TOWN OF BOW
NATURAL RESOURCES INVENTORY

Prepared for:
Bow Conservation Commission

Jeffry N. Littleton
Moosewood Ecological LLC
Innovative Conservation Solutions for New England
PO Box 9—Chesterfield, NH 03443
jeff@moosewoodecological.com
(603) 831-1980

TOWN OF BOW
NATURAL RESOURCES INVENTORY

Prepared for:
Bow Conservation Commission

JEFFRY N. LITTLETON
Principal Ecologist
Moosewood Ecological LLC

CHRIS KANE
Conservation Biologist
Kane Conservation

LAURA DEMING
Wildlife Biologist
Moosewood Ecological LLC

Moosewood Ecological LLC
Innovative Conservation Solutions for New England

PO Box 9
Chesterfield, NH 03443
(603) 831-1980
Jeff@moosewoodecological.com
www.moosewoodecological.com

February 2022

Cover Photograph This black gum (*Nyssa sylvatica*), with fresh bear claw markings, was observed in a small forested swamp at Nottingcook Forest, which may be serving as a vernal pool. This individual was over 2 feet in diameter, and it is estimated to be about 450 years old.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PHOTOGRAPHS

INTRODUCTION

Population Growth and Development

New Hampshire's population has been growing at a rate that is twofold that of the other New England states (SPNHF 2005). The population has doubled in the forty years leading up to the turn of the century in 2000, and there was a rise in population of 17.2% between 1990 and 2004 alone (SPNHF 2005). This rate of growth is followed by VT (10.4%), RI (7.7%), ME (7.3%), MA (6.7%), and CT (6.7%). In 2016, it was estimated that New Hampshire's population will increase 8.8% between 2010 and 2040 (RLS Demographics, Inc. 2016). However, a recent study found that New Hampshire is the fastest growing state in New England and has been for the previous three years (Johnson 2020). This rate of growth is also supported by the aforementioned 2005 study when comparing population growth between 1990 and 2004. New Hampshire's development pressure will tax the state's natural resources if not thoughtfully managed.

The bulk of population growth is in the southern half of the state; however, 75% of conservation lands are located in the northern regions. This entrusts towns in the southern half of New Hampshire with the responsibility of managing their natural resources and biological diversity, and establishes citizens as stewards of the land, requiring the use of informed decision making to promote a more sustainable approach to land use planning.

The town of Bow has likewise seen significant population growth in the last 50 years. From a population of 2,479 in 1970 to 7,163 in 2000, and a lower rate of increase since then, to 7,980 in 2019 (NH Employment Security 2021), the town has changed in fundamental ways since its predominantly agricultural and rural past. Many formerly active farms and working forests are now converted to residential use as the attraction of the area has created unprecedented demand for housing.

Bow today faces challenges that are familiar to many communities in southern New Hampshire. The rate of residential and commercial development and growth in general has continued to increase, especially over the past three decades. Larger challenges not widely foreseen a half century ago are now in plain sight, as global climate change and invasive species have become new causes for concern.

With the understanding that development will inevitably occur, Bow is faced with choices about directing growth and open space conservation so that a suitable balance can be achieved. Planning for the protection of open space is a critical and positive step towards solutions to these challenges.

Bow still has large areas of intact wildlife habitat of state-wide significance, extensive natural river frontage, unique natural communities, and relatively large areas of unfragmented forest. The acquisitions of significant conservation lands such as the Nottingcook Forest, the Hammond Nature Preserve, and the numerous other Town Forests are cause for optimism, but the protection of other valuable open space lands will become increasingly important. Time, money, and human resources are limited in the accomplishment of conservation. Making the effort to document and keep track of the natural resources of a town is an effective and forward-thinking step in taking stock of assets and needs relative to which resources are most important to conservation.

Natural Resources Inventory

In order to provide a strong foundation for proactive planning and informed decision making, a Natural Resources Inventory, or NRI, is essential (Stone 2016). An NRI is a description of the natural elements that are tied to the geography of a town, a watershed, or larger region. These often include elements such as wetlands, aquifers, ponds, rivers, forests, plants, soils, and wildlife. This

information can be created from existing data or from field-based assessments to better reflect the extent of natural resources within a community.

An NRI is not only an important starting point for informing conservation decisions, it is also a core responsibility written into the enabling State legislation allowing for the existence and authority of conservation commissions. This type of project helps to better understand what natural resources are within a town and where they are located. In conjunction with the conservation planning that it can inform, an NRI can also provide a basis for outreach to public, which can result in further support for land conservation.

New Hampshire statute RSA 36-A authorizes Conservation Commissions to create an NRI. Conservation Commissions are established "for the proper utilization and protection of natural resources and for the protection of watershed resources" of the town. RSA 36-A:2 continues to state that "Such commission shall conduct researches into its local land and water areas [and] … keep an index of all open space and natural, aesthetic, or ecological areas within the city or town … with the plan of obtaining information pertinent to the proper utilization of such areas, including lands owned by the state or lands owned by a town or city. It shall keep an index of all marshlands, swamps and all other wetlands in a like manner…"

An NRI can serve as the basis for developing innovative land use planning techniques that can be adopted to help protect various resources, such as water resources, wetlands, wildlife habitats, and biological diversity. Biological diversity, or biodiversity, refers to the variety, variability, and complexity of life in all its forms and includes various ecological processes (for example, nutrient cycling, flooding, fires, wind events, and succession) that have helped to shape species over time.

Biodiversity includes various levels of ecological organization such as individual species and their genes that have evolved over time, as well as the many intricate plant and wildlife populations. It refers to even higher levels of organization including the assemblage of ecological communities[1] and even entire ecosystems, such as wetlands, woodlands, and rivers. Therefore, the concept of biodiversity engenders all levels of biological organization and the interactions of living organisms within their physical environments. At its heart, the understanding of the dynamics of biodiversity can lead to the development of protection strategies, helping to ensure a healthy environment for humans, as well as all other life forms.

An NRI should not be a static record but one that stays current with changes in land use planning, new natural resources data, and climate change. It is a vision that should be based on the principles of conservation biology and that incorporates the current natural resources of a given area (such as a town, a watershed, or an entire region). Thus, conservation planning ideally strives to incorporate the socio-economic fabric of our world with that of the ecological structure. This effort can help build more sustainable and resilient New Hampshire communities far into the future as a result of implementing comprehensive land use planning that considers both our natural environment and built infrastructure.

Planning for the conservation of natural resources and biodiversity is not a new concept. It has helped in such efforts as the recovery of the American bald eagle; has assisted in building preserves and managing other lands for species of greatest conservation need, as well as our most

[1] An ecological community is a group of two or more populations of different species found in the same place. For example, this would include the wetland bird community of the Turee Pond wetland complex.

common species; aided in the identification of biodiversity hot spots; and has helped to identify and protect critical wildlife habitats within our landscape. It has been a center piece for natural resources protection, restoration, and adaptive management for the past four decades.

The need for this type of informed land use planning is becoming more evident with the passing of time. Ecosystems have long been susceptible to long-term degradation from overexploitation and misuse of natural resources. This has led to the loss of critical habitats as a result of sprawling residential and commercial developments. While the past few decades have seen significant development and land conversion, there has been a concomitant rise in conservation planning efforts over the same time period, especially in New Hampshire.

The Town of Bow published its latest Master Plan in 2017, providing a guide for the town's overall character and development. The Natural Resources chapter

> "serves as a lens focusing attention on certain critical environmental and resource issues that need to be monitored, studied, or addressed. The idea is to increase the information base about Bow's natural resources, and make that information available to the public and decision makers to not only be used to refine existing management plans but to support more informed land use decisions. This information can also be helpful in identifying areas where additional data or research is still needed" (Town of Bow 2017).

In developing the Natural Resources chapter, the town crafted the following vision to support stewardship of its natural resources.

- Working to preserve and maintain the abundant natural resources that contribute to the Town's rural character;
- Building capacity to bring awareness of Bow's land and water resources that sustain wildlife, biodiversity, and water quality to residents and ensure that the benefits of the natural environment are maintained for future generations; and
- Promoting efficient transportation and well-designed development that sustain a clean and healthy community by preserving the natural environment and the ecological function of natural resources.

Statement of Purpose

The Bow Natural Resources Inventory (NRI) was initiated in July 2019. The overall scope of this project was to develop an enhanced Phase I NRI (primarily map-based but with field observations) to support the Town's natural resource protection efforts and provide a basis for informed land use and conservation planning. Goals of the project were to 1) review and analyze existing natural resources data and reports, 2) develop a series of NRI maps designed for educational and planning purposes, 3) refine existing data such as grassland, active agricultural lands, conservation lands, and potential vernal pools, 4) conduct field investigations of wildlife habitats and significant natural communities, as well as biodiversity, including species of greatest conservation need, and 5) combine the natural resources data and maps into this NRI report and conduct a public presentation of our findings.

The information found herein can be used in many ways by the Conservation Commission, Planning Board, and Select Board, as well as landowners, natural resource professionals, and the

general public. The NRI is intended to provide more detailed information to support the following Conservation Commission goals:

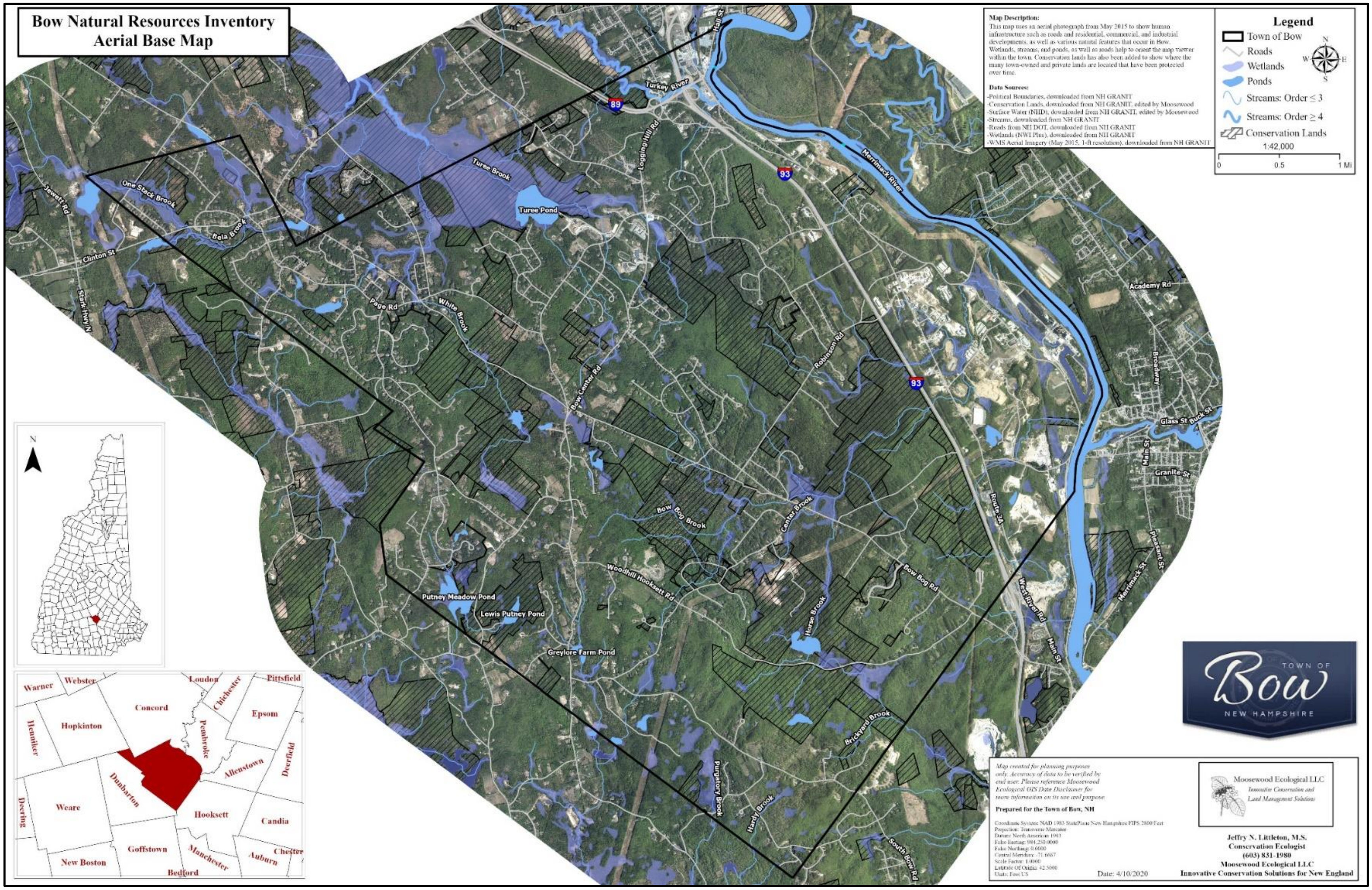
- Better management of Town-owned lands for wildlife and recreation, including land currently protected;
- Identification of Town-owned lands that may warrant protection by easements or other means;
- Identification of additional land that may warrant protection based on significant natural resource value;
- Identification of threats to resources to inform parcel-based land use decisions or changes to current land use regulations;
- Support outreach to citizens about the importance of the Town's natural resources.

