2021 Town of Charlestown Natural Resources Inventory

Town of Charlestown, New Hampshire

Charlestown Conservation Commission

2021

Halls Pond. Credit: Jim Fowler, 2021.

A historic town with a long shoreline on the Connecticut River that takes pride in the diversity of natural resources located within – for recreation, for economy, for wildlife, and for health. This natural resource inventory seeks to understand these resources and strategies to maintain them into the future.

with technical assistance from the
Upper Valley Lake Sunapee Regional Planning Commission

ACKNOWLEDGMENTS

The Charlestown Conservation Commission would like to thank its members and community residents who contributed greatly to the development of this Natural Resource Inventory for the Town of Charlestown:

Special thanks to

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TABLE OF CONTENTS

TABLES

FIGURES

1. Introduction

Charlestown is an historic town on the Connecticut River, with a residential, agricultural, and rural landscape. Charlestown covers 38 square miles in western New Hampshire and has 13 miles of shoreline on the Connecticut River, the longest of any town in New Hampshire. The Connecticut River is the dominant feature of the town's landscape, in terms of history, recreation, and aesthetics. The valley and hills to the east of the river provide a diverse array of natural resources, including substantial acreage of farmland.

Charlestown relies on its natural resources for drinking water, agricultural production, construction materials, wood-based heat, and other necessities. The natural resources of the town also promote a high quality of life with its country setting abundant in wildlife, scenic vistas, and recreational opportunities. Charlestown has an estimated 5,154 residents according to the 2019 estimate from the New Hampshire State Data Center. In general, Sullivan County has largely been exempt from the rapid population growth of the other southern counties in New Hampshire during the past twenty years, but that trend may not continue into the future. The pace of land development is expected to stay strong statewide, as New Hampshire's population is expected to increase another 28% from 2000 to 2025 (SPNHF 2005). Although, the population of Charlestown is projected to remain stable in the next twenty years, with 5,211 residents in 2040 (NHOEP 2016), this model does not take into account recent migration trends during the COVID-19 pandemic. Further, the state of New Hampshire has been recognized as a relatively more resilient region in regards to climate change, which may result in additional in-migration (EPA 2017). The long term impacts of these migrations and regional statewide population growth are unclear; however, the Town of Charlestown could face greater pressure on its natural resources and needs to be prepared for changing conditions.

With this future providing both challenges and opportunities, the Charlestown Conservation Commission, informed by NH RSA 36-A:2, states the goal of this Natural Resources Inventory:

- ❖ Identify critical natural resources and resource areas
- ❖ Prioritize protection and conservation efforts
- ❖ Inform decision-making about future land use, appropriate development, and land conservation

This Natural Resources Inventory contains a visual and written description of the natural resources within the Town of Charlestown, as well as an analysis of the current and potential future protections needed for these resources. The information contained in this report can and should be used to:

- Document current conditions so that changes over time can be assessed
- Develop land conservation priorities and a plan for Charlestown

- Educate and promote awareness about Charlestown's natural resources informed by both local knowledge and publicly available data
- Help land owners understand the values associated with their land and make informed land use decisions
- Provide a basis for master planning, regulation development, and planning decisions

The status and significance of natural resources and their protections do change over time, and this inventory should not be construed as a "final product". The inventory includes a summary of what exists at the current time and recommends actions for the future; this document should be revisited periodically, suggested at every 8-10 years, to update with newly available data, protections, and priorities for natural resources conservation.

2. Methodology

The Charlestown Conservation Commission (CCC) developed this Natural Resources Inventory, with technical assistance from the Upper Valley Lake Sunapee Regional Planning Commission, winter and spring of 2021. The first phase involved a basic inventory, consisting of readily available data. With that information, a co-occurrence analysis was performed to identify areas of high resource value. With data and analysis in hand, the CCC reviewed and updated the Town Conservation Plan.

Information on the natural resources in Charlestown was derived both from statewide data sources and local knowledge. Corrections to the statewide data were made by the CCC. This information is represented descriptively and visually. Digital maps were created by Upper Valley Lake Sunapee Regional Planning Commission, using ArcMap 10.7.1. Detailed information about the natural resources data are described in Appendix A: Data Source Documentation.

3. Natural Resources

3.1. Geographic Location and Topography

Within the Town of Charlestown, there are several villages and places – North Charlestown, Charlestown, and South Charlestown. The town of Charlestown is located on the western border of New Hampshire in Sullivan County. The Connecticut River is the most prominent geographic feature for the town and also the western border, separating New Hampshire and Vermont. Charlestown is bordered by seven municipalities (Figure 1):

- Unity, Acworth, and Langdon to the east,
- Walpole to the south,
- Claremont to the north, and
- the Vermont towns of Springfield and Rockingham to the west.

The Little Sugar River and Connecticut River watersheds provide natural linkages between Charlestown and its neighboring towns and states.

The Connecticut River lies entirely within the state of New Hampshire; this means the high-water line on the western shore marks the state boundary. Therefore, roughly 1,400 acres of the Connecticut River are located within the town boundaries of Charlestown. Charlestown's total area of 38 square miles is 94% land and 6% water. Besides the Connecticut River, there are many small tributary streams, but few ponds or lakes in Charlestown (Table 1).

Charlestown Nature Trail along the Connecticut River. Credit: Janice Lambert, 2021.

The prominent peaks in Charlestown coincide with many, but not all the Town's slopes of moderate (15 to 25% slopes) or steep (more than 25% slope) grade (Figure 2). The lowest elevation in town is along the river, at just under 300 ft. above sea level. The highest elevation in town is 1,683 ft. above sea level at the top of Sams Hill, near South Hemlock Road. Prominent hills and mountains include:

- Perry Mtn.
- Calavant Hill
- Fall Mountain
- Prospect Hill
- Oak Ridge
- Hubbard Hill
- Rattlesnake Hill
- Perry Hill
- Oak Hill
- Page Hill

Charlestown falls on the edge of two different natural community types, due to the many physical and biological differences between the Connecticut River Valley and the hilly uplands to the east, known as the Sunapee Uplands. The vast majority of Charlestown falls within the Upper Connecticut River Valley region, characterized by river terraces, deep deposits of glacial outwash or glacial lake sediment, and metamorphic bedrock. The Sunapee Uplands, where the bedrock is composed of granite, is characterized by monadnocks (isolated peaks of resistant granite), numerous lakes and streams, and shallow, rocky soils (Sperduto and Nichols 2004).

Table 1. Land and water area in Charlestown

Category	Length (mi)	Acreage	% of Town
Lakes and Ponds	-	151	0.6%
Connecticut River	14	1,445	6%
Other Rivers and Streams	103	-	-
Land	-	22,912	94%
	Total	24,346	100.0%

Source: New Hampshire Hydrography Dataset, 2006

Figure 1. A map of Charlestown's location within its regional geographic context.

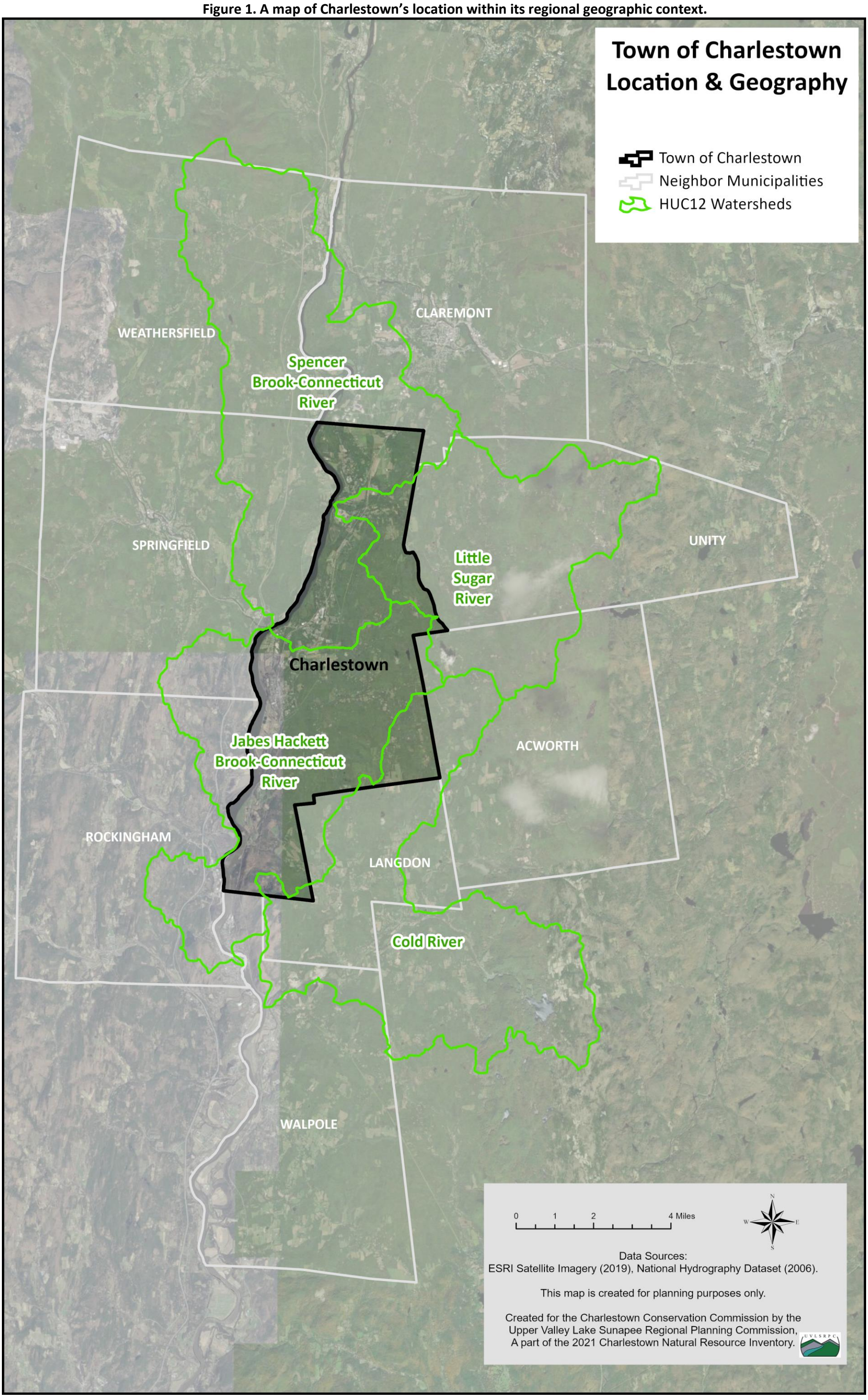
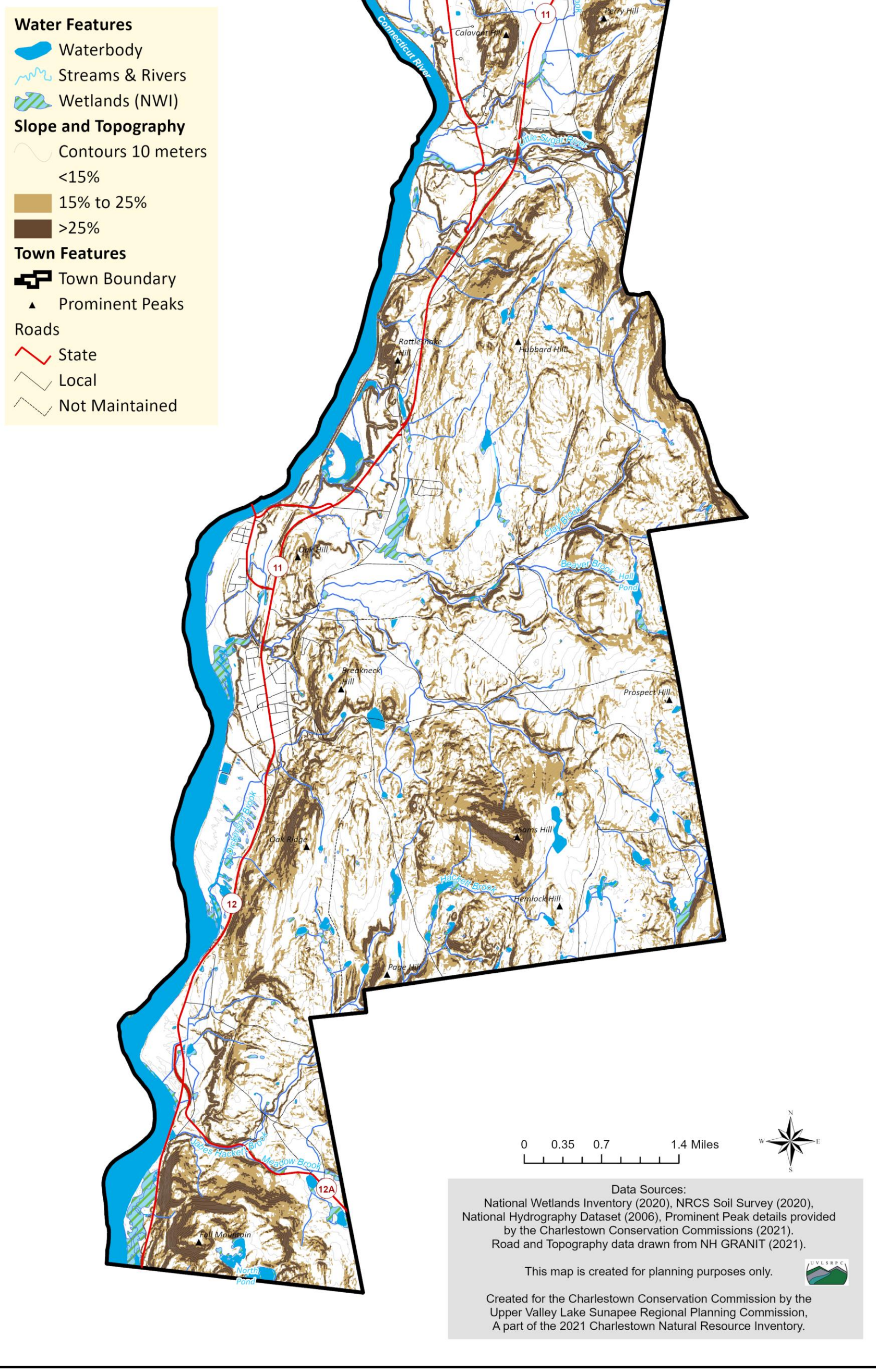


Figure 2. A map of Charlestown's topography, including steep slopes and prominent peaks.

Town of Charlestown Topography and Slope



Data Sources:
National Wetlands Inventory (2020), NRCS Soil Survey (2020), National Hydrography Dataset (2006), Prominent Peak details provided by the Charlestown Conservation Commissions (2021). Road and Topography data drawn from NH GRANIT (2021).

This map is created for planning purposes only.

Created for the Charlestown Conservation Commission by the Upper Valley Lake Sunapee Regional Planning Commission, A part of the 2021 Charlestown Natural Resource Inventory.

3.2. Surface Waters

Densely vegetated section of the Little Sugar River. Credit: Charlestown Conservation Commission, 2009.

All surface waters in Charlestown eventually drain to the Connecticut River which flows south into the Long Island Sound and Atlantic Ocean. Some of Charlestown's streams flow directly into the Connecticut River, while others flow into the Little Sugar River or the Cold River. 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. Charlestown's river and streams includes four HUC 12 watersheds (Figure 1, Table 2).

Table 2. HUC 12 Watersheds within Charlestown

Watershed	Town Waterbodies	Acreage	% of Town
Spencer Brook – Connecticut River	North Charlestown Tributaries	6,695	28%
Little Sugar River	Little Sugar River	2,538	10%
Jabes Hackett Brook – Connecticut River	South Charlestown Tributaries (Beaver, Clay, Dickerson, Hackett, Jabes Hackett, & Meadow Brooks)	13,148	54%
Cold River	Lower Tributaries	1,964	8%

Source: New Hampshire Hydrography Dataset, 2006

The Cold River watershed has its headwaters at the outflow of Crescent Lake on the border of Unity and Acworth and flows southwest through the towns of Acworth, Alstead, and Langdon

before entering the Connecticut River in Walpole. In the southwestern corners of Charlestown, Great Brook, Little Brook, and Mountain Brook drain to the Cold River.

The watershed including the North Charlestown Tributaries covers roughly one-quarter of the town's total area; streams within this watershed include a second stream named Beaver Brook, Hubbard Brook, Ox Brook and Smith Brook.

