

Natural Resource Inventory
of the Town of Newark, Vermont



Prepared for the
Town of Newark
by
Fritz Gerhardt, Ph.D.
23 December 2014

Beck Pond LLC

Founded in 2009, Beck Pond LLC partners with governmental and non-governmental organizations to conduct scientific research that guides on-the-ground conservation in northern New England and adjacent Canada. Beck Pond LLC is a limited liability company organized in the state of Vermont and is owned and operated by Dr. Fritz Gerhardt. Dr. Gerhardt has been working as an ecologist and conservation scientist since 1987 and has a wealth of experience applying ecological research to the conservation and restoration of natural ecosystems. He completed his B.A. in Religious Studies at Grinnell College, his M.F.S. in Forest Ecology at Harvard University, and his Ph.D. in Community Ecology at the University of Colorado. He has also worked with the U.S. Fish and Wildlife Service in Alaska, Harvard Forest in Massachusetts, and the Vermont Institute of Natural Science and NorthWoods Stewardship Center in Vermont. Dr. Gerhardt is dedicated to conducting scientific research that not only increases our understanding of the natural environment but also informs on-the-ground conservation actions. Among other projects, he has conducted scientific studies to assess the impacts of historical land uses on forest plant communities; to assess the impacts of invasive plants on grassland and forest habitats; to protect and improve water quality in the Lake Memphremagog, Connecticut River, and White River watersheds; to protect and restore floodplain forests and wetlands along the Upper Connecticut River; and to identify and protect wildlife habitat linkages across northern New England and eastern Canada.

***Cover.** This welcome sign, formerly located at the intersection of Newark and Center Pond Roads, directs travelers to two important natural features in the town of Newark, Vermont.*

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Executive Summary

As part of efforts to update the Town Plan, the Town of Newark contracted to undertake an inventory to identify and map the significant natural resources in the town. This report presents the results of this natural resource inventory and provides recommendations to further protect and enhance these significant natural resources.

The town of Newark encompasses 37.2 mi² (96.4 km²) as the northern-most town in Caledonia County in northeastern Vermont. Newark is lightly populated (581 residents in 2010) and is characterized by large blocks of contiguous forest habitat, several lakes and ponds, and extensive areas of aquatic and riparian habitats along the East and West Branches of the Passumpsic River and their tributaries. The town of Newark is home to a number of significant natural resources, ranging from those that occur across the broad landscape (enduring features, contiguous habitat, and connecting habitat) to those that occur at the community level (riparian and aquatic habitat, wetlands, vernal pools, and natural communities) to individual species (Rare, Threatened, and Endangered species; deer wintering areas; and mast stands).

At the landscape level, Newark supports a number of significant natural resources:

Enduring Features - Several large enduring features characterize the landscape in Newark. The most pronounced is the large north-south ridge that forms Packer and Walker Mountains and Hawk Rock in the eastern half of town. Farther west are another ridge that extends southeastward from Job and Bald Mountains towards Newark Hollow and a third ridge that extends southeastward from Newark Pond towards Maple Ridge Road. Between these ridges lay the valleys of the East and West Branches of the Passumpsic River and of Bean, Sleeper, and Roundy Brooks.

Contiguous Habitat - These ridges and valleys are blanketed by the most significant natural resource in the town of Newark: the large blocks of contiguous forest habitat that cover almost 88% of the town, especially in the northern and eastern parts of town. Fifteen large forest blocks range in size from 27-7,900 acres (11-3,197 ha) and, collectively, cover approximately 20,927 acres (8,469 ha). The largest forest blocks in Newark encompass Packer and Walker Mountains and Hawk Rock [7,900 acres (3,197 ha)] and the upper Bean Brook watershed [3,366 acres (1,362 ha)]. The eastern corner of Newark encompasses part of the second largest forest block in Vermont, which covers 116,846 acres (47,286-ha) on West and Seneca Mountains, and the western side of Newark encompasses part of another large forest block, which covers 15,335 acres (6,206 ha) on Job and Bald Mountains.

Connecting Habitat - These large forest habitat blocks also provide essential connecting habitat that links important wildlife habitats across northeastern Vermont, northern New England, and adjacent Canada.

Within this broader landscape, Newark also hosts a number of significant natural resources at the community level:

Riparian and Aquatic Habitat - Perhaps the most significant community-level natural resource in the town of Newark is the extensive areas of high-quality aquatic and riparian habitats. The town harbors several large ponds, including Newark and Center Ponds, and is drained by the East and West Branches of the Passumpsic River and their tributaries, including Bean, Sleeper, and Roundy Brooks.

Wetlands - Large areas of wetlands fill many of the valleys in Newark, especially along the East and West Branches of the Passumpsic River and Bean and Sleeper Brooks. In contrast, only limited numbers of vernal pools or potential vernal pools have been documented in Newark thus far.

Natural Communities - Newark also hosts a number of rare and uncommon natural communities. All of the mapped occurrences are northern white cedar swamp and are located along the West Branch of the Passumpsic River and Roundy Brook in the western corner of Newark. However, this natural community type has also been observed at several other locations across Newark. In addition, several other rare and uncommon natural communities have been observed near Center Pond (sweet gale shoreline swamp and northern white cedar sloping seepage forest), atop Packer and Walker Mountains (montane yellow birch-red spruce forest and montane spruce-fir forest), below the cliffs at Hawk Rock (boreal talus woodland and open talus), and along the East Branch of the Passumpsic River (lowland spruce-fir forest).

Within this broader context, Newark also hosts a number of important wildlife habitats and uncommon and Rare, Threatened, and Endangered (RTE) species:

Rare, Threatened, and Endangered Species - Bald eagles (*Haliaeetus leucocephalus*), a State-listed endangered species, have been observed regularly around both Center and Newark Ponds. In addition, American marten (*Martes americana*) and Canada Lynx (*Lynx canadensis*), both State-listed endangered species, have been observed with increasing regularity in neighboring towns, especially in the Seneca Range and the Nulhegan Basin, and likely will or already occur in Newark as well. Peregrine falcons (*Falco peregrinus*) have nested successfully on Hawk Rock in six of the last 12 years, and common loons (*Gavia immer*) have nested successfully at Newark Pond in 18 of the last 29 years (and unsuccessfully at Center Pond during 2013-2014). Two State-listed threatened and endangered plants [mare's-tail (*Hippuris vulgaris*) and sweet coltsfoot (*Petasites frigidus* var. *palmatus*)] have also been reported from Newark historically.

Deer Wintering Areas - Two large deer wintering areas, which provide critical habitat for white-tailed deer (*Odocoileus virginiana*) during the winter months, have been mapped in the town of Newark; however, other, smaller deer wintering areas likely occur in Newark as well.

Mast Stands - Although no areas were mapped as important beech mast stands, which provides critical habitat for black bear (*Ursus americanus*) and other wildlife, American beech (*Fagus grandifolia*) is a common species in forests throughout Newark, especially on Packer Mountain and near Hawk Rock.

Given the significant natural resources in Newark, there are a number of conservation and restoration opportunities that would protect and enhance these resources. Conservation of large forest habitat blocks and the associated natural communities and fish and wildlife species should be a top priority. Conserving these areas would provide both local and regional ecological benefits as well as maintaining and enhancing resource-based economic and recreational opportunities (e.g. timber production, maple sugaring, hunting, fishing, boating, and hiking). In addition, Newark is located within the critical wildlife habitat linkage connecting the northern Green and Worcester Mountains to the west and the Northern Highlands and northern White Mountains to the east. Consequently, conservation of the large forest blocks and associated habitats in Newark should be a high priority in regional planning and conservation efforts.

In addition, there are a number of opportunities to restore riparian and aquatic habitats that would further enhance the ecological and conservation values of these lands. In particular, we identified and mapped a number of areas where riparian restoration might benefit water quality, protect fish and wildlife populations, enhance aquatic and riparian habitats, and increase flood resiliency. In addition, there might be opportunities to improve aquatic connectivity along Bean Brook, where aquatic organism passage is currently impeded by a dam at the Bald Hill Wildlife Management Area.

In conclusion, although not well-studied, the town of Newark is home to a number of significant natural resources. In particular, the town of Newark contains several highly-visible enduring features; numerous large blocks of forest habitat; abundant lakes, ponds, rivers, streams and wetlands; and a number of rare and many uncommon species and natural communities. Although widespread, these significant natural resources are concentrated along the East and West Branches of the Passumpsic River, the length of Bean Brook and its tributary Sleeper Brook, the headwaters of Roundy Brook, and the ridge encompassing Packer and Walker Mountains and Hawk Rock. Because these natural resources are of such high quality and because they are located in close proximity to one another, the Town of Newark should undertake and support efforts to conserve these significant natural resources, especially the large blocks of forest habitat and the high-quality lakes, ponds, rivers, streams, and wetlands.

Introduction

“Newark is a rural town with a beautiful natural setting. Woodlands, open fields, hills, scenic vistas, clean water and air, and clean streams and pristine ponds make Newark a unique and pleasant community to visit and live in. The environment is clean and healthy. It is these characteristics which the Town of Newark intends to protect and preserve.”

This statement presents the vision of the Town of Newark expressed in the current Town Plan (Town of Newark 2012). As is clearly stated, Newark encompasses a diverse landscape characterized by fields, forests, ponds, streams, wetlands, and ridges. Each of these landscape characteristics plays a vital role in sustaining the diversity of plant and animal life, the clean air and clean water, and the quality of life that make Newark special. The Town Plan further identifies outdoor recreation (e.g. hiking, swimming, and boating), traditional activities (e.g. hunting, fishing, and foraging), and seasonal homes and camps as key elements in the town’s way of life and as the town’s most significant economic opportunities. Successfully nurturing this way of life and protecting and expanding these economic opportunities depends greatly on protecting and stewarding the town’s natural resources. Consequently, the Town Plan states that “The town will support efforts to identify and protect fragile elements of the environment, identify factors that may impact the environment, and promote awareness of good environmental practices.” A recent assessment by the Regional Planning Commission further concluded that the effectiveness of the Town Plan would be greatly enhanced by 1) conducting an inventory of the town’s natural resources and 2) recommending measures to protect and preserve the town’s most significant natural resources. Thus, in 2014, the Town of Newark sought and obtained funding to undertake a natural resource inventory to identify and map the most significant natural resources in the town. This report presents the results of this inventory and recommendations for protecting and stewarding the most significant natural resources in the town of Newark.

Study Goals

The purpose of the Newark Natural Resource Inventory was to map and inventory the significant natural resources in the town of Newark as part of efforts to update the Newark Town Plan. More specifically, the goals of this study were:

- 1) To identify, map, and characterize the significant natural resources in the town of Newark and
- 2) To develop recommendations for protecting and, where necessary, restoring these natural resources.

Approach and Methodology

To complete this natural resource inventory, we compiled and summarized the available data that map and identify the significant natural resources in the town of Newark. Most of these data were downloaded from three online sources: 1) the Vermont Center for Geographic Information (<http://vcgi.vermont.gov/>), 2) the Vermont Agency of Natural Resources' Natural Resources Atlas (<http://anrmaps.vermont.gov/websites/anra/>), and 3) the Vermont Agency of Natural Resources' Biofinder (<http://biofinder.vt.gov/>) (see Appendix B for a complete list of these data sets). However, other data were obtained from the staff of various public and private organizations (see Appendix B for a list of these contacts). Among others, these data sets included maps and information about contiguous forest blocks; significant stream reaches and riparian corridors; wetlands; natural communities; key wildlife habitats; and Rare, Threatened, and Endangered species. For the most significant natural resources, we also developed recommendations for protecting and enhancing these resources, in particular focusing on mapping and identifying opportunities to restore aquatic connectivity and riparian habitats. Finally, we conducted limited field assessments to verify and characterize the occurrences of some of the most significant natural resources in Newark and to assess opportunities to restore aquatic connectivity and riparian habitats. Throughout this project, we conferred with public and private partners to ensure that this inventory provided the most accurate, complete, and useful information.

As part of this study, we also developed a model to identify potential riparian restoration opportunities along rivers and streams in the town of Newark. For the purposes of this study, we defined riparian areas as those areas lying within 100 ft (30 m) of a mapped river or stream. To develop this model, we first created 100-ft (30-m) wide buffers along both sides of the centerline of all rivers and streams in Newark (the centerlines were obtained from the NHDFlowline database downloaded from the Vermont Center for Geographic Information). Within these 100-foot buffers, we delineated those areas that were not currently covered by forest, shrubland, or wetlands vegetation, except those areas that were clearly logged recently (the latter will presumably regrow into forests on their own). Within the delineated areas, we identified the current land use(s), and those areas that were currently being used or were recently used for agriculture were identified as potential restoration sites. To the extent possible, these sites were then evaluated in the field to determine their suitability for restoration.

Study Area

The town of Newark encompasses 37.2 mi² (96.4 km²) as the northern-most town in Caledonia County in northeastern Vermont (Figure 1). Newark is bordered by the towns of Burke to the south, Sutton to the west, Westmore to the northwest, Brighton to the north, Ferdinand to the northeast, and East Haven to the southeast. Almost the entire town is located in the watersheds of the East and West Branches of the Passumpsic River, which flows southward to the Connecticut River and ultimately into Long Island Sound. Only a small portion of the town of Newark is located in the watershed of the Clyde River, which flows north into Lake Memphremagog and ultimately into the St. Lawrence River.

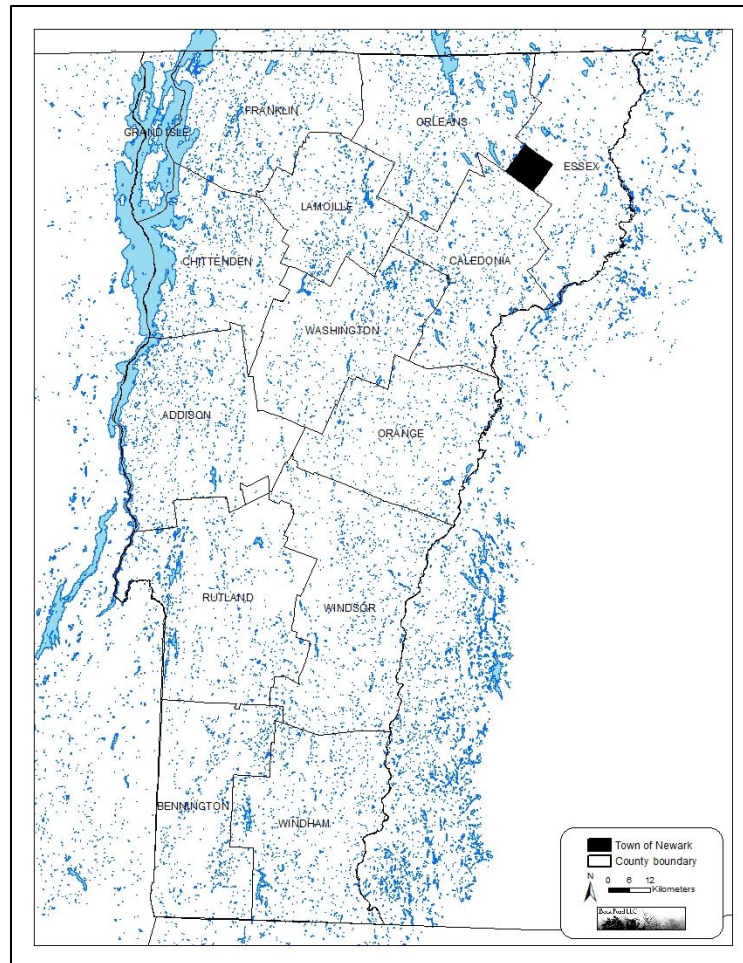


Figure 1. Location of the town of Newark in northeastern Vermont.

Climate

Newark is located in the Northeastern Highlands biophysical region of Vermont, which is the coldest and snowiest biophysical region in Vermont (Thompson and Sorenson 2000). The nearest climatological stations are located 6 miles (9.8 km) to the southwest in West Burke [elevation 900 ft (274 m), latitude 44°90' north, longitude 71°59' west] and 6.6 miles (10.7 km) to the north in Island Pond [1,200 ft (366 m), latitude 44°49' north, longitude 71°53' west], although both stations are located at considerably lower elevations than most of Newark. The mean January temperature at the West Burke station was 11°F (-12°C), and the mean July temperature was 65°F (18°C). Record temperatures ranged between -41°F (-41°C) and 98°F (37°C). At these two stations, mean annual precipitation ranged between 42-45 in (107-115 cm), and mean annual snowfall ranged between 93-113 in (236-286 cm). However, both precipitation and snow levels are generally higher at higher elevations in northeastern Vermont. Thus, a resident of Newark living at an elevation of approximately 1,680 ft (512 m) along Center Pond Road measured mean annual precipitation of 61 in (154 cm) and mean annual snowfall of 178 in (452 cm) during 1995-2013 (Bill Winsor, unpublished data). At these higher elevations, snow tends to fall earlier and stay on the ground longer than at lower elevations and in other regions in Vermont.

Topography

Elevations in Newark range from slightly less than 1,100 ft (335 m) along the East Branch of the Passumpsic River to 2,362 ft (720 m) atop “Abbott Hill” in the northwestern side of Newark just south of Job Mountain. The main topographical features in Newark are several north-south ridges, numerous rivers and streams, and several small lakes and large ponds (Figure 2). The most prominent north-south ridge rises between the East Branch of the Passumpsic River and Bean and Sleeper Brooks and includes Packer and Walker Mountains and Hawk Rock. Both Hawk Rock and Walker Mountain have large cliff formations that are very visible from Vermont Route 114, and Packer Mountain has large cliff formations visible from the center of town. A second ridge extends from the “Abbott Hill” area in the northwestern side of Newark southeast towards Newark Hollow, and a third ridge extends from the southeast corner of Newark Pond southeast through the center of town towards Maple Ridge Road. Between these three ridges flow the town’s rivers and streams, including the East and West Branches of the Passumpsic River; Bean, Sleeper, and Roundy Brooks; as well as numerous other smaller tributaries. Finally, Newark is home to several small lakes and large ponds, including Newark, Center, Beck, Walker, and Sawdust Ponds as well as small parts of Bald Hill and Brown Ponds.

