



2022

Town of Sunapee Natural Resources Inventory & Conservation Plan



Photo 1. Frank Simpson Preserve wetland. Credit: Barbara Chalmers.

Town of Sunapee Conservation Commission
With assistance from the Upper Valley Lake
Sunapee Regional Planning Commission



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Special thanks to Conservation Commission member

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Who led the update to this document, providing information and review that has advanced its purpose in service to the Town of Sunapee.

2. Introduction

Natural resources are an essential element and cultural contributor to the Town of Sunapee. Made up of soil, water, plant, wildlife, air, and energy, these natural resources are valuable in innumerable ways. These include but are not limited to: Aesthetic, inspirational, and spiritual aspects for public health and contemplation; Fundamental ecosystem services that are costly or impossible to replace; Recreational opportunities and its related recreation economy

Sunapee is a rural lakefront town covering 25 square miles in central New Hampshire, bordered on the east by Lake Sunapee. The town's lakes, ponds, river, and wetlands draw many seasonal human and wildlife visitors each year. These resources, in combination with open fields and forests, provide a diverse array of natural settings. Sunapee relies on its natural resources for drinking water, its tourist and seasonal home economy, and much of its taxbase. Its natural resources sustain production of agricultural products, construction materials, and wood-based fuel. Sunapee's natural resources also sustain a high quality of rural life with abundant wildlife, scenic vistas, and recreational opportunities.

This Natural Resources Inventory and Conservation Plan (informed by NH RSA 36-A:2) contains a visual and written description of the natural resources within the Town of Sunapee at the current time and suggests protections needed for the resilience of these resources. The goals are to:

- ❖ Identify critical natural resources, resource areas, and threats
- ❖ Prioritize protection and conservation efforts
- ❖ Inform decision-making about land use, development, infrastructure, and conservation
- ❖ Educate landowners about the values associated with their land for informed land use decisions

This report should not be construed as a “final product” as the status and significance of natural resources and their protections change over time. This document should be revisited periodically, suggested at least every 10 years, to update with newly available data, protections, and priorities for natural resources conservation.

3. Methodology

The Sunapee Conservation Commission (SCC) developed this Natural Resources Inventory and Conservation Plan, with technical assistance from the Upper Valley Lake Sunapee Regional Planning Commission (UVLSRPC) in 2022. The first phase involved an inventory consisting of readily available data and input from SCC members. With that information, a co-occurrence analysis was performed to identify areas of high resource value. Town policies, planning documents, and land conservation practices were reviewed for their alignment or misalignment with the protection and resilience of the Town's natural resources as outlined in the inventory. With data and analysis in hand, the SCC identified priority focus areas and conservation topics, culminating with an updated the Town Conservation Plan.

Information on the natural resources in Sunapee was derived both from statewide data sources and local knowledge. Corrections to the statewide data were made by the SCC. This information is represented descriptively and visually. Digital maps were created by UVLSRPC, using ArcGIS Pro. Detailed information about data are described in Appendix A : Data Source Documentation.

4. Natural Resources

4.01 Political location

The town of Sunapee is in the west and central part of New Hampshire in Sullivan County. As of the 2020 census, the Town makes up a single, independent census tract. Within the Town of Sunapee, there are several villages and places – Georges Mills, Sunapee Harbor and Upper Village, Lower Village, Wendell, and South Sunapee. Lake Sunapee is the most prominent geographic feature of the town and covers 13% of its land area. The lake shore forms the eastern edge of town adjoining the towns of New London and Newbury. Nearby to the south is Mount Sunapee with its State Park and snow skiing resort. Sunapee is bordered by six municipalities (Map 1):

- New London and Newbury to the east,
- Goshen to the south,
- Springfield to the north, and
- Croydon and Newport to the west.

4.02 Geology & Topography

Bedrock geology. The bedrock underneath the Town of Sunapee is mostly igneous rock such as granite that formed when melted rock solidified inside the earth. These kinds of internally formed rocks are known as plutonic. There is also a belt of metamorphic rock that runs north to south at the centerline of the town, which was created when older rocks were changed by heat or pressure underground (Map 2). This bedrock dates to the Devonian Period, roughly 400 million years before the present day. This geologic period is nicknamed the Age of Fishes due to the significant fish diversity present. The period is also known for the large number of early plants that spread on dry land, evolving into the first seed-bearing plants by the end of the period. The Middle to Late Devonian is when the Acadian orogeny occurred, the third of four mountain building events that created the Appalachian Mountains.



Photo 2. Bears Den, group of glacial erratics. Simpson Reserve 2021. Credit: Barbara Chalmers.

The bedrock of Sunapee provides potential sources of geological resources for the town. Most of the town's bedrock is granite or granodiorite, which are popularly used as construction material, decorative stone, road building material, and more. There is a single active quarry for this stone about a mile south of the town center. There are also

Topography. The most significant peak is Blueberry Mountain at 1,509 ft, in the south-west part of Town. Other prominent hills and mountains include Youngs Hill, Tucker Hill, Cemetery Hill, Blaisdell Hill, Burkehaven Hill, Keyser Hill, Garnet Hill, Browns Hill, Smith Hill, Mica Mine Hill, and Trow Hill. The lowest elevation in town is along the Sugar River, at just under 300 feet above sea level (Map 3). All water in Sunapee drains eventually to the Sugar River, which begins at the outflow of Lake Sunapee. The prominent peaks in Sunapee coincide with many, but not all the Town's slopes of moderate or steep grade (Table 1). Slope is important for planning purposes for several reasons. The increase in slope corresponds to the potential increase for surface runoff and erosion. The soil depth is also thinner as slopes increase, thereby decreasing the capacity of the land to filter septic system effluent. Low lying areas are typically associated with water resources such as river corridors or wetlands and may be prone to flooding,



Photo 3. c1940 Photo of rocky soil, rolling hills, taken west of Mt View Lake. Credit: Sunapee Historical Society Collection.

and/or contain deposits of sand and gravel or rich farmland soils. The most suitable slopes for development are from zero to 12-15%.

Percent Slope Category	Square Miles	Acreage	% Town
Waterbody	4.2	2,716	17%
Slight, <6%	4.8	3,101	19%
Gently sloping, <12%	6.1	3,882	24%
Moderately sloping, <15%	2.6	1,637	10%
Strongly sloping, <18%	2.0	1,294	8%
Moderately steep, <25%	3.0	1,896	12%
Steep, >25%	2.5	1,574	10%

Table 1. Slope presence by class in Sunapee, LiDAR derived
Source: New Hampshire Granit, 2021.



Photo 4. Scenic view of Croydon Mountain from Burkehaven Hill. Taken from top of Burkehaven Hill Road. July 2022. Credit: Barbara Chalmers.

4.03 Ecoregion

According to the Commission for Environmental Cooperation (CEC), “ecological regions are areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources”, identified by the CEC and supported by the US EPA (Omernick & Griffin, 2014). The CEC recognizes four levels of ecoregions in North America, with the two smallest levels updated in 2013. At the most refined scale of level IV, with 967 total, the Town keeps its namesake within the Sunapee Uplands ecoregion (Map 4).

“The Sunapee Uplands ecoregion of New Hampshire consists of open low mountains. With numerous, rolling, rocky hills and mountains, elevations are mostly 1000 to 2000 feet, but range from 500 to over 3000 feet. Monadnock Mountain anchors the southern end of the region at 3165 feet. Granite and granodiorite rocks are common with shallow, stony frigid soils, mostly coarse-loamy Spodosols. The uplands are dissected by numerous streams, and small lakes dot the landscape.” (Griffith et al. 2009)

At level III, which recognizes 182 identified ecoregions, Sunapee falls within the Northeastern Highlands ecoregion.

“The Northeastern Highlands covers most of the northern and mountainous parts of New England as well as the Adirondacks in New York. It is a relatively sparsely populated region compared to adjacent regions, and is characterized by hills and mountains, a mostly forested land cover, nutrient-poor frigid and cryic soils (mostly Spodosols), and numerous high-gradient streams and glacial lakes. Forest vegetation is somewhat transitional between the boreal regions to the north in Canada and the broadleaf deciduous forests to the south. Recreation, tourism, and forestry are primary land uses. Farm-to-forest conversion began in the 19th century and continues today. In spite of this trend, alluvial valleys, glacial lake basins, and areas of limestone-derived soils are still farmed for dairy products, forage crops, apples, and potatoes. In addition to the timber industry, recreational homes and associated lodging and services sustain the forested regions economically, but they also create development pressure that threatens to change the pastoral character of the region. Many of the lakes and streams in the region are sensitive to acidic deposition originating from industrial sources upwind from the ecoregion, particularly to the west.” (Griffith et al. 2009)

At the broadest level, the Town of Sunapee resides within the Atlantic Highlands of the Northern Forests ecoregion of North America, Level II and Level I respectively. Maps of all four ecoregion levels can be found in Appendix B : Ecoregions.

4.04 Surface waters, riparian zone & floodplains

Watershed. Water covers just over 16% of the total land area of Sunapee at 2,653 acres, while the land area of town is 13,447 acres (Map 5, Table 3).

All surface waters in Sunapee drain to the Sugar River which flows into the Connecticut River which flows into the Atlantic Ocean. This makes Sunapee fully a part of the Connecticut River watershed, HUC-4 level, and the Sugar River watershed, HUC-10. A watershed is the area of land that drains to a certain waterbody. The US Geological Survey uses hydrologic unit codes (HUCs) to identify a specific hydrologic feature, such as a drainage basin. The shorter the code, the larger the region delineated. The HUC-12 represents the local sub-watershed level, capturing tributary systems.



Photo 5. Lake Sunapee Harbor, view to east. Credit: Barbara Chalmers.

At the HUC-12 level, the Town is divided into two sub watersheds (Map 5, Table 2). The western portion of town is part of the Long Pond Brook-Sugar River watershed. The eastern side of town is a part of the Lake Sunapee watershed, draining directly into Lake Sunapee before flowing into the Sugar River.

HUC-12 Watershed	Square Miles	Acreage	% Town
Long Pond Brook-Sugar River	13.8	8,813	55%
Lake Sunapee	11.4	7,287	45%

Table 2. HUC 12 Watersheds within Sunapee

Source: National Hydrography Dataset Plus, 2018.

The riparian zone is a vegetated area abutting water, important for water quality, habitat, bank stabilization, and other functions (Figure 1). These strips of grass, shrubs, and/or trees along the banks of rivers and streams provide a transition zone between water and human land use, and are the single most effective protection for our water resources. Buffers are also complex ecosystems that provide habitat and improve the



Photo 6. Trask Brook at Johnson farm field 2020. Credit: Barbara Chalmers.

stream communities they shelter. While the important riparian zone varies by the function desired and stream size, this report standardizes the area to a 50-foot buffer from the stream centerline. As such the buffer area covers 703 acres or 4.4% of the Town. The New Hampshire Shoreland Water Quality Protection Act (RSA 483-B) (SWQPA) protects the riparian zone for public waters, including perennial streams of order four or above, and lakes or ponds greater than 10 acres. The Strahler stream order is a scientific method used to define stream size based on its place within the stream network, including intermittent streams.

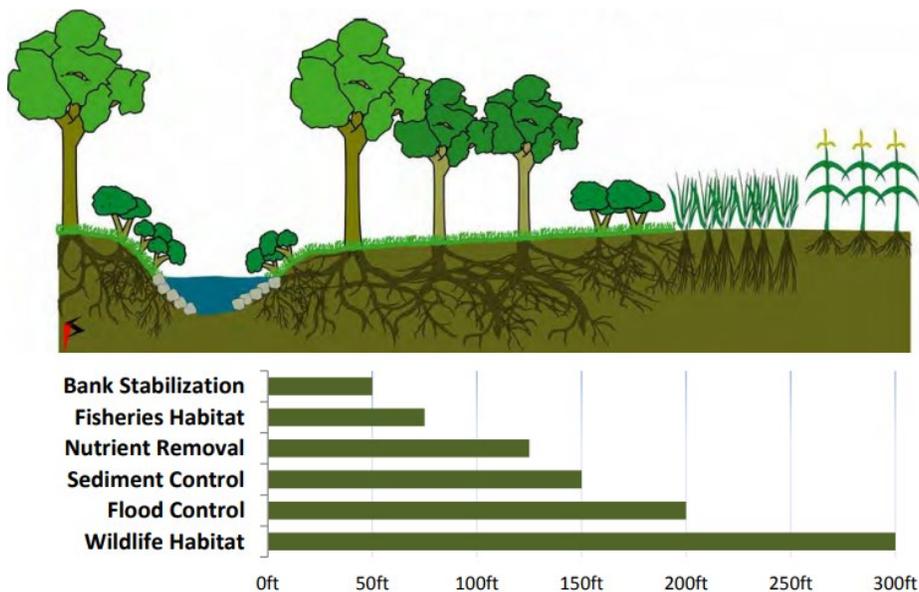


Figure 1. Common riparian buffer widths and their ability to perform various functions.

Source: Connecticut River Joint Commissions, 2018.

Streams and rivers. The Town contains 38 miles of streams and rivers with the larger Sugar River and Ledge Pond Brook stretching 4.7 miles. In particular, the influence of the Sugar River is significant

for the industrial history of the region. The Sugar River is also a secondary water supply for the City of Claremont. Smaller streams with names include Otter Pond Brook, Meadow-Muzzey Brook, and Angell-Trask Brook. First order streams represent the smallest headwater streams. Most streams in Sunapee, or 57.4%, are first order streams. While only 8.7% or 3.3 miles are fourth or fifth order streams, protected by the SWQPA.

Lakes and ponds. Sunapee is especially rich in surface waterbodies, with five lakes or ponds over 100 acres and numerous smaller ponds (Table 3). In Sunapee, Lake Sunapee is the largest body of water with a shoreland broken up by many coves and bays, including Georges Mill Harbor, Jobs Creek, Scott Cove, Gardner Bay, Sunapee Harbor, Hedgehog Cove, Burkehaven Harbor, Penny Cove, and Fishers Bay. The town shares Lake Sunapee with the Towns of Newbury and New London, linking them ecologically. The lake covers a total of 4,090 acres, with over half of its acreage in Sunapee. Unsurprisingly, the Lake provides layers of values to the Town. Drinking water for a significant portion of Sunapee’s population comes from Lake Sunapee (see section 4.10 Groundwater resources & public water supplies). Lake Sunapee is identified as important wildlife habitat (see section 4.07 Habitat types & value) and provides recreational and aesthetic value to residents and visitors alike. The level of Lake Sunapee is controlled by the NHDES Dam Bureau at its only outlet, the Sunapee Harbor dam, using historic hi-low levels established in 1902 from the Sunapee Dam Corporation lawsuit. Lake Sunapee is an iconic symbol of the region and has been protected by concerned citizens since 1898 when the Lake Sunapee Protective Association was formed.



Photo 7. Ledge Pond Brook, photo from trail in MacWilliams lot, Mar 2020 (left). Ledge Pond at hiking trail end looking west (right). Credit: Barbara Chalmers.

Category	Length (mi)	Acreage	Buffer (50 ft) Acreage	% Town Waterbody & Buffer
Lakes and Ponds	-	2653	231	17.9%
Ledge Pond	-	116	17	0.8%
Mountainview Lake	-	116	16	0.8%
Mud Pond	-	10	4	0.1%

Otter Pond	-	125	21	0.9%
Perkins Pond	-	157	17	1.1%
Lake Sunapee	-	2114	125	13.9%
Wendell Marsh	-	4	2	0.0%
<i>Unnamed ponds, <10 acres</i>	-	12	29	0.3%
Streams and Rivers	38.0	-	472	2.9%
Sugar River	1.6	-	-	-
Ledge Pond Brook	3.1	-	-	-
Stream Order 5	3.1	-	39	0.2%
Stream Order 4	0.2	-	3	0.0%
Stream Order 3	3.3	-	41	0.3%
Stream Order 2	9.5	-	118	0.7%
Stream Order 1	21.8	-	272	1.7%
Land	-	22,912		83.5%

Table 3. Land and water area in Sunapee

Source: New Hampshire Hydrography Dataset Plus, 2018.

Floodplains are low-lying areas next to streams, rivers, or waterbodies with a potential to inundate with water during rain and snow melt events. They are areas that may warrant conservation or restoration priority and consideration in community land use policies. Floodplains often contain nutrient rich soils and important wildlife habitat. Also, they are important ecosystem tools to protect immediate and downstream areas from flooding events by slowing water down and reducing peak flows. Floodplains help to determine risk of flooding for buildings and infrastructure. The US FEMA flood maps are the standard US resource to identify flood plains or what they call zones. The FEMA flood zone designations can be grouped into three general categories high-risk areas with a 1-percent annual flood chance (or 100-year), moderate-risk areas between the 1-percent and 0.2-percent annual flood chance (or 500-year), and minimal risk. The majority of Sunapee, not a waterbody, is within the minimal risk zone. Only a quarter of an acre along Lake Sunapee is of moderate risk. Within the high-risk area are 492 acres, or 3% of the town (Map 6). The FEMA flood maps are informed by historical precipitation, flooding, and modeling, and do not consider intense rainfall or climate change. The FEMA flood maps often receive political and homeowner challenges to expanded flood zones.

The First Street Foundation Flood Factor model illuminates potential pitfalls of the FEMA method through its own analysis. The First Street methodology “analyzes flood hazards, projects future climate scenarios, incorporates local adaptation, and validates against satellite and government records.” In Sullivan County, First Street shows more than double the number of properties with moderate risk of flooding over the next 30-year period (Flavelle et al., 2020).



*Photo 8. Sugar River at Lower Main St and Winn Rd bridge Mar 2021.
Credit: Barbara Chalmers.*

4.05 Land cover

The National Land Cover Database (NLDC), managed by the US Geological Survey, is updated every couple of years to show how the landscape changes due to both natural and human impacts. This regular reporting with spatial data allows communities to monitor land cover at a broader and longer time scale to identify trends or isolated challenges/opportunities. For details on types of land cover see Appendix A : Data Source Documentation.

2019 land cover. By far, the Town of Sunapee is dominated by a mixed forest land cover at 59% of Town. Another 17% of Town is covered by open water, wetland at 7% and hay/pasture at 4%.

As a rural town, the developed land cover sits at 12%, half of an open space type and the rest mainly at low or medium intensity. Residential development is densely clustered along the lakeshores, with some commercial development in Sunapee Harbor and along the state roads, Route 11 and 103. The western part of town is less developed than the eastern part near Lake Sunapee. An electric transmission line passes through Sunapee, heading south from I-89's Exit 12A toward the center of Sunapee and then west into Croydon. The pattern of development and network of interstate and state highways has fragmented the landscape (Map 7). Read more about fragmentation and intact habitat block in the next section 4.06 Habitat blocks.

Change in land cover between 2001 to 2019 shows a reduction in forest and hay/pasture agriculture, and an increase in developed areas and wetlands (Table 4, Map 7). The Northeast Land Cover analysis relies heavily on satellite imagery; there are inherent limitations to the accuracy of these estimates. An example of a misclassification is a single house with a small lawn surrounded by forest would likely be classified as forest, rather than developed. Therefore, the acreage reported for each class should be taken as an estimate, not as a direct measurement.



Photo 9. Sanctuary Dairy farm hayfields on W side of Route 103, to W is Trask Brook, S is Mt. Sunapee. Taken from Tasker Brook Rd. June 2021. Credit: Barbara Chalmers.

Between 2001 and 2011 is when most of the 158 acres (1.6%) of forest loss occurred, with some gains in the following decade but a continued decline of evergreen forest. Most of this change went to developed, grassland, or herbaceous land cover types.

Hay and Pasture agriculture decreased in land cover in both decades resulting in a total loss of 54 acres or 8.5% since 2001. Most of this loss happened in small patches around the edges of fields with conversion either to forested or developed land.

Developed land cover resulted in a 4.7% increase or 87 acres since 2001, mostly as either medium or high intensity. Some gains in open space occurred in the first decade, however this and more was lost in the recent decade. Most of this land cover change came from an expansion of an existing developed corridor or lot with consistent small increases around Sunapee's waters, especially Lake Sunapee and the wetlands in the south of Town.