Photograph 1 Lewis Putney Pond with lily pads and marsh habitat is significant for wildlife.

Land Use and Open Space

The aerial base map provides a perspective of the landscape -- current areas of development and open space in Bow (Figure 1). It displays roads, streams, rivers, ponds, and wetlands as a base layer to assist the viewer in navigating throughout the town with a bird's eye view.

FIGURE 1


Bow Natural Resources Inventory
Aerial Base Map
Map Description:
This map uses an aerial photograph from May 2015 to show human infrastructure such as roads and residential, commercial, and industrial developments, as well as various natural features that occur in Bow. Wetlands, streams, and ponds, as well as roads help to orient the map viewer within the town. Conservation lands has also been added to show where the many town-owned and private lands are located that have been protected over time.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conservation Lands, downloaded from NH GRANIT, edited by Moosewood
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
-Wetlands (NWI Plus), downloaded from NH GRANIT
-WMS Aerial Imagery (May 2015, 1-ft resolution), downloaded from NH GRANIT
Legend
Town of Bow
Roads
Wetlands
Ponds
Streams: Order ≤ 3
Streams: Order ≥ 4
Conservation Lands
1:42,000
0
0.5
1 Mi
N
S
E
W
Turkey River
Turee Brook
Turee Pond
One Stack Brook
Bela Brook
Jewett Rd
Clinton St
Stark Hwy N
Page Rd
White Brook
Logging Hill Rd
Hall St
Merrimack River
Robinson Rd
Academy Rd
Broadway
Glass St
Buck St
Main St
Granite St
Bow Center Rd
Bow Bog Brook
Center Brook
Route 3A
Woodhill Hooksett Rd
Bow Bog Rd
Putney Meadow Pond
Lewis Putney Pond
Greylore Farm Pond
Horse Brook
West River Rd
Merrimack St
Pleasant St
Brickyard Brook
Purgatory Brook
Hardy Brook
South Bow Rd
89
93
Warner
Webster
Loudon
Chichester
Pittsfield
Concord
Epsom
Henniker
Hopkinton
Pembroke
Deerfield
Allenstown
Dunbarton
Weare
Hooksett
Candia
Deering
Goffstown
Manchester
Auburn
Chester
New Boston
Bedford
TOWN OF
Bow
NEW HAMPSHIRE
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US
Date: 4/10/2020
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England

WATER RESOURCES

Water resources, including surface water and groundwater resources are among Bow's valuable assets. Drinking water sources depend on groundwater in bedrock or sand and gravel aquifers. Ponds, streams, and the Turkey and Merrimack Rivers provide recreational opportunities and habitat for many wildlife species and contribute to downstream drinking water supplies. Wetlands provide varied habitats for wildlife, flood control by absorbing floodwaters and slowly releasing them, support maintenance of base flows in streams, protect and maintain water quality, and shoreline stabilization, among many important functions. This section provides detailed information about the type and extent of these resources in Bow.

Wetlands

Wetlands include habitats such as marshes, wet meadows, beaver impoundments, swamps, fens, and bogs. As noted above, they perform a variety of functions and values, such as providing significant habitats for wildlife and plants, maintaining good water quality, storing floodwaters, and recreation opportunities.

In New Hampshire, wetlands are defined by RSA 482-A:2 as "an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soils conditions." Activities in wetland resources are regulated by the NH Dept. of Environmental Services Wetlands Bureau under RSA 482-A:2. These protected wetlands include forested, scrub-shrub, and emergent wetlands, marshes, wet meadows, bogs, shorelines of streams, rivers, lakes, and ponds, and in some communities 100-foot prime wetland buffer. Bow has 150-foot buffers to prime wetlands and smaller buffers for other wetlands in its zoning ordinance.

The US Fish and Wildlife Service (FWS) has mapped wetlands in the United States through its National Wetlands Inventory (NWI) program. The NWI use the Classification of Wetlands and Deepwater Habitats of the United States to describe the different types of wetlands (Cowardin et al. 1979 and Federal Geographic Data Committee 2013).

This NWI mapping products are used by the state, municipalities, and natural resource managers to promote the understanding, conservation, and restoration of wetlands. The NWI provides useful information, including the type of wetland as well as its hydrology, associated plant communities, water chemistry, and other descriptors such as man-made dams and beaver influence. The NH Department of Environmental Services recently updated the NWI for parts of the state, including Bow. This new dataset is referred as the NWI Plus, and includes additional functional assessment information.

Bow has approximately 1,784 acres of mapped wetlands dispersed throughout the town (Table 1 & Figure 2). These include three main types of wetland systems - lacustrine, riverine, and palustrine. Lacustrine wetlands include deepwater habitats in lakes and ponds (greater than 8.2 feet in depth) and the shallow littoral habitats that are considered wetlands. Examples of lacustrine wetlands in Bow include Putney Meadow Pond along the southwest town boundary, Turee Pond in the north, and the impounded section of the Merrimack River north of Garvin's Falls dam. Riverine wetlands are those associated with rivers. The section of the Merrimack River below the Garvins Falls dam is classified as a riverine wetland.

All other wetlands in Bow are palustrine wetlands, defined as shallow, freshwater habitats dominated by vegetation. These include aquatic bed communities dominated by water lilies and other floating or rooted aquatic plants, emergent marshes, shrub and forested swamps, and beaver ponds (unconsolidated bottom wetlands). The largest and most extensive wetlands can be found along the many streams and ponds. In addition, the landscape supports many small isolated palustrine wetlands.

Table 1 Summary of mapped wetlands in Bow.

Wetland Classification	Area (acres)
Lacustrine	125
Riverine	148
Palustrine	
Unconsolidated Bottom	67
Aquatic Bed	125
Emergent Marsh	399
Scrub-shrub Swamp	492
Forested Swamp	428

SOURCE: National Wetlands Inventory Plus (2017).

Under RSA 482-A:15, the Wetlands Dredge and Fill Law provides the opportunity for municipalities to designate prime wetlands. These wetlands are considered to have high importance due to their size, unspoiled character, fragile condition, and substantial significance in a community. To identify potential prime wetlands, a town conducts an evaluation of all wetlands greater than two acres and considers a variety of ecological functions and societal values that these wetlands provide. Once potential prime wetlands have been identified, a municipal vote is needed to designate them as such, and a report and maps documenting their significance must be filed with the NH Department of Environmental Services. Prime wetlands are afforded more protection and greater scrutiny where impacts to them are proposed.

In 1989, New England Environmental Associates, Inc. conducted the study for the Bow Conservation Commission to inventory and evaluate the town's wetlands and to identify wetlands for designation as prime (Rendall 1989). This study was also intended to help the Conservation Commission assess potential impacts of dredge and fill activities, to improve the general knowledge of wetlands, and to educate landowners about wetlands. As a result of the wetlands evaluation, Bow designated seven prime wetlands covering 875 acres. These include the large wetland complex associated with Turee Pond, two wetlands in Nottingcook Forest, one along Bow Bog Brook, and three wetlands along and in the headwaters of White Rock Brook at Bow Center (Table 2 and Figure 2).

