellow birch (*Betula alleghaniensis*). Other species associated with this cover type include red maple (*Acer rubrum*), white ash (*Fraxinus americana*), balsam fir (*Abies balsamea*), red spruce (*Picea rubra*), black cherry (*Prunus serotina*), and basswood (*Tilia americana*).

Most of the northern hardwood cover type within the BMU was logged heavily prior to State ownership; this logging was focused predominately on the lands within Bill Sladyk WMA.

All of the northern hardwood forests on BMU have been mapped as one occurrence of the Northern Hardwood Forest natural community type and this occurrence has been determined to be of state significance due to its size, condition and landscape context. Within this larger natural community are smaller examples of Rich Northern Hardwood Forests.

Spruce-Fir (Red Spruce-Balsam Fir) – low elevation

The Spruce-fir cover type (lowland) makes up 33% of the forests of the BMU. This system is a mosaic of lowland spruce-fir forest and red spruce swamp communities that form in low-lying areas where cool air settles and creates a suitable microclimate, characterized by especially moist mineral soils. These range from well or moderately well drained upland forests to poorly or very poorly drained swamps. When soils are very poorly drained, these systems tend toward black spruce peat swamps. In stands with mature timber, the dominant canopy position is occupied by red spruce and balsam fir. Occasional canopy associates include a variety of hardwoods such as paper birch (*Betula papyrifera*), yellow birch, red maple, quaking aspen (*Populus tremuloides*) and American beech.

The majority of the acreage occupied by this cover type is found within Black Turn Brook State Forest and Bill Sladyk WMA south of Holland Pond. Timber management has occurred within

this cover type for many years; forest inventory data suggest that greater than 50% of the spruce-fir acreage falls in the 8-inch diameter class or smaller. Historical harvesting practices in some areas have resulted in conversion of former spruce-fir sites to northern hardwood-conifer forest.

Red Spruce – Yellow Birch

This mixed hardwood/softwood type represents approximately 33% of the BMU. This system is generally considered a climax type, particularly on moist sites and in the absence of timber harvesting (Westveld 1953). In general, on the BMU this cover type can be found on lower slopes, benches and moist, well drained flats. Its presence is due both to site condition (as a transition between northern hardwoods and spruce-fir types) and past harvesting practices. Indiscriminate harvesting of spruce on the best sites has led to a great reduction of the spruce component and the predominance of hardwoods. Once the spruce was removed, the forest type gave way initially to yellow birch. Most of the yellow birch was then removed, and the type has been converted to stands of paper birch, pin cherry, aspen, yellow birch, red maple, poor-quality sugar maple and beech, balsam fir and the occasional red spruce and hemlock. Unfortunately, this mixture dominates the Red Spruce-Yellow Birch type found on the BMU. Other occasional canopy associates in this type include striped maple (*Acer pensylvanicum*), mountain maple (*Acer spicatum*), and mountain ash (*Sorbus americana*).

Red Maple

This type only occurs on Bill Sladyk WMA where red maple comprises a majority of the stocking. Historically, red maple was considered an associate (often a minor one) of many different forest types. In recent years the proportion of red maple in many stands has increased dramatically, now frequently accounting for over half of the basal area (Leak 2006). Red maple's recent expansion as a cover type is generally attributable to disturbance in stands where red maple was formerly only an associate – this is true of the 4% of Bill Sladyk WMA that was typed as a red maple.

Within the BMU, current stocking data suggests previous harvesting left red maple as an undesirable residual. These residual trees have responded to release by growing rapidly and increasing their proportion of the stocking. In areas that experienced more severe disturbance, such as clearcutting, previous mixed species stands were converted to red maple.

Northern White-Cedar

The Northern White-Cedar type occurs on two of the ownerships within the BMU: Bill Sladyk Wildlife Management Area and Black Turn Brook State Forest. In total, these stands represent 4% of the BMU – 9% of Black Turn Brook SF and 4% of Bill Sladyk WMA.

Northern white-cedar often grows in pure stands, but can comprise the majority of stocking in mixed stands. It is commonly associated with balsam fir and tamarack where it occurs on the BMU. These stands generally grow best on limestone-derived soils that are neutral in pH, or slightly alkaline and moist, but well-drained. However, within the BMU the northern white-cedar type is found in swamps or along streams where the organic soils are well decomposed and soil water is actively moving.

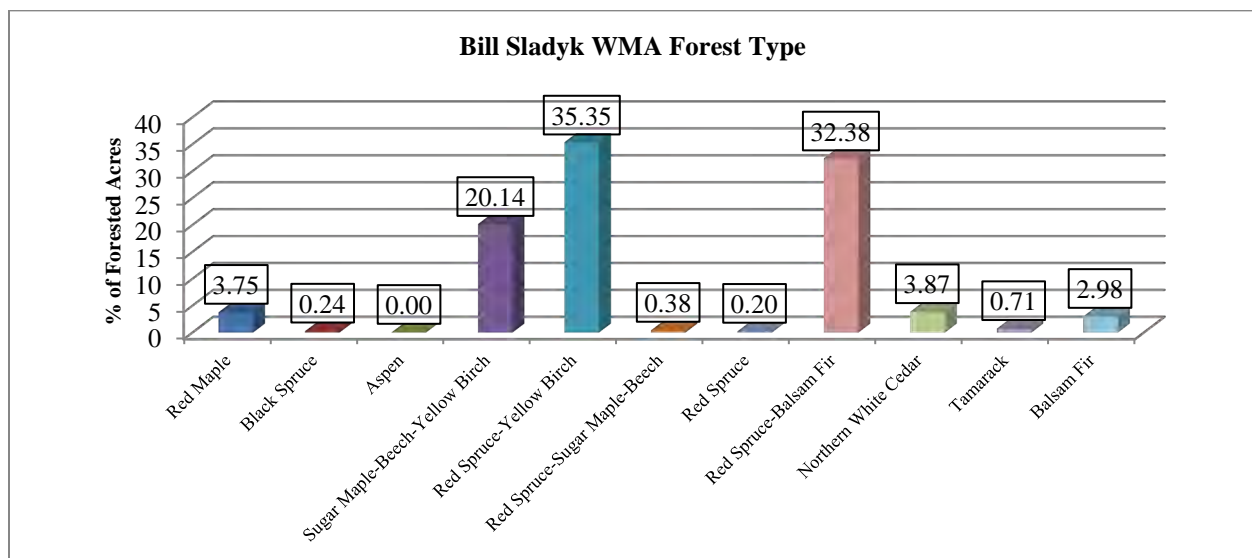
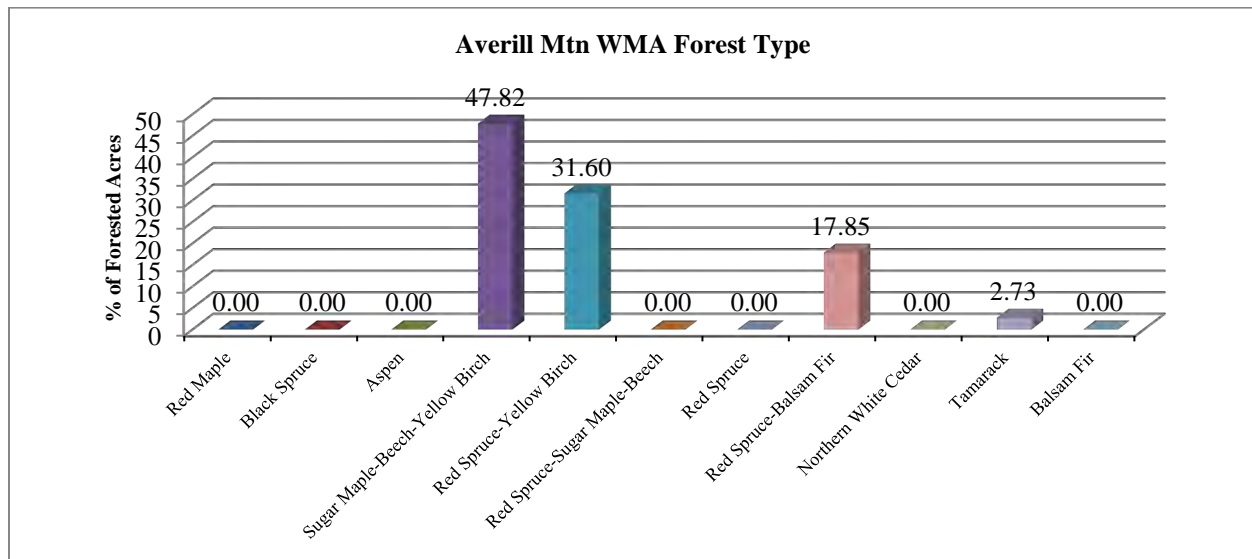
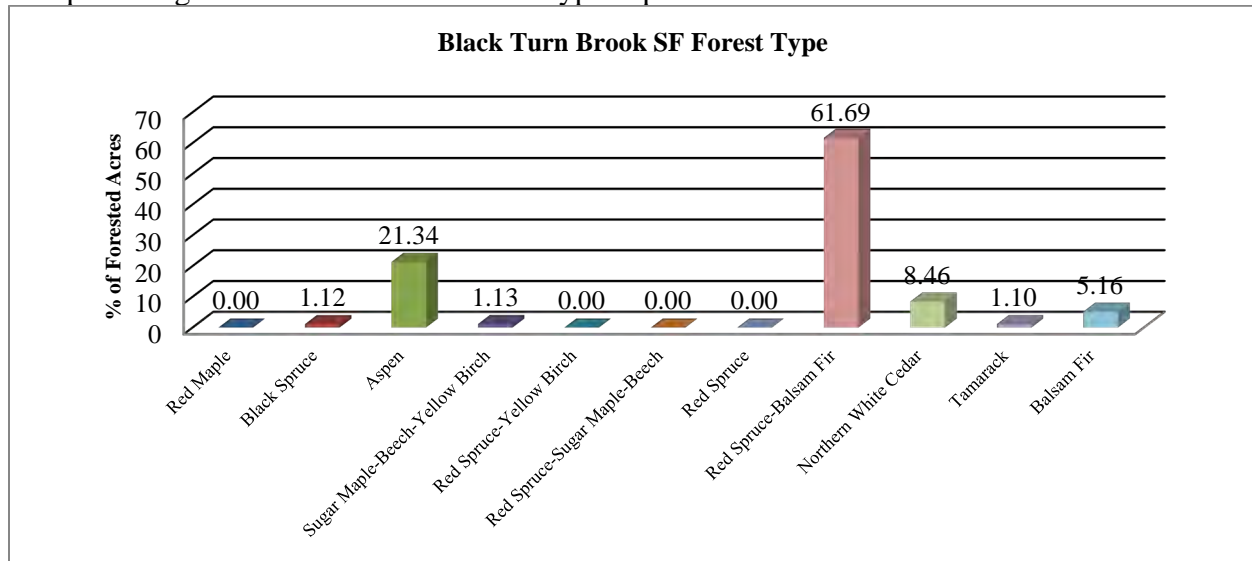
Without major disturbances the white cedar type can persist on a site because balsam fir is the only important associate sufficiently tolerant of shade to grow in dense white cedar stands (Thompson and Sorenson 2000). Due to its palatability and nutritional rating, northern white-cedar is an important source of winter browse for white-tailed deer, and many white-cedar stands provide important wintering habitat (Aldous 1941).

Aspen

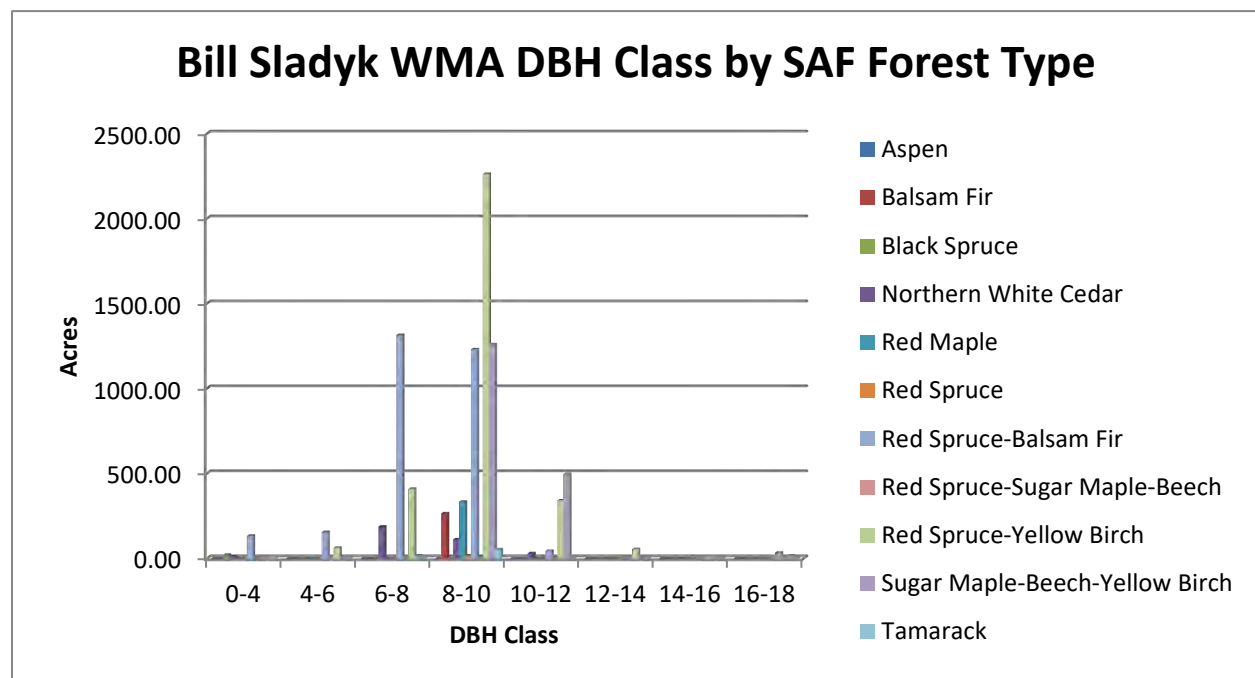
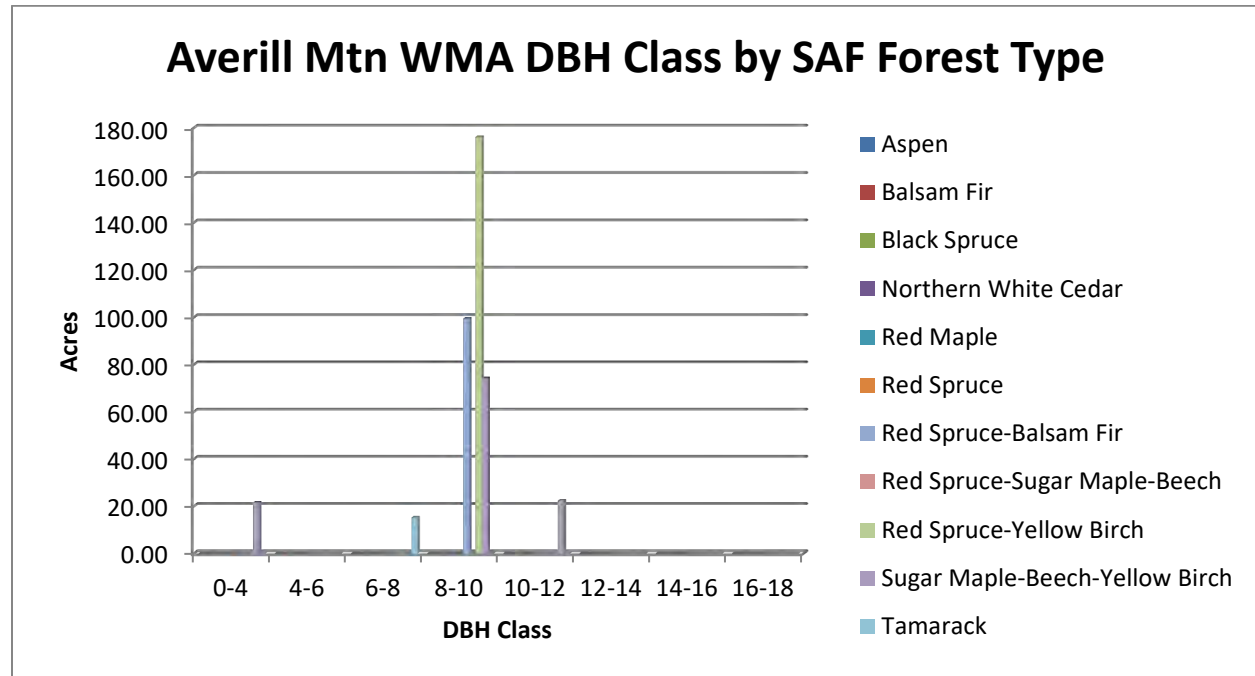
The Aspen forest type is only found on Black Turn Brook State Forest where it represents 22% of the acreage. Within the State forest the type is characterized by Aspen species interspersed with speckled alder and scattered associates, including balsam fir, paper birch, and pin cherry. This association is found on alluvion – poorly drained deposits likely created by the extensive beaver activity within Black Turn Brook State Forest.

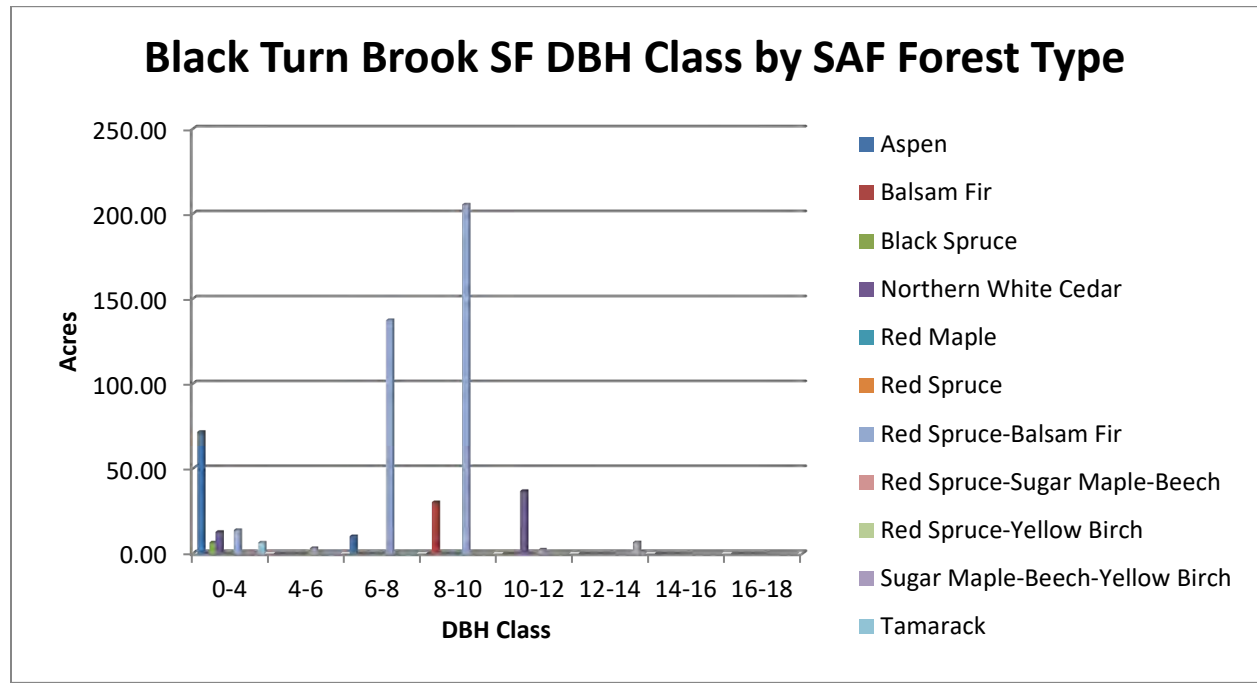
Much of this forest type was logged by the Department in the summer and winter of 2008. The harvesting activity focused on the removal of aspen in an effort to release established softwood species, increasing the potential for future deer-wintering habitat.

The percentage of forestland in each SAF type is presented below:

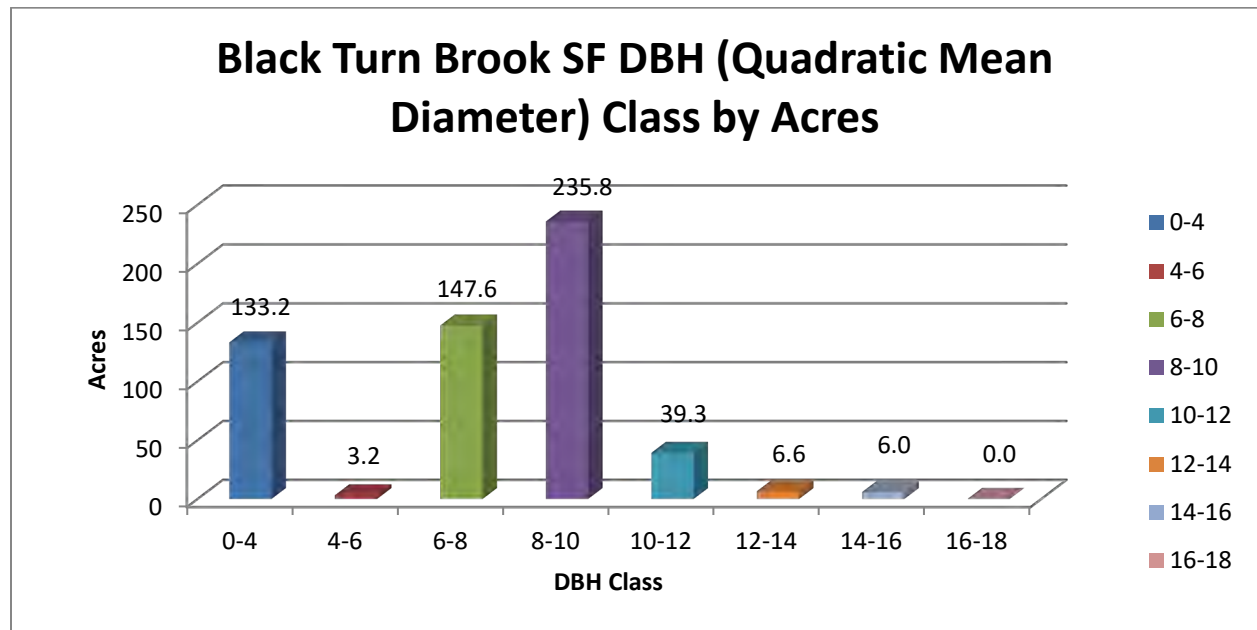


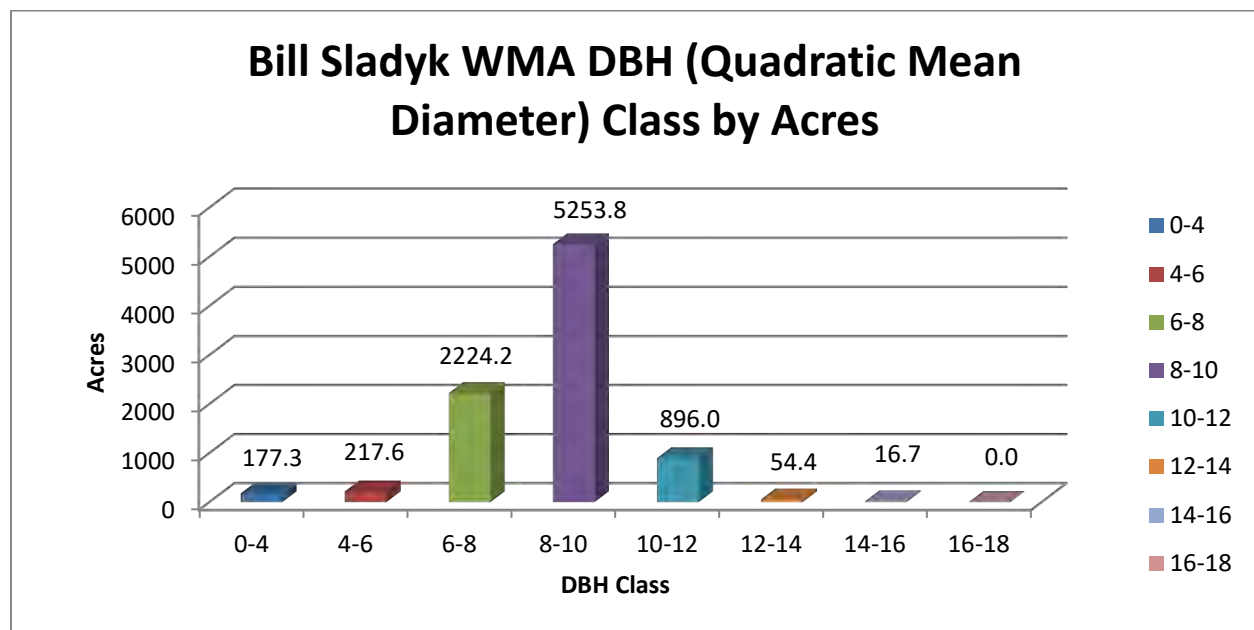
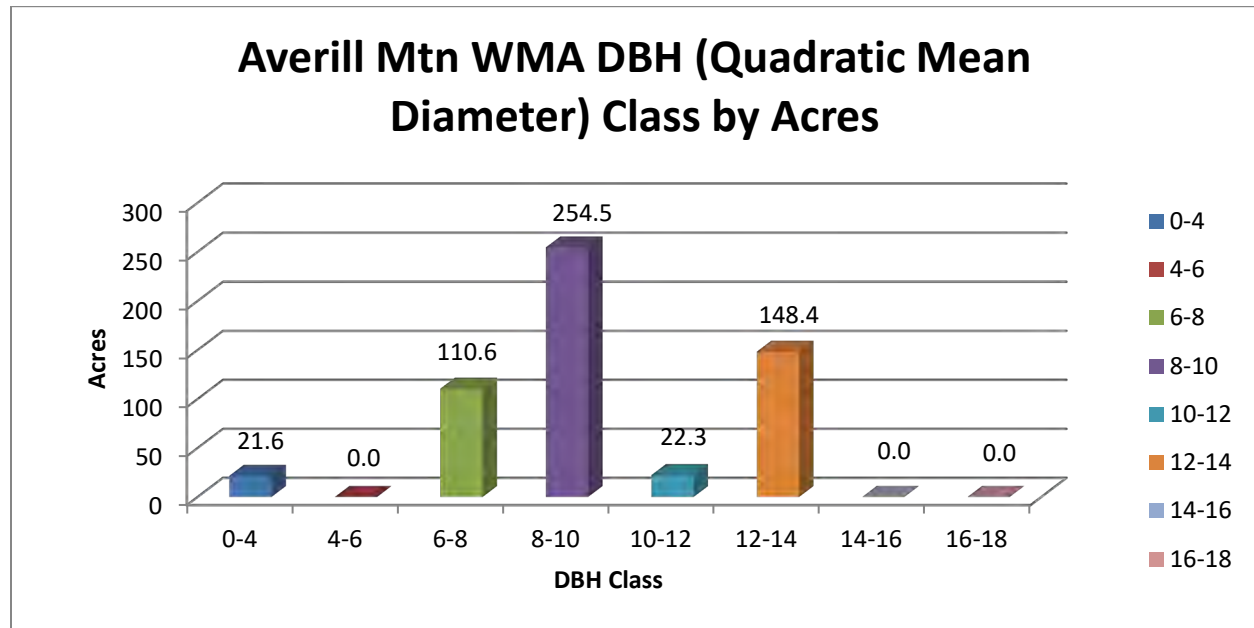
The large-scale timber harvesting that occurred between 1959 and the present have left the Border Management Unit in a predominately even-age condition with young forests. This is best represented by a reporting of the above forest types by the average diameter of a tree within that type. Table 1 tabulates the number of acres within each forest type by their diameter class.





Below are bar graphs depicting the diameter distribution by acres for the BMU.





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K. Water Resource Assessment

The Border Management Unit is located in the St Francis River Watershed and a small portion in the Upper Connecticut River Watershed as defined by the Agency of Natural Resources watershed planning basins. These watersheds represent two of the fifteen basins throughout the state for which plans are being written by the ANR under the leadership of the Department of Environmental Conservation, Watershed Management Division. A watershed, or basin, is a distinct land area that drains into a particular waterbody either through channelized flow or surface runoff.

Lands in the Bill Sladyk Wildlife Management Area are split between the Lake Massiippi and Coaticook River Watersheds. Lands to the Northwest of the Bill Sladyk Wildlife Management Area flow into Holland Brook which flows into Quebec and eventually into Lake Massiippi. Included in this watershed are Holland Brook and the remote Beaver, Round, Duck, Line (only partly in the WMA) and Turtle ponds. The larger and more accessible Holland Pond is only partially within the WMA boundaries.

In addition to the lakes in this portion of the watershed, there are a number of significant wetlands including wetlands along Holland Brook, on the south side of Holland Pond, and around Turtle Pond. The Holland Brook wetlands are considered a b/c ranked northern white cedar swamp, the wetlands at the south end of Holland Pond are considered a b ranked sweet gale shrub swamp and the Turtle Pond wetlands included a very old boreal acidic northern white cedar swamp.

The lands to the southeast of the Bill Sladyk Wildlife Management Area are in the Coaticook River watershed and most of these lands drain to Norton Pond. Also in this watershed are the Black Turn Brook State Forest and the majority of the Averill Mountain Wildlife Management Area with the exception of the northeast corner of this WMA. Some of the waters on state lands in the Coaticook River watershed include Hurricane and Coaticook brooks in addition to the remote Halfway Pond and Cranberry Bog. Halfway Pond which is largely in the Bill Sladyk Wildlife Management Area is one of the most remote lakes in the State. In addition, the nearby Cranberry bog is considered a b ranked dwarf shrub bog.

The northwest corner of the Averill Mountain Wildlife Management Area flows into Black Creek, which then flows into Leach Creek, Wallace Pond and eventually into the Connecticut River.

The lakes and ponds of the Bill Sladyk Wildlife Management Area exhibit many features that are unique in Vermont. Holland and Turtle ponds are identified in the Vermont Conservation Design as among the top 3 most important lakes in the state for preserving biodiversity, for lakes in their class. In addition, Holland and Beaver Ponds are long term research lakes being used to evaluate how climate change and acid rain are affecting Vermont's lakes. Minimizing disturbances in the watersheds of these lakes will allow us to better understand impacts from these large-scale stressors.

Three of the ponds; Beaver, Halfway and Turtle have been given the highest rating afforded by the VTDEC Lake Protection Classification System for their wilderness character. These lakes represent half of the lakes in the state with this rating and hence the characters of these lakes that make them rate so high should be protected in any management plans for this wildlife management area. The Lake Protection Classification System gives these ponds the wilderness = 10 rating because these lakes are 'remote; effort is required to reach it' and 'no visible past or present evidence of humans except undeveloped campsites or foot trail' exist. 'The distance to a two-wheel drive road is at least 1/3 mile', 'audible human activity is only occasional (e.g., trains, logging trucks), not constant (e.g. interstate, main thoroughfare)'. It should be kept in mind that the Lake Protection Classification System is used to rate all 291 lakes statewide that are 20 acres in size or greater. Again, of these only 6 in the state meet these criteria and half of them reside in this wildlife management area. This wilderness rating is not related to and should not be confused with the federal wilderness rating given to some federally owned public lands.