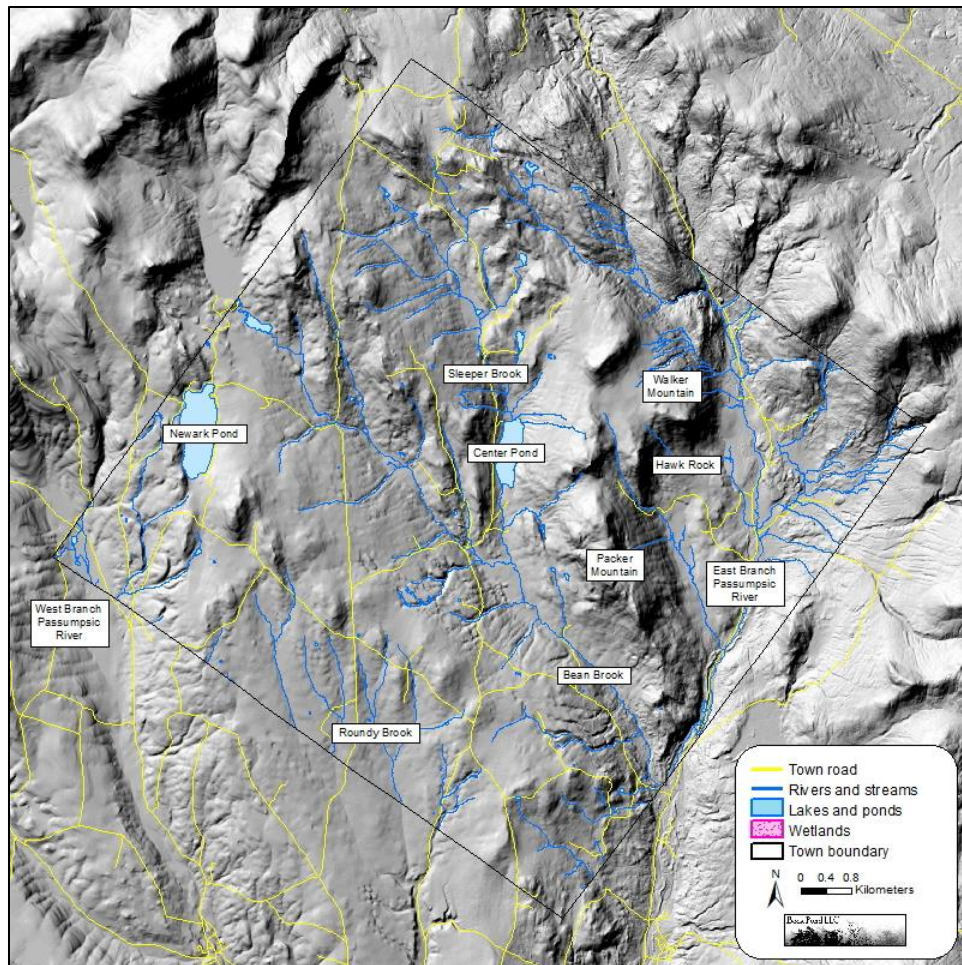


Figure 2. Major topographic features in the town of Newark, Vermont. Hill-shading creates a three-dimensional effect that emphasizes differences in elevation.

Bedrock and Surficial Geology

Bedrock and surficial geology affect natural ecosystems through their influence on topography, hydrology, soil chemistry, and nutrient availability. The town of Newark is largely underlain by five types of bedrock (Table 1, Figure 3). Much of the western two-thirds of Newark is underlain by the Waits River Formation, which is composed of schist, phyllite, and crystalline limestone that may be rich in calcium, magnesium, and other minerals. Much of the remainder of Newark is underlain by intrusive igneous rocks. The north-south ridge in the western corner of Newark south of Newark Pond is underlain by intrusive granite and granodiorite. The ridge in the northwestern side of Newark (“Abbott Hill”) is underlain by the

Willoughby Pluton, which is composed of pegmatite granite. Much of the eastern third of town, including Packer and Walker Mountains and the East Branch of the Passumpsic River, is underlain by the Newark Pluton, which is also composed of granite. These igneous rocks are generally hard, resist weathering, are carbonate-poor, and have few of the soluble minerals that are important for plant growth (e.g. calcium and magnesium). Furthermore, the low calcium content of these rocks reduces their ability to resist acidification and results in the formation of more acidic soils. Finally, small fingers of Gile Mountain Formation, which is composed of quartzite and non-carbonaceous quartz-mica schist, occur around the eastern side of the Newark Pluton.

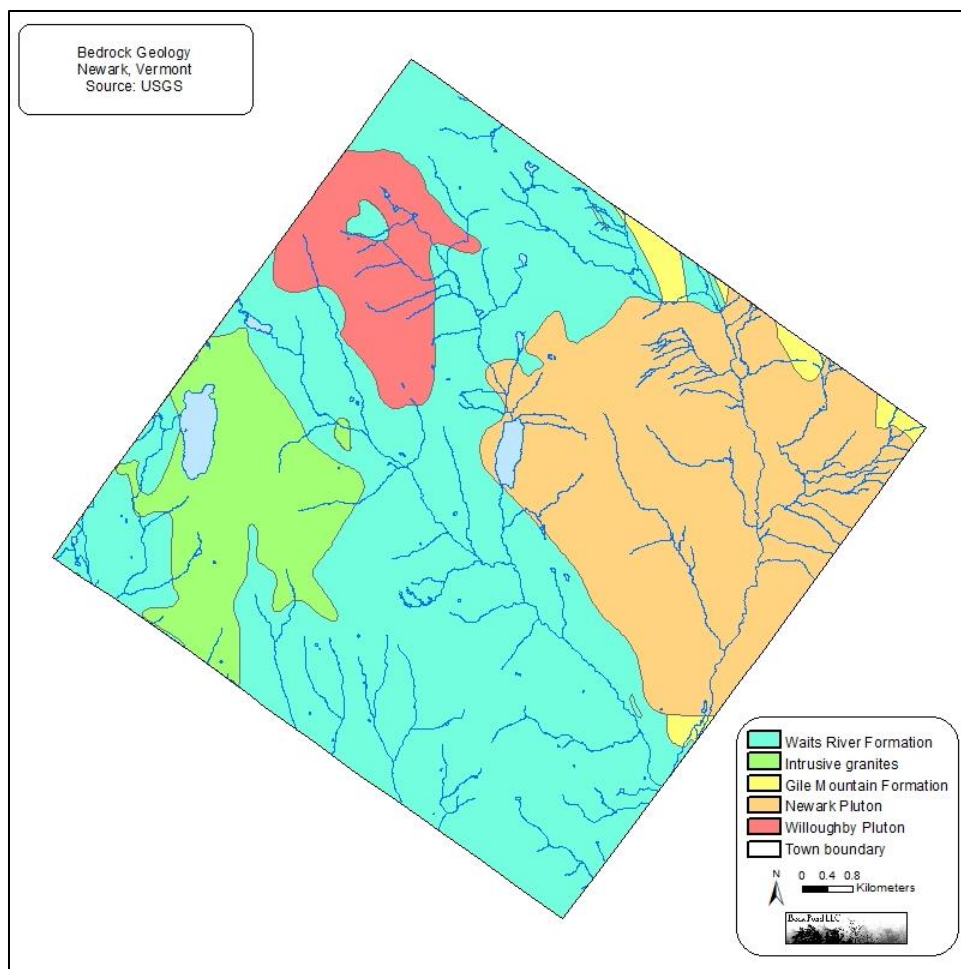


Figure 3. Bedrock geology of the town of Newark, Vermont. Bedrock geology was mapped by the U.S. Geological Survey and the Vermont Geological Survey.

Table 1. Bedrock types mapped in the town of Newark, Vermont. Bedrock geology was mapped by the U.S. Geological Survey and the Vermont Geological Survey.

<u>Lithologic Code</u>	<u>Bedrock Formation</u>	<u>Area (acres)</u>	<u>Area (ha)</u>
Dbg	New Hampshire Plutonic Series	2,577	1,043
Dgqs	Gile Mountain Formation	371	150
Dnbg	Newark Pluton	6,697	2,710
Dsw	Waits River Formation	12,513	5,064
Dswa	Waits River Formation (mafic member)	25	10
Dwmz	Willoughby Pluton	1,656	670

In terms of surficial geology, Newark is largely overlain by varying depths of unsorted basal till (Figure 4). However, in the river valleys, there are numerous glacial deposits, including kame terraces along the West Branch of the Passumpsic River and glacial moraine and alluvium along the East Branch of the Passumpsic River. On the higher ridges, especially Packer and Walker Mountains, there are exposures of the underlying bedrock (the cliffs on Hawk Rock and Packer and Walker Mountains being the most prominent). The other widespread surficial deposits in Newark are the peats and mucks that underlie many of the wetlands.

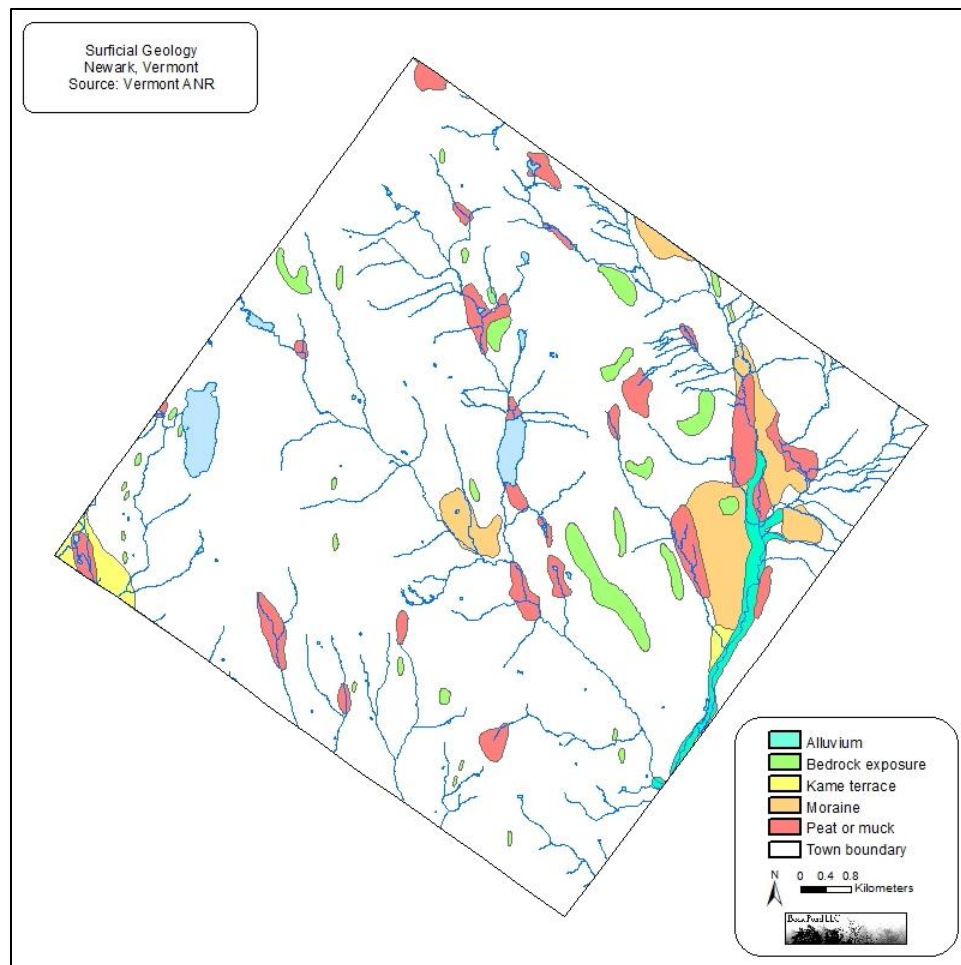


Figure 4. Surficial geology of the town of Newark, Vermont. White areas are overlain by unsorted basal till of varying depths. Surficial geology was mapped by the Vermont Geological Survey.

Soils

Soils in the town of Newark are primarily coarse to moderately coarse-textured and include a number of different series or complexes. The dominant soil series are Dixfield sandy loam, Monadnock fine sandy loam, Cabot silt loam, and a complex of Tunbridge fine sandy loam and Dixfield sandy loam (Table 2, Figure 5). The Monadnock fine sandy loams are largely confined to the valleys of the East and West Branches of the Passumpsic River and Bean Brook and its tributaries. The other dominant soil types are more broadly spread across the town. Finally, mucks, which are largely confined to areas of wetlands, cover approximately 1,025 acres (415 ha).

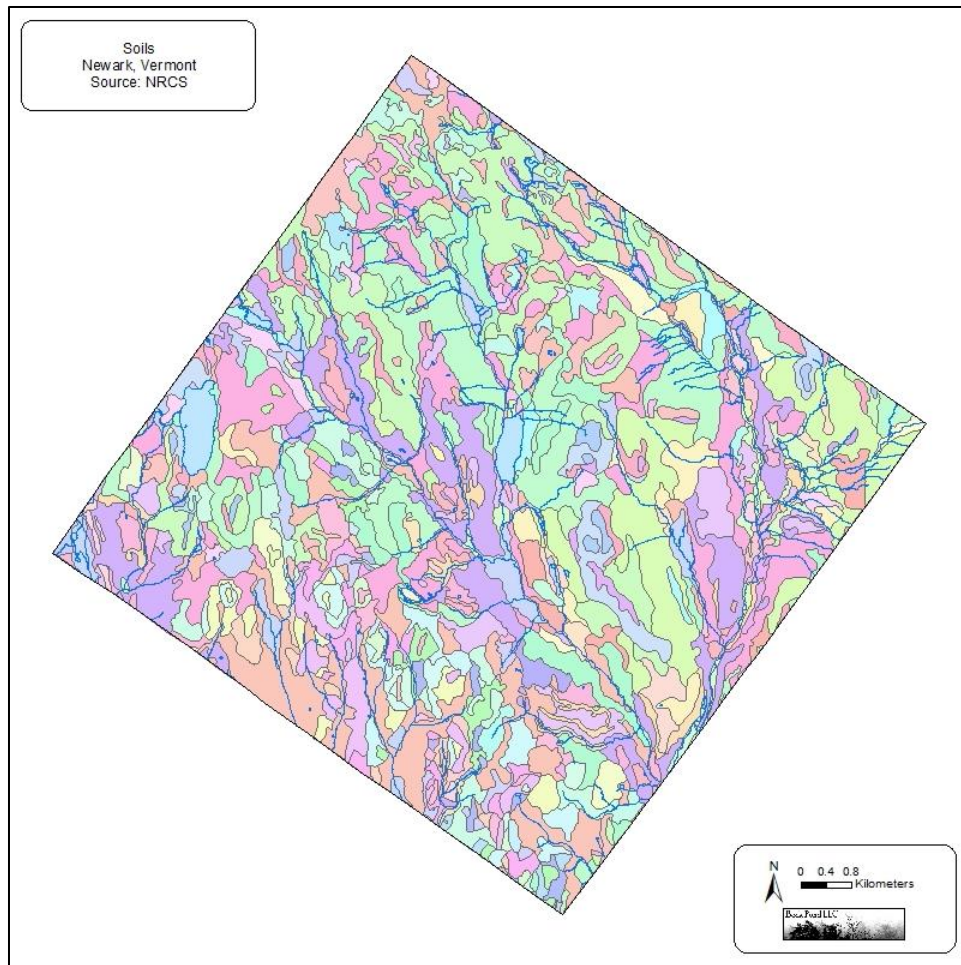


Figure 5. General soils map of the town of Newark, Vermont. Given the large number of soil types, a legend is not presented, but rather the map illustrates the complex distribution of soils in the town. The soils were mapped by the Natural Resources Conservation Service.

Table 2. Soil types mapped in the town of Newark, Vermont. Soil series are arranged from coarsest to finest in texture and were mapped by the Natural Resources Conservation Service.

<u>Series or Complex Name</u>	<u>Texture</u>	<u># Polygons</u>	<u>Area (acres)</u>	<u>Area (ha)</u>
<u>Soil Series</u>				
Croghan	Loamy fine sand	4	82	33
Dixfield	Sandy loam	97	6,701	2,712
Sheepscot	Gravelly fine sandy loam	1	22	9
Buckland	Fine sandy loam	53	1,060	429
Monadnock	Fine sandy loam	1023,514	1,422	
Rumney	Fine sandy loam	4	94	38
Dummerston	Very fine sandy loam	19	279	113
Moosilauke	Very fine sandy loam	15	356	144
Cabot	Silt loam	1043,329	1,347	
Bucksport	Muck	6	121	49
Peacham	Muck	6	74	30
Wonsqueak and Pondicherry	Muck	33	830	336
<u>Complexes</u>				
Colonel-Cabot complex		55	1,683	681
Colton-Duxbury complex		1	5	2
Lyman-rock outcrop complex		5	72	29
Tunbridge-Dixfield complex		74	3,321	1,344
Tunbridge-Lyman complex		34	825	334
Tunbridge-Monadnock complex		7	297	120
Vershire-Lombard complex		43	907	367

Human History

Native Americans undoubtedly lived and hunted in the area now encompassed by the town of Newark prior to European settlement; however, their populations were likely small and centered in the lowlands around Lake Memphremagog and along the Upper Connecticut River. Likewise, European settlement of Newark and other upland towns lagged behind that in the other more fertile and hospitable regions of Vermont. The Town of Newark was chartered on 15 August 1781, but the first land was not cleared until 1795 and the first family did not settle in Newark until 1797 (Hemenway 1867). Over the next several decades, large tracts of forest land were cleared to grow wheat, potatoes, and grass seed. In addition, numerous lumber, shingle, starch, and grist mills harnessed the power provided by the many streams in town [for example, in 1860, there were seven saw mills, one grist mill, and two starch mills in Newark (Hemenway

1867)]. Despite the widespread clearing, extensive forests of maple, beech, and birch remained, especially along the ridges in the eastern half of town (e.g. Packer and Walker Mountains and the foothills of the Seneca Range). Currently, 93% of the town is forested with the remaining land being used for agriculture (5.8%), development (1.5%), or sand and gravel pits (0.1%) (Town of Newark 2012). Paralleling these patterns of development, the population of Newark peaked at 679 inhabitants in 1880, dropped to 144 inhabitants in 1970, and rebounded to 581 inhabitants in 2010 (Town of Newark 2012).

Natural Resource Elements

In the sections that follow, we describe the significant natural resources known to occur in the town of Newark. These resources are grouped into the three levels of organization suggested by Austin et al. (2013): 1) landscape level, which describes those resources encompassing large areas of the landscape (e.g. enduring features, contiguous habitat, and connecting habitat), 2) community level, which describes those resources comprising groups of species and their physical settings (e.g. riparian and aquatic habitat, wetlands, vernal pools, and natural communities), and 3) species level, which describes individual species and their habitat requirements (e.g. Rare, Threatened, and Endangered species; deer wintering areas; and mast stands).