Another significant watershed includes the Little Sugar River, originating in the town of Unity, immediately to the west of Charlestown. There are few streams that join the Little Sugar River in Charlestown; the only named stream on USGS maps is Swett Brook. The Little Sugar River flows into the Connecticut River just south of North Charlestown.

The Connecticut River has formed several unique natural features that together make a fourth relevant watershed in Charlestown. On the eastern edge of the Connecticut River are the extensive marshlands of Great Meadow and Lower Meadows. Near South Charlestown is the protected embayment Meany's Cove. Near North Charlestown is the long and narrow Glidden Island. There are also smaller marshes, oxbows, and coves in Charlestown not named on the US Geological Survey maps.

Great Meadows. Credit: Jim Fowler, 2021.

Charlestown is rich in streams and rivers, but has few ponds. Halls Pond is the largest waterbody in town, at 14.5 acres, and is a part of the public water supply for Town residents. This pond, along with North Mountain Pond and the Connecticut River, are deemed public waters in New Hampshire, which includes great ponds, public rivers and streams, and tidal waters (Table 3).

Table 3. Public Waters and Designated Rivers in Charlestown

Waterbody Name	Description	Acreage	% of Town
Halls Pond	Artificial Impoundment, Town Water Supply	14.1	<1%
North Mountain Pond	Natural Lake stretching into Langdon (21.9 acres total)	15.5	<1%
Connecticut River	Designated River	1,954.0	8%
	Total	1,984.0	8%

Note. This table does not include non-designated, freshwater public rivers and streams.
Source: NH DES Official List of Public Waters, 2016.

3.3. Wetlands

The State of New Hampshire defines wetlands by three characteristics: hydrology, soils, and vegetation. All three must be met in order 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."

By looking at both the National Wetland Inventory (NWI) data and hydric soils data, one can obtain a general appreciation for the extent and location of potential wetlands in Charlestown covering 2,294 acres or 9% of the Town (Figure 3). The NWI was an effort undertaken by the US Fish and Wildlife Service to catalog wetlands over the entire United States. Not all wetlands were 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. 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 NRCS Soil Survey database (2020) 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 B.

Wetlands on West side of Beaver Brook
Credit: Charlestown Conservation Commission, 2009.

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. Table 4 summarizes the major

wetland types, defined by vegetation, in Charlestown. Figure 7 illustrates wetlands where overlaps exist with working farms and land cover of higher density development.

Table 4. Wetlands and Hydric Soils in Charlestown

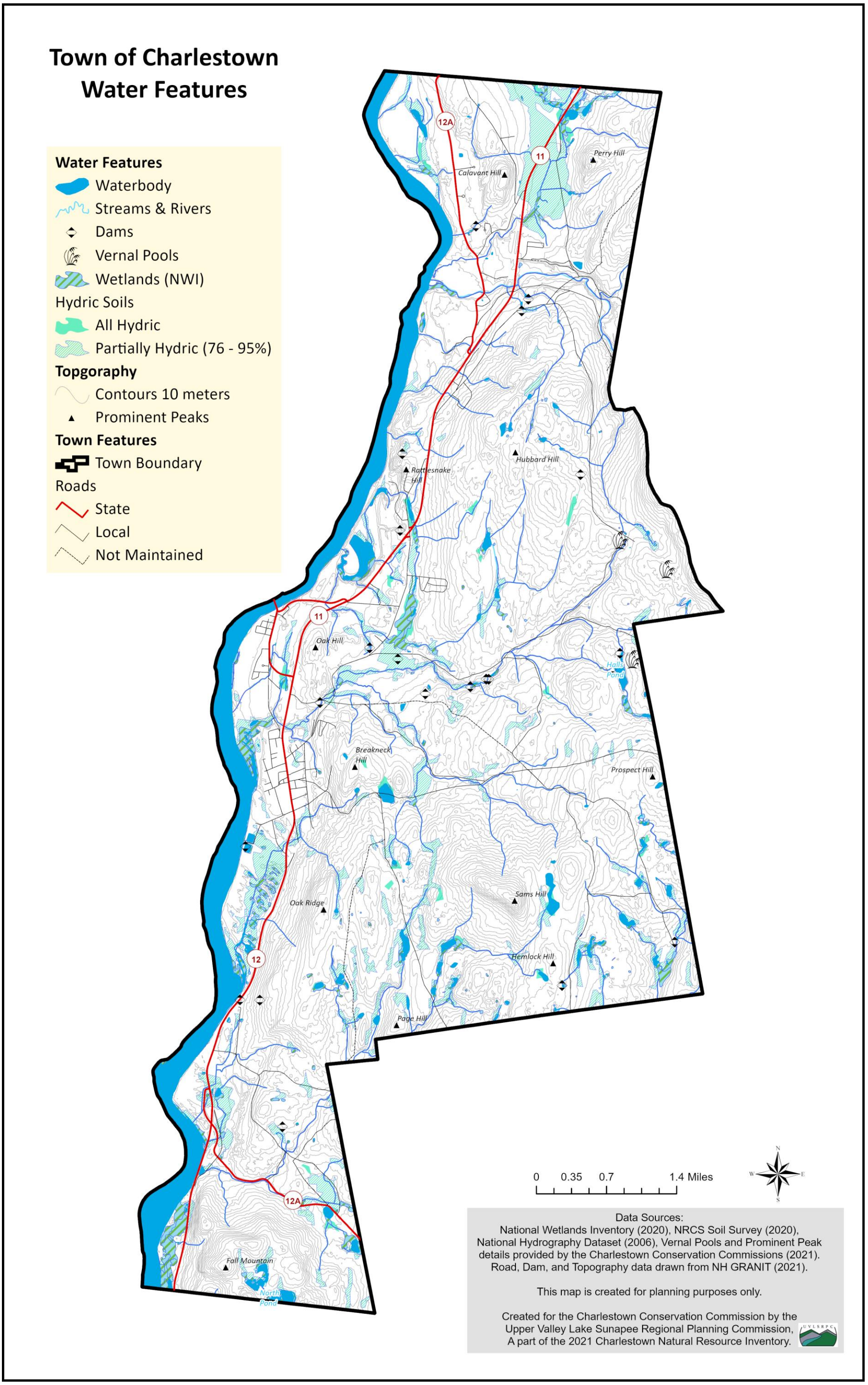
Type	Acreage	% of Town
Freshwater Emergent Wetland (e.g., cattail, reeds)*	127	<1%
Freshwater Forested Wetland*	169	<1%
Freshwater Scrub-shrub Wetland*	169	<1%
Unconsolidated Shore, Temporarily or Seasonally Flooded*	14	<1%
Hydric Soil**	2,105	9%
NWI & Soil Survey overlap	290	1%
Total Coverage	2,294	9%

NWI classifications not acknowledged in this list include riverine systems and areas permanently, semi-permanently or artificially flooded.
Source: National Wetlands Inventory 2020* and NRCS Soil Survey 2020**.

Generally not included in the National Wetlands Inventory 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, like fish. 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 three vernal pools on town-owned land (Figure 3); there are undoubtedly many more undocumented vernal pools in Charlestown.

Vernal Pool
Credit: Charlestown Conservation Commission, 2009.

Figure 3. A map of Charlestown's water features – rivers, streams, wetlands, and known vernal pools.



3.4. Groundwater

Charlestown's location in the Connecticut River Valley makes it especially rich in 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, with 19% of Charlestown underlain (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.

Most of the aquifers in Charlestown, just under 95%, have low transmissivity or less than 2,000 square feet per day[1]. Most of the remaining has a moderate transmissivity rate of 2,000 to 4,000 square feet per day, with just less than 1% with high transmissivity or greater than 4,000 square feet per day. Stratified drift aquifers have the greatest potential for development for community wells, but most residential wells are drilled into fractured bedrock. NH Department of Environmental Services 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) (Figure 4).

Residents and businesses in Charlestown derive their drinking water from a variety of sources. The North Charlestown Water Department and Charlestown Water Works serve residents in the two major village areas; Charlestown public schools are also served by these water systems. In addition, there are six other active public water supplies registered with NH Department of Environmental Services (Table 5).

Community Well, Lower Meadows. Credit: Charlestown Conservation Commission, 2009.

[1] 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.

Table 5. Public Water Supplies in Charlestown

Public Water Supply Name	System Type	Well Type	# Served
Camp Hawkeye	Transient	Artesian Well	150
Charlestown Water Works	Community	2 Gravel Packed Wells	2,500
Connecticut River MHP	Community	Gravel Packed Well	50
Life Fellowship Foursquare Church	Transient	Bedrock Well	100
Meadowview Apartments	Community	2 Bedrock Wells	58
North Charlestown Water Dept.	Community	2 Gravel Wells	325
Sugar River Mennonite Church	Transient	Bedrock Well	50
Windy Acres Cooperative Inc.	Community	2 Bedrock Wells	180

Definitions:

Community Water System : A water system which supplies drinking water to 25 or more of the same people year-round in their residences.

Transient Water System : A water system which provides water in a place such as a gas station or campground where people do not remain for long periods of time. These systems do not have to test or treat their water for contaminants which pose long-term health risks because fewer than 25 people drink the water over a long period. They still must test their water for microbes and several chemicals.

Artesian Well : A water well that does not require a pump to bring water to the surface.

Bedrock Well : water well drilled into bedrock.

Gravel Well : A water well that captures water in the upper unconsolidated soil and rock deposits. Gravel wells are typically installed to depths greater than 30 feet and are installed using specialized drilling equipment.

Gravel Packed Well : A water well that uses a sand-control method to prevent production of formation sand.

Source: NH Department of Environmental Services 2005 & the Town of Charlestown Conservation Commission 2021.

Figure 4. A map of Charlestown's aquifers, public water supplies and potential contamination sources.

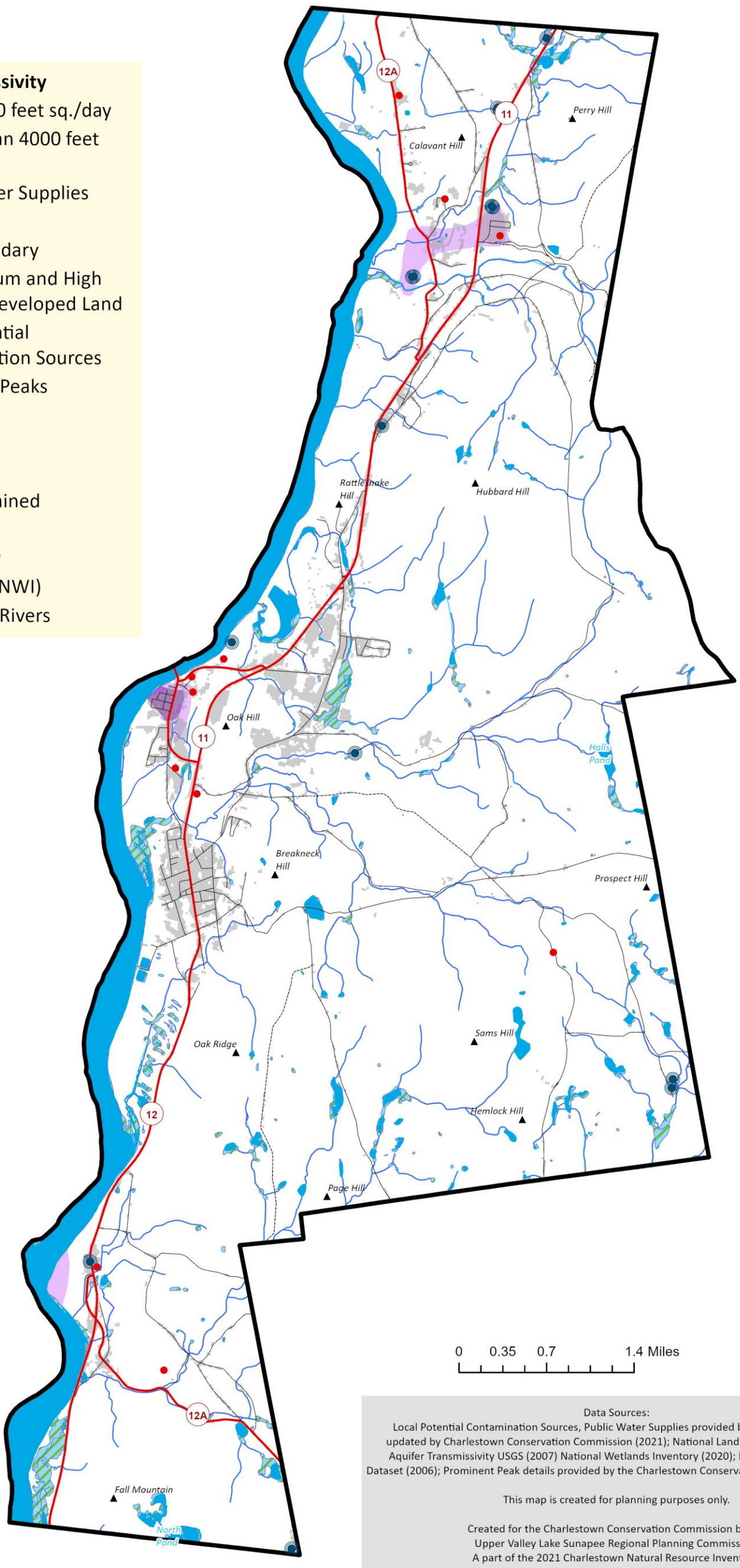
Town of Charlestown Groundwater

Aquifer Transmissivity
- 2000 - 4000 feet sq./day
- Greater than 4000 feet sq./day
- Public Water Supplies

Town Features
- Town Boundary
- Low, Medium and High Intensity Developed Land
- Local Potential Contamination Sources
- Prominent Peaks

Roads
- State
- Local
- Not Maintained

Water Features
- Waterbody
- Wetlands (NWI)
- Streams & Rivers



Data Sources:
Local Potential Contamination Sources, Public Water Supplies provided by NHDES (2020) and updated by Charlestown Conservation Commission (2021); National Land Cover Dataset (2016); Aquifer Transmissivity USGS (2007) National Wetlands Inventory (2020); National Hydrography Dataset (2006); Prominent Peak details provided by the Charlestown Conservation Commissions (2021).

This map is created for planning purposes only.

Created for the Charlestown Conservation Commission by the Upper Valley Lake Sunapee Regional Planning Commission, A part of the 2021 Charlestown Natural Resource Inventory.

3.5. Land Cover

Residential and commercial development is concentrated in three village areas: North Charlestown, Charlestown, and South Charlestown. These three village areas are in the relatively flat river valley. Rural residential development is dispersed throughout town along the few main roads that cross the hills to the east of the river valley. Agriculture is primarily located in the river valley, but there is some farmland in the hills. Change in land cover between 2006 to 2016 shows a reduction in forest and agriculture, and an increase in developed areas and wetlands (NLCD 2006 & 2016) (Table 6, Figure 5)[2]. Outside of the river valley, Charlestown remains heavily forested. Over three-quarters of the land area is under forest cover. For details on types on the types of forest cover or habitat, see Section 3.9 Habitats and Exemplary Natural Communities.