The VTDEC Lake Protection Classification system also rates lakes greater than 20 acres under a category called Unusual Scenic or Natural Features. This category includes lakes that have significant scenic or natural features observable from the lake that are exceptional and rarely found on lakes in Vermont. Three of the ponds; Beaver, Halfway and Holland have features that meet these criteria. Undeveloped islands that provide scenic value to a lake are extremely rare (there are 5 or fewer examples in the state) in Vermont, because Beaver Pond has two islands it

has a scenic rating of 9. Solid exposed bedrock which either slopes into the lake or forms an abrupt edge where it meets the water is very rare (there are between 6 and 20 examples in the state) in Vermont, it is for this reason that Halfway Pond received a scenic rating of 7. Because Holland Pond has two very rare natural and scenic features, ledge and a bouldered shore, it has a scenic rating of 8.

Four of the five lakes that have plant survey data, harbor plants that are listed as rare in Vermont. *Utricularia gemniscapa* was found in Beaver Pond. *Utricularia purpurea* was found in Beaver, Turtle and Holland Ponds and *Potamogeton confervoides* was found in Beaver, Halfway and Holland Ponds. There may be additional populations of rare plants in Line and Duck Ponds, but no survey data is available. Some of these surveys are old (Holland Pond 1987) and others were not thorough plant surveys (Round Pond 2003), so plant survey visits to all the ponds in the wildlife management area are warranted to update this information important to preserving rare aquatic plant species in Vermont.

All of the ponds in the Bill Sladyk Wildlife Management Area are located in a watershed with soil and bedrock characteristics which are low in acid neutralizing capacity. The ponds are situated in an area with little to no buffering capacity and Duck Pond and Halfway Pond are considered extremely sensitive to acid deposition and are now on the TMDL list as impaired waterbodies.

The most pronounced chemical observations that we have noted are the declining sulfate, calcium and magnesium and increasing total phosphorus levels in the ponds of the Bill Sladyk Wildlife Management Area. The sulfate declines are a direct result of the passage of the Acid Rain Title IV Amendments of the 1990 Clean Air Act.

Holland and Norton Ponds are showing increasing total phosphorus concentrations. Most increasing trends in total phosphorus are due to anthropogenic activities in the watershed. Land clearing, road erosion, manure spreading, lawn and agricultural fertilizer applications, logging, destabilization of riverbanks through straightening and dredging of rivers, failing septic systems and combined sewer overflows are many of the common causes of increasing total phosphorus levels in lakes and ponds. While there are private camps along the shorelines of both Holland and Norton Ponds, much of the watersheds of these ponds are located within the wildlife management area, this increase in total phosphorus is curious and a watershed survey to determine what sources of phosphorus there may be in the watershed is warranted. While increased spring turnover sampling events are also merited, the increasing nature across the two ponds suggests the trends are real.

Physical features of Bill Sladyk WMA Lakes and Ponds

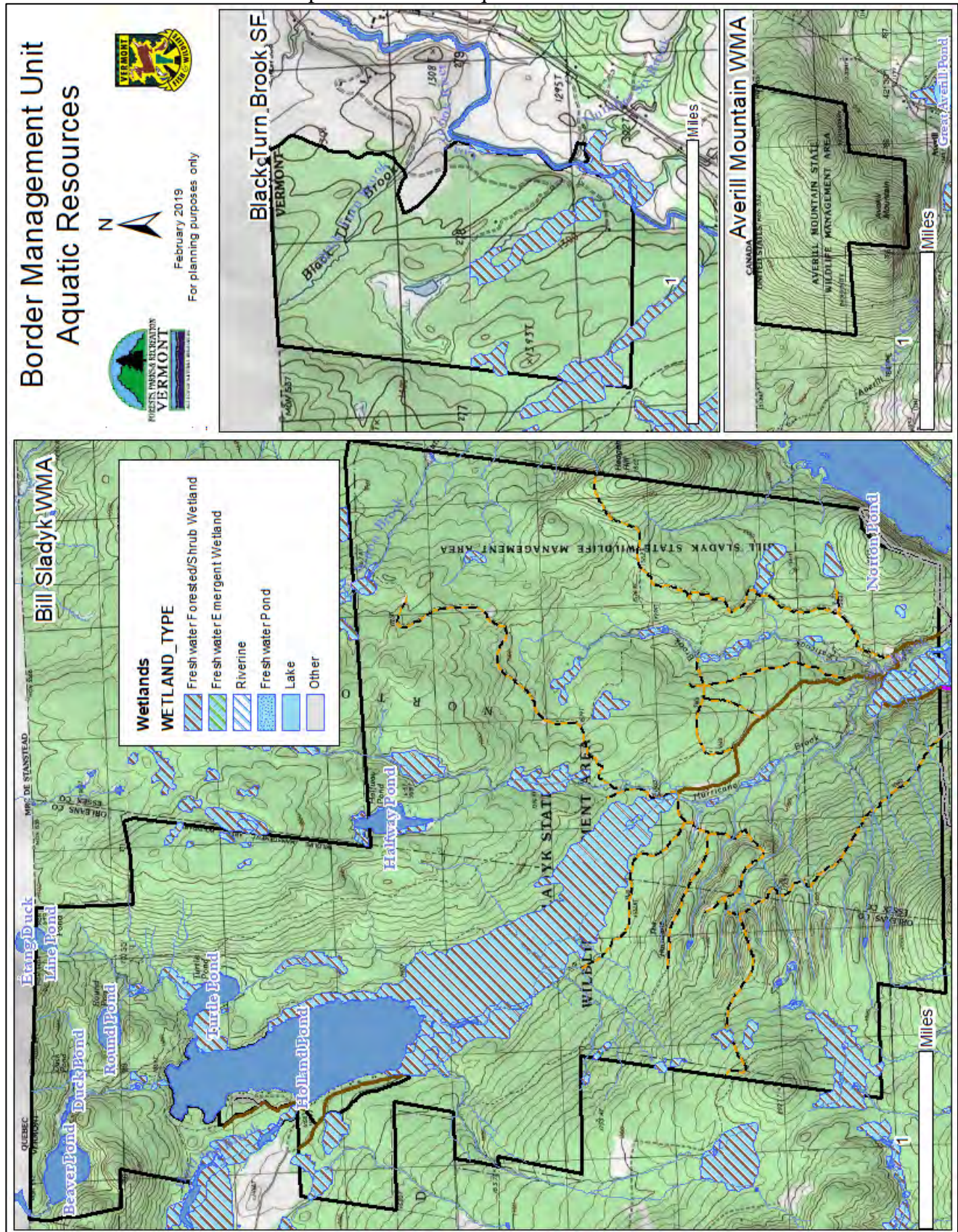
| Lake | Lake Area (acres) | Basin Area (acres) | Max Depth (ft) | Mean Depth (ft) | Flush Rate (# times/yr) | Outlet Type | Meters of shoreline | Wilderness rating if 20 acres | Scenic rating if 20 acres |
|------|-------------------|--------------------|----------------|-----------------|-------------------------|-------------|---------------------|-------------------------------|---------------------------|
| | | | | | | | | | |

| | | | | | | | | | |
|---------|-----|------|----|----|-----|--|------|----|---|
| BEAVER | 40 | 602 | 80 | 30 | 1.3 | Natural | 1962 | 10 | 9 |
| DUCK | 6 | 102 | | | | | 604 | | |
| HALFWAY | 22 | 154 | 4 | | | Natural | 1706 | 10 | 7 |
| | | | | | | Natural with Artificial Control | | | |
| HOLLAND | 325 | 5696 | 39 | 17 | 1.7 | | 7148 | | 8 |
| LINE | 13 | 211 | | | | | 771 | | |
| ROUND | 14 | 198 | | | | | 939 | | |
| TURTLE | 27 | 1120 | 34 | | | Natural | 1531 | 10 | |

Watershed and water resources: Potential Management Options

- 1) Maintain the unique wilderness character of Beaver, Halfway and Turtle ponds as defined by VTDEC Lake Protection Classification. Intensive management or improved road development should not be undertaken in close proximity to these waterbodies. To maintain the Lake Protection classification 10 rating management will need to:
 - a. Ensure all two wheel drive roads remain at least 1/3 mile from the pond.
 - b. Ensure that the only visible past or present evidence of humans is limited to foot trails or undeveloped campsites. So, no developed campsites, lean-tos or temporary use cabins.
 - c. No four wheel drive access
- 2) Maintain the quality of habitats in the ponds and along buffer areas around ponds that support RTE species.
- 3) Maintain the unique wetland communities that have been identified within the Boarder Lands Management Unit.
- 4) Minimize water quality and aquatic habitat impacts from management activities in buffers along streams, wetlands, and ponds within the Boarder Lands Management Unit.
- 5) Find and abate the potential sources of phosphorus in the watershed that may be responsible for the increasing phosphorus trends observed in these ponds.

Map 7 - Water and Aquatic Resources



L. Fisheries Resource Assessment

The topography of the Bill Sladyk WMA and Black Turn SF is predominantly gentle and middle elevation. Accordingly, their streams are first- to third-order, are moderate to low gradient, and support extensive beaver activity. The 510 acres of Averill Mountain WMA is the exception, rising steeply from about 1600' at its northwest margin to just under 2300' at the mountain's peak. Its mainly ephemeral water courses and first order streams are high gradient.

BMU lands enclose four named ponds, Beaver, Round, Duck and Turtle, all in Sladyk WMA. In addition, BMU has frontage on but does not enclose three other named ponds, Holland, Line and Halfway. Numerous beaver flowages are present throughout Sladyk WMA.

The enclosed ponds are relatively small, ranging in size, from 6 acres to 40 acres. With regard to depth, only Beaver Pond is remarkable. At 80' maximum, it can be categorized as dimictic, meaning that it consistently stratifies thermally. Two of the three ponds not enclosed by the BMU are similar to the enclosed ponds in size and depth. Holland pond is an outlier due to its large size. All the ponds are of natural origin. Holland is the only one with an artificial control structure at its outlet.

Fisheries Division staff have undertaken sampling to inventory the current fish communities in waters at Sladyk WMA. Locations sampled include Beaver and Holland ponds, north and south inlets to Holland Pond, and Hurricane Brook and Coaticook Brook. In addition two stream locations in Black Turn State Forest were sampled. No sampling was undertaken at Averill Mountain WMA where the perennial water courses originating on the WMA are very small and presumed fishless. This sampling complements past investigations dating back as early as the 1940s.

A list of fish species documented in ponds is presented in a table below. A list of fish species documented in sampled streams is presented in a table below. These findings are considered in the context of current fisheries management at these waters and the direction of future fisheries management.

Fisheries management at the ponds that BMU borders but does not enclose is not within the scope and authority of the Long Range Management Plan for BMU. These waters will be addressed only in their limited connection to the BMU, that is, insofar as land use activities of the BMU affect or rely on them, and the public land ownership of the BMU affords access to them.

Beaver Pond

Beaver Pond (40 acres; drainage area = 600 acres / 0.94 miles²) is the largest and deepest of the enclosed ponds. The pond is nestled in a bowl among high hills on all sides. Its north shore is situated within just a couple hundred yards of the Quebec border. Its principal inlet which includes extensive beaver flowage just upstream in Quebec is at its west end in flat terrain. Its outlet at its extreme east end represents the origin of the unnamed tributary that enters the north end of Holland pond. Most of the pond's depth exceeds 10', its mean depth is 30', and there is a sizable deepwater zone between 40' and 80' at the pond's center .

Dissolved oxygen and temperature profiles from 1958 through 1992 from VTFW and VTDEC sources show thermal stratification and a mid-summer thermocline between 15' and 20'. They showed reasonably high hypolimnetic dissolved oxygen concentrations through 1988, illustrated by a dissolved oxygen reading on September 15, 1958 of 8.9 mg/l at a temperature of 4.8oC at 70'. However, the 1992 oxygen measurements point to a decline in deepwater oxygen early in the summer season, exemplified by a July 8 reading of 4.1 mg/l at a temperature of 6.6oC at 20'. Additional sampling is needed to verify current conditions. According to information from VTDEC, Beaver Pond is slightly acidic (median pH = 6.44), mesotrophic based on transparency (3.55m / 140") and phosphorus levels (7.56 ug/l), and chemically low productivity based on alkalinity (median = 3.45 mg/l CaCO₃) and specific conductance (21.7 uS/cm).

Fish population sampling through the decades has employed mainly gill nets. Standard minnow traps were placed at the inlet and outlet in 2007. Based on historic sampling, the fish community was been dominated by white suckers, brown bullheads, the coregonine round whitefish, northern redbelly dace and brook trout. Common shiners were documented in 1959. Of particular note was the occurrence of round whitefish at each sampling occasion from 1958 – 1973. Round whitefish have limited distribution, with documentation of historic occurrence in only 4 water bodies, all in the St. Francis drainage. As a result they are a Vermont "species of special concern" in VTFW's listing of Rare and Uncommon Animals in Vermont. They are also classified as a "species of greatest conservation need" in Vermont's Wildlife Action Plan. Our most recent sampling, which was aimed at beginning the assessment of the current status of brook trout and round whitefish, documented the presence of only white suckers and brown bullheads in the pond, northern redbelly dace at the inlet and banded killifish at the outlet.

Beaver Pond's morphometry, water chemistry and simple fish community are consistent with management of coldwater fish populations, with emphasis on the species assumed to be indigenous, namely brook trout and round whitefish. Wild production of brook trout has not been documented. VTF&W annually stocks 1500 fall fingerling (4") brook trout, intended for a put-grow-take fishery in a remote, walk-in setting. Gillnetting in 2007 and 2012 indicated that the stocked trout did not survive through the winter, likely due to a robust white sucker population which outcompete the trout for food, and stocking ended in 2012.

Duck Pond

Duck Pond (6 acres; drainage area = 100 acres / 0.16 miles²) is the smallest of all of the ponds and among the shallowest. The pond is located about midway between Beaver and Round ponds, roughly a quarter-mile south of the Quebec border and a half-mile directly north of Holland Pond. Like Beaver, it is roughly oval in shape, oriented east-west. The pond is a headwater with a very small watershed mostly immediately to the north, with about half of that in Quebec. It has no well defined inlets. Its outlet is at its extreme west end and joins roughly 150 yards downstream with the Beaver Pond outlet stream that enters the north end of Holland pond. We have no bathymetric information about Duck Pond, but the record from VTDEC water chemistry sampling points to it being less than 5' at its deepest.

According to information from VTDEC, Duck Pond is acidic (mean pH=5.33), dystrophic based on transparency (1.3 m / 51.2") (phosphorus not measured) and chemically ultralow productivity based on alkalinity (mean = 0.34 mg/l CaCO₃) and specific conductance (16.1 uS/cm). There is no record of dissolved oxygen sampling. No oxygen / thermal profile could be developed

regardless, owing to the pond's shallowness. Ice cover in some winters could potentially freeze most of the pond nearly to the substrate. It is probable that anoxic or low oxygen conditions would exist in any small zones of pond that might not freeze.

VTFW has no documentation about the pond's fish community. It is likely that any fish species that do occur there would be highly acid tolerant.

Access to Duck Pond is by foot travel only. From the southeast the route it is along a woods road from the Holland Pond Access area. Portage of paddlecraft requires a 1.1 mile hike from the WMA gate on the northwest side of Holland Pond, and negotiation of blowdowns and wet stretches. Access could be gained from the Line Farm Road and Beaver Pond to the west, but is far less convenient than the route from the south.

Round Pond

Round Pond (14 acres; drainage area = 200 acres / 0.31 miles²) is part of the drainage basin that feeds the east shore inlet to Holland Pond, via Turtle Pond. It is slightly southeast of Beaver Pond, roughly a quarter-mile south of the Quebec border and a half-mile directly north of Holland Pond. Like Beaver, it is roughly oval in shape, oriented east-west. It is a headwater with a very small watershed mostly immediately to the north, with about half of that in Quebec. The pond does not have well defined inlets. Its outlet is in its northeast corner and joins roughly 300 yards downstream with the Line Pond outlet stream. Round Pond is notably deep (50') and its bathymetry is that of almost a perfect bowl. Nearly all of the pond's depth exceeds 10'. The mean depth is estimated at 25', and the entire central area of the pond exceeds this.

Dissolved oxygen and temperature profiles in 1958, 1959 and 2003 from VTFW and VTDEC sources show thermal stratification and a mid-summer thermocline between 15' and 20'. Dissolved oxygen levels appear to decline sharply in the hypolimnion. Readings below 3 mg/l at 30' and deeper were documented in older and contemporary sampling. According to information from VTDEC, Round Pond is slightly acidic (median pH = 6.4), mesotrophic based on phosphorus levels (mean = 11.0 ug/l), and chemically low productivity based on alkalinity (median = 3.9 mg/l CaCO₃) and specific conductance (16.0 uS/cm).

The Round Pond fish community was inventoried in the late 1950s, and again in 1984. Fish population sampling in the 1950s employed gill nets and electrofishing. Only gillnets were used in 1984. The fish community was and is relatively simple, but has experienced a major change over these 3 decades. Brook trout, largely or entirely attributable to stocking, brown bullheads and three species of minnows were present in 1959. Impressive brook trout specimens (3.5 pounds and 4.0 pounds) were captured in 1958. During the summer 1959 sampling numerous brook trout were captured that were attributable to stocking from that year and the prior year. Chain pickerel (up to 22.7", 2.8 pounds) and a single longnose sucker were the only specimens captured in 1984. The appearance of the chain pickerel had been rumored. Other ponds in the area were known to contain them as a result of earlier introductions by anglers. The status of brook trout as an indigenous species is likely though not confirmed by the historical record. Round Pond had a reputation for a high quality brook trout fishery prior to the appearance of chain pickerel as a naturally reproducing population. Its morphometry, water chemistry and simple fish community, except for the addition of chain pickerel in recent decades, are consistent with management as a brook trout water.

Turtle Pond (27 acres; drainage area = 1100 acres / 1.74 miles²) is situated 150 yards immediately east of Holland Pond. Its watershed is mainly to the north and east and extends into Quebec. It is the terminus of the Round Pond and Line Pond drainage basins. Turtle Pond is kidney-shaped and oriented northwest to southeast. The topography on the northeast shoreline is flat. The main inlet from Round and Line Ponds disperses through this large wetland complex. Turtle Pond's outlet is at its extreme northwest. The Turtle Pond outlet is assumed to be influenced at times by beaver activity. From Turtle Pond to Holland Pond there is a nominal elevation drop of 8', apparently attributable mainly to natural topography. The pond deepens uniformly to a maximum of 42' almost dead center. There is a substantial area in center of the pond at 30' and deeper. Extensive areas of shallow depth (less than 5') characterize the south and northwest. The mean depth is estimated to be 18'.

Our information about the Turtle Pond fish community is limited to sampling in 1959. No new information has been gathered for this plan. Relevant water chemistry information was collected at the same time, and again in 1991.

Dissolved oxygen and temperature profiles by VTFW and VTDEC showed thermal stratification and a mid- to late-summer thermocline between 15' and 20'. Dissolved oxygen levels appeared to decline below the thermocline. Based on a reading of 1.0 mg/l at 35' anoxic conditions are likely to exist in at least part of the hypolimnion, and low oxygen levels in most of it. According to information from VTDEC, Turtle Pond is mesotrophic based on transparency (3.5 m, / 137.8") and phosphorus levels (mean = 7.8 ug/l), and chemically low productivity based on alkalinity (median = 3.06 mg/l CaCO₃) .

Fish population sampling in 1959 employed only gill nets. The fish community at the time was very simple: chain pickerel, brown bullheads and white suckers. The file notes that no minnows were observed despite some effort to locate them, and that chain pickerel stomachs contained invertebrates. Brook trout fingerlings had been stocked in the years prior to sampling. None were recaptured, and angler reports at the time confirmed that no fishery had developed. The presence of chain pickerel was attributed to a "grudge" introduction by anglers or others at Line Pond in the 1930s. The visible presence of numerous small pickerel in the shallows was noted more recently by DEC personnel during water chemistry sampling. The status of brook trout as an indigenous species in Turtle Pond is likely though not confirmed by the historical record. Turtle Pond has never been recognized for any fishery, though the existing chain pickerel population may offer that potential. Turtle's extensive shallow inshore areas that may warm to the extreme in summer, and its low oxygen levels at depth may present challenges in some years to in-pond survival of coldwater species, such as indigenous brook trout.

Halfway Pond

Halfway Pond (22 acres; drainage area = 150 acres / 0.24 miles²) straddles the northern border of the Sladyk WMA in the east. It is irregularly shaped and elongated in a north-south orientation. Its small watershed and a parallel drainage of 1st and 2nd order watercourses and wetlands immediately to its east represent the headwaters of Hurricane Brook. It has no well defined inlets. Its outlet is at its extreme south end and becomes Hurricane Brook proper roughly a half mile further downstream. Bathymetric information about Halfway Pond is from spot soundings through the ice in 1971, more or less corroborated by VTFW in winter 1985 and by

VTDEC in summer 2001. The pond is uniformly shallow with a maximum depth of less than 5 ‘. Much of it is less than 3’.

According to information from VTDEC, Halfway Pond is very acidic (pH=5.12 – 4.56), dystrophic based on transparency (1.3 m / 51.2”), (phosphorus =15 ug/l) and chemically ultralow productivity based on alkalinity (0.57 mg/l CaCO₃) and specific conductance (mean =14.6 uS/cm). There is a record of dissolved oxygen readings, but no oxygen / thermal profile could be developed, owing to the pond’s shallowness. Summer and winter readings have measured dissolved oxygen at the surface between 6 and 10.4 mg/l, and near the bottom as low as 2.4 mg/l. Based on a late July noontime temperature reading of 26.4oC it is apparent that the pond may become very warm at times. Ice cover in some winters could potentially freeze most of the pond nearly to the substrate. It is probable that anoxic or low oxygen conditions would exist in any small zones of pond that might not freeze.

Fish sampling in 1972 by gillnet and piscicide (rotenone) yielded no fish. It is likely that any fish species that do occur there would be highly acid tolerant and high temperature tolerant.

Line Pond

Line Pond (13acres; drainage area = 150 acres / 0.33 miles²) straddles the northern border of both the Sladyk WMA and an international boundary. The pond is located about one-half mile northeast of Round Pond. Line Pond is kidney-shaped and oriented northeast to southwest. The pond is a headwater with a very small watershed immediately to the west, north and east , and mostly in Quebec. Its main inlet is at the north. The topography along the north shoreline is flat and characterized by many openwater channels through a large wetland complex. Line Pond’s outlet is at its extreme southwest, and its surface elevation may be influenced at times by beaver activity. Its outlet joins roughly a half-mile downstream with the Round Pond outlet stream. These combined outlets form the main inlet to Turtle Pond. We have little bathymetric information about Line Pond, but the record from VTDEC water chemistry sampling points to it being uniformly shallow and little more than 3’ deep at the maximum. Examination of aerial photos gives the impression that the broadest portion of the pond on the Quebec side is progressing toward a floating bog condition.

According to information from VTDEC, Line Pond is acidic (pH=5.74), mesotrophic to dystrophic based on transparency (1.3 m / 51.2”), (phosphorus unmeasured) and chemically low productivity based on alkalinity (3.27 mg/CaCO₃/l) and specific conductance (mean =20 uS/cm). There is no record of dissolved oxygen readings, but no oxygen / thermal profile could be developed regardless, owing to the pond’s shallowness. It is likely that the pond may become very warm at times. Ice cover in some winters could potentially freeze most of the pond nearly to the substrate. It is probable that anoxic or low oxygen conditions would exist in any small zones of pond that might not freeze.

We have no record of fish sampling. It is likely that any fish species that do occur there would be highly acid tolerant and high temperature tolerant.

Holland Pond

Holland Pond (325 acres; drainage area = 5700 acres / 8.9 miles²) is the largest, by a factor of 8, of Sladyk WMA’s enclosed and peripheral ponds. Its north shore is situated about three-quarters

of a mile south of the Quebec border. Lands of the Sladyk WMA border the pond on the north, east and south, but ownership along the west shore is predominantly private. The pond is the terminus for the drainages of all the previously discussed ponds (with the exception of Halfway Pond), along with one larger stream and several smaller water courses draining the land around the southern third of the pond. Its outlet is on the west shore about midway between its north and south ends, and represents the origin of Holland Brook. The pond is elongated in shape and oriented north-south, narrower in its northern third. Much of the pond's depth exceeds 20'. Its mean depth is 17', and there is a sizable deepwater zone between 30' and 39' at the pond's center. The south end is has a large area of relatively shallow water.

There is documentation about the Holland Pond fish community and relevant water chemistry characteristics spanning a period from the 1940s to the present, including two fish sampling efforts over the past decade.

Dissolved oxygen and temperature profiles from 1940 through 1992 from VTFW and VTDEC sources show thermal stratification at least in some years and a mid-summer thermocline between 25' and 30'. Deeper water dissolved oxygen concentrations are consistently low. Dissolved oxygen readings less than 3 mg/l below 30' were documented in each of the 3 years of sampling.

According to information from VTDEC, acidity readings in the waters of Holland Pond have ranged widely (pH = 5.8 – 7.4). The pond is chemically low productivity based on alkalinity (median = 5.73 – 7.62 mg/l CaCO₃) and specific conductance (29.2 – 34.6 uS/cm).

Fish population sampling through the decades has employed gill nets and electrofishing.. Based on historic sampling, the fish community is dominated by white suckers, chain pickerel, brown bullheads, the coregonid round whitefish, rainbow trout and brook trout. Golden shiners, common shiners and rainbow smelt were documented recently, only in 2007. Of particular note has been the occurrence of the round whitefish in the 1940 and 1973 sampling. Round whitefish have limited distribution, with documentation of historic occurrence in only 4 water bodies, all in the St. Francis drainage. As a result they are a Vermont “species of special concern” in VTFW's listing of Rare and Uncommon Animals in Vermont. They are also classified as a “species of greatest conservation need” in Vermont's Wildlife Action Plan. Our two most recent sampling efforts by electrofishing, the most recent of which was targeted specifically to capture round whitefish during their spawning season in late fall, did not result in any capture.

Holland Pond's morphometry, water chemistry and fish community are most conducive to management for apparently very abundant chain pickerel, a warmwater predator that, by all indications, is not indigenous to the pond. Presently water temperature may be too high and dissolved oxygen levels too low in some summers to provide optimal conditions for the salmonids (brook trout) and coregonids (round whitefish) that may have been native to the Holland Pond watershed.

Holland Pond has had a reputation for good rainbow trout and brook trout fishing through the years. Historically VTF&W has stocked both species; at the present time annually 1500 rainbow trout yearlings, in the 10” – 12” size range, and 1500 brook trout in the 8” – 10” size range, intended mainly for a put & take fishery. This was slated to change to annual stocking of solely 3000 rainbow trout, but recent shortfalls in rainbow trout production have delayed this transition. Sixteen rainbow trout were captured during sampling in November 2007. All were in the 12” –

15" size range and had fin characteristics indicative of hatchery rearing, suggesting they were all attributable to stocking in spring 2007. Survival and growth through summer conditions in 2007 are a good indication of the suitability of the conditions in the pond for rainbow trout. However, the absence in the collection of larger, multi-year hold-over rainbow trout or any hatchery-origin brook trout is less auspicious of suitability in all years. Reports of round whitefish landings are virtually non-existent. The observed abundance of chain pickerel is expected to limit potential for wild production of trout, and may pose a major challenge for the persistence of the indigenous round whitefish population.

Streams

The BMU's three subunits are home to relatively few significant stream resources. The BMU water courses are mainly small first- and second-order headwaters that originate within or along its boundaries. Only four streams grow to a size of 2 miles² (~ 1300 acres) within or before reaching the BMU, and the total BMU stream length with drainage area this size or greater is small, less than 3.5 miles. Only one stream, the unnamed tributary to the south end of Holland Pond, enters a BMU pond after draining more than 2 square-miles, and only due to the confluence of its two similar size branches a short distance upstream of Holland Pond. The largest single stream leaving the BMU is Holland Brook, with its origin at the outlet of Holland Pond, essentially on the edge of the BMU. Its drainage area is 8.9 miles². The next largest stream is Hurricane Brook (7.0 miles²) which terminates at Norton Pond, just beyond the edge of BMU. Other water courses sizable enough to be noteworthy include the stream leading from Beaver and Duck ponds to Holland Pond, the stream leading from Line and Round ponds to Turtle Pond and then into Holland Pond, the unnamed stream entering the south end of Holland Pond, and Black Turn Brook, the northernmost stream crossing Black Turn SF before entering the Coaticook River on the eastern margin of Black Turn SF. The elevation range in the BMU from the highest mountain top to lowest point on valley floors is roughly 1200'. Gradients of the first- and second-order streams are mostly moderate (>2%). All the larger water courses are moderate to low, <2%.

There is a relationship between stream size, fish assemblages and fishery resources. For most coldwater streams, the fish assemblages are simple. The smaller the drainage area of a stream, the greater the probability that it will be ephemeral (seasonally ceasing to flow above ground in most years). Seasonal streams may be fishless. Streams that dry out every few years may have simple fish communities that are dependent entirely on re-colonization from permanent waters downstream. Likewise streams that are reduced seasonally to intermittent pools may have fish communities that are simple and numbers that are low. High stream gradient (steep slope) may have major implications for re-colonization following droughts and other events that extirpate fish populations. Some stream segments in the BMU may fall into these categories. The presence of the many ponds and beaver flowages in the BMU, especially in Sladyk WMA, will influence re-colonization of stream reaches upstream and downstream, because they provide refugia during the most extreme drought conditions. For all streams, species richness begins with one species, usually brook trout. The further downstream, the more species are added.

We do not have any gauge of the locations of the transition zones from fish-bearing to fishless for individual streams. The geology of the area (Averill pluton) is indicative of intrinsically low productivity of the BMU's surface waters. Relatively low pH and buffering capacity is characteristic of these waters.

Little documentation of past fish population sampling was found for BMU streams. Over the past couple years we have sampled the fish community in several streams by electrofishing. Fish assemblages are simple, in a couple cases consisting of only brook trout. The brook trout populations observed were all likely to be of natural origin and assumed to be native to the BMU. It cannot be readily ascertained whether these populations have been influenced by past stocking by VTFW or by current stocking by individuals participating in an area conservation organization's brook trout rearing and stocking collaboration with VTFW. Wild self-sustaining populations of brook trout are expected to exist in most of the BMU's perennial streams. Brook trout at an abundance level and growth rate high enough to attract angling interest are known to occur in the larger streams, especially in their lower reaches.

Brook Trout

Brook trout are central for many anglers in Vermont, and the BMU along with the rest of the Northeast Kingdom represents some of the last best habitat for this species. The importance of this species for recreational use as well as in the ecology of the area mean that brook trout should feature prominently in management actions taken across the unit.