Landscape-Level Elements

At the landscape level, there are a number of significant natural resources in the town of Newark, including enduring features, contiguous habitat, and connecting habitat.

Enduring Features

According to the Vermont Fish & Wildlife Department, “[e]nduring features are the parts of the landscape that resist change. They are the hills and valleys, the underlying bedrock, and the deposits left behind by glaciers. They remain the same even when changes in land cover and wildlife occur. They remain the same as plants and animals move, and they remain the same even as the climate changes.” There are a number of such enduring features in the town of Newark. The large north-south ridge that forms Packer and Walker Mountains and Hawk Rock is probably the most pronounced enduring feature in town (Figure 6-7). Farther west are the ridge extending southeastward from Job Mountain through the center of town towards Newark Hollow and another ridge extending southeastward from Newark Pond towards Maple Ridge Road. Other enduring features in Newark are the valleys of the East and West Branches of the Passumpsic River and Bean and Sleeper Brooks (the latter including Center Pond). Collectively, these enduring features define the topography and landscape encompassed by the town of

Newark and provide the conditions necessary to support the habitats, natural communities, plants, and animals that inhabit Newark.



Figure 6. *Looking east from Duford Road, one can view two of the dominant enduring features in the town of Newark, Vermont: the valley of Bean Brook (foreground) and the ridge forming Packer Mountain (background).*

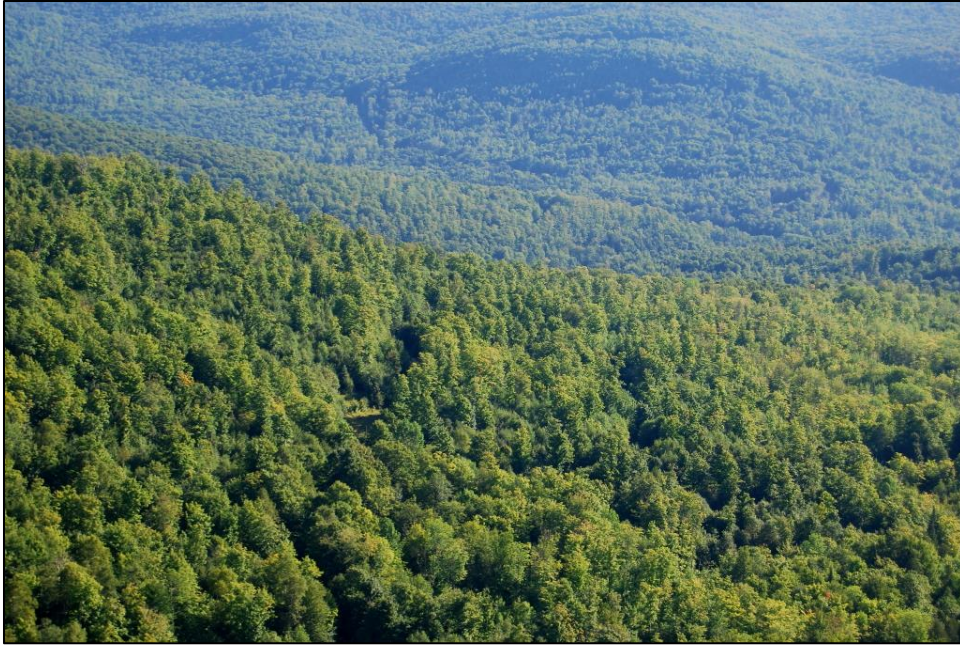


Figure 7. Flying above Vermont Route 114, one can view two other dominant enduring features in the town of Newark, Vermont: the valley of the East Branch of the Passumpsic River (foreground) and the ridge forming Walker Mountain, Hawk Rock, and Packer Mountain (background). Photograph courtesy of Tim King.

Contiguous Habitat

Perhaps the most significant natural resource in the town of Newark is the large areas of contiguous forest habitat (Figure 8). Large blocks of deciduous, coniferous, and mixed forests cover approximately 20,927 acres (8,469 ha), representing 88% of the town of Newark (Figure 9). These forests occur within fifteen large forest blocks that range from 27-7,900 acres (11-3,197 ha) in size. The largest forest block in Newark is located between Center Pond Road and Vermont Route 114 and covers 7,900 acres (3,197 ha), encompassing Packer and Walker Mountains and Hawk Rock [the full extent of this forest block covers 9,452 acres (3,825 ha), as it extends farther north into the town of Brighton]. The second largest forest block in Newark covers 3,366 acres (1,362 ha), encompassing much of the upper Bean Brook watershed between Center Pond Road and Newark Street [the full extent of this forest block covers 3,390 acres (1,372 ha), as it extends slightly into the town of Westmore]. However, several areas of Newark are parts of even larger forest blocks. The area of Newark located east of Vermont Route 114 encompasses a small portion of the second largest forest block in the state of Vermont, although only 2,053 acres (831 ha) of this 116,846-acre (47,286-ha) block are located in Newark (the majority of this block is located in the towns of Granby, Maidstone, Ferdinand, and East Haven). The northwest corner of Newark is part of another large forest block, although only

1,292 acres (523 ha) of this 15,335-acre (6,206-ha) block are located in Newark (the majority of this block is located in the towns of Westmore, Brighton, and Charleston).



***Figure 8.** Large blocks of contiguous forest habitat, such as this area located in the eastern half of town, are one of the defining natural resource in the town of Newark, Vermont. Photograph courtesy of Tim King.*

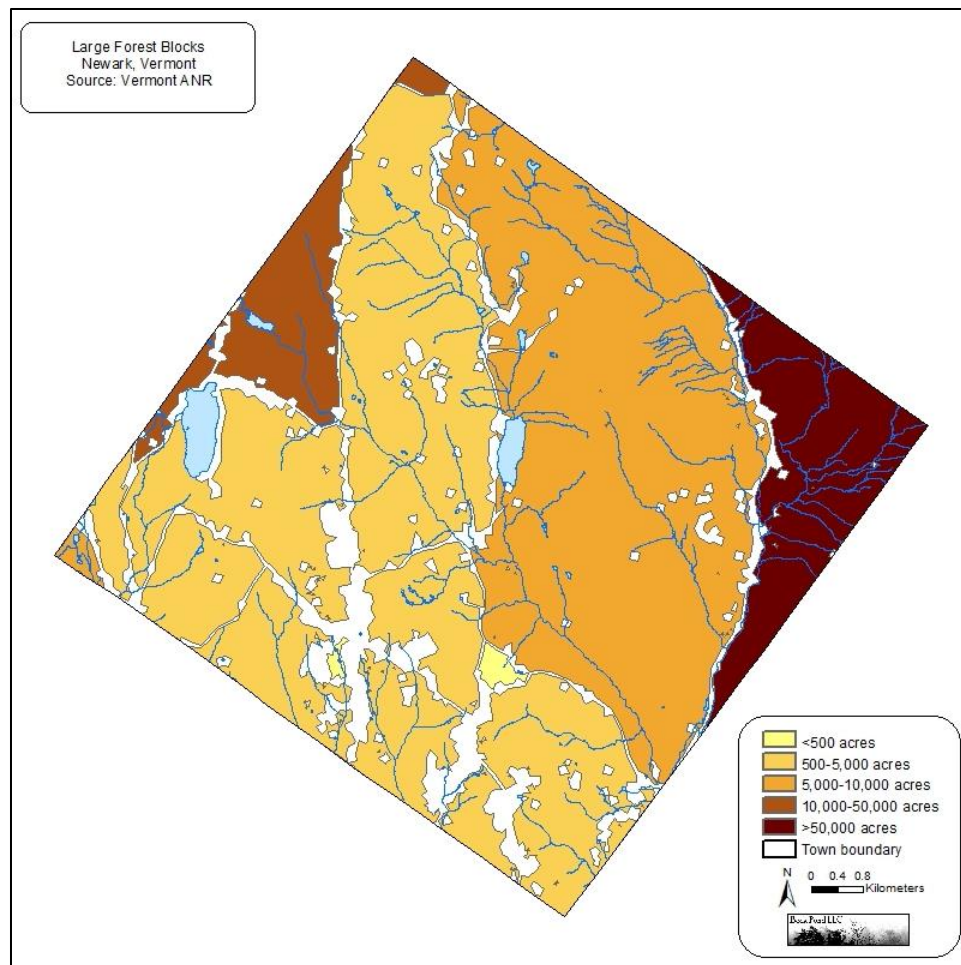


Figure 9. Locations of large, contiguous forest blocks in the town of Newark, Vermont. White areas are located outside of large forest blocks. Forest blocks were mapped by the Vermont Fish and Wildlife Department.

Maintaining these large blocks of contiguous forest should be one of the central goals of any conservation efforts in the town of Newark. Maintaining these blocks will protect important ecological processes and viable occurrences of forest natural communities and their associated plant and animal species, including wide-ranging and forest interior species. To best protect these characteristics, these forest blocks should incorporate a variety of forest age classes and natural community types and should encompass areas dominated by other important natural communities and habitats as well (e.g. wetlands and riparian areas). Such diverse, ecologically-intact habitat blocks would support the many species that require large areas of forest cover to grow, reproduce, and survive [e.g. moose (*Alces alces*), black bear (*Ursus americanus*), American

marten (*Martes americana*), fisher (*Martes pennanti*), Canada lynx (*Lynx canadensis*), bobcat (*Lynx rufus*), and many forest interior birds]. Populations of many forest birds and mammals are now in decline due, in part, to the loss of such large blocks of contiguous forest habitat; and the successful re-establishment of other native species, such as American marten and Canada lynx, depends on the availability of large blocks of unfragmented forest (Kart et al. 2005). Finally, maintaining these large forest blocks will support local social and economic opportunities afforded by timber production, maple sugaring, hunting, fishing, hiking, and other economic and recreational activities.

Connecting Habitat

As is clear from the preceding discussion, the town of Newark encompasses and is located in the midst of a large number of large forest blocks. When viewed from a regional perspective, the large forest blocks in Newark are clearly important as “stepping stones” connecting the large forest blocks extending across northeastern Vermont (Figure 10). The large forest blocks in Newark lie between those in the Seneca and West Mountains and Nulhegan and Victory Basins to the east and those around Lake Willoughby and Crystal Lake and Stannard Mountain to the west. Maintaining these connections is critical for allowing wildlife to disperse, for maintaining cohesive populations, and for promoting genetic exchange and diversity both within and among populations. These connections also provide pathways for seasonal movement patterns and accommodate the large home ranges of numerous large mammals, including black bear, bobcat, fisher, and moose, as well as other species requiring large blocks of forest habitat [e.g. northern goshawk (*Accipiter gentilis*)]. In addition, these connections have the potential to facilitate the successful re-establishment of other native species, such as American marten and Canada lynx, that depend on the ability to move among large blocks of unfragmented forest. Finally, these connecting lands adjoin and connect the large public and private ownerships in the West Mountain and Nulhegan and Victory Basins to the east and those surrounding Lake Willoughby to the west.

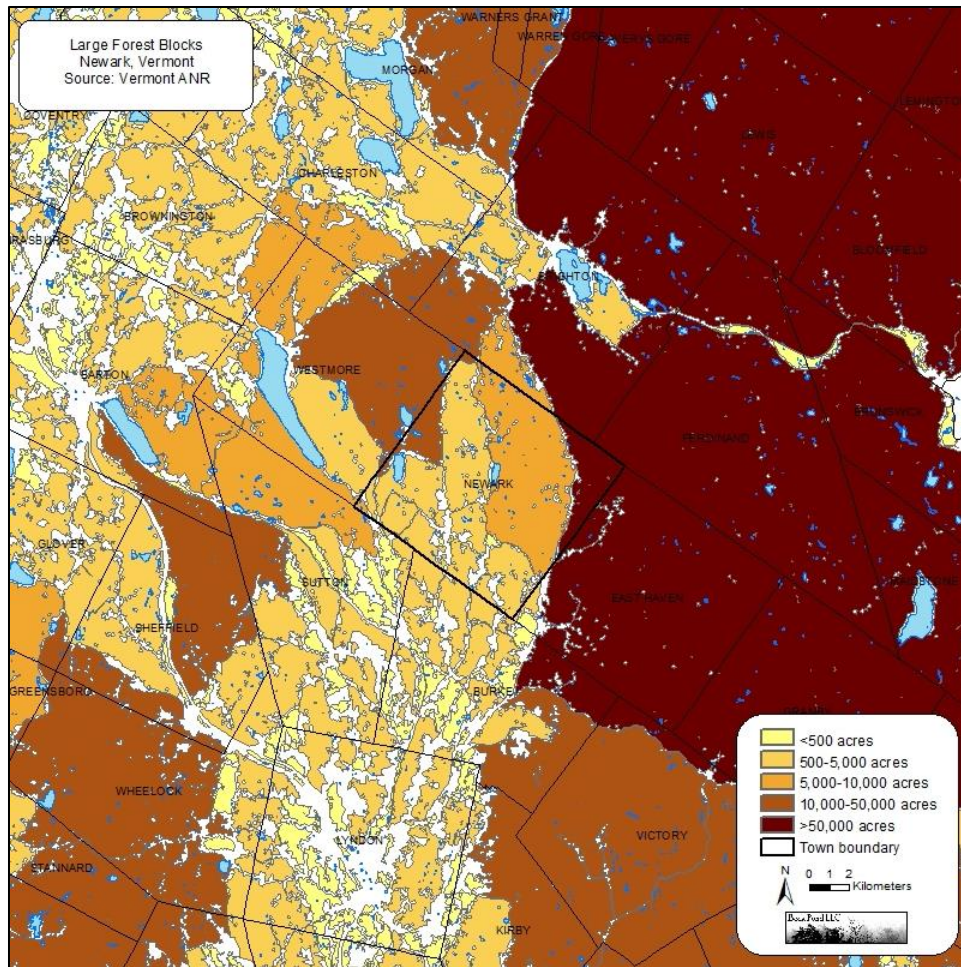


Figure 10. Location of the town of Newark within the larger mosaic of large forest blocks in northeastern Vermont. White areas are located outside of large forest blocks. Forest blocks were mapped by the Vermont Fish and Wildlife Department.

Community-Level Elements

At the community level, there are a number of significant natural resources in the town of Newark, including riparian and aquatic habitat, wetlands, vernal pools, and natural communities.

Riparian and Aquatic Habitat

In addition to contiguous forest habitat, another outstanding natural resource in the town of Newark is the abundance of high-quality riparian and aquatic habitat, including lakes, ponds, rivers, and streams.

Lakes and Ponds

Several small lakes and ponds occur within or border the town of Newark (Table 3, Figure 11).

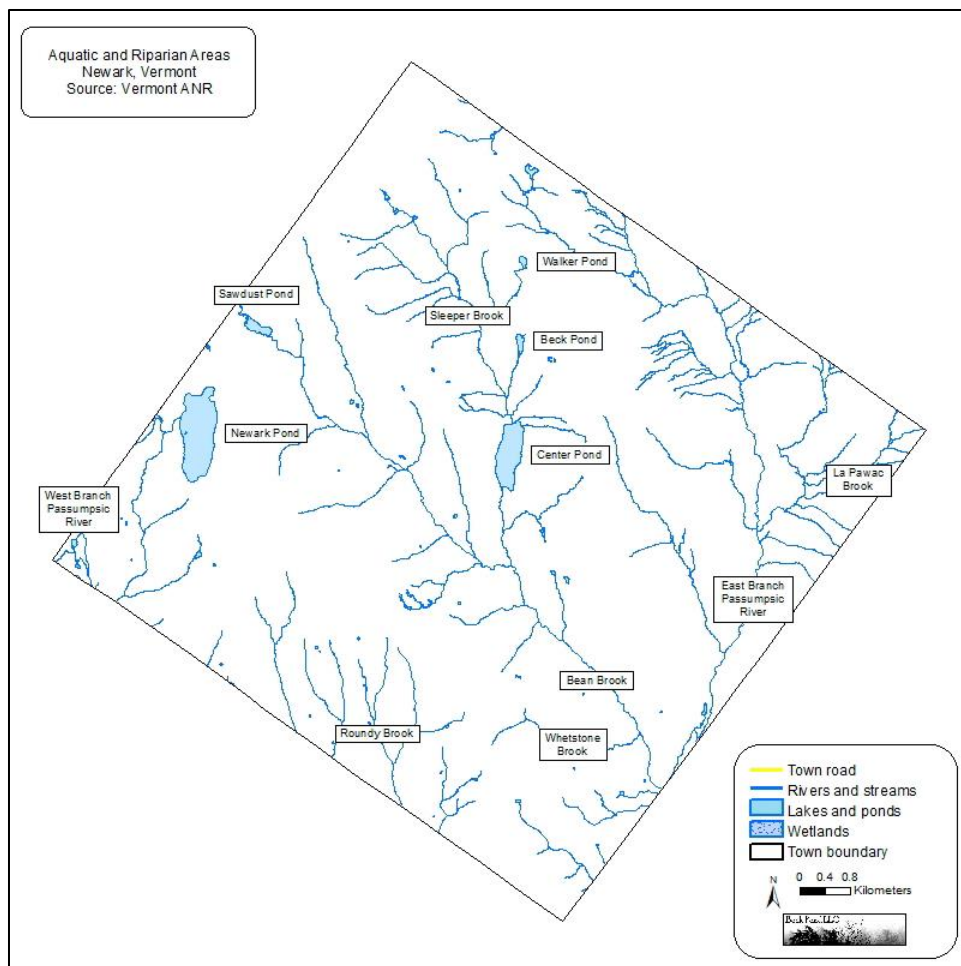


Figure 11. Significant riparian and aquatic natural resources in the town of Newark, Vermont.

Table 3. Lakes and ponds in the town of Newark, Vermont. Information obtained from the basin assessment and tactical basin plan (State of Vermont 2009, 2014).