Increases to wetlands were small but notable at 28 acres, a 2.7% increase. These changes can be seen at Fishers Bay on Lake Sunapee, the north end of Otter Pond, and around Wendell Marsh. Almost all this increase occurred in the last ten years.

Future land cover change. The last few years are not yet reflected in currently available NLCD data. Much of this time was during the COVID-19 pandemic, when Sunapee experienced an increase in use of its seasonal homes and higher residential development, especially during 2021 (Vital Communities 2022). It is then likely that the increase in developed land cover will continue into the next decade and that thoughtful consideration of land use policy may be needed to maintain appropriate coordination between development and natural resource protections. One such known increase in development is taking place on the slopes of Blueberry Mountain off Route 103B.

An adaptive, realistic balance can advance the economic vibrancy, livability, and affordability of the Town alongside the functioning of the Town's natural resources for its value to ecosystem services, aesthetics, recreation, business, and wildlife habitat.

Land Cover Class	2001		'01 to '11 Change		2011		'11 to '19 Change		2019		'01 to '19 Change	
	Acreage	% Town	Acreage	% Town	Acreage	% Town	Acreage	% Town	Acreage	% Town	Acreage	% Town
Developed High Int.	23	0.1%	3.2	14.1%	26	0.2%	3.6	14.0%	29	0.2%	6.8	30.1%
Developed Medium Int.	252	1.6%	25.0	9.9%	277	1.7%	26.5	9.6%	304	1.9%	51.4	20.4%
Developed Low Int.	598	3.7%	26.1	4.4%	624	3.9%	10.0	1.6%	634	3.9%	36.2	6.0%
Developed Open Space	978	6.1%	24.1	2.5%	1,002	6.2%	-31.2	-3.1%	971	6.0%	-7.1	-0.7%
Developed Sub-Total	1,851	11.5%	78.4	4.2%	1,929	12.0%	8.9	0.5%	1,938	12.0%	87.3	4.7%
Emerging Herbaceous Wetlands	53	0.3%	-2.2	-4.1%	51	0.3%	14.9	29.2%	66	0.4%	12.8	24.0%
Woody Wetlands	983	6.1%	2.4	0.2%	986	6.1%	12.7	1.3%	998	6.2%	15.1	1.5%
Wetlands Sub-Total	1,037	6.4%	0.2	0.0%	1,037	6.4%	27.6	2.7%	1,064	6.6%	27.8	2.7%
Deciduous Forest	1,307	8.1%	-1.2	-0.1%	1,306	8.1%	16.7	1.3%	1,322	8.2%	15.5	1.2%
Evergreen Forest	3,784	23.5%	-79.2	-2.1%	3,705	23.0%	-48.9	-1.3%	3,656	22.7%	-128.1	-3.4%
Mixed Forest	4,501	28.0%	-85.0	-1.9%	4,416	27.4%	39.5	0.9%	4,455	27.7%	-45.5	-1.0%
Forest Sub-Total	9,591	59.6%	-165.5	-1.7%	9,426	58.5%	7.3	0.1%	9,433	58.6%	-158.1	-1.6%
Shrub/Scrub	149	0.9%	58.4	39.2%	207	1.3%	34.6	16.7%	242	1.5%	93.0	62.5%
Herbaceous	131	0.8%	72.5	55.4%	203	1.3%	-44.5	-21.9%	159	1.0%	28.1	21.5%
Hay/Pasture	633	3.9%	-40.1	-6.3%	593	3.7%	-13.5	-2.3%	580	3.6%	-53.6	-8.5%
Barren Land	11	0.1%	-0.9	-8.0%	10	0.1%	7.7	74.6%	18	0.1%	6.8	60.6%
Open Water	2,696	16.7%	-2.8	-0.1%	2,693	16.7%	-28.3	-1.1%	2,665	16.6%	-31.2	-1.2%

Table 4. Land cover change in Sunapee

Source: National Land Cover Dataset 2011, 2011 & 2019.

4.06 Habitat blocks

Many wildlife species rely on large blocks of contiguous forest and secure connections to other large forest blocks for all or part of their habitat needs. Contrastingly, landscape fragmentation can be detrimental in terms of loss of habitat area, loss of habitat connectivity, increased potential for incursions of invasive or damaging species, and increased potential for vehicle-wildlife collisions as well as other undesirable human-wildlife interactions.

The maintenance of large forest blocks benefits both wide-ranging species, as well as habitat-specific species that live in interior forests, such as wood thrush. Native black bear, bobcat, fisher, and moose require huge acreages, often spanning two or more towns, to find food, shelter and successfully rear their young. The wildlife value of these forest blocks increases with size and with connectivity to wetlands, lakes, and rivers (Kanter *et al.* 2001).

A regional, bi-state project by the Linking Lands Alliance (LLA) seeks to identify and understand important natural habitats and connecting lands that support large, wide-ranging wildlife species. The maps produced from this project have been used by teachers in lessons about policy and ecology. As a result of this effort, a regional dataset of habitat blocks and their relative ecological importance is available for the Town of Sunapee, located on the southeastern edge of the LLA study region. Habitat blocks in the study were fragmented by:

1. Land cover types – developed lands, bare land, cultivated crops, and pasture/hay
2. Buildings and Roads (not including private / unmaintained) with a 330 ft buffer
3. Blocks less than 20 acres

To determine ecological importance, ten features were considered. These ten features were Wildlife Action Plan ranked habitats, ecological landscape unit groups, element occurrence count, percent core, block size, density of interior roads, percent lakes and ponds, percent wetlands, order and density of stream, and percent TNC matrix block. Full methodology details can be found on the LLA website.

The three most significant habitat blocks seen in Map8 in Sunapee include:

1. One in the south of 760 acres, completely contained within the Town, cover most of Blueberry Mountain and recently experienced residential development along Route 103B.
2. The highest scoring block is located on the southeastern edge of town and stretches beyond to more than 9,000 acres. This is the northernmost extent of the Sunapee-Pillsbury Highlands. Much of this mountainous area is protected from development by Mount Sunapee, Pillsbury State Parks and adjacent conservation land.
3. Another above average block has 45% of its almost 5,000 acres in the northwestern corner of Sunapee, including Ledge Pond and extending into Croydon and Springfield.

The most fragmented areas of Town are around Lake Sunapee and Routes 11 and 103B. The majority of town consists of forest blocks less than 500 acres in size, but there are five large blocks of unfragmented land with some coverage in Sunapee (Map 8). Most of these blocks were determined to be at or below the average ecological importance score for the NH part of the region. There are five habitat blocks with an above average ecological importance, including one for Lake Sunapee.

4.07 Habitat types & value

4.07(a) Native Species Value and Threats

By identifying and protecting the full range of ecological communities present in Sunapee, it should be possible to provide habitats for all native species, including those not identified as rare. Native wildlife and plants have evolved to local environments, in tune with each other and their surroundings.

Native plants provide essential nutrients to wildlife through nectar, nuts, fruits, and other edible products. These plants also provide essential materials and spaces for wildlife shelter, nesting, and micro-climates. For example, cold water fish habitat is maintained in part through a healthy native, riparian buffer that provides nursery habitat and river shading for temperature control. These cool, water corridors are likely to become increasingly important to many wildlife as global warming continues to escalate. Native plants often exist in concert with each other to establish ecological communities. While some plants fix nitrogen to the soil, others spread their roots increasing soil aeration or provide unique habitats (e.g., mycorrhizae fungi, epiphytes, orchids).

Native wildlife serves their host habitats through seed dispersion and an interconnected food web. Keystone species provide linchpin roles in ecosystem dynamics. Beavers uniquely engineer their homes in a way that provides habitat for other species, some of which only live in beaver impacted areas. Beavers are also a common conflict species due to their ability to damage and reduce the functioning of infrastructure. Fortunately, new technologies, such as the beaver deceiver, are being implemented and refined to address these beaver conflicts in a mutually beneficial way. Another keystone species are high-level predators, such as coyotes. Some native wildlife such as gulls, corvids, and raccoons often become overpopulated and threaten other native wildlife populations (e.g., ground nesting birds), habitats (e.g., deer feeding on forest understory), and human health (e.g., increased risk of Lyme disease).

Invasive exotic species are those that are non-native (or alien) to the ecosystem and whose introduction causes or is likely to cause economic or harm to environment or human health. Not all exotic species are invasive. Those that are persist in a way that can be hard to control, altering native habitat composition and structure. This ability is due to a lack of natural predators and habitat dynamics curtailing growth. In Sunapee, multiple terrestrial plant species have raised concern. Japanese knotweed is observed along Routes 11 and 103B as well as several spots in the harbor area and at town hall. Phragmites, reed grasses found in wet areas, required active management at water and the wastewater treatment plant near Wendell Marsh. In 2000, Lake Sunapee did support a small infestation of Variable milfoil, but due to early detection and rapid response actions, the lake is invasive plant species-free now. As this example highlights, the best management for invasives focuses first on prevention and monitoring for early removal. Once established, many invasive species can be very difficult, or impossible, to remove.

Diseases and parasites are another threat to native wildlife and plants. Emerald Ash Borer, a non-native insect pest, is attacking ash trees in Sunapee and elsewhere. Other concerns include but are not

limited to white nose syndrome attacking native bats and hemlock woolly adelgid thinning out of hemlock stands.

4.07(b) Habitat types

The New Hampshire Fish and Game Department completed an analysis of habitat type, condition, and priorities for conservation published as the Wildlife Action Plan (WAP), most recently updated in 2020. Brochures for habitat types including species information are produced by NH Fish and Game for the Wildlife Action Plan and a subset of those relevant are included in this report as Appendix C : Habitat Types & Associated Species. The habitat classification used by the WAP separates habitats into broad ecological communities, summarized for Sunapee in Table 5 and visualized in Map 9.

Hemlock-hardwood-pine mixed forest is the dominant forest matrix in Sunapee covering 57.8% of Town. Hemlock-hardwood-pine forest is a broadly defined land cover type; this forest is heterogeneous, with varying amounts of hemlocks, hardwoods, and pines depending on water availability, nutrient status, and fire frequency. This forest type represents a transitional region between eastern deciduous forest, dominated by oaks, hickories,



Photo 10. Scenic historic view of Mt. Sunapee from Trow Hill Rd, circa 1930s. Credit: photographer unknow, Sunapee Historical Society.

and other hardwoods, and the boreal forest, dominated by spruces, firs, and other conifers. Common tree species include eastern hemlock (*Tsuga canadensis*), American beech (*Fagus grandifolia*), red oak (*Quercus rubra*), and white pine (*Pinus strobus*). Early successional stages of this forest may have large numbers of paper birch (*Betula papyrifera*), red maple (*Acer rubrum*), and striped maple (*Acer pennsylvanicum*). Two typical understory plants are witch hazel (*Hamamelis virginiana*) and wintergreen (*Gaultheria procumbens*). Hemlock-hardwood-pine forest is also the most dominant forest type in New Hampshire, and supports 140 vertebrate species, including 15 amphibians, 13 reptiles, 73 birds, and 39 mammals, as well as many invertebrate species. All 4 New Hampshire big-game species are common in this type of forest: moose, white-tailed deer, black bear, and turkey.

Northern hardwood-conifer forest, also in Town, covers 2.7% of Town. Northern hardwood-conifer forest is dominated by American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), and yellow birch (*Betula alleghaniensis*), and tends to proliferate at elevations between 1,400 to 2,500 ft. This forest type is generally found mixed in the landscape with hemlock-hardwood-pine forests, with more

hardwoods on richer soils, more hemlocks on damp soils, and more pines on dry soils. Within this forest type are many defined communities, and there is a wide range of associated woody and herbaceous plant species within those more closely defined communities. Three of the most common herbaceous species are starflower (*Trientalis borealis*), wild sarsaparilla (*Aralia nudicaulis*), and Canada mayflower (*Maianthemum canadense*). The northern hardwood-conifer forest also hosts 137 vertebrate species, including ruffed grouse, American woodcock, wood thrush, veery, several warblers, 5 species of bat, and many reptiles and amphibians.

Floodplain forest can be found along the Sugar River in Sunapee. This habitat type covers just 0.2% of Town. Floodplain forests in New Hampshire rivers typically have silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), or red maple (*Acer rubrum*) as the dominant tree species. These forests are an interface between the river and upland forests, and the plants growing here can tolerate some flooding, but not constant standing water. The specific makeup of the Sugar River floodplain forests in Sunapee would require a habitat survey.

Wetland complexes, either of swamp or peatland type, cover 5.4% of Town. Marshes are scattered throughout town in stream valleys; in addition, the north end of Otter Pond and Perkin’s Pond also have some swampland. Peatlands are less common than marshes at only 53 acres; the largest peatland is located near Stagecoach Rd. Wetlands provide habitat for a great number of amphibians, reptiles, birds, and invertebrates; moose are a frequent visitor to marshes and shallow ponds during the summer months. Vernal pools provide breeding habitat to many amphibians in the spring. More details on wetlands can be found in section 4.08 Wetlands.



Photo 11. Jobs Creek wetland looking north from Jobs Creek Rd, 2020. Credit: Barbara Chalmers.

Grasslands cover 6.7% of town and are defined as areas greater than 25 acres dominated by grasses, forbs, and sedges with little shrub or tree cover. The largest blocks of grassland are primarily located along Rt. 103 and Rt. 11 on the far western edge of town. Although grasslands were relatively rare prior to European settlement, they expanded in the mid-1800’s. Several species of bird have adapted to take advantage of these communities, relying on the grasses for breeding grounds as well as a source of abundant food, in the form of seeds or insects. Now New Hampshire grasslands host some important native pollinators, as well as bird species endangered in their native states, such as the Northern Harrier (*Circus cyaneus*) and Upland Sandpiper (*Bartramia longicauda*). In the Northeast, large grasslands have been disappearing, and the populations of grassland birds have declined more rapidly than any other group of birds (NH Fish and Game, 2015). Due to their ecological significance, preserving remaining grassland habitat is a conservation goal for many. The historic Roger’s farm meadow at

Dewey Woods, Town Forest, requires mowing to maintain this habitat. The National Park Service recommends once a year.

Lake and ponds with both coldwater and warmwater habitats are in Sunapee. The shorelines of these waterbodies are valuable real estate in New Hampshire, but their importance as wildlife habitat is also significant. The qualities that make shorelines attractive to wildlife may be very different from what makes them attractive for boating and swimming. The aquatic habitats in Sunapee range from large lakes to small shallow marshes, and support a wide variety of fish and invertebrate life. Lake Sunapee is noted as among the most resilient coldwater lakes in New Hampshire due to its quantity of deep-water. In fish surveys, Lake Sunapee is known to host many species, including Brown bullhead, Landlocked salmon, Lake trout, Smallmouth bass, Largemouth bass, Burbot, Eastern chain pickerel, and Rock bass (NH Fish and Game, 2017). The Sunapee trout (*Salvelinus aureolus oquassa*) was native to Lake Sunapee but has been extirpated and is listed as an endangered species in New Hampshire. Perkins Pond, one of the warmwater ponds, is known to host a smaller number of fish species, including Brown bullhead, Eastern chain pickerel, and Smallmouth bass. The Sugar River provides a coldwater habitat for Blacknose dace, Longnose dace brook, Creek chub, Common shiner, Common sunfish, Eastern brook trout, Eastern chain pickerel, Fallfish, Rainbow trout, and Yellow bullhead.

4.07(c) Natural community

A natural community is defined as a recurring assemblage of plants and animals that recurs across the landscape under similar physical conditions (NH Natural Heritage Bureau 2022). The NH Natural Heritage Bureau (NHB) tracks “exemplary” natural communities, which are those “of a rare type or must be a relatively undisturbed occurrence of a common community in good condition”. These exemplary natural communities represent the best remaining examples of the state’s biological diversity and are tracked by NHB. The NHB provides summary data of natural communities for public consumption at a coarse landscape level, specifically two square mile hexagon areas. Two areas covering both Sunapee and Newbury on the south-eastern border of Town include exemplary communities.

1. A Montane - subalpine circumneutral cliff on the southern end of Lake Sunapee
2. A Northern hardwood - conifer forest system with old growth on the very south-eastern corner of Town.

Appendix C : Habitat Types & Associated Species contains summaries of each community which are both flagged as “High Importance.”

4.07(d) Habitat value ranking

In the Wildlife Action Plan, habitat types are ranked according to their condition and risk of degradation. Measuring habitat condition entailed a lengthy analysis of various factors that impact wildlife, including those related to the landscape context, biodiversity, human recreation, development and land use, and air and water quality. For a thorough description of this analysis, please refer to the Wildlife Action Plan.

The WAP analysis results in four tiers of conservation value:

- Tier 1 - Highest ranked habitat in the state (top 10-15%),
- Tier 2 - Highest ranked habitat in the biological region,
- Tier 3 - Supporting landscapes important to highest ranked habitats, and
- Habitat not highly ranked.

Tier 1 wildlife habitat is of greatest conservation priority because they represent the top 10-15% of habitat in the entire state. Tier 2 wildlife habitat is also of high conservation priority because each part of the state has unique species and habitat types that are important on a regional scale. Tier 3 wildlife habitat helps maintain the high level of biological integrity of Tier 1 and Tier 2 habitat (Map 8, Table 5).

Many of the lakes and wetlands in and around Sunapee have very high wildlife value and have been ranked as top-tier habitat. There are large areas of high-quality habitat around Ledge Pond, Lake Coniston, Perkins Pond, and Lake Sunapee, and, to a lesser extent, around Mountainview Lake and Otter Pond. The floodplain forests and wetlands on the Sugar River, especially near Wendell village and the Wendell Wildlife Management Area, are also high-quality habitat. These areas may consist of open water, marsh or other wetland, and forest, which provide a mix of habitats to support many species.



Photo 12. Otter Pond. Credit: Barbara Chalmers.

Habitat type	Tier 1 - Highest Ranked in State		Tier 2 - Highest Ranked in Biological Region		Tier 3 - Supporting Landscape		Total Habitat Area in Town	
	Acreage	% Tier	Acreage	% Tier	Acreage	% Tier	Acreage	% Town
Open water	2,138	56.8%	-	-	-	-	2,653	16.5%
Hemlock-hardwood-pine	1,147	30.5%	174	42.2%	627	57.6%	9,298	57.8%
Developed Land	141	3.7%	-	-	2	0.1%	1,629	10.1%
Wet meadow/shrub wetland	105	2.8%	21	5.1%	12	1.1%	369	2.3%
Grassland	99	2.6%	181	44.2%	386	35.5%	1,085	6.7%
Northern swamp	90	2.4%	12	2.9%	47	4.3%	420	2.6%
Temperate swamp	14	0.4%	-	-	4	0.4%	34	0.2%
Rocky ridge	11	0.3%	-	-	1	0.1%	89	0.5%
Floodplain forest	7	0.2%	21	5.2%	-	-	29	0.2%
Northern hardwood-conifer	7	0.2%	-	-	1	0.1%	433	2.7%
Peatland	3	0.1%	2	0.4%	8	0.8%	53	0.3%
Cliff and Talus	-	-	-	-	-	-	5	<0.1%
Acreage Total	3,762		411		1,090			
% Town	23.4%		2.6%		6.8%			

Table 5. Important wildlife habitat types and value in Sunapee

** - Reported acreage for cliff and ridge community types is intentionally exaggerated. These areas have extraordinary ecological value; therefore the New Hampshire Heritage Bureau generalizes the data to protect them. Source: NH Fish and Game's Wildlife Action Plan, 2020.*

4.08 Wetlands

The State of New Hampshire defines wetlands by three characteristics: hydrology, soils, and vegetation. All three must be met to define an area as a wetland. The wetlands definition states “those areas that are inundated or saturated by surface water or groundwater at a frequency and duration of sufficient to support, and do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.”