Fish species found in Border Management Unit ponds , based on sampling by minnow traps, trap nets, gill nets and electrofishing

| | Beaver | Round | Turtle | Halfway | Line | Holland |
|-------------------------------|----------------------------|----------|----------|---------|------|---------------------------------|
| SPECIES GROUPS AND SPECIES | | | | | | |
| | | | | | | |
| CATASTOMIDAE (suckers) | | | | | | |
| longnose sucker | | x (1984) | | | | |
| white sucker | x (1958;1959;1970;2007) | | x (1959) | | | x (1940;1959;1973;1995;2007) |
| | | | | | | |
| CENTRARCHIDAE (bass, sunfish) | | | | | | |
| largemouth bass | | | | | | |
| pumpkinseed | | | | | | |
| rockbass | | | | | | |
| smallmouth bass | | | | | | |
| | | | | | | |
| CYPRINIDAE (minnows) | | | | | | |
| blacknose dace | | x (1959) | | | | |
| bluntnose minnow | | | | | | |
| common (redfin) shiner | x (1958) | | | | | x (2007) |
| creek chub | | | | | | |
| lake chub | | x (1959) | | | | |
| golden shiner | | | | | | x (2007) |
| lake chub | | x (1959) | | | | |
| northern redbelly dace | x (2007) | x (1959) | | | | |
| unidentified species | | | | | | x (1995) |

| | | | | | | |
|--------------------------------|---------------------------------------|-----------------------------|----------|--|--|--|
| ESOCIDAE (pike,pickerel) | | | | | | |
| chain pickerel | | x (1984) | x (1959) | | | ^x (1940;1959;1973;1995;2007) |
| FUNDULIDAE (killifishes) | | | | | | |
| banded killifish | x (2007) | | | | | |
| ICTALURIDAE (catfish) | | | | | | |
| brown bullhead | x (1959;2007) | ^x (1958;1959) | x (1959) | | | x (1940;1959;1973;2007) |
| PERCIDAE (perch,darters) | | | | | | |
| yellow perch | | | | | | |
| OSMERIDAE | | | | | | |
| rainbow smelt | | | | | | x (2007) |
| SALMONIDAE (char,trout,salmon) | | | | | | |
| Atlantic salmon | x (1973) | | | | | |
| brook trout | x (1959;1970) | ^x (1958;1959) | | | | x (1940;1959;2007) |
| brown trout | | | | | | |
| rainbow trout | | | | | | x (1973;1995;2007) |
| round whitefish | ^x (1958;1959;1970;1973) | | | | | x (1940;1973) |

Fish species found in Border Management Unit streams, based on sampling by electrofishing.

| Stream | Coaticook Brook | Hurricane Brook | Black Turn Brook | unnamed middle brook Black Turn SF | Holland Pond | | | Coaticook River | |
|----------------------------------|--------------------------------------|--------------------------------------|------------------|---------------------------------------|------------------------------------|----------------------------------|------------------------------|-------------------------|-------------------------|
| | | | | | north inlet (Beaver Pond brook) | south inlet (southeast brook) | south inlet (Mt. John brook) | | |
| Elevation (feet above sea level) | 413 | 417 | 400 | 391 | 437 | 445 | 442 | 382 | 391 |
| Date | 7/13/2009; 7/26/2010; 8/9/2011 | 7/13/2009; 7/26/2010; 8/9/2011 | 11/9/2009 | 11/9/2009 | 8/4/2008 | 11/9/2009 | 8/4/2008 | 8/25/2008; 9/13/2018 | 7/22/1999; 9/13/2018 |
| SPECIES GROUPS AND SPECIES | | | | | | | | | |
| CATASTOMIDAE (suckers) | | | | | | | | | |
| longnose sucker | | | | | | | | x | |
| white sucker | x | | | | x | | x | | x |
| CENTRARCHIDAE (bass, sunfish) | | | | | | | | | |
| largemouth bass | | | | | | | | | |
| pumpkinseed | x | | | | | | | | |
| rockbass | | | | | | | | | |
| smallmouth bass | | | | | | | | | |
| CYPRINIDAE (minnows) | | | | | | | | | |
| blacknose dace | x | | x | x | x | | x | x | x |
| bluntnose minnow | | | | | | | | | |
| common (redfin) shiner | | | | | | | | | |
| creek chub | x | | x | x | | x | x | x | x |

| | | | | | | | | | |
|--------------------------------|----------|----------|----------|--|---|--------|-----------|-------|---------------------|
| fallfish | | | | | x | | | x | x |
| golden shiner | | | | | | | | | |
| lake chub | | | | | | | | | |
| longnose dace | | | | | | | | x | x |
| northern redbelly dace | x | | | | | | | | |
| uniden tified species | | | | | | | | | |
| ESOCIDAE (pike,pickerel) | | | | | | | | | |
| chain pickerel | | | | | | | | | |
| FUNDULIDAE (killifishes) | | | | | | | | | |
| banded killifish | | | | | | | | | |
| ICTALURIDAE (catfish) | | | | | | | | | |
| brown bullhead | | | | | x | | | | |
| PERCIDAE (perch,darters) | | | | | | | | | |
| yellow perch | | | | | | | | | |
| OSMERIDAE | | | | | | | | | |
| rainbow smelt | | | | | | | | | |
| SALMONIDAE (char,trout,salmon) | | | | | | | | | |
| Atlantic salmon | | | | | | | | | |
| brook trout | x-- ≥yoy | x-- ≥yoy | x-- ≥yoy | | | x--yoy | x-- ≥yrlg | | x-- ≥yoy |
| brown trout | | | | | | | | x-yoy | x-- ≥yrlg & stocked |
| rainbow trout | | | | | | | | | |
| round whitefish | | | | | | | | | |

M. Historic Resource Assessment

Agency lands are managed with sensitivity to cultural and scenic values. With this in mind, the University of Vermont Consulting Archaeology Program (UVM-CAP) was contracted to report on the potential for Native American Cultural Resources of the Bill Sladyk WMA and Averill Mountain WMA, and the Archaeology Research Center of the Department of Social Sciences and Business of the University of Maine at Farmington (UMF-ARC) was contracted to investigate the historic resources (Euroamerican sites greater than 50 years old) of Bill Sladyk WMA and surrounding landscape context as part of this planning process. Detailed inventories and recommendations can be found in the reports.¹

Native American Resources

No known precontact native American resources exist within the BMU. However, historical accounts emphasize the role this general area may have played as a travel route and refuge area between Lake Memphremagog and the upper Connecticut Valley.

Averill Mountain WMA

While the proximity to a waterbody increases the potential for archeological resources, the typically steep terrain of Averill Mountain WMA led UVM to conclude precontact era Native American sites are not expected within the WMA.

Bill Sladyk WMA

While no known sites exist, precontact era Native American archaeological potential was identified within the Bill Sladyk WMA, especially adjacent to the wetland connecting Holland and Norton Ponds. Another area of high potential may be located in the southwest corner of the WMA, associated with the headwaters of a tributary of Hurricane Brook.

Black Turn Brook SF

While no known sites exist, precontact era Native American archaeological potential may exist within Black Turn Brook SF, especially adjacent to the Coaticook River.

European Historic Resources

European activity in the area is better documented, though settlement came late to this area of Vermont. A particularly dramatic incident occurred as Rogers Rangers fled south from a raid on the village of St. Francis in 1759—splitting into multiple parties, the Rangers fought with French forces, got lost, and struggled to survive, all in and around what is now Bill Sladyk WMA and Black Turn Brook SF.

Averill Mountain WMA

¹ Reports a) *The Cultural Landscape of the Bill Sladyk Wildlife Management Area* by UMF-ARC b) *Archaeological Precontact Site Sensitivity Analysis and GIS Mapping for the Vermont Agency of Natural Resources - St. Johnsbury District - Averill Mountain WMA and Bill Sladyk WMA* report by UVM-CAP.

No historic period Euroamerican sites are depicted on historic 1800s atlases or the 1928 USGS maps. While this area likely shares the same logging history as the other parcels of the BMU, it appears to not have hosted any significant infrastructure.

Bill Sladyk WMA and Black Turn Brook SF

No specific historic sites are known within Bill Sladyk WMA or Black Turn Brook SF despite extensive known historic Euroamerican uses, primarily based around logging. Historic sites, however, may exist somewhere on the WMA.

A number of mills were built on the outlet stream of Holland Pond, with the earliest recorded in 1850. A dam and wooden sluice were built on Holland Pond. By the late 1800s, at least three mills existed along Holland Brook, and the village known as Caswell's Mills (to become North Holland) contained a blacksmith/wagon shop, two general stores, a schoolhouse, a church, mill houses, and a large boarding house.

Logging in the Norton area progressed much like the developments in Holland – though in this case, development from Canada spurred growth in Norton. Settlement in Norton began in the 1860s, shortly after completion of the Grand Trunk Railway from Canada. Mills just over the border in Canada processed wood from the area, including a large steam-powered mill built in the 1870s that could producing 10 million board feet of wood annually. By 1878, there were as many as six dams on the Coaticook River and a number of rail stations between Norton Pond and the Canadian border.

Logging camps certainly existed on the WMA, though locations of specific camps are unknown. Over the years the area was used by many companies, including Caswell & Davis, Fitzgerald, Ames, Frontier Lumber, Norton Mills, Keenans' Siding, Woodard & Lyster, the Canadian mills of Gale, Cleveland and Cameron and later in time, Brown Company and James River Company.

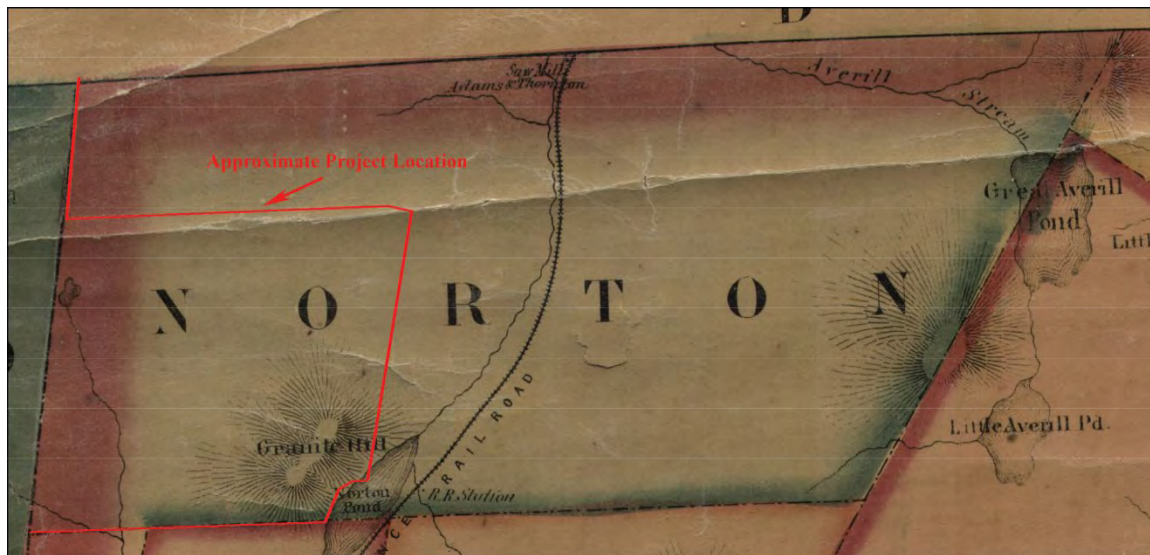
Agriculture in the area was been limited largely to the western border of the WMA, with little settlement in its boundaries. The rough terrain, poor soils, extensive wetlands, and distance from settlement of the area would have made farming difficult.

One area, however, is known to have hosted a farm settlement. The current "Ben Cole clearing" is located near farms dating to the late 1800s owned by the Cole and Trucotte families. The Cole farm included 40 acres of hay and at least three barns. Little is known about the Trucotte farm, though it is likely both were located along the "Hinman Road" to serve logging companies between Holland and Norton.

The "Hinman Road" (also known as the "old county road,") was built by Timothy Hinman in the late 1790s to connect Holland and Averill as well as farther connections as far as Lake Memphremagog and the Connecticut River. Much of the evidence of this road has likely been destroyed by subsequent development of the road with heavy equipment.



Walling's 1859 map of Orleans County containing those portions of the Bill Sladyk WMA within the town of Holland.



Walling's 1859 map of Essex County containing those portions of the Bill Sladyk WMA within the town of Norton.



Historic view of Caswell's Mills, west of Holland Pond on Holland Brook.

N. Recreation Resource Assessment

The primary recreational activities on the Border Management Unit include hunting and fishing, bird watching, wildlife viewing, snowmobiling, walking, hiking, camping, and boating. Other identified recreational uses in the BMU include mountain biking, horseback riding, cross-country skiing, and snowshoeing.

The BMU is in a remote area of the Northeast Kingdom, yet sections of it are easily accessed from I-91 and just to the south, the communities of Island Pond and Burke are becoming popular year-round recreational destinations. The area is 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. Although the lack of developed facilities will limit certain types of recreational pressure, the area will continue to attract hunters and fishermen and others seeking a remote dispersed recreational experience.

Walking/Hiking

Pedestrian travel takes place throughout the Border Management Unit but is not an intensive use.

There is a trail to the summit of Averill Mountain, which has been long-associated with other nearby paths maintained for summer guests of the Quimby Lodge and other sport camps on Forest Lake, Little Averill and Big Averill Lakes, and Wallace Pond. Access to this trail is by

foot travel only and at the discretion of private landowners along Route 114, where an informal trailhead exists. Much of the Averill Mountain Trail is in poor condition with widespread stormwater damage, erosion, and braided pathways.

There is also an informal trail network leading to the lean to at Round Pond and its neighboring backcountry ponds in the Bill Sladyk WMA. Although there are no other developed trails, the network of old logging roads in the BMU provides access to the self-reliant hiker.

Levels of use across the BMU are unknown, but do not seem excessive anywhere.

Hunting

Averill Mountain WMA likely sees minimal hunting. Black Turn Brook SF is to known support some level of hunting, for grouse and woodcock, deer, and moose. Most hunting in the BMU likely occurs in Bill Sladyk WMA.

The size and remoteness of Bill Sladyk WMA lead to its value for hunting deer, moose, and bear. Within the WMA, deer are able to evade Vermont's high hunting pressure and those that do hunt there have a chance to harvest older (3.5 years+) bucks than exist in much of the rest of the state. In addition, the large expanses of forest and wetland provide excellent habitat and uninterrupted hunting for wide-ranging animals like moose and bear.

Bill Sladyk WMA is also known to support grouse, woodcock, and hare hunting, though the intensity is not known.

Fishing

We have limited information about the interest in or intensity of fishing throughout the BMU. The best fishing opportunities are on the Bill Sladyk WMA, where the numerous ponds and brooks support a variety of legal fish species. A 2008 ANR survey of WMA visitors suggests a low level of visitation for fishing generally. VTFW provides a developed Fishing Access Area for motorboat launching at the end of a town highway on the west shore.

Snowmobile Trail System

Snowmobiling has been a long-term use through the Border Management Unit. There are two VAST Primary Trail Corridors on the BMU, all in the Bill Sladyk WMA. The corridors mainly consist of eight-foot wide trails groomed by local snowmobile clubs, with financial aid from VAST.

Cross-country skiing and snowshoeing

These forms of winter pedestrian access the only way to get to much of the BMU in the winter months. These uses appear to be occasional. There are no developed cross country ski trail systems. The network of management roads and old logging roads in the BMU provides access for those want to strike off on an ungroomed trail. The groomed snowmobile corridor trails can be skied with appropriate caution.

Mountain Biking

Existing Agency of Natural Resources policy regarding Mountain Bike use on public lands restricts this activity to gravel surfaced roads or trails officially designated for this use. A few

miles of gravel roads around the main entrances to Bill Sladyk WMA have been designated as available, however, they do not encourage high levels of use because they are dead-end roads with few specific sights or features for biking.

Horseback Riding

The BMU lands have had occasional use of some of the existing truck roads for horse riding activities. However, most use is by local people familiar with the road systems available. Current Agency of Natural Resources policy regarding horseback riding restricts this activity to gravel surfaced roads or trails officially designated for this use. No roads have been designated for this use on the BMU.

Water-Based Recreation

Within or adjacent to the BMU there are two large water bodies—Norton Pond and Holland Pond. Another fairly large pond, Great Averill Pond, is in close proximity to the Averill Mountain WMA and enhances its recreational use. These three large ponds likely have the highest levels of use for the area, including motorized recreation. In addition, there are a number of remote ponds completely within the Bill Sladyk WMA— Beaver, Duck, Round, Halfway and Turtle Ponds. These ponds are accessible by foot only and are likely less-visited, and only traveled by human-powered boats.

Wildlife Viewing and Nature Appreciation

Wildlife viewing and nature appreciation opportunities are plentiful throughout the ownership due to the myriad of habitats and species present.

Camping

Primitive camping (not to be confused with designated camping areas at Ben Cole Clearing, Ben Cole Camp, and Round Pond) is a specific activity that is allowed on state lands by certain guidelines. Within the Border Management Unit, the public has the right of access to the entire property for primitive camping, with the exception of Averill Mountain WMA. Those who want to undertake the challenge of primitive camping must follow the primitive camping practices outlined in the Department of Forests Parks and Recreation brochure entitled Vermont Guide to Primitive Camping on State Lands.

There are also *designated* camping areas for hunters during legal deer and moose seasons at Ben Cole clearing and Ben Cole camp on the Bill Sladyk WMA. Facilities are primitive and consist of an outhouse at each site. These areas may be reached by motor vehicle. In addition, a lean-to was constructed at Round Pond 1973 to control indiscriminate camping in that area.

Remote Areas

Thanks to its large size, the BMU is able to host not only to a variety of recreational activities, but different user experiences as well. There are parts of the unit which are very remote and interaction with other visitors is highly unlikely. On the other hand, there are popular areas, close to established roads, trails, and facilities where the user is likely to interact with numerous other visitors.

Sladyk WMA user survey (2008)

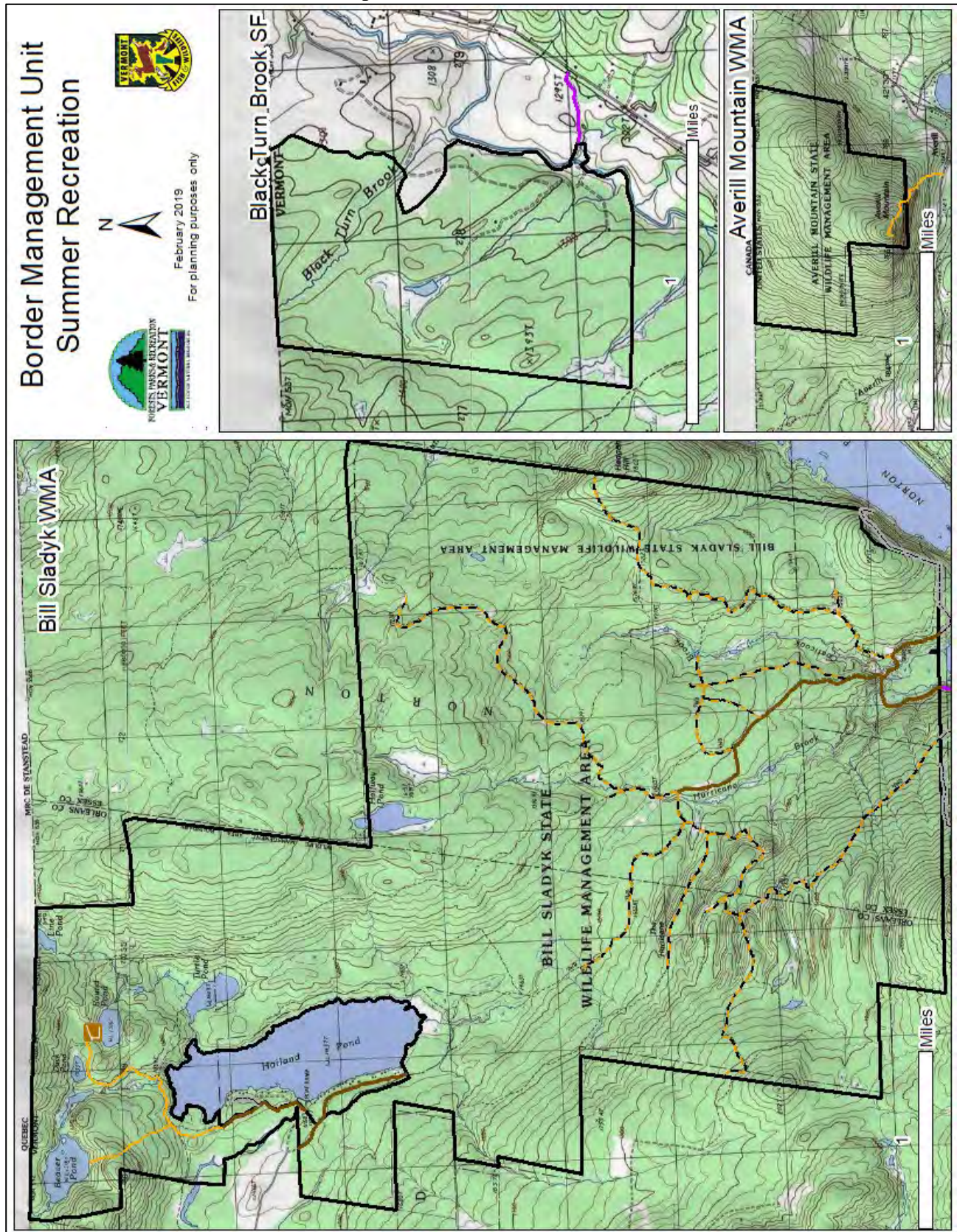
Stations at public access points at Sladyk WMA were established to dispense questionnaires to visitors regarding their activities at the WMA from late spring through fall of 2008. It was our particular intention to gauge current fishing interest at the WMA ponds and streams. The details and results of the survey are presented in Table 5.

| Access location | | HURRICANE KIOSK ¹ | HOLLAND POND KIOSK ² | LINE FARM TRAIL |
|-------------------|----------------------------|------------------------------|---------------------------------|-----------------|
| | # of respondents | | | |
| | parties | 37 | 45 | 1 |
| | individuals | 78 | 107 | 1 |
| | % Vermont respondents | 71.8 | 77.6 | 100.0 |
| | % non-resident respondents | 28.2 | 20.6 | 0.0 |
| | % residence unknown | 1.8 | 0.0 | 0.0 |
| activity declared | % of respondents | | | |
| HUNTING | parties | 32.4 | 26.7 | |
| | individuals | 37.2 | 25.2 | |
| FISHING | parties | 10.8 | 13.3 | |
| | individuals | 10.3 | 12.1 | |
| WILDLIFE VIEWING | parties | 59.5 | 62.2 | 100.0 |
| | individuals | 56.4 | 68.2 | 100.0 |
| HIKING | parties | 18.9 | 60.0 | |
| | individuals | 17.9 | 69.2 | |
| OTHER | parties | 27.0 | 20.0 | |
| | individuals | 26.9 | 16.8 | |

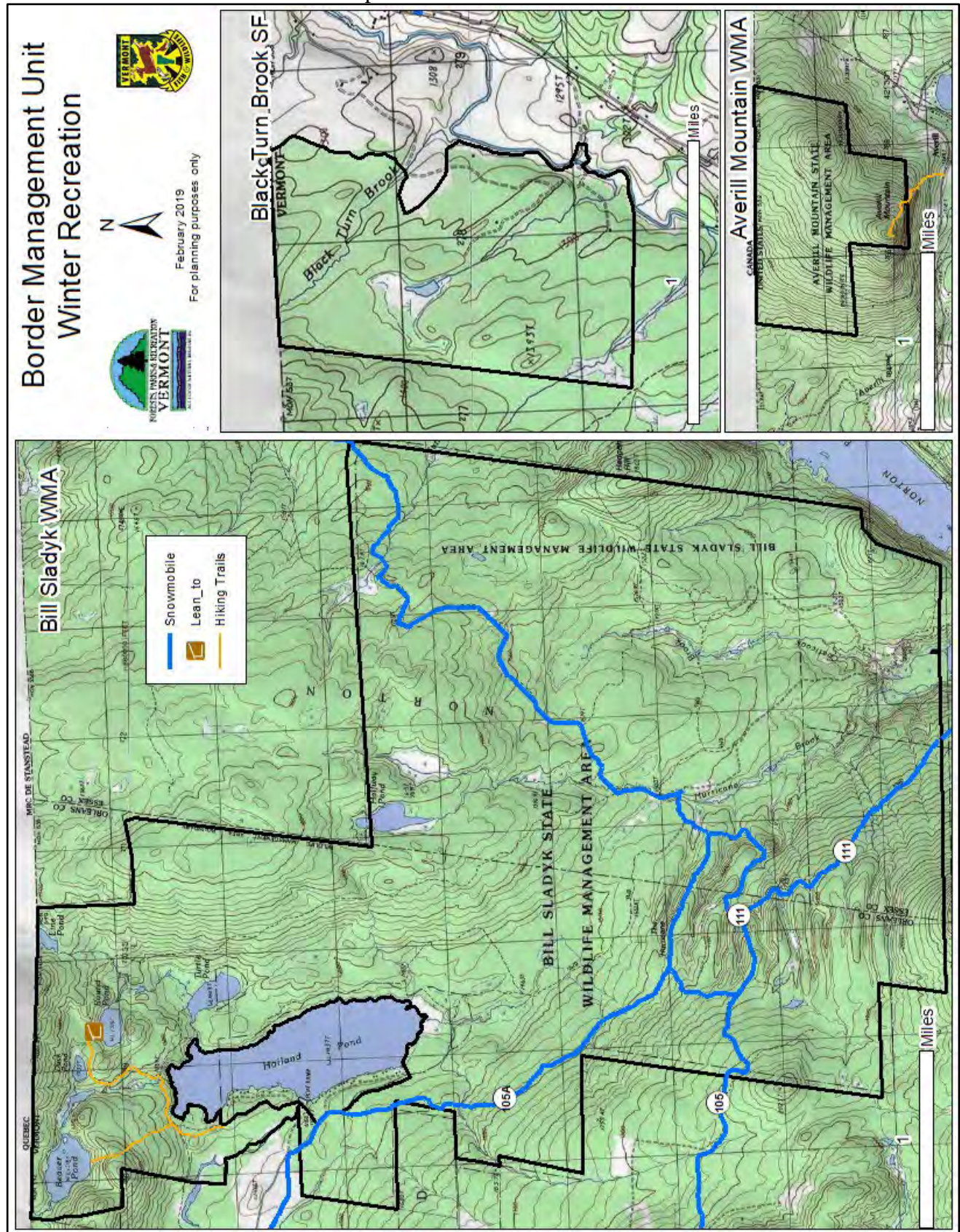
¹ Three of the four parties, and five of the eight individuals declaring fishing as their visitation purpose at the Hurricane Kiosk survey location were fishing at Norton Pond, not part of the Border Management Unit.

² Three of the six parties, and four of the thirteen individuals declaring fishing as their visitation purpose at the Holland Pond Kiosk survey location were fishing at Holland Pond, on the periphery of the Border Management Unit, and accessed by a VTFW Fishing Access Area that is not within Sladyk WMA.

Map 8 - Summer Recreation



Map 9 - Winter Recreation



O. Infrastructure and Public Access Assessment

The BMU can be accessed from several roads. The primary access points to Bill Sladyk WMA are from Holland Pond Road and Hurricane Road. In the summer and fall the Hurricane Road leads to an extensive network of internal roads, many of which originated from logging operations. Access to Black Turn Brook SF and Averill Mountain WMA is by foot from Route 114.

1. Existing Conditions:

For management purposes, roads are placed into three classes based on their function and condition:

Class A - A paved or unpaved state forest highway that is open for year-round public vehicle use.

Class B - A paved or unpaved state forest highway that is generally open for public vehicle use, but may be closed at certain times of the year to restrict such access.

Class C - An unpaved state forest highway not generally open for public vehicle use. Class C Roads typically do not have an aggregate surface or permanent drainage structures and are used primarily for management activities (e.g., logging operations) under frozen ground conditions.

The BMU contains almost 18 miles of Class B and C roads. No Class A roads exist within the BMU under ANR's management.

Averill Mtn WMA

Currently there are no public roads, or rights-of-way that serve as access points to this parcel. Prior to the State acquiring this parcel, timber management was conducted so there are winter truck roads on the property.

Bill Sladyk WMA

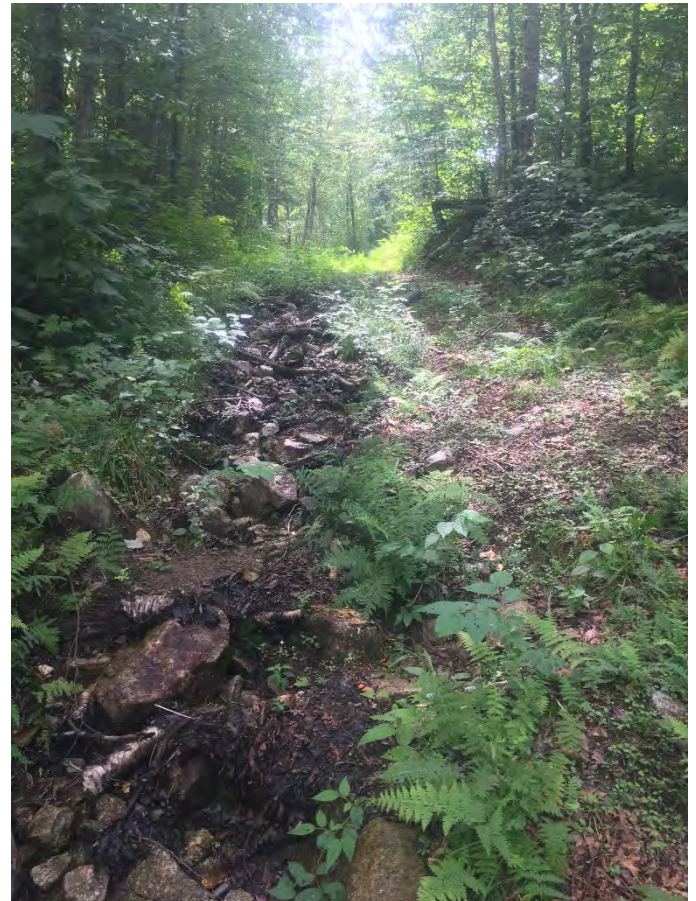
Roads

| Road Class | Miles |
|---|--------------|
| Class B (<i>passable by passenger car</i>) | 3.66 |
| Class C (<i>when open, high-clearance 4WD required</i>) | 13.96 |

Access to the Holland Pond area of Bill Sladyk WMA is available from the South Shore Road and North Shore Road off the Holland Pond Road. These class B roads both end at parking areas, after which users must travel on foot.

Access to the core of Bill Sladyk WMA is over the Hurricane Brook Road. This Class B road can be taken by passenger cars in to the Ben Cole clearing, near the center of the WMA. From there, numerous Class C roads radiate out in multiple directions. These roads were built primarily for the removal of forest products prior to the State purchasing the property. These roads currently serve as walking trails for the general public, in some instances as snowmachine trails, and are utilized for a range of unauthorized activities. Many Class C roads have been left open to the public and are passable to some degree by high-clearance, four-wheel drive vehicles and are used lightly by the public.

A 2018 assessment of road conditions across the WMA found that most of these Class C roads are in very poor condition and present both limitations for public use and negative natural resource impacts. These roads are commonly composed of large rocks, mud holes, eroding channels, and overgrown vegetation which make public use difficult and dangerous. In addition, these roads have numerous areas of significant erosion which is damaging water quality.



Culverts

Culverts are tube-like structures that allow water to pass under roads. A 2018 assessment of culverts on roads across the WMA found 43 culverts carrying perennial streams that cross roads

on the WMA. The majority of these structures are too small and too poorly positioned to allow high flows of water to pass safely or to allow fish to pass upstream. Many of these culverts are in some state of failure, with the worst being completely eroded and washed out of position. These failing culverts negatively impact fish habitat and populations, negatively impact water quality, and make public access more difficult and less safe.