Waterbody ID	Name	Area (acres)	Maximum Depth (ft)	Watershed Area (acres)	% Shoreline Developed
VT15-07L01	Newark Pond	153	31	554	71
VT15-08L03	Center Pond	79	72	3,793	48
VT15-08L06	Beck Pond	15	<5	294	6
VT15-08L02	Sawdust Pond	15	-	2,751	0
VT15-08L05	Walker Pond	3	-	45	0
VT15-08L01	Bald Hill Pond	108	42	2,588	-
VT15-08L04	Brown Pond	15	-	254	-

The largest pond in the town of Newark is Newark Pond [153 acres (62 ha)]. Newark Pond is a shallow, oligotrophic pond. This pond is the most developed pond in Newark, and, consequently, the shoreline condition, >70% of which is developed, is only ranked as “fair” (State of Vermont 2014). However, water quality in Newark Pond is generally good [average spring phosphorus concentration = 7.46 ug/l (based on 11 years of data), average summer phosphorus concentration = 8.1 ug/l (based on 2 years of data), average Secchi disk measurement = 5.9 m (based on 2 years of data), and average chlorophyll-*a* concentration = 2.55 ug/l (based on 2 years of data)]. Newark Pond was historically a brook trout (*Salvelinus fontinalis*) pond, but brook trout have been eliminated by the illegal introductions of smallmouth bass (*Micropterus dolomieu*) and yellow perch (*Perca flavescens*) (J. Kratzer, personal communication). Newark pond is stocked annually with rainbow trout (*Oncorhynchus mykiss*).

The second largest pond in the town of Newark is Center Pond [79 acres (32 ha)]. Center Pond is a deep, oligotrophic pond. Less than half of the shoreline around Center Pond is developed, and the water quality is generally very good [average spring phosphorus concentration = 6.61 ug/l (based on 12 years of data)]. Center Pond has been ranked as a “Very High Quality Lake” among the top 10% of lakes in Vermont due to its water quality and biological diversity (State of Vermont 2014). Center Pond was historically a brook trout pond but is now stocked annually with both brook trout and lake trout (*Salvelinus namaycush*). Center Pond also supports an abundant population of white sucker (*Catostomus commersoni*), which may be the major reason that a self-sustaining brook trout population no longer exists there (J. Kratzer, personal communication).

Three other small ponds [<15 acres (<6 ha)] and parts of two other ponds (Bald Hill and Brown Ponds) also occur in the town of Newark (Figure 12). The three small ponds (Sawdust, Beck, and Walker Ponds) are almost entirely undeveloped, although all three have been negatively impacted by sedimentation from unidentified sources (State of Vermont 2009). Beck Pond and Brown Pond are stocked annually with brook trout, and Bald Hill Pond is stocked annually with rainbow trout.



Figure 12. Beck Pond is one of three smaller ponds located in the town of Newark, Vermont.

Rivers and Streams

Numerous rivers and streams flow from and through Newark (Figure 11). The major rivers are the East and West Branches of the Passumpsic River, which flow through the eastern and western corners of town, respectively. Bean Brook is the major tributary of the East Branch in town and drains the center of town, and Sleeper Brook, which is the major tributary of Bean Brook, drains into and out of Center Pond (Figure 13). The headwaters of Roundy Brook drain the southern corner of Newark. Most of the streams in Newark are moderate-gradient headwater streams. The East and West Branches of the Passumpsic River, although not large, have lower gradients and tend to meander across their floodplains. Self-sustaining populations of brook trout are likely present in almost all of the rivers and streams in Newark, including the East Branch of the Passumpsic River (J. Kratzer, personal communication). Other common fish are slimy sculpin (*Cottus cognatus*), blacknose dace (*Rhinichthys atratulus*), and longnose dace (*Rhinichthys cataractae*). The East Branch of the Passumpsic River and Bean Brook were stocked with Atlantic salmon (*Salmo salar*) historically, and the East Branch continues to be stocked with brook trout (State of Vermont 2009). Undersized bridges and culverts and road erosion present some of the most significant water quality and aquatic habitat issues for many of these streams. Based on the most recent assessment of the macroinvertebrate community, water quality conditions in Bean Brook (Site Bean Brook 4.8) were ranked very good to excellent (State of Vermont 2014).



Figure 13. *Bean Brook, a tributary of the East Branch of the Passumpsic River, drains much of the central and northwestern sections of the town of Newark, Vermont.*

Wetlands

Based on the Vermont Significant Wetlands Inventory maps, wetlands cover approximately 1,292 acres (523 ha) within the town of Newark (Figure 14). These 1,292 acres (523 ha) are divided among 98 discrete wetlands, which are concentrated along the East and West Branches of the Passumpsic River and Bean, Sleeper, and Roundy Brooks. The mapped wetlands range in size from 0.30-173 acres (0.12-70 ha) with the three largest being located along the East Branch [173 acres (70 ha)], Bean Brook [163 acres (66 ha)], and a small tributary of the East Branch that drains the eastern slopes of Packer Mountain and southern slopes of Hawk Rock [104 acres (42 ha)]. All of these wetlands are classified as Class 2 wetlands by the State of Vermont. The majority of these wetlands are classified as Palustrine Forested Wetlands, which are defined as “non-tidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height” (Dobson et al. 1995). Other, more limited areas are classified as Palustrine Scrub/Shrub Wetlands, which are defined as “non-tidal wetlands dominated by woody vegetation less than or equal to 5 meters in height”, or Palustrine Emergent Wetlands, which are defined as “non-tidal wetlands dominated by persistent emergents, emergent mosses, or lichens”.

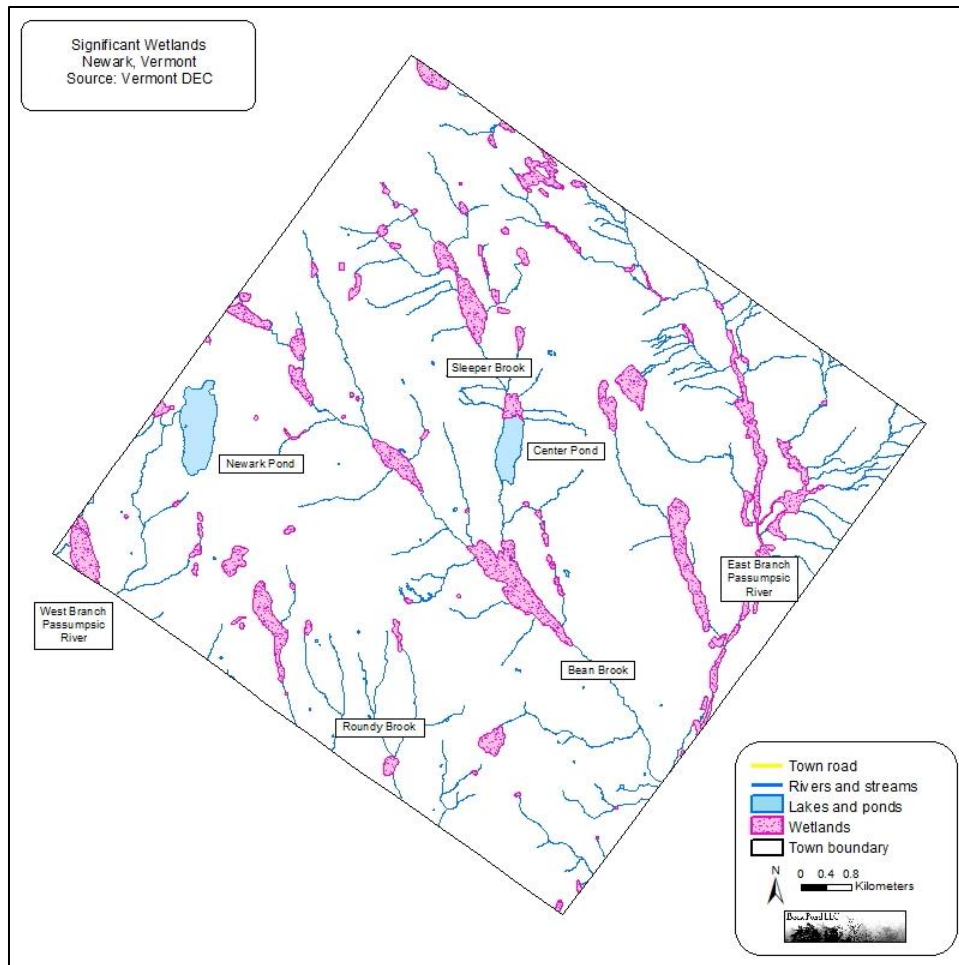


Figure 14. Locations of wetlands in the town of Newark, Vermont. Wetlands were mapped by the Vermont Agency of Natural Resources as part of the Vermont Significant Wetlands Inventory.

Vernal Pools

Vernal pools are seasonal wetlands that fill with water for only part of the growing season, typically during the spring and early summer. Because they are seasonal, they do not support fish populations and so are important breeding habitat for many amphibians. Only two vernal pools, both located in the northwestern corner of Newark near Jobs Pond, are documented in Newark (Figure 15). When visited in 2009, both pools were heavily impacted by recent logging. In addition, six potential vernal pools have been mapped in Newark: two pools on the southern slopes of Packer Mountain and four pools along a northern tributary of the East Branch of Passumpsic River. The relative paucity of vernal pools in Newark may reflect limited

search effort, and additional efforts should be undertaken to identify and map any vernal pools in the town of Newark.

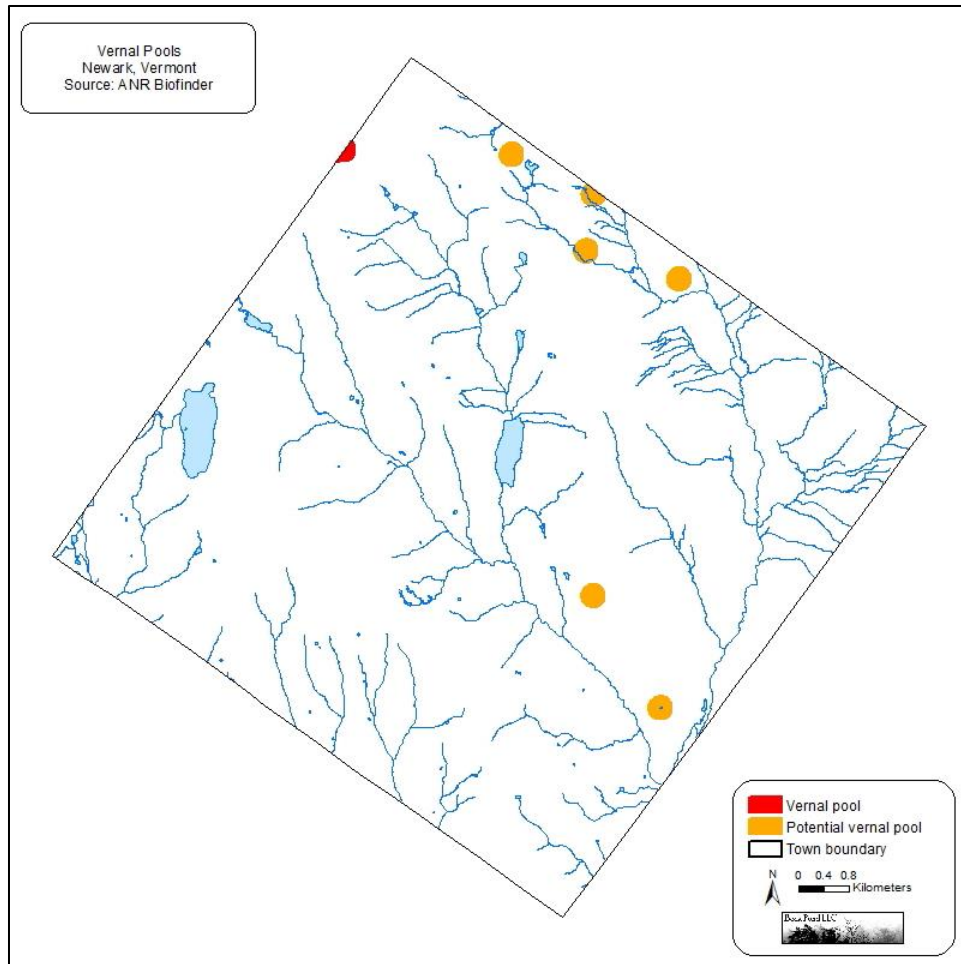


Figure 15. Locations of vernal pools and potential vernal pools in the town of Newark, Vermont. Vernal pools were mapped by the Vermont Agency of Natural Resources.

Natural Communities

Natural communities have not been well-studied in the town of Newark. The only rare or uncommon natural community types mapped on publicly-available data layers were three examples of northern white cedar swamp, which is ranked as uncommon (S3) in Vermont (Figure 16). All three of these examples were located in the western corner of Newark: 1) along the upper reaches of a tributary of Roundy Brook [168 acres (68 ha)], 2) along the West Branch

of the Passumpsic River [52 acres (21 ha)], and 3) near the outlet of Bald Hill Pond [12 acres (5 ha)]. However, other examples of this natural community type have been observed elsewhere in Newark, including on the town land at the north end of Center Pond and in the saddle to the northwest of Hawk Rock, among others (Eric Sorenson and Matt Langlais, personal communication). This natural community type is typically dominated by an overstory of northern white cedar (*Thuja occidentalis*) and an understory of various species of Sphagnum moss (e.g. *Sphagnum girgensohnii* and *Sphagnum warnstorffii*).



Figure 16. Northern white cedar swamp is the most common uncommon natural community type documented in the town of Newark, Vermont. This example is located in the headwaters of Roundy Brook.

As part of the deliberations about a proposed industrial wind development on Hawk Rock, a consultant prepared a preliminary map of rare and uncommon natural communities on Packer and Walker Mountains. As is true in much of Newark, the dominant natural community types were northern hardwood forest and red spruce-northern hardwood forest (both State-ranked S5). However, they also mapped extensive areas of lowland spruce-fir forest (State-ranked S3) along the East Branch of the Passumpsic River and montane yellow birch-red spruce forest and montane spruce-fir forest (both State-ranked S3) along the ridges of Packer and Walker Mountains. In addition, untyped wetlands were mapped along the East Branch of the Passumpsic River, a tributary that drains the eastern slopes of Hawk Rock and Packer Mountain, and in the saddle to the northwest of Hawk Rock.

Although not documented in State databases, several other rare and uncommon natural community types have been reported from Newark:

- ▶ A small area [<0.5 acres (<0.2 ha)] of sweet gale shoreline swamp (State-ranked S3) on the Town land at the north end of Center Pond,
- ▶ A small area [>6.7 acres (>2.7 ha)] of northern white cedar sloping seepage forest (State-ranked S3) along a small tributary of Center Pond (Figure 17),
- ▶ Small areas of boreal talus woodland (State-ranked S3) and open talus (State-ranked S2) below the cliffs at Hawk Rock (Figure 18-19).

Based on discussions with the State Ecologist, a number of other rare and uncommon natural community types may occur in the town of Newark.



Figure 17. Northern white cedar sloping seepage forest, an uncommon natural community in Vermont, occurs along a small tributary of Center Pond in the town of Newark, Vermont.

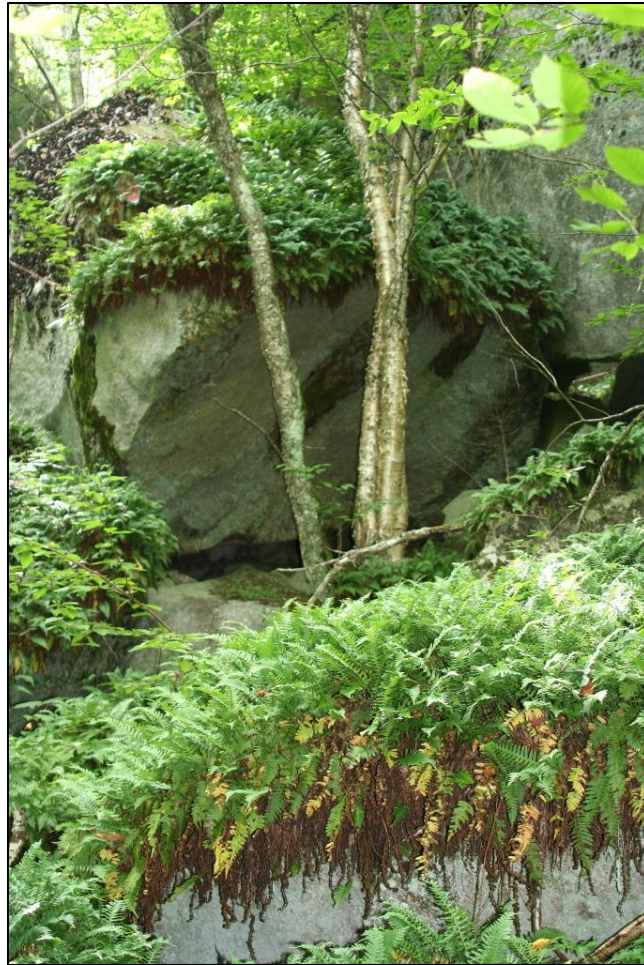


Figure 18. The geologically more stable talus slopes above and below the Hawk Rock cliffs are vegetated by boreal talus woodland, an uncommon natural community type in Vermont.

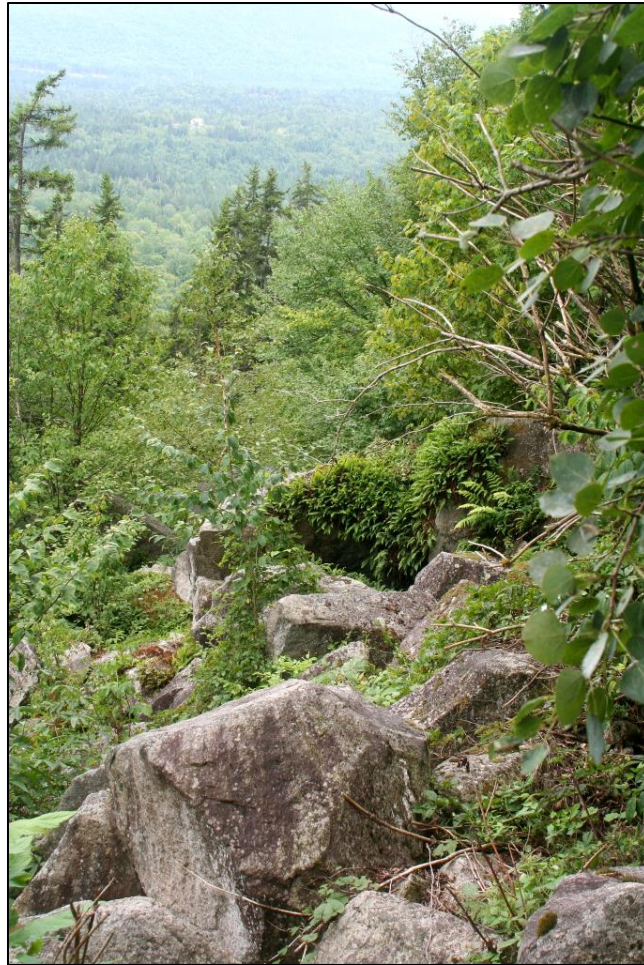


Figure 19. The more geologically active talus slopes located below the Hawk Rock cliffs are mostly devoid of vegetation and are characterized as open talus, a rare natural community type in Vermont.