Since the arrival of Europeans in North America, the most common uses of wetlands were conversion to other land uses, either by draining or filling in wetlands to create uplands, and impounding wetlands to create deep water lakes and ponds. This devaluation of wetlands as a land cover type led to the loss of roughly 50% of all wetlands in the United States, and roughly 9% in New Hampshire. Today, the values of intact wetlands are more recognized, and range from flood control to fish and wildlife habitat. The New Hampshire Method for Functional Wetlands Assessment (Ammann and Stone 1991) lists the following fourteen “functional values” of wetlands:

1. Ecological Integrity
2. Wetland Wildlife Habitat
3. Finfish Habitat
4. Education Potential
5. Visual/Aesthetic Quality
6. Water Based Recreation
7. Flood Control Potential
8. Ground Water Use Potential
9. Sediment Trapping
10. Nutrient Attenuation
11. Shoreline Anchoring and Dissipation of Erosive Forces
12. Urban Quality of Life
13. Historic Site Potential
14. Noteworthiness (such as habitat for endangered species)

Wendell Marsh

One noteworthy wetland in Sunapee is Wendell Marsh along the Sugar River. This marsh is a Wildlife Management Area with almost 280 acres of conserved lands. These lands are stewarded by the NH Fish and Game Department, Sunapee Conservation Commission, and Ausbon Sargent Preservation Land Trust. As part of the Sugar River floodplain, this marsh helps control floods and trap sediments. The marsh also provides important wildlife habitat and a resource for low impact recreation, with trails managed by the Lake Sunapee Snowmobile Club. In addition, there are wellheads on the property that could be used in the future for municipal water production.

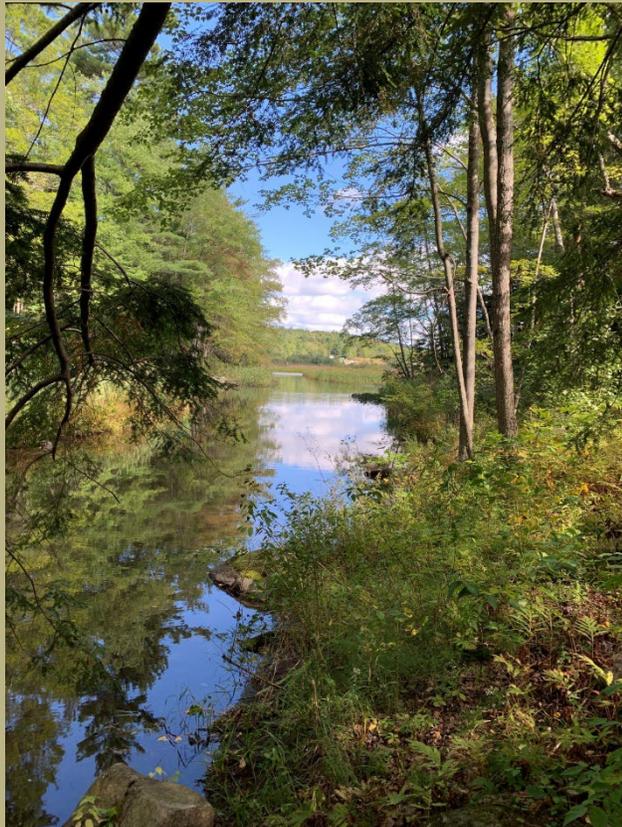


Photo 13. Wendell Marsh at NH Fish & Game access, Sept 2022. Credit: Barbara Chalmers.

Wetlands come in a wide variety of types; they may be forested, grassy, or covered in shrubs; they may be connected to a stream, lake, groundwater spring, or fed only by rainwater. This variety in wetlands leads to a diversity of wetland functions. Some wetlands are more important for flood control or nutrient retention, while others may be better for wildlife.



Photo 14. Trask Brook Marsh at Bradford Road looking south, Nov 2021. Credit: Barbara Chalmers.

Wetlands Inventory.

The only Town-wide wetlands inventory available is based on satellite imagery through the National Wetland Inventory (NWI) and hydric soils data. Together, these provide an appreciation for the extent and location of potential wetlands in Sunapee covering 2,037 acres or 12.7% of the Town (Map 10, Table 6). The NWI was an effort undertaken by the US Fish and Wildlife Service to catalog wetlands over the entire United States. Not all wetlands are mapped, due to the limitations of the study methodology and scope of work. Therefore, the NWI underestimates the total amount of wetlands, especially small wetlands.

The State of New Hampshire allows municipalities to designate “prime wetlands” under RSA 482-A:15. These are typically delineated by a wetland scientist. The municipality then designates specific high-quality wetlands as a “prime wetland”, often due to its large size, unspoiled character, and ability to sustain important habitat for wildlife.

Type	Acreage	% Town
Wetlands	712	4.4%
Freshwater Emergent Wetland (e.g., cattail, reeds)	170	1.1%
Freshwater Forested Wetland/Shrub Wetland	542	3.4%
Hydric Soils	1,840	11.4%
Partially Hydric (76-95%)	1,415	8.8%
All Hydric	425	2.6%
NWI & Soil Survey overlap	515	3.2%
Total Coverage	2,037	12.7%

Table 6. Wetlands and Hydric Soils in Sunapee

NWI classifications not acknowledged in this list include riverine systems and areas permanently, semi-permanently or artificially flooded. Source: National Wetlands Inventory 2022 and Gridded National Soil Survey Geographic Database 2021.

Hydric soils are those soils that have developed under saturated conditions and are one of the three indicators of a wetland under the New Hampshire definition. Hydric soils from the Soil Survey database (2021) are identified through multiple parameters. Those soils meeting more than

75% of these parameters are called *hydric soils* in this report. A thorough description of hydric soil ratings can be found in Appendix D : Soil Survey Descriptions.

Named wetlands in Sunapee include the Wendell Marsh, MacWilliams Lot, Simpson Reserve Marsh, Flint-Webb Lot Marsh, Leone Lot Marsh, Jobs Creek Marsh, Perry-Sleeper Rd Marsh, Johnson-Sleeper Rd Marsh, Nutting Road Trask-Angell Brook Marsh, Hargbol-Route 103 Marsh, Perkins Lot-Mud Pond Marsh, and Webb Forest Marsh. There are also floodplain forests along the Sugar River, parts of which may be classified as wetlands. These areas provide flood retention, shoreline anchoring, wildlife habitat, and a unique natural community that is uncommon in the state.

Vernal Pools. Generally, not included in the NWI is a special type of small wetland, a vernal pool. This is an intermittently flooded small pond that is filled with water in spring and early summer, but completely dry the rest of the year. Vernal pools provide critical breeding habitat for many amphibians, as the intermittent nature of these ponds do not support aquatic predators. Amphibians breeding in vernal pools in New Hampshire include marbled salamanders, wood frogs, spotted salamanders, and Jefferson or blue-spotted salamanders. These species depend on vernal pools, which make this wetland type a highly important resource. Members of the Conservation Commission are aware of several vernal pools in Sunapee, seen in Map 8; however, many more are undoubtedly undocumented.



Photo 15. Vernal Pool east of Garnet Street, Apr 2022. Credit: Barbara Chalmers.

4.09 Rare Species

Sunapee’s natural landscape is a mixed forest interspersed with grasslands, wetlands, and aquatic habitats. The heterogeneity of the landscape provides habitat for many species of wildlife, both the common and rare. Common species by habitat type are summarized in section 4.07(a) with additional information in Appendix C: Habitat Types & Associated Species from brochures produced by NH Fish and Game.

The iconic common loon is looked for by residents and visitors alike. A species on the state threatened list due to population declines from habitat degradation and lead poisoning from ingesting fishing tackle, common loon populations reportedly increased in 2014 with 289 pairs that nest on lake edges in New Hampshire, up 85 pairs in ten years (NH Natural Heritage Bureau, 2015).

In addition to local sources of information, the state also keeps records of wildlife and natural communities in New Hampshire. The New Hampshire Natural Heritage Bureau maintains a database of occurrences for rare, threatened, and endangered species and exemplary natural communities. In Sunapee, three documented rare species have been reported, all since 2011 (Table 7, Map 8). Exemplary natural communities are summarized in Section 4.07(c). The Natural Heritage Bureau has not exhaustively surveyed the state, so it is possible that additional rare species and exemplary natural communities do occur within Sunapee. If town residents have information about rare species occurrences in Sunapee, they should contact the Natural Heritage Bureau.

In areas of surrounding towns, within two miles of Sunapee, several other rare species have been spotted (Table 7). It is possible these species extend into Sunapee, even though they have been documented only in neighboring towns. The exact ranges are not provided for public consumption by the NH Natural Heritage Bureau.

Type	Species (Common – Scientific Name)	Listed in NH	Spotted in
Bird	American Kestrel – <i>Falco sparverius</i>	Special Concern	Sunapee
Bird	Common Loon – <i>Gavia immer</i>	Threatened	Sunapee, Springfield, Croydon
Plant	American water awlwort – <i>Subularia aquatica ssp. americana</i>	Endangered	Sunapee
Bird	Bald Eagle – <i>Haliaeetus leucocephalus</i>	Special Concern	Sunapee, New London
Plant	Fragrant Wood Fern – <i>Dryopteris fragrans</i>	Threatened	Newbury
Plant	Greater Fringed-Gentian – <i>Gentianopsis crinita</i>	Threatened	Newbury
Plant	Loesel's wide-lipped orchid – <i>Liparis loeselii</i>	Threatened	Newbury
Mammal	Canada Lynx – <i>Lynx canadensis</i>	Endangered	Springfield

Table 7. Rare Plants and Animals Reported during the last 20 years in Sunapee.

Source: NH Natural Heritage Bureau 2022 & Sunapee Conservation Commission 2022.

4.10 Groundwater resources & public water supplies

Aquifers. Sunapee has an abundance of surface waters, but somewhat limited groundwater resources in the form of stratified-drift aquifers. Stratified-drift aquifers are sand and gravel deposits from glacial lakes and rivers through which water can flow in large quantities. This flow is measured through transmissivity, which quantifies the ability for an aquifer to transmit water. In the State of New Hampshire, 12% of land and water is underlain by aquifers (USGS 2007). The methods utilized by USGS to create the aquifer dataset included hydrologic data, soils maps, existing well data, bridge-boring records and supplementary test wells/holes.

NHDES guidance for potential community well sites are to be located at aquifers with moderate or high transmissivity in areas away from potential contamination sources, such as roads, residences, and commercial development (Local potential contamination sources, NHDES 2019). The aquifers within Sunapee were found to have low transmissivity, less than 2,000 square feet per day (Flanagan 2007). For the report referenced, US Geological Survey defines transmissivity as foot squared per day. The standard unit for transmissivity is cubic foot per day per square foot times foot of aquifer thickness, which reduces to foot squared per day.

Ground water contaminants. The NHDES Drinking Water and Groundwater Bureau provides information on naturally occurring and artificial contaminants. About half of the state's bedrock wells have radon at levels of concern, and an estimated 30% have arsenic at levels that exceed the limit for public water systems. Iron and manganese are also quite common at levels that taste bad or cause staining of laundry or fixtures. Manganese may also occur at potentially unsafe levels. Fluoride, beryllium and radionuclides other than radon are less common but do occur naturally at levels of concern for human consumption throughout the state. Dug wells are less likely to have problems with minerals (arsenic, radon, etc.) but are more likely to have issues with bacteria, low pH, road salt and nitrate.

Sodium and chloride from salt used on roads during winter weather or used in drinking water treatment systems are detected in many residential wells and statewide concentrations in groundwater are generally increasing. Nitrate from septic systems and landscape fertilizer can be detected at levels of concern in residential wells. Volatile organic compounds (VOCs) occur statewide in groundwater, but several activities and land uses seem to be associated with a higher likelihood of contamination. These include nearby fuel spills or leaks and businesses that use petroleum products or petroleum-based chemicals. Poly- and perfluoroalkyl substances (PFAS) are in products that are used in domestic, commercial, institutional, and industrial settings. PFAS have also been used to fight certain types of fires. PFAS have affected wells throughout New Hampshire but are more frequently detected at elevated levels in southern New Hampshire. See Appendix H : Additional Resources for a summary of private well contaminant presence.

Groundwater wells and Wellhead protection areas. Groundwater wells draw water from a three-dimensional zone around the wellhead, rather than a single point below the wellhead. Therefore, the groundwater resource is best represented as an area, referred to as a wellhead protection area. Wellhead protection areas have been delineated for the active community

systems (Map 11). These protection areas are defined as the area from which water is expected to flow to the well under extremely dry conditions (Witten et al., 1995). Private well locations are regulated by the state permitting process (see section 5.02 State regulations). Potential water quality impacts of private wells are described in Section 4.11 Stormwater & water quality. These wellhead protection areas cover roughly 1,300 acres, or 10% of land area.

Public Water Supplies. Roughly half of Sunapee’s residents receive their drinking water from Lake Sunapee, through a service connection with the Sunapee Water Department through three main system connections, as seen in Table 8. All others receive their drinking water from bedrock wells, either privately owned or from a public water supply. In addition to Sunapee Water Department, there are eight active public water supply systems registered with the NH Department of Environment Services, and five inactive.

Inactive wells can be reactivated by following the procedures for a new well approval. The system population would not change except if there is an expansion. Inactive wells are listed under their last approved registration name, even if has since changed. For example, Seminole Point Hospital area now hosts a private home after shut down in 1996 and building torn down in 1998.

In the Wendell Marsh, potential wells located on Town land may be used in the future as a municipal water source by the Sunapee Water Department, if and when the town has to stop using Lake Sunapee water. Four wells are being eyed as potential sources for a community system. The survey of these wells includes a 400-foot buffer as its well sanitary zone. These wells would need to work through the permitting process to become active systems.

Status	Name	System Type	Population	Service Connections
Active	Sunapee Water Dept.	C	1,680	507
Active	Sunapee Water Dept. – Georges Mills Village	C	500	200
Active	Sunapee Water Dept. – Granliden Village	C	292	117
Active	Georges Mills Cottages	T	33	6
Active	Mount Royal Academy	N	217	3
Active	Sunapee Pizza Chef	T	50	1
Active	Meadow Brook at Sunapee	C	56	20
Active	Dexters Inn	T	30	3
Active	Ziggys Pizza	T	100	1
Active	SUNA Restaurant	T	150	1
Active	Dollar General Store	T	100	1
Inactive	Woodham Spring Condominiums	C	20	10
Inactive	Seminole Point Hospital	N	65	6
Inactive	Burkhaven Motel	T	-	-
Inactive	The Inn at Sunapee	T	50	2
Inactive	Double Diamond Cafe	T	85	1
Potential	Wendell Marsh	C	-	-

Table 8. Public water supply wells by type and population served.

A public well is a piped water system having its own sources of supply. C – Community systems include municipally managed operations. N – Non-transient, non-community systems include schools, businesses. T – Transient, non-community systems include hotels, campgrounds.

Source: NHDES 2022.

4.11 Stormwater & water quality

Given Sunapee's reliance on its abundance of water resources, maintaining and protecting water quality is critical. The water in Lake Sunapee is regularly monitored by the Lake Sunapee Protective Association, the New Hampshire Department of Environmental Services, citizen volunteer programs, and other organizations. According to the 2020/2022 NHDES 305(b)/303(d) assessments, or "watershed report cards," for the two watersheds present in Sunapee, all 144 tested locations achieved category 2 for drinking water. This means that they "[meet] water quality standards/thresholds by a relatively large margin" (NHDES, 2022). In addition, most tested locations in town passed inspection for swimming and other recreation (NHDES, 2022). However, there are several factors that can threaten this water quality, including human influence, deteriorating infrastructure, harmful organisms, and stormwater.

Chemicals & Nutrients. Some human-derived water pollution concerns include per- and polyfluoroalkyl substances (PFAS), road salt, agriculture, mining and industry, and recreational activities. These cause an increase in nutrients, heavy metals, mercury, and other chemicals, which may seriously harm water quality and threaten aquatic life. In Sunapee, mining and industry are unlikely to pose a significant threat due to their limited presence. Future expansion, however, could introduce pollutants such as heavy metals and acids into the water supply, as well as increasing water demand for industrial processes. Fortunately, Sunapee's zoning ordinance places strict prohibitions on location of hazardous materials, junkyards, and salt storage to protect local water, and the NH Department of Environmental Services (NHDES) currently reports no PFAS detected in Sunapee's water supplies (NHDES, 2021a). However, mercury levels in the region are high enough to warrant an NHDES warning against too much local fish consumption (NHDES, 2021b). The NHDES watershed report cards also label a sizable portion of sampled locations as poor quality for the integrity of aquatic life due to high phosphorus levels, low dissolved oxygen, and changing pH (NHDES, 2022a, 2022b). It is important to note that some of the pollutants listed can be deposited over the landscape via atmospheric deposition caused by human activity occurring outside the town of Sunapee, so the absence of such activity in Sunapee does not prevent all risk.

Sunapee's infrastructure may also provide several possible sources for water quality contamination, including aging septic systems, public sewer lines, and road runoff. These can directly or indirectly introduce pollutants into the water supply if not fully addressed. Much of Sunapee is underlain with glacial till with hardpan at shallow depths, which has moderate to poor absorption capability. This makes septic system and other infrastructure failure a critical issue, as the surficial geology does not have the capacity to serve as a natural leach field. Older septic systems, particularly those installed before plumbing code, can be a particular threat to water bodies that are in close proximity. Perkins Pond had been identified since the 1970s as being threatened by high phosphorus levels, which according to the NHDES is attributable to failing septic systems. However, after the construction of a municipal sewer line to shoreline cottages in 2014, the water quality in the pond improved dramatically. This and other new infrastructure installations, as well as nearby water quality trends, should be reviewed and carefully monitored for improvements.

In addition to major water bodies and public water supplies, private wells can be at great risk from decaying or misplaced infrastructure. Shallow wells that serve single residences can easily be affected by surface and near-surface contamination, and are often located at sites containing septic systems, cesspools, and outhouses.

Another one of the most significant pollutants in Sunapee's water supply is sodium chloride, widely used to de-ice roads in the winter. In Lake Sunapee alone, the level of specific conductivity, which can be used to determine salt content, has risen approximately 45% since the 80s (LSPA, 2016). Salt contamination can be even more severe in streams and rivers, especially those with lower flow rates. Proximity to water bodies does not necessarily decrease risk, as dissolved salts can easily spread across watersheds.

Beyond directly polluting water, substances such as these can have other indirect effects, such as a population increase of harmful organisms.

Cyanobacteria, or blue-green algae, are photosynthetic microorganisms that live in all types of water and are typically harmless to humans and wildlife. A rapid increase in population, or "algal bloom", however, can be very dangerous to humans and aquatic life, as cyanobacteria can produce powerful toxins, block sunlight, and negatively affect water composition. These dangerous blooms can occur in warm, slow-moving waters with high nutrient loads, causing populations to explode (CDC, 2022). In Sunapee, a unique type of cyanobacteria called *Gloeotrichia echinulate* is found that has only been documented in the northeastern United States. *Gloeotrichia echinulata*, unlike most cyanobacteria, can easily bloom in low-nutrient waters (NHDES, 2021c). Although harmful algal blooms are rare in Sunapee, they have been occurring more often in recent years due to nutrient pollution and increasing global temperatures (LSPA, NHDES). Cyanobacteria can also easily contaminate drinking water, with that drawn from Lake Sunapee being particularly vulnerable.

Stormwater and heavy precipitation can be very problematic for water quality. Runoff carries large quantities of pollutants such as oil, chemicals, pesticides, and fertilizers into bodies of water, as well as transporting sediments and increasing water turbidity. Turbidity is a measure of the number of suspended particles, and high turbidity can cause increased microbial growth. Sunapee is fortunate to have some natural protections against runoff, especially heavy forest cover that naturally slows, spreads, and absorbs water, and floodplains that slow water and reduce peak flow (Figures, previous section). Development, however, produces the opposite effect, reducing absorption and significantly increasing runoff (Map 6).

One way in which development exacerbates stormwater issues is through the replacement of permeable areas with impervious cover such as pavement and structures. This problem is twofold: 1) it increases and sometimes channels runoff, which poses flooding and erosion risks; and 2) it allows stormwater to pick up and carry



Photo 16. Dewey Beach erosion from uncontrolled road drainage Sep 2022. Credit: Barbara Chalmers.

materials deposited on these impervious surfaces as it flows. Drainage infrastructure helps avoid these issues by encouraging water infiltration and filtering pollutants but must be sufficiently sized or it can quickly become overwhelmed. Sunapee has such infrastructure, but it may be of limited effectiveness as climate patterns shift and precipitation increases. For example, a 2012 assessment estimated that anywhere between 35% and 75% of culverts in Sunapee could end up undersized for future needs (Simpson, et al., 2012). Some town roads established prior to 1900 continue to have rudimentary storm drainage infrastructure, including primitive catch basins without sumps to settle dirt and debris or no catch basins at all at culverts flowing into streams and waterbodies. For example, Garnet street was built in 1888 and continues to have rough-dug and rock-lined catch basins providing no settlement or pre-treatment of surface flows into Lake Sunapee.