Public Recreational Infrastructure

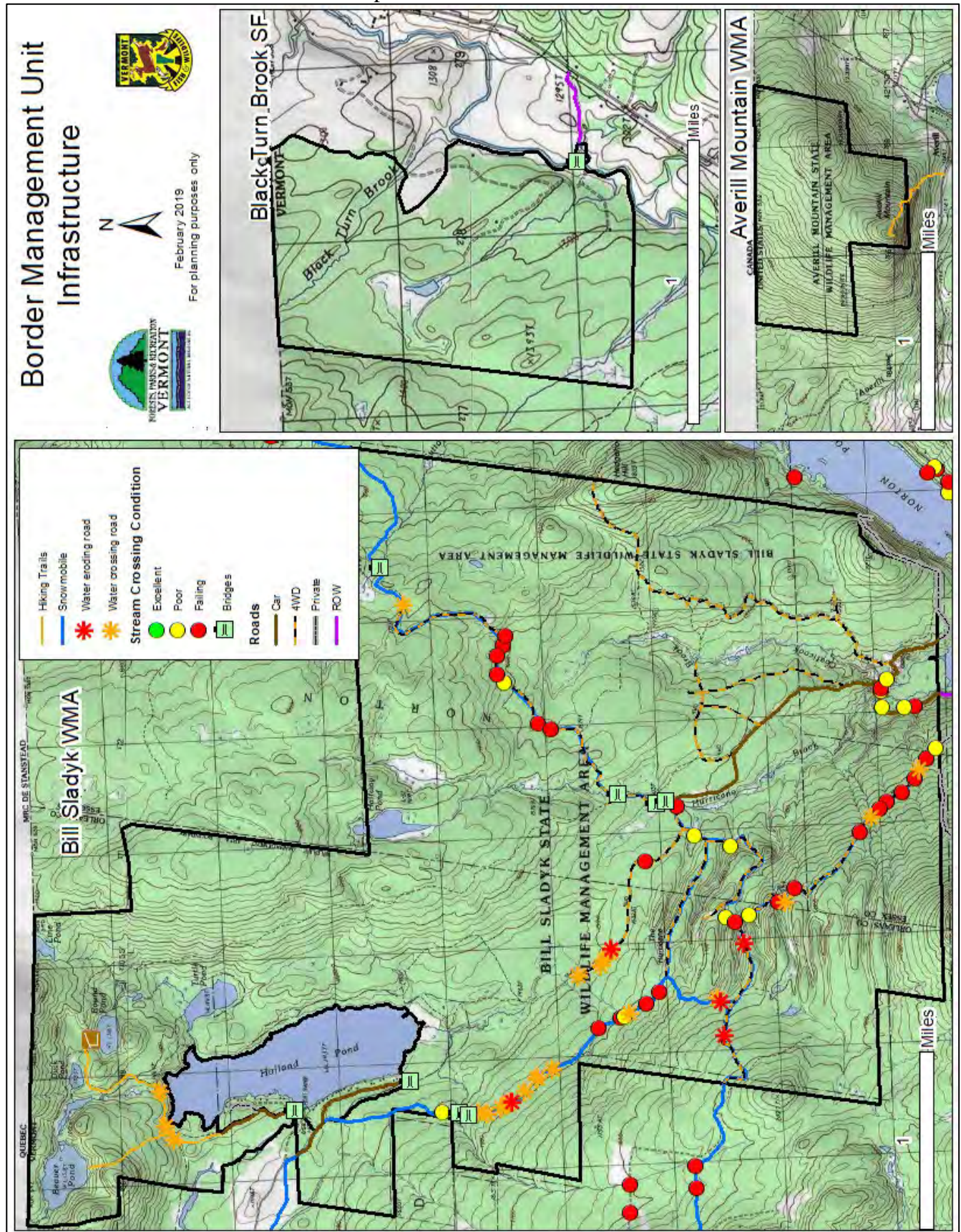
There are designated camping areas for hunters during legal deer and moose seasons at Ben Cole clearing and Ben Cole camp on the Bill Sladyk WMA. Facilities are primitive and consist of an outhouse at each site. These areas may be reached by motor vehicle. In addition, a lean-to was constructed at Round Pond 1973 to control indiscriminate camping in that area. While the lean-to has fallen into disrepair, improvements are planned for the structure in 2018-2019.

Black Turn Brook SF

The main access is at the southern end of the property off Vermont Route 114 in the town of Norton. This road is located on a ROW across three parcels of private property. It is currently gated on the west side of the railroad crossing. A parking facility is located on private property that is currently owned by Dr. Stanley Miller between the railroad and Vermont Route 114. The ROW follows along the edge of agricultural fields before crossing a major bridge crossing the Coaticook River. This bridge is roughly 38 feet in length and in good condition.

On the State Forest itself, there are no publicly accessible roads.

Map 10 - Infrastructure



P. Scenic Resource Assessment

Averill Mtn WMA

Scenic resources at Averill Mountain WMA are primarily the summit of Averill Mountain, which offers an excellent view to the south.

Bill Sladyk WMA

Scenic resources at Bill Sladyk WMA are primarily focused around the numerous ponds that are part of the WMA, which offer expansive views of largely undeveloped shorelines in a remote setting.

Black Turn Brook SF

Scenic resources at Black Turn Brook SF are primarily close-distance views of the Coaticook River.



Historical photo of view from the top of Averill Mountain

IV. MANAGEMENT ACTIONS

A. Management Vision for the Border Management Unit

Over the long term, the BMU will be a place where:

- Ecosystems function naturally and provide services including clean water, clean air, wildlife populations, and forest products.
- A range of native biological diversity is present, including rare, threatened, and endangered species.
- Wildlife habitat will be maintained and enhanced through management of vegetative conditions and special focus on selected habitats and species.
- A variety of wood products are produced through exemplary and sustainable practices.
- A range of sustainable recreational uses is managed for public use.
- Existing historical, cultural, and scenic resources are maintained.
- An ethic of respect for the land, sustainable use, and exemplary management is fostered in visitors.
- Management will adapt with new scientific understanding, changing resources, and varying uses.

As stated in I.A. (Purpose of Ownership) and the Mission Statements on Page 3, each department has its own mission and priorities. Specific differences in how the parcels will be managed may be found in the land use classifications and strategies laid out in section IV.C. *Location-specific management strategies*.

B. General Management Strategies

Natural Communities

Each natural community type serves as a proxy for the species it is expected to support. Rather than attempting to identify and protect all species on a landscape, protecting high-quality natural communities can ensure that all species, known and unknown, are supported. Natural communities with the best likelihood of supporting the most native species, because of their size, condition, and landscape context, are designated as State-Significant. These State-Significant natural communities are believed to provide excellent habitat for the majority of their associated native species, and are the foundation for conserving the full range of Vermont's species.

1. Goal: maintain or enhance the condition of all State-Significant natural communities.
 - a) State-Significant matrix communities (Northern Hardwood Forest, Red Spruce-Northern Hardwood Forest, and Lowland Spruce-Fir Forest) will be actively managed for forest products, wildlife habitat, and recreational use without degrading their condition, in accordance with FW's Vermont Natural Community Ranking Specifications. Such management will include limiting the size of canopy openings, managing invasive species, and retaining woody material.
 - b) Smaller State-Significant communities (mostly wetlands and high-elevation forests on the BMU) will be classified as Highly Sensitive under the landuse categories (see IV.C. for more details), and active management and recreational development will be limited.

Forest Health

2. Goal: Prevent the introduction of additional nonnative invasive plants to the BMU
 - a) All logging and earthwork equipment will be required to undergo cleaning before use on the BMU, to prevent the introduction of nonnative invasive plants.
 - b) All gravel sources will be inspected for nonnative invasive plants before use on BMU.
 - c) All roads will be monitored for nonnative invasive plants annually.
 - d) All earthwork and timber harvest sites will be monitored for nonnative invasive plants annually for at least 2 years after completion.
3. Control or eradicate all known nonnative invasive plant populations on the BMU.
 - a) All known occurrences of nonnative invasive plants will be treated as necessary for their control or eradication.
 - b) Within six months of first identification, a plan will be created to control or treat any nonnative invasive plants found.
4. Goal: Prevent or manage any non-native invasive pests identified on the BMU.
 - a) Within six months of the detection of any non-native invasive pest, ANR will develop and engage in adaptive management strategies to respond to the potential threat in collaboration with other appropriate agencies.
5. Goal: manage native forest health threats identified on the BMU.
 - a) Identify, monitor, and manage native forest health threats including shoe string rot, hypoxilin canker, black knot, and beech bark disease in collaboration with FPR Forest Health staff.

Forest and Wildlife Habitat Management

The general approach in the BMU is to maintain the area as extensively forested; protect valuable ecological resources such as wetlands and rare natural communities; develop arrangements, types, and sizes of vegetation as productive wildlife habitat; and sustainably harvesting forest products. This will be done by employing a variety of forest management techniques.

As the BMU is almost entirely forested, manipulation of vegetation will most often be accomplished via commercial timber sales, however, some pre-commercial activities may be utilized to achieve desired habitat conditions (e.g., to improve crown development and species composition in deer wintering areas).

Timber harvesting will occur on the BMU in the General Management Area and portions of the Special Management Areas (see section IV.C.). Within the next 10 years, stands totaling 2,247 acres have been selected for possible management, and are shown in chronological order of operations – with 1 being soonest and 6 being latest (see Map 11). Silvicultural approaches will include both even-aged and uneven-aged treatments, and will include the creation of up to 440 acres of regenerating young forest. Acknowledging that this parcel is part of a large block of conserved and managed lands, the actions taken here will be evaluated, and adapted as needed, based on how they compliment what is happening on neighboring properties. The type, scope,

and geography of harvests/habitat management may be altered somewhat from those planned in order to better accomplish the goals of this LRMP within the broader landscape, particularly stand structures and landscape connectivity.

Northern Hardwood Forest Types

These forest types are associated with the Northern Hardwood natural community consisting of sugar maple, beech, yellow birch, white ash, and associated species. Overstory beech trees are declining due to widespread beech bark disease and are growing root system “suckers”. This is creating a dense understory of beech saplings which outcompete other hardwood species. Management across the BMU will strive to provide habitat for a variety of wildlife species (including grouse and woodcock focal species) while improving the quality of the timber resource and harvesting forest products.

6. Goal: Manage Northern Hardwood forests for diverse structures, age classes, and species compositions, utilizing both even-aged and uneven-aged silvicultural systems.
 - a) In hardwood stands adjacent to deer wintering area, 1-2 acre regeneration treatments may be used to promote the growth of accessible woody browse. The potential for such treatments will be assessed by a FW Biologist when harvests adjacent to the deer winter area are being planned.
 - b) Even-aged silvicultural systems may be utilized to encourage species diversity where the understory is dominated by beech saplings.

Red Spruce-Northern Hardwood

These forest types are associated with the Red Spruce-Northern Hardwood Forest natural communities. They are primarily found at the mid to upper elevations and in the transition area from upland hardwood communities to lowland spruce-fir forests along drainages. Since many of the softwood species have been sought for numerous cutting cycles the percentage of softwood in these stands is less than would occur naturally.

7. Goal: Manage Red Spruce-Northern Hardwood stands to become multi-aged forest communities with diverse compositions of red spruce, white pine, sugar maple, yellow birch, and American beech and complex structural characteristics, while sustainably producing forest products and enhancing habitat for focal wildlife species.
 - c) During harvesting operations, practices will generally seek to maintain or increase the level of softwood species within the harvest unit.
 - d) Planting of softwood species such as white pine may be used to enhance natural regeneration and increase softwood composition and species diversity.
 - e) Breeding season surveys for black-backed woodpecker nests will be conducted in all Red Spruce-Northern Hardwood stands scheduled for harvest before treatment. One acre around confirmed nest sites will be retained.

Lowland Spruce-Fir Types

These forests are associated with Lowland Spruce-Fir natural communities, and occur primarily along the major drainages at lower elevations. The species mix in many of these stands is heavy

to balsam fir, and as fir stands reach the age of natural mortality and decline, blowdown events increase.

Montane spruce-fir communities found at the highest elevations of the management unit are classified as Highly Sensitive and will be managed as Highly Sensitive natural communities, as described in Section IV.C.

Uneven-aged spruce fir forests are vital to providing the high, continuous canopies that protect deer from deep snow, strong winds, and low winter temperatures. Such forests are also important for a host of northern species including moose, snowshoe hare, gray jay, black-backed woodpecker, and American marten.

8. Goal: Manage Lowland Spruce-Fir stands to support the development of multi-aged forest communities with substantial components of red spruce and white pine, complex structural characteristics, and natural disturbance dynamics, while sustainably producing forest products and enhancing habitat for focal wildlife species.
 - a) Long-term, uneven-aged silvicultural management of these communities will be preferred. In the near term, however, even-aged management will be necessary in some areas—for example, large stands of overmature balsam fir present a high risk for blowdown and subsequent dominance by shade-intolerant hardwoods. Management in such stands may use even-aged techniques such as shelterwoods and patch cuts to promote desirable spruce and fir regeneration before the overstory is lost.
 - b) Coniferous species diversity will be maintained and enhanced by actions including:
 - designing treatments to favor softwoods over hardwoods.
 - designing treatments to favor red spruce over balsam fir.
 - retaining hemlock and northern white cedar where present.
 - supplementing natural regeneration by planting white pine seedlings in chosen locations.
 - c) The age of red spruce and pine components will be allowed to increase, with some individuals eventually reaching over 200 years.
 - d) Deer winter shelter will be promoted by maintaining at least 50% of the area in functional shelter (softwood cover >35 feet in height and with >70% average crown closure) when possible.
 - e) 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.
 - f) Thinning treatments may be conducted before stands reach the poletimber stage, to preserve functional deer winter shelter.
 - g) Breeding season surveys for black-backed woodpecker nests will be conducted in all Lowland Spruce-Fir stands scheduled for harvest before treatment. One acre around confirmed nest sites will be retained.

Vegetation Management Standards

The following are general strategies that will apply to most vegetation management activities across forest types.

Even Aged Silvicultural Standards

- Regeneration cuts will be up to 25 acres in size, though most will be smaller. If strip cuts are used, the maximum length will be 800 feet.
- Thinning will often occur between groups/patches, to favor preferred species and enhance growing conditions.
- Where possible, softwood components will be maintained and increased.
- Individual trees of special wildlife significance will be protected.

Uneven Aged Silvicultural Standards

- Stands will be treated on a 20 to 25 year cutting cycle.
- Techniques will be single tree or group selection (generally under 2 acres), to maintain canopy cover, promote regeneration of shade tolerant softwood species, and release regeneration.
- Trees of all sizes may be removed in each entry, but a range of ages and sizes will be constantly retained in the stand.
- Minimum basal areas will be consistent with silvicultural guides.
- Harvest openings will be designed to create a vertical structure within the stand.
- Where possible, softwood components will be maintained and increased.
- Individual trees of special wildlife significance will be protected.

Salvage Harvest Standards

- Salvage harvest will be considered only in stands designated for vegetation management in accordance with this plan.
- Salvage harvest will be implemented only if it furthers the goals of the stand as described in this plan.
- Retention of woody features will be implemented as with all operations across the BMU.

Treatments for Specific Wildlife Habitats and Ecosystem Functions

Young, Regenerating Forest: Regenerating forest provides important habitat and resources for deer, moose, black bear, snowshoe hare, ruffed grouse, woodcock, bobcat, red fox, shrubland birds, and other species. Simultaneously, other species (such as American marten) will not persist in landscapes with too much open and young forest.

9. Goal: Maintain a small portion of the BMU as young, regenerating forest at all times, while maintaining natural community condition ranks.

- a) In the long term, create regenerating forest² on up to 7% of lowland spruce-fir communities, 4% of red spruce-northern hardwood communities, and 2% of northern hardwood communities.
- b) Where possible, aspen stands will be targeted for harvest to produce dense aspen regeneration, for its value to wildlife.
- c) Some harvests may specifically target areas adjacent to beaver ponds and wetlands, in order to produce high quality habitat for Canada warbler.
- d) Develop one or more Hare Management Area(s) with habitat management specifically to provide for snowshoe hare, in areas that are accessible to hunters during the winter.

Upland Openings: Openings provide somewhat similar habitats and resources as regenerating forest, but can provide a different species composition and structure, creating additional habitat diversity. Such openings, for instance, can be important foraging areas for bats and other wildlife. These openings complement natural disturbances like beaver activity and flooding, which can create similar, but often more ephemeral, openings.

10. Goal: Maintain up to 20 acres of the BMU in permanent upland openings.

- a) Existing openings will be mowed or burned approximately every three years to maintain open, herbaceous conditions.
- b) Mowing will occur after August 1 to allow fledging of ground nesting birds, and in areas where wood turtles are likely to occur, mowing will take place after October 1 to prevent direct mortality.
- c) New openings may be developed to replace current openings by mowing or burning recent log landings.
- d) New acreage may be converted from forest into shrub upland opening, within the 20 acre total. This would likely occur adjacent to existing openings or wetlands where suitable vegetation (native shrubs) already exist.

Deer wintering areas: Forests with conifers providing high, continuous canopies serve a crucial function in protecting deer from the deep snows, strong winds, and low winter temperatures in northern Vermont. While predominantly softwood forests are optimal for deer wintering habitat, mixed conifer-deciduous forests may also provide adequate winter protection. Red spruce-northern hardwood forest in the WMA identified as deer wintering area may be managed to enhance its value as deer habitat.

11. Goal: manage lowland spruce-fir forests to accommodate deer wintering needs

- a) Management will aim to provide functional shelter across at least 50% of the deer wintering area.
- b) Connectivity throughout all non-regenerating segments of the winter area will be maintained.
- c) Browse accessible from shelter areas may be provided in adjacent hardwood areas. The managing Biologist will review potential timber sales adjacent to deer wintering areas before development of prescriptions to assess and plan for any such browse enhancement.

² Defined here as 0-15 years old and in patches of greater than 2 acres.
Border Management Unit – DRAFT Long-Range Management Plan

Beech Mast Production Areas: American beech is the key mast producing tree in northern Vermont. Its nuts provide significant food resources for black bear, white-tailed deer, American marten, fisher, wild turkey, ruffed grouse, and many small mammal and bird species.

12. Goal: Develop and maintain beech mast production areas in northern hardwood stands with sufficient healthy beech trees and evidence of bear use, through uneven-age management.

- a) Generally, BMPAs will be managed in accordance with VDFW Guidelines (including the strategies below), but management may vary depending on site-specific conditions:
 - Crowns of crop mast trees will be released crowns from competition by crown-thinning on 3 sides (W-N-E).
 - In areas without crop trees, single-tree and ½ acre group selection may be used to encourage crown development on healthy trees and to encourage regeneration.
 - A 200 foot wide uneven-aged buffer zone will be established around the BMBA to maintain shade and prevent winter injury to beech crop trees from sun scald.
 - Operations will generally be conducted in winter conditions, on frozen ground or more than 12 inches of snow, to minimize injury to beech roots and boles.

Riparian Areas: Terrestrial areas bordering streams, ponds, and wetlands serve critical functions including providing terrestrial and aquatic wildlife habitats and maintaining water quality.

13. Goal: manage riparian areas to provide ecosystem services and wildlife habitat.

- a) Riparian areas will be managed as per ANR Guidelines on Riparian Area Management.
- b) Forest management may be used within proximity to wetlands to create habitat conditions for Canada Warbler and Rusty Blackbird.
- c) Forest management planning will consider habitat connectivity through riparian areas for American marten and other wildlife, particularly connectivity of softwood types both within the property and leading to adjacent properties.

Vernal Pools:

14. Goal: Manage vernal pools for amphibian habitat, in accordance with the Vermont Agency of Natural Resources Riparian Management Guidelines.

- a) No ground disturbance or vegetation management will be allowed within the pool itself and within 100 feet of the pool edge, except for restorative purposes as described in the Guidelines.
- b) 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.
- c) Landings, skid roads, and truck roads will not be located inside the secondary buffer zone whenever possible.
- d) Operations will avoid disturbing fallen logs, will leave limbs and tops where felled, and may create downed coarse woody material by cutting large trees and leaving them in place.

- e) Canopy cover and downed woody material between pool, wetland, and riparian habitats will be maintained whenever possible.

Snags, cavity trees, and woody material: Dead and dying wood are important resources for wildlife habitat and ecosystem function. Snags (standing dead trees) are used extensively by insects, bats, birds, and other species. Cavity trees (living or dead trees with hollows in them) are critical nesting, denning, and roosting sites for species including owls, bats, wood duck, American marten, and black-backed woodpecker. Dead wood on the ground plays a role in regulating forest nutrient cycling, water flow, and erosion, while also providing a critical resource for dozens of species of wildlife, including: insects for bear foraging; den sites for bears, lynx, and American marten; cover for snowshoe hare and salamanders.

15. Goal: Retain wood habitat elements in harvested areas to provide ecosystem services and wildlife habitat for a range of species.

- a) A minimum of 6 snags per acre, four of which are >14" dbh and two of which are >24" dbh, will generally be retained where possible. Where trees of this diameter are lacking, retaining both large healthy trees, and large diameter trees with defects will maximize current and future snag habitat.
- b) Where feasible, all cavity trees will be retained, unless they pose a safety hazard to the loggers or the public. When this target substantially conflicts with the silvicultural prescription, a lesser number of snags may be retained, counting as part of living "recruitment" tree goals below.
- c) Downed woody material will be retained in all but specific circumstances to meet defined management objectives. Generally, a minimum of 3-5 stems >18" in diameter and 16 feet in length and 10 stems >14" in diameter and 16 feet in length should be provided per acre.
- d) Whole-tree harvesting will be avoided in low-fertility sites, shallow-to-bedrock soils, coarse sandy soils, poorly drained soils, steep slopes, and erosion-prone sites.
- e) A minimum of 5 living "recruitment" trees per acre, four of which are >15" dbh and one of which is >20" dbh, will be retained where possible, to ensure a future supply of snags, cavity trees, and dead material. Where trees of this diameter are lacking, a minimum of 5 of the largest trees possible will be retained.

Structural Complexity Enhancement: The structural complexity of forests is key to their habitat value and ecosystem function. The history of intensive timber management on the WMA has left a simplified structure—for example, most of the forest belongs to one or two young age classes, dead and downed wood is limited, some features created by natural disturbances (like wind-thrown and ice-damaged trees) are uncommon, and large-diameter trees (live or dead) are relatively rare.

16. Goal: Maintain and enhance the structural complexity of the BMU's forests.

- a) Identify locations where management to enhance the structural diversity of the forest may be used to accelerate the development of features and processes of old forests, for ecological restoration or the mimicking of natural ecological processes.

Remote Forest Reserve: Given that much of the landscape in and around the BMU has been, and will continue to be, managed for direct benefits to humans, primarily for forest products, the designation of other areas to develop naturally as communities is an important conservation tool to ensure the needs of all of Vermont's 40,000 native species are met and to preserve the greatest value in ecosystem services such as clean water and carbon storage. For example, such an area on the BMU will promote habitat for species including black bear which avoid human disturbance, American marten which require extensive mature forests, black-backed woodpeckers which rely on woody habitat features, and reptiles and amphibians which require leaf litter, undisturbed soils, and downed woody material. In addition to rare natural communities identified above, such an area must represent common natural communities, in order to support the many species that rely on them.

A key goal of this area is also to provide for remote recreational experiences, which are increasingly difficult to find in the region. Maintaining and enhancing the BMU's value as a destination for remote hunting, angling, and wildlife watching experiences was a central theme of public comments. Implementation of the recreational goals for the area are described in greater detail elsewhere in this plan.

17. Goal: Maintain and enhance the ecosystem, wildlife habitat, and other values of the BMU's forests by designating areas that will not be subject to timber harvesting.

- a) An area of Bill Sladyk WMA, approximately 3,100 acres in size and encompassing the far northern extent of the property around Holland Pond and the numerous small ponds, and extending south and east to Hurricane Brook will be maintained to promote the functions and values of the natural communities present, including the extensive wetlands, numerous ponds, and remote forests. (see Figure 13)
- b) This area will be managed primarily to allow natural processes to proceed and will not be subject to vegetation management in the future, except for ecological restoration such as treatment of nonnative invasive species. Existing roads and trails may be maintained through these areas and priority will be placed on restoring degraded infrastructure, while development of new permanent infrastructure will be prohibited.
 - I. A small number of stands within the Remote Forest Reserve will be targeted for treatment over the next 10 years to increase the complexity of structure and species composition within the area before the area is left to develop without intervention (see Figure 11).

Soft Mast Concentrations: Soft mast such as the fruits of cherries, *viburnum*, *rubus*, and apples are important food sources for a variety of wildlife.

18. Goal: Maintain and enhance soft mast species for their value to wildlife.

- a) Natural soft mast areas will be maintained by limiting disturbance of those communities and maintaining the ecological processes allowing them to persist.
- b) Maintenance of permanent upland openings and creation of temporary silvicultural openings will contribute additional soft mast.
- c) Fruit bearing trees may be retained, released, and pruned in appropriate locations, to provide mast for wildlife.

Bird nests:

19. Goal: Limit disturbance to any active bird nests of priority species.

- a) When identified, active heron rookeries and nests of raptors, black-backed woodpeckers, spruce grouse, and other rare species will be managed with appropriate buffers, in accordance with FW guidance. Disturbance will be limited within buffer zones and any timber harvesting will avoid the active nesting period.

Nest boxes and platforms:

20. Goal: Supplement natural habitat features for priority species with nesting and roosting structures as needed.

- a) Nesting structures such as osprey platforms, bat boxes, and wood duck boxes may be used in suitable locations to enhance limiting habitat elements.

Habitat connectivity:

21. Goal: Enhance conditions that allow unimpeded movement of wildlife and plants across the landscape.

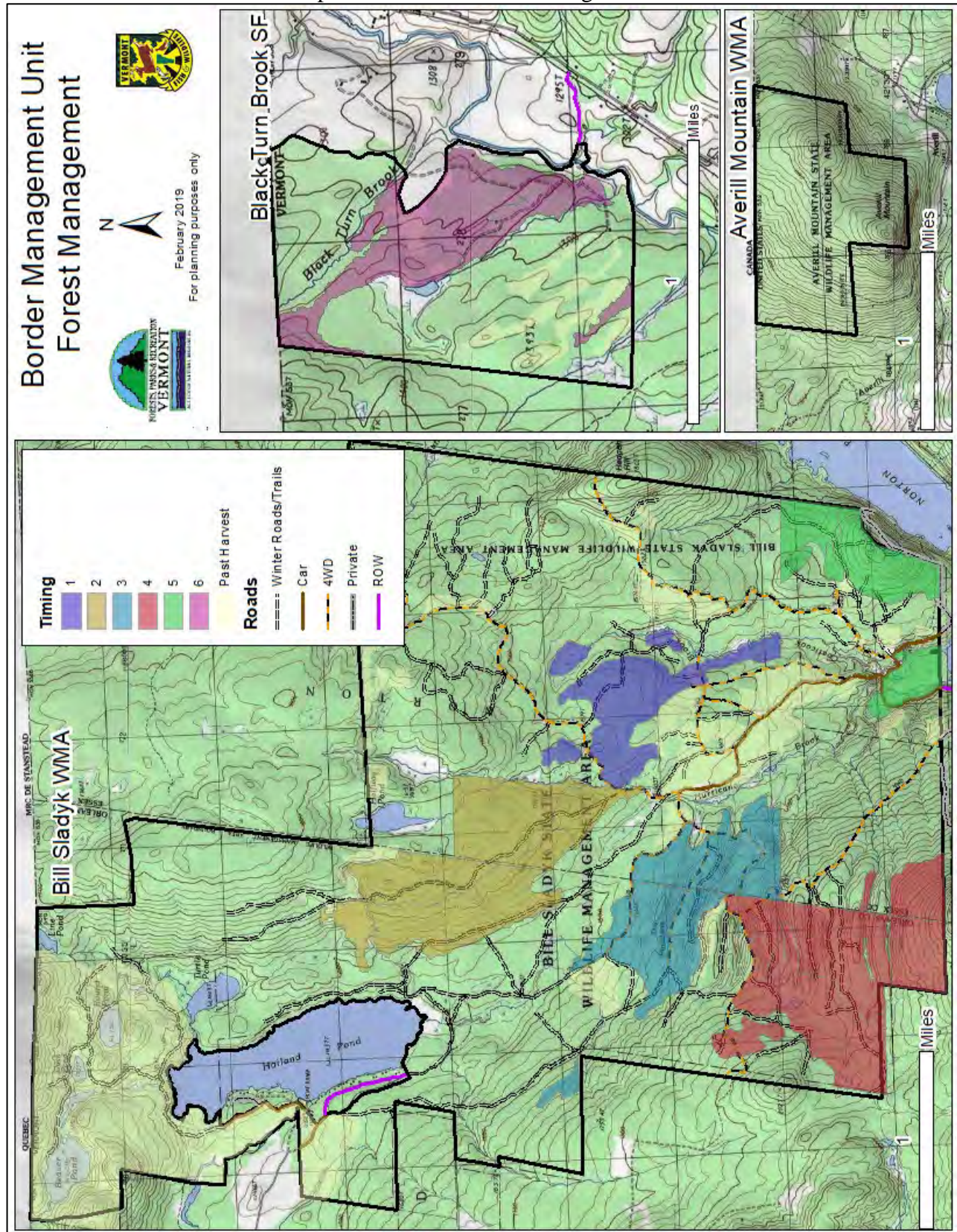
- a) Pursue opportunities to work to adjacent landowners and municipalities in maintaining and improving habitat conditions and connectivity.

Schedule for Implementation

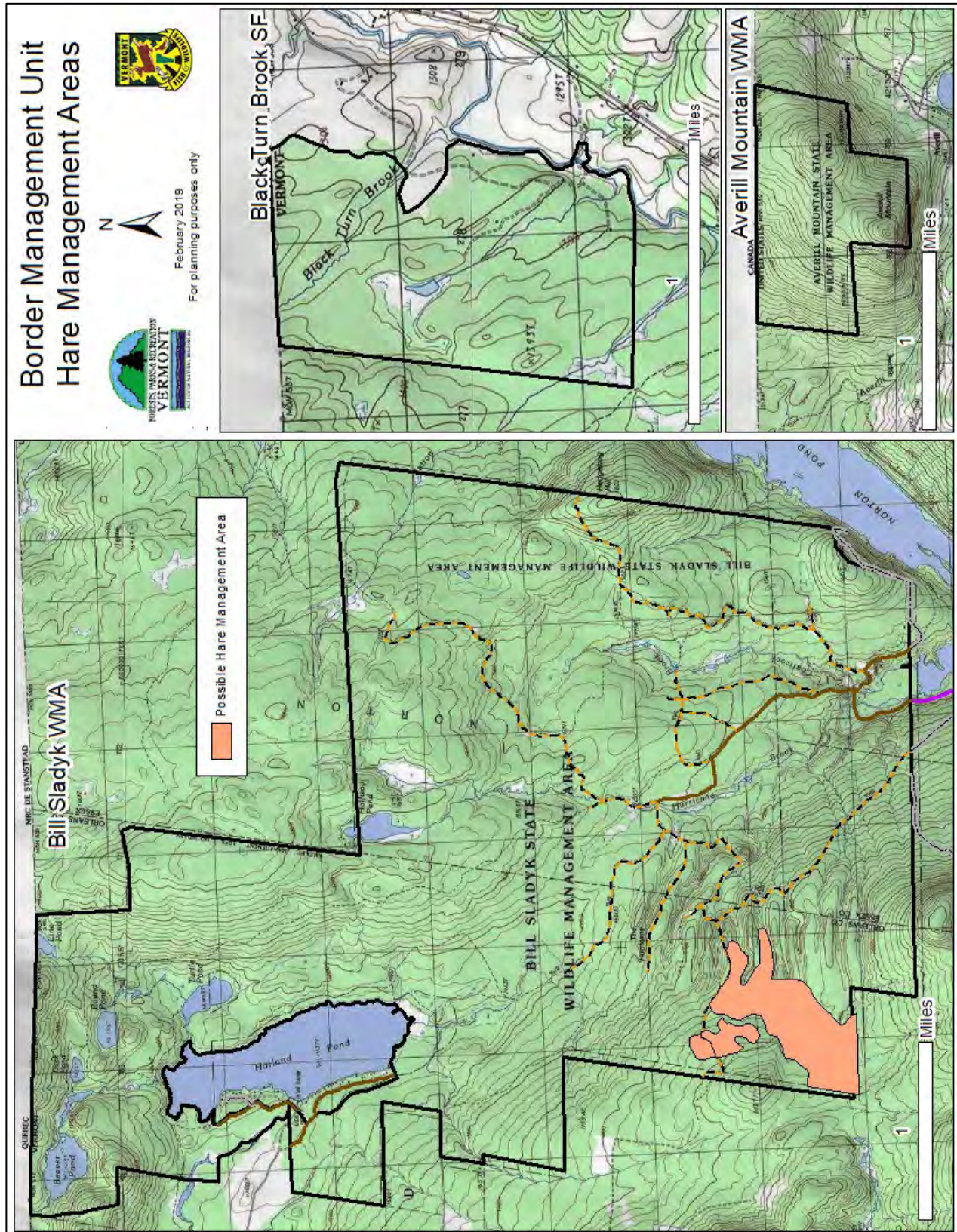
The following is based on inventories to gain general information on the forests of the BMU. Prior to the development of harvesting prescriptions, a more intensive assessment of the wildlife and timber resources in each location targeted will be completed.