FIGURE 2

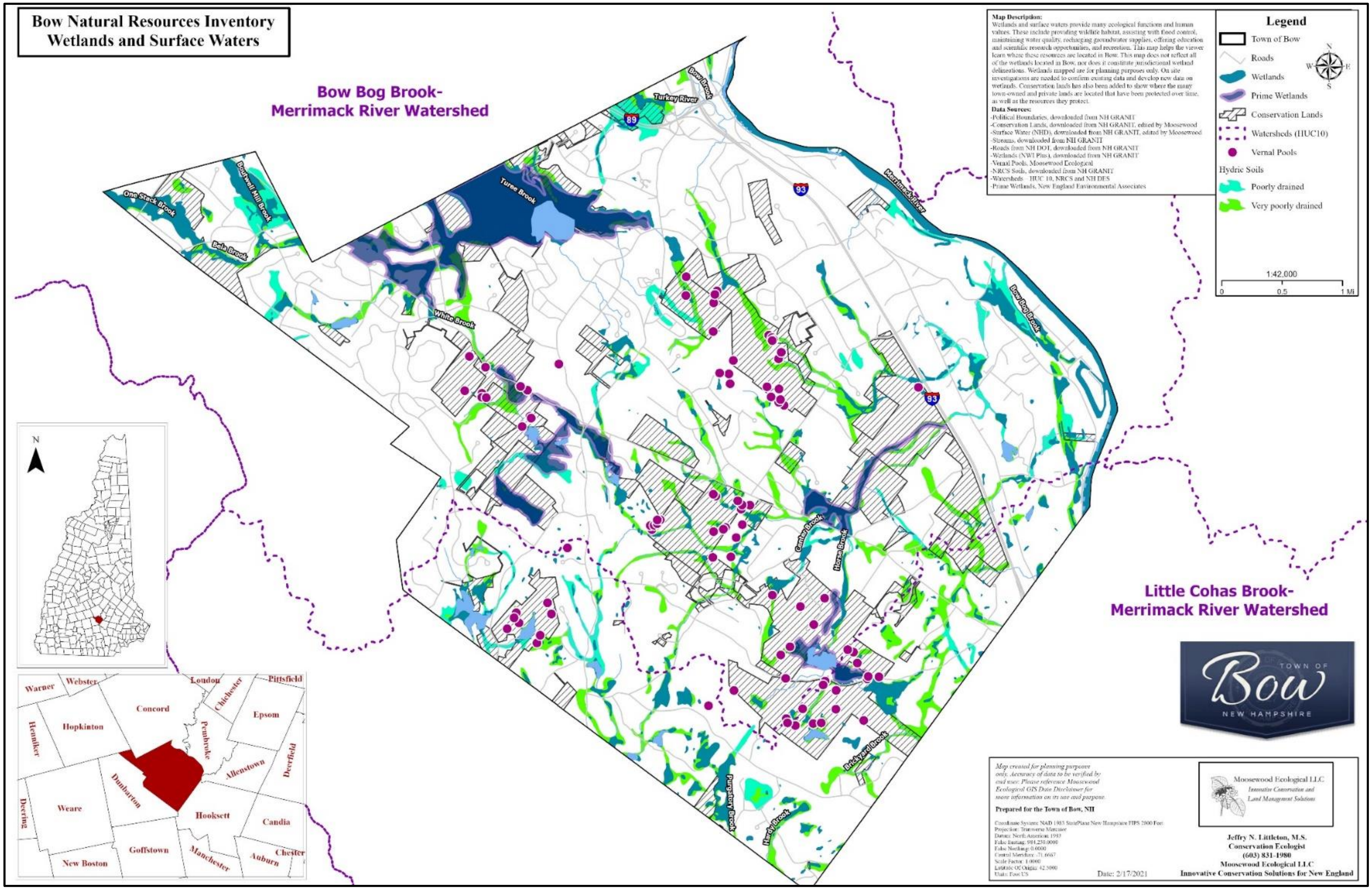

Bow Natural Resources Inventory
Wetlands and Surface Waters
Bow Bog Brook-
Merrimack River Watershed
Little Cohas Brook-
Merrimack River Watershed
Map Description:
Wetlands and surface waters provide many ecological functions and human values. These include providing wildlife habitat, assisting with flood control, maintaining water quality, recharging groundwater supplies, offering education and scientific research opportunities, and recreation. This map helps the viewer learn where these resources are located in Bow. This map does not reflect all of the wetlands located in Bow, nor does it constitute jurisdictional wetland delineations. Wetlands mapped are for planning purposes only. On site investigations are needed to confirm existing data and develop new data on wetlands. Conservation lands has also been added to show where the many town-owned and private lands are located that have been protected over time, as well as the resources they protect.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conservation Lands, downloaded from NH GRANIT, edited by Moosewood
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
-Wetlands (NWI Plus), downloaded from NH GRANIT
-Vernal Pools, Moosewood Ecological
-NRCS Soils, downloaded from NH GRANIT
-Watersheds – HUC 10, NRCS and NH DES
-Prime Wetlands, New England Environmental Associates
Legend
Town of Bow
Roads
Wetlands
Prime Wetlands
Conservation Lands
Watersheds (HUC10)
Vernal Pools
Hydric Soils
Poorly drained
Very poorly drained
1:42,000
0
0.5
1 Mi
Turkey River
Turee Brook
White Brook
Bow Brook
Merrimack River
Bow Bog Brook
One Stack Brook
Bela Brook
Garvins Brook
Horse Brook
Brickyard Brook
Hardy Brook
Warner
Webster
Loudon
Chichester
Pittsfield
Concord
Epsom
Hopkinton
Henniker
Pembroke
Allenstown
Deerfield
Dunbarton
Weare
Hooksett
Candia
Deering
Goffstown
Manchester
Auburn
Chester
New Boston
TOWN OF
Bow
NEW HAMPSHIRE
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US
Date: 2/17/2021
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England

Table 2 List of prime wetlands in Bow by location and size.

Prime Wetlands	Area (acres)
Turee Pond wetland complex	575.6
White Brook wetlands including Hammond Preserve (3 wetlands)	160.1
Nottingcook Forest wetlands (2 wetlands)	70.0
Bow Bog Brook wetland	68.8

SOURCE: Rendall (1989)

To adequately characterize and delineate wetlands, one must consider hydric soils, which include wetland soils categorized as poorly drained and very poorly drained. These soil types have been mapped for general planning purposes by the USDA Natural Resources Conservation Service. Poorly drained soils are estimated to cover about 1,150 acres, while very poorly drained soils cover 1,621 acres, based on GIS calculations and totaling 2,771 acres. This differs from the estimated area of wetlands noted above. The difference in these two datasets is primarily due to the types of data used and the inherent errors associated with these data. Delineation of wetlands for site-specific purposes (i.e., developments) requires on-site examination by a wetland scientist, under RSA 310-A.

Photograph 2 This wetland at the northern end of the Hammond Nature Preserve is home to a heron rookery.

Watersheds
A watershed is an area of land that drains to a common outlet. Watersheds exist at an almost infinite range of scales, from the tiniest tributary stream that is not mapped to major continent-draining rivers. Regardless of their scale, watersheds are a convenient way to parse the landscape into smaller ecological units. All precipitation within a watershed drains toward a common water resource, which may be a wetland, lake, pond, or ocean. The land use within a watershed affects the quality and quantity of surface waters and the underlying groundwater. Land use planning based on watershed protection can help protect a town's water resources, ensuring clean water for humans and ecosystem health.

Bow is in the Merrimack River watershed. Most of Bow, including Bow Bog Brook, drains north to the Merrimack River, while some tributaries drain south ultimately reaching the Merrimack River (Figure 2). The watershed of northern tributaries is identified as "Bow Bog Brook-Merrimack River watershed." The watershed with tributaries draining to the south is labeled "Little Cohas Brook-Merrimack River watershed."

Surface Waters
Bow's surface waters range from small unnamed streams to the large Turkey and Merrimack Rivers and small unnamed ponds to the 47-acre Turee Pond (Figure 2). Our surface waters provide a multitude of human benefits such as fishing, hunting, boating, swimming, and nature observation, and they are essential for wildlife and plants that depend upon these resources for their life cycle needs. Threats to water resources include potential water quality degradation by mobile, stationary, or area pollution sources, such as mercury from coal-based emissions in the mid-west that has impacted surface waters in Bow and the entire Northeast; habitat loss due to surrounding land use including unsustainable forestry and agricultural practices; and land conversion associated with roads and other development.

Ponds
Bow has numerous ponds distributed throughout the town. The US Geological Survey and the NH Dept. of Environmental Services (NHDES) have identified five distinct named ponds. These ponds cover approximately 352 acres, ranging in size from about 6 acres to 250 acres (Table 3 and Figure 2). The Garvin's Falls Dam in the Merrimack River creates an impoundment with pond/lake-like conditions. Town Pond is another central feature in Bow; it was originally created to provide a source of water for fire-fighting purposes. Many other smaller ponds also exist in Bow but were not specifically identified as part of this project.

Turee Pond has been the subject of water quality monitoring by the Bow volunteers under the Volunteer Lake Assessment Program managed by the NHDES. In the 2020 report, it was noted that dissolved oxygen periodically exceeded water quality standards (NH Dept. of Environmental Services 2020). In addition, NH Fish and Game has conducted fish surveys in Turee Pond during 2000 and 2017. A total of seven species were documented in those two surveys, including all species in Appendix B except American eel.

Table 3 Summary of Ponds in Bow.

Ponds	Size (acres)
Greylore Farm Pond	5.9
Lewis Putney Pond	9.9
Town Pond	9.5
Putney Meadow Pond	30
Turee Pond	47
Merrimack River Garvin's Falls Impoundment	250

SOURCE: USGS topography (2009) and NH Hydrography (2019).

Photograph 3 Turee Pond is Bow's largest natural pond and is part of the largest designated prime wetland in town.

Streams and Rivers

Approximately 74 miles of streams and rivers have been mapped in Bow (Table 4 and Figure 2). Fourteen streams and rivers are named on U.S. Geological Survey maps. The Merrimack River and Turkey River are the largest flowing waters in Bow followed by Bela Brook, Bow Bog Brook, Turee Brook, and White Brook. There are approximately 40 miles of unnamed perennial and intermittent streams. Most of these are tributaries of the largest rivers and streams in Bow.

Not all intermittent streams, those that flow seasonally, have been mapped for Bow. Also, ephemeral streams that flow in response to rain events have not been mapped. Most of these drainages are not shown on USGS topographic maps or in digital datasets used to map surface waters. Similar to perennial streams, intermittent streams have defined channels. However, they are typically fed by periods of high groundwater and supplemented by snowmelt and rain storms, and they typically do not have flowing water during dry periods. In contrast, perennial streams flow generally throughout the year. In contrast, ephemeral streams are drainages that do not have distinct channels and only flow during snowmelt and rain storms. It is important to make these distinctions as each provides a different habitat, but all are important aspects of our landscape and their role in draining water from the uplands into perennial streams and wetlands. Developments that do not include all of these drainages into the planning process can potentially cause unintended erosion and sedimentation of our water resources.

Table 4 Summary of rivers and streams in Bow.

Streams	Length (miles)	Stream Order
Merrimack River	7.8	7th
Turkey River (Bow/Concord)	3.4	4th
Bela Brook	1.7	3rd
Bow Bog Brook	6.2	3rd
Turee Brook	0.9	3rd
White Brook	4.8	3rd
Boutwell Mill Brook	1.1	2nd
Brickyard Brook	1.2	2nd
Hardy Brook	0.9	2nd
Horse Brook	2.2	2nd
One Stack Brook	1.2	2nd
Bow Brook	1.4	1st
Center Brook	0.9	1st
Purgatory Brook	1.1	1st
Unnamed Streams	39.5	1st - 3rd

SOURCE: USGS topography (2009) and NH Hydrography (2019).

Photograph 4 Streams like Bow Bog Brook provide habitat for fish, stream salamanders, and aquatic macroinvertebrates such as dragonflies and damselflies.

Shoreland Water Quality Protection Act

The Shoreland Water Quality Protection Act (SWQPA), RSA 483-B, is a state statute enacted (initially as the Comprehensive Shoreland Protection Act) to protect the shorelands and water quality of public waters. These include all great ponds (>10 acres), fourth order streams or higher (Figure 3), and state-designated rivers have been identified by the NH Dept. of Environmental Services as water bodies that are subject to the SWQPA. The Act established minimum standards for the subdivision, use, and development of the shorelands along the state's larger waterbodies. For most new construction, as well as land excavating and filling, a state permit may be required (certain exemptions apply). Putney Meadow Pond, Turee Pond, and the Merrimack River Impoundment above Garvin's Falls Dam, Merrimack River, and Turkey River are public waters and therefore included on the NHDES Consolidated List of Water Bodies subject to the SWQPA.

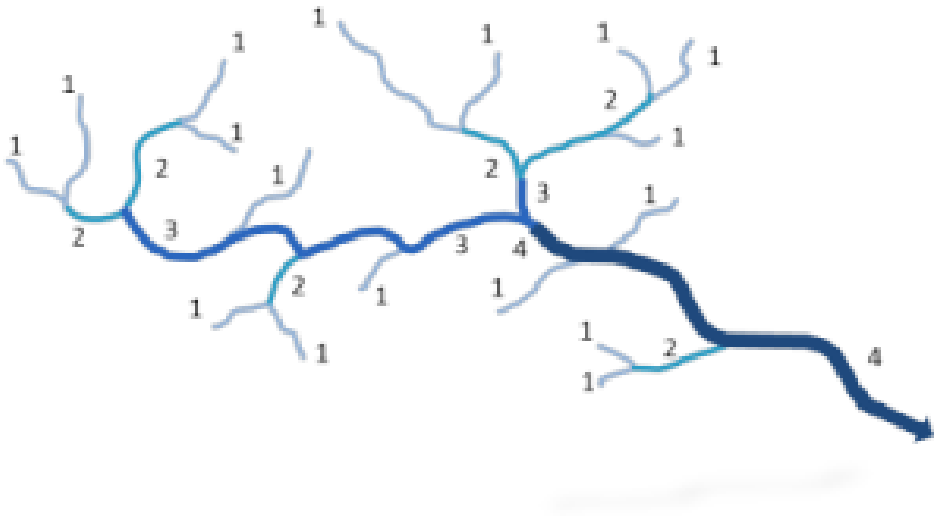


Figure 3 Diagram of how stream order is determined. Stream ordering is a method of classifying the hierarchy of tributaries within a watershed. The smaller the stream order value, the smaller the stream. First order streams include the headwater streams that can be found along the steeper slopes in Bow. When two first order streams converge, they form a second order stream, and so on. The numbers in this figure represent the stream order.