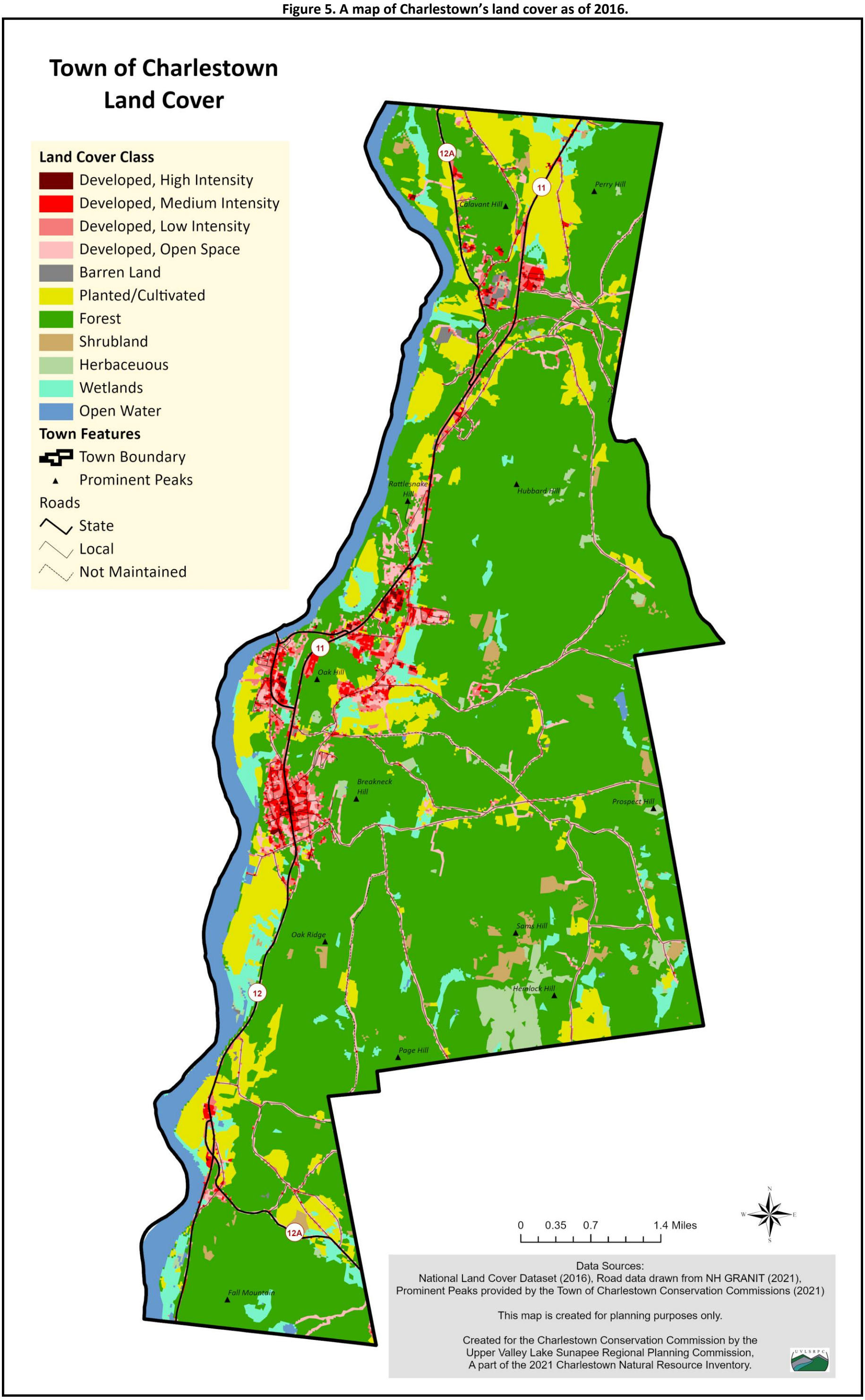
Table 6. Land Cover in Charlestown

Land Cover Class	Acreage in 2016	% of Town in 2016	% of Town in 2006
Developed	2,272	9%	5%
Agriculture	2,453	10%	12%
Forest	16,296	67%	74%
Barren Land	58	<1%	<1%
Wetland	1,041	4%	3%
Water	1,475	6%	6%
Other	750	3%	<1%

Source: National Land Cover Dataset, 2016 & 2006

[2] Both the Northeast Land Cover analysis and the Wildlife Action Plan habitat assessment rely 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 land use, forest type, or habitat class should be taken as an estimate, not as a direct measurement. Further detail on agriculture, forests, and wildlife habitat is provided in other sections of this report.

Figure 5. A map of Charlestown's land cover as of 2016.



3.6. Agriculture

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. One exception to the dominant soil composition in New Hampshire exists in the major river valleys, where ancient glacial lakes accumulated fine-grained sediments. The Connecticut River Valley is underlain by deep deposits of silt, sand, and gravel; these deep, well-drained soils on gently sloping land provide large areas of good farmland.

Because of the long time required for soil development (tens of thousands of years), agricultural soils should be considered a nonrenewable resource. In the Sullivan County Soil Survey, there are three classes of agricultural soils, so chosen by their relative value for raising crops or livestock. These classes include: Prime farmland, Farmland of statewide importance, and Farmland of local importance.

Prime farmland soils, or the best soils for the production of food, feed, fiber, forage, and oilseed crops, have been 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 soils are classified as prime farmland soils. In Charlestown, 8% of the land (1,967 acres) is considered prime farmland, which is well above average for New Hampshire.

The other soil classifications include soils that are useful for agricultural production, but have some limitations that preclude their designation as "prime farmland", such as stoniness, nutrient limitations, or excessive drainage. Farmland of statewide importance is the second tier of agricultural soil classification. Criteria for defining and delineating farmland of statewide importance are determined by a state committee. The third tier of important agricultural soils is farmland of local importance. The County Conservation District Board determines which soil units are locally important. The extent of agricultural soils in Charlestown is summarized in Table 7.

These classes represent the capability of the soil for agricultural production, not the current land use. In addition, the CCC has identified working farms as of 2021 (Figure 6) as well as where impact might have or may be occurring on wetland habitats (Figure 1).

Table 7. Farmland Soils in Charlestown

Farmland Soil Class	Acreage	% of Town
Prime (federally designated)	1,967	8%
Of Statewide Importance	1,960	8%
Of Local Importance	3,712	15%
Total	7,640	31%

Source: NRCS Soil Survey 2020.

Figure 6. A map of Charlestown's productive soils for agriculture and the location of working farms.

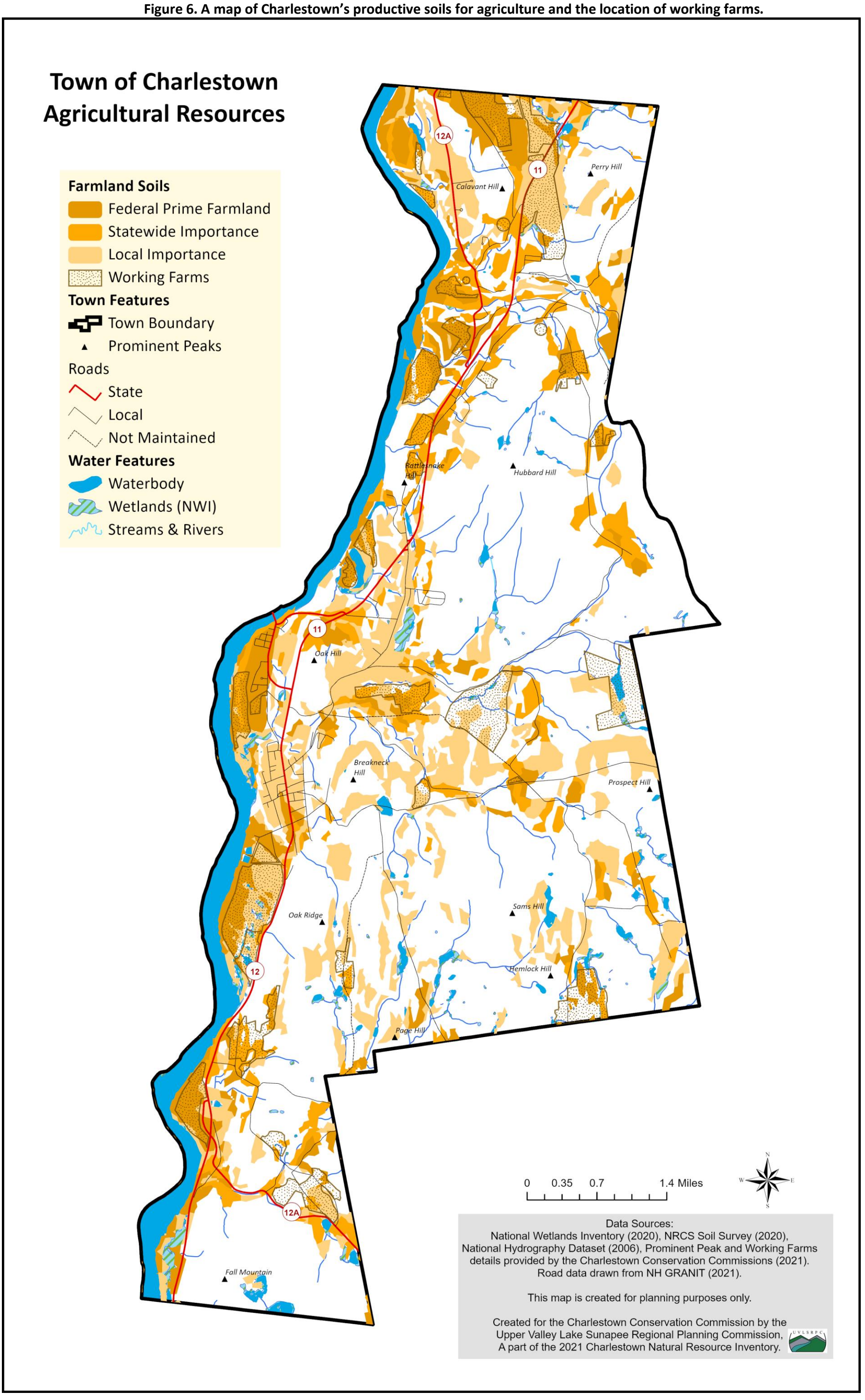
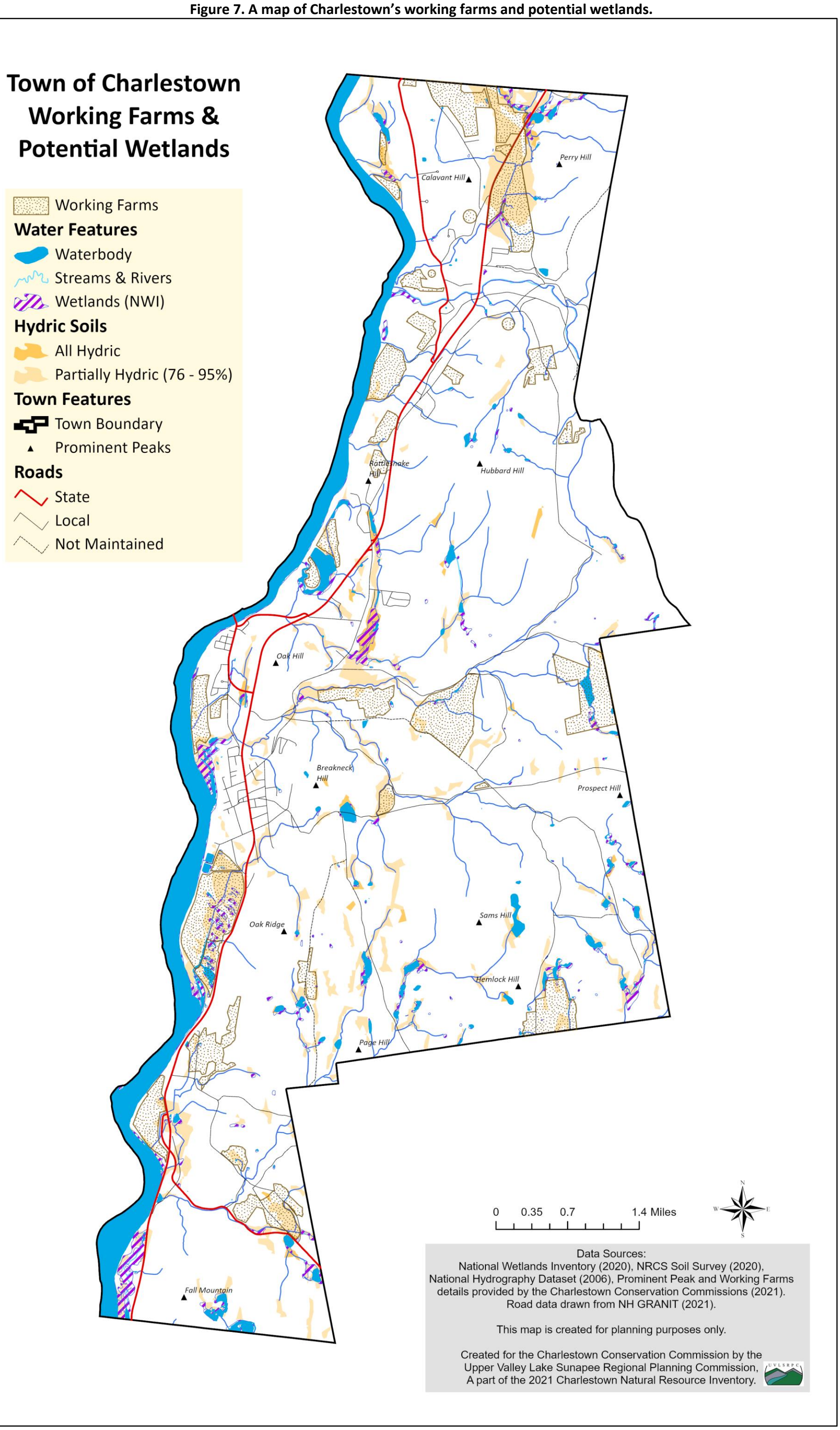


Figure 7. A map of Charlestown's working farms and potential wetlands.



3.7. Forest Soil Resources

More than three-quarters of Charlestown's land area is under forest cover, primarily of a mixed hemlock-hardwood-pine forest type (for detailed statistics and forest types see Sections 3.5 Land Cover and 3.9 Habitats and Exemplary Natural Communities, respectively). Several parcels of land are managed for forest production, including state and town forests and some privately-held tracts of land. However, the soil types that are most favorable for tree growth cover only 31% of the town's land area (Figure 8).

Logging at Halls Pond.
Credit: Richard Holmes, 2019.

Each county soil survey classifies soil types by their capability to support sufficient tree growth for commercial forestry operations, which are broken into 5 classes: IA, IB, IC, IIA, and IIB (summarized in Table 8). The dominant tree species on these soil types varies depending on the succession stage of the forest or stand.

Group I soils are the best soils for forest management and have the least restrictions on growth or management strategy. Group IA soils are the best soils for hardwood production because they are relatively deep, fertile, and well-drained. Group IB soils are slightly less fertile and sandier than Group IA soils; tree growth is not quite as vigorous. Group IC soils are composed of outwash sands and gravels, and are ideally suited to softwood production. The most significant acreage in Charlestown is covered by Group IA soils.

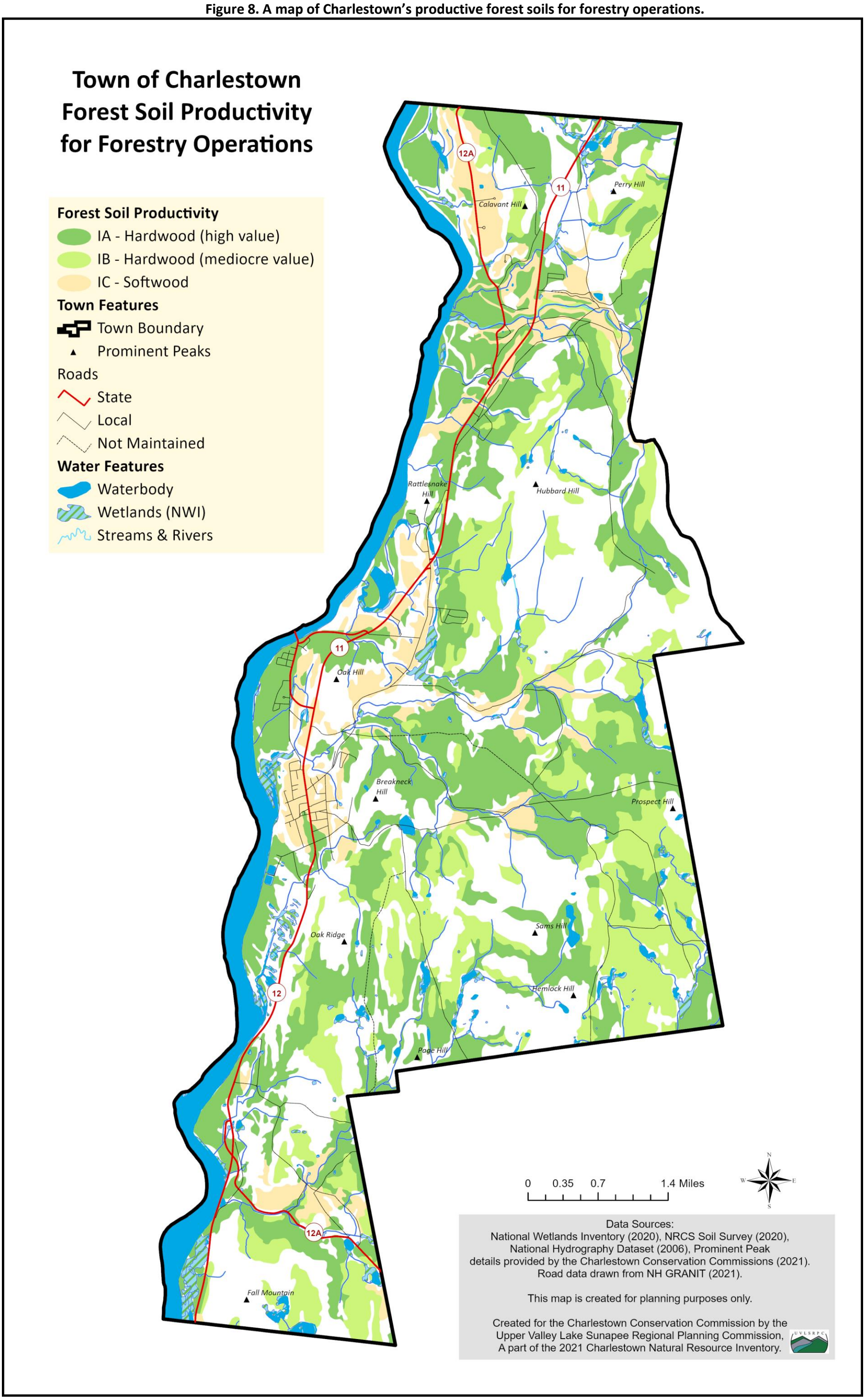
Group II soils have significant limitations on either tree growth or management because of more severe physical features. Group IIB soils are poorly drained and therefore generally have lower productivity and significant management limitations. A thorough description of each group can be found in Appendix B.