Areas for treatment have been identified for the next 10 years as illustrated in Figure 11. These stands were identified based on the general condition of each stand, the size class distribution of forests/habitats across the BMU, and the size class distribution within the individual compartments.

Map 11 - Planned Forest Management



Map 122 – Hare Management Areas



Maple sugaring

Private leases of maple sugaring rights are allowable under Forests, Parks, and Recreation policy on State Forests and Parks (but are not allowable on WMAs under Fish and Wildlife policy). Leases may be considered in General Management Areas, where they are consistent with the

goals of the area as specified in this plan, including future vegetation management, wildlife habitat, and public access. Forests, Parks, and Recreation will evaluate and implement sugaring leases in accordance with Department policy. Any such potential lease would be made available to the public through an open bid system.

Water and Fisheries

22. Goal: Maintain and enhance water quality, wetland functions, and aquatic conditions.

- a) All waters will be managed for characteristics of a nearly natural condition, and limited to minor changes from reference conditions for aquatic macro-invertebrates, fish assemblages and aquatic habitat.
- b) All streams and waterbodies will be evaluated for strategic wood addition activities and if appropriate management will occur.
- c) At a minimum, all logging operations will follow the guidelines set forth in “Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont” (August 15, 1987 or successive versions) and Agency of Natural Resources Riparian Management Guidelines.
- d) Where possible, impacts of beaver impoundments on infrastructure will be mitigated with water control devices, rather than lethal controls.
- e) All future development (such as roads and parking areas) will minimize impacts to riparian areas, as per ANR state Riparian Management Guidelines.
- f) Timber harvesting will be conducted in accordance with ANR policy on Riparian Management.
- g) High quality brook trout populations in the streams and ponds of the BMU will be a primary focus of management.
- h) Maintaining habitat for round whitefish where they may persist or be restored.
- i) Reclamation of Round Pond to restore native fish and aquatic communities will be explored by Fisheries and DEC staff, as part of a separate permitting process.
- j) Develop a restoration plan for the most downstream road crossings of Coaticook and Hurricane Brooks. Interruption of Aquatic Organism Passage may be preferable at these locations, to prevent non-native northern pike from extending upstream from Norton Pond.
- k) Maintain the unique wilderness character of Beaver, Halfway and Turtle ponds as defined by VTDEC Lake Protection Classification by limiting intensive management, including roads and designated camping areas in close proximity to these waterbodies.

23. Goal: Maintain and enhance native fish species diversity and fish habitat connectivity and quality.

- a) Structures causing undue erosion or sedimentation, prohibiting aquatic organism passage, or with poor geomorphic compatibility will be planned for repair or replacement.
- b) Oversimplified fish habitat may be enhanced by cutting riparian trees, dropping them into streams, and anchoring them to create structures that guide the stream and provide fish cover. Such “Strategic Wood Addition” restoration activity will be at the direction of the Fisheries Division of FW.

Historic

24. Goal: Maintain or enhance the condition of historic resources.

- a) Management that occurs near known historic resources (e.g., mowing historic fields with cellar holes) will be designed to avoid negatively impacting resources.
- b) The Vermont Division for Historic Preservation will be consulted before implementing activities that disturb the soil.

Recreation, Public Access, and Infrastructure

The central goal of recreational use and public access across the BMU is to permit and support a variety of recreational and public use opportunities in appropriate locations and times, while protecting important resources. Due to the nature of these strategies, this section will not use the goal-objective format as with the natural resource sections above.

Permitted and Prohibited Uses

The permitted uses listed below are consistent with the goals and objectives for the Border Management Unit and State policy. These uses are believed to have limited impacts on the resources of the BMU and its other users.

- *Dispersed*, low-impact activities are generally allowed throughout the management unit, including: walking/hiking, wildlife observation, photography, hunting, fishing, trapping, swimming, picnicking, snowshoeing, skiing, canoeing, gathering renewable and abundant resources (e.g., berries and shed antler) for non-commercial use, campfires, and dispersed primitive camping for groups of less than 10 (in accordance with FW and FPR primitive camping policies, which differ).
- The development of *roads and trails* and the concentrated public use of such facilities are allowed in designated corridors only, including: Motor vehicle use, snowmobiling, horseback riding, hiking, and skiing.
- Certain activities are allowed with a license or Special Use Permit from ANR, in advance, including: Commercial guiding, non-commercial group outings (e.g., non-profit tours, school trips), and scientific research.

Uses that are allowed on State Forest and Park land, but are not allowed on Wildlife Management Areas (except where specifically designated), as per state policy include:

- Ice and rock climbing, biking, and horseback riding.

Uses that significantly conflict with other public uses; have detrimental impacts to the fish, wildlife, and habitat of the management unit; and/or are inappropriate for the physical and aesthetic setting of the management unit are prohibited.

- Prohibited uses (except where specifically designated) include target and skeet shooting, all-terrain vehicle use (ATVs) (except for access by persons with disabilities on designated trails and with a no-cost user pass and agreement from ANR), commercial activities other than ANR-licensed guiding (e.g., commercial group tours; collection of fish, wildlife, plants and their fruits for sale), timber harvesting by the public, including collection of firewood or Christmas trees, maple sugaring, artifact hunting, and the construction of permanent structures including permanent hunting stands.

Trail and Corridor Management

Concentrated public uses will continue to be managed by ANR in designated trails. These trails will be managed to minimize impacts to the natural resources and other users of the property.

General corridor management

- Where appropriate recreational trails will be designed and improved to support multiple uses.
- Managing and maintaining trail networks will be conducted cooperatively with partner organizations where possible.
- New trail proposals will be evaluated based on agency and department policy and using criteria including compatibility with deed restrictions, the Land Use Classification, and the Recreation Opportunity Spectrum.
 - Are there significant resource issues? wildlife habitat; rare, threatened and endangered species; wetlands; cultural/historic, etc.
 - Are there other user group conflicts?
 - Is an Act 250 permit required? local permits required? Is a storm water permit required? wetland permits?
 - Who will be responsible for construction, maintenance, signing, parking, enforcement, etc.?
- Where trail proposals are only described in concept in this LRMP, ANR will seek additional public comment on the projects if and when full, detailed proposals are ready.

Remote Forest Reserve

Recreational uses across the BMU are largely dispersed, originating from state-provided access areas on ponds and roads. Across Bill Sladyk WMA, this plan envisions improved vehicular access in some areas to create more permanent and sustainable road conditions and allow access to most areas of the land. In addition, a section of the WMA (see Map 13) will be reserved primarily for dispersed uses, to ensure users are able to find experiences with remote character.

1. In this area, new intensive recreational proposals will be discouraged during the life of this plan.
2. The existing trails and lean-to within this area will be maintained.

Ski trails

- No maintained ski trails will be designated on the BMU, though dispersed skiing is allowed across the ownership.

Hiking trails

- The hiking trail up Averill Mountain, and foot trails to the ponds at Bill Sladyk will receive basic maintenance to improve trail conditions and user experience. A FW State Land sign will be added on the trail at the state land boundary.
- ANR will maintain contact with local landowners for the possibility of securing legal access to Averill Mountain WMA.
- Pedestrian uses of roads and trails is, and will continue to be, allowed throughout the BMU.

Snowmobiling trails

Snowmobiling trails exist across a large area of Bill Sladyk WMA. These trails are cooperatively managed with the Vermont Association of Snow Travelers (VAST). Trail management tasks including signing and water crossing maintenance are regular activities on the BMU, as with all snowmobile trails, and will be conducted as needed. No new trails or relocations of existing trails are planned. Trail relocations will be evaluated as necessary to maintain the integrity of the VAST network in the region.

- As identified in the Infrastructure Assessment, the VAST trail south of Holland Pond has significant water quality issues, which will need to be fixed in collaboration with VAST.

Equestrian trails

- No equestrian trails will be designated for use on the BMU.

Biking trails

- Bikes will continue to be allowed on gravel-surfaced roads open to vehicles on the across the BMU (note, the only such roads are on Bill Sladyk WMA).

All-Terrain Vehicles (ATVs)

- ATV use anywhere on the BMU is illegal, as per state law. This use will be controlled through enhanced use of signs and enforcement.

Public use infrastructure

Camping areas

- The lean-to and camping clearing at Bill Sladyk WMA will be regularly maintained.
- Pit toilets at Ben Cole clearing will be removed, as ANR cannot keep up with maintenance needs.

Kiosks

- Kiosks will be regularly maintained with updated information and signage.
- A new kiosks will be placed at Ben Cole Clearing.

Parking areas

- Parking areas will be maintained at a standard to allow use by the public.

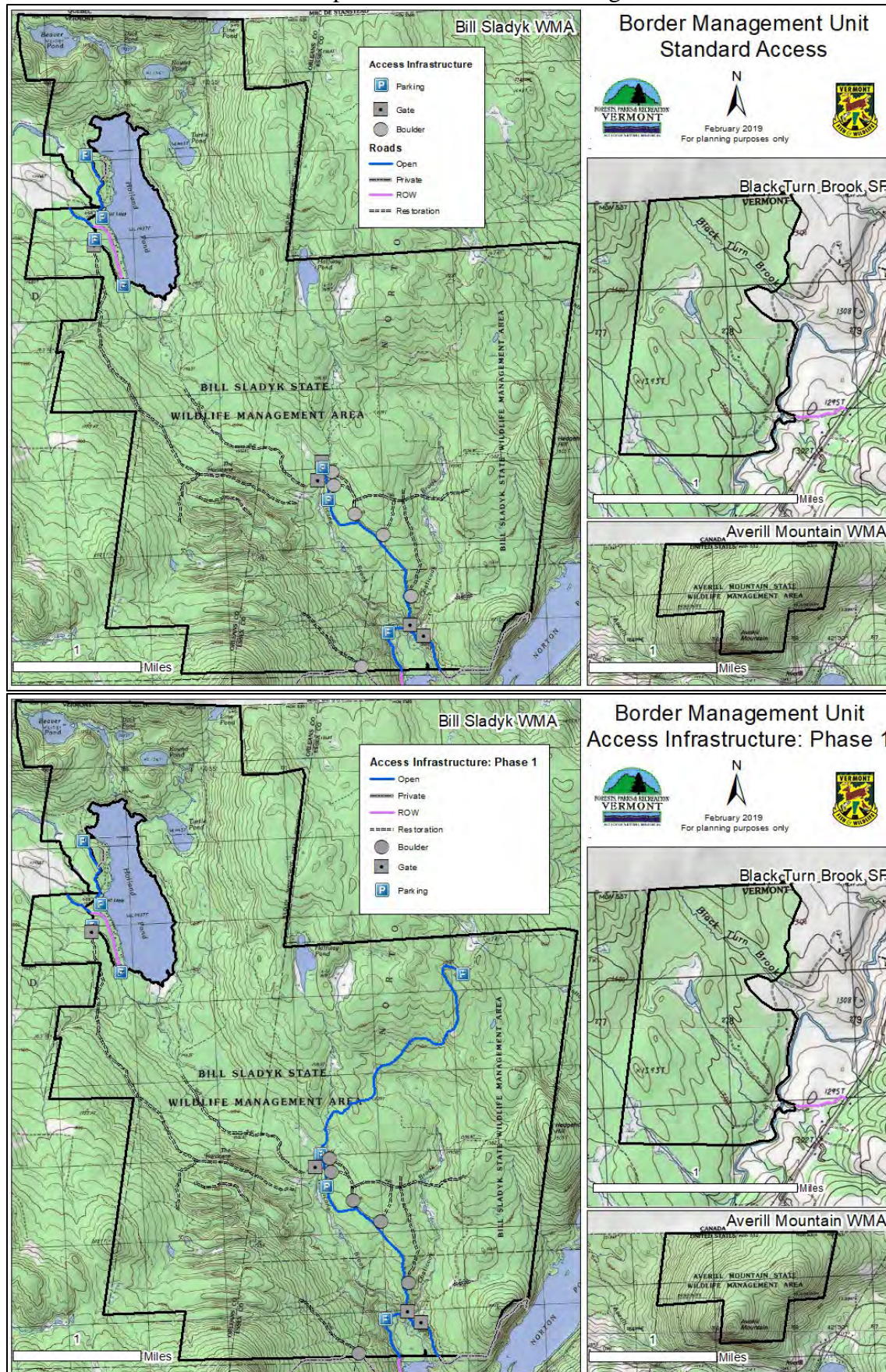
Roads and Gates

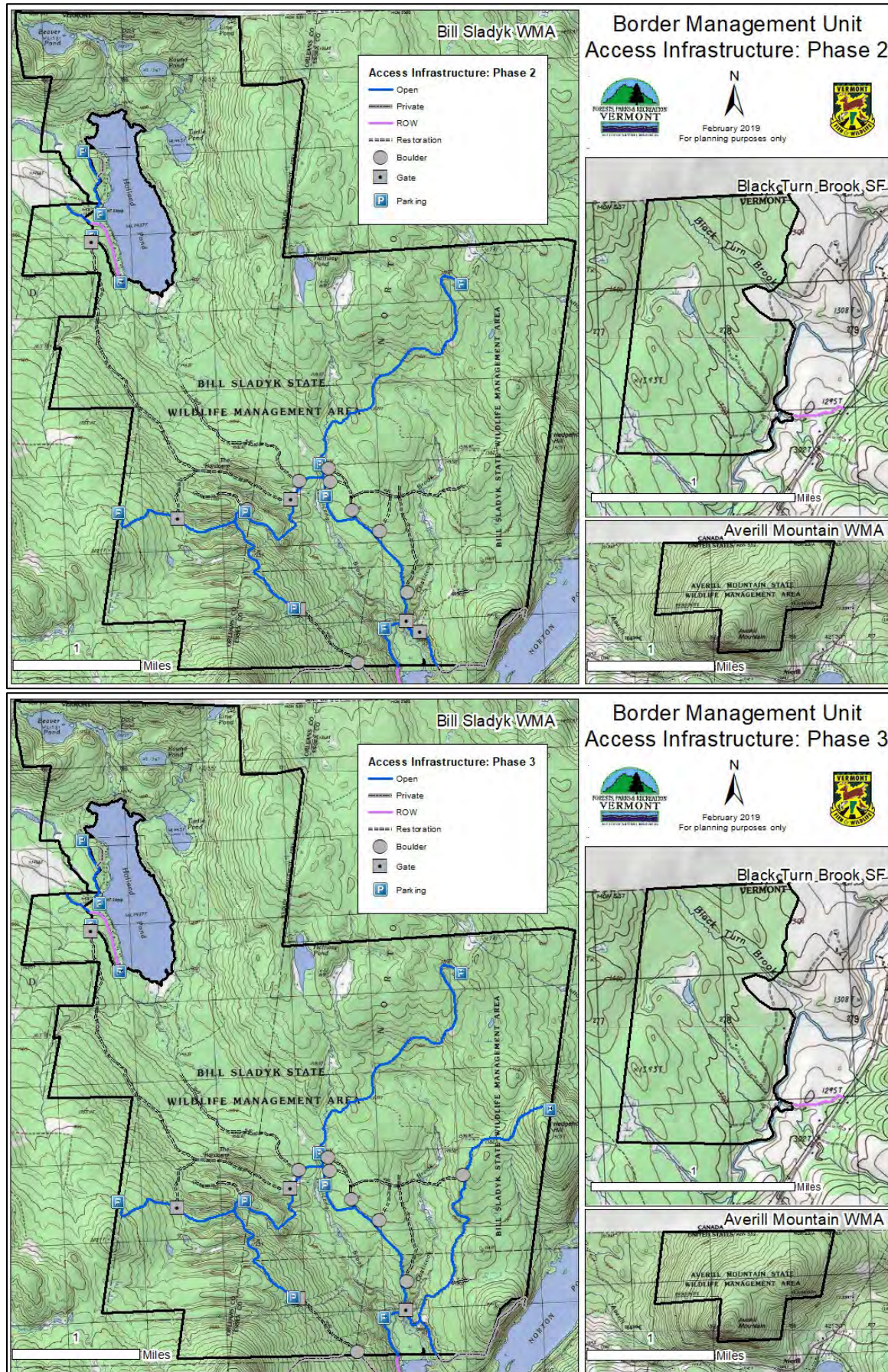
- The gate at Black Turn Brook State Forest will be left open so long as conditions allow, to enable public access to the property. To prevent damage to the private farm field, directional signs will be added to guide the public to the State Land.
- Unmaintained roads at Bill Sladyk WMA are leading to the most pressing natural resource impacts and public safety limitations on the property. The deteriorating condition of these roads are resulting in sedimentation of streams, loss of valuable public infrastructure, interruptions of aquatic organism passage, and risks for public use.

With limited resources, ANR must prioritize maintenance and repair of roads that are causing the most serious impacts and/or are most important for public access. To address these conditions, the following actions will be taken:

- Maintenance operations will focus on improving and maintaining primary access roads, so they are accessible to most vehicle types, and provide users a variety of starting points to access the WMA as well as adjacent conserved lands. This will increase public accessibility across the area. (See Map 13)
- No new permanent roads will be constructed. Short extensions or winter logging roads, however, may be constructed to access timber sale landings off of existing roads. Any new or improved logging roads will be blocked to vehicular access at the end of operations.
- Roads that are not essential for public access will be closed to public use and stabilized to prevent further deterioration, water quality issues, and public confusion. (See Map 13)
- Forest management roads will be inspected periodically and graded, resurfaced, mowed, and drainage structures kept up as needed and as funding permits.
- Culverts impacting geomorphic compatibility and aquatic organism passage on permanent roads will be replaced when possible. Larger culverts will be replaced with bridges when possible.
- Road improvements may be combined with nearby vegetation management activities.
- Gates will be installed where VAST trails intersect publicly-accessible roads, to stop summer vehicular use which is compounding the negative impacts of the degraded trail sections.
- These operations will be conducted as time and funds allow, generally in order of the phases laid out in Map 13.

Map 133 - Infrastructure Management





Public safety

- Wildfire detection will be based upon public reporting and air patrols. The town Forest Fire Warden in each town is responsible for wildfire suppression within their municipality. A list of contacts within the Forestry Division who are able to assist if necessary is located in the District Fire Plan available at the district office.
- Each year, heavily used areas (such as camping and parking areas) will be monitored for hazard trees. These trees will be evaluated and treated in accordance with FPR Procedure. As in all forests, however potentially hazardous trees will exist naturally across the management unit, and such trees may be left in place for their value in ecosystem function and wildlife habitat. Visitors must use their own judgment to ensure their safety in the woods.

Education and Outreach

- Exemplary land management practices will be demonstrated across the BMU so that they may find broader application on private lands.

Access for people with disabilities

- Efforts will be made to comply with Americans with Disabilities Act (ADA) standards allowing wheelchairs to access pedestrian-accessible areas.
- In accordance with the ADA, the Agency of Natural Resources issues free passes for the use of Other Power Driven Motorized Devices in appropriate areas to any individual with a disability who requests access.

Scenic

- Construction of roads, parking areas, buildings, or other infrastructure will be discouraged (but not prohibited) at areas identified in the Scenic Resources Assessment. Timber harvesting will not be precluded in these or other areas based on scenic concerns.

Climate change and flood resilience adaptation

The effects of climate change are an ongoing management issue at the Border Management Unit.

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

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

Anticipated Climate Change Effects

Scientific studies estimate a variety of potential changes in the future, including:

- Increased temperatures, especially in winter
- Increased precipitation, especially rain in winter
- Increased extreme weather events, including floods, wind storms, 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 BMU, as with forests across the state. The table below lists examples of anticipated effects and timeframes of many key climate factors on upland forests of Vermont.

Expected Climate Change Effects and Timeframes³

| Key Climate Change Factors | Expected Effects | Timeframe |
|-----------------------------------|---|---|
| Warming temperatures | Compositional changes associated with changes in thermally suitable habitat (loss of cold-adapted species and increase in warm-adapted species) | 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 disease, decreased productivity and increased tree mortality | Immediate |
| | 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 snow pack, leading to change in deer and moose browsing patterns, which may affect regeneration | Immediate |
| | Lengthening of growing season resulting in changes in species competitiveness, especially favoring non-native invasive plants | Immediate |
| Increase in extreme storm events | Increased physical damage and disturbance, leading to gap formation, which could facilitate the spread of invasive plants | Immediate |
| Phenology (timing) | Longer growing season | Immediate |
| | Early spring thaws/late frosts can damage buds, blossoms & roots, which affects regeneration | Immediate |

³ Source: TetraTech. 2013. Climate change adaptation framework. Prepared for Vermont Agency of Natural Resources.

| | | |
|---|--|---|
| | 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 snow packs, and hotter drier summers conducive to increased fire risk | Immediate |
| Increase in number of short-term droughts | Declines in forest productivity and tree survival associated with water limitation | Long-term |

Land Management Adaptation Strategies

Adaptation to these effects will take a variety of forms, many of which have long been a part of the excellent land management ANR strives to practice. Some of the key adaptation goals and strategies which will be used across the BMU include:

A) Sustain fundamental ecological functions: protect soil quality, nutrient cycling, and hydrology.

- Enhancing nutrient cycling and soil protection by retaining woody material on the forest floor.
- Matching harvesting equipment to the site for soil protection.
- Minimizing the number of skid roads and trails.
- Maintaining roads in good condition and following all AMP's.
- Replacing and enlarging inadequate culverts and stream crossing structures.

B) Reduce impact of existing biological stressors: increase pest and pathogen resistance, limit herbivory, and manage invasive species.

- Eradication and/or management of all non-native invasive plants.
- Avoiding negative impacts of overbrowsing through deer and moose population management.
- Management of Beech Mast Production Areas to promote resistant trees.

C) Moderate impacts of severe disturbances, such as fire and wind disturbance

- Managing for a multi-age, structurally diverse forest.

D) Maintain or create refugia and increase ecosystem redundancy.

- Maintaining areas not subject to timber harvesting and rare and sensitive natural communities as potential refugia.
- Maintaining and developing biological “legacies,” such as very old trees.

E) Maintain, enhance species and structural diversity and facilitate community adjustments through species transition.

- Maintaining and developing a forest with a diversity of species and age classes.

- Retention of biological legacies from a variety of tree species.

F) *Promote landscape connectivity.*

- Maintain a landscape-scale focus, by planning in conjunction with the other nearby lands, and being mindful of management in the surrounding region.
- Reduce landscape fragmentation by closing designated roads in Core Area.

In addition, the BMU's extensive spruce-fir and mixed forests are valuable communities in the face of a changing climate, and management to maintain and enhance them will favor many species encountering additional stresses over time. Such strategies will include:

- Promoting natural softwood regeneration
- Enhancing natural softwood regeneration with native species such as white pine
- Limiting hardwood regeneration
- Promoting softwood recruitment into the overstory through silviculture
- Favoring species expected to do better in a changing climate (red spruce over balsam fir)
- Maintaining lowland spruce-fir forests as potential refugia

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. For example, maintaining lowland spruce-fir forests, which may decline in a warming climate, and landscape connectivity should allow the rare boreal species of the region to persist on the BMU and move across the landscape as needed.

Infrastructure and Public Use 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 West Mountain WMA.

Potential effects could include:

- Floods damaging roads, trails, and camp structures.
- Fires endangering WMA users, camp 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 BMU as extensively forested, with significant riparian buffers and intact wetlands is a key strategy to reduce and mitigate flooding in the BMU and downstream areas. 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 relocating some roads away from streams.

C. Location-specific Management Strategies

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*.

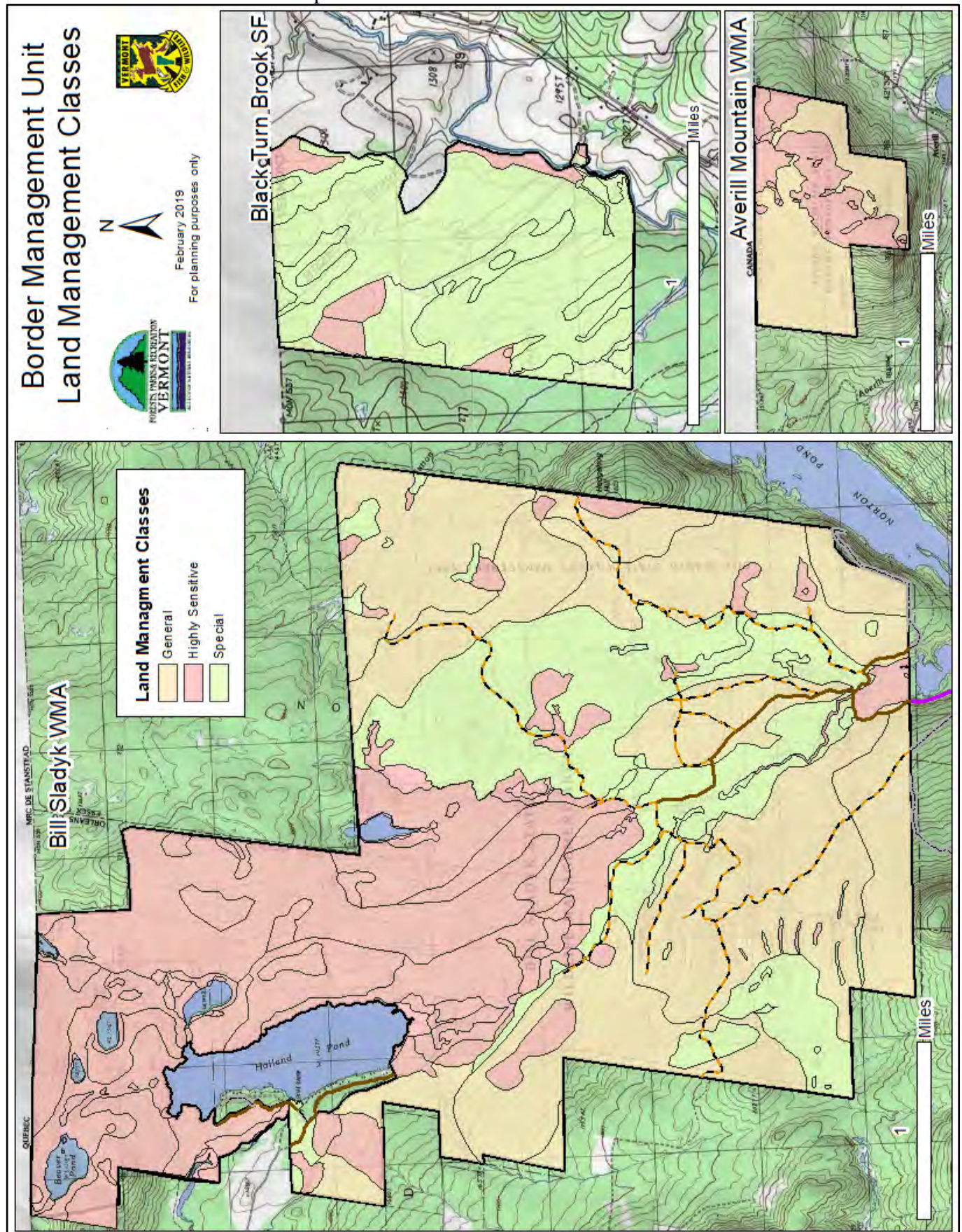
As part of the planning process, the lands, resources, and facilities held by the ANR are evaluated and assigned to the appropriate land management category. Assignment of management categories for the BMU is based on a thorough understanding of the resources identified and the application of over-arching 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** – Highly Sensitive Management areas contain uncommon or outstanding biological, ecological, geological, scenic, cultural, or historic significance where protection of those resources is the primary consideration for management.⁴ Human activities and uses should not compromise the exceptional feature(s) identified.
- 2.0) Special Management Areas** – Special Management Areas contain 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. However, timber harvesting, wildlife management, roads, and recreational activities should not compromise the unique or special resource(s) identified.
- 3.0) General Management Areas** – The General Management areas contain few rare resources and support dominant uses including sustainable timber harvesting, wildlife habitat management, concentrated trail networks, dispersed recreation, and other general land 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.
- 4.0) Intensive Management** – Intensive Management areas 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.

⁴ Highly Sensitive areas were chosen based having one or more of the following criteria: state significant (non-matrix) natural communities, S1 or S2 wetlands, seeps, vernal pools, threatened or endangered species habitat.

Some features and resources do not fit this classification system perfectly. For example, trail corridors that cross land use classification zones and natural communities or historic resources too small to represent as individual units. In cases such as these, management activities will be adjusted based on site-specific resources, constraints, and opportunities and will follow the management directions outlined previously in this document.