Development, particularly deforestation, can also rapidly hasten the process of water erosion, especially in areas of steep slopes. In extreme cases of vegetation loss and severe weather in these areas, this can cause land movement such as mudslides. However, even in milder cases, stormwater can deteriorate slopes and carve paths through soil, deforming the landscape and bringing sediment loads into nearby bodies of water. Loss of vegetation in the riparian zone is especially harmful to water quality, as plants form “riparian buffers” that slow and filter water from runoff and flooding.

4.12 Agricultural resources

New Hampshire has relatively scarce agricultural resources compared to more fertile parts of the United States. Glaciers scoured the land down to bedrock 10,000 years ago and soil has been slowly rebuilding since then. Soils tend to be nutrient-poor, shallow, and rocky, and much of the terrain is hilly, which limits the agricultural uses of the land. Because of the long time required for soil development (tens of thousands of years), agricultural soil should be considered a nonrenewable resource.

Active Farms. In Sunapee, there are two working farms as of 2022 - Johnson Farm and Webb Farm (Map 12). A sense of the historical importance of farming in Sunapee can be ascertained by the extensive number of farm houses recognized as significant historic buildings, seen in Map 12 and listed in Appendix F : Historic & Cultural Resources. At one point, Sixty percent of Sunapee’s families farmed and lived off the products of their land. That number dropped in half during the 1880s as workers left farming for mill jobs along the Sugar River and elsewhere.

Agricultural Soils. At the soil scale, the national soil survey database provides soil classes to reflect its capability for agricultural production, not the current land use. The soils chosen are based on qualities for raising crops or livestock and are differentiated into four classes: prime farmland, farmland of statewide importance, farmland of local importance, and unique farmland. These soil classes have been summarized in Table 9 and Map 12, with full definition in Appendix D : Soil Survey Descriptions.

Prime farmland soils are described as the best soils for production of food, feed, fiber, forage, and oilseed crops. Prime soil is designated for the purpose of carrying out the provisions of The Farmland Protection Policy Act of 1981. This Act was established to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses. Less than 2% of New Hampshire soil is classified as prime farmland soil. In Sunapee, 2.4% of the land is considered prime farmland, which is slightly above average for New Hampshire.

The other soil classifications include soils that are useful for agricultural production and have some limitations that preclude their designation as “prime farmland”, such as stoniness, nutrient limitations, or excessive drainage. Farmland of statewide importance is informed by criteria for defining and delineating soils with qualities determined by a state committee. The third class of important agricultural soils is farmland of local importance. The County Conservation District Board determines which soil units are locally important.

Farmland Soil Class	Acreage	% of Town
Prime (federally designated)	379	2.4%
Of Statewide Importance	442	2.7%
Of Local Importance	2942	18.3%
Total	3763	23.4%

Table 9. Farmland Soils in Sunapee

Source: Gridded National Soil Survey Geographic Database 2021.

4.13 Forest resources

In Sunapee, several parcels of land are managed for forest production, including state and town forests and some privately held tracts of land. Sunapee’s land area is 60% under forest cover, primarily of a hemlock-hardwood-pine mixed forest type (for details see sections 4.04 Surface waters, riparian zone & floodplains and 4.05 Land cover). However, the soil types that are most favorable for tree growth occupy only 46% of Town (Table 10 and Map 13).

Forest Soils. The national soil survey database classifies soil types by their capability to support sufficient tree growth for commercial forestry operations, which are broken into 5 ratings: IA, IB, IC, IIA, and IIB (summarized in Table 10). The dominant tree species on these soil types varies depending on the succession stage of the forest or stand.

Group I soil is the best soil for forest management. Group IA soil is best for hardwood production because they are relatively deep, fertile, and well-drained. Group IB soil is slightly less fertile and sandier than Group IA soil where tree growth is less vigorous. Group IC soils are composed of outwash sands and gravels, and are ideally suited to softwood production. The most significant acreage in Sunapee is covered by Group IA soils at 24%.

Group II soil has significant limitations on either tree growth or management. Group IIA soil is physically limited (e.g., steep slopes) in a way that challenges management and increases cost. Group IIB soil is poorly drained and therefore generally has lower productivity and management limitations. A thorough description is found in Appendix D : Soil Survey Descriptions.

Forest Soil Group – Class I	Acreage	% of Town	Forest Soil Group – Class II	Acreage	% of Town
IA	3,792	23.6%	IIA	4,180	26.0%
IB	3,271	20.3%	IIB	1,394	8.7%
IC	281	1.7%			
Class I Sub-Total	7,344	45.6%	Class II Sub-Total	5,574	34.6%
Total = 12,918 acres or 80.2% of Town					

Table 10. Important Forest Soils in Sunapee

Source: Gridded National Soil Survey Geographic Database 2021.

Town Forest. The Town of Sunapee completed an update to their Forest Management Plan in 2018 with the assistance of Meadowsend Consulting. The plan covers the area of Bartlett Tyler Lot, Dewey Woods, Ledge Pond, Tilton Morse, Wendell Marsh, and Webb-Flint and Fieldstone Lot. Recommended actions are placed on a priority list through 2028 in areas of silviculture, recreation, boundaries, and open field. Silviculture, the “art and science of growing trees”, is an important and under-appreciated activity. Silviculture activities are various depending on the type of forest and stated goals for management. In some cases management mimics a large-scale disturbance of wind, allowing for less shade tolerant species to grow or adjustment to overall forest age. Another management type is single tree selection where various sizes of a specific tree are removed to promote growth of remaining trees and space for regeneration. The Town’s plan discusses a dozen different silvicultural treatments.

4.14 Sand & gravel resources

Sand and gravel are important raw materials for building, roadway maintenance, and other commercial purposes. Soil containing significant deposits of these materials are relatively scarce in New Hampshire. Sand and gravel sources are of glacial lake/river origin and are thus concentrated in river valleys or old lake beds. These sources do not require crushing for a product. The soil survey rates soils as "good", "fair" or "poor" in relation to their potential for sand or gravel; a rating of "good" or "fair" means that the source material is likely to be in or below the soil. A thorough description of these soil features can be found in the Appendix D : Soil Survey Descriptions.

Sunapee only contains fair rated soils for gravel or sand sources, summarized in Table 11 and Map 2. Although most of Sunapee's land area is indicated with a fair sand source rating, these are primarily occupied by loam soils that are unlikely to be significant opportunities for raw sand materials. For soils with a fair gravel source rating, only 4% of Town is identified, primarily along the western border.

There are no known sand or gravel operations in Town. There are rock mining and crushing operations which require additional machinery to achieve the desired product.

	Acreage	% of Town
Gravel Source – Fair	663	4.1%
Sand Source – Fair	13,088	81.3%
Gravel & Sand Source	663	4.1%

Table 11. Soils with a Fair Rating as a Sand or Gravel Source in Sunapee
Source: Gridded National Soil Survey Geographic Database 2021.



Photo 17. Stocker's quarry, google aerial view 2022, east of Edgemont Road and west of old Boyce quarry (left). Pine Hill Construction Chase Marine Pit, gravel mining & crushing, Rte 11 (right). Credit: Barbara Chalmers.

4.15 Renewable energy resources

Throughout its history, Sunapee's residents and businesses have relied to some degree on renewable energy resources. The Sugar River powered the mills, factories and earliest electric lights of yesteryear and today provides electricity to homes and businesses. Wood was previously the primary source of home heating fuel, and remains of some importance. There is a growing interest in tapping other renewable energy sources, such as solar and wind energy. Both biomass and geothermal energy resources are noted as limited potential in Town according to the National Renewable Energy Laboratory (NREL). Sunapee has the potential for developing systems for new hydro, solar, and wind energy. NREL provided maps and descriptions can be found in Appendix E : Renewable Energy.

Sunapee currently has one municipal hydro-electric generating plant located at the 1923 site of the former Lake Sunapee Power Company hydro-electric station, adjacent to Sunapee Town Hall. In 2015, this facility generated 1,663,360 kilowatt hours, operating from water flow at the historic granite block dam on River Road. The town also operates a water-powered pump, when water flow allows, at the granite block dam which pumps Lake Sunapee water up to the municipal reservoir tank on Burkehaven Hill. Historically water flow from Lake Sunapee into the Sugar River and the river's elevation drop within the town of Sunapee, powered ten to fifteen mills at any one time between the 1850s and 1920s. There is potential to develop more hydro-electric power in Sunapee, including power for the municipal sewer treatment plant.

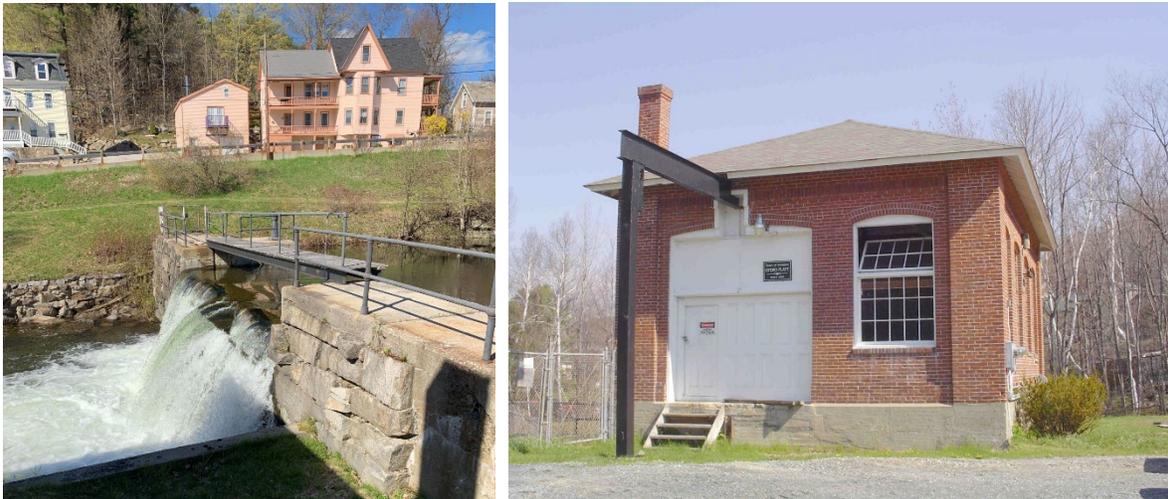


Photo 18. Historic 1840 granite block dam at River Rd, penstock in-flow for municipal hydro station and Town hydro-powered water pump. 2019 (left). Municipal hydro-electric generating station, next to town office (right). Credit: Barbara Chalmers.

The utilization of solar energy requires prolonged exposure to sunlight, which requires a clear site where trees, other buildings, or the terrain will not shade the building or energy-harvesting device. Solar panels are best placed on south-facing roofs with a slope between 15 and 40 degrees. Sunapee is hilly and primarily forested, which limits somewhat the locations that could feasibly utilize passive solar design or a solar energy system. According to the National Solar Radiation Database (NSRDB), the Town has just below average direct normal irradiance (DNI) for the United

States. The DNI represents the amount of solar radiation from the direction of the sun, which is Sunapee is generally estimated to produce between 4 and 5 kWh/m²/Day. New Hampshire experiences significant variation in DNI by month, with more resource in April to September, peaking in July.

Wind energy also has some potential in Sunapee, primarily along the ridgelines or at residential scale. Like solar energy systems, wind turbines must be sited away from other buildings and trees, which cause turbulence and decrease the amount of energy that can be harnessed. Measurement of wind energy potential is based on average wind speed at different heights from ground level. Heights of approximately 30-meter represent many current small residential systems, 50-meter height community systems, and 100-meter or higher for utility scale. In Sunapee, there is reasonable capacity for residential systems with wind speed potential near an average of 5.0 m/s. For community systems, opportunity is more marginal and focused on small patches near Lake Sunapee. Similarly, limited capacity for utility scale wind power resource has been identified in Town. Wind systems are known to have mortality to bird and bat species due to collisions and wind disruptions. Innovations are available and advancement under development to reduce these conflicts and establish best management practices. Wind Exchange, a resource of the U.S. Department of Energy, provides resources on current research on this conflict and best practices for siting. In 2022 there are no private or community wind installations in Sunapee.

Increasing renewable energy capacity is considered as a positive environmental change due to the impacts on emissions that worsen climate change. Also, the greater potential for more distributed energy systems can allow for local control. As technology prices become more competitive and its accessibility improves to more communities, Sunapee may do well to further their use locally as part of an integrated energy network. Simultaneously, the value of other natural resources must be considered during the development of solar and wind energy projects. Siting towers, solar arrays, or new homes in inappropriate locations may cause degradation. The Wildlife Action Plan describes two types of impacts on wildlife: collision with towers resulting in mortality and habitat loss and degradation from site development (NH Fish and Game 2006). Clearing and developing land near the tops of hills for renewable energy production would fragment the landscape and could cause significant erosion. In addition, there is potential for the aesthetic value of a rural landscape to be diminished. The potential and risk to harness local renewable resources of energy must be kept in balance to safeguard a holistic resilience considering climate change, energy independence, and conservation.

4.16 Historic & recreational resources

Human civilization is known to settle where natural resources and potential for commerce is available. People transform their surroundings for a particular aim, often exploiting and living off natural resources, and changing a place's form to better social or aesthetic qualities. In 2022, the Town of Sunapee thrives on a local economy that is inextricably linked to the natural resources of its land. Many live and visit Sunapee to enjoy, find peace, and play in its forests, lakes, ponds, and other natural attractions. Although outdoor recreation is largely what Sunapee is known for now, the Town's history is more deeply rooted in using natural resources for business and using the Sugar River to connect with outside markets and give power to industry.

Sunapee's cultural, historic, and some recreation resources are shown in Maps 14 and 15, and listed in Appendix F : Historic & Cultural Resources.

Farming. Sunapee's rich farming history can be appreciated by the extensive presence of historic structures (Map 12). Farm houses make up more than half of the town's significant buildings, totaling 59 structures scattered to every corner of the Town and dating back to 1780.

Many historic barns, barn foundations, and cellar holes are also found across

town. In addition, the well-known New England stone walls run across Sunapee in a multitude of directions, once used to demarcate areas of farming and pasture, with others along roads, lakes, and rivers. These structures represent the community's foundational link to the land as a source of sustenance and human ingenuity to survive and thrive.



Photo 19. c1800 Lot line stone wall, northwest Sunapee, 2020. Credit: Barbara Chalmers.



Photo 20. Boyce and Bailey granite quarry, circa 1890s. Credit: Sunapee Historical Society.

Geologic Features.

Sunapee’s geologic features feed another rich history for Sunapee in the way of mines, quarries, and beautiful natural rock formations.

When mica was worth one-tenth the price of gold, a mica mine operated in Sunapee (est. 1895 to 1905). Granite quarries established a more long-standing business in Sunapee when Samuel Bailey, Sunapee’s early and

best-known quarry man, started his first operation using hand tools in the 1830s. The Boyce and Bailey granite quarry is Sunapee’s largest quarry that produced a fine grain granite called Light Sunapee and Dark Sunapee, well suited for monuments and building use. Blocks from this quarry were purportedly used for the Library of Congress building in Washington D.C. The industry was aided by the arrival of the railroad in 1877 and continues to present day with the Stocker granite quarry, located on a portion of Bailey’s original quarry.

Although often exploited, rock formations are also an attraction in Sunapee, particularly Indians Cave, Pulcifer Rock, and Bears Den (Map 2).



Photo 21. Railroad bed trail at Harding Hill Farm. Nov 2022. Credit: Barbara Chalmers.

Transportation and Energy.

The ability to move people and goods advanced growth in Sunapee. Dating back to 1769, early settlement roads, and their culverts and bridges, crisscross the town. The Sugar River is the largest river in the region and provided the energy necessary for the industrial mill development of the mid-to-late-1800s. The River is still tapped for hydroelectric energy in the Sunapee Harbor village. In the 1870s, the Sugar River Railroad arrived, connecting Sunapee to communities in Newbury and Newport.

Recreation.

A number of cultural and recreational opportunities are unique to Sunapee, and serve as important centers of community activity (Map 15). In the 1900s, Sunapee began to use its access to beautiful lakes and mountains as an outdoor recreational benefit to residents and draw for visitors. Sunapee’s first parks, the Sunapee Town Ski Tows, known today as Tilton Park, and Dewey Beach, along with the town of Sunapee Recreation

Committee, were established in 1938. In 2022 Sunapee has 9 parks and public recreation areas

including: Tilton Park, Georges Mills Town Wharf and Beach, Dewey Beach, Dewey Woods Ball Field, Veterans' Park, Sunapee Harbor Town Wharf and Park, Ben Mere Bandstand Park, Hames Park, and Coffin Park.

Scenic vistas of Lake Sunapee, Mount Sunapee in Newbury, and the Sugar River are significant recreational attractions. The Lake Sunapee Region Chamber of Commerce describes the special draw of Lake Sunapee:

"Visitors and residents alike know that Lake Sunapee is a destination in itself. Year-round recreational opportunities abound, including boating, biking, swimming, snowmobiling, downhill and cross-country skiing, ice-boating and maple-sugaring. Local residents take pride in Lake Sunapee for its exceptional water quality and beauty. Protection efforts have enabled Lake Sunapee to consistently be named one of the cleanest lakes in the state."

The Lake Sunapee Scenic & Cultural Byway takes the interested traveler on a 25-mile route that borders Lake Sunapee and is a slow paced and beautiful experience. Extending from Lake Sunapee, snowmobile trails (also used for hiking) form a network through town.

Hiking and cross-country ski trails have been developed on the Town Forests and private lands with conservation easements that establish low-impact public recreation access. In addition, the



Photo 22. Scenic view of Mt Sunapee from Dewey Woods town forest. Taken from east side of Seven Hearths Lane. Dec 2021. Credit: Barbara Chalmers.

Sunapee Ragged Kearsarge Greenway, a 75-mile loop circles the Lake Sunapee area and connects Sunapee, Ragged, and Kearsarge Mountains. The traveler who walks the whole loop will travel through the full North-South length of Sunapee plus nine more towns: Andover, Danbury, Goshen, Newbury, New London, Springfield, Sutton, Warner and Wilmot.

4.17 Climate change & resilience

Sunapee has both vulnerabilities and resiliencies to climate change impacts on its ecosystems and environment, natural resource industries, and infrastructure. This section provides a summary of the most recent climate change impact reports for the Sunapee region, which is then followed by an analysis of resilient land in Sunapee based on data from The Nature Conservancy.

4.17(a) Climate change impacts

A note on climate versus weather. Weather reflects short-term conditions of the atmosphere while climate is the average daily weather for an extended period at a certain location. In other words, “Climate is what we expect. Weather is what we get.” (Mark Twain)

Two reports inform this summary of historical and projected climate change trends and impacts. The 2018 National Climate Assessment, mandated by the Global Change Research Act of 1990, is required to be provided to the United States Congress and the President no less than every four years (January 2018). In addition, the University of New Hampshire published a report in 2014 on Climate Change in Southern New Hampshire, including the Town of Sunapee, as well as a 2022 updated report titled New Hampshire Climate Assessment. The two New Hampshire reports provide a more focused impact assessment of historical data and two future climate scenarios. In southern New Hampshire, the major concerns for climate change include, but are not limited to, extreme heat, increase in precipitation, increase in extreme precipitation events, drought, decrease in snow cover, lengthening growing season, and reduced seasonality.

(i) Temperature

Historical long-term trends (1895-2012) show an increase in temperatures, with greatest increases in minimum, rather than maximum, during the winter season, and significant year-to-year variability. These trends have become more significant in recent decades and recent years show winters warming three times faster than summers (1970-2009) (Figure 2). By the end of the century, the largest increase in maximum temperatures would take place during the spring and summer, while in the winter minimum temperatures are projected to warm the most. These impacts are projected to result in significantly more extreme heat days and fewer extreme cold days. These changes will also result in the loss of the more distinctive seasons.