Groundwater Resources – Stratified Drift Aquifers
Groundwater resources that can serve as sources for drinking water are referred to as aquifers. Groundwater is located in two types of aquifers - sand and gravel deposits and bedrock.

In the last post-glacial period as glaciers melted, these meltwaters left behind layers of sorted sediments including sand and gravel. The larger spaces between the particles in the sand and gravel provides groundwater storage and flow. Groundwater stored in *stratified drift aquifers* can serve as an excellent source of drinking water due to the larger quantities available. Locating these geologic features and protecting them as current and future water sources can help to ensure a supply of clean drinking water free of contamination. In contrast, bedrock aquifers typically produce lower quantities of water than stratified drift aquifers; however, bedrock aquifers provide drinking water for a majority of households in Bow through private wells.

Bow contains approximately 3,796 acres of stratified drift aquifers (Table 5 and Figure 4). The largest and most significant aquifer is associated with the Merrimack River Basin on the east side of town (Stekl and Flanagan 1997), where the Bow Municipal Water System is located. Other stratified drift aquifers are associated with One Stack Brook in the northwest and Turee Pond in the north, as well as Nottingcook Forest, Bow Bog Brook, and Horse Brook to the south.

Stratified drift aquifers are grouped into categories based on *transmissivity*, or the rate at which water moves through them. Transmissivity is measured in square feet per day (ft^2/day). Therefore, higher rates of transmissivity correspond to a potentially higher yield of groundwater. Most of the stratified drift aquifers in Bow have a transmissivity rate of 2,000 ft^2/day or less. Higher transmissivity rates occur in the Merrimack River Basin.

While transmissivity takes into account the quantity of water moving through an aquifer system it does not reflect the quality of the source. To assist in addressing this issue and to identify potential future public water supplies for communities, the NH Dept. of Environmental Services (NHDES) and the Society for the Protection of NH Forests prepared a Favorable Gravel Well Analysis (FGWA) for the entire state. This project analyzed stratified drift aquifers for transmissivity rates in combination with water quality based on known and potential locations of surface and groundwater pollution, affording the opportunity for town planners and water suppliers to determine quantity and quality constraints on aquifers. The FGWA areas are illustrated in Figure 4.

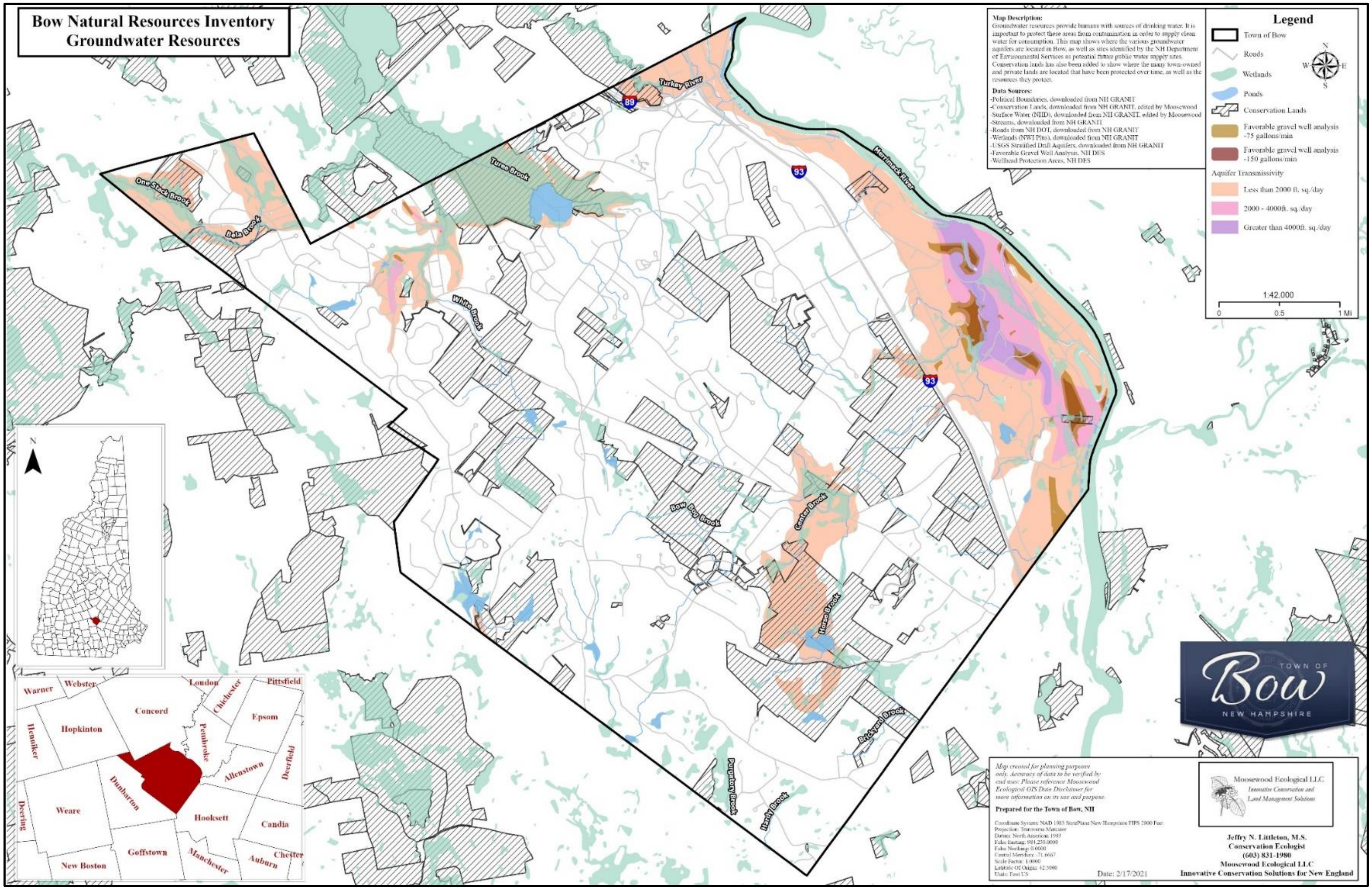
Table 5 Extent of Bow's stratified drift aquifers and favorable gravel well analysis.

Groundwater Attribute	Size (acres)
Stratified Drift Aquifer Transmissivity Rates	
<2,000 $feet^2$/day	3,163.0
2,000-4,000 $feet^2$/day	418.0
>4,000 $feet^2$/day	215.0
Favorable Gravel Well Analysis	
>75 Gallons/Minute	120.0
>150 Gallons/Minute	61.0

Source: USGS stratified drift aquifers (2000) and NH DES favorable gravel well analysis (2010).

The FGWA created buffers to avoid all known and potential contamination sources and examined potential well yield to identify the most suitable areas for potential community wells. In effect, this effort is encouraging communities to take proactive measures at protecting their most significant groundwater resources. As such, the higher yielding aquifers associated with the Merrimack River have been identified by the FGWA. It was estimated that some of these areas could produce more than 150 gallons per minute. However, the Municipal well permit for Bow provided for 700 gallons per minute.

FIGURE 4


Bow Natural Resources Inventory
Groundwater Resources
Map Description:
Groundwater resources provide humans with sources of drinking water. It is important to protect these areas from contamination in order to supply clean water for consumption. This map shows where the various groundwater aquifers are located in Bow, as well as sites identified by the NH Department of Environmental Services as potential future public water supply sites. Conservation lands has also been added to show where the many town-owned and private lands are located that have been protected over time, as well as the resources they protect.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conservation Lands, downloaded from NH GRANIT, edited by Moosewood
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
-Wetlands (NWI Plus), downloaded from NH GRANIT
-USGS Stratified Drift Aquifers, downloaded from NH GRANIT
-Favorable Gravel Well Analysis, NH DES
-Wellhead Protection Areas, NH DES
Legend
Town of Bow
Roads
Wetlands
Ponds
Conservation Lands
Favorable gravel well analysis -75 gallons/min
Favorable gravel well analysis -150 gallons/min
Aquifer Transmissivity
Less than 2000 ft. sq./day
2000 - 4000ft. sq./day
Greater than 4000ft. sq./day
N
S
W
E
1:42,000
0
0.5
1 Mi
Turkey River
Merrimack River
Turee Brook
One Stack Brook
Bela Brook
White Brook
Bow Bog Brook
Center Brook
Horse Brook
Bricky Brook
Hardy Brook
89
93
Warner
Webster
Loudon
Pittsfield
Concord
Chichester
Epsom
Henniker
Hopkinton
Pembroke
Allenstown
Deerfield
Dunbarton
Deering
Weare
Hooksett
Candia
Goffstown
Manchester
Auburn
Chester
New Boston
TOWN OF
Bow
NEW HAMPSHIRE
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Projection: Transverse Mercator
False Northing: 0.0000
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US
Date: 2/17/2021
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England

ECOLOGICAL RESOURCES

Ecological resources are natural resources that provide certain necessary but overlooked system maintenance functions within ecosystems (Scott et al. 1998). Ecological resources in Bow include many features such as wildlife habitats, natural (plant) communities, and rare species. These natural resources encompass the realm of biodiversity, or the variety and variability of life, which supports healthy ecosystems for wildlife, plants, and humans.

This Natural Resources Inventory was enhanced by field surveys on select public and private properties to assess some of Bow's biodiversity on the ground. These surveys focused on assessing Bow's wildlife and plant diversity and habitats on 1) town-owned properties, 2) roadside surveys, and 3) assessments on private properties where landowners provided permission. These assessments, which are described below, provide a representative sample of Bow's landscape to support proactive land use planning, community education, and land stewardship. The following sections provide a glimpse into the range of diverse species and habitats present in Bow.

Field Surveys

Field surveys were conducted on several properties during summer and fall 2019 and winter and early spring 2020. Habitats with a high potential to harbor rare species and natural communities were identified using GIS mapping to guide field efforts. A subset of parcels identified for field surveys was chosen beginning with properties owned or protected by the Town or other conservation entities. A list identifying private lands as suitable for surveys was created, and this list formed the basis of a permissions-based outreach effort to individual landowners. Those who granted permission to conduct a survey were contacted in advance based on their preferences, and their properties were surveyed for a variety of ecological features. A total of nine town-owned properties and 14 private properties were visited in the field during the study, as well as observations from the roadsides. Highlights of the field work are included below in the wildlife habitat descriptions.

NH Wildlife Action Plan

Bow's landscape supports a variety of wildlife habitats and natural communities, including rivers, streams, ponds, wetlands, and floodplains interspersed with a variety of upland forests, rocky ridges, grasslands, and shrublands distributed throughout the town. This diverse landscape supports a high degree of biodiversity.

The NH Fish and Game Department, in cooperation with other agencies, organizations, and individuals, produced the NH Wildlife Action Plan (WAP) in 2005. The latest revision was produced in 2015 (NH Fish and Game 2015). Habitat data is revised every 5 years. As such, these data were last revised in 2020, as the NRI was concluding. The WAP was designed as a planning and educational tool for federal, state, and municipal governing bodies, conservation commissions, land trusts and other conservation organizations, natural resource professionals, and private landowners, as well as the general public, to promote the conservation and management of NH's biological diversity. The WAP provides a resource for developing informed land use decisions and land management planning. The intent was to ensure that an adequate representation of various wildlife habitats is maintained across New Hampshire's landscape, keeping common species common in New Hampshire and working to prevent the loss of our rare and endangered species.

The WAP project grouped habitats at three scales: broad-scale (matrix forests and sub-watershed groupings), patch-scale (priority habitats such as grasslands and peatlands), and site-scale (documented occurrences of rare and uncommon species and natural communities). Mapped data are available for viewing and use only at the broad- and patch-scale levels. Habitat mapping is intended to predict, not necessarily guarantee that the habitats shown are present. For this reason, field and remote sensing

verification is recommended by NH Fish and Game to increase the accuracy of the mapping at the parcel and municipal scale.