Map 145 - Land Use Classification



Highly Sensitive Management Areas

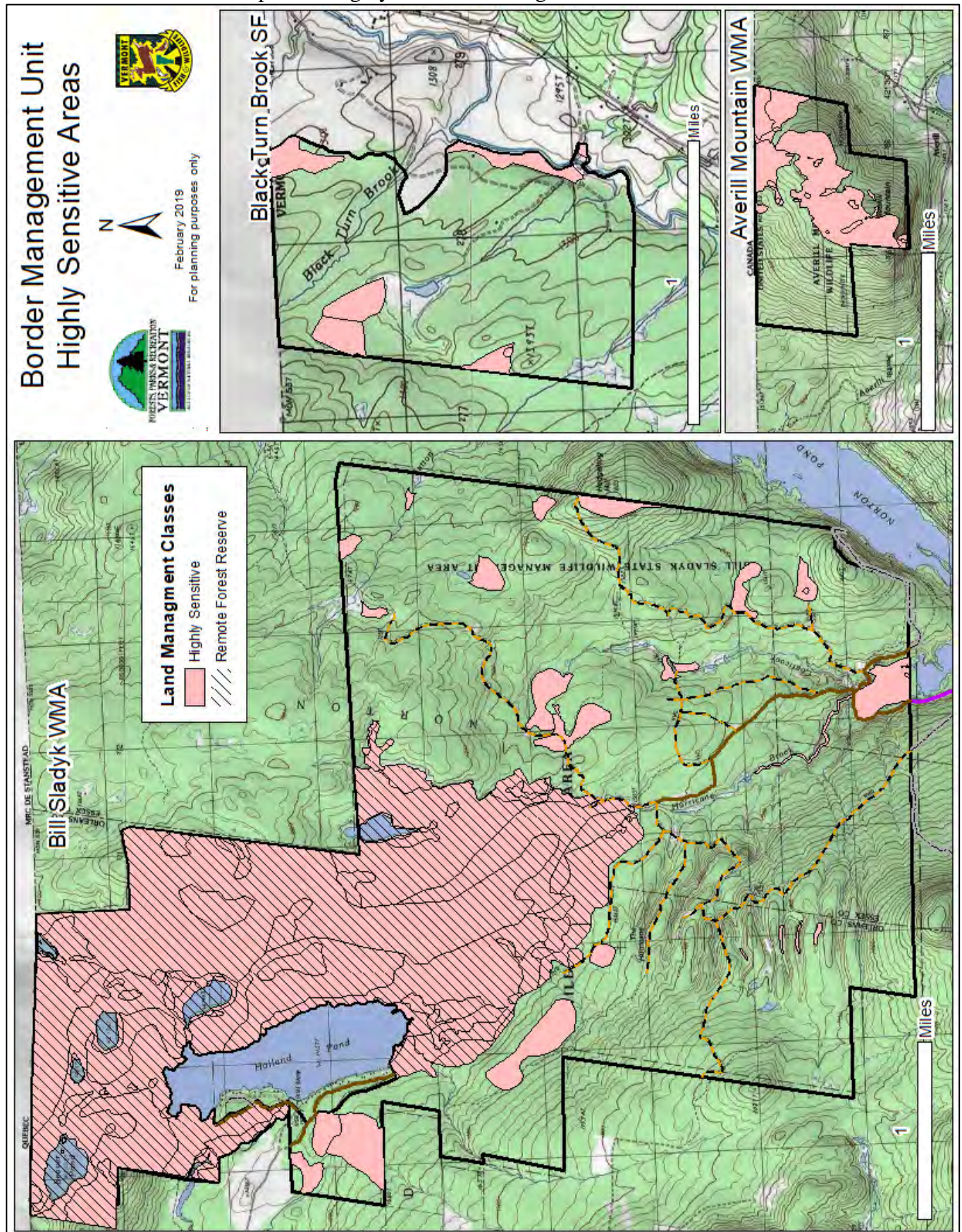
Highly Sensitive Management Area Goals

1. Protect rare, threatened and endangered plants and animals.
2. Protect examples of rare and exemplary natural communities.
3. Protect high elevation areas with steep slopes and fragile soils.
4. Maintain the natural condition of surface waters.
5. Protect significant and unique wildlife habitats.
6. Maintain areas of remoteness.
7. Provide recreational opportunities where appropriate and compatible with other goals.
8. Provide opportunities for education and outreach.

3,660 acres of the BMU (36% of the land area) are designated for Highly Sensitive management.

Acres managed under this category will be managed for the functions and values of the resources within them. In general, these will be achieved by allowing natural process to occur without active forest or habitat management, but in some limited cases vegetation may be manipulated for natural community restoration; management of specific habitats for rare, threatened, and endangered species; and to maintain safe and enjoyable recreational conditions. New recreational and public access infrastructure will be kept to a minimum and designed carefully to maintain natural resources.

Map 156 - Highly Sensitive Management Areas



Highly Sensitive Areas: Averill Mountain WMA

Description: Communities including montane yellow birch-red spruce forest, spruce-fir tamarack swamp, and seepage forests.

Featured management: Management will seek to maintain and enhance natural ecosystem function and development over time.

Implementation:

- The trail up Averill Mountain will be allowed to continue, and will receive additional maintenance to mitigate any unwanted impacts (e.g., erosion, widening).

Highly Sensitive Areas: Black Turn Brook SF

Description: Wetland communities including white cedar swamps, black spruce swamps, and conifer floodplain forests.

Featured management: Management will seek to maintain and enhance natural ecosystem function.

Implementation:

- Limited harvesting may occur around these communities for targeted wildlife habitat creation.

Highly Sensitive Areas: Bill Sladyk WMA, Remote Forest Reserve

Description: Areas in and around the numerous ponds of Bill Sladyk WMA including wetlands communities of beaver wetlands, northern white cedar swamps, black spruce bogs, dwarf shrub bogs, as well as areas of red spruce-northern hardwood forest, northern hardwood forest, and lowland spruce fir forest.

Featured management: These forests and wetlands will be allowed to develop naturally, to create and enhance habitats and habitat features that are uncommon in the region including large trees, large downed material, and natural disturbance patterns. The existing “remote,” undeveloped nature of the area will be maintained for the benefit of users seeking such experiences.

Implementation:

- These areas will be allowed to develop passively. New vegetation management, infrastructure development, and other activities will generally be avoided.
- Maintenance may occur on the hiking trails and lean-to near the ponds.
- Some forest stands near Turtle Pond may be treated during the 10-year schedule of this plan, to increase the diversity of the forests within the reserve (see Map 11).

Highly Sensitive Areas: Bill Sladyk WMA, other areas

Description: Numerous areas small, rare natural communities dispersed across the WMA. Primarily wetlands.

Featured management: Management will seek to maintain and enhance natural ecosystem function and development over time.

Implementation:

- Limited harvesting may occur around these communities for targeted wildlife habitat creation.
- Road infrastructure will be maintain so as to minimize impacts on these natural communities.

Special Management Areas

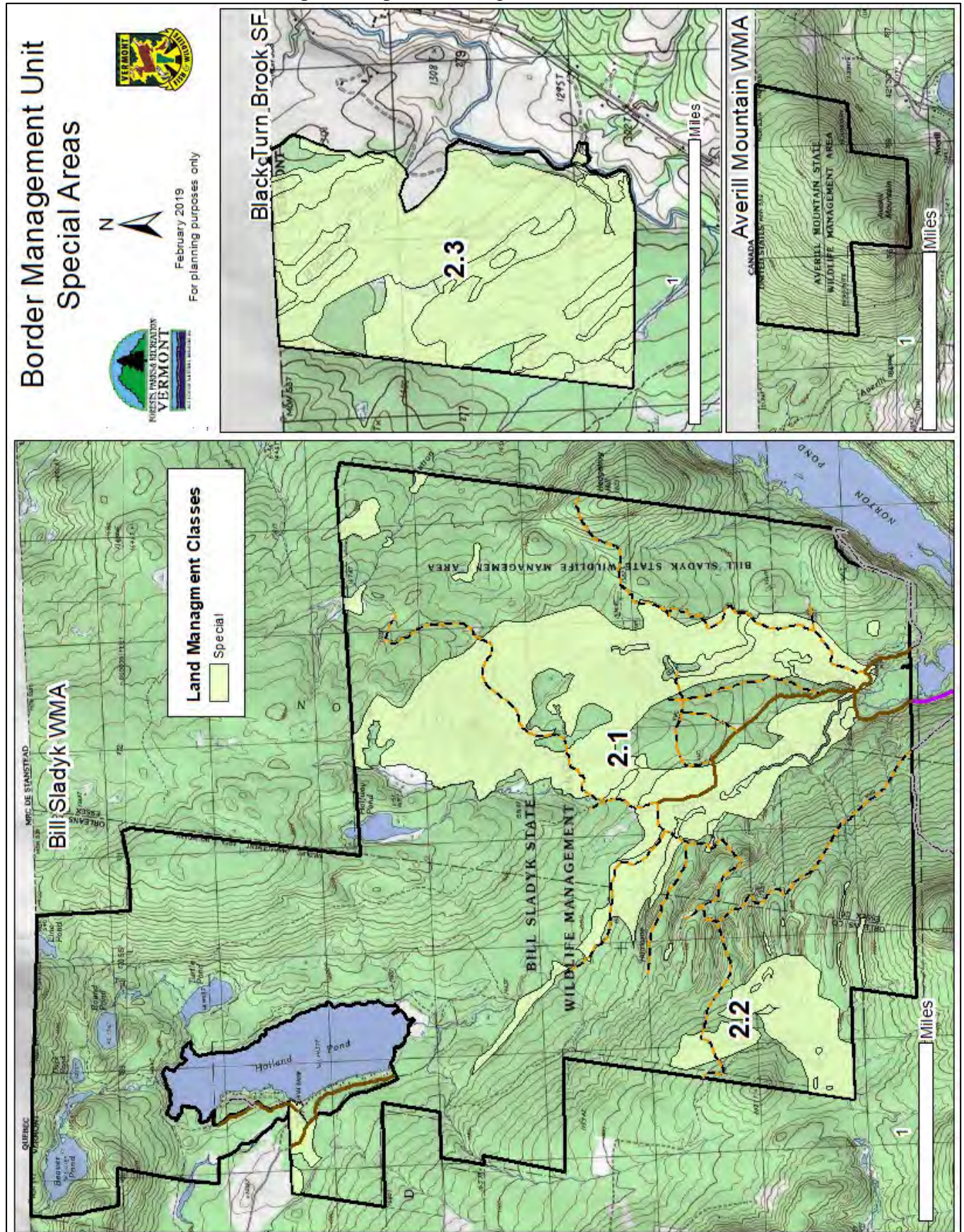
Special Management Area Goals

1. Provide high quality habitat for target wildlife species.
2. Provide opportunities for compatible recreational pursuits.
3. Maintain the natural or almost natural conditions of surface waters, with minimal changes from reference conditions for aquatic macroinvertebrates and fish assemblages.
4. Produce high quality timber where compatible with the “special” resource.
5. Protect representative examples of typical landscapes and natural communities.
6. Protect cultural and historic resources

2,358 acres of the BMU (23% of the land area) are designated for Special management.

Areas managed under this category will be managed primarily for the special resources within them. Forest and wildlife habitat management, recreation, and other uses may be conducted where appropriate.

Map 167 - Special Management Areas



Special Areas: Averill Mountain WMA

(none)

Special Areas: 2.3 Black Turn Brook SF

Description: The majority of Black Turn Brook SF, including large areas of lowland spruce-fir forest intermixed with a variety of wetlands.

Featured management: A multi-aged, structurally diverse forest with a significant component of spruce, for the production of forest products and the provision of valuable habitat for wintering deer, American marten, and other wildlife.

Implementation:

- Stands within this area have been targeted for vegetation management (See Map 11).
- Vegetation management will be consistent with ANR Riparian Guidelines.

Special Areas: 2.2 Western Bill Sladyk WMA

Description: The majority of Black Turn Brook SF, including large areas of lowland spruce-fir forest intermixed with a variety of wetlands.

Featured management: A multi-aged, structurally diverse forest with a significant component of spruce, for the production of forest products and the provision of valuable habitat for wintering deer, American marten, and other wildlife.

Implementation:

- Some stands within this area have been targeted for vegetation management (See Map 11).

Special Areas: 2.1 Central Bill Sladyk WMA

Description: Spruce-fir stands, with components of hardwood. Located fairly accessibly off the VAST trail and near the western property boundary.

Featured management: Young spruce-fir habitat creation (“hare management area”).

Implementation:

- A portion of this area will be harvested specifically to create young spruce-fir habitat for the benefit of snowshoe hare and other wildlife preferring this condition, such as rusty blackbird.
- The remainder (the majority) of the area will be managed as a multi-aged, structurally diverse forest with a significant component of spruce, for the production of forest products and the provision of valuable habitat for wintering deer, American marten, and other wildlife.

General Management Areas

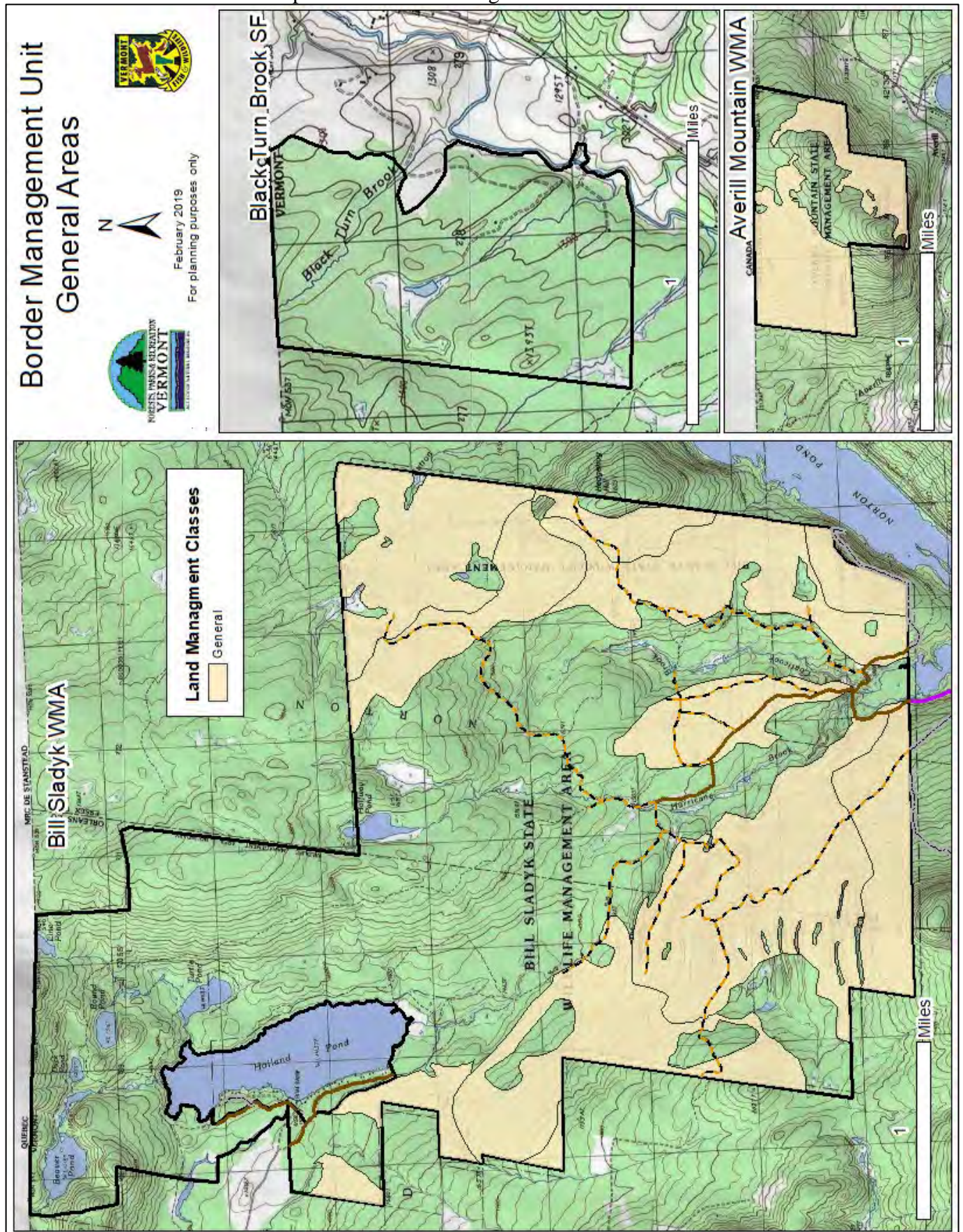
General Management Area Goals

1. Promote healthy natural communities, protect rare and endangered plant and animal species, and sustain and enhance biodiversity.
2. Provide a sustainable flow of high quality forest products and to demonstrate sound forest management practices.
3. Provide high quality habitat for target and general wildlife species.
4. Provide opportunities for a wide variety of dispersed recreational pursuits to meet current and future needs of the public.
5. Improve and develop necessary recreational services and facilities to meet current and future needs of the public.
6. Promote visitor knowledge of the natural and cultural history of the property.
7. Provide opportunities for education, research, and monitoring activities.
8. Maintain or enhance high quality water resources and aquatic habitats.
9. Protect cultural, historic, and pre-historic resources.

4,065 acres of the BMU (40% of the land area) are designated for General management.

Areas managed under this category have fewer rare and special resources and will therefore support a variety of uses including forest and wildlife habitat management, dispersed recreation, concentrated trail networks, and public access infrastructure.

Map 178 - General Management Areas



General Areas: Bill Sladyk WMA

Description: These are the large concentrations of hardwood forest in the BMU. Generally occurring at mid-elevations, these forests contain a mix of maple, beech, birch, and other species. Primary access is through the Hurricane Brook Road then the network of roads on the WMA.

Featured Management: Forests diverse in structure and composition, supporting the production of forest products, contiguous wildlife habitat, and a range of public uses.

Implementation:

- Forest and wildlife habitat management details are described in section IV.B.
These strategies include:
 - In the long term, young forest habitat will be created to benefit wildlife species, within natural disturbance ranges, on areas up to 2% of northern hardwood communities.
 - In hardwood stands adjacent to deer wintering area, 1-2 acre regeneration treatments may be used to promote the growth of accessible woody browse.
 - Up to 20 acres of openings may be maintained as herbaceous or shrub wildlife habitat.
 - Stands with high percentages of healthy beech and signs of bear use may be managed as beech mast production areas.
- Recreation and public use management details are described in section IV.B.
These strategies include:
 - The primary focus of road maintenance will be on main access roads, while smaller roads will be targeted for restoration of ongoing ecological impacts.

General Areas: Averill Mountain WMA

Description: These are areas of hardwood forest across Averill Mountain WMA. These forests contain a mix of maple, beech, birch, and other species. Primary access is from Route 114.

Featured Management: Healthy forest ecosystems, supporting wildlife habitat, dispersed public uses, and the hiking trail to Averill Mountain.

Implementation:

- Forest and wildlife habitat management details are described in section IV.B.
These strategies include:
 - No stands within Averill Mountain WMA have been targeted for vegetation management.
- Recreation and public use management details are described in section IV.B.
These strategies include:
 - Maintain the hiking trail up Averill Mountain in good condition.

Intensive Management Areas

0 acres of the BMU (0%) are designated for Intensive management.

Areas managed under this category are intended to support a variety of uses including the most concentrated public uses and public access infrastructure.

V. MONITORING AND EVALUATION

During the life of the LRMP for the Border Management Unit, periodic monitoring and evaluation will be conducted to ensure that the resources are protected from fire, insect and disease, encroachments, or unforeseen problems that may occur within the BMU. 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 BMU 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 management unit?

Obtaining quality information is critical to making informed decisions and conducting sound, thoughtful management actions. Research projects on the BMU are directed by the District Stewardship Team to ensure that they do not conflict with the goals and objectives for the management unit 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.

Ecological/Wildlife

Maintaining the biological diversity of the Border Management Unit 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 BMU (including forest inventory, aerial insect and disease surveys, amphibian and reptile surveys).
- Monitor rare, threatened, and endangered species and natural communities.
- Consider and support appropriate, credible research projects which further understanding of ecological elements and wildlife habitat on the BMU and the impacts of management activities.

Timber

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 completion within the BMU will be periodically reviewed by the District Stewardship Team 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.
- Conduct a Continuous Forest Inventory based on a system of permanent plots to be first established and sampled in 2015. This data will add important information about the growth and development of forests across the BMU.

Recreation

Public recreation will be periodically monitored across the property by the District Stewardship Team to identify where recreational uses are in conflict with or may be damaging 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.

Historic

There are both historic and suspected pre-contact resources within the BMU. 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 management unit 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 management unit.

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 District Stewardship Team will monitor the BMU for the presence of invasive exotic species and work with cooperating partner organizations to develop a monitoring protocol. The District Stewardship Team 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 control goals and implement.
- Assess and document levels of introduction of invasive exotic plants by species and location.
- Monitor timber harvest areas before and after timber sale activities. Control invasive species as necessary and practical.
- Evaluate invasive species control projects for effectiveness.

Climate Change

If the most conservative current models of climate change are accurate (Iverson, Prasad, Hale, & Sutherland), the Border Management Unit, like the rest of the region, will experience strong impacts over the next 50-100 years. 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.
- Support appropriate research project proposals which further understanding of climate change on the BMU.

VI. NEW USES AND PLAN AMENDMENT PROCESS

The long range management plan 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 departments of Fish & Wildlife and Forests, Parks and Recreation undertake an amendment or plan update process when significant changes to the current long range management plan 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); and
- 11) Renaming of natural features (prior to recommendation to 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 the 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 District Stewardship Team.

VII. 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; and
- 4) parcels that serve an identified facility, infrastructure, or program need.

In addition to these broad goals, the Stewardship Team for this region has identified the following as priority goals for future acquisition: 1) Enhancing wildlife connectivity both within the BMU and to/from adjacent areas, 2) Enhancing opportunities for public access and use of state land. Most importantly, these goals should be evaluated in light of the connections and relationships to the large area of public and conserved lands to the north of the BMU, throughout the Northeast Kingdom.

All new acquisitions of land to the Border Management Unit 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 Border Management Unit will be accordance with Agency of Natural Resources policies and ultimately approved by the Secretary of the ANR after consultation with the regional planning commission and the town(s) in which the parcel is located.

VIII. APPENDICES

Appendix A: Public Comment Summary

Public Scoping Meeting (2009) and Comment Period

- Continuing the history of timber management on the parcel.
- Both support and concern over the idea of “core” areas that would not be managed for timber or, potentially, motorized recreation.
- Increasing the level of timber harvest to support game species.
- Interest in access to Black Turn Brook without a gate or with a gate closer to the parcel.
- Managing deer winter areas on the lands to support local deer populations.
- Interest in the road system of Bill Sladyk WMA being open as much as possible, from spring through deer season.
- Management emphasizing low impact recreation, leaving the parcels undeveloped and in relatively the same condition as it is at present.
- Management emphasizing wildlife habitat and wildlife-compatible uses.
- Allowing primitive camping, within rules.
- Encouraging educational use of the parcel, particularly by local youth groups.
- Management for multiple use--forestry, recreation, education, wildlife, conservation.
- Nonmotorized recreation trails should be designated.

Public Scoping Meeting (2018) and Comment Period

Roads

- Limited motorized activity and trails across unit, especially Black Turn Brook SF
- More dispersed hunting opportunities, no vehicular increases
- Do not close roads. Keep them maintained. Access is important.
- Do not create a through road at Bill Sladyk WMA
- Provide camp owner access through Sladyk WMA
- Beaver activity on South Shore Road is an issue
- Access roads (Holland Pond and Hurricane Brook) need attention
- Improve poor culverts to enhance fish habitat
- Fix issues with Hurricane Road that impact Norton Pond

Trails

- Enhance recreational access to Averill Mountain and Bill Sladyk WMA
- Convert some old roads to walking paths for non-motorized multi-use (hunting, etc)
- Limited motorized activity and trails across unit, especially Black Turn Brook SF
- Maintain VAST trails
- Designate mountain bike trails
- Concentrate trail access – not single use trails
- Maintain trails to minimize erosion
- Do not increase VAST mileage
- Make Class B and C roads open to horses
- Upgrade VAST trails for ATVs

Camping

- Camping at Ben Cole clearing – what is maximum stay? are people observing it?
- Allow primitive camping on Bill Sladyk WMA, also outside of hunting season
- Consider creating a campground (Park) to increase use of the area
- Limit trail development for recreation to areas with 1/3rd mile of open gravel roads

Other, Access

- Preserve remote character, experience of solitude
- Move gate to bridge at Black Turn Brook SF
- Block access to Trucott Rd in Holland
- Obtain access to Averill Mtn for parking and hiking trail
- “Big parking lot” (where?)
- Lean-to at Sladyk WMA needs a new roof
- Safety concern of no cell service and poor roads, locked gates

Timber and Habitat Management

- Management of forest for carbon sequestration
- Emphasis on water quality during harvest operations
- Pre-commercial thinning in pole stands
- Map and protect deer winter areas
- Harvest to enhance Deer Wintering Area – try to complement adjacent areas of landscape
- Want to see more deer
- More timber harvest across the management unit
- Increase softwood
- Create a reserve area without timber management
- Wildlife corridors are essential
- Rare plants need protection
- Aim for 15% early-successional habitat
- Focus on young regenerating forest on all parcels, for upland birds
- Black Turn Brook – restriction on timber harvesting promised by Gov Dean?
- Consider inventory of beaver ponds
- No unnecessary tree removal, to enhance carbon sequestration and water quality
- Target some early-successional habitat on Black Turn Brook, where appropriate
- What is happening with Sweet Tree across the street with respect to moose habitat?

Other, general

- Purchase private land to ensure more contiguous state lands
- Restore EPP Rock monument
- Can ANR do anything about water quality (phosphorus) in Norton Pond?

Appendix B: Natural Community Descriptions

Alder Swamp – S5

Alder swamps are found in Black Turn Brook SF, where six patches form a single B-ranked, 84-acre occurrence of this community type. Because this is a common community type statewide, this example in the BMU is not considered state-significant.

Although superficially similar to beaver wetlands, the alder swamps at Black Turn Brook State Forest do not appear to be maintained by beaver activity. These swamps are found in between the low ridges, in small drainage valleys. While some of these valleys have small flowing streams, in general the swamps have saturated peat soils and may have some subsurface water flow. Detailed field notes were not taken in any of the six patches that form this occurrence, however, speckled alder (*Alnus incana*) cover was generally 50-60%, and up to 10 feet in height. A very sparse scattering of spruce (*Picea* spp.) and northern white cedar (*Thuja occidentalis*) trees reached heights of up to 25 feet. Herbs in the swamps include a sedge (*Carex stipata*), a manna grass (*Glyceria* sp.), and a bedstraw (*Galium* sp.). Of particular note, a statewide uncommon species, swamp thistle (*Cirsium muticum*) is locally abundant in the alder swamps at Black Turn Brook SF.

These swamps can provide wildlife habitat for a number of bird species, such as common yellowthroat and yellow warbler. Snowshoe hare, spotted salamanders, wood frogs, and gray treefrogs are additional species that might use this habitat within the BMU.

The disturbance and successional trends of alder swamps are poorly understood. Currently, the saturated substrate, combined with the dense alders, seems to limit tree growth. Over time, however, it is possible that changes in hydrology could alter the wetland. Drier conditions could allow trees to become established, and these patches could begin to transform to forested wetlands. Alternatively, beaver activity could flood these patches and maintain them as open wetlands.

Beaver Wetland – not ranked

Beaver wetlands are very common in the BMU. Out of a total of 140 wetland patches mapped in this inventory, a third of these (47) are beaver wetlands. When beavers enter a wetland, they construct dams that alter water levels and hydrologic flow, and selectively harvest vegetation in and around the wetland. The result can be a dramatic change from the undisturbed wetland.

Eventually, as food resources dwindle, beavers will move to other wetlands in search of new resources. The abandoned wetlands then begin a new period of change: as the dam is no longer maintained, water levels and hydrologic flow are again altered, often resulting in a “drying up” of areas formerly flooded. Vegetation changes again, too, particularly if trees and shrubs re-establish on the site. This cycle creates a seemingly endless variety of wetland communities, many of which are short-lived. Because of their dynamic nature, these wetlands are not classified according to the community types described in Thompson and Sorenson (2000). Instead, this report attempts to describe the range of variation observed in beaver wetlands at the BMU, and to describe the most ecologically significant patches, with the expectation that many of these sites will naturally change over time.

Beaver wetlands are found in Sladyk WMA and Black Turn Brook SF. (The more mountainous terrain of Averill Mountain WMA does not have any beaver influence.) Beaver wetlands range in size from less than a half-acre to over 20 acres. Soils are peats or mucks, ranging in depth from less than a foot to greater than 4 feet. Shallower organic soils often have a few inches of gravel beneath them, on top of bedrock. These soils are usually damp, and sometimes are saturated or even flooded. (Open water is frequently found within beaver wetlands; whenever possible, these areas have been mapped as a separate polygon.)

Vegetation cover ranges from sedge-dominated meadows to emergent marsh to cattail-dominated to dense shrub thickets. Small trees (up to 20-30') are sometimes present, including northern white cedar (*Thuja occidentalis*), tamarack (*Larix laricina*), and, less commonly, black spruce (*Picea mariana*), red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*). Other tree species noted include white pine (*Pinus strobus*), eastern hemlock (*Tsuga canadensis*), sugar maple (*Acer saccharum*), black ash (*Fraxinus nigra*) and yellow birch (*Betula alleghaniensis*). Tree cover, if present, rarely exceeds 30%. Shrubs can form a substantial layer in beaver wetlands. A few wetlands have nearly 100% cover of speckled alder (*Alnus incana*), but most have 20-30% cover of alder and other shrubs. Frequent tall shrubs include speckled alder, meadowsweet (*Spiraea alba* var. *latifolia*), and mountain holly (*Nemopanthus mucronatus*). Less common are wild raisin (*Viburnum cassinoides*), hobblebush (*Viburnum lantanoides*), and common elderberry (*Sambucus racemosa*). Low shrubs include Labrador tea (*Ledum groenlandicum*), sheep laurel (*Kalmia angustifolia*), leatherleaf (*Chamaedaphne calyculata*), and velvet leaf blueberry (*Vaccinium myrtilloides*) – plants typical of boggy, acidic and nutrient-poor environments. The low shrub sweet gale (*Myrica gale*) is present in environments with slightly higher nutrient levels.

Beaver wetlands have many herb species, and these reflect the substrate and saturation level of any particular patch. Less saturated sites tend to have joe-pye weed (*Eupatorium maculatum*),

sensitive fern (*Onoclea sensibilis*), long beech fern (*Phegopteris connectilis*), and many aster species. More saturated sites tend to have species such as blue-flag iris (*Iris versicolor*), marsh St. Johnswort (*Triadenum virginicum*), marsh fern (*Thelypteris palustris*), and sedges such as drooping sedge (*Carex crinata*) and three-seeded sedge (*Carex trisperma*). The boggiest sites have pitcher plant (*Sarracenia purpurea*), round-leaved sundew (*Drosera rotundifolia*), and spatulate-leaved sundew (*Drosera intermedia*). These bog sites may have substantial cover of sphagnum moss (*Sphagnum* spp.) (nearly 100%).

Several rare and uncommon plants are known from beaver wetlands in the BMU; a full list of species can be found in the table in the “fine filter” section of this ecological assessment. Most of these are found at Line Pond in the granite pavement pondshore community variant; these species are reported in that section (described below). An A-ranked population of bog aster (*Aster nemoralis*) is found in the beaver wetlands to the northwest of the Ben Cole clearing. 400-500 stems of this species are found at the edge of the wetland. This occurrence was first reported in 1998, and the population appears equally vigorous today, suggesting that this wetland has been relatively stable in the last decade. Changes in hydrology or overstory vegetation, however, could threaten the long-term persistence of bog aster at this site.

A small clump of the non-native, invasive phragmites grass (also called common reed; *Phragmites australis*) is found in one of the beaver wetlands at Sladyk WMA. This plant has the potential to spread rapidly and displace native plants in wetlands; it is a common invasive weed of roadsides and other disturbed wetlands outside of the WMA.