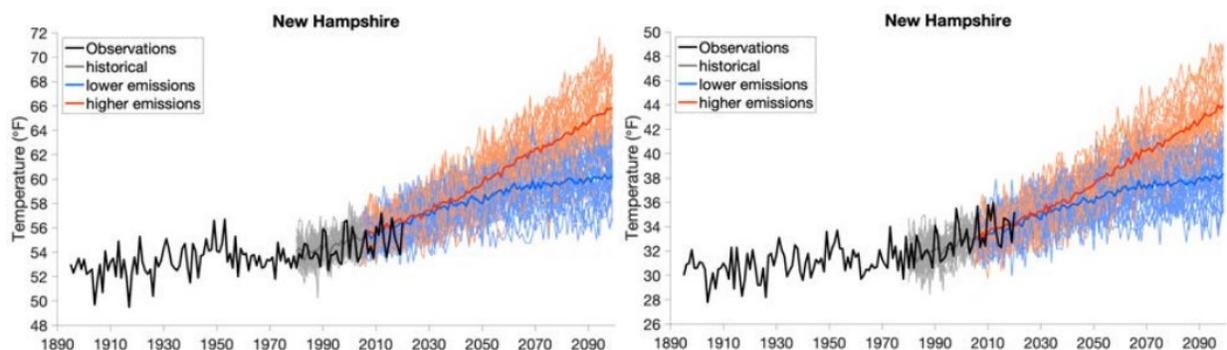


Figure 2. Mean annual minimum and maximum temperatures in NH under lower and higher emissions scenarios.

Annual maximum temperature (Left) and Annual minimum temperature (Right). Source: Lemcke-Stampone, 2022.

(ii) Precipitation

Recent trends (1970-2012) show an increase in annual precipitation, double to triple that since 1895 and largely driven by higher-than-average precipitation totals during 2005 to 2011. While these annual trends are more modest, the frequency of extreme precipitation events has increased four to ten times during the same period. One startling statistic relates to the FEMA funds spent on “Presidentially declared disasters and emergency declaration”. Between the almost 20-year period of 1986 to 2004, only one event occurred where damages exceeded \$10million (in 2012 dollars) While between 2005 to 2012, five of those eight years experienced events where damages exceeded that amount, both from floods and ice storms (Figure 3). This statistic reflects extreme events, aging infrastructure, and development patterns that are more vulnerable to damage.

In both future scenarios, annual precipitation is projected to increase between 8% to 12%. The difference between the two scenarios is not significant (Figure 4). More extreme precipitation events are expected under both scenarios.

(iii) Drought and Wildfires

During the spring and summer of 2016, 2020 and 2021, much of New Hampshire experienced what is known as a flash drought. These droughts develop over two to six weeks and is an area of active research. These droughts happen due to a lack of precipitation combined with other extreme weather conditions that increase evapotranspiration. In addition to temperature and precipitation, the frequency of droughts will depend in part on how ecosystems respond, especially New Hampshire’s forests.

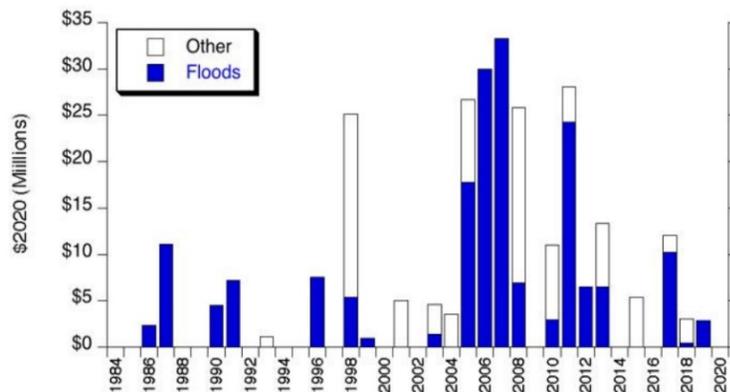


Figure 3. Federal Expenditures on Presidentially Declared Disasters and Emergency Declarations in New Hampshire from 1984 to 2020.

Expenditures adjusted to \$2020 using the consumer price index. Source: Lemcke-Stampone, 2022.

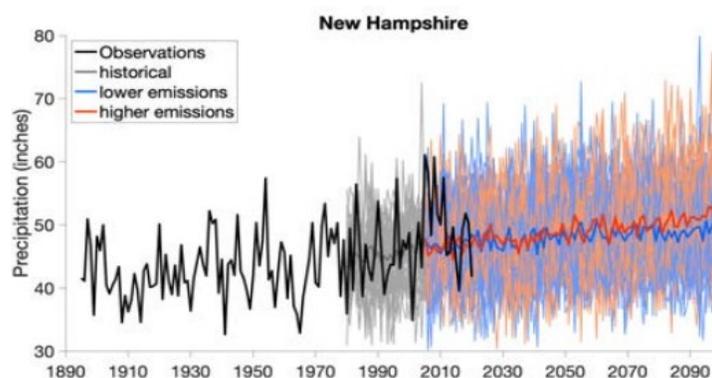


Figure 4. Mean annual precipitation in NH under lower and higher emissions scenarios.

Source: Lemcke-Stampone, 2022.

Flash droughts can have severe impacts on vegetation health, agriculture productivity and water availability. These most recent flash droughts show an increased risk for wildfires in New Hampshire. Although a large fire such as those seen on the US West Coast is unlikely, New Hampshire will be at a higher relative risk with impacts to air quality.

(iv) Snowpack and Lake Ice-out

The winter snowpack is important for its role in regional hydrology and the winter recreation industry, including that at Mount Sunapee. From 1971 to 2020, sites have been monitored across the state for snowpack, including three in the Lake Sunapee watershed. All three of these sites indicate declines in annual maximum snow water equivalent, a metric for snowpack. Over these 50 years, the trends show a decrease between 40% and 51% of this metric in the Lake Sunapee watershed sites. Under future scenarios, the number of days with deep snow is projected to decrease to as low as one month of snow-covered days per season (Figure 5).

Lake ice-out is the date when a boat can travel from the north end to the south end of the lake, a common indicator for early spring. Lake ice melt begins even earlier, encouraged by large areas of lake shore kept ice-free by dock bubblers and because the ice gets pushed by the wind southward and jams up at the islands. According to state sources, lake ice-out is now coming more than 2 days earlier every decade at Lake Sunapee (Figure 6). Local data extends to 1869 and show consistent trends as the state data, details found in Appendix H : Additional Resources. The trends to earlier ice-out dates impact the winter recreation season at Lake Sunapee, the dynamic thermal stratification lake process with potential reductions of dissolved oxygen, and the biological interactions among species under new conditions.

(v) Impacts

Ecosystems and Wildlife. The changing climate is already showing ecosystem responses, such as an earlier leaf-out and blooming, and shifting species distribution by elevation. Along the 1,500-mile Appalachian Mountain range, suitability for spruce-fir and northern hardwood forests

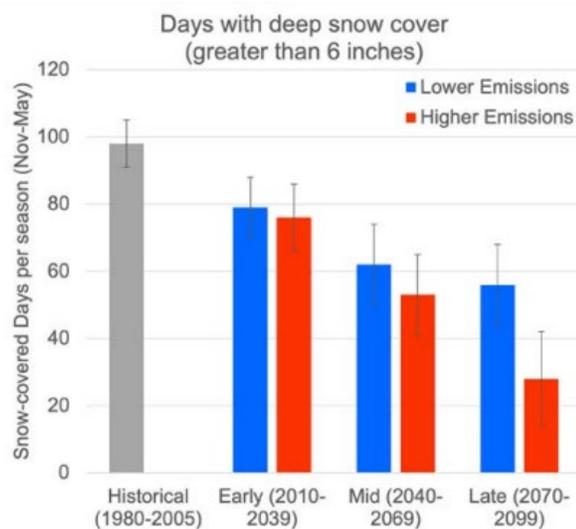
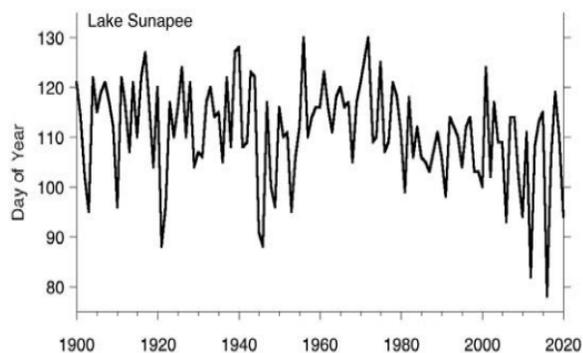


Figure 5. Number of days with deep snow in NH under historical and future emissions scenarios.
Source: Lemcke-Stampone, 2022.



1901-2020: **1.3** days earlier per decade
1971-2020: **2.2** days earlier per decade

Figure 6. Ice-out dates on Lake Sunapee, 1900-2020.

Source: Lemcke-Stampone, 2022.

are projected to decline while zones for southern oaks and pines to increase (NWF, 2013). A longer growing season has been observed to be partially responsible for increases in forest growth; however, they have also resulted in reduced seasonal growth to native trees due to hard freezes that follow early blooming. In addition, warmer winters and less snow cover will increase white-tailed deer populations that degrade native forest understory. For freshwater ecosystem species, such as salamanders and cold-water fish like trout, climate change impacts increase their vulnerability due to flow changes and warmer water temperatures.

Although it is difficult to project and will likely have varied responses, availability of food sources for wildlife, including vegetation, nuts, and seeds, is a concern. Many food sources do not bear fruit during extreme drought, such as acorns that are important for squirrels, mice, jays, woodpeckers, bears and deer. For black bears, this loss of food, as well as shifting hibernation patterns during mild winters, will lead to bears looking to supplement their diet with food found in more human residential areas, increasing the number of bear-human conflicts (NWF, 2013).

While some birds are expected to be more adaptable, others are expected to become more vulnerable. Migratory birds may migrate earlier and experience misalignment with food source availability and thus increasing vulnerability. Some of these food sources are also experiencing shifts with early blooming of wildflowers and woody perennials, important for migratory birds. The Audubon Society's *Survival by Degrees*, provides a picture of vulnerable birds based on changing abilities to find food and reproduce, effecting both local and continent-wide populations.

Pests and invasives. The changes in temperature and growing season will have negative effects on the health of forests due to earlier insect emergences, and expanded ranges of pathogens and invasive plants, including hemlock woolly adelgid and emerald ash borer. Important ecological and tourism species are also likely to be impacted, such as moose that are already experiencing hardship from increased parasite infections and deaths from ticks.

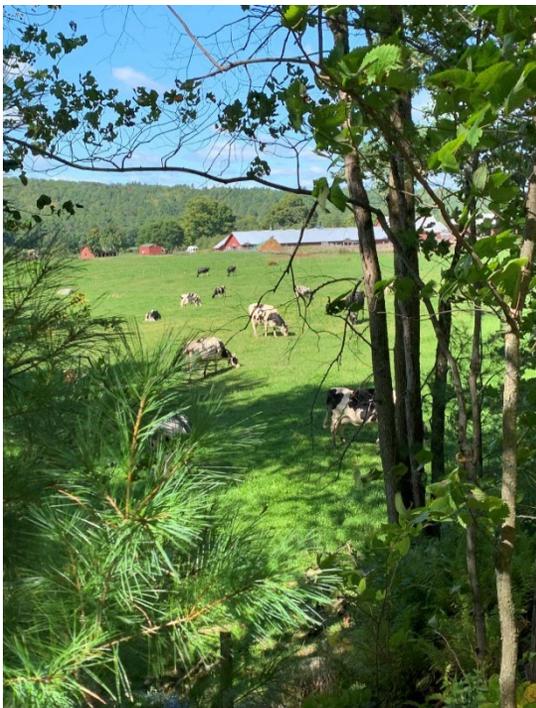


Photo 23. Johnson's Sanctuary Farm, dairy farm Rte 103, Sep 2022 (left). Webb's Harding Hill Farm, beef & maple products, Stagecoach Rd, 2022 (right). Credit: Barbara Chalmers.

Agriculture. In the short-term agriculture is likely to benefit from a longer growing season (since 1960 it has increased 15 to 52 days in southern New Hampshire, Figure 7); however, the trend is likely to cause problems over time. Increasing intense precipitation events will increase the risk of soil compaction due to overly wet soils, as well increase nutrient runoff into waterbodies. There is risk of frost-freeze damage occurring more frequently as premature warming is followed by frost that can kill premature leaf-out or blooms; resulting in a large loss of fruit varieties. Further, wet springs will delay planting, extending harvest dates and potentially reducing yields. During the summer, too little water and more extreme heat will increase heat stress and drought. This shifting climate is also likely to increase weed and pest pressures, and the related interest in use of herbicides and pesticides.

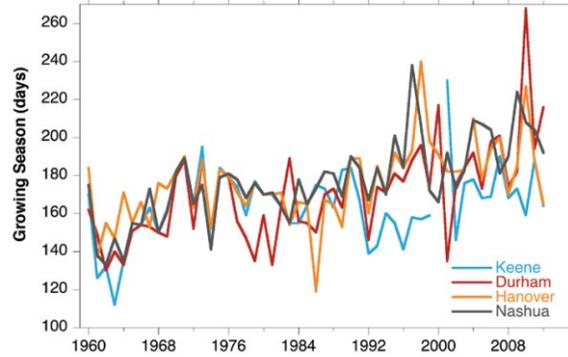


Figure 7. Length of the growing season.
Taken from four GHCN-Daily stations in southern New Hampshire, 1960-2012. (UNH, 2014)

Tourism, Logging, and Maple Sugar Industries. In New England, seasonality is an important element to the regional economy in both recreation and natural resources. A decrease in the winter recreation season is expected by mid-century. The number of annual visitors to ski areas is strongly correlated to the number of days per season with natural snow cover. Also, natural resource-based industries will face new challenges. For logging, poor road conditions may limit operation due to the need for frozen or snow-covered soil. In addition, changes to forest composition and stress due to climate change will require targeted actions to address as part of an adaptive management strategy, as recommended in the Town's 2018 Forest Management Plan. For maple syrup producers, production is already experiencing shifts due to changes in habitat and seasonality needed for quality sap production.

Infrastructure and development. These changes to climate and ecosystem functions in Sunapee will affect local infrastructure and development. For infrastructure, impacts may be most severely experienced by roads, culverts, and bridges functioning under more extreme precipitation events. Also, access to well water may be affected by flash droughts and reduced infiltration rates needed to replenish groundwater resources.

The national context of impacts puts the region’s resilience ahead of many other places, which may result in additional migration to the region, and Sunapee. This migration would increase the need for development and infrastructure, beyond the current housing crisis, and thus requires thoughtful land use planning to be adaptive to future population needs.



Photo 24. Lake Sunapee Harbor public access 2021. Credit: Barbara Chalmers.

4.17(b) Resilient land

Resilient land in Sunapee is based on datasets from the Resilient Land Mapping Tool created by The Nature Conservancy (Anderson, 2014). The results largely align with important areas identified in earlier sections as ecologically important habitat blocks and habitats of priority for the state of New Hampshire (see sections 4.06 Habitat blocks and 4.07 Habitat types & value). These analyses are conducted on a regional scale and with limited local detail due to the complexity and local nuances of climate change. Still, the information is informative to conservation planning in Sunapee that seeks to be adaptive and resilient to the impacts of climate change. This TNC resource includes five major analyses, included below.

(i) Resilient and Connected Network

The Resiliency Network identifies the overlap between three major datasets where the location value is above average: 1) Biodiversity Value, 2) Resilient Sites, and 3) Local Connectedness, explained next. This map (Map 16) drives home the impact of the state road and development around Lake Sunapee. Identified land in this map is largely found in the northwest corner of Town, with small patches at Tucker Hill and Blueberry Mountain.

Landscape Diversity. Current research emphasizes the significance of landscape diversity in enabling a species to survive through a changing climate. This analysis reflects the ability for a

species to persist in an area relative to its variety of microclimates. In Sunapee, the largest landscape diverse areas are found around Blueberry Mountain, Mountain View Lake, and Mud Pond to the south, as well as Cemetery Hill, Perkins Pond and Ledge Pond. Smaller areas are found, most notably at Tucker Hill and just west of Wendell Marsh.

[Biodiversity Value \(Map 17\)](#). This analysis assembles information on places recognized for their biodiversity value (rare species, intact habitat, or exemplary natural communities), including those at Cemetery Hill and Blaisdell Hill.

[Resilient Sites \(Map 18\)](#). This analysis gives a Resilience Score to sites across the landscape according to its capacity to maintain species diversity and ecological function as the climate changes, although TNC admits that understanding of these impacts are limited. TNC describes the model's intention:

"We expect that these sites will support an array of specialist and generalist species, even as the composition and ecological processes change. In contrast, a vulnerable site was defined as one where processes are disrupted and fragmented, and where the site is likely to lose diversity. We expect that these sites will increasingly favor opportunistic "weedy" species adapted to high levels of disturbances and anthropogenic degradation. Climate change is expected to greatly exacerbate the degradation of vulnerable sites; however, these sites may still perform many natural services, such as buffering storm effects or filtering water. Thus, vulnerable sites are not without value, but they are places where it will be increasingly difficult to sustain the natural functions and species diversity of whole ecological systems over time." (TNC, 2016)

The amount of resilient area reflects the highest scoring one-third of each setting in the region and is not an absolute measure of how much area is equally resilient to climate change. In Sunapee the most resilient sites are limited to Cemetery Hill and Blueberry Mountain, with additional sites above average.

(ii) Wildlife pathways

Conserving resilient sites would go a long way towards sustaining biological diversity, but it is not enough. If nature thrives in these sites, then the inhabitants (trees to salamanders) will produce offspring and these offspring will disperse to find new resilient sites, and over time the landscape will change. The value of connectivity in facilitating range shifts for wildlife and their adaptation has strong historical evidence and widespread agreement among the scientific community. TNC provides multiple products from this analysis, two have been highlighted as part of this report.

[Local Connectedness \(Map 19\)](#). This analysis identifies local connectedness by measuring the contrasting barriers to movement, such as the amount and configuration of human-created barriers like major roads, development, energy infrastructure, and industrial farming and forestry land. The analysis in Sunapee highlights the northwest corner of Town including areas of Cemetery Hill, Ledge Pond, and Perkins Pond, as well as small areas in the south that represent the northern reaches of the Sunapee-Pillsbury Highlands, mentioned in section 4.06 Habitat blocks.

Flow Permeability (Map 20). The objective of the flow analysis by TNC is to facilitate flow dynamics and identify conservation priorities, to ensure that plants and animals are thriving, landscape remains permeable to movement, and dispersing species have a place to go. TNC describes their modeling:

“Thus you can identify where population movements and potential range shifts may become concentrated or where they are well dispersed, and it is possible to quantify the importance of an area by measuring how much flow passes through it, and how concentrated that flow is... This may include pinch-points that play a disproportionately important role in facilitating range shifts, diffuse areas that offer many options for movement, or low-flow areas that could be improved through restoration.” (Anderson et al., 2016)

This analysis classifies areas of flow groups based on the amount and concentration of flow.

- Diffuse flow: areas that are extremely intact and consequently facilitate high levels of dispersed flow that spread out to follow many different and alternative pathways. The strategy here might be to keep these areas intact and prevent the flow from becoming concentrated.
- Concentrated flow: areas where large quantities of flow are concentrated through a narrow area. These pinch points are good candidates for land conservation.

5. Natural Resource Protections, Opportunities & Challenges

5.01 Land Use & Development

5.01(a) Current use lands

Current use assessment is a program designed to encourage preservation of open space by taxing undeveloped land at its “current use” rather than its “highest and best use.” RSA 79A authorizes this program, which allows for a reduced assessment for parcels of the following use:

- field, farm, forest, and wetland of 10 acres or more
- natural preserves or recreation land of any size
- farmland of any size generating annual revenues in excess of \$2,500

A penalty, the Land Use Change Tax, exists for withdrawing land from current use for another purpose, but it is possible to withdraw land from current use and develop it. Therefore, current use is not considered a long-term conservation method.