In addition to the unique natural communities associated with Hawk Rock, there is also an area of much older forest located approximately 400 ft (120 m) to the southwest of the ridge atop Hawk Rock (Figure 20). Although this stand has not been assessed quantitatively, it appears to be old growth that was not cleared historically and that has not been logged for many years, if ever. The stand is restricted to an area of moderately steep, rocky slopes, which may explain why it has not been logged and, at least roughly, corresponds to an area mapped as a possible deer wintering area. Among the remarkable characteristics of this stand (all of which are defining characteristics of old-growth forest) are the large trees [18-24 in (46-61 cm)] diameter at breast height], a mixed age class and structure, and abundant downed woody debris. The stand is dominated by red spruce (*Picea rubens*), eastern hemlock (*Tsuga canadensis*), and sugar maple (*Acer saccharum*). Although not assessed quantitatively, the natural community type of this stand is

likely either red spruce-northern hardwood forest or hemlock-northern hardwood forest. Although neither natural community type is uncommon in Vermont, the characteristics of this stand suggest that it would be classified as "old-growth forest" [or "old forest" in the terminology of Environmentally Sensitive Treatment Areas (ESTA) as defined by the State of Vermont], which is an uncommon condition for forests in Vermont, especially in the Northeast Kingdom, which has a long history of intensive forest management. Given the uniqueness of this stand, it should be more thoroughly evaluated to map its full extent, to evaluate whether or not it actually is old-growth forest (i.e. whether or not it has ever been logged), and to identify its correct natural community type.



Figure 20. An area of old(er)-growth forest is located on the southwest-facing slope of Hawk Rock in the town of Newark, Vermont. Note the large size of the canopy trees and the abundant coarse woody debris on the forest floor.

Species-Level Elements

At the species level, there are a number of significant natural resources in the town of Newark, including Rare, Threatened, and Endangered species, deer wintering areas, and mast stands.

Rare, Threatened, and Endangered Species

Several Rare, Threatened, and Endangered (RTE) species have been documented as occurring or likely to occur in the town of Newark. These species include four species listed by the State of Vermont as Threatened or Endangered: American marten, bald eagle (*Haliaeetus leucocephalus*), mare's-tail (*Hippuris vulgaris*), and sweet coltsfoot (*Petasites frigidus* var. *palmatus*). A number of other rare species also occur in the town of Newark: black-backed woodpecker (*Picooides arcticus*), northern goshawk, swamp fly-honeysuckle (*Lonicera oblongifolia*), and ground-fir (*Diphasiastrum sabinifolium*). In addition, a large number of uncommon species occur in the town of Newark: common loon (*Gavia immer*), peregrine falcon (*Falco peregrinus*), osprey (*Pandion haliaetus*), northern saw-whet owl (*Aegolius acadicus*), common raven (*Corvus corax*), pine grosbeak (*Pinicola enucleator*), white-winged crossbill (*Loxia leucoptera*), Makasin's yellow lady-slipper (*Cypripedium parviflorum* var. *makasin*), white water-crowfoot (*Ranunculus aquatilis* var. *diffusus*), and slender spikerush (*Eleocharis nitida*). Several other RTE species occur in neighboring towns and, thus, may occur in Newark as well: Canada lynx, rock vole (*Microtus chrotorrhinus*), rock shrew (*Sorex dispar*), eastern small-footed bat (*Myotis leibii*), and Bicknell's thrush (*Catharus bicknelli*). In the sections that follow, we describe some of the rare and uncommon species that have been reported from the town of Newark.

American Marten

American marten are presently listed as very rare (S1) and as an Endangered Species in Vermont. In the northeastern United States, viable breeding populations of American marten are only known to occur in northern Maine and northern New Hampshire. However, in recent years, there have been increasing numbers of credible sightings of American marten in northeastern Vermont and in the southern Green Mountains (C. Bernier, personal communication). In the Northeast Kingdom, the majority of these sightings have occurred in the mountains to the north of the Nulhegan Basin, the Seneca and West Mountains, and the mountains ringing Victory Basin. However, a confirmed sighting has also occurred immediately southwest of the shared corner of the towns of Newark, Burke, and Sutton. American marten require large blocks of intact late successional forest with abundant downed woody debris; abundant small mammal populations (their preferred prey); and deep, fluffy snow beneath which they can hunt. Both loss and fragmentation of forests can be a problem for marten: Optimal habitat includes at least 75% late successional forest with the appropriate vertical and horizontal

structure. In addition, maintaining connectivity between the appropriate habitats in Vermont and breeding populations in New Hampshire, Maine, and Quebec will be critical for the recovery of a viable, breeding population of American marten in Vermont. Given that American marten move across large distances [home range size >2,470 acres (>1,000 ha); Kart et al. 2005], require large blocks of forest cover, and have been observed in neighboring towns, there is a high probability that this species already does or soon will occur in Newark as well.

Bald Eagle

Bald eagles are currently listed as a very rare breeding species (S1B) and as an Endangered Species in Vermont. In 2014, Vermont hosted approximately 16 territorial pairs of bald eagles, and nests have been confirmed at six locations within the state. Although bald eagles have not been observed nesting in Newark, they have been observed frequently over the past few years in the vicinities of Center and Newark Ponds (Tim King and Mark Ellingwood, personal communication). Given the large amount of forest and the abundant ponds, there is the distinct possibility that bald eagles could nest in the town of Newark as long as they are not disturbed and suitable nest sites are available [bald eagles typically nest in the tops of tall, sturdy, live trees, such as eastern white pine (*Pinus strobus*) that provide easy access in and out of the nest and have unobstructed views of the surrounding areas].

Common Loon

Common loons are currently ranked as an uncommon breeding species (S3B) in Vermont and at moderate risk of extinction or extirpation. Common loons were removed from Vermont's Endangered and Threatened Species List in April 2005 thanks to concerted efforts of many individuals and organizations to reintroduce and protect this species. Common loons prefer to nest on shorelines and islands but also nest on artificial platforms. According to the Vermont Fish & Wildlife Department, Newark and Center Ponds are two of approximately 80 known common loon nesting sites in Vermont. In Newark Pond, common loons nest on the shoreline of a small island located on the western side of the pond. Since 1986, common loons have nested or attempted to nest at Newark Pond in 28 of the last 29 years (Table 4). During that time, they nested successfully in 18 years and produced a total of 26 surviving chicks. Although loons have been frequent summer residents on Center Pond since at least 2007, they have nested or attempted to nest on a half-submerged artificial platform located along the southeastern corner of the pond during only the last two years (Kim Fried, personal communication). In 2013, they completed a nest but the nest failed due to mammalian predation. In 2014, a territorial pair started building but did not complete a nest there.

Table 4. Nesting success of common loons at Newark and Center Ponds in Newark, Vermont during 1986-2014. In 1989, no survey was conducted at Newark Pond. Data generously provided by the Vermont Center for Ecostudies.

<u>Year</u>	<u>Status</u>	<u>Nest Outcome</u>	<u># Chicks Fledged</u>
<u>Newark Pond</u>			
1986	Nested	Failed	0
1987	Nested	Failed	0
1988	Nested	Failed	0
1989	Not surveyed	-	-
1990	Nested	Successful	1
1991	Nested	Successful	1
1992	Territorial	-	-
1993	Nested	Successful	1
1994	Territorial	-	-
1995	Nested	Successful	2
1996	Nested	Failed	0
1997	Nested	Failed	0
1998	Nested	Successful	2
1999	Nested	Failed	0
2000	Nested	Successful	1
2001	Nested	Failed	0
2002	Territorial	-	-
2003	Nested	Successful	2
2004	Nested	Successful	1
2005	Nested	Successful	2
2006	Nested	Failed	0
2007	Nested	Successful	2
2008	Nested	Successful	1
2009	Nested	Successful	2
2010	Nested	Successful	1
2011	Nested	Successful	2
2012	Nested	Successful	2
2013	Nested	Successful	2
2014	Nested	Successful	1
<u>Center Pond</u>			
2011	Present	-	-
2012	Present	-	-
2013	Nested	Failed	0
2014	Territorial	-	-

Peregrine Falcon

Peregrine falcons are currently ranked as an uncommon breeding species (S3B) in Vermont and at moderate risk of extinction or extirpation. Peregrine falcons were removed from Vermont's Endangered and Threatened Species List in April 2005 thanks to concerted efforts of many individuals and organizations to reintroduce and protect this species. Peregrine falcons prefer to nest on high ledges near the open areas where they hunt (e.g. rivers, lakes, and fields). According to the Vermont Fish & Wildlife Department, Hawk Rock is one of approximately 50 known peregrine nesting sites in Vermont and one of only seven in the Northeast Kingdom (Figure 21). Peregrine falcons have been monitored at Hawk Rock almost every year since at least 2000, except 2011 and possibly 2001 (Table 5). Peregrine falcons nested successfully on Hawk Rock in six years (2003-2005 and 2012-2014) and unsuccessfully in one other year (2006). Both the Vermont Fish & Wildlife Department and Vermont Audubon note that, in the years in which nesting occurred, the Hawk Rock site has been a highly productive nesting site. During the seven years that they have nested on Hawk Rock, the peregrine falcons were successful in six years and fledged an average of 2.6 chicks per year, the fourth highest productivity average of the 46 sites monitored in Vermont.

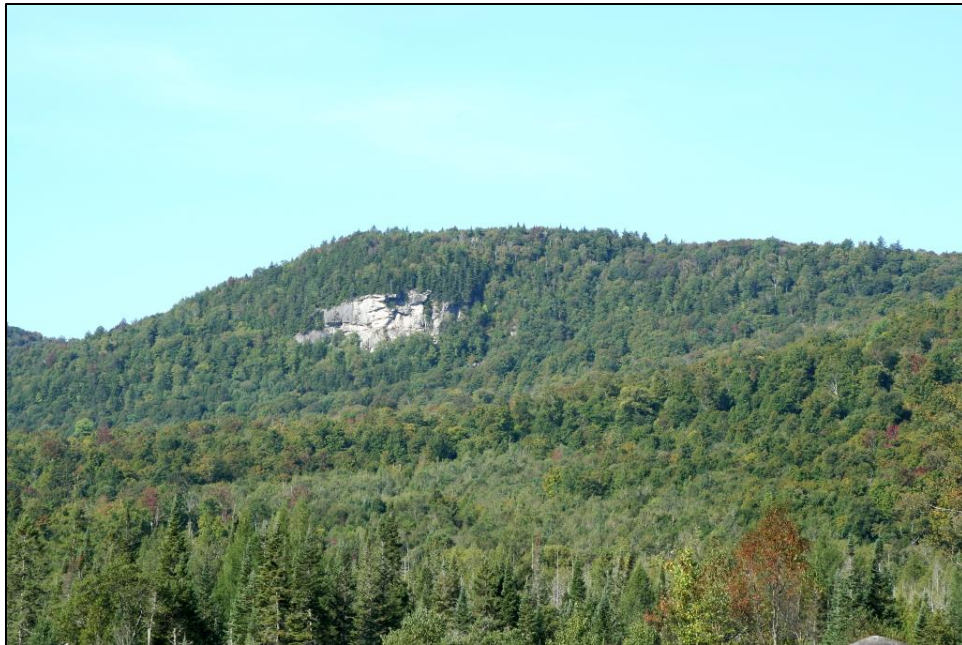


Figure 21. *Peregrine falcons have nested on the cliffs on the eastern slope of Hawk Rock in seven of the last 12 years.*

Table 5. Nesting success of peregrine falcons on Hawk Rock in Newark, Vermont during 2000-2014. No surveys were conducted at Hawk Rock in 2011 and possibly in 2001. Data generously provided by Vermont Audubon.

<u>Year</u>	<u>Status</u>	<u>Nest Outcome</u>	<u># Chicks Fledged</u>
2000	Not occupied	-	-
2001	Not surveyed?	-	-
2002	Not occupied	-	-
2003	Nested	Successful	2
2004	Nested	Successful	3
2005	Nested	Successful	4
2006	Nested	Failed	0
2007	Not occupied	-	-
2008	Not occupied	-	-
2009	Not occupied	-	-
2010	Not occupied	-	-
2011	Not surveyed	-	-
2012	Nested	Successful	3
2013	Nested	Successful	3
2014	Nested	Successful	3

Other Rare and Uncommon Birds

A number of other rare and uncommon birds have been observed in Newark during the past few years:

- Osprey (*Pandion haliaetus*), an uncommon breeder in Vermont (State-ranked S3B), were observed perched near and flying over Center Pond in May 2012 (Sue Winsor, personal communication).
- Northern goshawk, a rare breeder and uncommon resident of Vermont (State-ranked S2B/S3N), were observed flying through the northern hardwood forests along the western slopes of Packer Mountain in 2005 and 2009.
- Northern saw-whet owls (*Aegolius acadicus*), an uncommon breeder and resident of Vermont (State-ranked S3B,S3N), have been heard calling from the western slopes of Packer Mountain during April-May in several years.

- A pair of black-backed woodpeckers (*Picoides arcticus*), a rare species in Vermont (State-ranked S2), nested at the edge of a northern white cedar swamp in the southern part of Newark (Sally Newell, personal communication). In addition, black-backed woodpecker sign has been observed in the northern white cedar swamp at the north end of Center Pond and farther up a small tributary of Center Pond.
- Common ravens (*Corvus corax*), an uncommon resident of Vermont (State-ranked S3), have been observed frequently in the vicinity of Beck and Center Ponds and Packer Mountain. We suspect, but have not confirmed, that they nest in a small red pine (*Pinus resinosa*) plantation along Beck Pond Road.
- In many winters, small flocks of pine grosbeaks (*Pinicola enucleator*), an uncommon winter resident of Vermont (State-ranked S3N), have been observed feeding along the Class 2 and Class 3 roads of Newark.
- Finally, white-winged crossbills (*Loxia leucoptera*), an uncommon breeder and winter resident of Vermont (State-ranked S3B,S3N), were observed feeding on the abundant spruce (*Picea* species) seed crops during at least one winter (2007).

Vascular Plants

In addition to these rare and uncommon animals, seven rare and uncommon vascular plants have been documented in the town of Newark (Table 6). Three of these species are still extant and include two species ranked as uncommon (State-ranked S3) in Vermont but globally common (G5) and one species that is ranked rare in Vermont (S2) but globally regular (G4). In addition, four other rare or uncommon plants, including one endangered and one threatened species, have been documented from Newark historically but have not been observed in recent years. Due to landowner concerns and the sensitivity of these species to human disturbances, we are not describing or presenting maps of their locations.

Table 6. Rare, Threatened, and Endangered plant species that have been observed in the town of Newark, Vermont.

<u>Common Name</u>	<u>Scientific Name</u>	<u>State Rank</u>	<u>Last Observed</u>
Mare's-tail	<i>Hippuris vulgaris</i>	S1 (E)	1895
Sweet coltsfoot	<i>Petasites frigidus</i> var. <i>palmatius</i>	S2 (I)	1896
Ground-fir	<i>Diphasiastrum sabinifolium</i>	S2	1981
Swamp fly-honeysuckle	<i>Lonicera oblongifolia</i>	S2	Extant
White water-crowfoot	<i>Ranunculus aquatilis</i> var. <i>diffusus</i>	S3	Extant
Makasin's yellow lady-slipper	<i>Cypripedium parviflorum</i> var. <i>makasin</i>	S3	Extant
Slender spikerush	<i>Eleocharis nitida</i>	SH	1963

Deer Wintering Areas

Because white-tailed deer (*Odocoileus virginiana*) in Vermont occur near the northern edge of their range, they depend on special habitat conditions in order to survive the severe winter conditions. These deer wintering areas (also known as “deer yards”) typically occur in areas dominated by coniferous forest located in valley bottoms and on south-facing slopes (Austin et al. 2004). Deer wintering areas are considered critical and necessary habitat, because, as the Vermont Fish & Wildlife Department notes, they “provide essential relief to deer from winter conditions”. By providing shelter from deep snow, cold temperatures, and wind and by providing food sources, deer wintering areas increase over-winter survival. As the Vermont Fish & Wildlife Department further notes, “[w]intering areas do not change significantly between years and can be used by generations of deer over many decades if appropriate habitat conditions are maintained.” Deer wintering areas also provide important habitat and winter foods for a number of other species, including porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), fisher, red fox (*Vulpes vulpes*), eastern coyote (*Canis latrans*), and bobcat.

The State of Vermont has mapped only two deer wintering areas in the town of Newark (Figure 22). The largest, covering 1,310 acres (530 ha), is located along Bean and Sleeper Brooks from Center Pond downstream to the East Haven town line. The second one, covering 250 acres (101 ha) in Newark, is located along Roundy Brook; however, the full extent of this deer wintering area extends far into the town of Burke and covers a total of 828 acres (335 ha). Other deer wintering areas may exist in the town of Newark. As part of efforts to site an industrial wind development in Newark, a possible deer wintering area of unknown extent was identified along the southwestern slopes of Hawk Rock (Arrowwood Environmental 2012). This area was described as being dominated by a closed-canopy forest of red spruce and balsam fir (*Abies balsamea*) and exhibited evidence of deer use in past winters (Figure 23).