Beaver wetlands can be important wildlife habitat in the BMU because they are naturally-occurring open areas within a largely forested landscape. A great many species of mammals, birds, amphibians, fishes, and invertebrates make use of these wetlands.

a. Granite Pavement Pondshore variant

Line Pond, which is on the international boarder at the northern edge of Sladyk WMA, is unusual among the ponds in the WMA, and probably across the state, because part of its shoreline is flat granite rock (which geologists call “pavement”). This pond is situated in a shallow bedrock basin near the top of a low, broad ridge, and drains south into Sladyk WMA. A now-defunct beaver dam appears to have at one time blocked this exit, and raised the water levels. During summer inventory visits, the flat to gently-sloping granite pavement was raised only several inches to a foot above the water level, and so was likely flooded by the beaver activity. The pavement may also flood seasonally during spring high water. It is possible that the water slowly drains over time, and this community becomes increasingly dry, in a process similar to

that which occurs on the outwash plains pondshore natural community known from across New England (see Thompson and Sorenson (2000) for a description of the Vermont expression of this type). Further study is needed, however, to fully understand the natural dynamics of the Line Pond site.

Regardless of whether this site is a unique community or variant type, Line Pond hosts an interesting vegetative association. Overall, the granite pavement is sparsely vegetated, mainly by herbs growing in cracks in the rock. Tall and short shrubs are common around the edges of the granite, and include speckled alder (*Alnus incana*), sweetgale, leatherleaf, mountain holly (*Nemopanthus mucronatus*), sheep laurel, and wild raisin (*Viburnum cassinoides*). Herbs include small cranberry (*Vaccinium oxycoccus*), marsh St. Johnswort (*Triadenum virginicum*), three-way sedge (*Dulichium arundinaceum*), royal fern, horned bladderwort (*Utricularia cornuta*), and bog clubmoss (*Lycopodiella inundata*). Line pond hosts a number of rare or uncommon species which grow in the granite pavement pondshore and the adjacent floating bog mats. In particular, the rare and state-listed threatened northern yellow-eyed grass (*Xyris montana*) is found in this community (and the bog mats) at Line Pond, and several hundred stems were noted at this site. Additionally, the uncommon northeastern sedge (*Carex cryptolepis*) is found within this community.

Black Spruce Swamp – S2

A single, 7-acre occurrence of this community type is found on the western boundary of Black Turn Brook SF, where it is part of a larger wetland complex that includes beaver wetland, alder swamp, and additional wetlands on adjacent private lands. This swamp is highly variable in character, with small portions (an acre or less each) resembling other boreal wetland natural community types, such as northern white cedar swamp, spruce-fir-tamarack swamp, and balsam fir-black ash seepage swamp. This occurrence is C-ranked, but considered state-significant because black spruce swamps are a rare in Vermont.

The portion of this swamp that most typifies the community type occurs in the center, likely on the deepest peat accumulations. Soil here is three feet of peat of a layer of grey clay. This clay appears to be throughout the swamp, and depth to the clay may likely influence the vegetation. The acidity of this peat was measured as a pH of 5.2, relatively moderate for black spruce swamps. Vegetation includes a canopy (50% cover, 40' tall) of black spruce (*Picea mariana*) and tamarack (*Larix laricina*). The same species also compose an emergent canopy (5% cover, 60' tall), and an understory canopy (20% cover, 20-25' tall). Shrub cover is never more than 30%, and includes mountain holly (*Nemopanthus mucronata*), speckled alder (*Alnus incana*),

and balsam fir (*Abies balsamea*). Low shrubs are similar with the addition of Labrador tea (*Ledum groenlandicum*). Herb cover (30-35%) includes three-seeded sedge (*Carex trisperma*), creeping snowberry (*Gaultheria hispidula*), turtlehead (*Chelone glabra*), and bunchberry (*Cornus canadensis*). Sphagnum moss cover is abundant.

To the south, this swamp is slightly different. In this section the substrate is a shallow but quaking peat mat, twelve inches deep on top of the clay layer. The peat has a pH of 5.2-5.4, and the clay has a pH of 6.8, or almost neutral. Balsam fir and black spruce are the primary canopy trees here as well, but there is a dense shrub layer of speckled alder, and the low shrubs and herbs are slightly more diverse and indicative of more nutrient enrichment. Some species noted include alder-leaved buckthorn (*Rhamnus alnifolia*), fringed sedge (*Carex crinita*), boreal bog sedge (*Carex magellanica*), and a grass (*Calamagrostis* sp.). The vegetation fits closely with a “rich black spruce swamp” in the International Vegetation Classification (NatureServe 2009), though this type is not documented to be in New England.

Wildlife in the black spruce swamp likely includes moose and deer. Rare birds like the gray jay or the spruce grouse might use this community type, and many common species of songbirds (northern parula, ruby-crowned kinglet) might breed in this swamp.

Black Spruce Woodland Bog – S2

Three occurrences (totaling 9 acres) of the rare black spruce woodland bog community have been identified in the BMU; all are in Bill Sladyk WMA. One occurs at the center of a spruce-fir-tamarack swamp; the second occurs at the margin of Turtle Pond, and has been influenced by changing water levels, most likely a result of beaver activity. The third is found on a floating bog mat which has been flooded by beavers. (Additionally, some areas similar to a black spruce woodland bog can be found in beaver wetlands, but due to the dynamic nature of these systems, they have not been mapped as this rare community type.) None of the examples is particularly well-developed. The smaller examples are C-ranked, and the beaver-flooded example is BC ranked. These are all considered state-significant because this is a rare community type.

Black spruce woodland bogs typically occur in settings with deep, poorly-decomposed peat, which is acidic and nutrient-poor. Sphagnum moss (*Sphagnum* spp.) dominates the ground cover, and can be responsible for much of the peat accumulation in this type in the BMU. Trees are short and sparse, averaging 20' in height and 25% cover. Black spruce (*Picea mariana*) is common, and red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and the occasional tamarack (*Larix laricina*) are also present. Two species of tall shrubs, red maple (*Acer rubrum*)

and mountain holly (*Nemopanthus mucronatus*), are present but uncommon, averaging just 5-10% cover. Low shrubs can be very abundant, up to 90% cover. Species include leatherleaf (*Chamaedaphne calyculata*), bog laurel (*Kalmia polifolia*), sheep laurel (*Kalmia angustifolia*), Labrador tea (*Ledum groenlandicum*), rhodora (*Rhododendron canadense*), wild raisin (*Viburnum cassinoides*), and early low blueberry (*Vaccinium angustifolium*). Sweet gale (*Myrica gale*) is present near the edge of this community at Turtle Pond, likely indicating slight mineral enrichment from the pond waters. Herb cover averages around 30%, and abundant species include pitcher plant (*Sarracenia purpurea*), marsh St. Johnswort (*Triadenum virginicum*), three-seeded sedge (*Carex trisperma*), and creeping snowberry (*Gaultheria hispidula*).

Many warblers and other songbirds, including Canada warbler, common yellowthroat, Lincoln's sparrow, and some flycatchers, use black spruce woodland bogs. The state-endangered spruce grouse and the rare black-backed woodpecker both may use this community in conjunction with the surrounding spruce-fir forests. Small mammals including the southern red-backed vole, masked shrew and the uncommon southern bog lemming also might be found in this community.

Boreal Outcrop – S4

Two small occurrences of this community are found in the BMU, one in Black Turn Brook SF and the other at Averill Mountain WMA. Both are small, covering less than an acre, and neither is considered state-significant.

Though they are floristically similar, in landscape position these two examples are quite different. At Averill Mountain WMA this community is on the steep, south-facing slope of Averill Mountain, adjacent to boreal talus woodland. At Black Turn Brook SF, this community occurs on a gently sloping area of exposed bedrock. In both cases, the bedrock is granitic gneiss, and the rock is often bare with little or no soil development in these patches.

This community is characterized by a sparse tree canopy and an abundance of low shrubs, herbs, and lichens. White pine (*Pinus strobus*), red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and northern white cedar (*Thuja occidentalis*) are the most abundant trees (with American beech (*Fagus grandifolia*) and white birch (*Betula papyrifera*) also present at Averill Mountain WMA). They reach a height of only 15 feet, though a few trees may emerge to 20 feet. Tree cover averages only 20%. Tall shrub cover is generally similar to the trees, with the addition of gray birch and wild raisin. Early low blueberry (*Vaccinium angustifolium*) is an occasional low shrub (average 10-15% cover). Herb cover is generally less than 15%, and species include bracken

fern (*Pteridium aquilinum*), common hairgrass (*Deschampsia flexuosa*), bunchberry (*Cornus canadensis*), pink lady slipper (*Cypripedium acaule*), Canada mayflower (*Maianthemum canadense*), common polypody (*Polypodium virginianum*), and Whorled wood aster (*Aster acuminatus*). Non-vascular species include a moss (*Polytrichum* sp.), lichens (*Umbilicaria* spp. and *Cladonia* spp.).

It is unlikely that many wildlife species rely primarily on this community. Bird species of the surrounding forest may travel through, and insects such as bees, moths and dragonflies may use these outcrops.

Boreal Talus Woodland – S3

A single, C-ranked occurrence of this community is found on the steep south face of Averill Mountain. Because it covers less than a half-acre, this example is not considered state-significant.

Although this boreal talus woodland is adjacent to northern hardwood talus woodland, there is a distinct boundary between the two communities due to differences in the bedrock and substrate. In this community large, angular blocks of granite form the substrate for this community, with little or no soil. Only a thin canopy (50% cover) of heart-leaved paper birch (*Betula papyrifera* var. *cordifolia*) and red maple (*Acer rubrum*) grows on the boulders, reaching a height of 30 feet. Other tree species present in a subcanopy include striped maple (*Acer pensylvanicum*), mountain maple (*Acer spicatum*), and mountain ash (*Sorbus americanus*). Bracken fern (*Pteridium aquilinum*) and Canada mayflower (*Maianthemum canadense*) were the only herbs observed, but this community was inventoried early in the growing season so other species are likely present as well. Rock tripe lichen (*Umbilicaria* sp.) was also present.

The jumbled crevices created by the talus blocks at this site create potential habitat for a number of wildlife species, including bobcat and porcupine. The rock vole is a rare species associated with this habitat type in the Northeastern Highlands region of Vermont. It is possible that this species is present at Averill Mountain.

Dwarf Shrub Bog – S2

Several dwarf shrub bogs occur in the BMU, the largest of which is Cranberry Bog, a remote 20-acre bog located near Halfway Pond in Bill Sladyk WMA. Dwarf shrub bogs are also found as

floating mats in Line Pond and Duck Pond, and on the margins of Turtle Pond. Small, floating bog mats may occur in some of the other ponds as well; if so they were too small to have been detected or mapped in this inventory. There are four occurrences of this community type in the BMU, totaling 34 acres. They were ranked either B or C, and because this is a rare community type, all are considered state-significant.

Throughout Vermont this community is found on organic soils of varying depth, but in the BMU all the dwarf shrub bogs appeared to be floating mats, which have only the organic matter collected in the tangle of roots. These bogs are generally nutrient-poor and acidic. Tree cover is almost entirely absent, although Cranberry Bog has a few scattered and stunted grey birch and tamarack (*Larix laricina*) trees. Standing dead trees suggest that beavers—while not the primary disturbance agent in the community—have influenced these dwarf shrub bogs by altering water levels over time. Tall shrubs above 3-4' (primarily speckled alder; *Alnus incana*) are also very sparse or absent, but lower shrubs are extremely abundant (>90% cover) and include speckled alder, sweet gale (*Myrica gale*), leatherleaf (*Chamaedaphne calyculata*), mountain holly (*Nemopanthus mucronatus*), wild raisin (*Viburnum cassinoides*), Labrador tea (*Ledum groenlandicum*), bog rosemary (*Andromeda polifolia*), sheep laurel (*Kalmia angustifolia*), bog laurel (*Kalmia polifolia*), small cranberry (*Vaccinium oxycoccus*) and blueberries (*Vaccinium* spp.). Herb cover averages approximately 20-30%, and frequently includes three-way sedge (*Dulichium arundinaceum*), three-seeded sedge (*Carex trisperma*), pitcher plant (*Sarracenia purpurea*), round-leaved sundew (*Drosera rotundifolia*), spatulate-leaved sundew (*Drosera intermedia*), marsh St. Johnswort (*Triadenum virginicum*), blue flag iris (*Iris versicolor*), horned bladderwort (*Utricularia cornuta*), and bog clubmoss (*Lycopodiella inundata*). Sphagnum moss (*Sphagnum* spp.) cover is 90-100%.

Several rare and uncommon plants are found in dwarf shrub bogs in the BMU. The rare and state-listed threatened northern yellow-eyed grass (*Xyris montana*) is found in the dwarf shrub bog mats at Line Pond (and in the associated granite pavement pondshore community there); several hundred stems were noted at the site. This plant is currently known from only 6 other sites in Vermont, three of which are in the nearby Nulhegan Basin area. A large (>100 stems) population of the uncommon to rare bog aster (*Aster nemoralis*) is found in Cranberry Bog. The uncommon rose pogonia (*Pogonia ophioglossoides*) is found on several of the bog mats in the BMU, and the uncommon northeastern sedge (*Carex cryptolepis*) is found in and around bog mats at Line Pond.

Hardwood-Softwood Seepage Forest – provisional community type

Several patches of forest in Bill Sladyk WMA and Averill Mountain WMA do not readily fit into the existing Vermont natural community classification system. These mixed hardwood-softwood forests are found on very seepy mineral soils, which usually appeared to be the result of the shallow, impermeable granite bedrock. Although the Vermont NNHP does not currently recognize this community type, the International Vegetation Classification (NatureServe 2009) identifies a hardwood-conifer seepage forest vegetation association that is similar, if not exactly identical, to the patches found in the BMU. Additionally, similar communities have been noted and described by Vermont NNHP ecologists and private consulting ecologists working at other sites in northern Vermont. Thus, there seems to be reasonable support for identifying these patches as a separate community type. This type has been mapped on 224 acres, and includes five occurrences. Four have been provisionally ranked as B, and a fifth has been ranked BC. Due to the provisional classification, these areas are not currently considered state significant.

This community is characterized by abundant groundwater seepage, which is usually caused by shallow, impermeable granite bedrock. Mineral soil depths measured in the field ranged from as little as 1" to more than 24" over bedrock. In some cases, a hardpan soil layer may be responsible for seepage, instead of rock. While a thin organic peat or muck layer may be found at the soil surface, deep organic soils are not found in this community. Where the NRCS has mapped soil types, these forests are found on dense glacial till, such as the Tunbridge-Dixfield and the Cabot series. These forests typically have a closed canopy (80-95%) of 60-70' tall trees, but species composition can vary. Some sites have a stronger hardwood component with sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), balsam fir (*Abies balsamea*), and black ash (*Fraxinus nigra*). Others are dominated by balsam fir, and have a smaller amount of white birch (*Betula papyrifera*), grey birch (*Betula populifolia*), and red maple (*Acer rubrum*). Northern white cedar (*Thuja occidentalis*) and red spruce (*Picea rubens*) are occasional throughout this community, and hemlock (*Tsuga canadensis*) is present at one site. Shrub cover is most often absent, but some areas have a dense cover (70%) of hobblebush (*Viburnum lantanoides*). Striped maple (*Acer pensylvanicum*) is also sometimes present, but never a large component. Depth to bedrock and/or the water table seems to be the best predictor of canopy type, with drier sites having more hardwoods and wetter sites having more softwoods (and red maple). Herbs also vary with soil saturation, and total herb cover averages 60-70%. In general, cinnamon fern (*Osmunda cinnamomea*), long beech fern (*Phegopteris connectilis*), whorled aster (*Aster acuminatus*), intermediate wood fern (*Dryopteris intermedia*), drooping wood reed (*Cinna latifolia*), starflower (*Trientalis borealis*), and Canada mayflower (*Maianthemum canadense*) are more common and are present on most sites. Dry sites can have abundant hobblebush and hay-scented fern (*Dennstaedtia punctilobula*). The wettest sites with a hardwood canopy have false hellebore (*Veratrum viride*), sensitive fern (*Onoclea sensibilis*), and ostrich fern (*Matteuccia struthiopteris*). Bryophytes noted in this community include stair-step moss (*Hylocomnium*

splendens), common fern moss (*Thuidium delicatulum*), windswept mosses (*Dicranum* spp.), and the liverwort three-lobed bazzania (*Bazzania trilobata*). Sphagnum moss (*Sphagnum* spp.) is generally absent.

Hardwood-softwood seepage forests probably provide important habitat for a wide variety of wildlife species. In particular, because the soil temperature is moderated by groundwater, seepage areas can be among the first places where plants grow in spring. The fresh growth feeds many animals, most notably black bear. Heavy deer browse was noted in some of these patches, and the relatively warm ground and softwood cover may prevent deep snow accumulation in wintertime, and provide favorable foraging habitat and protective cover for white-tailed deer. Two amphibians which are likely found in seepage forests in the BMU are the northern two-lined salamander and dusky salamander.

Further inventory work is needed to determine if these occurrences are indeed a unique community (or several communities/variants). A more thorough comparison of these sites to other known seepage forests may help provide context for the state- and region-wide abundance of this type, and help inform management decisions. Finally, note that one patch mapped as this community type was not visited; however, the landscape position, soil type, and canopy signature in the aerial orthophoto all strongly suggest a seepage forest.

Lowland Spruce-Fir Forest – S3

Lowland spruce-fir forest covers more of the BMU than any other community type, totaling 3261 acres, or just under a third of the roughly 10,300 acre management unit. Much of this lowland spruce-fir forest is part of one A-ranked occurrence of 2,500 acres; the remaining acres are split between four additional occurrences, all of which are B-ranked. All lowland spruce-fir forest in the BMU is considered state-significant.

This is a variable community type, and in particular two variants of this community type are described in this report: steep pondshore forest and mixed maple-birch-fir forest. These variants are mapped to help land managers and the public understand the distribution of the different expressions of lowland spruce-fir forest in the management unit.

The “classic” lowland spruce-fir forest described by Thompson and Sorenson (2000) is the most common variant in the BMU, covering 2,766 acres. It is found in one very large (approximately 1,300 acre) patch in the center of Bill Sladyk WMA, as well as in several smaller patches scattered around the BMU. In general, this community is found in flat lowlands where cold air

drainage collects. Soil in lowland spruce-fir forest is highly variable, ranging from a few inches of organic matter on bedrock to more than 2 feet of sandy or silty loam. The soil can be highly saturated, and often grades into spruce-fir-tamarack swamps without a clear demarcation between upland and wetland. Some of the most interesting lowland spruce-fir forest patches occur on soil that is several inches of peat over a thin layer of mineral soil on top of bedrock. This type is particularly evident in the forest between Holland Pond and Turtle Pond, but can be found at other sites in Bill Sladyk WMA as well.

Species composition depends in part on the hydrology of the site. While most sites have typical upland boreal species, the wetter sites have more swamp and bog species, such as black spruce (*Picea mariana*) or Labrador tea (*Ledum groenlandicum*). In general, however, the tree canopy is dense (80-100% cover) and around 50-60' tall. Red spruce (*Picea rubens*) and/or balsam fir (*Abies balsamea*) are almost always the most abundant species. Grey birch (*Betula populifolia*) and red maple (*Acer rubrum*) are sometimes present on drier sites, and black spruce is present on wetter sites. Rarely, small patches of eastern hemlock (*Tsuga canadensis*) can be found in this community. A secondary canopy 30-40' tall is occasional. Sometimes this is a nearly impenetrable thicket of balsam fir; often however this secondary canopy contains a mix of the overstory species and averages 30-40% cover. A regeneration layer follows a similar pattern: sometimes a dense stand of balsam fir, other times a more scattered mix of species is present. Tall shrubs average 10% cover and include wild raisin (*Viburnum cassinoides*), yellow birch (*Betula alleghaniensis*), mountain maple (*Acer spicatum*), and striped maple (*Acer pensylvanicum*). Low shrub cover is typically very sparse (<10%) with wild raisin frequently noted. Wetter sites have more low shrubs (up to 20% cover), including Labrador tea, sheep laurel (*Kalmia angustifolia*), and velvet leaf blueberry (*Vaccinium myrtilloides*). Abundant herbs include goldthread, bunchberry (*Cornus canadensis*), intermediate wood fern (*Dryopteris intermedia*), starflower (*Trientalis borealis*), creeping snowberry (*Gaultheria hispidula*) and pink lady slipper (*Cypripedium acaule*). Herb cover averages around 20%. Bryophytes are abundant, with Shreber's moss (*Pleurozium schreberi*), staircase moss (*Hylocomium splendens*), knight's plume moss (*Ptilium crista-castrensis*), and the liverwort three-lobed bazzania (*Bazzania trilobata*) commonly found. Sphagnum moss (*Sphagnum* spp.) is not uncommon in wetter areas.

Many animals use lowland spruce-fir forest, including white-tailed deer, moose, fisher, porcupine, red-breasted nuthatch, and blackpoll warbler. Dense conifer cover usually makes good deer wintering habitat, and large areas of spruce-fir forest in the BMU have been mapped by Vermont Fish and Wildlife as potential deer wintering habitat. Several birds of interest have been observed in this community in and around the BMU. Though a rare species on a statewide basis, gray jays are reported to be not uncommon in the spruce-fir forests of the BMU, and a nesting individual was observed in Black Turn Brook SF. The rare black-backed woodpecker,

which uses spruce-fir forest for nesting, has been found in Bill Sladyk WMA. Finally, the state-endangered spruce grouse uses this community for nesting in the nearby Nulhegan Basin, and while a few individuals have been observed at Bill Sladyk WMA, this species has not been documented to nest in the BMU.

Natural and human disturbance have had an important role in the lowland spruce-fir forests of the BMY. The shallow soils of the area make blowdown a frequent occurrence. This area was hard-hit by the 1938 hurricane that traveled up the Connecticut River Valley, and many even-aged spruce-fir stands originated after the tremendous blowdown of this storm. Repeated logging also influences this community, particularly if softwood species are selectively harvested and hardwood species are left. The mixed maple-birch-fir forest variant described below may be a successional stage of this community, possibly resulting from harvesting. Fire and insect infestations (like the spruce budworm) may also have a role in shaping these forests.

a. *Mixed Maple-Birch-Fir Forest variant*

This type closely matches the successional spruce-fir forest (*Picea rubens* - *Abies balsamea* - *Betula* spp. - *Acer rubrum* Forest) described in the International Vegetation Classification System (NatureServe 2009). It occurs on mesic-to-dry mineral soil, ranging from a fairly shallow coarse loam to more than 2 feet of sandy/gravelly loam. Ground cover is primarily leaf litter (90-100%) and boreal herb species. The mixed canopy of red maple, white birch (*Betula papyrifera*), yellow birch, quaking aspen (*Populus tremuloides*), bigtooth aspen (*Populus grandidentata*) and balsam fir may have multiple height classes, but these are almost certainly even-aged forests. They are likely relatively young stands that have regenerated after timber harvesting or natural disturbance. It is most likely that these would ultimately develop into typical lowland spruce-fir forest if left undisturbed, but given the landscape position and mesic-to-dry soils, it is also conceivable that they could develop to red spruce-northern hardwood forest. 478 acres of this variant were mapped in Bill Sladyk WMA, all as part of the same occurrence.

b. *Steep Pondshore Slope Forest variant*

A band of well-drained lowland spruce-fir forest was noted around many ponds, and also around some of the open wetlands, at Bill Sladyk WMA. These ponds and wetlands occur in bedrock basins, and there is often a steep ledge exposed around the edges of these ponds and wetlands. With thin soil over acidic bedrock, a generally droughty community develops, although bedrock micro-depressions can collect moisture and host wet-mesic species. Two patches (17.5 acres) of this community variant were large enough to map: one around Turtle Pond, and one near the

south end of Holland Pond, (although it borders the open wetland complex and not the pond itself). Thin bands of this variant also occur around many of the other ponds.

An overstory (60% cover, 70' tall) of red spruce, white pine (*Pinus strobus*), and occasional tamarack (*Larix laricina*) characterizes this community. A secondary canopy (30% cover, 20-40' tall) is composed of red spruce, balsam fir, and northern white cedar. Shrubs cover is dense (average 75% but up to 100%) and includes wild raisin, Labrador tea, mountain holly (*Nemopanthus mucronatus*), sheep laurel, early low blueberry (*Vaccinium angustifolium*), and leatherleaf (*Chamaedaphne calyculata*). Sarsaparilla (*Aralia nudicaulis*) and pink lady slipper (*Cypripedium acaule*) were the only herbs noted, though other common boreal herb species are likely present in low abundance. Moss cover was around 20%. Soil was typically shallow, though one sample found 8" of organic material over 6" sandy loam before hitting rock. Many animal species likely use steep pondshore slope forest because of the proximity to water. Of particular note, both bald eagles and ospreys could use the tall white pine or red spruce in this community as nesting locations. Common loons might nest in the flat shoreline areas at the margins of this community.

Montane Yellow Birch-Red Spruce Forest – S3

The upper elevations of Averill Mountain (roughly over 2100 feet) are forested with montane yellow birch-red spruce forest. A single 132-acre patch forms a B-ranked, state-significant occurrence.

Soils in this community are shallow, and very rocky and boulder-strewn. Small ledge outcrops are common, and in places the shallow bedrock holds water and creates seeps. Several large seeps are mapped in this community; additional seeps are probably present but were missed in the inventory due to their small size. The forest canopy reflects the challenging growing conditions of the soil and the elevation. The canopy varies, and in some places consists only of 30-40' tall yellow birch (*Betula alleghaniensis*) over an understory of dense false hellebore (*Veratrum viride*), mountain wood fern (*Dryopteris campyloptera*), and hay-scented fern (*Dennstaedtia punctilobula*). Where it is more developed, an emergent canopy of 60' tall red spruce (*Picea rubens*) has at most 30% cover over a secondary canopy (40-50' tall, 70% cover) of red spruce, yellow birch, some dead and dying white birch (*Betula papyrifera*), and the occasional sugar maple (*Acer saccharum*). A tertiary canopy includes (approx. 20' tall, 40% cover) red spruce, striped maple (*Acer pensylvanicum*), balsam fir (*Abies balsamea*), and yellow birch. Hobblebush (*Viburnum lantanoides*) forms a very dense (near 100% cover) shrub layer at times, and in these places moose browse is almost ubiquitous. Abundant herbs in this

community include sarsaparilla (*Aralia nudicaulis*), Canada mayflower (*Maianthemum canadense*), starflower (*Trientalis borealis*), bluebead lily (*Clintonia borealis*), common wood sorrel (*Oxalis montana*), intermediate wood fern (*Dryopteris intermedia*), and tree clubmoss (*Lycopodium obscurum*). Stairstep moss (*Hylocomium splendens*) is common on exposed rock.

As the abundant evidence of browsing indicates, this habitat is heavily used by moose. Other wildlife species likely present in this habitat include blackburnian warbler, and winter wren, which nests in tree root tip-ups. Windthrow (causing tip-ups) and ice damage are probably the two primary natural disturbances influencing these forests. The sunlit gaps created by ice-damaged trees, and the exposed mineral soil of tip-ups likely are important to the continued prominence of yellow birch in this forest, which might otherwise be out-competed by red spruce.

Northern Conifer Floodplain Forest – S2

Thirteen acres of this community type are found along the Coaticook River in Black Turn Brook SF. Although this example is has reduced ecological function because it has been disturbed and is surrounded by agricultural lands, it is still considered state-significant because northern conifer floodplain forest is a rare community type in Vermont, and this example in the BMU has the potential to develop into a more natural floodplain forest.

Detailed notes were not taken within this community type, but the following description is based on a composite of observations: The soil is a silty/sandy loam, with many buried shards of broken glass indicating the history of human disturbance. The flood regime was not readily apparent but may be less than annually. A thin canopy (40-50% cover) of 30-40' tall balsam fir (*Abies balsamea*) and occasional black cherry (*Prunus serotina*) overtops a 10-15' tall layer (40% cover) of speckled alder (*Alnus incana*). Meadowsweet (*Spiraea alba* var. *latifolia*) and a currant (*Ribes* sp.) are abundant low shrubs, and herbs include tall meadow rue (*Thalictrum pubescens*), swamp candles (*Lysimachia terrestris*), Canada mayflower (*Maianthemum canadense*), foamflower (*Tiarella cordifolia*), and wood strawberry (*Fragaria vesca*). Several goldenrod (*Solidago* spp.) and aster-like species (*Aster* spp. and others) were also present. Cow parsnip (*Heracleum maximum*) is abundant in the northern portion of this community.

The successional trends of this community type in Vermont are not well understood, however, it might be expected that a mature example of this community would include balsam fir, black cherry, black ash (*Fraxinus nigra*), white spruce (*Picea glauca*), northern white cedar (*Thuja occidentalis*), and balsam poplar (*Populus balsamifera*) in the overstory. Speckled alder and

beaked hazelnut (*Corylus cornuta*) would be expected in the shrub layer, and herbs might include ostrich fern (*Matteuccia struthiopteris*) and sensitive fern (*Onoclea sensibilis*).

Wildlife species likely to use this floodplain community in the BMU include common yellowthroat, yellow warbler, mink, muskrat and beaver.

Northern Hardwood Forest – S5

This is the third-most abundant community type in the BMU, covering 2,594 acres. Most of this acreage is part of a single A-ranked occurrence at Bill Sladyk WMA, which is considered a state-significant example. The remaining acres are divided between two smaller occurrences at Averill Mountain WMA and Black Turn Brook SF. Neither of these is state-significant.

Northern hardwood forest is found on mid-elevation slopes in the BMU, which are slightly warmer than valley bottoms. These forests occur on glacial till soils, some of which have been mapped as Tunbridge-Lyman and Tunbridge-Dixfield series by the NRCS. Field sampling at one site found 20" of sandy loam, over 12" of silt loam, over gravel and bedrock, but soils are sometimes shallower. In some places, the shallow and impermeable bedrock causes groundwater seepage—especially on Averill Mountain where this community intergrades with hardwood-softwood seepage forest—but mostly these are mesic forests.

As is typical of northern hardwood forests, a mix of sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*) and yellow birch (*Betula alleghaniensis*) dominate the closed canopy (60-70' tall, 90% cover). White ash (*Fraxinus americana*) is fairly common on more productive sites, while red maple (*Acer rubrum*) enters on less productive sites. Black cherry (*Prunus serotina*) is an occasional canopy tree. Secondary and tertiary canopies are common but low in cover (20-30% for both), and around 50' and 25' in height, respectively. The species mix varies, but is almost exclusively sugar maple, beech and yellow birch, and sometimes balsam fir (*Abies balsamea*). Tall shrubs are usually sparse, and can include hobblebush (*Viburnum lantanoides*), striped maple (*Acer pensylvanicum*), beech, beaked hazelnut (*Corylus cornuta*) and common elderberry (*Sambucus racemosa*). In places, especially those with a history of timber harvest or natural disturbance, hobblebush can form a nearly continuous thicket. The low shrub layer, if present, is mostly composed of hobblebush in widely varying density (0-100% cover). Herb cover averages 20-30%, and includes intermediate wood fern (*Dryopteris intermedia*), long beech fern (*Phegopteris connectilis*), New York fern (*Thelypteris noveboracensis*), common wood-sorrel (*Oxalis montana*), foamflower (*Tiarella cordifolia*), shining clubmoss (*Huperzia lucidula*), sessile-leaved bellwort (*Uvularia sessilifolia*), rose twisted stalk (*Streptopus roseus*),

and drooping woodreed (*Cinna latifolia*). Ground cover is leaf-litter, with little of the bryophyte cover common in nearby spruce-fir forests.