Table 8. Important Forest Soils in Charlestown

Forest Soil Group	Acreage	% of Town
IA	7,519	31%
IB	4,030	17%
IC	888	8%
IIA	7,082	29%
IIB	1,937	8%
Total	22,455	92%

Source: NRCS Soil Survey 2020.

Figure 8. A map of Charlestown's productive forest soils for forestry operations.



3.8. Sand and Gravel

Sand and gravel are important raw materials for building, roadway maintenance, and other commercial purposes, and soils containing significant deposits of these materials are relatively scarce in New Hampshire. Similar to aquifers, sand and gravel sources are of glacial lake and river origin, and are concentrated primarily in river valleys or old lake beds. 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 Appendix B. Charlestown only contains fair rated soils, summarized in Table 9. According to the CCC, many of the areas identified as a sand source are primarily occupied by loam soils that are unlikely to be significant opportunities for raw sand materials. There are five active quarries or pits as of 2021 (Figure 9).

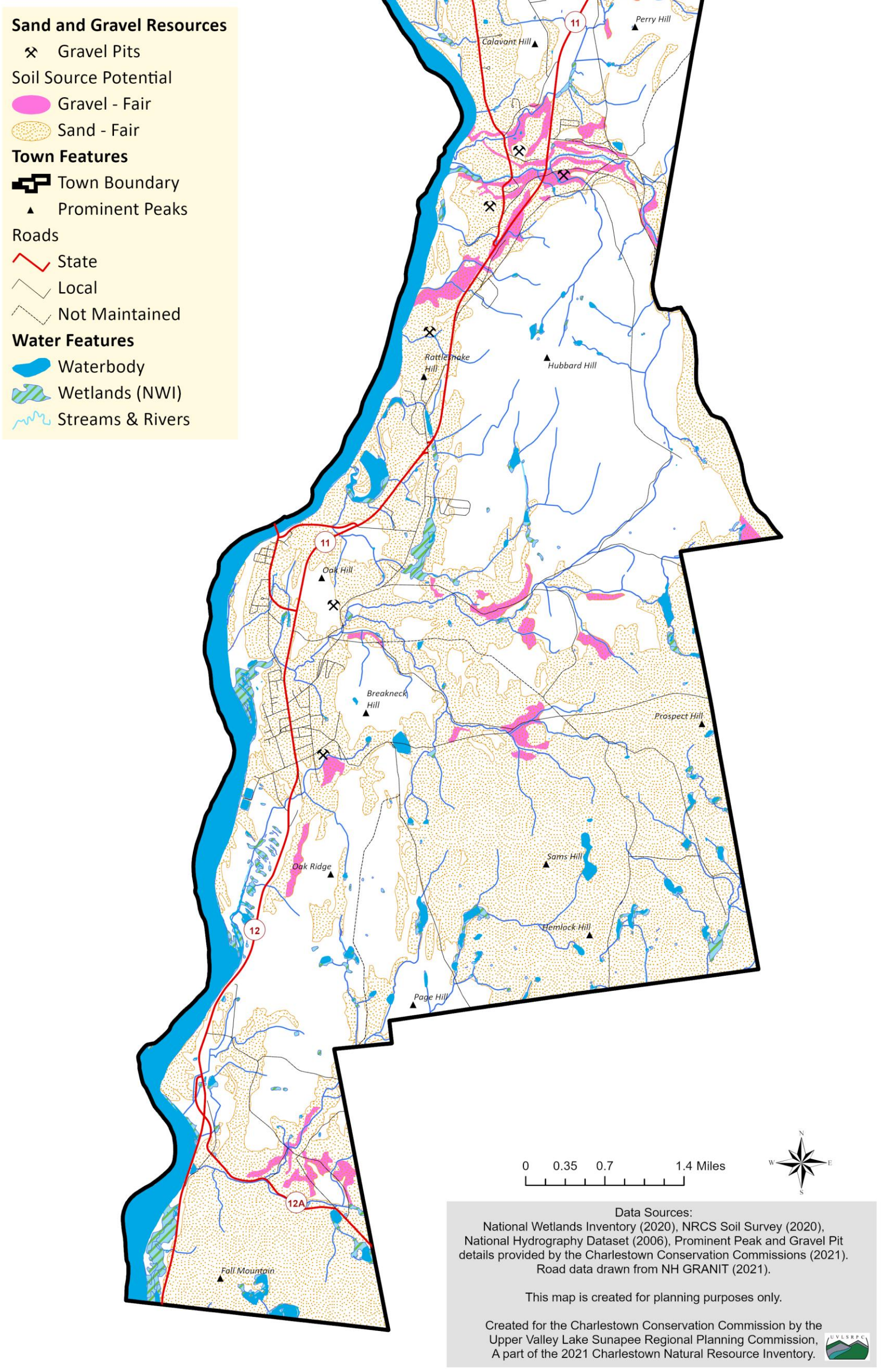
Table 9. Sand and Gravel Soils in Charlestown

Fair Rating	Acreage	% of Town
Sand Source Only	11,842	49%
Gravel & Sand Source	660	3%
Total	12,502	51%

Source: NRCS Soil Survey 2020.

Figure 9. A map of Charlestown's likely sand and gravel source soils.

Town of Charlestown
Sand & Gravel Source Potential



3.9. Habitats and Exemplary Natural Communities

The New Hampshire Fish and Game Department completed an updated analysis of habitat condition, which was published in The Wildlife Action Plan. The habitat classification used by the Wildlife Action Plan (New Hampshire Fish and Game Department 2015) separates forested lands into broad ecological communities known as matrix forest types. Northern Hardwood-Conifer forest covers more than two-thirds of the Town. The majority of these forests are of the hemlock-hardwood-pine type, which is considered a transitional forest, situated between the southerly forests dominated by oak and pine, and the boreal forest dominated by spruce and fir. Two other types make up smaller portions of the Northern-Hardwood-Conifer forest; The first being of lowland spruce-fir, which occurs in wet, cool mountain valleys and wetlands; The second being of northern hardwood, on well-drained sites with high nutrient levels. Another forest community in Charlestown is the Appalachian oak-pine forest, which occurs on south-facing slopes and other warm, dry areas. The largest areas of floodplain forest are found in North Charlestown west of Route 12A, including areas along Ox Brook and the Little Sugar River.

In addition to these major forest types, there are a variety of medium and small-scale habitats within Charlestown. These habitat types do not cover large areas, but show the heterogeneity of the natural landscape. Large grasslands contiguous over 25 acres (i.e., farm fields) fall largely within the Connecticut River Valley. Wetland complexes, either of the marsh or peatland type, are scattered throughout town in stream valleys (Table 10, Figure 10).

Table 10. Summary of Habitats in Charlestown

Major Habitat Group	Acreage	% of Charlestown
Appalachian Oak-Pine Forest	347	1%
Northern Hardwood-Conifer Forest	16,897	69%
Cliff and Talus*	71	<1%
Large River Floodplain	53	<1%
Emergent Marsh	186	1%
Wet Meadow / Shrub Marsh	148	1%
Northern Swamp	312	1%
Water	1,528	6%
Total	19,541	80%

***** - 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: Wildlife Action Plan, 2015.

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, 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 analysis resulted in four classes:

- 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 (Figure 10).

In Charlestown, Great Meadow, North Pond, and the mouth of the Little Sugar River all had Tier 1 habitat. Tier 2 habitats were more widely spread, and includes habitat in and around the Fall Mountain Reservation, Connecticut River floodplain, and land in the southwestern and central parts of town. More details on Tier 1, 2, and 3 habitats in Charlestown can be found in Table 11.

Table 11. Important wildlife habitat types and areas in Charlestown

	Tier 1 - Highest Ranked in State		Tier 2 - Highest Ranked in Biological Region		Tier 3 - Supporting Landscape	
Habitat type	Acreage	% Tier	Acreage	% Tier	Acreage	% Tier
Appalachian Oak-Pine Forest	52	1%	163	5%	108	1%
Northern Hardwood & Conifer	4,784	64%	2,688	88%	6,487	78%
Large River Floodplain	33	0%	12	0%	7	0%
Emergent Marsh	71	1%	17	1%	87	1%
Wet Meadow / Shrub Marsh	54	1%	1	0%	76	1%
Northern Swamp	122	2%	21	1%	112	1%
Agricultural / Grassland	1,235	16%	29	1%	822	10%
Cliff and Talus	7	0%	27	1%	30	0%
Water	1,045	14%	86	3%	305	4%
Urban/Suburban Built	93	1%	6	0%	271	3%
Acreage Total	7,495		3,049		8,303	
% of Town	31%		13%		34%	

Source: NH Fish and Game's Wildlife Action Plan, 2015.

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 2020). The NH Natural heritage bureau 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 within each town. In Charlestown, two terrestrial natural communities are listed with reports noted within the last 20 years – a rich mesic forest and rich Appalachian oak rocky woods. Both of these communities are flagged with "Very High Importance".

A rich Appalachian oak rocky woods. Credit: NH Natural Heritage Bureau.

Figure 10. A map of Charlestown's habitat types, tier ranked habitats and wildlife sightings.

Town of Charlestown Wildlife Habitat

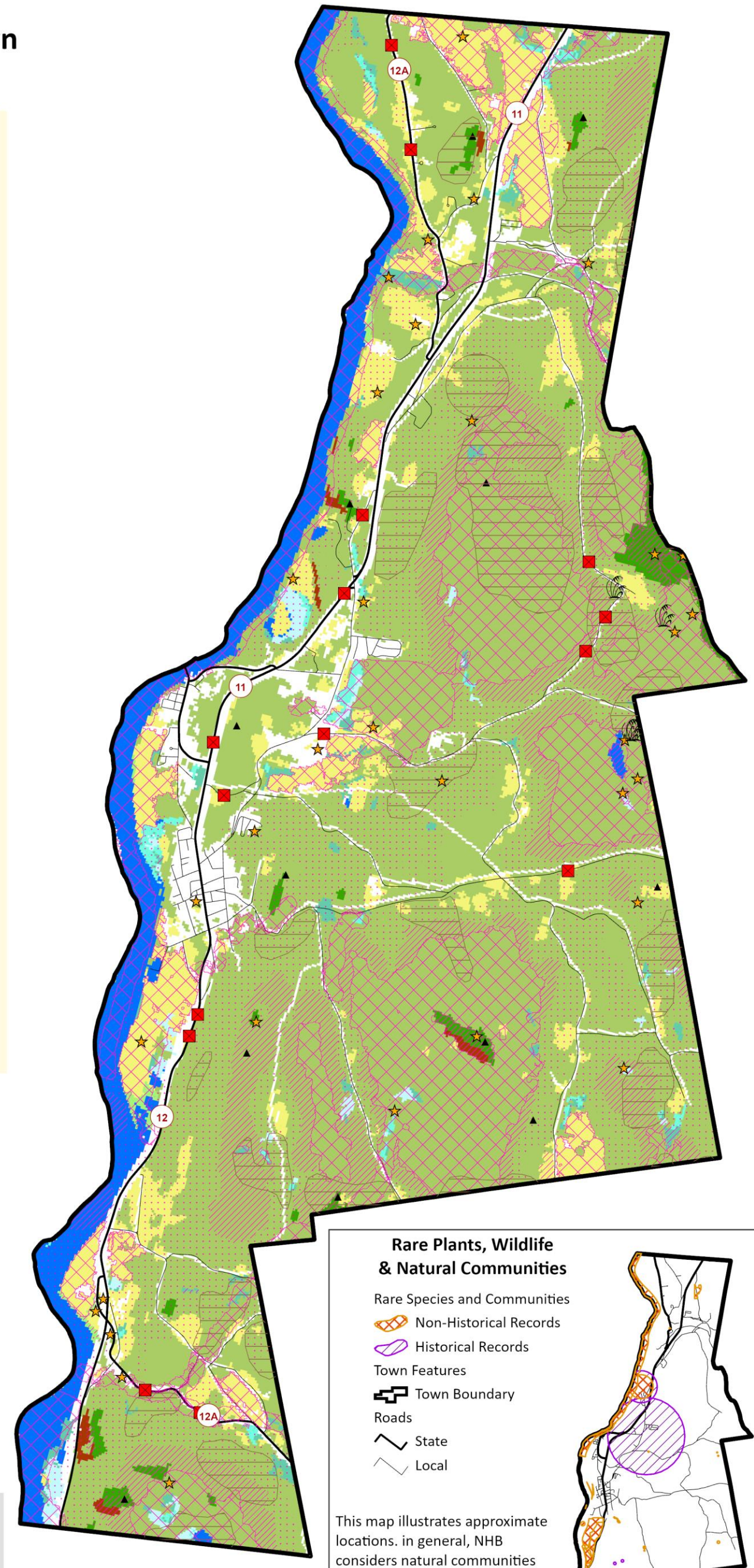
Wildlife Features
- Wildlife Sighting
- Crossing
- Vernal Pool
- Historic Deeryards

Tier Habitat by Ecological Condition
- Tier 1. Highest ranked in the state
- Tier 2. Highest ranked in the biological region
- Tier 3. Supporting landscapes

Habitat Type
- Appalachian Oak-Pine Forest
- Northern Hardwood-Conifer Forest
- Large River Floodplain
- Emergent Marsh
- Wet Meadow / Shrub Marsh
- Northern Swamp
- Agricultural / Grassland
- Cliff and Talus
- Water
- Urban/Suburban Built

Town Features
- Town Boundary
- Prominent Peaks

Roads
- State
- Local



N
W E
S

0 0.35 0.7 1.4 Miles

Data Sources:
Wildlife Habitat Tier and Type (Wildlife Action Plan, 2015); Road and Deeryard data drawn from NH GRANIT (2021); Prominent Peaks provided, Vernal Pools, Wildlife Sightings and Crossings by the Town of Charlestown Conservation Commissions (2021)

This map is created for planning purposes only.

Created for the Charlestown Conservation Commission by the Upper Valley Lake Sunapee Regional Planning Commission, A part of the 2021 Charlestown Natural Resource Inventory.

Rare Plants, Wildlife & Natural Communities

Rare Species and Communities
- Non-Historical Records
- Historical Records

Town Features
- Town Boundary

Roads
- State
- Local

This map illustrates approximate locations. in general, NHB considers natural communities and natural community systems "historical" after 40 years, and rare plants and wildlife after 20 year.
Contact the NH Natural Heritage Bureau for more information.

3.10. Rare Wildlife and Plants

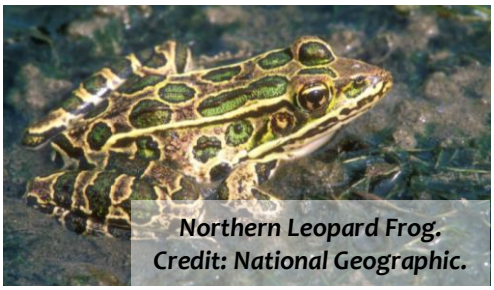
Charlestown's natural landscape is a mixed forest interspersed with grasslands, wetlands, and aquatic habitats. The heterogeneity of the landscape provides habitat for many species of wildlife, both the common and rare.