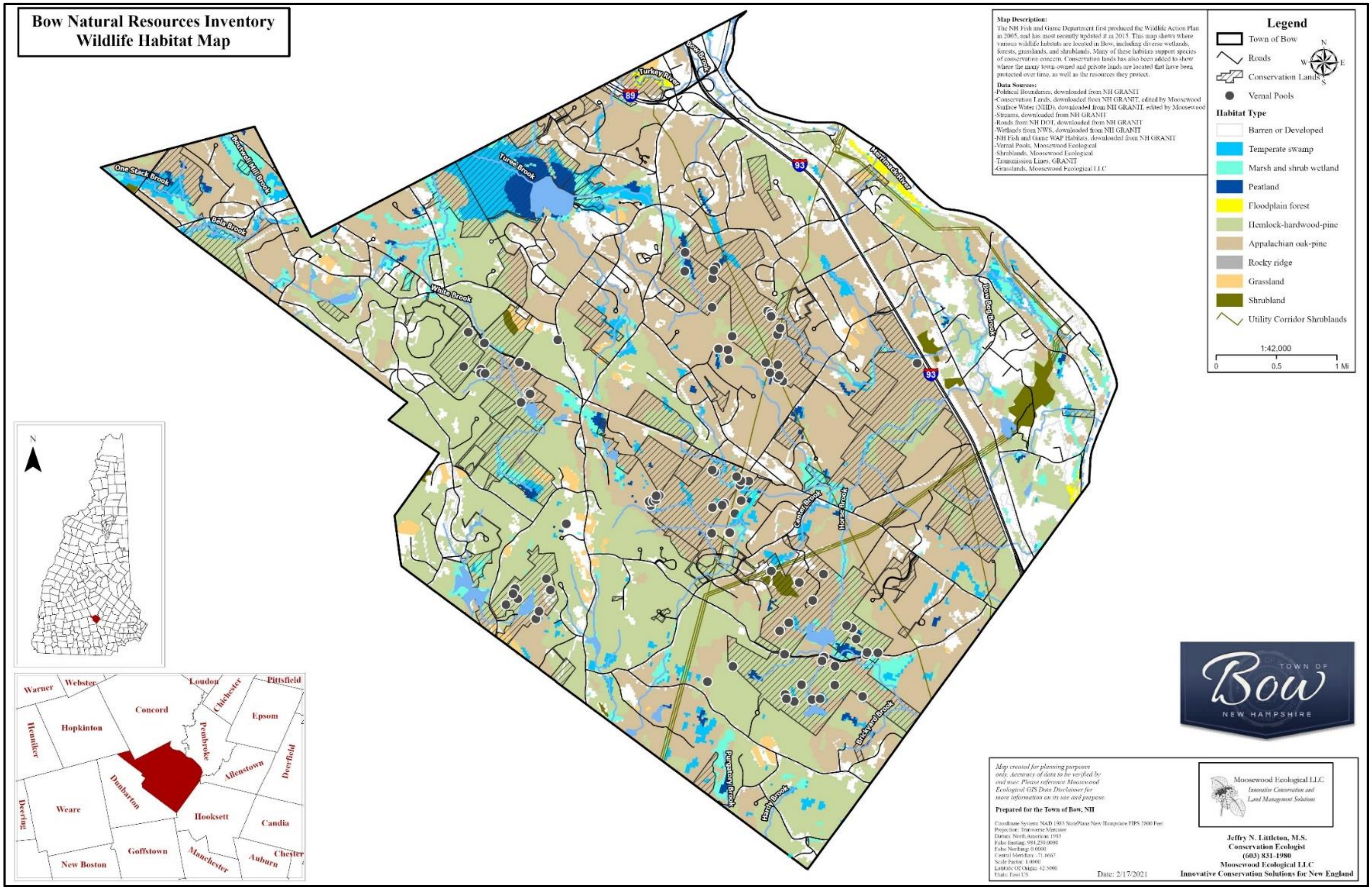
A total of 13 wildlife habitats described in the WAP were mapped for Bow (Table 6 and Figure 5). Potential and confirmed vernal pools were mapped using 2015 aerial photography interpretation, data provided by the Bow Conservation Commission, and data collected in the field by Moosewood Ecological LLC during the 2019 and 2020 field seasons (Littleton et al. 2019-2020). The WAP recognizes vernal pools as unique wetlands that provide critical breeding habitat for several amphibian species of greatest conservation need in New Hampshire; however, these isolated wetlands have not been mapped for New Hampshire. Vernal pool locations can be predicted through aerial photograph interpretation and LiDAR (Light Detection and Ranging) technology, providing the first step in identifying their potential distribution. However, pools are best mapped using on-site field assessments and verification of use by obligate species, those species that require vernal pools for part of their life cycles.

Table 6 Summary of habitats mapped by the Wildlife Action Plan in Bow.

Wildlife Habitat	Extent (Area or Miles)	Percent of Town
Appalachian oak-pine forest	7,347 acres	40.2%
Hemlock-hardwood-pine forest	5,521 acres	30.2%
Rocky ridge	2 acres	0.01%
Grassland	172 acres	4.8%
Shrublands	408 acres	2.2%
Floodplain forest	46 acres	0.3%
Marsh and shrub wetland	752 acres	4.1%
Peatland	268 acres	1.5%
Temperate forested swamp	671 acres	3.7%
Vernal Pools	93 pools	N/A
Open water/ponds	352 acres	1.9%
Streams	74 miles	N/A
Barren or Developed	2,554 acres	14.0%

SOURCE: Wildlife Action Plan (2015), NH Hydrography (2019), Vernal pools from Bow Conservation Commission (2019-2020) and Moosewood Ecological LLC (2019-2020), Shrublands from aerial photography interpretation by Moosewood Ecological LLC and Kane Conservation (2019).

FIGURE 5


Bow Natural Resources Inventory
Wildlife Habitat Map
Map Description:
The NH Fish and Game Department first produced the Wildlife Action Plan in 2005, and has most recently updated it in 2015. This map shows where various wildlife habitats are located in Bow, including diverse wetlands, forests, grasslands, and shrublands. Many of these habitats support species of conservation concern. Conservation lands has also been added to show where the many town-owned and private lands are located that have been protected over time, as well as the resources they protect.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conservation Lands, downloaded from NH GRANIT, edited by Moosewood
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
-Wetlands from NWS, downloaded from NH GRANIT
-NH Fish and Game WAP Habitats, downloaded from NH GRANIT
-Vernal Pools, Moosewood Ecological
-Shrublands, Moosewood Ecological
-Transmission Lines, GRANIT
-Grasslands, Moosewood Ecological LLC
Legend
Town of Bow
Roads
Conservation Lands
Vernal Pools
Habitat Type
Barren or Developed
Temperate swamp
Marsh and shrub wetland
Peatland
Floodplain forest
Hemlock-hardwood-pine
Appalachian oak-pine
Rocky ridge
Grassland
Shrubland
Utility Corridor Shrublands
1:42,000
0 0.5 1 Mi
Turkey River
Bow Brook
Merrimack River
One Stack Brook
Bela Brook
Turee Brook
White Brook
Bow Bog Brook
Cate Brook
Horse Brook
Bickford Brook
Purgatory Brook
Hardy Brook
89
93
Warner
Webster
Loudon
Chichester
Pittsfield
Concord
Epsom
Henniker
Hopkinton
Pembroke
Allenstown
Deerfield
Dunbarton
Weare
Hooksett
Candia
Deering
Goffstown
Manchester
Auburn
Chester
New Boston
TOWN OF
Bow
NEW HAMPSHIRE
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US
Date: 2/17/2021
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England

The following provides brief descriptions of the wildlife habitats observed on town-owned lands and private properties during the course of field work completed in summer and fall 2019, as well as winter and early spring 2020. These descriptions also include wildlife observations. However, this does not represent a comprehensive list of wildlife, and many other species are expected to be using these habitats at various points of the year.

Appalachian Oak-Pine Forests

The Appalachian oak-pine matrix forest ecosystem is widespread in southern New Hampshire, especially in the Merrimack River Valley making it the most abundant habitat available for a diverse suite of wildlife. These forests are limited in their distribution in New Hampshire and are typically found in lower elevations below 900 feet and are more widespread in southerly NH counties. They are associated with nutrient-poor, sandy soils or dry rocky ridges. In contrast, there are some rare forest communities within this ecosystem that occur in areas of nutrient-enriched soils. Fire is a common ecological process that helps to maintain many of the forest community types in this matrix forest complex. Plants found within this forest ecosystem are commonly found along the central and southern Appalachian Mountains, including white oak, black oak, scarlet oak, chestnut oak, pitch pine, and American chestnut, as well as mountain laurel and a variety of hickories.

According to the WAP, Appalachian oak-pine forests constitute the primary matrix forest community in Bow, and it is predicted to cover approximately 7,347 acres, or about 40.2% of the town. These predictions are based on habitat models that suggest these areas would most likely support this forest ecosystem, prehistorically and in the absence of human disturbance (i.e., timber harvesting). Examples of this matrix forest type can be found at Bow School Forest, Knox Town Forest, Bow Bog Brook – Robinson Forest, and Bow Town Forest – Turnpike Lots, Page Road Town Forest, Nottingcook Forest, and generally in the eastern parts of town.

Appalachian oak-pine forests support 104 vertebrate wildlife species, including 8 amphibians, 67 birds, 17 mammals, and 12 reptiles (NH Fish and Game 2015). In particular, wildlife observed in Appalachian oak-pine forests on town-owned lands and private properties included bobcat, coyote, red fox, fisher, raccoon, black bear, gray squirrel, chipmunk, wild turkey, pileated woodpecker, common raven, American crow, blue jay, black-capped chickadee, and white-breasted nuthatch.

One notable natural forest community included in this matrix forest complex was documented at the Londonderry Turnpike East lot. An exceptionally large and dense stand of mountain laurel occupies the areas along a slow stream drainage and associated dry uplands under various tree species including red oak, white pine, hemlock, and red maple. But the most unusual canopy tree present is a grove of sassafras, a classic southern of *Appalachian oak – mountain laurel forest* community.

Photograph 5 *Appalachian oak-pine forest* at Bow Town Forest – Turnpike Lots.

Photograph 6 Sassafras grove in *Appalachian oak – mountain laurel forest* community at Londonderry Turnpike East lot.

Hemlock-Hardwood-Pine Forests

This matrix forest is the second most widespread type in Bow, covering 5,521 acres, or 30.2% of the town. Most common in the western portion of Bow, hemlock- hardwood-pine forests can be observed at Nottingcook Forest, Hammond Nature Preserve, Walker Town Forest, and the Hallinan Easement. It supports 140 vertebrate wildlife species, including 15 amphibians, 13 reptiles, 73 birds, and 39 mammals (NH Fish and Game 2015). Our observations during field work roughly generated a similar suite of wildlife to that found in the Appalachian oak-pine forests, as these species are generalists and can be found in multiple forest types.

The hemlock-hardwood-pine forest ecosystem is a transitional forest type. It occurs at the overlap of the Appalachian oak-pine forest found at lower elevations and southward, and the northern hardwood-conifer forests found in higher elevations and farther north. Typically, this forest ecosystem is dominated by hemlock, beech, red oak, and white pine, with lower amounts of white ash, birches, maples, and occasionally hickories.