Some common wildlife species in northern hardwood forest include the red-backed salamander, hermit thrush, black-throated blue warbler, chipmunk, white-tailed deer, moose, and black bear. Bear in particular make use of mast stands of beech, feeding on beechnuts in the fall. These feeding areas can be recognized by an abundance of bear-claw-scarred beech trees. One small mast site was found in Bill Sladyk WMA, in the hardwood forest to the southwest of Cranberry Bog and Halfway Pond. Additionally, a great blue heron rookery is known to be located in the forest on the southern border of Bill Sladyk WMA.

Northern Hardwood Talus Woodland – S3

There is a C-ranked example of this community, covering slightly less than three acres, on the steep south face of Averill Mountain. Although it is adjacent to the boreal talus woodland, there is a distinct boundary between the two communities due to differences in the bedrock and substrate. Northern hardwood talus woodland is found where the calcareous Gile Mountain Formation rock intermingles with the intrusive Averill granite. Because of the calcareous rock, which weathers faster than granite and contains more plant nutrients, this community has more soil development and slightly more fertile growing conditions than the adjacent community.

The substrate for this community is a steep slope with a combination of bedrock exposures and talus blocks of both sedimentary and igneous rocks. Exposed rock totals about 40% of the ground cover. There is a thin layer of soil (mostly decomposed leaf litter) in the crevices of the rocks. A two-layered tree canopy (30' and 20' tall, both approximately 30% cover, for a total tree cover of 60%) includes white birch (*Betula papyrifera*), yellow birch (*Betula alleghaniensis*), and red maple (*Acer rubrum*). This community occurrence lacks many of the rich-site tree species common in other Northern Hardwood Talus Woodlands, such as sugar maple and basswood. Tall shrubs reach 8' in height and 30% cover, and include striped maple (*Acer pensylvanicum*), mountain maple (*Acer spicatum*), balsam fir (*Abies balsamea*), a serviceberry (*Amelanchier* sp.), and mountain ash (*Sorbus americana*). Low shrubs (to 3' tall, 20% cover) present are striped maple and mountain ash. Herbs (observed before the height of the growing season) include bracken fern (*Pteridium aquilinum*), marginal wood fern (*Dryopteris marginalis*), common polypody (*Polypodium virginianum*), whorled wood aster (*Aster acuminatus*), and shining club moss (*Huperzia lucidula*). Several additional herbs could not be positively identified to species in early season, including a sedge (*Carex* c.f. *communis*), a

hawkweed (*Hieracium* sp.) and a pussytoes (*Antennaria* sp.) Bryophyte cover was around 5% on soil, but lichens covered 30-60% of the exposed talus.

Wildlife in northern hardwood talus woodlands is not well-studied. The jumbled crevices created by the talus blocks at this site create potential habitat for a number of wildlife species, including bobcat and porcupine. The rock vole is a rare species associated with talus woodlands in the Northeastern Highlands region of Vermont. It is possible that this species is present at Averill Mountain.

Northern White Cedar Swamp – S3

Northern white cedar swamps cover 292 acres of the BMU. These are grouped into 16 occurrences, several of which are A-ranked examples. The others are either B or C-ranked. Twelve are considered state-significant.

This community type includes two variants, both of which are found in Bill Sladyk WMA: northern white cedar sloping seepage forest, and boreal acidic northern white cedar swamp, which are described separately below. The “sloping seepage” variant represents a clearly distinct type, though the one patch in the WMA is not a great example (it is C-ranked). The “boreal acidic” variant, however, is not so distinct in the BMU because of the overall lack of enrichment even in the regular northern white cedar swamp examples.

Northern white cedar swamps in the BMU are found in wetland basins and along stream margins, and are found on organic soils of varying depths. An average soil profile has 1-3’ feet of well-decomposed peat on top of muck. In some cases, mineral soil or bedrock could be found beneath the organic soil layers. These swamps are typically less acidic than other swamp types in the management unit, with pH measurements ranging from 6.0 to 6.5 (and possibly up to 7.0 in one example). Further south in Vermont, these swamps are often found in areas with calcareous bedrock, but here all the northern white cedar swamps are underlain by non-calcareous (acidic) granite.

Northern white cedar swamps have varying canopy cover, averaging around 60-70%. The main canopy is generally around 50’ in height. Northern white cedar (*Thuja occidentalis*) is dominant, with lesser amounts of balsam fir (*Abies balsamea*), red spruce (*Picea rubens*) and (occasionally) black spruce (*Picea mariana*). In the swamp adjacent to the northwest arm of Norton Pond, there is a 60-70’ emergent canopy of white pine (*Pinus strobus*) and white spruce (*Picea glauca*). A 20-30’ tall understory (average 50% cover) is common, including the same tree species as the

canopy. Rarely, black ash (*Fraxinus nigra*) is found in the understory at the edges of these swamps. Tall shrub cover varied depending on canopy cover—closed canopies typically had less shrub cover (5-10%) while more open canopies had more shrubs. Frequent tall shrubs include balsam fir, mountain holly (*Nemopanthus mucronatus*), speckled alder (*Alnus incana*), and mountain maple (*Acer spicatum*). Frequent low shrubs (around 5% cover under a closed tree canopy) include alder-leaved buckthorn (*Rhamnus alnifolia*), mountain holly, red maple (*Acer rubrum*), mountain ash (*Sorbus americana*), wild raisin (*Viburnum cassinoides*), and a currant (*Ribes* sp.). Herb cover can reach 50%, and can be relatively diverse. Some species present include three-seeded sedge (*Carex trisperma*), foamflower (*Tiarella cordifolia*), naked miterwort (*Mitella nuda*), goldthread (*Coptis trifolia*), bunchberry (*Cornus canadensis*), long beech fern (*Phegopteris connectilis*), marsh fern (*Thelypteris palustris*), oak fern (*Gymnocarpium dryopteris*), inflated sedge (*Carex intumescens*), dewdrop (*Dalibarda repens*), and twinflower (*Linnaea borealis*). In general, shrub and herb cover is fairly diverse in these swamps, with 29 herb species observed during the informal inventory of one swamp. Bryophytes cover nearly 100% of the ground, with species including stairstep moss (*Hylocomium splendens*), common fern moss (*Thuidium delicatulum*), knight's plume moss (*Ptilium crista-castrensis*), three-lobed bazzania (*Bazzania trilobata*) and several species of sphagnum moss (including *Sphagnum squarrosum* and *S. quinquefarium*). Three rare plants were found in northern white cedar swamps: the state-listed threatened arctic sweet coltsfoot (*Petasites frigidus* var. *palmatus*), and the rare moose dung moss (*Splachnum ampullaceum*) and swamp fly-honeysuckle (*Lonicera oblongifolia*).

Northern white cedar swamps commonly provide habitat for many wildlife species. Many songbirds, such as the winter wren, northern waterthrush, and northern parula, breed in this swamp type. Two important birds that might make use of this community include the rare black-backed woodpecker, and the state-endangered spruce grouse. White-tailed deer can use the dense, protective conifer canopy as wintering habitat, avoiding deep snow cover. Many small mammals, such as the deer mouse and short-tailed shrew, also use northern white cedar swamps.

a. Northern White Cedar Sloping Seepage Forest Variant – S3

One patch (1.7 acres) of this variant, which is found on gentle slopes, occurs at the north end of Holland Pond. Soils were not sampled in this patch, but this variant is generally found on shallow, well-decomposed mucks, with areas of groundwater seepage evident. This variant is almost exclusively known from areas with calcium-rich bedrock, but this patch in Bill Sladyk WMA is on bedrock mapped as granite. The tree canopy is closed (90% cover) and 30-35' tall. Northern white cedar is by far the most abundant, with yellow birch (*Betula alleghaniensis*),

white birch (*Betula papyrifera*), and balsam fir also present. Some of the larger cedar trees reach 20" or more in diameter. Tall shrubs (5% cover) include northern white cedar and balsam fir. The low shrubs layer is more diverse and abundant (50% cover) with much balsam fir, but also mountain holly, mountain maple (*Acer spicatum*), leatherleaf (*Chamaedaphne calyculata*), hobblebush (*Viburnum lantanoides*), wild raisin, early low blueberry (*Vaccinium angustifolium*), and American fly honeysuckle (*Lonicera canadensis*). Herb cover averages 75%, and includes inflated sedge, three-seeded sedge, starflower (*Trientalis borealis*), partridgeberry (*Mitchella repens*), dewdrop, Canada mayflower (*Maianthemum canadense*), crested wood fern (*Dryopteris cristata*), drooping woodreed (*Cinna latifolia*), marsh fern, cinnamon fern (*Osmunda cinnamomea*), interrupted fern (*Osmunda claytoniana*), and turtlehead (*Chelone glabra*). Bryophytes were not noted in this patch, but stairstep moss (*Hylocomium splendens*) and three-lobed bazzania (*Bazzania trilobata*) are likely present, but not nearly as abundant as in other cedar swamps. Wildlife species in this patch are likely similar to those found in the surrounding lowland spruce-fir forest.

b. Boreal Acidic Northern White Cedar Swamp Variant – S3

This variant includes northern white cedar swamps that occur in basin settings and lack the groundwater seepage that characterizes the typical northern white cedar swamp. 87 acres of this type were mapped in the BMU, as part of five different occurrences. In general, these swamps have deeper, less-well decomposed peat or muck substrates than the typical cedar swamp. Boreal bog species are also more abundant. These swamps are rather variable in vegetation structure, and show much evidence of blowdown and/or moderate beaver disturbance. They tend to have an emergent canopy 40-50' tall and varying from 10-30% cover, which is composed primarily of northern white cedar. Black spruce is co-dominant in one example; otherwise red spruce, black spruce, balsam fir, and tamarack (*Larix laricina*) are occasional canopy components. A 20-30' secondary canopy averages 40% cover and has a similar species composition. Some swamps have a patchy but dense layer of 15-20' tall red spruce, black spruce and balsam fir. The tall shrub layer (variable cover, average 50%) frequently is dominated by speckled alder (*Alnus incana*), but mountain holly, meadowsweet (*Spiraea alba* var. *latifolia*), and wild raisin are also present. Low shrubs (approximately 30% cover) include small cranberry (*Vaccinium oxycoccus*) and velvet leaf blueberry (*Vaccinium myrtilloides*). This variant frequently has abundant (90-100% cover) sphagnum mosses (*Sphagnum* spp.). Wildlife species found in these swamps are likely similar to those in the regular northern white cedar swamps and spruce-fir-tamarack swamps.

Red Spruce-Heath Rocky Ridge Forest – S3

This is a forest or woodland dominated by red spruce (*Picea rubens*) and sometimes balsam fir (*Abies balsamea*), but which occurs in settings that are neither montane (exposed to cold winds and frequent fog and precipitation) or lowland (cold air basins). It is found on low ridges and steep slopes where shallow acidic bedrock creates draughty, nutrient poor conditions. This community is not described by Thompson and Sorenson (2000), but is a more recent addition to the Vermont natural community classification.

Two small occurrences of this community were mapped at in the BMU (both at Bill Sladyk WMA) totaling approximately seven acres. Both are in the far northwestern corner of the WMA, on the ridges above Beaver Pond, and both are B-ranked and considered state-significant. A third patch of 25 acres has been tentatively mapped on the summit of Hedgehog Hill on the western edge of the WMA, but this patch was not visited during the inventory. It has not been assigned a quality rank and is not currently considered state-significant.

Two of these three areas are mapped by the NRCS as having very rocky Tunbridge-Lyman soils, and field sampling found the soil extremely shallow. On the ridge north of Beaver Pond, an inch of moss and organic matter covered bedrock ledge. A variable (50-80% cover, 40-60' tall) overstory of red spruce and balsam fir characterizes this community in the BMU. A secondary canopy includes red spruce, balsam fir, northern white cedar (*Thuja occidentalis*) and, occasionally red maple (*Acer rubrum*). Shrubs include balsam fir, red spruce, and white birch (*Betula papyrifera*). Bryophyte cover is abundant (near 100%), with stairstep moss (*Hylocomium splendens*) being common. Herb cover was less abundant (average 20% cover) and included Canada mayflower, starflower (*Trientalis borealis*), bluebead lily (*Clintonia borealis*), bunchberry (*Cornus canadensis*) and intermediate wood fern (*Dryopteris intermedia*). Lichen cover was also present, including abundant reindeer lichens (*Cladina* spp.).

Little is known about animal species that use this community. In the BMU, the small size of the patches means that birds and mammals in these patches are probably similar to the surrounding softwood or mixed forests. Small patch communities like this one can host distinctive insect assemblages, but these are not known to have been studied. Given their landscape position, wind throw is likely a frequent natural disturbance in these forests. Lightning-caused fires may also be part of the normal natural disturbance regime.

Red Spruce-Northern Hardwood Forest – S4

Much of the BMU is covered by a mixed forest of red spruce (*Picea rubens*), balsam fir (*Abies balsamea*) and northern hardwood species. When this mix appears likely to persist over time, the community type is mapped as red spruce-northern hardwood forest. Twelve patches have been identified at Bill Sladyk WMA, and these range in size from less than 20 acres to nearly 900 acres, and total 2,737 acres. The largest patch is located in the southwest portion of the WMA, over an interesting series of low, parallel ridges. This area also has some of the better examples of this type in the WMA, with older and larger trees that suggest little recent disturbance. These patches form four occurrences, of which two are A-ranked and two are B-ranked. All four occurrences are considered state-significant.

Found on a variety of glacial till soils, including sandy loams and rocky loams, red spruce-northern hardwood forest is primarily at middle and upper elevations in the ***WMA. When small patches of this type are found amid northern hardwood forest, it may be because of subtle differences in soil depth and drainage. Field sampling found 17" of silt loam over rock at one site, and at another site just 4" of organic litter over a 4" leach layer on top of bedrock. The overstory canopy (60-70' tall, 50-80% closed) is composed of yellow birch (*Betula alleghaniensis*), beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*) and red spruce. White birch (*Betula papyrifera*), white ash (*Fraxinus americana*), and red maple (*Acer rubrum*) are also present at some sites. A secondary canopy (50' tall, 60% closed) of sugar maple, yellow birch, red spruce and balsam fir is usually present. A tertiary canopy (30-40' tall, 30% closed) is also present. Beech can be abundant in this layer, along with the species already noted. Tall shrubs cover is around 10-20% and includes canopy tree species, balsam fir, mountain maple (*Acer spicatum*) and striped maple (*Acer pensylvanicum*). Low shrubs (30-60% cover) include hobblebush (*Viburnum lantanoides*; which can be very abundant), striped maple, wild raisin (*Viburnum cassinoides*) and American fly honeysuckle (*Lonicera canadensis*). Herb cover is around 40% and includes intermediate wood fern (*Dryopteris intermedia*), Canada mayflower (*Maianthemum canadense*), bluebead lily (*Clintonia borealis*), shining club moss (*Huperzia lucidula*), Indian cucumber-root (*Medeola virginiana*), pink lady slipper (*Cypripedium acaule*), and goldthread (*Coptis trifolia*). Ground cover is typically leaf litter, and bryophytes are not a large component.

Wildlife in these forests is probably similar to northern hardwood forest species such as red-backed salamander, hermit thrush, white-tailed deer, moose and black bear. Some boreal species may use areas of this forest that have a higher percentage of softwood cover. Throughout Vermont there are few mature examples of this community type, and so little is known about the long-term forest dynamics in this community. Single tree death and small gap dynamics are probably the most common natural disturbance. A history of timber harvesting, which has often

favorable softwood over hardwood species, may have had a lasting influence on this community type as well.

Rich Northern Hardwood Forest – S4

One occurrence of rich northern hardwood forest, covering just less than 8 acres, has been identified at Bill Sladyk WMA. It is B-ranked and is considered state-significant.

This forest type develops on soils that have high concentrations of calcium and other important plant nutrients. Most often, this is a result of colluvial (downhill) movement of soil, which concentrates nutrient-rich humus on lower slopes. Bedrock can also be a source of these nutrients, but the granite that underlies this particular patch does little to enrich the soil. It is not uncommon to find small areas of groundwater seepage in rich northern hardwood forests, and this water can be another source of nutrient input.

The patch is on a steep, bowl-shaped, east-facing slope on the western edge of the WMA. The soil is seepy and rocky, with undifferentiated sand loam deeper than 3 feet. The soil became mottled near the lower depths, suggesting seasonal saturation. The enrichment from seepage and colluvium makes for a highly productive forest. An overstory (70-80' tall, 95% closed) is composed almost entirely of sugar maple (*Acer saccharum*), but also contains some yellow birch (*Betula alleghaniensis*). Many of the sugar maples reach up to 24" DBH (diameter at breast height). A thin understory (40' tall, 10-15% cover) of sugar maple is also present, along with a third canopy (20' tall, 30% cover) of sugar maple, yellow birch and white ash (*Fraxinus americana*). Shrubs are almost absent except for a few individuals of elderberry (*Sambucus racemosa*) and hobblebush (*Viburnum lantanoides*). Ferns dominate the herb layer, which has about 80% cover. In order of abundance, these species are silvery glade fern (*Deparia acrostichoides*), intermediate wood fern (*Dryopteris intermedia*), Braun's holly fern (*Polystichum braunii*), lady fern (*Athyrium filix-femina*) and Christmas fern (*Polystichum acrostichoides*). Other herbs include foamflower (*Tiarella cordifolia*) and blue cohosh (*Caulophyllum thalictroides*). Rich northern hardwood forests often have showy spring wildflowers, and it is possible that many other herb species are also present on this site.

Animals that use this community are similar to those that use the surrounding northern hardwood forest and red spruce-northern hardwood forest. Outside of large wind events, natural disturbance in this community is probably limited to individual tree death and small gap dynamics. Because of the productive tree growth, rich northern hardwood forests often have a

history of logging, but on this site the absence of stumps and the relatively large trees for the region suggest that this site has remained undisturbed for a fairly long period of time.

Seep – S4

There are two large clusters of seeps in the BMU; one is at Bill Sladyk WMA, and the other at Averill Mountain WMA. Each cluster is considered one occurrence, and both are A-ranked and state-significant. These two seep occurrences are quite different in landscape position and vegetation, and so are described separately.

The occurrence on Averill Mountain is comprised of 13 mapped polygons (though others may be present but were not detected during inventory), covering eight acres. These seeps, which are on the slopes of the mountain, show strong evidence of mineral enrichment. One location the soil was neutral to basic, with a pH of 7.0-7.2. This is likely the result of downslope movement of nutrients in the soil, and possibly the influence of till derived from the calcareous Gile Mountain bedrock that is nearby. These seeps have mineral soil (sometimes with a thin layer of muck) of varying depths. One location sampled had relatively deep (approx. 12”), saturated soil; another had just 2” of inundated silt loam over bedrock. A sparse tree canopy (30% cover) of white birch (*Betula papyrifera*), yellow birch (*Betula alleghaniensis*), and red spruce (*Picea rubens*) was noted. Shrubs were generally absent, but herbs were abundant. Species observed include a jewelweed (*Impatiens* sp.) which was very common, and inflated sedge (*Carex intumescens*), mountain wood fern (*Dryopteris campyloptera*), and hay-scented fern (*Dennstaedtia punctilobula*). Additional species present, which indicate mineral enrichment, include: ostrich fern (*Matteuccia struthiopteris*), silvery spleenwort (*Deparia acrostichoides*), and blue cohosh (*Caulophyllum thalictroides*). The rare species boreal bedstraw (*Galium kamtschaticum*) is present in two of these seeps.

At Bill Sladyk WMA, four seeps form a single 6-acre occurrence. The individual seeps are found in the small valleys formed by an interesting set of parallel ridges in the southwest portion of the WMA. The geologic origin and structure of these ridges is unknown, but seeps often occur because of an impermeable layer of rock or soil that causes water to flow out of a slope. The groundwater flow sometimes can continue even through dry portions of the summer, and in winter the groundwater flow can moderate soil temperatures and prevent the ground from freezing. These seeps have a tree canopy (50’ tall and 70% cover) of red maple (*Acer rubrum*), balsam fir (*Abies balsamea*), and yellow birch. Tall shrub cover is limited (5%) but includes mountain maple (*Acer spicatum*) and hobblebush (*Viburnum lantanoides*). A low shrub/regeneration layer contains a small number of sugar maple (*Acer saccharum*) seedlings.

Herbs are abundant (>95% cover) and the most abundant species include lady fern (*Athyrium filix-femina*), ostrich fern, jewelweed (*Impatiens capensis*), foamflower (*Tiarella cordifolia*), mountain woodfern, cinnamon fern (*Osmunda cinnamomea*), and dwarf raspberry (*Rubus pubescens*). Mosses are abundant on the saturated peaty-muck soil, which had a depth of 2.5 feet above coarse gleyed sand.

All seeps can provide important wildlife habitat. Amphibian such as the northern two-lined salamander, spring salamander, and dusky salamander all use seeps. Bears emerging from hibernation take advantage of the early spring growth in seeps, foraging on grasses, sedges and tubers. Many of the small valleys similar to ones some of these seeps are found in have been dammed by beaver, suggesting that beaver influence may be a normal natural disturbance in this community in the BMU.

Spruce-Fir-Tamarack Swamp – S3

Spruce-fir-tamarack swamps are abundant in the BMU, and they are often closely related to the wettest examples of lowland spruce-fir-forest. The 18 occurrences found in the BMU range in size from less than a half-acre in small, isolated bedrock depressions, to over 200 acres in the large wetland complex south of Holland Pond. The largest example is A-ranked; the others are B or C-ranked. Eleven occurrences (totaling 429 acres) are considered state-significant.

This is a variable community type that occurs on a peat substrate in isolated basins or along the margins of boggy streams (such as Hurricane Brook). Peat depths measured in the field ranged from just a few inches over bedrock to up to 3' of poorly decomposed peat over gravel and bedrock. While the peat is sometimes saturated, this community is not flooded, and it is uncommon to find hollows with standing water in these swamps. This community has a canopy (average 40-50' tall) that varies in coverage (average 70%, ranged 30-100%), and which contains red spruce (*Picea rubens*), black spruce (*Picea mariana*), and balsam fir (*Abies balsamea*). Tamarack (*Larix laricina*) can be abundant in the canopy of some examples or, despite the name, completely absent in others. Northern white cedar (*Thuja occidentalis*) is also sometimes present in the canopy in low abundance (<25%). (When cedar is more abundant, the swamps usually have been mapped as northern white cedar swamps). If the canopy is closed, understory canopy layers are often sparse or absent, but when the canopy is more open several subcanopies can be present. These have a mix of the overstory species and the occasional northern white cedar, grey birch or mountain maple (*Acer spicatum*). Tall shrubs average 10-20% cover, and include speckled alder (*Alnus incana*), mountain holly (*Nemopanthus mucronatus*), American fly honeysuckle (*Lonicera canadensis*), and wild raisin (*Viburnum cassinoides*). Low shrubs

average 20-30% cover with sheep laurel (*Kalmia angustifolia*), Labrador tea (*Ledum groenlandicum*), and velvet leaf blueberry (*Vaccinium myrtilloides*) commonly present. Herb cover averages 50% and includes three-seeded sedge (*Carex trisperma*), inflated sedge (*Carex intumescens*), crested wood fern (*Dryopteris cristata*), shining club moss (*Huperzia lucidula*), creeping snowberry (*Gaultheria hispidula*), wintergreen (*Gaultheria procumbens*), bunchberry (*Cornus canadensis*), dewdrop (*Dalibarda repens*), and three-leaved false solomon's seal (*Smilacina trifolia*). Sphagnum moss (*Sphagnum* spp.) cover is typically high (>80%). Other bryophytes commonly present include Schreber's moss (*Pleurozium shreberi*), stairstep moss (*Hylocomium splendens*), and three-lobed bazzania (*Bazzania trilobata*).

The rare and state-listed threatened arctic sweet coltsfoot (*Petasites frigidus* var. *palmatus*) was found in one swamp of this type south of Holland Pond. Additionally, the state-endangered spruce grouse and the rare black-backed woodpecker, which have been reported at Bill Sladyk WMA and the surrounding area, both use spruce-fir-tamarack swamps for foraging and nesting.

In the Northeastern Highlands region, these swamps often intergrade with other wetland types, including northern white cedar swamp, black spruce woodland bog, and black spruce swamp; it is possible that small examples of these three types might exist with the larger spruce-fir-tamarack swamps but were not detected in this inventory effort.

Sugar Maple-Ostrich Fern Floodplain Forest – S2

Thompson and Sorenson (2000) describe sugar maple-ostrich fern floodplain forest as the floodplain community type found on many smaller, high-gradient rivers in Vermont. In the BMU, two areas of small stream floodplain forest totaling 7 acres have been mapped as this community type, but these sites vary somewhat from the vegetation association and disturbance regime usually found in this community type. Future inventory work might attempt a more thorough study of these sites to see if they are properly placed in this community type. Both occurrences are B-ranked and considered state-significant.

These floodplains occur on gently sloping terrain (10-15 degrees). The soil profile and vegetation suggested that this community floods occasionally, but not necessarily every year. In the first example (south of Holland Pond), soils have 24" of silty clay, over 6" sand, on top of saturated gravelly sand. The second example (near the western property boundary) has 14" of mottled silt loam. The first example has an overstory tree canopy 40-50' tall and 60% closed, with sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), white ash (*Fraxinus americana*) and balsam fir (*Abies balsamea*). A 30-40' second canopy has white ash, balsam fir

and sugar maple. Tall shrub cover (20%) includes beaked hazelnut (*Corylus cornuta*), black cherry (*Prunus serotina*), and balsam fir. Low shrubs (20-30% cover) include the tall shrub species and beech (*Fagus grandifolia*). Herb cover is abundant (60-80%) and includes false hellebore (*Veratrum viride*), blue cohosh (*Caulophyllum thalictroides*), tall meadow rue (*Thalictrum pubescens*), zigzag goldenrod (*Solidago flexicaulis*), rough-stemmed sedge (*Carex scabrata*) and foamflower (*Tiarella cordifolia*). Ostrich fern (*Matteuccia struthiopteris*) seems to be absent at this site. The second example has an overstory (50-60' tall, 100% closed) of sugar maple, red spruce (*Picea rubens*), and yellow birch; a second canopy (20-30' tall, 20% cover) of yellow birch, sugar maple and white ash; and some hobblebush (*Viburnum lantanoides*) in the very sparse shrub layer. Herbs include intermediate wood fern (*Dryopteris intermedia*), ostrich fern, false hellebore (*Veratrum viride*), lady fern (*Athyrium filix-femina*), sessile-leaved bellwort (*Uvularia sessilifolia*), foamflower (*Tiarella cordifolia*), tall meadow rue (*Thalictrum pubescens*), and jack-in-the-pulpit (*Arisaema triphyllum*), along with common boreal herbs such as Canada mayflower (*Maianthemum canadense*) and bluebead lily (*Clintonia borealis*).

Sweet Gale Shoreline Swamp – S3

Sweet gale shoreline swamp is a flooded swamp that is often found along the edges of ponds and streams in the BMU. Four occurrences (29 acres) of this community have been mapped, all in Bill Sladyk WMA at Holland Pond, Halfway Pond, Norton Pond and Turtle Pond. In addition, many other ponds have a very thin band of sweet gale shoreline swamp around their margins, though this may be only a few feet wide. Most of the patches of this community in the BMU are small (<5 acres), and are C or D-ranked because of their size (though they may be in good condition). The south end of Holland Pond has a larger, approximately 20 acre patch of this community, which is B-ranked and considered state-significant.

This is a permanently saturated and often flooded peat community, with the mat of peat and roots becoming floating further toward open water. Because of the flow of pond water into the peat mat, this community can be slightly more minerotrophic than many peatlands, but overall at the BMU these are not enriched wetlands. Small northern white cedar (*Thuja occidentalis*) and tamarack (*Larix laricina*) trees sometimes grow on the more stable portions of this community, reaching up to 20' and totaling about 5% cover, but primarily this is a shrub-dominated type. Tall shrubs cover 15%, and include speckled alder (*Alnus incana*), sweet gale (*Myrica gale*), and willows (*Salix* spp.). Low shrubs cover nearly 100%, with sweet gale and speckled alder most abundant. Meadowsweet (*Spiraea alba* var. *latifolia*), alder-leaved buckthorn (*Rhamnus alnifolia*), winterberry (*Ilex verticillata*), wild raisin (*Viburnum cassinoides*), and leatherleaf (*Chamaedaphne calyculata*) are also usually present in varying abundance. Herb cover averages

30-40% and includes blue flag iris (*Iris versicolor*), swamp candles (*Lysimachia terrestris*), water arum (*Calla palustris*), woolgrass (*Scirpus cyperinus*) and horsetails (*Equisetum* spp.) and sedges (*Carex* spp.). Sphagnum moss (*Sphagnum* spp.) can cover a substantial portion (up to 80%) of the ground in this community, but some examples that are regularly submerged can have less moss and herb cover.

Throughout Vermont, large occurrences of this community are used by birds such as the common yellowthroat, northern waterthrush and red-winged blackbird. Additionally, in the BMU, loons may nest in this community. Thompson and Sorenson (2000) report that several rare dragonflies associated with boggy streams may also be found in this community. Sweet gale shoreline swamps probably play an important role in cycling nutrients and providing habitat for the many fish and macro-invertebrates that live in the ponds.

Temperate Acidic Outcrop – S4

A small temperate acidic outcrop is found near the summit of Averill Mountain. Covering less than 0.1 acre and C-ranked, this example is not considered state-significant.

This small clearing, which is disturbed both by people trimming vegetation to improve the view, and very heavy moose browse along the margin, has no tree canopy in itself, but is surrounded by a brushy (15-20' tall) canopy of balsam fir (*Abies balsamea*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*), pin cherry (*Prunus pensylvanica*), red spruce (*Picea rubens*), and mountain ash (*Sorbus americana*). Shrubby white birch (*Betula papyrifera*), balsam fir and choke cherry (*Prunus virginiana*) reach 8' in height. Low shrubs include bush honeysuckle (*Diervilla lonicera*) and early low blueberry (*Vaccinium angustifolium*). Herbs are present in rock crevices (approx. 20% cover of the whole outcrop) and include poverty oatgrass (*Danthonia spicata*), common hairgrass (*Deschampsia flexuosa*), black raspberry (*Rubus occidentalis*), down-turned sedge (*Carex deflexa*), garden sorrel (*Rumex acetosa*), and a hawkweed (*Hieracium* sp.).

Aside from the abundant evidence of moose around the edges, this community probably is too small to act as a specific wildlife habitat in itself. Many species from the surrounding communities may at times visit this habitat. Because this community is on the mountaintop, it may be prone to lightening-caused fires.

Vernal Pool – S3

One vernal pool was mapped in the BMU, just north of the summit of Averill Mountain. It is likely that other vernal pools can be found in the BMU, but were not encountered during this inventory due to their small size. Vernal pools are unlike other natural communities in that they are better characterized by the wildlife species present—particularly amphibians—than the plant species present. This particular pool measured roughly 50' by 30', and was 10" deep in early May. No evidence of amphibians was observed; there were no egg masses in the pool. The pool flooded many grasses, sedges, mosses that were growing on the bottom, suggesting that a short hydroperiod for this pool. If this is the case it may not serve as good amphibian habitat, because the pool may dry up before amphibian eggs can hatch and the young become terrestrial.

Because there was no evidence of amphibian breeding, this pool is currently E-ranked (meaning only that it was observed). Future observations will be needed to determine whether this pool is used by amphibians such as spotted salamander and wood frog. Regardless, vernal pools also provide potential habitat for invertebrates, and may play an important role in forest nutrient cycling.