Charlestown's riverfront along the Connecticut River is part of the Middle Connecticut River Valley Important Bird Area (IBA), a designation assigned by the National Audubon Society for areas that provide critical habitat to birds during some stage of their annual cycle (refer to Appendix C for more details). The IBA includes listed species and important habitat, such as grasslands that include agricultural areas acting as importing feeding habitat to migratory waterfowl and other species. The NH Audubon has identifies the following issues facing the IBA: changes in land use, pollution, invasive plants, and changes in hydrology associated with the two hydro-electric dams along the Connecticut River (NH Audubon 2020).

One of the hot spots for avian diversity in Charlestown, within this Important Bird Area, is Great Meadow, just south of the wastewater treatment plant. Stan McCumber, a local birding enthusiast, has documented over 180 bird species in Great Meadow. His list is included as Appendix D, and includes species of waterfowl, shorebirds, herons, and passerine (perching) songbirds. Two other resident naturalists, Jim Fowler and Jan Lambert have documented a large number of plant and animal species around Charlestown. Their records, included as Appendix E, provide an important baseline for the town's wildlife species and populations. Wildlife sightings and crossings, particularly amphibians for the latter have been mapped by the CCC (Figure 10).

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 of rare, threatened, and endangered species and exemplary natural communities (Figure 10). Four endangered animal species have been documented in Charlestown (Table 12). The Natural Heritage Bureau has not exhaustively surveyed the state, so it is possible that more rare species do occur within Charlestown. The referenced table and map does not include occurrences considered historical, although a few of these may still be present. Natural community systems are considered historical after 40 years since their last observed date, while plants and animals after 20 years. If town residents have information about rare species occurrences in Charlestown, they should contact the Natural Heritage Bureau.

Little Brown Bat.
Credit: Geoffrey Kuchera.



Northern Leopard Frog.
Credit: National Geographic.

Table 12. Rare Plants and Animals Reported during the last 20 years in Charlestown.

Type	Species	Listed*		Heritage Bureau Importance Flag
	Common – Scientific Name	US	NH	
Plant	American Ginseng – *Panaz quinquefolius*	-	T	Extremely High
Plant	Flat-stem pondweed – *Potamogeton zosteriformis*	-	E	Very High
Plant	Grass-leaved mud-plantain – *Heteranthera dubia*	-	T	Extremely High
Plant	Long-leaved pondweed – *Potamogeton nodosus*	-	T	Very High
Plant	Northeastern bulrush – *Scirpus ancistrochaetus*	E	E	Extremely High
Mammal	Little Brown Myotis – *Myotis lucifugus*	-	E	Extremely High
Bird	Bald Eagle – *Haliaeetus leucocephalus*	T	SC	Very High
Bird	Eastern Meadowlark – *Sturnella magna*	-	T	Very High
Bird	Marsh Wren – *Cistothorus palustris*	-	-	Very High
Reptile	Wood turtle – *Glyptemys insculpta*	-	SC	Very High
Amphibian	Northern leopard frog – *Lithobates pipiens*	-	SC	Very High
Fish	American Eel – *Anguilla rostrata*	-	SC	Very High
Fish	Sea Lamprey – *Petromyzon marinus*	-	SC	Very High
Mollusk	Dwarf wedge mussel – *Alasmidonta heterodon*	E	E	Extremely High

*****Listed: E = Endangered; T = Threatened; SC = Special Concern.
Source: NH Natural Heritage Bureau 2020.

3.11. Climate Change and Resilience

Charlestown has both vulnerabilities and resiliencies to climate change impacts on its ecosystems and environment, natural resource industries, and infrastructure. For the purposes of this report, impacts to infrastructure will not be addressed. For context, this section provides a regional summary of the most recent climate change assessment and impact reports, followed by an analysis of resilient land in Charlestown.

CLIMATE CHANGE ASSESSMENT AND IMPACTS

First a quick note on climate versus weather. Weather reflects short-term conditions of the atmosphere while climate is the average daily weather for an extended period of time 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 (Jay 2018). In addition, the University of New Hampshire published a report in 2014 on Climate Change in Southern New Hampshire, including the Town of Charlestown. This report provides a more focused impact assessment of historical and two projected emissions scenarios. Both of these scenarios show an annual temperature increase of 2°F by 2040, which is a result of emissions that are already "baked into the climate systems"; however, it is in the latter part of the century that the scenarios diverge with the lower emissions scenario reflecting a 4°F increase and the higher emissions an 8 to 9°F increase (Wake 2014).

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.

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 11). In both projected scenarios minimum and maximum temperatures would continue to increase; however by the end of the century the largest increase in maximum temperatures would take place during the spring and summer, rather than the winter. 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 seasonality.

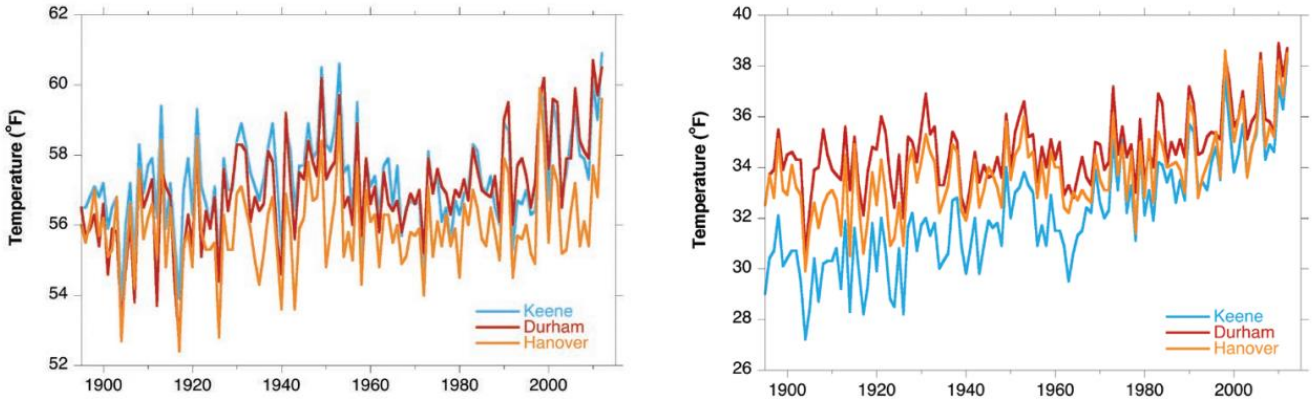


Figure 11. Annual maximum temperature (Left) and Annual minimum temperature (Right) records for USHCN stations in southern New Hampshire for the period 1895-2012. (Wake 2014)

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 time 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 12). This statistic reflects both extreme events and development patterns that are more vulnerable to damage

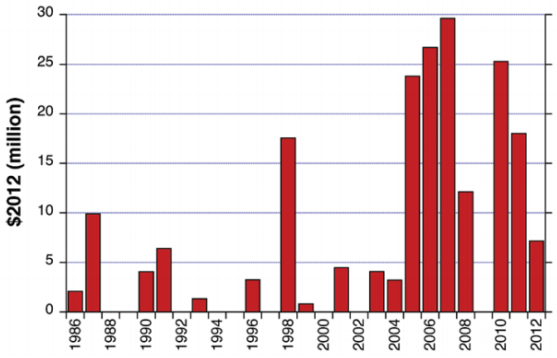


Figure 12. Federal Expenditures on Presidentially Declared Disasters and Emergency Declarations in New Hampshire from 1999 to 2012. Expenditures adjusted to $2012 using the consumer price index. Not increase in expenditures since 2005. (Wake 2014)

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, suitable sites for spruce-fir and northern hardwood forests 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 the follow the early blooming. These changes will have other negative effects on the health of forests due to earlier insect emergences, and expanded ranges of pathogens and invasive plants, including pests such as the hemlock woolly adelgid, and emerald ash borer. These could have increased impacts on important ecological and tourism species such as moose that are already experiencing hardship from increased parasite infections and deaths from ticks. In addition, warmer winters and less snow cover will increase white-tailed deer populations that degrade native forest understory. For freshwater ecosystems and species, such as salamanders and cold-water fish such as trout, climate change impacts increase their vulnerability as a result of temperature and flow changes, including cold-water fish like trout and salamanders.

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).

Palm Warbler.
Credit: Putney Pics/Flickr.

While some birds are expected to be more adaptable, others are expected to become more vulnerable Migratory birds, as they migrate earlier, may experience misalignment with food source availability and thus increasing their 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 as a result of changing abilities to find food and reproduce, effecting both local and continent-wide populations. In the Atlantic Flyway, largely the east coast of the United States, 11 species are listed as highly and 73 moderately vulnerable under their 1.5°C warming scenario, while their 3.0°C scenario lists 63 and 68, respectively. In the 2009 Charlestown bird checklist, at least four species were identified in Charlestown that are also listed as highly vulnerable in the 1.5°C warming scenario, while the 3.0°C

scenario shows at least 13 as highly vulnerable (Table 13). Some of these bird species are more vulnerable in the summer, while others in the winter, or both.

Table 13. Highly Vulnerable Birds in Charlestown.

Bird Species Highly Vulnerable under…	
1.5°C and 3.0°C warming scenarios	3.0°C warming scenario only
Black-throated Blue Warbler	Northern Parula
Black-throated Green Warbler	Chestnut-sided Warbler
Palm Warbler	Magnolia Warbler
Wood Thrush	Pine Warbler
	Rose-breasted Grosbeak
	Scarlet Tanager
	Eastern Towhee
	Blue-headed Vireo
	Winter Wren

*****This list is not a full review of all identified birds in Charlestown. There may be others that would be considered highly vulnerable.

Agriculture. In the short term agriculture is likely to benefit from a longer growing season (since 1960 it has increase 15 to 52 days in southern New Hampshire, Figure 13); 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.

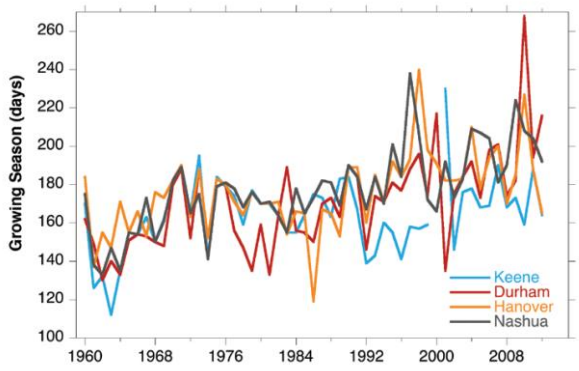


Figure 13. Length of the growing season for four GHCN-Daily stations in southern New Hampshire, 1960-2012. (UNH 2014)

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. Also, natural resource based industries will face new challenges. This includes poor road conditions limiting logging operations that require frozen or snow covered soils. Also maple syrup production is already seeing shifts due to changes in habitat and seasonality needed for quality sap production.

RESILIENT LAND IN CHARLESTOWN

Resilient land in Charlestown is based on datasets from the Resilient Land Mapping Tool created by The Nature Conservancy (Anderson 2014). These analyses are conducted on a regional scale and with some local detail, although limited due to the complexity and local nuances of climate change that are difficult to capture and predict. Still, the information is informative to conservation planning in Charlestown that seeks to be adaptive and resilient to the impacts of climate change. This TNC resource includes five major analyses that are most useful to this report, and are included below.

Resiliency Network (Figure 14)**.**
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. This map drives home the impact of the state road and Connecticut River corridors creating a barrier that limits the resilience. All identified land in this map is on the western side of Charlestown.

Landscape Diversity (Figure 14)**.**
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.

Biodiversity Value (Figure 14)**.**
This analysis assembles information on places recognized for their biodiversity value (rare species, intact habitat, or exemplary natural communities).

Resilient Sites (Figure 14)**.**
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. The amount of resilient area reflects the highest scoring one-third of each setting in the region and it is not an absolute measure of how much area is equally resilient to climate change.

Flow & Connectedness.
Conserving resilient sites would go a long way towards sustaining the biological diversity of the study region, 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 to establish in, 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. Still, there is much uncertainty about how the effects of climate change will play out.

The objective of the flow analysis is to facilitate these dynamics, to ensure that plants and animals are thriving, to ensure that the landscape remains permeable to movement, and to ensure that dispersing species have a place to go. This series of analysis includes three outputs included in this report.

Local Connectedness (Figure 14).
This analysis identifies local connectedness by measuring the amount and configuration of human-created barriers like major roads, development, energy infrastructure, and industrial farming and forestry land.

Flow Based on Permeability (Figure 15).
Climate flow refers to the gradual movement of populations in response to changes in the climate. Over time, climate flow results in range shifts and the formation of novel communities. This analysis measures climate flow based on anthropogenic resistance (resistance to movement caused by human modification) and climatic gradients (upslope, northward and riparian).

Flow Based on Concentration (includes recommended conservation strategies) (Figure 15).
This map classifies climate flow groups based on the amount and concentration of flow. Each type suggests a different conservation strategy.

- Diffuse flow: areas that are extremely intact and consequently facilitate high levels of dispersed flow that spreads 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.
- Constrained flow: areas of low flow that are neither concentrated nor fully blocked but instead move across the landscape in a weak reticulated network. These areas present large conservation challenges. In some cases, restoring a riparian network might end up concentrating the flow and creating a linkage that will be easier to maintain over time.
- Blocked/Low flow: areas where little flow gets through and is consequently deflected around these features. Some of these might be important restoration areas where restoring native vegetation or altering road infrastructure might reestablish a historic connection.

ADDITIONAL RESOURCES

For further information on this topic, you may reference those documents noted in this chapter and also in Appendix G. These authors will also continue to report updated information on climate change impacts, projections and adaptation strategies, and are a good initial resource for anyone who would like to monitor this topic

Figure 14. A map of Charlestown's climate change resilience and connectivity for ecosystems and wildlife.