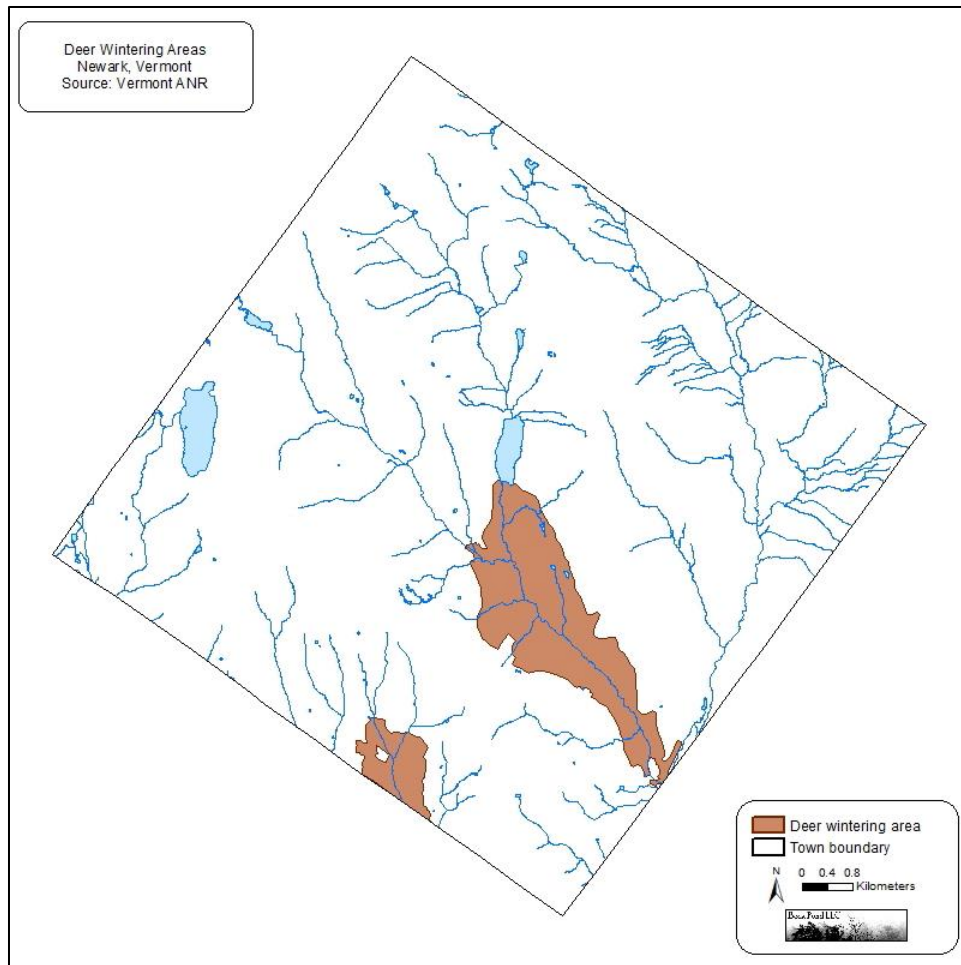


Figure 22. Locations of deer wintering areas in the town of Newark, Vermont. Deer wintering areas were mapped by the Vermont Fish and Wildlife Department.



Figure 23. Both recent and historic white-tailed deer browse were evident on the balsam fir saplings in the area of old(er) growth forest to the southwest of Hawk Rock.

Mast Stands

Many wildlife species depend on the availability of hard mast (that is, nuts and seeds eaten by wildlife) in the fall in order to ensure over-winter survival. When mast production is concentrated in local areas, these areas are referred to as mast stands. Mast stands are discrete habitat patches that contain an abundance of trees and shrubs that produce hard mast. According to the Vermont Fish & Wildlife Department, forest stands containing American beech (*Fagus grandifolia*) are necessary habitat for black bears. As has been indicated by a number of studies, the availability of beech nuts and other hard mast in the autumn is critically important for black bears and determines whether or not female bears reproduce in a given year, the minimum reproductive age and productivity rates of female bears, and cub survival rates. Thus,

the Vermont Fish & Wildlife Department has concluded that beech stands “used by black bear are absolutely essential for the survival and reproduction of this species in Vermont”. In addition, American beech provide valuable and potentially irreplaceable food resources for a variety of other wildlife. Although American beech is a common tree in Northern Hardwood Forests, the Vermont Fish & Wildlife Department has noted that “concentrated stands of beech that are used by black bears are not common”. Although American beech is a common canopy tree in Newark, no mast production areas have been mapped in the town of Newark by the State of Vermont. However, abundant bear-scarred beech trees have been observed in the northern hardwood stands located atop Hawk Rock and along the western slopes of Packer Mountain (Figure 24)(Arrowwood Environmental 2012).



Figure 24. Both recent and historic bear claw marks were abundant and widespread on many of the larger American beech growing to the north and northeast of Hawk Rock and elsewhere in the town of Newark, Vermont.

Tiered Contribution to Biodiversity

As part of the Biofinder, the Vermont Agency of Natural Resources has calculated an overall summary of biological diversity. This Tiered Contribution to Biodiversity incorporates 21 components of biodiversity grouped into three general categories (landscapes, aquatics, and species and natural communities)(Table 7). To create the Tiered Contribution to Biodiversity, the 21 components of biodiversity were weighted and used to calculate a biodiversity value for each 33-ft x 33-ft (10-m x 10-m) location in Vermont. These values were then grouped into six tiers: Tier 1 contains the highest concentrations of components contributing to biological diversity, and Tier 5, the lowest concentrations (Tier 6 denotes those locations lacking sufficient data).

According to the Tiered Contribution to Biodiversity, several areas in Newark have relatively higher concentrations of biodiversity (Table 8, Figure 25). Almost 70% of Newark encompasses areas that contain moderate to high concentrations of the components of biodiversity (Tiers 3-4). However, 11% of Newark encompasses areas having the greatest concentrations of the components of biodiversity (Tier 1), and 19% of Newark encompasses areas having very high concentrations of components of biodiversity (Tier 2). In contrast, only 21 acres (8.5 ha) in the town of Newark have low concentrations of the components of biodiversity (Tier 5). The areas having the greatest or very high concentrations are located primarily in the valleys of the West and East Branches of the Passumpsic River, Bean Brook, and the upper reaches of Roundy Brook. In these areas, the most important components of biodiversity include surface waters and riparian areas (A1), riparian connectivity (L8), habitat blocks (L1), representative physical landscapes (L4), and, in places, wetlands (SN8).

Table 7. The 21 components of biodiversity and the area covered by each component in the town of Newark, Vermont. The sum of all of the areas across all 21 components greatly exceeds the total area of the town of Newark, because each location in town may include multiple components of biodiversity.

Layer <u>ID</u>	<u>Component Name</u>	Area <u>(acres)</u>	Area <u>(ha)</u>
<u>Landscapes</u>			
L1	Habitat blocks	21,026	8,509
L2	Grasslands and shrublands	0	0
L3	Rare physical landscapes	63	25
L4	Representative physical landscapes	10,828	4,382
L5	Connecting lands (<2,000 acres)	8,308	3,362
L6	Connecting blocks (2,000-10,000 acres)	12,378	5,009
L7	Anchor blocks (>10,000 acres)	3,377	1,367
L8	Riparian connectivity	3,442	1,393
L9	Wildlife road crossings	913	369
<u>Aquatics</u>			
A1	Surface waters and riparian areas	4,158	1,683
A2	Representative lakes	81	33
A3	Important aquatic habitats and species assemblages	702	284
<u>Species and Natural Communities</u>			
SN1	Rare species	38	15
SN2	Uncommon species	2	1
SN3	Rare natural communities	0	0
SN4	Uncommon natural communities	242	98
SN5	Common natural communities	0	0
SN6	Vernal pools	22	9
SN7	Vernal pools (potential)	152	62
SN8	Wetlands	1,316	533
SN9	Mast production areas	0	0

Table 8. Ranking of areas in the Town of Newark in terms of the concentration of the components of biodiversity as calculated by the Vermont Agency of Natural Resources.

Tier	Components of Biodiversity	Area (acres)	Area (ha)	% of Total Area
1	Greatest concentration	2,620	1,060	11
2	Very high concentration	4,637	1,877	19
3	High concentration	6,609	2,675	28
4	Moderate concentration	9,988	4,042	42
5	Low concentration	21	8	<1
6	Insufficient data	0	0	0

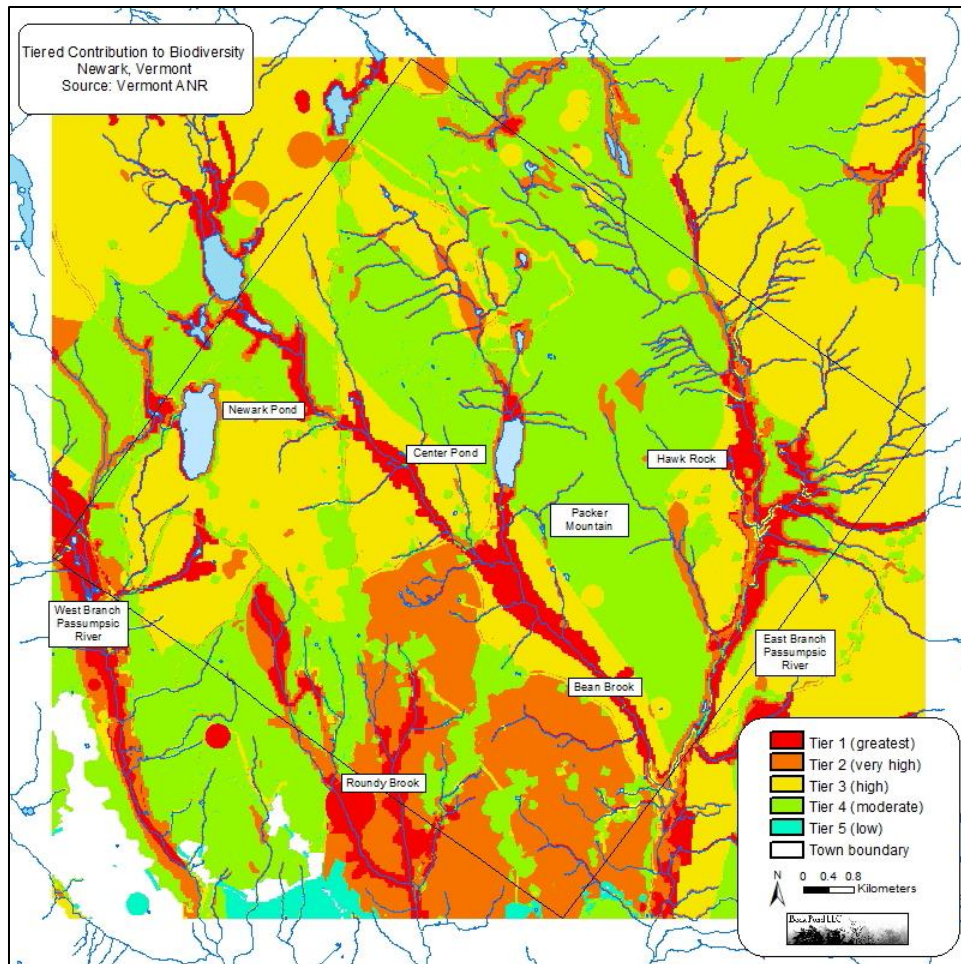


Figure 25. Tiered contribution to biodiversity in the town of Newark, Vermont. Biodiversity values were calculated and mapped by the Vermont Agency of Natural Resources.

All Elements Combined

In summary, several areas in the town of Newark are notable for their high concentrations of significant natural resources. Not including the large forest blocks, the other significant natural resources are concentrated along the main rivers and streams in town, including along the East and West Branches of the Passumpsic River and Bean, Sleeper, and Roundy Brooks (Figure 26). However, including the large forest blocks expands the area covered by significant natural resources to include not only those areas but also much of the northern two-thirds of the town, including Packer and Walker Mountains and Hawk Rock, which also have significant concentrations of wetlands and rare and uncommon natural communities (Figure 27).

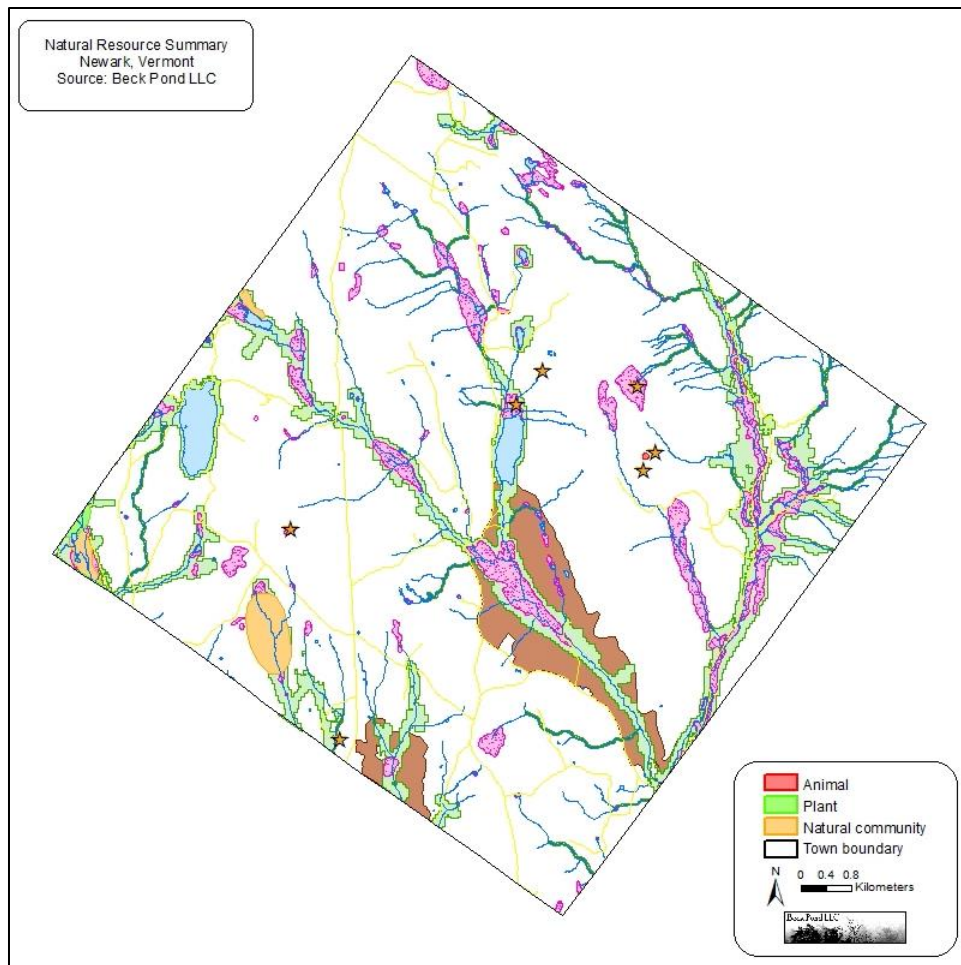


Figure 26. Locations of the many significant natural resources, excluding the large forest blocks, in the town of Newark, Vermont.

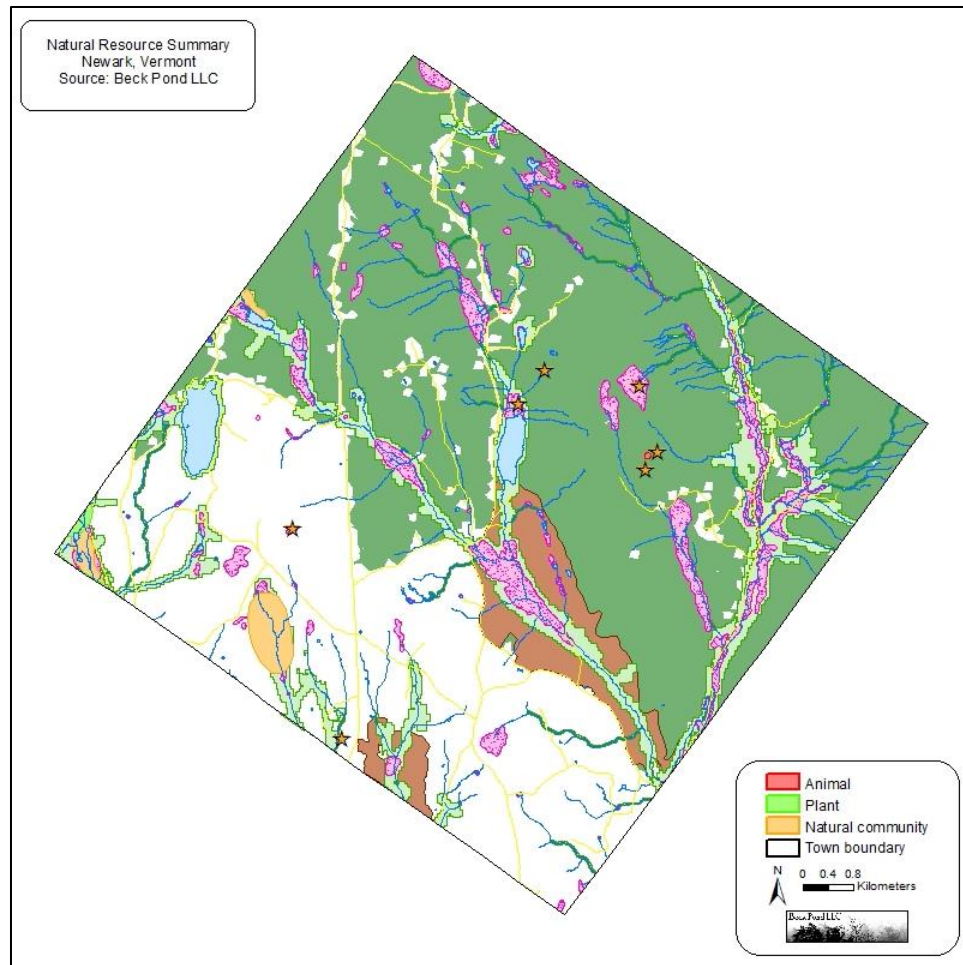


Figure 27. Locations of the many significant natural resources, including the four largest forest blocks, in the town of Newark, Vermont.

Conservation Opportunities

Currently, there are 17 conserved parcels totaling 1,670 acres (676 ha) in the town of Newark (Figure 28). These conserved lands include parts of the State-owned Bald Hill Wildlife Management Area [two parcels totaling 722 acres (292 ha)] and Willoughby State Forest [44 acres (18 ha)]; the Town-owned Newark Town Forest [111 acres (45 ha)]; the Newark Natural Area, owned by The Nature Conservancy of Vermont [42 acres (17 ha)]; and three State-owned fishing accesses on Beck, Center, and Newark Ponds. In addition, three properties,

encompassing nine parcels ranging in size from 0.5-546 acres (0.2-221 ha), are encumbered by conservation easements held by the Vermont Land Trust and other organizations. Forestry and agricultural values are also protected on 63 parcels totaling 10,275 acres (4,158 ha) that are enrolled in the Use Value Appraisal program (also known as “Current Use”), which prohibits their conversion to other land uses (Matt Langlais, personal communication).