As of 2021, 6,587 acres are enrolled in current use, or 49% of the town’s land area, according to the Department of Revenue Administration’s annual current use report. This represents a slight increase of lands in current use up from 6,294 in 2002 and 6,556 in 2007. Taxation rates are based on the use of the land, which is broken into five categories: forest, forest with stewardship, farmland, wetland, and unproductive land (Table 12). These lands are held by 166 different landowners, and constitute 238 parcels, up from 144 owners and 206 parcels in 2007. The Town of Sunapee maintains a list of parcels with a portion or all of its lands under current use. These parcels, as of September 2022, can be viewed in Map 6.

Current Use Type	2021		2007		Change 2007 to 2021
	Acreage	% CU Land	Acreage	% CU Land	
Forest	4,800	72.9%	3,695	56.4%	+30%
Forest with stewardship	629	9.6%	1,381	21.1%	-54%
Farmland	495	7.5%	737	11.2%	-33%
Wetland	414	6.3%	412	6.3%	0%
Unproductive	249	3.8%	331	5.0%	-25%
Total in Current Use	6,587 acres 49% of Sunapee		6,552 acres 49% of Sunapee		

Table 12. Current Use land in Sunapee by category, 2021 and 2007.

Definitions for each category can be found in Appendix A : Data Source Documentation.

Source: NH Department of Revenue Administration, 2021 and 2007 current use reports.

For the same period, Sullivan County has seen a slight increase in current use land, up from 68% in 2007 to 70% in 2021 of the county’s land area. Sullivan County has the highest proportion of its land area in current use out of all counties in the State, with a 2021 State total of 52%.

5.01(b) Conservation lands

Conservation lands in Sunapee take many forms: they are owned by the state, the town, and by private individuals. Some are designated for public recreation, for wildlife, for forestry, or for drinking water. They range widely in size and in location. The smallest protected parcel in Sunapee is Dewey Beach on Lake Sunapee at 0.9 acres, and the largest is Webb Woods at 377 acres (Map 6). In total 2,531.7 acres, is protected from development with a summary by type of ownership in Table 13.

Sunapee also falls within the [Quabbin to Cardigan partnership](#) (Q2C), an effort to conserve 3,000-square-miles of intact and interconnected corridor straddling the New Hampshire and Massachusetts border. The Q2C corridor is a conservation priority with collaborative research for many land trusts and non-profit organizations. Most recently, the Q2C updated their Conservation Plan with additional data considering climate resilient wildlife corridors, see Appendix H : Additional Resources. In Sunapee, Q2C core conservation focus area and connectivity corridors were identified, specifically along the western border.

The [State of New Hampshire](#) owns 151 acres of conservation land in Sunapee (Map 15). The majority of which is owned by the Department of Fish and Game (F&G) through the management of three Wildlife Management Areas (WMA) in Sunapee. The Department of Resources and Economic Development (DRED) owns and manages the Ledge Pond Islands.

There are 14.9 acres protected as [water supply lands](#) by the Sunapee Water Department. Two-thirds of this land is owned by the Department, and the other third is under a protective easement.

The [Town of Sunapee](#) owns 728 acres of land that is undeveloped and has some degree of protection. Much of this land is permanently conserved and managed by the town. There is also some “unofficial” conservation land, such as Dewey Beach and School District SAU #43 land, which is not permanently conserved, but the use of the land is not compatible with development. The Town also owns the boat launch and the gazebo/bandstand area, which are considered valuable community assets and therefore undevelopable open space.

[Privately-owned land](#) protected with a conservation easement covers 1,637 acres; this is by far the most popular method of land conservation in Sunapee. Private landowners donate or sell the development rights on their property, but retain ownership of the land itself. Conservation easements are held and monitored by the Town or by a non-profit land conservation organization, such as Ausbon Sargent Land Preservation Trust or the Society for the Protection of New Hampshire Forests.

Property Name		Acres	Property Name		Acres
SWSD	SWSD Easement	4.2	State Owned	DRED - Ledge Pond Islands	3.5
	SWSD Land – Geo Mills wells	10.7		F&G - Gordon WMA	36
	SWSD Land – Village system	5.2		F&G - Smith Hill WMA	99
	Barrett-Archers Lot*	29		F&G – Wendell Marsh WMA	9
	Sub-Total	49.1			
Private or Land Trust Owned	Brown Hill Associates Easement	93.5	Town Owned	Sub-Total	147.5
	Frank H. Simpson Reserve	114.8		Barrett-Archers Lot*	13
	Gordon Chetwood Trust Easement	39.6		Bartlett-Tyler Garnet Hill Park	47
	Harrison Farm Easement	185		Ben Mere Park	3.6
	Johnson Farm Easement	160		Birch Point Circle	4.3
	Jolyon Johnson Easement	34.1		Coffin Memorial Park	3.4
	Marcia Wright Easement	27.1		Collins Lot	14
	Nielsen Farm Easement	58.5		Dewey Beach	1
	Nutting Family Farm Easement	84.4		Dewey Woods	94.8
	Otter Pond Prot. Assoc. Easement	1.9		Harbor Park & Boat Launch	1
	Rowell MacWilliams Woodlot	265		Highway Dept-Recycling Lots	47.3
	Sorrento-Gallup Easement	37		Ledge Pond Properties	110.6
	Soule Easement	16.6		Lots 14/15 – Penacook Woods	3.8
	Stockwell-McAllister Otter Pond	1.7		Ludwig lot by Garnet Hill Park	2.8
	V-Oz Harding Hill Farm Easement	37		Rose Pratt Property	4.1
	Webb Harding Hill Farm Easement	84.4		Sunapee School District	40.9
	Webb Forest Preserve – Home Farm	382.1		Tilton Park	10.5
	Webb Forest Preserve -Dane	74		Verne Morse Lot	10
	Webb Forest Preserve -Harrison	69		Veterans Park-Safety Services	6.1
	Sub-Total	1,765.7		Webb-Flint Lot & Access	66.9
				Wentzell Subdivision Lots	7.2
		Wendell Marsh Extension	39.5		
		Wendell Marsh North	136.4		
		Wendell Marsh South	143.4		
		Sub-Total	811.4		
TOTAL = 2,773.7 acres					

Table 13. Conservation land in Sunapee by ownership.

Definitions: Department of Fish and Game (F&G), Department of Resources and Economic Development (DRED), Sunapee Water Department (SWD), Ausbon Sargent Preservation Land Trust (ASPLT).

*Note: *29-ac of the 42-ac Barrett-Archers Lot where the water treatment plant and future expansion is located is proposed for removal from town forest designation at 2023 town vote for use by town water and sewer department.*

Source: NH Granit Conserved Lands, 2021. Sunapee Conservation Commission, 2022.

5.01(c) Population & new development

In general, Sullivan County has largely been exempted from the rapid population growth experienced by southern New Hampshire during the past twenty years, but that trend may not continue. The pace of land development is expected to stay strong statewide, as New Hampshire's population is expected to increase almost 125,000 by 2050. Although, the population of Sunapee is projected to remain stable through 2050 (NHOSI 2022), this model does not consider recent migration trends during the COVID-19 pandemic, in which many of Sunapee's seasonal residents converted their homes to full-time use and became local voters. Further, the state of New Hampshire has been recognized as a relatively more resilient region regarding climate change, which may result in additional in-migration (EPA 2017). As a result, Sunapee could face greater pressure on its natural resources, especially if not planned for thoughtfully and respectfully.

In 2020, Sunapee has an estimated 3,342 year-round residents. For vacant units, Sunapee had an estimated 1,233, the highest number in the Upper Valley Lake Sunapee (UVLS) region by 346 (number two being Lebanon). This number is up 36% since 2010 with most being seasonal or recreational units, specifically 1,164 in 2020. Overall, seasonal units make up 46% of the total housing stock in Sunapee, up from 33% in 2010. This data comes from ACS 5-year estimates for 2016 through 2020, and 2006 through 2010. The seasonal home aspect of the recreation economy in Sunapee places pressure on natural resources through their need to be accessible for public use and the valuable siting of homes in scenic locations. In Sunapee, Lake Sunapee and its shoreland is especially vulnerable. Simultaneously, this recreational aspect provides for appreciation and investment by many residents to ensure protection.

Sunapee must plan proactively in how to balance priorities for natural resources and maintaining and developing infrastructure, including year-round housing, needed for continued vitality. Development and poor land management can impact natural resources and the Town's relationship to them in a variety of ways:

- Lost or fragmented habitat, breeding places, or corridors for movement
- Degraded or lost productive use of important soils for agriculture/forestry, or locations for local renewable energy
- Increased stormwater runoff and creation/accumulation of pollutants
- Reduced air quality, water quality and groundwater recharge
- Extirpated native wildlife and plants
- Exacerbated flooding
- Less public access to inspirational, healing, and healthful experiences and life styles
- Increased impact/cost of roads and public reliance on personal cars

Sunapee's farms and forests are important to wildlife, local economy, public health, and culture. In addition, the need for reasonable regional independence from global supply chain issues, has been emphasized since the start of the COVID-19 pandemic with shortages and increased costs for goods such as food and construction raw materials. When siting locations for new development and crafting land use policies, these habitats and valuable soil should be safeguarded to a reasonable extent.

The UVLS region has experienced multiple recent storms where significant flood and fluvial erosion damage were caused, from Tropical Storm Irene to localized microbursts. This risk extends into Sunapee and cannot be wholly removed; however, policies and planning can be used to mitigate risks. New homes should not be built in flood prone areas or areas important for stormwater management. Further, consideration needs to be paid to the increasing frequency of intense storm events and how that expands the extent of flood prone areas. Also, Sunapee needs to maintain and improve river and wetland capacity to manage stormwater pollutants, recharge groundwater and mitigate flooding by protecting or restoring surface waters access to floodplains, well-functioning riparian areas, and reduced upland runoff primarily from impervious surfaces through techniques including but not limited to green infrastructure. By safeguarding these natural resources, those resources will also provide other valuable services such as water quality, wildlife habitat, and attractive waterfront areas.

If rural character is to be maintained in some form, Sunapee's development will need to hold multiple priorities simultaneously, sometimes in contradiction. This challenge is particularly salient regarding year-round home development, required to address New Hampshire's housing crisis. Some impact on natural resources from this development is expected, however the degree can be minimized and could even be offset by the implementation of other strategies on both new and existing development. At the same time, natural resource protection cannot be held up as a barrier to any realistic affordable housing development. Thus, creative strategies for land use policies, housing design, and Town infrastructure is needed to achieve goals for both natural resource and housing development priorities. To advance cooperation rather than entrenched conflict, advocates for an issue cannot expect to function without limits and would do well to work together. By timing this report's completion before that of the Town's updated Master Plan, the Sunapee Conservation Commission hopes to further this goal for cooperation.

5.02 State regulations

The State of New Hampshire legislates some broad protections and the need for permitting on activities that impacts natural resources. These protections and permits are typically carried out by the NH Department of Environmental Services (NHDES). This section provides highlights of these state-level permits but is not an exhaustive list.

The [Comprehensive Shoreland Protection Act](#) provides protection for Lake Sunapee and the Sugar River. This Act establishes minimum standards for the subdivision of adjacent lands and limits land uses within a 250' shoreland buffer zone for the purpose of protecting water quality and aquatic habitat. There are restrictions on the amount of impervious surface in this zone, as well as provisions to preserve natural vegetation.

Activities impacting [wetlands](#), such as excavation, removal, filling, dredging and/or construction of structures, are regulated by the NHDES Wetlands Bureau. Streets, roads, and utility right-of-way easements and water impoundments affecting wetlands require approval from NHDES, USDA Natural Resources Conservation Service, and Sunapee Conservation Commission, as well as the Sunapee Planning Board.

The [Alteration of Terrain](#) (AoT) permitting program requires the control and treatment of stormwater from large developments. The program applies to earth moving operations, such as gravel pits, as well as industrial, commercial, and residential developments. Treatment usually occurs through biological or physical means, and can take the form of rain gardens, infiltration ponds, gravel wetlands or other best management practices. [Sand and gravel](#) operations are regulated by the state under the provisions of RSA 155-e.

[Drinking water](#) provided by public water systems is regulated and monitored by the NHDES Drinking Water and Groundwater Bureau, but residential well water is not. NHDES recommends that residential well users test their water supply to determine whether the water should be treated before consuming it. The New Hampshire Groundwater Protection Act (RSA 485-C) identified [potential contamination sources](#) which should be avoided near surface water or groundwater supplies.

The NHDES Subsurface Systems Bureau must review design plans and specifications for proposed [septic systems](#) to ensure the proper siting, construction, and operation of these systems. Once the designed plans have been approved by NHDES and, if required, the municipality, NHDES will issue an Approval for Septic System Construction.

5.03 Town regulations

Zoning, a tool that allows towns to address the growth and development of a community, was adopted by the Town of Sunapee in 1987. The purpose of Sunapee’s zoning ordinance is “to promote the health, safety and general welfare of the community by encouraging the most appropriate use of land (RSA 674:16,17), thereby protecting our natural resources and preserving the vitality, atmosphere and varied economic forces of our town.”

The Zoning Ordinance, with its most recent amendment on March 8, 2022, addresses natural resources protection in several ways:

1. Zoning districts and Water resources overlay districts with different allowable uses and development requirements.
2. Subdivision stipulations with provision for cluster development and planned unit development.
3. Erosion control measures.
4. Provision for small wind energy systems.
5. Floodplain development measures.

5.03(a) Zoning districts

Sunapee has eight zoning districts (Map 21): Village Commercial, Village-Residential, Mixed Use I, Mixed Use II, Mixed Use III, Residential, Rural Residential, and Rural Lands. This is up from five districts reported in the 2009 Sunapee NRI.

Farming and forestry are uses permitted by right in the Rural Residential and Rural Lands districts. In all other districts, farming and forestry are neither permitted by right or special exception. Commercial and industrial uses are primarily restricted to the Village and Mixed Use districts. Residential development is allowed in all districts of varying types and densities. Workforce housing development provides incentives for the creation of added affordable units through easing of a zoning district’s restrictions for density, building size, and lot size (article 4.80). Small wind generation systems are permitted by special exception in all districts. The minimum lot size for each district ranges from 0.5 acre to 3 acres in size (Table 14). A lot’s dimensional requirements may be superseded by the water resources overlay district, which is made up of the aquifer, shoreline and wetlands overlays, summarized in Table 14 and Table 15.

District	Minimum Lot Size (acres)	Maximum Residential Density	Permitted Uses* (by right / special exception)	Maximum Lot Coverage	% of Sunapee
Village Commercial	0.5	1 du / 10,000 ft ² or 0.23 acre	SFD, Duplex, MF 3-5 Multifamily / ADU, Wind	80%	1%
Village Residential	0.5	1 du / 10,000 ft ² or 0.23 acre	SFD, Duplex, MF 3-5 / ADU, Wind	60%	1%
Mixed Use I	0.5	1 du / 0.5 acre	SFD, Duplex / MF 3-5, ADU, Wind	80%	<1%
Mixed Use II	1.0	1 du / 0.5 acre	SFD, Duplex / MF 3-5, ADU, Wind	50%	<1%
Mixed Use III	1.5	1 du / 1.5 acre	SFD, Duplex / ADU, Wind	40%	1%
Residential	1.0	1 du / 1 acre	SFD, Duplex / MF 3-5, ADU, Wind	50%	9%
Rural Residential	1.5	1 du / 1.5 acre	Farming, Forestry, SFD, Duplex / ADU, Wind	40%	57%
Rural Lands	3.0	1 du / 3 acre	Farming, Forestry, SFD, Duplex / ADU, Wind	30%	14%
Aquifer overlay	2.0	NA	NA	20%	2%
Shoreline overlay		Variable – see Table 15			7%
Wetlands overlay	1.5	NA	NA	0%	10%

Table 14. Dimensional Requirements of each Zoning District and Water Resources Overlay.

*Note: Overlay district area does not include areas for Lakes or Ponds. du = dwelling unit, SFD = single family dwelling, Duplex = two family dwelling; MF = multifamily; ADU = accessory dwelling unit. * the list of permitted uses only includes reference to farming, forestry, residential, and wind generation uses, excluding reference to all other uses.*

Source: Town of Sunapee Zoning Ordinance, amended March 8, 2022.

5.03(b) Water resources overlay district

The Water Resources Overlay District is comprised of aquifer, shoreline, and wetland overlays (articles 2.30 and 4.30, amended 2020) (Map 22). Areas covered by this overlay district have more restrictive regulations with the intention to protect water resources and ecologically fragile areas.

The aquifer overlay, covering 338 acres or 2% of Town, is “defined as the areas having a high, medium or low potential to yield groundwater”. The aquifer overlay allows construction of buildings, but prohibits potentially polluting uses, such as landfills, salt storage, and hazardous materials storage. In addition, natural drainage and vegetation must be maintained to allow recharge of the aquifer. Lots here have a two-acre minimum lot size and 20% maximum lot coverage.

The shoreline overlay, covering 1,068 acres or 7% of Town, is “defined as all lands within 250 feet of lakes and ponds greater than 10 acres and the Sugar River.” The shoreline overlay allows docks and beaches as permitted uses that are subject to the requirements of the State and Town. It prohibits potentially polluting uses, including those identified in the aquifer overlay as well as

fertilizer application. Cutting and clearing is regulated within 150 feet of the Normal high-water, and construction requires an approved erosion control plan. Lots within the shoreline overlay have variable dimensional requirements by zoning district (Table 15).

District	Minimum Lot Size (acres)	Maximum Lot Coverage	
		Impermeable	Impermeable and Permeable
Village Commercial	1.0	60%	80%
Village Residential	1.0	30%	60%
Mixed Use I	1.0	40%	80%
Mixed Use II & III	<i>Not Applicable</i>		
Residential	1.0	30%	50%
Rural Residential	1.5	25%	40%
Rural Lands	1.5	20%	30%

Table 15. Dimensional Requirements within the Shoreline Overlay.
Source: Town of Sunapee Zoning Ordinance, amended March 8, 2022.

The wetland overlay, covering 1,610 acres or 10% of Town, is “defined as those areas mapped as very poorly drained soils and any contiguous poorly drained soils by the USDA Natural Resources Conservation Service. The district shall also include any poorly drained soils which are contiguous to the shorelines of lakes and ponds greater than 10 acres in area. The area 25’ surrounding the above mapped areas shall also be part.” The wetlands overlay protects wetlands by prohibiting the construction of structures or buildings, dredging, or addition of fill. Streets, roads, and utility right- of-way easements, as well as water impoundments, require approval from the State Wetlands Bureau, USDA Natural Resources Conservation Service, and Sunapee Conservation Commission. Lots within the wetlands overlay is restricted to a minimum lot size to 1.5 acres that is not wetland, and no allowable lot coverage.

5.03(c) Subdivision regulations

Subdivision regulations describe the municipal requirements for subdividing land and are developed to reflect the goals of the Master Plan. The purpose of these regulations (amended 2019) in Sunapee is “to foster the development of an economically and environmentally sound and stable community and to protect the people of the Town of Sunapee from the consequences of improper subdivision, planless growth and haphazard development.”

The subdivision regulations place responsibility on the subdivider to protect existing natural features. Section 4.05 states, “The subdivider shall give due regard to the preservation and protection of existing features, trees, scenic points, brooks, streams, rock out-cropping, water bodies, other natural resources and historic landmarks in order to preserve the natural environment.”

Minimum design requirements are established for subdivision road design. Of note are requirements for a drainage design to address a increase or modified drainage on a site based on a minimum 25-year return period. Driveways are required not to interfere with the connecting street’s drainage.

In addition, these regulations stipulate that lots do not encroach upon environmentally sensitive or hazardous areas, i.e., areas with “health hazard or/and perils of fire, flood, poor draining, poor soils, slopes over 25% or other hazardous conditions.” These areas cannot constitute more than 35% of the minimum lot size for the Zoning District. Also, there are additional restrictions and requirements for areas in the floodplain, inadequate capacity for sanitary sewage disposal, or with lake or pond access.

Protections for open space are also included in the subdivision regulations. Section 5.01 states, “Where a proposed park, playground, or other open space shown on the Master Plan located in whole or in part in a proposed subdivision, the Board may require substantial compliance with the Master Plan.” Beyond open spaces identified in the Master Plan, the Planning Board also has the ability, where it deems essential, to require that a community open space or park is designated within any proposed subdivision. However, the size of this open space is not to exceed 15% of the total area of the subdivision. Alternative subdivision design with broader incorporation of open space fall under the Town’s provisions for cluster development and planned unit developments, explained in the next section.