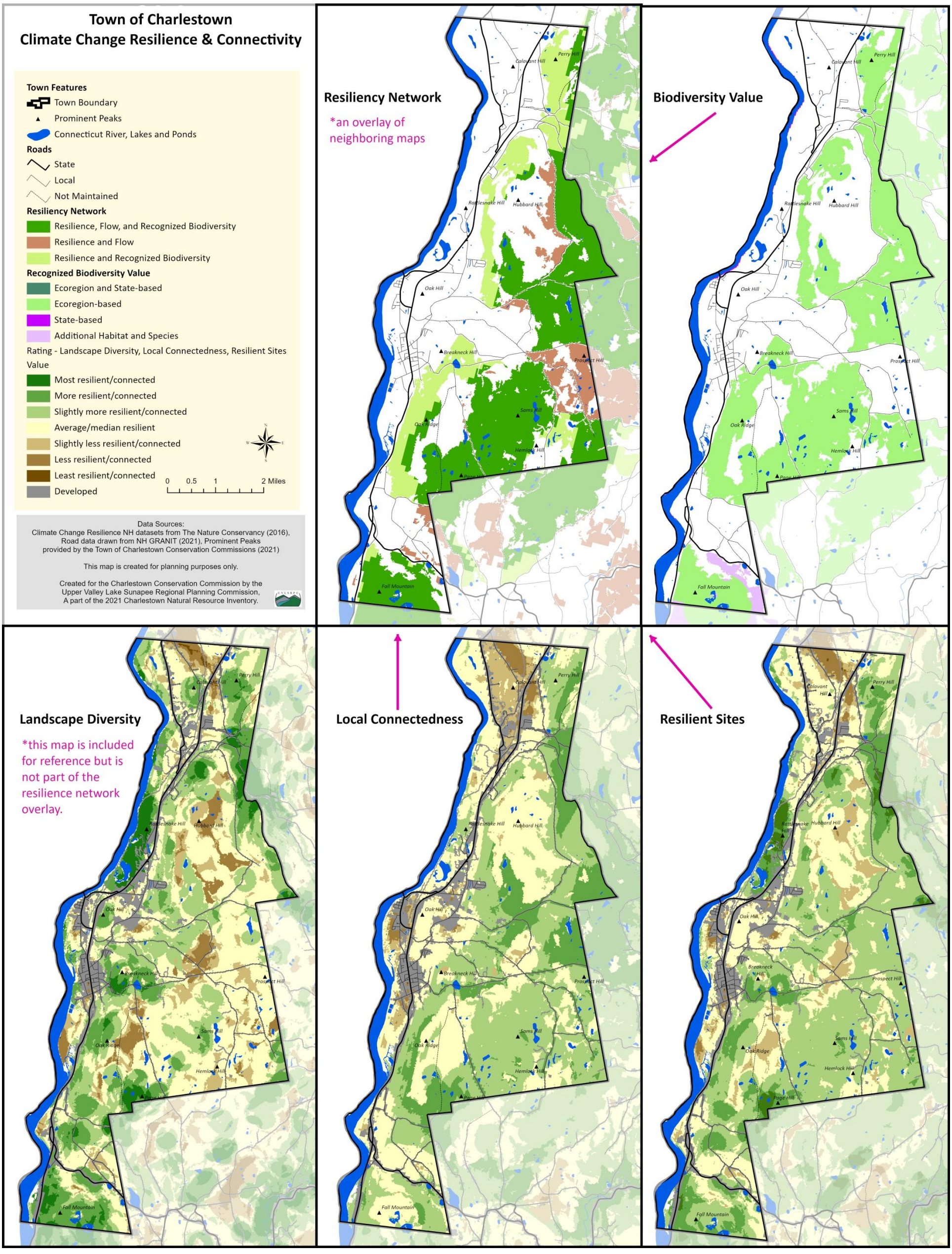
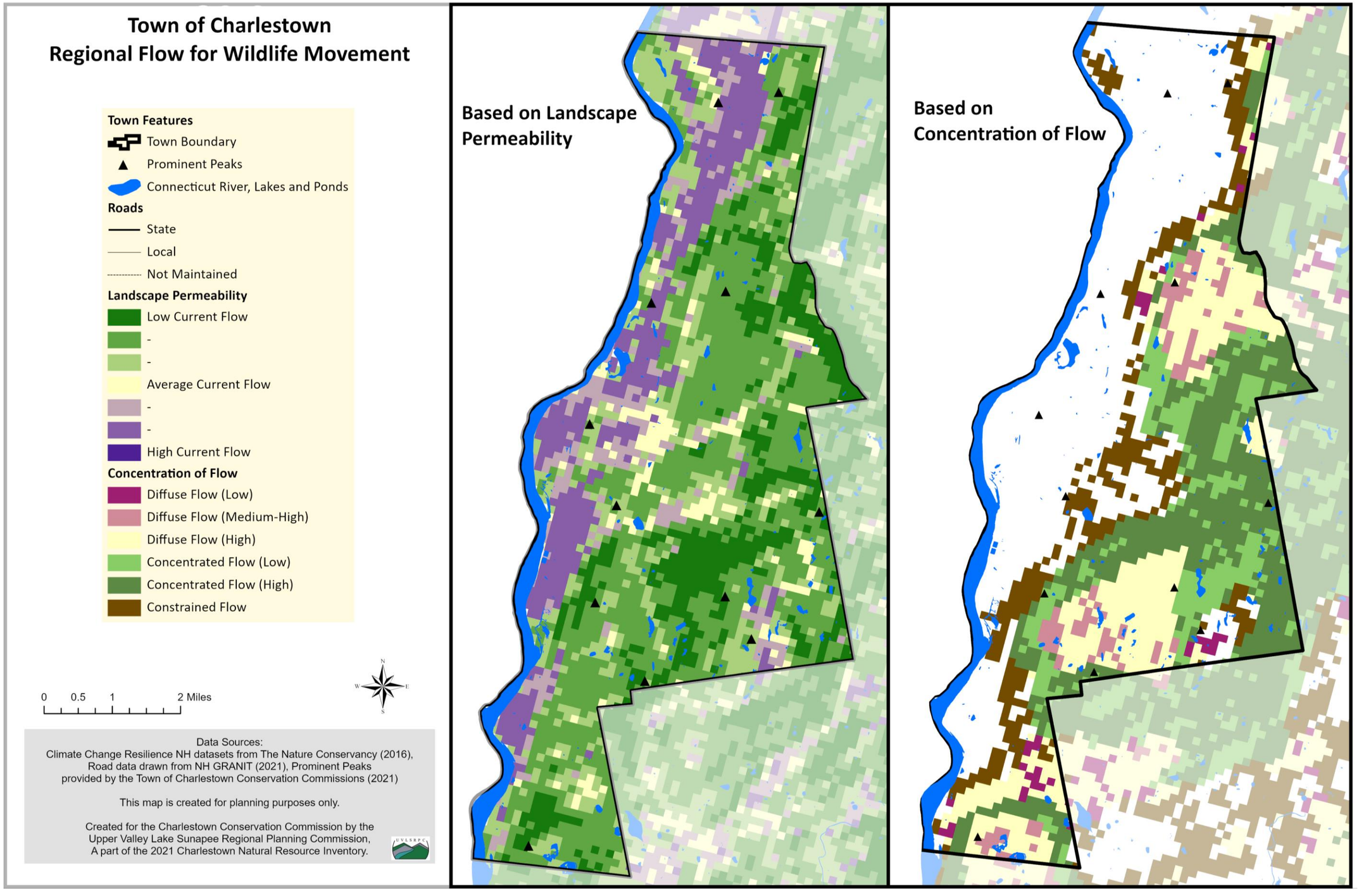


Figure 15. A map of Charlestown's potential flow of wildlife during a time of climate change.



3.12. 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

As of 2019, 14,187 acres are enrolled in current use, 62% of the town's land area or 58% of the town's total area. These lands are held by 233 different owners, and constitute 384 parcels (Figure 16). Although from 2002 to 2007, the acreage of land in current use increased by about 1,200 acres; from 2007 to 2019, the acreage decreased by 239 acres. Since 2007, Sullivan County has seen minimal overall change in current use acreage, which increased from 68% to 70% 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.

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 14). Forest land with documented stewardship has a lower assessment, to reflect the cost of active stewardship of the land; documentation of a Certified Tree Farm, a Forest Stewardship plan from a licensed forester, or a summary of a Forest Stewardship plan developed privately are sufficient to enroll a parcel in current use as forest land with documented stewardship.

Table 14. Current Use Lands in Charlestown

Current Use Type	Acreage		% of CU Land	% of Town
	Change Since 2007	2019	2019	
Forest	-460	8,703	61%	36%
Forest with stewardship	555	2,677	12%	11%
Farmland	-284	2,252	10%	9%
Wetland	-80	12	<1%	<1%
Unproductive	31	543	2%	2%
Total	-238	14,187	100%	58%

Source: NH Department of Revenue Administration, 2008 and 2019.

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. In Charlestown, the withdrawal of land from current use has been minimal; 238 acres were removed from current use in the years 2007-2019.

3.13. Conservation Lands

Conservation lands are undeveloped lands that are protected from future development by governmental ownership or conservation easement. Depending on the type of protection, these lands may or may not be protected in perpetuity. A conservation easement is a permanent legal agreement that restricts certain land uses to protect the land's natural features; the current landowner retains ownership of the land. Publicly owned land without special protection retains its development rights, which provides no permanent protection; these lands are sometimes referred to as unofficial conservation lands. Examples of public lands that do have special protection include:

- state parks
- state forests
- wildlife management areas
- public land with conservation easements

Conservation lands in Charlestown take many forms: they are owned by the state, the town, and by private individuals (Figure 16). 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 Charlestown is around a drinking water wellhead in North Charlestown at 0.2 acres, and the largest is Hubbard Hill State Forest at 756 acres. In total, 11% of Charlestown's land, 2,500 acres, is protected from development. Acreages reported here are based on best available data from New Hampshire GRANIT supplemented by information from Upper Valley Land Trust (Table 15).

In addition to this list, there is a new conservation easement, the Beaudry easement, which protects 5 acres and abuts Hubbard Hill State Forest; this easement is held by the Town of Charlestown.

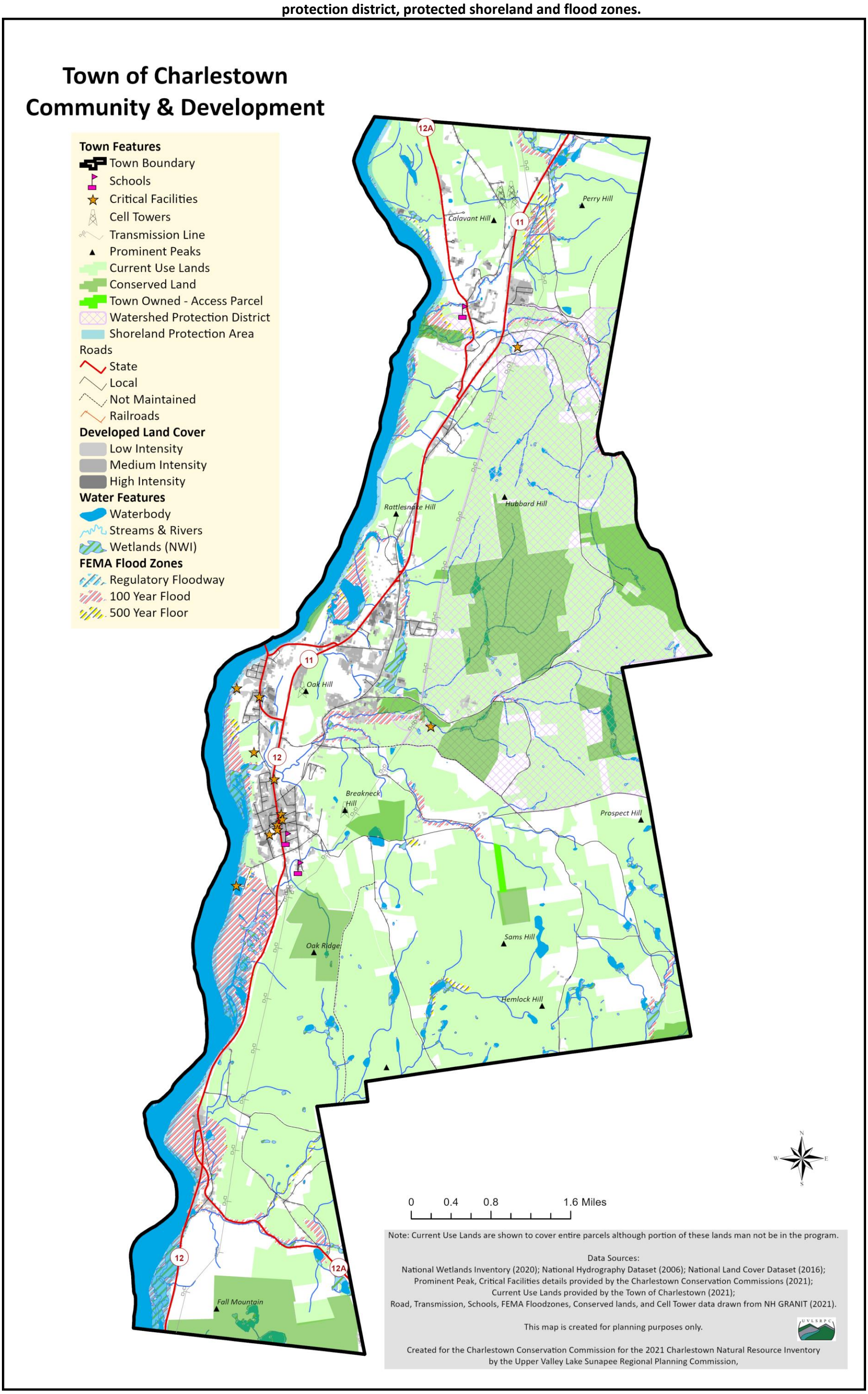
Through the Natural Resources Conservation Service, land directly along the Connecticut River in Great Meadow and Lower Meadows is now protected by a 150-ft-wide natural vegetation buffer. It should be noted that this is a land management tool, rather than permanent land conservation.

Table 15. Conservation Lands in Charlestown

Parcel Name (Current Owner, if different)	Protection Type(s)	Protecting Agencies	Acreage	Funding Program
Bascom, K.R.B. & E. (Bascom Sugar House Inc.)	Conservation Easement	NH Dept. of Agriculture	~ 34	Land Conservation Investment Program
Charlestown Town Forest	Publicly Owned	Town	18.0	
Charlestown Town Forest - Halls Pond Lot	Publicly Owned	Town	186.0	
Charlestown Town Forest - South Hemlock	Publicly Owned	Town	62.0	
Charlestown Water Dept. – Riverfront	Publicly Owned	Town	16.6	
Charlestown Water Dept. - Borough Rd.	Publicly Owned	Town	8.2	
Connecticut River State Forest	Publicly Owned	NH DRED	220.0	
Fall Mountain	Publicly Owned, Conservation Easement, Executory Interest	Nature Conservancy; NH DRED; State of NH	476.5	Land & Community Heritage Investment Program
Francis (Remick Trustee)	Conservation Easement, Deed Restriction	Town; OEP	291.3	Land Conservation Investment Program
Hubbard Hill State Forest	Publicly Owned, Deed Restriction	DRED	756.5	Land and Water Conservation Fund
North Charlestown Water Department	Publicly Owned	Town	0.2	
Soper (McPherson)	Conservation Easement, Executory Interest	Connecticut River Watershed Council; SPNHF	40.4	
Spaulding WMA (NH Fish & Game)	Publicly Owned	NH Fish and Game Dept.	56.0	
Sussman (Schaefer)	Conservation Easement, Executory Interest, Deed Restriction	Town; NH DRED; NH OEP	44.6	Land Conservation Investment Program
Swift Farm (Smith Trustees)	Conservation Easement	Upper Valley Land Trust	55.4	
Town Forest - Reservoir Lot	Publicly Owned	Town	189.0	

Source: NH GRANIT, 2008, verified by Conservation Commission 2021.

Figure 16. A map of Charlestown's development and restrictive landscape features – developed land, current us and conserved lands, watershed protection district, protected shoreland and flood zones.



3.14. Natural Resources Co-occurrence

To identify areas with high natural resource value, the Charlestown Conservation Commission (CCC) used a method known as co-occurrence analysis. This is a geographic analysis of natural resource overlap and spatial coincidence. In such an analysis, important resources are identified and their locations analyzed to yield "hot spots" showing where multiple important natural resources occur in the same location. This type of analysis helps to create a "shared vision" of conservation values and prioritization of land and resource conservation.

To organize this analysis, seven natural resource categories were identified by the CCC. 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 16).

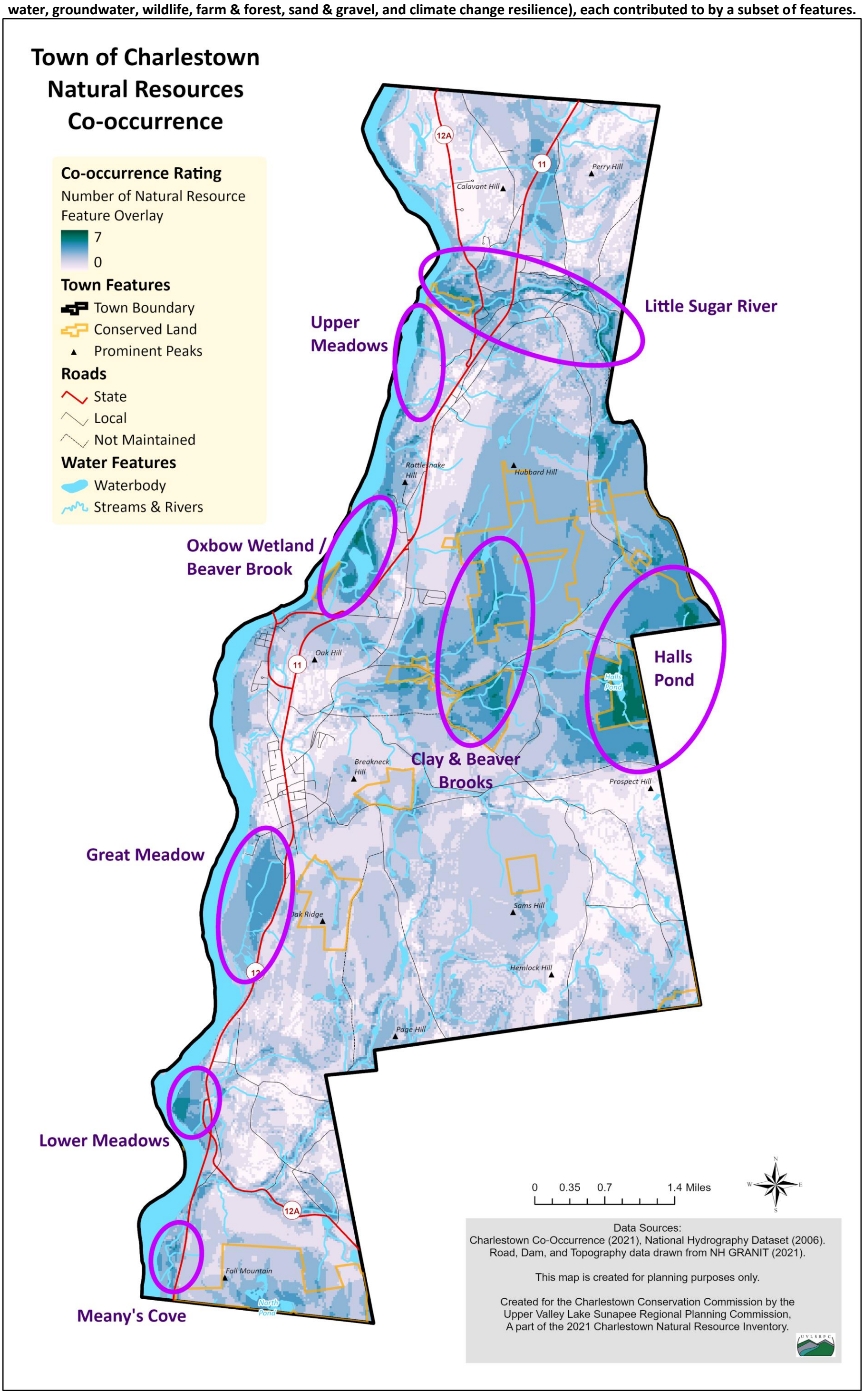
All of the measured features within each of the seven categories were combined and assigned a value of 1 for the co-occurrence analysis. This data was then analyzed using a spatial overlay algorithm in ArcGIS Pro 2.7.2. This algorithm added up the number of categories coincident at all locations throughout Charlestown; in other words, where categories overlapped, their "1" values were added up. Therefore, the results of the co-occurrence analysis are easy to interpret and explain – a spot with a score of "7" indicates that at least one feature of all 7 categories is present at that location.