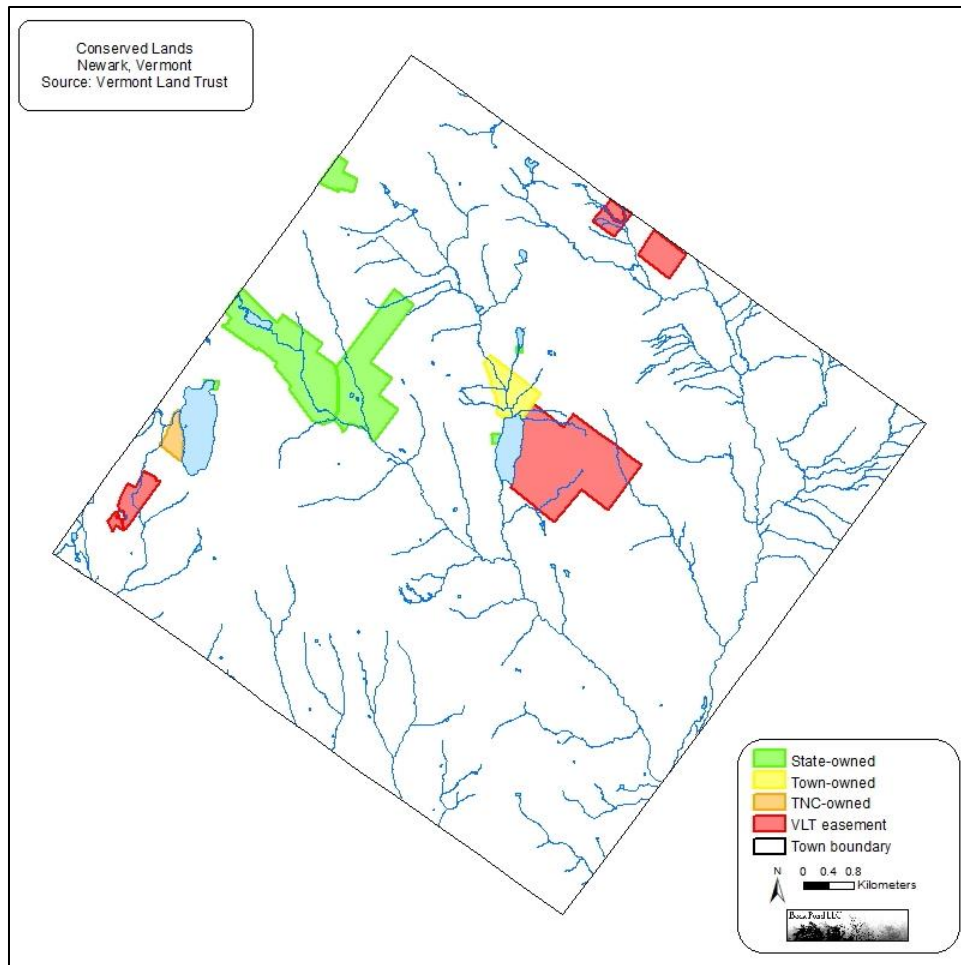


Figure 28. Locations of 17 conserved parcels in the town of Newark, Vermont. These conserved parcels include both those owned in fee and those encumbered by conservation easements. Data generously provided by the Vermont Land Trust.

Beyond the existing conserved lands, there are a number of outstanding opportunities to conserve the significant natural resources in Newark. In particular, conservation could focus on the large forest blocks and the important riparian and aquatic habitats. Focusing future

conservation efforts on these areas would provide numerous ecological benefits, including maintaining biological diversity, protecting and enhancing fish and wildlife habitat, and improving water quality. Conserving these areas would also provide numerous social and economic benefits, including timber production, maple sugaring, flood protection, and recreational opportunities such as hunting, fishing, boating, and hiking. Finally, conserving these areas would not only maintain and enhance the ecological, economic, and social values of Newark's "working landscape" but would also maintain Newark's valued rural character.

One of the outstanding conservation opportunities is the opportunity to conserve the important habitat connections afforded by the large forest blocks and significant riparian and aquatic habitats in the town of Newark. Much of the northern two-thirds of the town is located within an important wildlife linkage area identified by the Staying Connected Initiative, a partnership of 21 governmental and non-governmental organizations working to restore and enhance landscape connectivity across the Northern Appalachians (Figure 29). The town of Newark lies squarely in the middle of and incorporates more than half of the only linkage connecting the Green, Worcester, and Lowell Mountains to the west and the Northeastern Highlands, northern White Mountains, and Boundary Mountains to the east (Figure 30). This linkage includes Seneca and Bull Mountains in Ferdinand, Packer and Walker Mountains and Hawk Rock in Newark, Bald and Job Mountains and Mounts Pisgah and Hor in Westmore, and Wheeler Mountain in Sutton. The critical location of the town of Newark in the middle of this important wildlife linkage may provide additional incentives and opportunities to generate outside interest in and to secure additional resources for conserving the working lands, large forest blocks, and important riparian and aquatic habitats in the town of Newark.

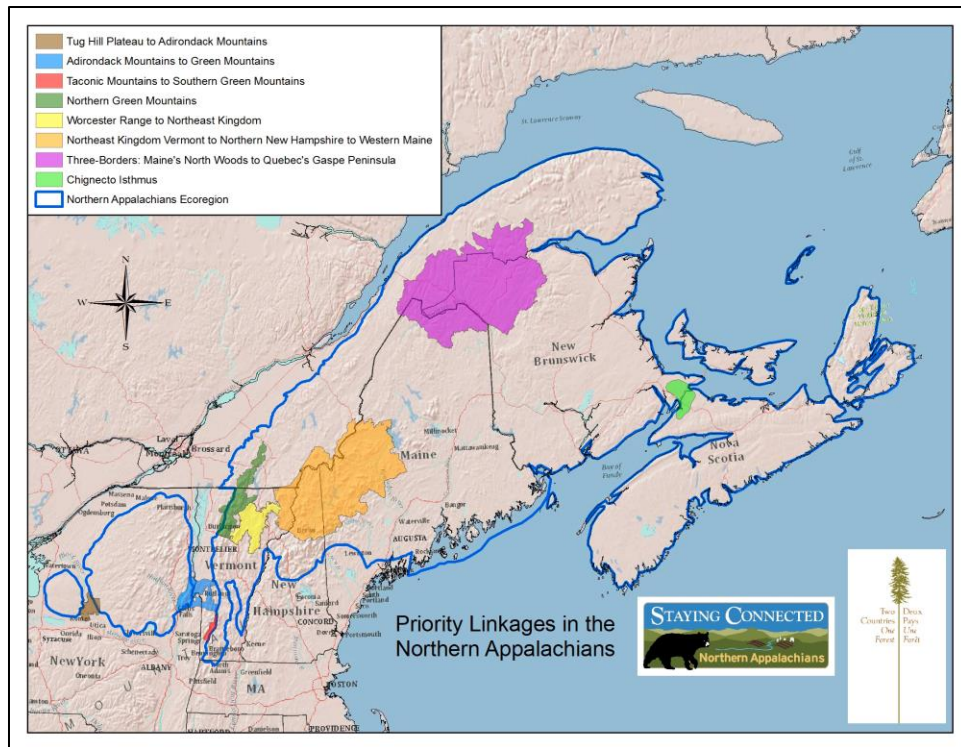


Figure 29. The town of Newark, Vermont is located within one of six important wildlife linkage areas identified by the Staying Connected Initiative as critical linkages connecting core habitats across the northeastern United States and eastern Canada. Map provided courtesy of the Staying Connected Initiative.

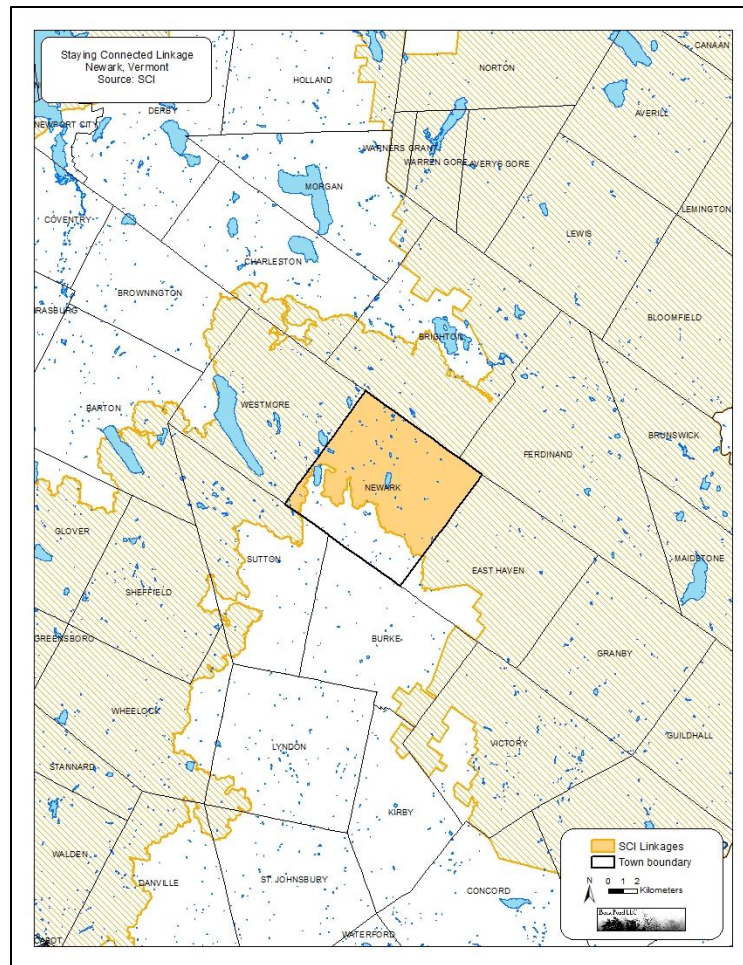


Figure 30. The town of Newark, Vermont represents more than half of the width of the key wildlife linkage area connecting the Worcester and Northern Green Mountains to the west and the Northeast Highlands and northern White Mountains to the east. The wildlife linkage area was mapped by the Staying Connected Initiative.

Restoration Opportunities

In addition to conservation opportunities, there are also a number of opportunities to restore aquatic and riparian habitats in the town of Newark. In particular, restoration actions should focus on maintaining and enhancing aquatic connectivity and restoring riparian areas. Restoring these aquatic and riparian habitats would have numerous ecological and societal benefits, including improving water quality, improving fish and wildlife habitat, reducing fluvial

erosion hazards, and increasing flood resiliency. Undertaking such restoration projects would further protect and enhance the significant natural resources in the town of Newark.

Aquatic Connectivity

Aquatic connectivity is important for maintaining healthy populations of many native aquatic and riparian species. In Newark, aquatic connectivity has been compromised by several dams and numerous bridges and culverts. Currently, eight dams or former dams are documented in the town of Newark (Table 9, Figure 31). Given the large number of mills that occurred in Newark historically [e.g. Hemenway (1867) noted that there were seven saw mills, one grist mill, and two starch mills in Newark in 1860], there were likely more dams historically. Removing or modifying any remaining dams has the potential to greatly enhance aquatic organism passage in these streams. However, these ecological benefits must be considered in tandem with any economic, social, or other benefits still being provided by these dams as well as the costs of removing or modifying these dams.

Table 9. Documented dams in the town of Newark, Vermont. Information based on data layers and Excel spreadsheets provided by the Vermont Agency of Natural Resources.

State <u>ID</u>	<u>Dam Name</u>	<u>Stream</u>	<u>Owner</u>	<u>Status</u>	Barrier to Aquatic Organism <u>Passage?</u>
137.01	Center Pond	Sleeper	Private	?	?
137.02	Bean Brook (upper)	Bean	Private	Breached	No
137.03	Bean Brook (lower)	Bean	Private	Breached	No
137.04	Donaldson Mill (upper)	Sleeper	?	?	?
137.05	Donaldson Mill (lower)	Sleeper	?	?	?
137.06	Sleeper Brook	Sleeper	?	?	?
137.07	Bald Hill Fish Hatchery (upper)	Bean	State	In service	Yes
137.08	Bald Hill Fish Hatchery (lower)	Unnamed	State	In service	Yes

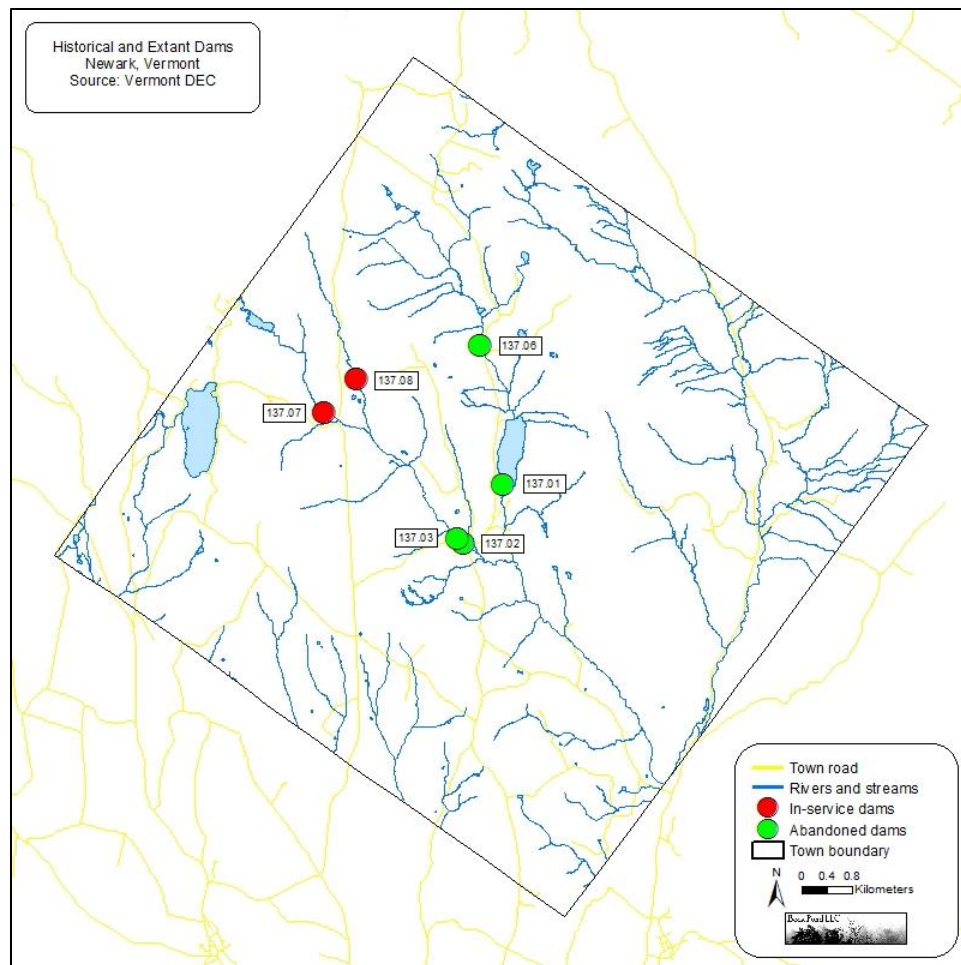


Figure 31. Locations of historical and extant dams in the town of Newark, Vermont. The status of four of the eight dams was unknown, as we were unable to relocate or visit the dam sites.

As part of this project, we relocated and assessed four of the eight dams documented in the town of Newark (Table 9, Figure 31). Two of these dams (State IDs 137.07 and 137.08), which were located along Bean Brook and an unnamed tributary, supply water to the Bald Hill Fish Hatchery. Thus, both of these dams continue to provide important economic and social benefits. However, both dams are currently formidable barriers to aquatic organism passage. Although removal of these two dams is unlikely to occur and may compromise operation of the fish hatchery, these two dams might be modified to allow aquatic organisms to move more freely up and down their respective streams. Such an action might be particularly beneficial at the larger of the two dams (State ID 137.07), which may be the principal barrier to aquatic

organism passage along much of the 10-mile (16-km) length of Bean Brook (Figure 32). Two other former dams along Bean Brook (State IDs 137.02 and 137.03) were completely breached, although large numbers of ledges and boulders were observed at and downstream of both sites.



Figure 32. The upper Bald Hill Fish Hatchery dam (State ID 137.07) poses a formidable barrier to aquatic organism passage in Bean Brook.

We did not identify or assess potential restoration projects at bridges and culverts, as that was beyond the scope of this project. However, bridge and culvert inventories have been completed for the Town of Newark by the Northeastern Vermont Development Association (NVDA); and bridge, culvert, and road erosion risk assessments are being completed by the Caledonia County Natural Resources Conservation District (NRCD). As part of these efforts, the Town of Newark, Caledonia County NRCD, and Vermont DEC are discussing potential projects to improve aquatic organism passage and flood resiliency at problematic bridges, culverts, and roads (Kerry O'Brien and Ben Copans, personal communication). In addition, the NVDA is leading efforts to train individuals to conduct assessments of short structures [i.e. bridges with spans of 6-20 ft (1.8-6.1 m)], which are now the responsibility of towns. Collectively, these assessments will greatly assist efforts to identify and improve problem bridges and culverts that compromise the ecological values of rivers and streams in Newark.

Riparian Areas

Riparian areas are important components of the landscape, as they represent the interface between the terrestrial and aquatic environments. For the purposes of this study, we defined riparian areas as those areas lying within 100 ft (30 m) of a mapped river or stream. Based on our analyses of restoration opportunities within these areas, we identified a total of 224 sites that were being used for human land uses within 100 ft (30 m) of rivers and streams (Figure 33). Of these, 127 sites were being used for roads, houses, or ponds and, as such, weren't likely to be restored to floodplain or other riparian habitats. The remaining 97 sites, however, were located in areas that were being used for agriculture (primarily hay fields). In general, these sites were concentrated along the East Branch of the Passumpsic River, but other sites were located along the West Branch of the Passumpsic River and along several tributaries of Bean and Roundy Brooks. These sites, which ranged in size from <0.02-3.8 acres (<0.01-1.5 ha), should be considered as potential sites for restoration of floodplain forest, wetlands, and other riparian habitats. Such restoration projects would have numerous ecological and economic benefits, including storing flood waters, reducing flood damage, improving water quality, and providing important fish and wildlife habitat.