Rocky Ridges, Cliffs, and Talus Slopes

Rocky ridges are characterized by open bedrock and thin soils that support sparse vegetation. These areas are typically very dry, excessively well-drained, and acidic, supporting forest communities that are maintained by periodic fires due to exposure to lightning. Similarly, cliffs are relatively open with sparse vegetation. They are characterized as very steep rock faces over 10 feet tall. Talus slopes occur at the base of cliffs where boulders accumulate, forming crevices and caves that wildlife use to raise their young or hibernate during winter. These areas are uncommon and can contain rare natural communities. They may support rare wildlife species, such as timber rattlesnake (State-endangered species). Rocky outcrops and talus slopes that face south also provide wonderful sunning sites for bobcat in the winter months.

A very small area of this habitat type was mapped by the WAP in the Hammond Nature Preserve area. However, closer inspection of aerial photography and LiDAR (Light Detection and Ranging) technology data indicates that this area was incorrectly typed. However, talus slope and cliff habitat were field verified in 2019 in several locations on the steep upper slopes of Great Hill in Nottingcook Forest. The loose, excessively well-drained rocky slopes limit soil accumulation and productivity of the site, allowing only black birch and red oak to dominate, resulting in a sparse canopy with ferns and various other herbaceous species forming the understory. This uncommon community is classified as *Red oak – black birch wooded talus* (S3S4).

Photograph 7 *Red oak – black birch wooded talus* forest community on Great Hill, Nottingcook Forest.

Grasslands

Grasslands are non-forested areas maintained for a variety of uses, such as hay, pastures, and wildlife habitat. They are dominated by grasses and forbs (an herbaceous flowering plant that is not grass-like) with little to no presence of trees and shrubs. Grasslands were more abundant during the late 1700s through the 1800s before farms were abandoned and allowed to revert into forest. As such, there has been a steep decline in the diversity of wildlife associated with this habitat.

Locations of grasslands were revised from the WAP as part of this NRI. Grasslands were delineated and mapped using 2015 aerial photography, yielding a total of approximately 172 acres in Bow. Grasslands include active pastures, hayfields, and meadows. They support numerous species of greatest conservation need, and therefore, are some of Bow's most significant habitats for wildlife. In fact, they can support rare species such as meadowlark, grasshopper sparrow, vesper sparrow, horned lark, wood turtle, and northern leopard frog.

Shrublands

Shrublands contain thickets of young trees and shrubs mixed with occasional grasses and forbs. Shrubland habitat is declining in the state, and this decline has a profound effect on wildlife. Shrublands provide an important habitat for 139 species of reptiles, amphibians, mammals, and birds in New Hampshire (NH Fish and Game 2015). Several of these species have been identified as species of greatest conservation need. In fact, 22 of 28 species of shrubland birds are currently in decline.

Shrublands are difficult to quantify and map since they represent transitional habitat between forests and open areas, such as fields, sand and gravel pits, and developed sites. Most shrublands revert to forest if not maintained by natural disturbances (i.e., fire) or active management (i.e., mowing). For this reason, the authors created a new shrublands data layer for this project based on 2015 aerial photography interpretation. Some upland sites, such as utility corridors, may provide relatively consistent shrublands as they are maintained periodically to prevent trees from growing into the powerlines. Shrub swamps, shorelines, and other wetland sites also provide long-term shrub habitats where trees cannot grow due to flooding.

Floodplains

Floodplains are found along river valleys directly adjacent to rivers, streams, and larger wetland complexes, including the Merrimack River. They can vary in their species composition and overall structure from forests to open herbaceous floodplains with shrub swamps, oxbows, and vernal pools. They are strongly influenced by the size of the watershed and the gradient of the river. Historically, many of our floodplains were cleared for agricultural fields in the 1700s-1800s. Many have now been converted into residential, commercial, and industrial developments, while others remain as farmlands. As a result, floodplains are more limited due to these types of land conversion, as well as construction of dams that control water levels.

Floodplains and riparian forests play critical roles in helping to protect water quality by slowing floodwaters and supporting diverse plant communities. They also provide significant habitat for a wide variety of wildlife including several species of greatest conservation need, such as wood turtle, Blanding's turtle, spotted turtle, smooth green snake, northern leopard frog, Jefferson salamander, American woodcock, cerulean warbler, and veery.

It is estimated that Bow has a total of 46 acres of floodplain forests found in two locations along the Merrimack River – just downstream of Garvin's Falls, and on the Hooksett town line. The Garvin's Falls example was documented in the field. It contains a diverse array of habitats from typical floodplain forest of green ash and silver maple, to pure stands of shagbark hickory, to old field white pine stands and open grassy meadows. The most natural area supports a small example of the *Silver maple - false nettle - sensitive fern floodplain forest* (S2) natural community. Other areas have become infested with invasive plants including Asian bittersweet and glossy buckthorn – a condition common to floodplains which are also along such major bird migration corridors as major rivers.

Photograph 8 *Silver maple - false nettle - sensitive fern floodplain forest* on Town-owned lot on the Merrimack River.

Marsh and Shrub Wetlands

There are about 752 acres of marsh and shrub wetlands in Bow. They are widely dispersed throughout the town. The largest occurrences are Bow Bog, wetlands in and near Nottingcook Forest, wetlands near South Bow Dunbarton Road, and those associated with Turee Pond, Putney Meadow Pond, and the Arrowhead Drive wetlands. However, many smaller examples can be also found along streams, associated with beaver ponds, and small isolated pockets scattered throughout Bow in low-lying depressions or perched basins.

Marshes are often dominated by a combination of grasses, sedges, rushes, and to a lesser degree, forbs, and may contain areas of open water. Edges of beaver ponds tend to support marshes and abandoned beaver ponds usually revert to marsh habitat with less open water. Shrub swamps, in contrast, are dominated by wetland shrubs such as highbush blueberry, arrowwood, northern wild raisin, winterberry, and speckled alder. Marsh and shrub wetlands are distinctly different in their habitat structure and therefore, will support different wildlife communities. However, they are often found existing together, supporting relatively high biodiversity. Marsh and shrub wetlands support 18 wildlife species of greatest conservation need in New Hampshire, as well as rare plants and plant communities (NH Fish and Game 2015).

Photograph 9 Lewis Putney Pond and associated marsh wetland communities at Hallinan Easement.

Peatlands

Peatlands are open wetland habitats dominated by shrubs, sedges, and *Sphagnum* mosses. They are characterized by peat soil - organic soil of partially decomposed plants. Peatlands form in sites of limited or no surface water input and range from being highly acidic and poor nutrient levels to moderately nutrient-enriched. “Quaking” bogs are one uncommon type of peatland. Peatlands are often isolated in basin settings, or occupy the shallow end of larger wetlands or shallow ponds. The low pH (indicator of acidic conditions) is a strong factor influencing the composition of plant species.

Typical plants associated with poor to medium nutrient peatlands include insectivorous pitcher plants and sundews, diverse sedge communities, mosses, highbush blueberry, mountain holly, speckled alder,

sheep laurel, bog rosemary, and forbs such as bog aster and bog goldenrod. Fifty-four rare plants are supported by peatlands state-wide, including dwarf huckleberry, several rare sedges, and rare orchids. Associated uncommon wildlife species of note include ringed boghaunter dragonfly, palm warbler, mink frog, and ribbon snake.

It is estimated that there are about 268 acres of peatlands distributed across Bow's landscape. Most are small, isolated wetland habitats at the beginning of small headwater streams and other areas of slow, sluggish waters. Peatlands are present within several wetlands in Bow. The most significant example is at Turee Pond, which is documented as part of an exemplary *Poor level fen/bog system*. Examples of previously undocumented *Black gum – red maple basin swamp* (S3) natural communities were documented near Nottingcook Forest and on the Hallinan Easement during this study.

Photograph 10 Huge black gum tree in *Black gum – red maple basin Swamp* near Nottingcook Forest.

Temperate Forested Swamps

There are about 671 acres of forested swamps in Bow. Forested swamps are typically isolated wetlands found in low-lying basins. However, they can also be part of larger wetland complexes such as those associated with Bow Bog Brook, Horse Brook, and numerous other streams. Similar to marsh and shrub

wetlands, forested swamps help maintain water quality, store floodwaters, recharge groundwater supplies, and may support vernal pools as well. The most common examples include *Red maple – Sphagnum basin swamps, Seasonally flooded red maple swamp,* and *Hemlock - cinnamon fern forest*. Several small occurrences of the *Black gum - red maple basin swamp* were documented in the field in Bow in 2019, at the Hallinan Easement and along a trail to Nottingcook Forest. While not rare, it is uncommon and regionally significant.

Vernal Pools

Vernal pools provide unique and critical habitats for a variety of species. These pools typically fill during the spring, dry out completely or partially later in the summer, and contain no viable fish populations. These attributes are critical for the long-term survival of vernal pool obligate organisms. They also have no permanent inlet or outlet streams. For vernal pools to continue to function as critical wildlife habitats, they require a forested canopy around the vernal pool and significant intact, natural forest surrounding them, as many obligate species spend most of their life cycles up to 1,000 feet from the vernal pool in these forested uplands. It is for this reason that larger forested buffers surrounding vernal pools are encouraged.

Amphibians such as wood frog, spotted salamander, and Jefferson's salamander (a species of greatest conservation need) use vernal pools. Vernal pools are also significant for other species of greatest conservation need, including Blanding's turtle, spotted turtle, and ribbon snake. Many aquatic macroinvertebrates such as fairy shrimp and fingernail clam depend upon this habitat. Documented local examples are present on conservation lands at Nottingcook Forest, Knox Forest, Londonderry Branch Turnpike E. Lot, Hallinan Easement, Bow School Forest, Walker Town Forest and on the NRCS Wetlands Reserve Program easement.

Ninety-three confirmed or potential vernal pools have been identified thus far throughout Bow. These can be found in many settings in the landscape, such as at the beginning of headwater streams on hilltops and ridges, along benches on side slopes of hills and peaks, riparian forests, floodplain forests, and level areas between hilltops, as well as where the topography forms small depressions in flat areas.

Photograph 11 Spotted salamander egg masses in a vernal pool at the Londonderry Branch Turnpike E Lot.

Ponds/Open Water

There are approximately 352 acres of ponds in Bow. The largest ones are Turee Pond, Putney Meadow Pond, Lewis Putney Pond and Greylore Pond. They can provide significant recreational resources, as well as wildlife habitat not available elsewhere. Ponds are an important habitat for many species of reptiles and amphibians such as snapping turtles, painted turtles, red-spotted newts, green frogs, bullfrogs, and pickerel frogs. Many species of waterfowl use these habitats for resting during migration, as well as for feeding and breeding, including great blue herons, mallards, and geese. They even provide a food source for bald eagles and osprey. Otters are often observed along with racoons hunting for fish and crayfish. In addition, there are numerous aquatic macroinvertebrates in ponds and lakes, providing a rich source of food for other wildlife species.

Photograph 12 Turee Pond and its surrounding wetland complex provides excellent habitat for a diverse suite of plants and wildlife. This area supports two exemplary wetland ecosystems and is designated as a prime wetland. The NH Fish and Game reports at least seven different species of fish, some of which were introduced such as the largemouth bass and black crappie.

Rivers and Streams

There are approximately 74 miles of rivers and streams in Bow. They are quite diverse as they provide important resources for a variety of species that thrive in both cold water and warm water habitats. Most of Bow's cold-water streams can be found cascading down its hills and ridgelines where they provide cold, clear, highly oxygenated waters. These streams are important for brook trout and stream salamanders such as the spring salamander, as well as many aquatic macroinvertebrates that are a source of food.

The dominant flowing water in the region, the Merrimack River, forms the eastern border of Bow, and is the most significant water resource in the Town. Starting in the industrial age and into the 1960's, the river was impacted by sewage, industrial wastes, and soil runoff that degraded the water quality to where it was unsafe to swim. With the passage and subsequent implementation of the federal Clean Water Act in 1972, these trends started to reverse, and the river started to be appreciated again for its scenic and ecological values, as well as for recreation. Today, the river is safe for swimming and supplies drinking water to the City of Nashua and surrounding towns and communities to the south in Massachusetts.