5.03(d) Cluster development & planned unit development

In 2003, Sunapee adopted two innovative land use techniques for subdivision development to promote flexibility in land development design and to promote the conservation of open space, historic resources, and natural features. Cluster development and planned unit development involve developing portions of a parcel while setting aside another portion as open space. Per the provisions of the ordinance, this open space should be suitable for use as a common area, recreation, agriculture, or conservation, and should be located so that the environmentally sensitive areas are protected, and scenic impacts minimized.

Cluster development (article 4.50, adopted 2003) pertains to development with a clustering of dwelling units more closely than otherwise permitted alongside at least 50% open space. The gross land area must be at least five acres, and the underlying dimensional requirements and uses of the zoning district, such as dwelling unit density and lot coverage, must be abided. All zoning districts are eligible for cluster development. The clustering of homes decreases the demand for road construction and utility extension, and natural resource protections increased through a continuous open space area.

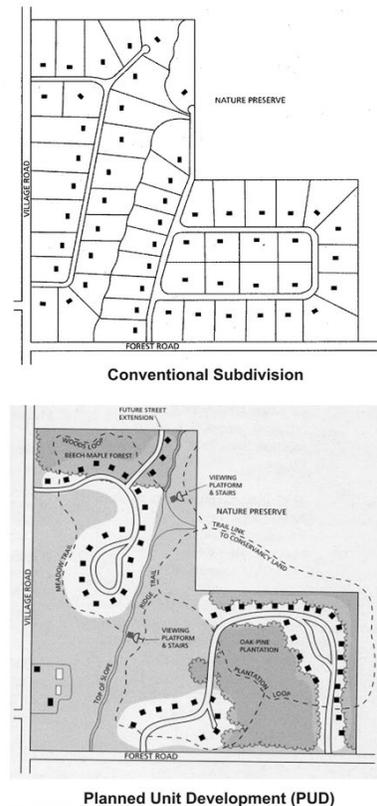


Figure 8. Planned Unit Development.

Source: Ardizzone et al., 2010.

Planned unit development (article 4.60, adopted 2003) pertains to development of commercial and/or residential uses in a form that preserves open space. This type of development is permitted in the Village, Mixed-Use, and Rural Residential zoning districts. In the Village and Mixed-Use districts, at least 25% of the land area must be protected as open space; in the Rural Residential district, at least 50% must be open space. Like cluster development, the underlying zoning district requirements must be abided.

5.03(e) Erosion control provisions

The Zoning Ordinance prohibits construction on slopes greater than 25% (section 3.40, amended 2022). Driveways, stairways, and utilities are exempt, but require a drainage and erosion control plan. An erosion control plan is required for land clearing of greater than 100,000 square feet, or new construction on slopes greater than 15% with disturbance exceeding 1,000 square feet (section 3.40, amended 2011).

A vegetative buffer of 25 feet is required along major roads in the Rural land, Rural residential, and Mixed Use III districts. This requirement applies to Route 11, 103, and 103B (section 3.40, amended 2020). Depending on the width, a vegetative buffer can help with sediment control, filter out some pollutants in stormwater, diminish noise, and provide wildlife improved habitat and a travel corridor.

5.03(f) Small wind energy systems

Small wind energy systems and meteorological towers (article 4.70, adopted 2009) increase local mitigation from the use of fossil fuels and local energy independence and resilience through a distributed and renewable resource. The intent of the article is to allow the use by special exception and provide limits to protect public health, consistency with land use policy, compatibility with rural setting and character, and establishing standards for this use. These systems are limited to a height of 150 feet with limitations in number and specific locations on a lot in order to diminish noise and visual impacts to the neighborhood. There are additional limitations on lighting, signage, and a single non-reflective paint color. As of 2022, no wind energy systems have been installed in Sunapee.

5.03(g) Floodplain development ordinance

Adopted in 2006, the floodplain development ordinance applies to all lands designated as special flood hazard areas by the Federal Emergency Management Agency (FEMA) (described in Natural Resource section 4.04 Surface waters, riparian zone & floodplains). Permits are required for development on these lands in order to ensure “building sites will be reasonably safe from flooding”. Design guidelines include but not limited to requirements for the use of materials resistant to flood damage, water and sewer systems designed to eliminate infiltration from flooding.

5.04 Non-Regulatory protections

Education, voluntary programs, and monitoring play an important role in protecting natural resources. In Sunapee, these programs include:

- Household hazardous waste collections
- Water-quality monitoring
- Environmental education in schools and in the community
- Invasive species monitoring, education, and control
- Watershed planning projects for the Lake Sunapee watershed

Sunapee organizes [household hazardous waste](#) collections with neighboring New London and Newbury, and also participates in collections organized by the Upper Valley Lake Sunapee Regional Planning Commission; these collections minimize the risk of inappropriate disposal or accidental release of common toxic materials that may pollute the water supply.

New Hampshire Department of Environmental Services (NHDES) and local lake associations monitor water quality in Lake Sunapee, Ledge Pond, and Mountainview Lake through the [Volunteer Lake Assessment Program](#). Each year, a water quality report is produced and improvements or declines in water quality can be identified and addressed.

Lake Sunapee has been protected by concerned citizens since 1898 when the Lake Sunapee Protective Association (LSPA) was formed. LSPA is involved in [environmental education](#), both in schools and in the community, about issues that affect the lake and its watershed. This includes public events and presentations as well as demonstration sites for improved stormwater management.

The threat of [invasive species](#), in particular variable milfoil, is addressed through several programs organized by the LSPA. Weed Watchers are volunteers who survey lakes to spot areas where milfoil is growing, providing early detection on new infestations. LSPA also organizes efforts to manage milfoil infestations, which involves divers harvesting the plants. The primary mechanism for milfoil spread is through boats moving among waterbodies. Lake Hosts educate boaters on milfoil and how to clean their boats, as well as inspecting incoming and outgoing boats and sending suspicious plant samples for species identification. In addition, there is a boat washing station at Sunapee Harbor to thoroughly clean off invasive plant parts.

In March 2020, LSPA completed a [watershed management plan](#) for Lake Sunapee. The plan identifies six categories for its action plan: Education and Outreach, Research, Further Evaluation, Monitoring and Assessment, Land Conservation and Land Use Regulation, Zoning and Ordinance. Similar action items would likely prove effective in improving water quality in other watersheds in Sunapee.

5.05 Planning documents

5.05(a) Master plan

The Sunapee Master Plan is a document that describes the status and future goals for the town. It is periodically updated to reflect changes in development, community attitudes, and new information. The most recent plan was adopted in 2010, and includes information on important natural, cultural, and historical resources, as well as a plan for future land use. The Master Plan provides the legal basis for zoning and other land use regulations for the Town.

In the 2010 Master Plan, the people of Sunapee outlined their support for the protection of the town's most important features. This included Lake Sunapee and Perkins Pond, the peaceful, rural nature of life, large undeveloped tracts of land, and outdoor recreational activities. Acknowledging land use trends over the last two centuries, the Sunapee Master Plan labels the town as a "recreation center and second home/retirement community," with an important rural character and environmental awareness.

Community attitudes and priorities informed the development of the Master Plan's goals for land use and approach to natural resources. For instance, the plan encourages denser development in existing village centers, while maintaining low-density development and uninhabited tracts of land in outlying areas. This approach would maintain the town's rural character, as well as protect resources found in such outlying areas from the negative effects of development. However, an increase in density must be met with higher utility and infrastructure capacity to avoid issues related to the stressing of natural resource functions such as wastewater and stormwater. A smaller consideration should be made to the effects of increased population density on the highly valued rural quietness and dark night sky in Sunapee, if only specifically in those important areas.

A subset of goals outlined in the Master Plan is to protect natural resources and the environment, while ensuring public access to and enabling use of these natural resources. By tying recreation and preservation together, Sunapee creates a system that encourages both. This system can also produce unique issues. Special care should be taken to ensure these goals do not conflict beyond a reasonable extent, as an imbalance in one could negatively affect the other. For example, overuse of a recreational beach could lead to contamination from chemical pollutants and bacteria. On the other hand, significantly limiting recreational use affects the town's important primary status as a recreation center. Complete lack of use of a natural resource could also lead to neglect and lower perceived value, preventing both goals from being reached.

When comparing the Master Plan's 2008 existing land use map to both the future land use map and a modern land use map from 2022, Sunapee has fallen short of the goal to meet the state's recommended percentage of conserved land. However, a significant amount of progress has been made through a combination of private and public land conserved in priority areas highlighted in the Land Use section of the Master Plan.

A limitation of the 2010 Master Plan are goals or ideas with vague or nonexistent plans to advance them. Examples of this include goals to protect prime wetlands, which have no

explanatory text in the recommendations portion of Section III. The Master Plan also acknowledges the lack of an institutional framework to address internal natural resource protection, but only goes so far to suggest the Town establish a process to identify groups who will be responsible for solving this problem. Although naming these goals begins the process of reaching them, the lack of clear next steps and/or identified leaders may cause inaction or hampered action that prevent effective implementation of goals.

The Master Plan is currently undergoing revision, and it is anticipated that this Natural resources inventory and Conservation plan will be used to inform the master planning process.

5.05(b) 2010 Natural resources plan

The Town of Sunapee 2010 Natural resources plan, informed by the 2009 Natural resources inventory, represents the Conservation Commission’s guiding document to inform efforts to maintain, protect, and increase access to the Town’s natural resources. This 2022 Natural resources inventory and Conservation plan intends to provide a comprehensive update and revision to these documents. This section will specifically focus on summarizing conversations and evaluate progress and challenges on recommendations in the 2010 plan (Table 16).

Goal	Recommendation	Status
Create and maintain a process for natural resource protection	Collaborate with neighboring Towns and watershed partners in the protection of Lake Sunapee	See Section 5.04
	Educate citizens on the value of natural resources and the importance of protecting these resources	See Section 5.04
	Assign town boards and staff to implement resource protection initiatives and administer code enforcement	In 2014, a public sewer line was put in around Perkins Pond
Protect the natural environment	Implement a Visual Resource Protection District around scenic areas and/or a Ridgeline Development ordinance*	Under Consideration
	Actively protect natural resources through conservation easements and land purchases*	New conservation easements purchased, Section 5.01(b)
	Increase the percentage of Land Use Change Tax dedicated to conservation, set at 50%	No Update
	Designate “prime wetlands” and allow special review by the State Wetlands Bureau*	The SCC started prime wetlands mapping in the 90s but it was not completed.
	Protect Lake Sunapee as a public drinking water supply	See Section 5.04
	Amend the zoning ordinance to reduce densities in rural areas and increase in village areas where connections to municipal water / sewer system are possible	No Update
	Implement a Transfer of Development Rights provision to encourage preservation of rural lands	No Update
	Introduce additional Low Impact Development provisions within zoning, subdivision, and site plan review	No Update
	Reclassify areas around drinking water wells according to the state Groundwater Protection Act	No Update

Goal	Recommendation	Status
	Create a local health ordinance for groundwater protection to allow inspection of septic systems for failure*	The Town is currently pursuing an ordinance to require the pumping/inspection of septic systems.
	Amend the Water Resource Overlay District to require stormwater treatment onsite, require submission of erosion control plans for construction permits, and minimize wetland disturbance	No Update
	Educate the public as to the value of conservation lands and easements	No Update
Provide public access to significant natural areas	Foster low-impact recreation in undeveloped areas while allowing high-impact recreation in appropriate locations	New hiking trails to improve public access to conservation land have been created in the past ten years: Wendell marsh trail, 3 new trails at Ledge Pond lot, Herbert Welsh trail at Dewey Wood and Bartlett-Tyler lot. Outdoor exercise equipment at Coffin Park.
	Incorporate into subdivision and site plan review regulations requirements to protect natural resources and provide easements for trails connecting conservation and recreation areas	No Update
Provide an opportunity for the use of significant natural resources	Protect prime agricultural soils and productive forest soils through amendment to the zoning ordinance	No Update
	Maintain existing agriculture-friendly zoning provisions	No Update
	Continue to protect the infrastructure required to support forestry and agricultural activities, e.g. log and farm roads, accessory structures, etc.	No Update
	Through landowner education, ensure that cultivation, management, harvesting, or extraction of natural resources takes place under conditions which foster compatibility with existing surrounding land uses, especially regarding Best Management Practices (e.g., Forest Management Plans, improvement cost-sharing programs, methods to prevent nuisance animals)*	No Update
Additional recommendations from the 2009	Align the Zoning Ordinance with the revised Comprehensive Shoreland Protection Act	No known issues, and any misalignment will be addressed in the next master plan, likely 2023.
	Increase the minimum lot size on lake shorelines, or adopt impervious surface standards; Increase minimum lot size in areas of high resource value	No Update

Goal	Recommendation	Status
Natural resources inventory	Extend jurisdiction of the Water Resources Overlay District to perennial streams and 100 ft on either side; to include a 100' upland buffer around wetlands. Any increase beyond 50' should be consistent across other waterbody protections.	In 2020, wetlands buffer to provide a 25' setback around jurisdictional wetlands.
	Create stormwater management regulations	No Update
	Incorporate into subdivision/site plan review regulations voluntary guidelines for developers to protect habitat	Subdivision has an allowance for up to 15% of land to be used for conservation purposes - this includes trails or any other potential use by SCC. The SCC worked successfully with a developer of an 85-acre former farm lot on the south side of Trow Hill Road and got a 10-acre or so set aside with access off a road that then provided access to a contiguous large landlocked wetland lot conserved in 1971.
	Develop a water resources protection plan for incorporation with the master plan	See LSPA 2020 Watershed Management Plan
	Establish a Local Agricultural Commission to advise town boards on agricultural issues and advocate for farming	No Update
	Create an Agriculture Conservation District in Zoning Ordinance, providing incentives to farm in this district	Considered in 2020. No action made as much of the prime ag land is already under deeded conservation easements.
	For renewable energy, consider town tax credits for residential installations and adopt a site plan review process which includes wildlife and other environmental considerations	No Update
	Present 2009 NRI results to the public via Town Meeting, roundtable discussions, presentations to local organizations	No Update
	Identify additional inventory work, such as mapping and documenting recreational, scenic, and historic resources	See Section 4.16 Missing vernal pools, invasive plants, and native wildlife sightings
	Develop a conservation plan	Complete

Table 16. Status on recommendations by goal put forward in the 2010 Natural resource plan and 2009 Natural resources inventory.

*Note: Those recommendations found in both documents are indicated with a *. Source: Sunapee Conservation Commission 2022*

6. Natural Resource Co-Occurrence

To identify areas with multiple natural resource value, the Sunapee Conservation Commission (SCC) used a method known as co-occurrence analysis. This is a geographic analysis of natural resource overlap and spatial coincidence. In such an analysis, the overlay resources yield “hot spots” where multiple important resources occur in the same location.

To organize this analysis, seven natural resource categories were identified by the SCC. Within each category, Commission members selected at least one mapped feature that represented the natural resource, such as riparian areas around ponds to represent the surface water resource (Table 17). Within each of the seven categories, all measurable features were combined and assigned an equal value. Therefore, the results are easy to interpret and explain –a score of “7” indicates that at least one feature of all 7 categories is present at that location. This analysis is performed using a spatial overlay algorithm in ArcGIS Pro 2.7.2.

The results are not authoritative, meaning hot spots are not always a priority or inclusive of all natural resource values. Areas that have the most overlap are likely to have the most natural resource value because they serve multiple identified purposes. Low overlap areas may be identified as a high priority for reasons to protect nearby natural resources or to restore value that has been diminished. The results are shown in Map 23 and conclusions highlighted in Section 7 Conservation plan.

	Natural Resource Category	How this Resource was measured
I	Wildlife	Important habitat identified in Wildlife Action Plan (Tier 1 / 2)
		Habitat Blocks greater than 500 acres
II	Surface Water	Lakes and ponds and land within 50-ft
		Streams and rivers and land within 50-ft
		Wetlands and land within 50-ft (identified by NWI / hydric soils)
		Floodplains (Regulatory floodway, 100 & 500 year floods)
III	Farm and Forest Land	Prime agricultural soils or Active farms
		Group IA forest soils
IV	Climate Change Resilience	Resilient sites (more / most resilient)
		Wildlife pathways (diffuse / concentrated flow permeability)
V	Water Protections	Land in Water Resources Protection Overlay District
		Wellhead protection area for active public water supplies, and sanitary zone for potential community systems (Wendell Marsh)
VI	Land based protections	Conservation land and land within ½-mile of conservation land
		Erosion control. Steep slopes –greater than 15%
VII	Cultural / Recreation Natural Resources	Natural Rock Features: Indians Cave, Bears Den, Pulcifer Rock and land within 50ft
		Waterbody access including land within 50ft for points only
		Abandoned sugar river railroad bed trail & Sunapee Ragged Kearsarge Trail including land within 50ft

Table 17. Natural resource categories for Town of Sunapee co-occurrence analysis.

7. Conservation plan

Purpose. The Sunapee Conservation Plan provides the Sunapee Conservation Commission (SCC) and other town officials with a science-driven and consensus-based approach to guide the SCC’s mission. The plan integrates the best available information at the regional and local level with expert judgment. The Plan should be updated on a regular basis and used to inform revisions of the Sunapee Master Plan and to guide the town’s sustainable growth and conservation of its natural resources.

Four priority zones and seven strategies are identified to inform an action plan. Recommended actions for each of the leading strategies have been outlined as part of this Conservation Plan. These actions range in type from discussion and partnership to assessment, education, regulatory, and management. This is an ambitious plan and the SCC welcomes participation. In fact, any effort to achieve these will require extensive partnership and engagement.

Priority Zones	Leading Strategies	Minor Strategies
Z.A. South Sunapee	LS.1. Planning and zoning collaboration	MS.1. Conserved lands management and advancement
Z.B. Drinking water supply areas	LS.2. Resilient area protection	MS.2. Natural settings recreation advancement
Z.C. Red Water Creek to Mud Pond	LS.3. Water quality protection	MS.3. Farmland protection
Z.D. Northwest Sunapee	LS.4. Invasives management	

7.01 Overview of planning process

In the Spring of 2022, the SCC initiated a process to update the Town’s NRI and Conservation Plan. The primary purpose of these documents is to inform the Town Master Plan update and actions to be taken by the SCC. The process used to create this Conservation Plan included five steps by the SCC:

1. Understand the Town’s natural resources through an NRI update.
2. Evaluate where SCC natural resource priorities exist in co-occurrence, described in section 6.
3. Identify topics and locations of conservation priority through a facilitated exercise, described in section 7.02.
4. Consult Town staff and community stakeholders on identified conservation priorities, described in section 7.02.
5. Review the Plan in consultation with Town staff and the Planning Board.

This planning process was facilitated by the project consultant, the Upper Valley Lake Sunapee Regional Planning Commission.

7.02 Geographic zones of priority

Informed by the 2022 Natural Resources Inventory (NRI) and its co-occurrence analysis, the SCC will prioritize Conservation Plan strategies with impact on four geographic zones (Map 23). These areas received strong support from most SCC members. In addition to these four zones, the Lower Sugar

River area is given honorable mention with strong support from a few SCC members. The Zone for drinking water supplies partially covers the Lower Sugar River area due to the proximity of Wendell Marsh.

Z.A. South Sunapee

The South Sunapee zone encompasses the land southwest of Route 103. The western and eastern edges of this zone host important natural resources for water resources and wildlife habitat. The eastern edge remains undeveloped, besides the main roads. The western edge hosts low density single-family homes along Nutting Road near Trask Brook. In the zone's mostly forested central area, there are stretches of steep slopes, contributing to its minimal development. The SCC co-occurrence analysis results in high scores along the western edge that coincides with Trask Brook.

Along the zone's western edge is a large wetlands complex including forested, shrub/scrub, and emergent habitats. Trask Brook flows through these wetlands, feeding them, until joining the Sugar River. This corridor is recognized by the NH Wildlife Action Plan (WAP) as a Tier 1 important habitat where the rare American Kestrel has been spotted. The area is also significant with underlying aquifers, roughly half of all found in Sunapee. A FEMA Floodway is designated along Trask Brook between Penacock Path and Depot Road. One public water supply is in this area at the former Touchette mobile home park.