The results of the co-occurrence analysis are shown in Figure 17. More than 90% of Charlestown was identified with at least one natural resource category, with the majority of 81% containing one to three categories. Less than 1% of Charlestown contained the highest of six or seven categories.

Table 16. Features of natural resources co-occurrence analysis

Natural Resource Category	How this Resource was measured
Surface Water	Ponds and land within 500-ft of a pond
	Streams and rivers (4th order and higher – namely the Connecticut River) and land within 500-ft
	Clay Brook, Little Sugar River, and land within 50-ft
	Wetlands (identified by both the National Wetlands Inventory and Natural Resources Conservation Service hydric soils feature)
	Floodplains (FEMA flood zones – Regulatory floodway, 100 & 500 year floods)
Groundwater	Stratified-drift aquifers (all with a transmissivity greater than 2,000 square feet per day)
	Wellhead protection areas
	Land in Watershed Protection Overlay District
Wildlife	Important habitat identified in Wildlife Action Plan (Tier 1 and 2)
	Amphibian/reptile habitat – land within 500-ft of known vernal pools, road crossings, and breeding areas
	Approximate locations of rare species that are not considered historical (Natural Heritage Bureau 2021)
Farm and Forest Land	Prime agricultural soils (federal designation only)
	Actively farmed land or working/managed forests
Sand and Gravel	Soils likely to be sources for both sand and gravel raw materials
Open Space	Conservation land or land within ½-mile of conservation land
	Upper slopes of Sam's Hill – above 1,460-ft
	Steep slopes –greater than 15%
Climate Change Resilience	Resilient sites (more and most resilient according to The Nature Conservancy)
	Local Connectedness for Wildlife (more and most resilient according to The Nature Conservancy)

Figure 17. A map of Charlestown's co-occurrence analysis. This analysis identifies overlaps between 7 natural resource categories (surface water, groundwater, wildlife, farm & forest, sand & gravel, and climate change resilience), each contributed to by a subset of features.



4. Conservation Focus Areas

From the results of the co-occurrence analysis (as described in Section 3.14), eight different "conservation focus areas" were identified. These focus areas, also known as "hot spots", are areas with clusters of multiple natural resources, resulting in a high score (Figure 17). It is important to recognize that these focus areas represent the most valuable areas for multiple resources; there are other areas of town that are important for a single resource or a small number of resources.

The conservation focus areas were named after the most prominent natural or cultural feature on or near the site. From north to south, these eight focus areas are:

- Little Sugar River
- Upper Meadows
- Oxbow Wetland/Beaver Brook
- Clay & Beaver Brooks
- Halls Pond
- Great Meadow
- Lower Meadows
- Meany's Cove

It should be noted that all of the conservation focus areas are clustered along waterways. This is due to co-location or proximity of surface water resources, groundwater resources, agricultural uses, sand and gravel deposits, climate resilience, and important wildlife habitat along the Connecticut River and its major tributaries in Charlestown, namely the Little Sugar River and Clay Brook, as well as Halls Pond. Due to the lack of significant areas of aquifer, sand and gravel deposits, and agricultural land in the eastern sections of town, these areas are not well-represented by this focus area analysis. Their under-representation in this analysis should not be interpreted to construe that the upland forests of eastern Charlestown are not valuable; In particular, these eastern areas receive high ratings for their importance to habitat resilience in the face of climate change. For this reason, the conservation plan that follows in Section 5 includes recommendations to better manage resources in all parts of Charlestown, not just the eight conservation focus areas.

The Charlestown Conservation Commission provided information on many of these same conservation focus areas as part of the 2009 NRI, which was reviewed and updated for this 2021 NRI. This local knowledge helps to verify the results of the co-occurrence analysis and to gather more site-specific information. Each of the eight conservation focus areas are described in detail on the following pages, and information from site visits in 2009 or 2021 are described further in Appendix F.

4.1. Little Sugar River

The Little Sugar River flows through the Town of Unity and through the village of North Charlestown before entering the Connecticut River. This focus area is centered on the lower reaches of the river, near the village of North Charlestown.

The dominant land use of this area is residential, but there are also forested lands, hayfields, and two active gravel pits. Public access is currently limited, partly due to the steep terrain. Unofficial trails do exist, especially between Route 12A and the railroad culvert on the north side of the river and west of Wheeler Rand Road on the south side.

Mouth of the Little Sugar River looking upstream (left) and downstream at the confluence with the Connecticut River (right). Credit: Sue Forcier.

The land is part of the river's riparian area and floodplain, and its floodplain forest has been given the highest ranking in the state Wildlife Action Plan. The floodplain forest contains several uncommon tree species, including sycamore and yew. Other forest types are hemlock and mixed deciduous, with hemlock being more prevalent on steep slopes near the river.

The invasive species Japanese knotweed is very common throughout the area and is especially common along the river and roadways. Wetlands are limited to narrow drainage areas or oxbow/floodplain areas of the river. Steep slopes are common, and there are a few areas of exposed ledge, generally near the waterfall south of Morningside Lane.

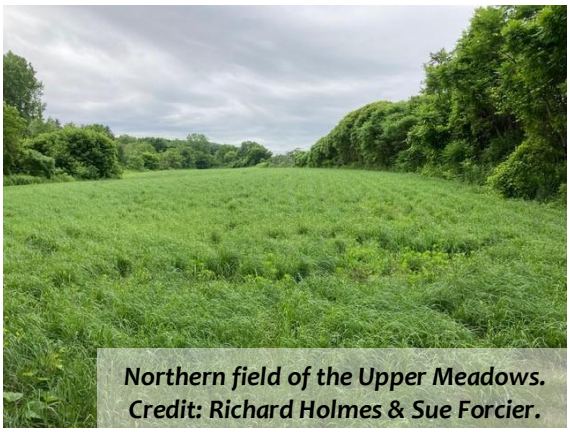
Common wildlife in the area at the time of survey was a variety of bird species; also abundant were deer and turkey sign. The Natural Heritage Bureau has documented a rare reptile species in the area. The varied terrain, agriculture fields, forested areas, and riparian areas suggest that a wide range of species would occupy this area. It should be noted that Route 12 and the railroad corridor substantially impact the connectivity of terrestrial wildlife habitat along the river. Culverts underlying Route 12 and the railroad may inhibit the movement of aquatic organisms. In addition, invasive species are beginning to impact the ecology of the river corridor.

The Little Sugar River corridor is of special cultural importance to the community. The North Charlestown Water Department's well field and wellhead protection area are located here, and the area is underlain by aquifer. The immediate area around the North Charlestown gravel wells is protected from development, and the mouth of the river is protected by conservation easement. The prominent location of the river corridor and its proximity to the historic village of North Charlestown increases its value to the community.

4.2. Upper Meadows

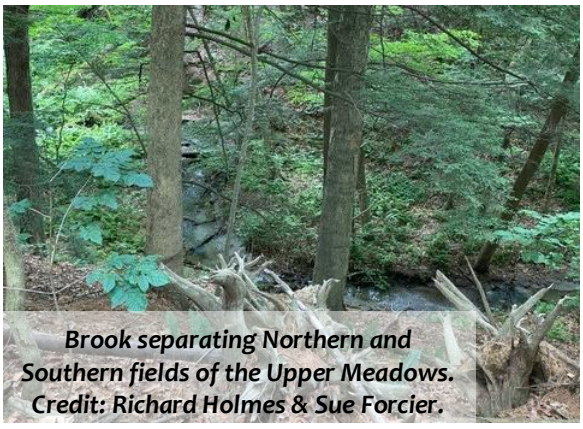
The Upper Meadows encompasses high value hardwood and prime agricultural soils, a working farm, area in the 100 year flood zone, area that is more connected and resilient for wildlife in the face of climate change, Tier 1 state ranked habitat, and is a part of the New Hampshire Audubon Important Bird Area. Upper Meadows runs along the length of the Connecticut River with a protected shoreline. Portions are experiencing significant bank erosion along the Connecticut River, with some indication of up to 15 feet lost every year. Much of the Upper Meadows is under Current Use for agriculture and within zoning district E – Mixed Use, which does not have any use restrictions except for those that apply due to the presence of the 100 year flood zone.

The Northern part of the focus area is a part of the St. Pierre Inc. property with a nearby gravel pit. The area is mostly flat with a high berm separating it from the active gravel pit. It hosts a one acre wetland with a small pond, and deer and turkey have been seen at the site. Separated from the north section by a small brook, the southern part of the focus area includes what is sometimes called the Old Weeks Farm.



Northern field of the Upper Meadows. Credit: Richard Holmes & Sue Forcier.

Southern field of the Upper Meadows. Credit: Richard Holmes & Sue Forcier.



Brook separating Northern and Southern fields of the Upper Meadows. Credit: Richard Holmes & Sue Forcier.

4.3. Oxbow Wetland/Beaver Brook

Between the Connecticut River and Routes 11/12, near the CEDA Industrial Park, lies a large shallow wetland that drains to the Connecticut River. This focus area includes this wetland, its tributaries, and immediate watershed. The wetland was formed by the natural meandering of the Connecticut River, which formed an oxbow lake that has since filled in to become a wet meadow. There is a small pond within this wetland. Incoming streams feed the wetland from the north and the south; a stream on the western side connects the wetland to the river, passing under the railroad corridor via a culvert.

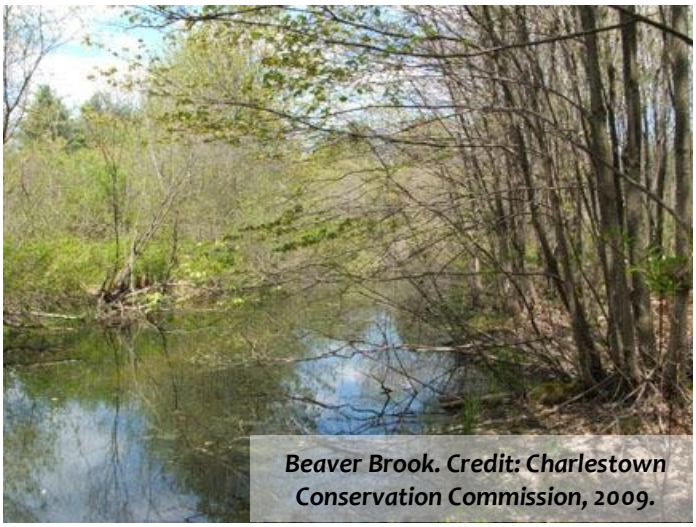
The land inside and to the north of the C-shaped wetland is used for farming (corn for silage). Stream dredging and streambank clearing near the fields has occurred in the past few years. Other land around the wetland is forested. The eastern side of the wetland is mainly hemlock, the western side is aspen and cottonwood with a few white birches and elms, and the edges of the wetland host ash-leaf maple, black willow, speckled alder, and red osier dogwood. Invasive species in this area include purple loosestrife (widespread), honeysuckle (widespread), and European buckthorn (limited, near the railroad.) There is a rare plant species in the vicinity.

Oxbow. Credit: Charlestown Conservation Commission, 2009.

Common wildlife in and around the wetland include: numerous species of birds, including migrating birds in spring and fall, deer, muskrat, beaver, and many species of fish and amphibians. Mink, otter, and moose have also been seen in this area.

Public access to the northern side of the wetland is limited during the growing season by a locked gate May through October. At other times of year, the gate is open and this is a popular hunting and fishing spot; in the fall, the state stocks the fields with pheasant. There is no public access on the south side of the wetland, and the land is posted against trespassing.

Beaver Brook is the tributary on the southern end of the wetland with a railroad culvert running across. This brook flows through medium-density and high-density residential areas; despite this, it appears from the aerial photograph that riparian buffers remain relatively intact. The headwaters of Beaver Brook are a large wetland complex on the east side of Old Claremont Rd. This wetland is primarily a red maple swamp with some open water; the eastern side is predominately tall red maples with little understory, while the western side has more shrubs, including dogwood, serviceberry, opposite-leaf maple, and red maple. A power line cuts through one corner of the swamp. Signs of deer, bear, and beaver were seen, and ducks were heard during the field survey. This area is extremely wet, and therefore unlikely to attract public recreation. Another brook flows into the oxbow wetland from the north; beaver activity has created wetland areas along this brook.



Beaver Brook. Credit: Charlestown Conservation Commission, 2009.

The watershed includes CEDA Industrial Park, several manufactured housing parks, and medium-density residential development. Forested areas are interspersed between developed areas. In addition to the large wetland complexes described above, there are several small wetlands, brooks, and drainages throughout the area. There are some areas of steep slopes, but no significant erosion was noted during the field survey. This watershed area abuts wellhead land along the river owned by the Charlestown Water Department. As this area is highly developed compared to other areas in town, the wetlands and remaining forested areas are extremely valuable for flood attenuation, absorption of stormwater, and water supply protection.

4.4. Clay & Beaver Brooks

The land around Clay and Beaver Brooks, and along North Hemlock Road includes land cleared for farm fields or pasture, supporting a beef cattle farm and a vegetable farm, as well as significant areas of conserved land. Part of this area is protected from development by the Swift Farm easement and the Hubbard Hill State Forest. The other half is mixed forest, much of which is protected from development for water supply protection and the land is owned by the Charlestown Water Department.

Clay and Beaver Brooks are one of the major tributaries to the Connecticut River in Charlestown, is part of the floodplain, and is connected to several wetlands in the area along North Hemlock Rd. Some of the wetlands are heavily vegetated; some have areas of open water. This area also hosts some of the most resilient and connected land with biodiversity value for wildlife in the context of climate change resiliency.

The forested area around Clay Brook is part of a very large hemlock-hardwood-pine forest community extending into surrounding towns. There are several areas of steep slopes, but no erosion along the creek was noted. The invasive species, honeysuckle and Japanese barberry, were documented in this area. A rare plant species has been documented in the vicinity of Clay Brook by the Natural Heritage Bureau. Survey volunteers noted deer tracks in the area.

Recreational opportunities in this area include hiking and snowmobiling as well as hunting and fishing. Beaver Brook that flows through the northern part of the focus area, flows for the majority of the year. This brook hosts a couple of small ponds and wetlands. It also feeds the oxbow wetland, another identified focus area. This northern area has been largely identified as Tier 1 state ranked habitat through the Wildlife Action Plan. The rest of the focus area has also been highlighted for its important in the biological region or as a supporting landscape.

False Solomon Seal, maianthemum racemosum, near Clay Brook. Credit: Sue Forcier.

4.5. Halls Pond

The Halls Pond focus area contains some of the most resilient, connected habitat with recognized biodiversity value in Town. Generally, the area is low in elevation with some more extreme elevation changes and multiple peaks surrounding area. The Halls Pond focus area is often visited for its recreational features in hiking, snowmobile, canoe, horseback riding, and ATV use.