The Merrimack River and its tributaries provide habitat for a diverse wildlife community of aquatic and terrestrial mammals, fish, birds, reptiles, amphibians, and insects. Rivers and streams are threatened by climate change due to increasing water temperatures and erosion from more frequent and intense rainstorms. In addition, development adjacent to rivers and streams can degrade wildlife habitats by increasing the level of invasive plants, reducing water quality, and fragmenting landscapes.

Photograph 13 Stream near Hammond Nature Preserve.

Photograph 14 Shoreline of Merrimack River at a town-owned parcel.

Wildlife Action Plan Highest Ranked Habitat by Ecological Condition

The Wildlife Action Plan Highest Ranked Habitats map (Figure 6) shows where habitats in the best ecological condition in the state are located; this was based on biodiversity, arrangement of habitat types on the landscape, and lack of human impacts.

With the goal of setting priorities for conservation of important wildlife habitat in New Hampshire, the WAP also identified areas of the state with unusually pristine, influential, diverse, or extensive examples of "exemplary" habitat. These areas were, in turn, ranked by condition on both sub-state regional and statewide levels, resulting in a tiered ranking of priority areas for conservation. Figure 6 illustrates the highest ranked habitat for conservation in the town of Bow.

Color-coded areas shown in Figure 6 indicate highest ranked habitats by condition, both within New Hampshire (hot pink) and within an ecoregion (green), and include several areas along the Merrimack River, at Turee Pond, and in four large patches in the center of the town. The extensive matrix of highest-ranked habitats is surrounded by large areas of "Supporting Landscape," indicating that Bow has substantial highest-ranked WAP wildlife habitats. Supporting Landscapes (in orange) provide important habitat of local significance. All three categories are considered unusually significant for wildlife, and especially important areas for land conservation.

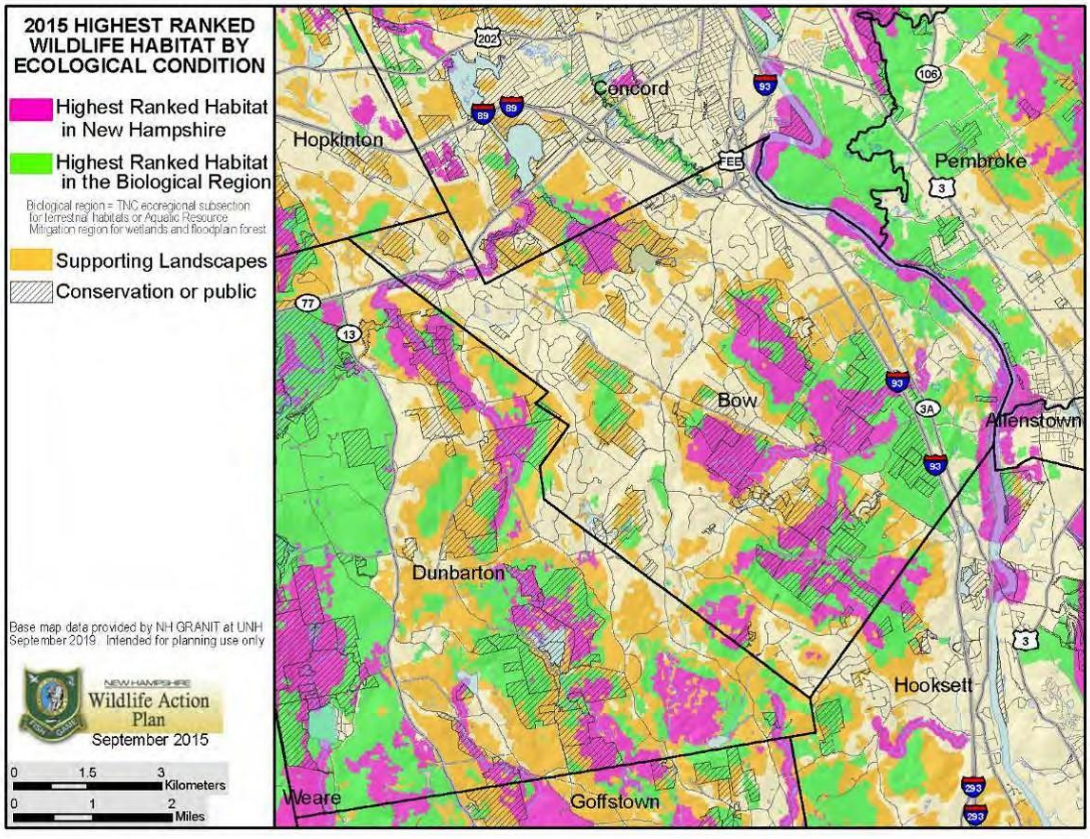


Figure 6 NH Wildlife Action Plan - Highest Ranked Habitat Map.

Documented Rare Species and Natural Community Systems in Bow

Numerous rare and uncommon plant and animal species have been documented in the town of Bow, and these data are maintained by the New Hampshire Natural Heritage Bureau of the NH Division of Forests and Lands, in cooperation with the New Hampshire Fish and Game Department's Nongame and Endangered Wildlife Program. Generalized information on the presence of these species and communities is available from the Natural Heritage Bureau by municipality. According to the Bureau's *Rare Plants, Rare Animals, and Exemplary Natural Communities in New Hampshire Towns*, the species and exemplary natural communities/systems listed in Table 7 have been documented in the town of Bow in the last 20 years (NH Natural Heritage Bureau 2020). Supplemental data was provided by the Bow Conservation Commission (2019-2020) and Martin (2021). All natural communities and systems follow the classification system developed by the New Hampshire Natural Heritage Bureau (Sperduto 2011, Sperduto and Nichols 2011).

Table 7 Rare species and natural community systems documented in Bow.

Taxonomic Group	Species or System Name	Common Name	Rarity Rank	Last Observed
Ecological System - wetland	Sand plain basin marsh system		S2	1993
Ecological System - wetland	Poor level fen/bog system		S3	2006
Bird	*Falco peregrinus anatum*	Peregrine Falcon	S2	2018
Bird	*Haliaeetus leucocephalus*	Bald Eagle	S3	2021
Fish	*Anguilla rostrata*	American Eel	S3	2000
Insect	*Gomphus quadricolor*	Rapids Clubtail	S3	2007
Mammal	*Sylvilagus transitionalis*	New England Cottontail	S1	2002
Plant	*Isotria medeoloides*	Small Whorled Pogonia	S2	2020
Reptile	*Emydoidea blandingii*	Blanding's Turtle	S1	2020
	Heterodon platirhinos	Eastern Hognose Snake	S1	2009
	Coluber constrictor constrictor	Northern Black Racer	S2	2005
	Glyptemys insculpta	Wood Turtle	S3	2010

SOURCE: NH Natural Heritage Bureau (2020); Bow Conservation Commission (2019-2020); Martin, C. (2021).
S1: State Endangered. S2: State Threatened. S3: Watch List / Species of Special Concern

The specific location and extent of these rare species and communities have not typically been available for this type of study due to data release policies of the NH Division of Forests and Lands, which houses the NH Natural Heritage Bureau. However, a recent data sharing release policy has allowed for site-specific Natural Heritage data to be accessed for use in identifying open space priority areas, limited to the current study. The agreement does not allow for graphic display of, or references to, specific locations, but these data have been incorporated into the conservation priorities analysis as an importance factor in determining open space priority areas.

The geological, glacial, and fluvial history of the Merrimack River has resulted in the formation and development of a diverse suite of natural habitats and communities. The artifacts of ancient glacial lakes Hooksett and Merrimack, including large deposits of sand and gravel near the river, have been reworked by the river and various tributary streams to create steep bluffs and ravines, as well as floodplain terraces. These landforms provide conditions unlike those elsewhere in the town, which is otherwise characterized by rolling hills blanketed by glacial tills, with some small areas of outwash sediments.

Two exemplary wetland community systems have been documented in Bow: *Sand plain basin marsh system* near the Hooksett town line, and *Poor level fen/bog system* at Turee Pond. Each mapped record of a species or community is based on actual observation points, degree of confidence regarding actual location and extent, knowledge of the biology or ecology of a particular species or natural community, and the extent of suitable habitat. The location and extent of these elements are one basis for the delineation of conservation focus areas.

The town is especially rich in records of reptiles. The rare wood turtle and Blanding's turtle, as well as the rare black racer and eastern hognose snake have been documented in multiple locations. Bow is an especially important location for Blanding's turtle, which has been documented at 10 wetland locations across the town.

The Federally-threatened orchid species, the small whorled pogonia, has been documented at one location in Bow. A GIS species distribution model developed by NatureServe was referenced during the field surveys in hopes of targeting additional populations.

Wildlife of Bow

Bow's wetland and upland habitats support an incredible diversity of wildlife. From 2000 to 2019, a total of 116 species were observed in Bow during four separate field surveys (Littleton et al. 2019-2020, Carpenter 2000, Hunt 2002, and Carpenter 2017). These included 72 birds, 16 mammals, 11 amphibians, 8 reptiles, 8 fish, and 1 dragonfly (Appendix B). Of these, there are 17 *species of greatest conservation need* as noted by the NH Wildlife Action Plan (NH Fish and Game 2015), including three NH Endangered species and three NH Threatened species. The list in Appendix B includes rare wildlife previously documented by the NH Natural Heritage Bureau (NH Natural Heritage Bureau 2020; Table 7). This list of wildlife is not a comprehensive list of all the wildlife known in Bow, but it does provide a source to build upon. Appendix C provides residents with contact information for reporting wildlife in New Hampshire, as well as suspected rare plants.

Unfragmented Lands and Habitat Connectivity

Unfragmented lands are relatively large blocks of contiguous habitat that include a mix of forests, wetlands, riparian areas, or other habitat and thus support wide-ranging mammals and forest interior birds. Unfragmented lands are defined by the lack of human infrastructure, such as roads and developed areas. Fragmentation of landscapes can negatively affect wildlife populations in various ways, from reducing habitat quality and availability to causing direct mortality for wildlife migration across roads. Increased predation and nest parasitism occurs along edges of smaller blocks of habitat resulting in diminished breeding success, and may lead to species loss altogether. The degree of severity of fragmentation can be affected by the size and shape of unfragmented blocks, the species or natural community in question, the extent of loss of natural habitats, intensity of human use, and colonization by invasive species.

The NH Wildlife Action Plan developed an unfragmented lands analysis. However, this data layer has inherent errors due to incorrect classification of Class VI roads as being a fragmenting feature. As such, the unfragmented lands were refined to more accurately reflect Bow's landscape (Figure 7). Fragmenting features were defined as 500 feet from existing roadways, including all state and town

roads, but excluding Class VI roads and trails, as well as private driveways. This analysis assumes that most development occurs within 500 feet of roadways.