The small eastern part of the zone provides a link to a 30,000 acre habitat block stretching south across Mount Sunapee and through the Towns of Goshen, Newbury, and Washington. This small section in Sunapee is recognized by the Quabbin to Cardigan partnership (Q2C) as a key wildlife connectivity corridor, which extends up through Northwest Sunapee (another priority zone for the SCC). This small edge hosts soil identified with potential high forest productivity, coinciding with Northern hardwood-conifer forest. Rare plant species have been spotted in or near this eastern part of the zone.



*Photo 25. Trask Brook wetland off Nutting Rd, Nov 2022.
Credit: Olivia Uyizeye.*

Z.B. Drinking water supply areas

This priority zone includes all current well head protection areas, aquifers, potential future municipal wells and their sanitary zone in the Wendell Marsh conservation land, areas on Lake Sunapee and other water bodies not served by municipal sewer, and Lake Sunapee at-large as a surface water used for Town's municipal water supply. This priority zone is closely aligned with the leading strategy for water quality protection outlined in the next section.

These drinking water supply areas also coincide with other natural resource features, and with three other geographic zones of priority. Most notably, overlays occur with important Trask Brook and its wetland complex, Red Water Creek, and Ledge Pond. The drinking water priority zone also adds areas, most notably the large Wendell Marsh area with ecological assets for habitat, wildlife, and flood control; Lake Sunapee and its harbor with significant recreational, cultural, and wildlife value (e.g., habitat for the Common Loon); and the Georges Mills village area.



Photo 26. Left – Lake Sunapee, public water supply, view from Mount Sunapee, 2022. Right - Wendell Marsh Public Access, 2022. Credit: Meghan Hoskins, Barbara Chalmers.

Z.C. Red Water Creek to Mud Pond

This priority zone includes three important natural features: Red Water Creek at the zone's northern boundary, Mud Pond at the southern edge, and Blueberry Mountain between them. Route 103B cuts through Red Water Creek and extends south near Mud Pond. The road gives access to housing developments on Lake Sunapee side developed since the late-1960s. On the northeastern slopes of Blueberry Mountain, a recently approved single-family home development is underway. The SCC co-occurrence analysis results in high scores throughout much of Red Water Creek and to the south through the zone.

From its headwaters in a large wetland complex, Red Water Creek flows into Lake Sunapee at Fishers Bay. Almost all of these wetlands are identified as Tier 1 important habitat in the State’s Wildlife Action Plan. The Creek’s headwaters are protected by two parcels, totaling almost 142 acres, with conservation easements held by the Ausbon Sargent Land Preservation Trust (ASLPT). These conserved lands protect wetland and upslope habitat. Both parcels allow access to the public, including parts of the Sunapee Ragged Kearsarge Greenway (SRKG) trail. The SCC, along with many others, contributed to the acquisition of the easements for these parcels. A historic water-powered mill site on Red Water Creek is also protected by this conserved land. The Meadow Brook development wellhead protection area covers much of the land near the outlet of Red Water Creek.

Blueberry Mountain is the central feature of this zone, part of the 760-acre habitat block completely contained within Sunapee’s borders. This large undeveloped and forested area is a result of the Mountain’s steep slopes, and a conserved parcel named the Webb Forest Preserve. While Blueberry Mountain is part of the Lake Sunapee watershed, the Webb Preserve is part of the headwaters for Trask Brook to the West and includes valuable wetlands. The conservation easement on Webb Preserve is held by ASPLT, covers 376 acres, and provides unlimited public access for low impact recreation, such as the SRKG trail. This part of the zone also hosts multiple historic deeryards, and the stone remains of 18th century farms.

Mud Pond sits below the slopes of Blueberry Mountain, to the north of Mountain View Lake. House along Route 103B is the closest development. A few small wetlands surround Mud Pond, which is relatively isolated and undeveloped, in contrast to Mountain View Lake which hosts residential lake-side development.



Photo 27. Left – Red Water Creek at Simpson Reserve, 2021. Right – View of Blueberry Mountain towards Mud Pond from the Mountainview Lake southern shore, Nov 2022. Credit: Barbara Chalmers, Olivia Uyizeye.

Z.D. Northwest Sunapee

The Northwest Sunapee zone encompasses all of Ledge Pond, its surrounding forests, and undeveloped stretches to the west. To the south and east of this zone are Perkins Pond Road, North Road, and Route 11. The entire zone is part of a 4,636-acre habitat block that stretches into the Towns of Croydon and Springfield. Ledge Pond has housing on its south and west shores as well as surrounding large parcels in the Rural Lands zoning district, the lowest density in Sunapee. The SCC co-occurrence analysis results in medium-high scores throughout much of this zone.

For productive soils, the zone contains patches of federally and locally designated prime agricultural soils, and more extensive areas of productive forest soils for high and moderate value hardwood. The cultural resources in this zone includes scenic views from Trow Hill, historic Twin Willow Mica Mine, stone remains of 19th century farms, and Ledge Pond public access. This access is in the Ledge Pond Lot town forest, which hosts part of a designated municipal wellhead protection area. This zone includes a Tier 1 habitat area of the state Wildlife Action Plan. Additional Tier 1 and Tier 2 habitats run along the western part of this zone. These habitats support a couple of rare species, including the Canada Lynx. Historic deeryards are found in patches across this zone. A network of Ledge Pond Brook wetlands on the southern end in the Rowell-MacWilliams Lot is already protected by a conservation easement with Ausbon Sargent Preservation Land Trust. This woodlot allows for low impact recreation.



Photo 28. From Rowell MacWilliams woodlot. Left – Ledge Pond Brook wetland, Mar 2020. Right – Of recreational trail on property, Apr 2021. Credit: Barbara Chalmers.

7.03 Strategies to conservation

Action to conserve important natural resources in Sunapee has been structured into five leading strategies (LS) and three minor strategies (MS). The SCC will seek to advance these strategies with particular emphasis on the Priority Zones. Minor strategies will receive attention to maintain existing work and may be advanced through synergies.

7.03(a) Leading Strategies

LS.1. Planning and zoning collaboration

The SCC plans to more frequently advise town planners and decision makers regarding the town's conservation priorities to ensure they are reflected in the town's zoning map, local regulations, processes, and planning efforts. The SCC sees it as a priority to inform planning and zoning decisions relative to land development and enforcement. This is of particular concern given the interest in seasonal developments and the need for more affordable housing in Sunapee and throughout New Hampshire. On this topic of collaboration, the SCC identified the following topics for focused attention:

- Ensure changes in local regulations and planning documents include consultation with SCC
- Reduce variance approvals and increase predictability
- Advance appropriate enforcement, use of fines, and coordination with Town staff
- Advance development needed for overall community vitality and public health where infrastructure is available
- Improve infrastructure in a way that conserves natural resources (e.g., public water and wastewater services expansion)
- Increase density in villages and reduce in rural residential

The SCC is aware that situations exist where a site's potential may be well suited for more than one land use, and that conservation cannot always be given priority at every location. With simultaneous needs for public health, community character, and transportation, the SCC seeks to inform a Town-wide view that keeps these needs, alongside those for conservation, in balance. Further, the SCC seeks to advance efficient planning and zoning strategies, so that any seemingly necessary loss in ecosystem value or function is done with full knowledge of the impact and with a result that provides tangible community wide benefits.

LS.2. Resilient area protection

The SCC seeks to advance protections for areas important for the long-term resilience of native wildlife populations, natural communities, and functioning ecosystems services. Of special priority includes protections to maintain and expand wildlife corridors and wetlands in Town.

LS.3. Water quality protection

The SCC seeks to increase protection for water quality, especially drinking water, through regulation and education. Regulations need to be reviewed for their adequacy to provide baseline protection for important riparian buffers, aquifers, wellhead protection areas for current and future municipal wells (e.g., Wendell Marsh wells), and surface waters, especially Lake Sunapee used as a public drinking water source. The Town's 2018 Forest Management Plan includes detailed recommendations for water quality protections for the SCC to review for broader applications or educational opportunities. The Lake Sunapee shore in New London and Newbury is not served by a municipal sewer system, but Sunapee has been proactive in the regard and much but not all of Sunapee's shoreline is served by Sunapee's municipal sewer system. Along the shoreline of Lake Sunapee in Sunapee, residential homes rely on private septic systems are around Jobs Creek, Fishers Bay, and in Burkehaven. Adopting an enforceable regulation that requires periodic septic system pumping and inspection as a first measure and ultimately connecting these homes to the municipal sewer system is an SCC priority. Pollution at Mountain View Lake with its many old cottages on small lots with septic systems is also of concern, as this waterbody and the Mt. Sunapee State Park with its thousands of winter visitor ultimately are part of the Lake Sunapee watershed. Perhaps a future Sunapee municipal sewer line extension along Route 103 will address these concerns and pollution sources. SCC looks to protect and target public infrastructure investments, as well as reduce additional costs and public health impacts due to poor water quality. Through this effort, the Town will better optimize the value of manmade and natural ecosystem functions for all-around benefit.

LS.4. Invasives management

The SCC seeks to control invasive plant species throughout the town, while increasing the presence of important native species. As of 2022 there has been no Town-wide assessment or management plan for invasive species, although problem areas are known, and a few are actively managed by various private entities. Transportation rights of way and boat landings are especially at high risk of spreading invasive species. Important scenic vistas are found along many roads and waterbody public access points, which are diminished by the presence of invasives. The Lake Sunapee Protective Association runs a volunteer driven program called Invasives Watch. This program is focused on both the identification and management of aquatic invasive species in Lake Sunapee. Once a thorough assessment is made within the Town beyond the lake shore, the SCC can explore a partnership with LSPA to expand or establish a parallel land-based program. The SCC management program for invasives will seek to identify opportunities for native plantings, or green infrastructure, when the removal of invasives is sufficient.

7.03(b) Minor Strategies

MS.1. Conserved land acquisition and management

The SCC serves as the manager of Sunapee's town forests where active forest management and low-impact recreation is happening. The responsible management of these forests can serve as a model and educational opportunity to private landowners. The SCC will continue to provide community hikes as educational events for the public at times of active work for town forest management. The SCC shall continue to acquire properties and develop conservation easements for the purpose of conserving priority lands in Town. The SCC maintains a Conservation Fund to support these activities. The fund receives revenue from the Land Use Change Tax, and conservation land warrant articles.

MS.2. Natural settings recreation advancement

The SCC seeks to further recreation located in natural settings for its value to the local economy, public health, and education. The most common form of public recreation in Sunapee's town forests is trail use by hikers, runners, skiers, and mountain bikers. The public's enjoyment of trails is generally a function of accessibility to well-constructed and maintained trails, forest aesthetics, and the opportunity to view wildlife. Trails need to be constructed and maintained to allow access to a diversity of users in a variety of natural settings. Many actions are already outlined in the Town's 2018 Forest Management Plan. Additional actions, such as building accessible trails for the mobility-impaired could be considered. Improvements made in 2022 at trailhead kiosks could be expanded to be available in Town facilities, and along trails themselves to improve public understanding and appreciation for the natural resources that surround them. Access points can be interconnected to other Town hot spots, such as field-based recreation parks or facilities, commercial activity, residential neighborhoods, and multi-modal pathways. For example, the Sunapee Recreation Department is interested in providing a facility for recreation and public events, which the SCC could seek to support at a suitable location that integrates with natural setting recreation.

MS.3. Farmland protection

The SCC seeks to maintain existing agriculture-friendly zoning provisions, as recommended in the 2010 Natural Resources Plan. As part of the SCC's broader effort to influence planning and zoning rules and decisions, the SCC will continue to advise town boards on agricultural issues and advocate for farming, and protection of prime agricultural soils. The impacts of climate change on agriculture, as well as pandemic induced disruptions to food supply, highlight the need for increasing opportunities for local food production. The SCC recognizes the importance of the working landscape of agricultural soils and active and potential farmland as critical infrastructure needed to strengthen resiliency.

7.04 Action plan

Strategy Code	Action Type	Description	(Confirmed) Partners	Funding	Timeline (yrs)	Plus Strategies	
LS1 - Planning and Zoning Collaboration	LS1-a	Partnership	Establish quarterly or bi-yearly communications on local regulatory topics among the planning, zoning and conservation commission in compliance with RSA 676:2.	PB, ZBA	NA	1	
	LS1-b	Partnership	Support Town staff to implement resource protection initiatives and administer code enforcement*	<u>Town Manager</u>	NA	Ongoing	
	LS1-c	Assessment	Consult with Water and Sewer Department on system capacity, condition, and expansion options, including those that would further higher village density and connection of homes on waterbodies with private septic systems.	<u>Water & Sewer Dept</u> , PB	CWSRF	2	LS3
	LS1-d	Assessment	Perform a build out analysis to evaluate and inform SCC zoning recommendations that align with conservation priority zones and inform implementation of the Town's 2023 Master Plan update. Consider application of the UVLSRPC Places for Homes.	<u>UVLSRPC</u> , PB, ZBA	InvestNH	1	LS2, LS3, MS3
	LS1-e	Education	Present 2022 NRI and Conservation Plan results to the public via Town Meeting, roundtable discussions, and presentations to local organizations.	<u>UVLSRPC</u> , <u>PB</u> , <u>LSPA</u>	TBD	Ongoing	
	LS1-f	Regulatory	Amend the zoning ordinance to reduce densities in rural areas and increase in village areas where connections to municipal water / sewer system are possible. Potentially informed by build-out analysis action*	PB, ZBA, <u>UVLSRPC</u>	InvestNH	2	
	LS1-g	Regulatory	Implement a Transfer of Development Rights provision to encourage preservation of rural lands*	PB, ZBA	InvestNH	TBD	LS2
	LS1-h	Regulatory	Introduce additional Low Impact Development provisions within zoning, subdivision, and site plan review*	PB, ZBA	InvestNH, LSWPG	TBD	LS2, LS3
	LS1-i	Regulatory	Incorporate into subdivision and site plan review regulations requirements to provide easements for trails connecting conservation and recreation areas*	PB, ZBA	TBD	3	MS2, MS1
	LS1-j	Regulatory	For renewable energy, adopt a site plan review which includes specific environmental considerations. For example, windmills with one blade painted show reduced wildlife collisions.*	Energy Committee	TBD	3	LS2

Strategy Code	Action Type	Description	(Confirmed) Partners	Funding	Timeline (yrs)	Plus Strategies	
LS1-k	Regulatory	For renewable energy, consider town tax credits for residential installations.*	Energy Committee	TBD	5	LS2	
LS2 – Resilient Area Protection	LS2-a	Discussion	Review Wetlands Overlay District. Consider the following questions – Are all important wetlands protected? Are wetlands protected with little ecosystem service value? Should a broader water quality buffer be considered, up to 100 feet?	LSPA, PB, ZBA	LSWPG	1	LS1, LS3
	LS2-b	Assessment	Delineate Town Wetlands.		TBD	TBD	
	LS2-c	Assessment	Map vernal pools.		Volunteer	3	
	LS2-d	Assessment	Review existing maps and supplement with any needed inventory and mapping of Town natural settings recreation, including ownership, accessibility, and condition.	Recreation Committee, SRKG, LSRCC	Volunteer	1	MS2
	LS2-e	Education	Increase awareness of and programming for natural settings recreation (e.g., maps available at Town facilities and Recreation website, advance youth programs in Town Forests).	Recreation Dept, LSRCC, SRKG	TBD	3	MS2
	LS2-f	Regulatory	Designate “prime wetlands” and allow special review by the State Wetlands Bureau*	PB	NA	5	
	LS2-g	Management	In Town Forests, enact adaptive management strategies and provide simultaneous educational opportunities with property owners, especially regarding water quality and habitat.			Ongoing	LS3, MS1
LS3 – Water Quality Protection	LS3-a	Partnership	Keep informed and support LSPA efforts to implement the 2020 Lake Sunapee Watershed Management Plan	LSPA	NA	Ongoing	
	LS3-b	Discussion	Consult with Highway Department yearly on water quality issues and improvements, such as efforts to reduce the use of salt on Town roads and storm drainage improvements.	Highway Dept	NA	Ongoing	LS2
	LS3-c	Discussion	Review Shoreline Overlay District. Consider the following questions – Should a broader water quality buffer be considered, up to 100 feet?	LSPA, Water & Sewer Dept	LSWPG	1	LS1, LS2
	LS3-d	Discussion	Discuss opportunities to improve groundwater protection through inspection of private septic systems for failure. Performed either through a Health Ordinance and/or expansion of the LSPA Watershed Wise program*	LSPA, PB	LSWPG	TBD	LS2

Strategy Code	Action Type	Description	(Confirmed) Partners	Funding	Timeline (yrs)	Plus Strategies	
LS3	LS3-e	Assessment	Assess current stormwater management regulations.	<u>Highway Dept</u>	LSWPG, CWSRF	TBD	LS2
	LS3-f	Assessment	Evaluate needs for green infrastructure improvements and identify funding mechanisms to further priority projects.	<u>Highway Dept</u> , <u>UVLSRPC</u>	LSWPG, CWSRF	2	LS2, MS1
	LS3-g	Education	Educate the public on PFAS impact on wastewater management to encourage reductions in contamination.	<u>Water & Sewer Dept</u> , LSPA, LSRCC	LSWPG	TBD	LS1
	LS3-h	Education	Educate the public on protecting drinking water. Support and consider expanding the LSPA Watershed Wise program to be Town-wide. Consult Town Forest Management Plan.	<u>LSPA</u>	LSWPG	3	LS2
	LS3-i	Regulatory	Expand the Aquifer Overlay District to include wellhead protection areas, including future municipal wells at Wendell Marsh.	<u>Water & Sewer Dept</u> , PB	LSWPG	1	
	LS3-j	Regulatory	Reclassify areas around drinking water wells according to the state Groundwater Protection Act*	<u>Water & Sewer Dept</u> , PB	LSWPG	3	LS1
LS4 – Invasives Mgmt	LS4-a	Assessment	Inventory and map locations with known invasive species.	<u>Highway Dept</u> , <u>LSPA</u>	Volunteer Driven	1	MS2
	LS4-b	Education	Educate the public on identification of invasive species and known mechanisms in their spread. Support and consider expanding the LSPA Invasive Monitor program to be Town-wide and include terrestrial invasives.	<u>LSPA</u>	TBD	TBD	MS1
	LS4-c	Management	Create an Invasives Management plan. Prioritize invasives management at Scenic Viewing sites. Incorporate native species plantings when appropriate.		TBD	TBD	MS2
General	Discussion	Regular review and discussion of Conservation plan.	SCC	NA	March, September		

Table 18. 2022 Conservation Plan Action List for the Sunapee Conservation Commission.

*Note: Those actions previously mentioned in SCC planning documents are indicated with a *.*

Shorthand Partner Note: PB = Planning Board, ZBA = Zoning Board of Adjustment, LSPA = Lake Sunapee Protective Association; LSRCC = Lake Sunapee Regional Chamber of Commerce; SRKG = Sunapee Ragged Kearsarge Greenway. Shorthand Funding Note: NA = fits within baseline function of SCC; CWSRF = NHDES Clean Water State Revolving Fund; LSWPG = NHDES Local Source Water Protection Grant Program; InvestNH = NH Housing InvestNH Grant Program.

8. MAPS

The maps in this NRI and Conservation Plan include:

- Map 1. Local Geography
- Map 2. Geology
- Map 3. Topography
- Map 4. Level IV Ecoregion around Sunapee
- Map 5. Surface Waters: Waterbodies and Streams
- Map 6. Community and Development
- Map 7. Land Cover
- Map 8. Wildlife and Important Habitat
- Map 9. Habitat Types
- Map 10. Surface Waters: Wetlands
- Map 11. Groundwater
- Map 12. Agriculture
- Map 13. Forest Soil Productivity
- Map 14. Culturally Historic Resources
- Map 15. Recreation and Conserved Land
- Map 16. Resiliency Network
- Map 17. Recognized Biodiversity
- Map 18. Resilient Sites
- Map 19. Local Connectedness
- Map 20. Regional Wildlife Flow
- Map 21. Zoning
- Map 22. Water Protections
- Map 23. Natural Resource Co-Occurrence and Priority Geographic Zones