New Footbridge over brook feeding Halls Pond, facing area logged in 2019 (left) and Lady Slipper, cypripedium reginae, on the banks of Halls Pond (right). Credit: Sue Forcier.

A diversity of wildlife can be seen in the area, including moose, deer, bear, turkey, and a variety of bird species. The focus area contains a significant amount of Tier 1 state ranked and Tier 2 biological region ranked habitats according to the NH Wildlife Action Plan. Further, with area contains high value hardwood productivity soil potential with a part of the focus area a registered tree farm.

The focus area is both private and Town owned, with the pond itself owned by the Town and a part of the Town water system. The Town maintains the dam in order to help influence the flow into the North Hemlock well. The area around Halls Pond is under conservation with much of the remaining focus are in current use. The Halls Pond focus area falls within zoning district D – Watershed Protection, where the minimum lot size is five acres and lowed uses include residential, home occupations, and agriculture and forestry that is not detrimental to the watershed.

Halls Pond (left) and Halls Pond Dam (right). Credit: Jim Fowler, 2021.

4.6. Great Meadow

Great Meadow, located south of Charlestown west of Route 12, is primarily agricultural land, which is owned by TransCanada and leased to farmers. In the past, the management of this land and Lower Meadows has been altered to improve the value of wildlife habitat and to protect the shoreline of the Connecticut River. Most notably, in 2002, a shoreland buffer was planted by the joint efforts of TransCanada, the Sullivan County Conservation District, the Natural Resource Conservation Service, and a large number of local volunteers.

Agricultural uses of the land are for growing corn, hay, and pasture for cattle. At the southern end of Great Meadow, there are extensive marshes as well as an area of silver maple floodplain forest. The buffer zones between agricultural fields and the river have been planted with white pine, red oak, dogwoods, and silver maple; there are also naturally-occurring boxelder, poplar, sumac, alder, grasses, and herbaceous plants. Purple loosestrife is present in wet areas of the cornfield; *Galerucella* beetles were released in 2002 to control this invasive plant. Invasive species present on the southern end of Great Meadow include honeysuckle, Japanese barberry, and multiflora rose.

The riverbanks are steep and sandy, prone to chronic erosion. The buffer zones planted in 2002 have helped to lessen bank erosion, although some erosion is still evident. Cows have recently been fenced out of Dickerson Brook, which has allowed aquatic and riparian vegetation to grow back. Great Meadow is also important for protecting water quality, as it is underlain by aquifer and also lies in the floodplain of the Connecticut River.

Great Meadow is part of a regional wildlife corridor, designated as the Lower Connecticut River Important Bird Area (IBA) by the National Audubon Society– the IBA includes all low-lying land along the Connecticut River from the Massachusetts border to Springfield, Vermont, and Charlestown, New Hampshire (Appendix C.) At the time of the field survey, bobolinks, grassland sparrows, goldfinches, red-winged blackbirds, and Canada geese were present. The buffer zone is now well-established, providing shelter and food for wildlife. Great Meadow is proximate to a known amphibian crossing area. There is also a beaver lodge, reported to be active by a local fisherman, on Dickerson Brook. Fish in Dickerson Brook include bass, pickerel, northern pike, and perch. Bank swallows nest in the riverbanks. This is a popular area for birdwatching, fishing, and duck hunting.

Along the river lies a walking trail maintained by the Conservation Commission. Great River Hydro maintains a boat ramp and picnic area at the northern end of Great Meadow, and boats can also travel from the Connecticut River up Dickerson Brook.

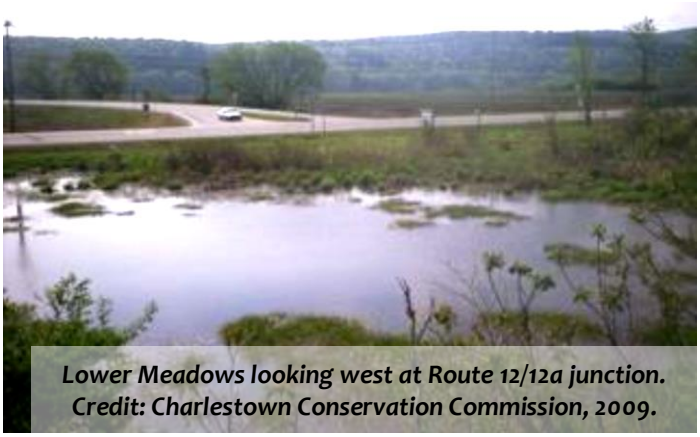
4.7. Lower Meadows

Lower Meadows looking south.
Credit: Richard Holmes.

Lower Meadows is located just west of South Charlestown near the Route 12/12A jug handle on the Connecticut River. Agricultural lands cover about 80% of this area. The area west of Route 12 is predominately well-drained while the area to the east is poorly drained.

This area, similar to Great Meadow, has great value for flood protection and lies partially in the wellhead protection area for a community well for a mobile home park. This area is underlain by aquifer.

Wetlands are primarily located east of Route 12 and near the railroad tracks; there are also some wetlands west of Route 12 in the agricultural fields. Marshes with some open water are the predominant type of wetlands in this area. Purple loosestrife has invaded the wetlands near the Route 12/12A junction.



Lower Meadows looking west at Route 12/12a junction.
Credit: Charlestown Conservation Commission, 2009.

Natural land cover is limited to the bank of the Connecticut River and in and around wet areas and drainage ditches. Willow is the most common tree with lesser numbers of poplar, cherry, and white birch. Invasive honeysuckle is widespread in the wooded area, and rugosa rose is also present. As

with Great Meadow, there is a shoreland buffer planted in 2001 by the joint efforts of TransCanada, the Sullivan County Conservation District, the Natural Resource Conservation Service, and a large number of local volunteers. From the field survey, the riparian buffer seems to have had a minimal impact on bank erosion but has served to keep fertilizer and manure away from the river. Some of the area planted in 2001 has since eroded into the river. Bank erosion is less severe at Lower Meadows than at Great Meadows due to differences in topography and upstream river management structures (i.e., rip-rap above Great Meadow, but none near Lower Meadows.)

Lower Meadows provides several types of wildlife habitat. The cornfields are important as a stopover for migrating waterfowl in the spring and fall. The wetlands east of the railroad tracks provide habitat to nesting birds. Beaver activity is noticeable on the Connecticut River banks as well as in wetlands near Old Route 12.

Lower Meadows has very limited public access during the growing season due to the agricultural nature of the area; in the fall, the fields are a popular site for duck hunting.

4.8. Meany's Cove

This focus area south of South Charlestown is an embayment or backwater of the Connecticut River; it lies due west of the Fall Mountain State Forest. Once used heavily for agriculture, there are now only a few acres of field in the northern section. About 90% of Meany's Cove is a very large wetland area that provides flood protection, aquifer protection, and wildlife habitat. Roughly half of the wetland area is open water, which is heavily utilized by waterfowl both for nesting and as a migratory stopover. There were also many songbirds in the wetland at the time of the field survey. Meany's Cove is directly across the river from Herrick's Cove, one of the premier birdwatching locations in New England; this is a very important stopover for migratory waterfowl.

While a large part of Meany's Cove is open wetland, there are some forested areas, including a small area of floodplain forest. Common trees are willow, poplar, and cherry, with sumac and alder in the understory. Along Route 12 east of the wetland and just north of a cluster of houses is an upland forest with shagbark hickory, pine, and maple. The Natural Heritage Bureau has documented a rare plant species in the vicinity. Invasive honeysuckle is widespread; purple loosestrife and rugosa rose are also present. The riparian buffer along the Connecticut River is intact, but there is some erosion caused by fluctuating water levels and the cove's location on a bend in the river.

Shagbark Hickory at Meany's Cove.
Credit: Charlestown Conservation Commission, 2009.

Meany's Cove looking south.
Credit: Richard Holmes.

Public access to Meany's Cove is from Route 12; this is a popular fishing spot but parking is very limited. There was evidence of human disturbance and erosion around this access point. An Adopt-A-Highway program helps to clean up trash twice per year along the roadway. There may be an opportunity to improve access to this area via a trail or canoe launch from the field north of the cove.

5. A Conservation Plan for Charlestown

Based on the information gathered in the Natural Resources Inventory, the Charlestown Conservation Commission developed an action plan to promote "the proper utilization and protection of the natural resources and for the protection of watershed resources of [Charlestown]" (RSA 36-A). This action plan has been updated from the town's previous plan in 2009.

As was done in 2009, the Conservation Commission reviewed the Town Master Plan and other towns' natural resources inventories and conservation plans to create a prioritized listing of the work the Conservation Commission should seek to undertake to better protect natural resources. In addition, the Conservation Commission evaluated its efforts based on the 2009 conservation plan. From this endeavor, three major goals were identified:

1. Improve Land Management
2. Increase Land Use Planning & Conservation
3. Expand Knowledge of Town Resources

5.1. Improve Land Management

The United Nations defines sustainable land management as "the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions".

The Conservation Commission has identified three primary routes to promote responsible land management. The Conservation Commission proposes to focus on these activities over the next two years, after which time the membership will evaluate their progress and revisit their planning goals:

1. ***Manage town lands responsibly so as to be a model for private landowners***

The first route is to manage town lands responsibly and serve as a model to private landowners. The Commission will consider the certification for Town Forests through the American Tree Farm system and also will seek to develop management plans for all town-owned parcels of conservation land. As of 2021, two out of the three town forests are certified American Tree Farms and all have forest management plans. The Conservation Commission's current focus is Sam's Hill forest due to recent access changes that will allow for management of the area the first time since it was Town owned in 1905. Part of the forest management plan for Sam's Hill is to keep a part as old growth.

Logging near Halls Pond in 2019. Credit: Richard Holmes.

For the Halls Pond and Reservoir Lot management plan, items have been implemented as outlined. Although a part of all plans, the Reservoir Lot forest includes a significant amount of terrestrial invasive species management. For the Halls Pond logging effort in 2019 a method of harvesting was used that creates the least disturbance to the existing forest and minimizes the amount of trips in and out to the landing (see photos). The yellow machine is a feller-buncher with a wood processing attachment. In the vertical position shown the bottom clamps open up and clamp the tree while a saw behind the clamps cuts the tree off. The head then is rotated to a horizontal position with the whole tree. The spiked wheels then pull the trunk through the limber blades and the trunk is measured for

the maximum log size for that section and the saw then cuts the log off the remaining tree and so on until no more logs can be cut. This machine is used in what is called "cut to length" harvest where the logs are cut in the woods instead of whole trees being dragged to the landing and being cut to length there. This leaves all debris in the woods to rot and provide nutrients for the remaining vegetation. The green machine is a forwarder which picks up the piles of logs in the woods left by the processor and carries them to the landing for trucking to the mill.

2019 Harvest at Halls Pond using a forwarder (left) and feller-buncher (right). Credit: Richard Holmes & Sue Forcier.

2. *Provide educational resources to landowners and residents on land stewardship*

The second route is to provide information on land management methods that conserve natural resources. One regular outreach strategy that the Conservation Commission uses is public events with the Town forester prior to management work being done on Town properties. In addition to this, the Commission has identified the following way to expand its educational impact:

- Provide educational materials on forestry best management practices to forestland owners, potentially when landowners file Intent to cut forms.
- Educate landowners regarding issues such as the importance of vegetated buffers and the impacts of improper use of fertilizers.
- Educate landowners about the importance of protecting and enhancing migratory and resident wildlife habitat, by providing workshops and/or displaying wildlife maps, handouts, and publications in the Town offices and library.
- Educate the public on invasive species so that the control of these plants can be done at the landowner level along with other property maintenance.
- Educate residents about the benefits of and need to preserve groundwater resources, potentially through fact sheets/flyers sent with water and sewer bills.

Partners for Outreach

Local, regional and state organizations are likely partners for the Conservation Commission in delivering outreach on natural resources conservation and protection.

- Local - Multi-town events, organized by Conservation Commissions in adjacent towns, are one option to attract a wider audience.

- Regional - The County Conservation District, UNH Cooperative Extension, and the Upper Valley Lake Sunapee Regional Planning Commission are involved in public education and outreach. Non-profit organizations, such as the Connecticut River Joint Commissions, Connecticut River Conservancy, and Trout Unlimited, may also have outreach materials available for distribution, or may have funding available to help with educational campaigns.
- State - In addition, staff from state agencies are often involved in public outreach on current "hot" topics, in particular NH Department of Environmental Services (on shoreland protection) and NH Department of Agriculture (on invasive species). State agencies may also have funding available to help with educational campaigns.

3. Support the work of related groups and organizations

The third route is to support and coordinate activities with other conservation organizations to accomplish mutually beneficial work. Some examples of partnership opportunities include:

- Provide the Natural Resources Inventory to the Planning Board for use in development application review and policy development;
- Support the Tree Committee's work to maintain and care for street trees;
- Work with other towns or the Upper Valley Lake Sunapee Regional Planning Commission to investigate options for household hazardous waste collections;
- Work with the Mt. Ascutney subcommittee of the Connecticut River Joint Commissions on water protection efforts, including road salt reduction initiatives;
- Work with the Planning Board to discuss designation of Scenic Roads, per RSA 231:157, to protect the trees and stone walls of scenic road corridors;
- Support the continuation of the Current Use tax assessment program.

5.2. Increase Land Use Planning & Conservation

Lands with specific resource presence, quality and landscape position are a priority for the Conservation Commission to protect. The co-occurrence analysis identified eight focus areas where many of these important resources overlap, however priority areas will not be limited to these sites. Sites of interest may arise due to opportunities from non-related efforts, or specific focused action by the conservation commission. These targeted and opportunistic areas will be high priorities for land conservation and also environmentally sensitive land management.

The Conservation Commission seeks to protect the following resources via land use planning, conservation easement or land acquisition:

- Forestry resources, including expanding Town Forests when possible;
- Agricultural lands, primarily through conservation easement;
- Areas of important wildlife habitat;
- Riparian lands;
- Wetlands;
- Aquifers that currently provide or have the potential to provide drinking water;
- Areas important for habitat resilience in response to climate change.

The Conservation Commission will seek to achieve this goal of increased land conservation through collaboration with the planning board, the financial support of the Conservation Fund, and also landowner or developer education. The landowner education is to be accomplished in concert with land management efforts (Goal 1, see above). The Conservation Commission is aware that situations exist where a site's potential may be well suited for more than one land use. Under these situations, the Conservation Commission will seek to find mutually agreeable solutions that do not undermine the conservation value of the site. Work towards increased land conservation will be ongoing, with a planned evaluation of progress every two years.

Partners for Land Conservation

The Charlestown Conservation Commission continues to partner with organizations to promote and support land conservation activities. Partners to consult on land use techniques include the Upper Valley Lake Sunapee Regional Planning Commission and the NH Office of Strategic Initiatives. Land trust partners include the Upper Valley Land Trust, Society for the Protection of New Hampshire Forests, The Nature Conservancy, Audubon Society of New Hampshire, and New England Forestry Foundation.

State and federal agencies may also be involved in land conservation, often by administering grant programs. The NH Department of Environmental Services' Drinking Water Supply Protection Program administers the Water Supply Land Protection Grant Program to protect drinking water supplies. The Natural Resources Conservation Service, part of the US Department of Agriculture, administers the Farm and Ranch Lands Protection Program to protect agricultural land. US Fish and Wildlife Service manages the Silvio O. Conte National Wildlife Refuge, which seeks to protect the native plants and animals of the Connecticut River Watershed.

5.3. Expand Knowledge of Town Resources

The Natural Resources Inventory represents a comprehensive, town-wide index of natural resources in the Town of Charlestown. The inventory focused on resources that have already been mapped or studied by state or federal agencies. Although the Conservation Commission and town residents did undertake some data collection and field surveys, there are opportunities for further study to obtain more site-specific information about local natural resources.

The Conservation Commission has identified multiple areas where more information must be gathered in order to develop a plan to adequately protect the Town's resources:

- Inventory of parcels of unfragmented land, particularly those abutting conservation land, waterbodies, or wildlife habitat and travel corridors;
- Prioritization of land parcels with important cultural, historical, and recreational value, in addition to their ecological value;
- Inventory and mapping of vernal pools;
- Inventory of scenic views and vistas, particularly those at risk of being lost and those along the Connecticut River Byway.

The Town of Charlestown middle school currently performs some monitoring and educational activities along Clay Brook. Projects include water quality monitoring, tackling invasive species, and a carbon count to evaluate carbon sequestration value in the area. Additional work on information-gathering projects will progress as time and funding allows, with progress evaluation to be done by the Conservation Commission after two years.