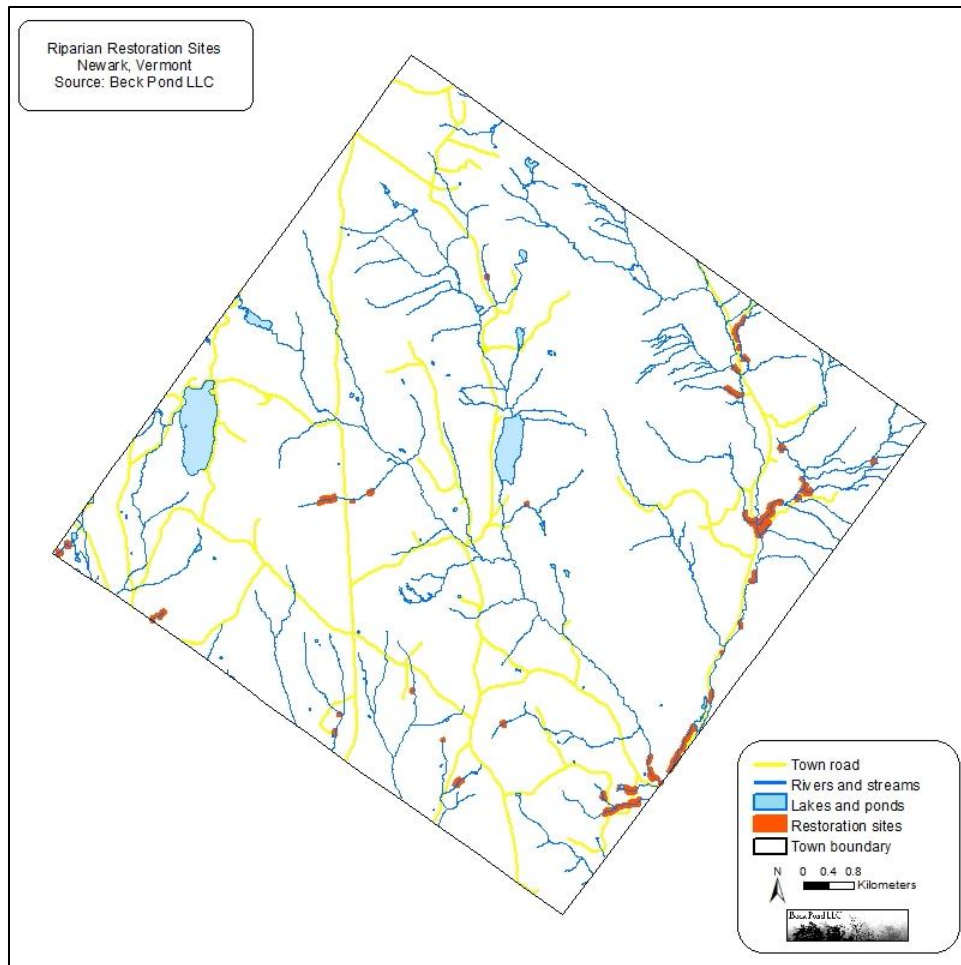


Figure 33. Potential riparian restoration sites in the town of Newark, Vermont.

Based on our field assessments, we classified many of these sites as low priorities for restoration. Many of these sites, except those along the East Branch of the Passumpsic River, are very small or even seasonal headwater streams, occupy very small areas, and/or are not part of active floodplains. Thus, restoring these sites would have only limited (although positive) benefits for water quality and fish and wildlife habitat. In contrast, several sites along the East Branch of the Passumpsic River offer great opportunities for restoring floodplain and/or riparian habitats (Figure 34). These sites are currently being used for agriculture, occur on the floodplain or in the riparian corridor, and are generally larger. Many of these sites would best be restored by eliminating the current land uses and planting the appropriate native floodplain and/or wetland vegetation. However, in some instances, streambank instability might require

more aggressive actions to stabilize the streambank, reduce channel migration and streambank erosion, and restore the appropriate vegetation and natural communities. Ultimately, restoring the appropriate vegetation and habitats would serve to store flood waters, reduce streambank erosion, filter nutrients and sediments, and create high-quality fish and wildlife habitat.

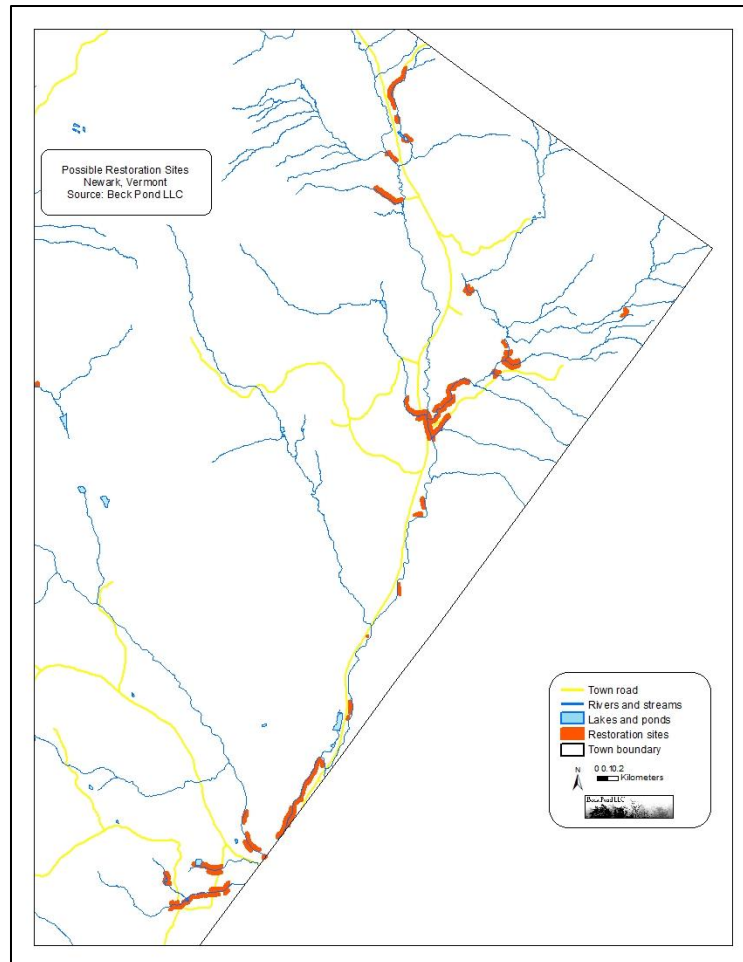


Figure 34. Potential riparian restoration sites along the East Branch of the Passumpsic River in the town of Newark, Vermont.

Conclusion

In the process of completing this natural resource inventory, it became clear that the town of Newark is not well studied in terms of its ecology and natural resources. Although numerous online databases and maps are available, little field work has been done to identify, map, and assess the many terrestrial and aquatic natural resources in the town. Thus, we recommend that studies be undertaken to provide more detailed data describing and mapping the significant natural resources in town, particularly in terms of natural communities; wetlands; vernal pools; and Rare, Threatened, and Endangered (RTE) species. More specifically, we recommend that the following be studied:

1. The natural communities and possible rare plants in the forested wetlands along the West Branch of the Passumpsic River,
2. The natural communities and wetlands along the East Branch of the Passumpsic River and an unnamed tributary that drains the valley east of Packer Mountain and south of Hawk Rock,
3. The natural communities and wetlands in the headwaters of Roundy Brook,
4. The wetlands along Bean and Sleeper Brooks,
5. The natural communities and their associated plants and animals on the slopes of Packer and Walker Mountains and Hawk Rock, especially in the areas surrounding the cliffs and talus slopes on these three ridges,
6. The possible presence of American marten and Canada lynx in the town of Newark, and
7. Any information about the invertebrates, fungi, mosses, lichens, and other less “charismatic” fauna and flora inhabiting the town of Newark.

Despite the lack of detailed study, it is clear that Newark hosts a number of significant natural resources. In particular, the town of Newark contains several highly-visible enduring features; numerous large blocks of forest habitat; abundant lakes, ponds, rivers, streams and wetlands; and a number of rare and many uncommon species and natural communities that are dependent on these habitats (Figure 35). Although widespread, these significant natural resources are concentrated in a few areas: 1) the East Branch of the Passumpsic River, 2) the West Branch of the Passumpsic River, 3) the length of Bean Brook as well as its tributary Sleeper Brook, 4) the headwaters of Roundy Brook, and 5) the ridge encompassing Packer and Walker Mountains and Hawk Rock. Because these natural resources are of such high quality and because they are located in close proximity to one another, the town of Newark should embrace efforts to conserve these natural resources, especially the large forest blocks and the high-quality lakes, ponds, rivers, streams, and wetlands (Figure 35).



Figure 35. The town of Newark, Vermont is characterized by the juxtaposition of several significant natural resources, such as the enduring features, large forest blocks, and aquatic and riparian habitats, and uncommon natural communities visible in this view looking north across Center Pond towards Bald Mountain in the neighboring town of Westmore. Photograph courtesy of Tim King.

Bibliography

- Arrowwood Environmental. 2012. *Environmental Assessment for 4 Meteorological Towers to be located in Brighton, Ferdinand and Newark, Vermont*. Arrowwood Environmental LLC, Huntington, Vermont.
- Austin, J.M., C. Alexander, E. Marshall, F. Hammond, J. Shippee, E. Thompson and Vermont League of Cities and Towns. 2013. *Conserving Vermont's Natural Heritage: A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife, and Biological Diversity*. Vermont Fish & Wildlife Department and Agency of Natural Resources, Montpelier, Vermont.
- Dobson, J.E., E.A. Bright, R.L. Ferguson, D.W. Field, L.L. Wood, K.D. Haddad, H. Iredale III, J.R. Jensen, V.V. Klemas, R.J. Orth and J.P. Thomas. 1995. *NOAA Coastal Change Analysis Program (C-CAP): Guidance for Regional Implementation*. NOAA Technical Report NMFS 123, U.S. Department of Commerce, Washington, D.C.
- Hemenway, A.M. (ed.). 1867. *The Vermont Historical Gazetteer: A Magazine Embracing a History of Each Town, Civil, Ecclesiastical, Biographical and Military*. Miss A.M. Hemenway, Burlington, Vermont.
- Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar and B. Popp (eds.). 2005. *Vermont's Wildlife Action Plan*. Vermont Fish & Wildlife Department, Waterbury, Vermont.
- State of Vermont. 2009. *Passumpsic River Watershed Water Quality and Aquatic Habitat Assessment Report*. Vermont Department of Environmental Conservation, Waterbury, Vermont.
- State of Vermont. 2014. *Passumpsic and Upper Connecticut River Tactical Basin Plan*. Vermont Agency of Natural Resources, Montpelier, Vermont.
- Thompson, E.H. and E.R. Sorenson. 2000. *Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont*. Vermont Department of Fish and Wildlife and The Nature Conservancy, Waterbury, Vermont.
- Town of Newark. 2012. *Newark, Vermont Town Plan*. Town of Newark, Newark, Vermont.

Appendix A. Glossary of ecological, geological, and other terms used to describe the natural resources in the town of Newark.

Alluvium - Sediment deposited by rivers and streams.

Basal till - Unstratified and unsorted material carried at the bottom of and directly deposited by glacial ice.

Basin – A region or area bounded peripherally by a divide and draining into a particular water course or water body.

Biodiversity (or biological diversity) - The variety of life inhabiting a particular habitat or ecosystem at a given point in time.

Connectivity - The degree to which similar landscape elements, such as habitat patches or rivers and streams, are connected to each other so as to facilitate the movement of target organisms and ecological processes between them.

Corridor - Components of the landscape that provide a continuous or near continuous pathway that may facilitate the movement of target organisms or ecological processes between areas of suitable habitat.

Extant - Still in existence.

Headwater stream - The smallest part of a river or stream network that is nearest the source of the stream and furthest from its endpoint or confluence with another river or stream.

Hectare (ha) - A metric measure of area. One (1) hectare equals approximately 2.47 acres.

Kame terrace - A terrace-like accumulation of sand and gravel deposited at or near the margins or terminus of a glacier by a meltwater stream.

Linkage - See Corridor.

Moraine - Material deposited by glacial ice, often at the terminus or margin of a glacier.

Muck - A soil containing 30-50% organic matter that is generally well decomposed.

Natural Community Type - An interacting assemblage of organisms, their physical environment, and the natural processes that affect them.

Oligotrophic - The trophic status of a lake or pond characterized by low nutrient levels and low primary productivity.

Peat - Unconsolidated material consisting mostly of undecomposed or only slightly decomposed organic matter.

Riparian buffer – A strip of unmanaged vegetation growing along the shoreline of a river or stream. Riparian buffers reduce erosion, filter sediments and pollutants, and provide important fish and wildlife habitat.

Soil complex - Map unit in which two or more soil series are so intertwined geographically that it is not practical to map them separately.

Soil series - Soils that are similar in all major soil profile characteristics, including physical and mineralogical properties.

Soil texture - The relative proportions of the various sizes of mineral soil particles, including sand, silt, and clay.

Surface waters – Water bodies that lie on top of the earth's surface, including lakes, ponds, rivers, streams, and wetlands.

Tributary – A water body, such as a river or stream, that flows into another water body.

Vascular plant - Plants that have lignified tissues for conducting water, minerals, and photosynthetic products throughout the plant. Vascular plants include ferns, club mosses, flowering plants, conifers, and other gymnosperms.

Wetland – Area in which water saturation is the dominant factor determining the nature of soil development and the types of plant and animal communities that live there.

Appendix B. Geospatial data sets and natural resource and conservation professionals queried as part of efforts to identify and map the significant natural resources in the town of Newark, Vermont.

Geospatial Data Sets

<u>Layer</u>	<u>Source</u> ¹	<u>Date</u>
A1 Surface Waters and Riparian Areas	ANR Biofinder	-
A2 Representative Lakes	ANR Biofinder	-
A3 Important Aquatic Habitats & Species Assemblages	ANR Biofinder	-
L1 Habitat Blocks	ANR Biofinder	-
L2 Grasslands and Shrublands Blocks	ANR Biofinder	-
L3 Rare Physical Landscapes	ANR Biofinder	-
L4 Representative Physical Landscapes	ANR Biofinder	-
L5 Connecting Lands 2000ac	ANR Biofinder	-
L6 Connecting Blocks 2000 10000a	ANR Biofinder	-
L7 Anchor Blocks 10000a	ANR Biofinder	-
L8 Riparian Connectivity	ANR Biofinder	-
L9 Wildlife Road Crossings	ANR Biofinder	-
SN1 Rare Species	ANR Biofinder	-
SN2 Uncommon Species	ANR Biofinder	-
SN3 Rare Natural Communities	ANR Biofinder	-
SN4 Uncommon Natural Communities	ANR Biofinder	-
SN5 Common Natural Communities	ANR Biofinder	-
SN6 Vernal Pools	ANR Biofinder	-
SN7 Vernal Pools Potential	ANR Biofinder	-
SN8 Wetlands	ANR Biofinder	-
SN9 Mast Production Areas	ANR Biofinder	-
National Wetlands Inventory	USFWS	2011
Deer Wintering Areas	VFW	2011
Habitat Blocks and Wildlife Corridors	VFW	2011
Rare Threatened and Endangered Species and Communities	VFW	2013
Uncommon Species and Other Features	VFW	2013
Caledonia County Soil Survey Data	NRCS	2011
Surficial Geology Data	VGS	2008
Vermont Habitat Linkages	SCI	2014
Bedrock Geology	USGS	2012
Vermont Dams Inventory	DEC	2009

<u>Layer</u>	<u>Source</u> ¹	<u>Date</u>
Vermont Significant Wetlands Inventory	DEC	2010
Vermont Hydrography Dataset	VCGI	2008
Vermont Hydrography Dataset	VCGI	2008
Tiered Contribution to Biodiversity	VFW	-
Marten and Lynx Sightings	VFW	2014
Rare Threatened and Endangered Species and Communities	VFW	2014
Vermont Land Trust Conserved Lands	VLТ	2014
Other Conserved Lands	VLТ	2012
Use Value Appraisal Parcels - Essex and Caledonia Counties	VFPR	2010
Seneca Mountain Wind GPS Data	AE	2013
Bicknell's thrush habitat	VCE	2005
Large forest land ownership blocks (Northern Forest)	VCGI	1996
Biological Hotspots in Vermont	VBP	1999
Aggregate sand, gravel and stone resources	ANR	1992
C-CAP New England 2010-Era Land Cover	NOAA	2010
Class A Waters	ANR	2008
Wildlife Linkage Habitat Analysis	VFW	2006
Land Cover/Land Use Dataset for Vermont	UVM	2002
Vermont Cropland Data Layer	USDA	2012
National Agriculture Imagery Program	USDA	2014
National Agriculture Imagery Program	USDA	2012
National Agriculture Imagery Program	USDA	2011
National Agriculture Imagery Program	USDA	2009
National Agriculture Imagery Program	USDA	2008
National Agriculture Imagery Program	USDA	2003
Potential Riparian Restoration Sites	Beck Pond LLC	2014

¹ Data sources include Vermont Agency of Natural Resources (ANR), Vermont Agency of Natural Resources Biofinder (ANR Biofinder), Vermont Department of Environmental Conservation (DEC), Vermont Fish and Wildlife Department (VFW), Vermont Department of Forests Parks and Recreation (VFPR), Vermont Geological Survey (VGS), Vermont Center for Geographic Information (VCGI), U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USFWS), National Oceanographic and Atmospheric Administrations (NOAA), University of Vermont (UVM), Vermont Land Trust (VLT), Vermont Center for Ecostudies (VCE), the Staying Connected Initiative (SCI), Arrowwood Environmental (AE), and Beck Pond LLC.

Natural Resource and Conservation Professionals

<u>Name</u>	<u>Title</u>	<u>Organization</u>
Ben Copans	Watershed Coordinator	Vermont Department of Environmental Conservation
Bob Popp	Botanist	Vermont Fish & Wildlife
Jens Hawkins-Hilke	Community Wildlife Program Conservation Planning Biologist	Vermont Fish & Wildlife
Jud Kratzer	Fisheries Biologist	Vermont Fish & Wildlife
Bob Zaino	Lands Ecologist	Vermont Fish & Wildlife
Eric Sorenson	Natural Communities Ecologist	Vermont Fish & Wildlife
John Austin	Wildlife Biologist	Vermont Fish & Wildlife
Chris Bernier	Wildlife Biologist	Vermont Fish & Wildlife
Matt Langlais	Caledonia/Essex County Forester	Vermont Forests Parks and Recreation
Margaret Fowle	Conservation Biologist	Audubon Vermont
Kerry O'Brien	District Manager	Caledonia County Natural Resources Conservation District
Jon Binhammer	Director of Protection	The Nature Conservancy
Eric Hanson	Loon Biologist	Vermont Center for Ecostudies
Kent McFarland	Conservation Biologist	Vermont Center for Ecostudies
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