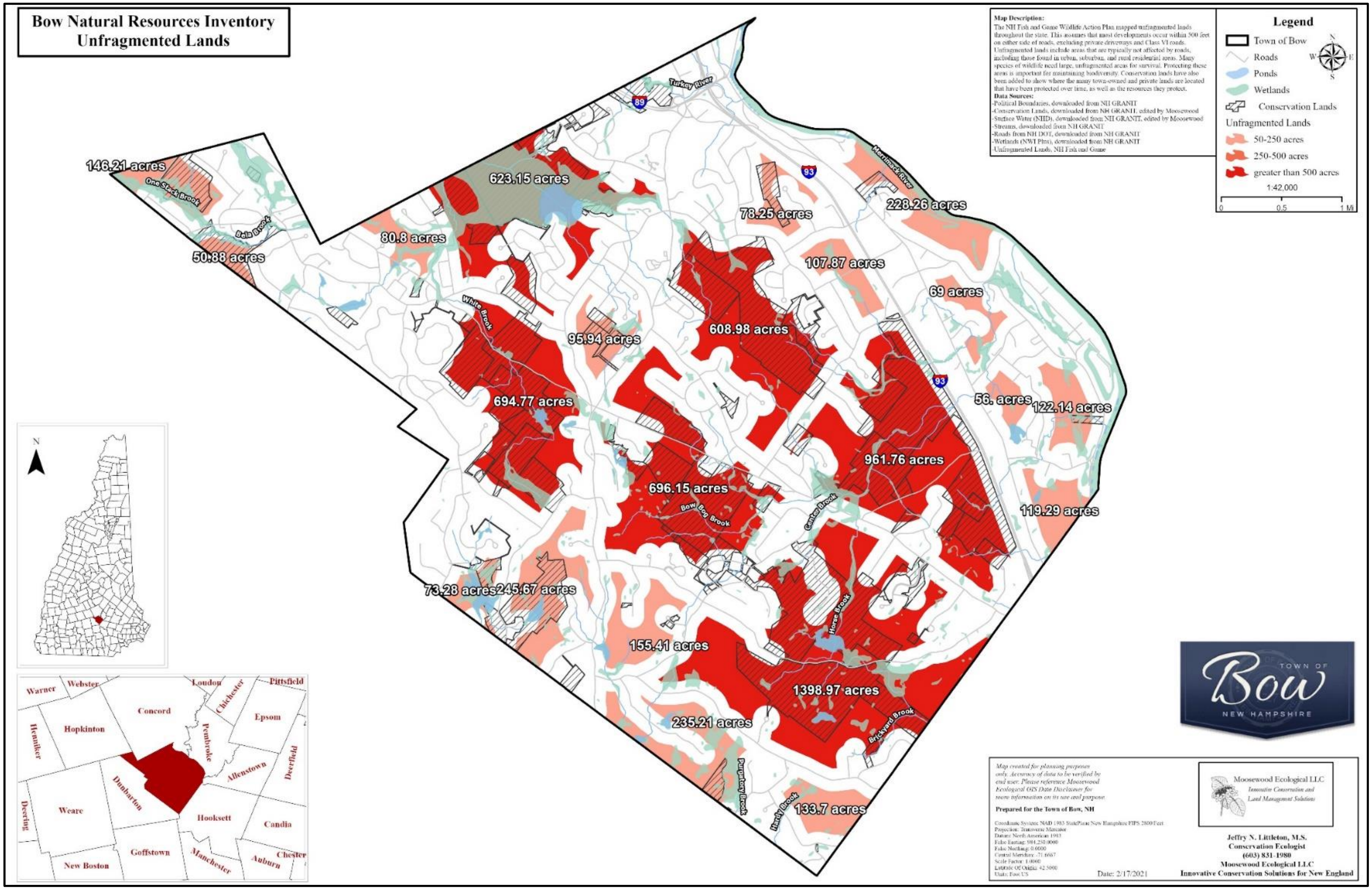
Larger blocks of unfragmented areas support greater biodiversity than smaller blocks. They include a variety of natural habitats such as forests, wetlands, streams, and ponds but also can include human-modified areas such as agricultural lands and shrublands. As unfragmented areas become fragmented due to the construction of roadways and development, their biodiversity generally decreases. This fragmentation effect has less immediate impact on generalist species or those with small home ranges (such as gray squirrel, raccoon, many amphibians, and small rodents) while affecting and potentially eliminating area-sensitive specialists that need large forested blocks in order to maintain their home ranges and for long-term survival (such as bear, bobcat, moose, wood thrush, goshawk, and various reptiles such as Blanding's turtles). Appendix D provides a general list of habitat block size requirements for wildlife to help illustrate this point. Species noted in bold type were observed in Bow during this project.

Large unfragmented landscapes allow wildlife to move among critical feeding, breeding, nesting, and overwintering habitats, and to migrate to new territories. Maintaining connectivity between critical habitats can provide permanent wildlife corridors within the built environment, enabling wildlife populations to survive.

Wildlife must be able to travel safely throughout the landscape to meet their biological needs. Many depend upon a variety of habitats for their survival and may utilize many natural features for travel. These include features such as riparian zones of wetlands, ponds and streams, ridgelines, utility rights-of-way, and forest patches acting as a safe route between two or more habitats. A variety of wildlife can be associated with these corridors, including otter, muskrat, fox, coyote, bobcat, deer, moose, fisher, mink, and bear.

Wildlife corridors are not only significant for mammals but equally important for amphibians, reptiles, and migratory birds. Amphibians and reptiles begin to move from their wintering habitats to their respective breeding and nesting grounds in the spring. This is the time of year that most mortality can be noticed as these species travel across roadways in search of suitable habitats. This negative effect is repeated when the same individuals return to their wintering habitats. Thus, there is a great significance in maintaining habitat connectivity, as well as understanding where these patterns of movement are taking place. This latter point can be an especially important focus for community education and awareness about wildlife corridors that cross roadways. It can provide a means to adjust transportation patterns to help eliminate potential road mortality or identify sites for road modifications, including bridges and culverts designed to allow wildlife to safely cross within them.

FIGURE 7


Bow Natural Resources Inventory
Unfragmented Lands
Legend
Town of Bow
Roads
Ponds
Wetlands
Conservation Lands
Unfragmented Lands
50-250 acres
250-500 acres
greater than 500 acres
1:42,000
146.21 acres
623.15 acres
78.25 acres
228.26 acres
80.8 acres
50.88 acres
107.87 acres
69 acres
95.94 acres
608.98 acres
694.77 acres
56. acres
122.14 acres
961.76 acres
696.15 acres
119.29 acres
73.28 acres
245.67 acres
155.41 acres
1398.97 acres
235.21 acres
133.7 acres
Turkey River
Merrimack River
White Brook
Bow Bog Brook
Horse Brook
Brickyard Brook
Hardy Brook
Bela Brook
Prospect Brook
Bow
NEW HAMPSHIRE
Warner
Webster
Loudon
Chichester
Pittsfield
Concord
Epsom
Henniker
Hopkinton
Pembroke
Allenstown
Deerfield
Dunbarton
Deering
Weare
Hooksett
Candia
Goffstown
Manchester
Auburn
Chester
New Boston
Prepared for the Town of Bow, NH
Date: 2/17/2021
Moosewood Ecological LLC
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England

Invasive Species

Invasive species are defined as any species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. These invasive species aggressively compete with and displace the associated flora and fauna communities (Mehrhoff et al. 2003). In other words, they possess many traits that provide them with a competitive edge, including the production of numerous offspring, adaptation to a variety of site and soil conditions, thrive in areas of disturbance, and early, rapid development in the spring.

Many of our invasive plants were brought here for many uses such as ornamental components of landscaping, erosion control, and food for native wildlife. Several other invasive species, including plants, macroinvertebrates, and fungi, were brought to North America inadvertently through shipments of various products from other continents. Historically, these invasive organisms have caused the demise of American chestnuts and elms. Currently, we are faced with many other pathogens that are affecting our forests, including emerald ash borer, beech bark scale disease, hemlock wooly adelgid, Asian long-horned beetle, and red pine scale.

As with most communities in New Hampshire, Bow has some areas that have a strong presence of invasive plants while other areas may have relatively low to no presence. Edges of natural habitat including shorelines and road frontage, powerlines, recently logged areas, old farm fields, and abandoned buildings and properties are especially likely to have invasive plant species, as we found in Bow. Invasive plants were also observed at several properties in Bow, including Turnpike Road, the Town parcels near the Merrimack River, and Hammond Nature Preserve. Species observed include Japanese knotweed, Asian bittersweet, glossy and common buckthorn, Japanese barberry, multi-flora rose, burning bush, and bush honeysuckles. Variable milfoil is also known to be present in Turee Pond where a long-term management plan has been prepared to help control this aquatic invasive species (NH Dept. of Environmental Services 2016).

Cultural Features

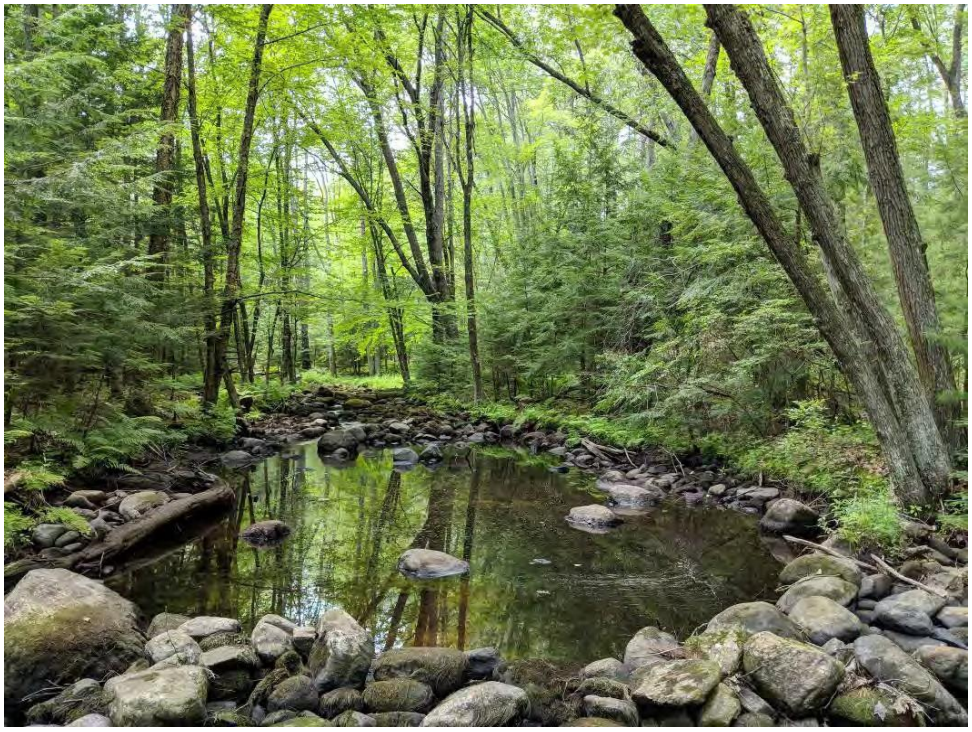
Several cultural features were observed during field surveys. In the Londonderry Branch Turnpike East Lot, a stone and earthen dam, probably built in the 1800's was observed. It apparently was built to provide water power to a sluiceway along a stream course. On the same property an isolated granite boulder was observed with chisel and wedge marks, indicating that it had been used as a "boulder quarry" to produce granite slabs.

On lower Bow Bog Brook in Robinson Road Forest, rows of placed stones cross the brook on each of its branches, creating pools in the brook. These are potentially the remains of very old fish weirs, used to trap fish migrating to and from the nearby Merrimack River. Other such examples have been verified elsewhere in southern New Hampshire.

Photograph 15 Stone and earthen dam on Londonderry Branch Turnpike E Lot.

Photograph 16 Remains of stone-lined sluiceway along stream draining dam.

Photograph 17 Granite "boulder quarry" with chisel/wedge marks from granite slab removal, on Londonderry Branch Turnpike E Lot.



Photograph 18 Possible fish weir on lower Bow Bog Brook in Robinson Road Forest.

Photograph 19 Second possible stone fish weir on lower Bow Bog Brook in Robinson Road Forest.

AGRICULTURAL AND FOREST RESOURCES

Bow has a variety of soils that have supported forestry and agriculture over the years. These areas represent some of the best soils for the production of forest products and food, feed, and fiber from farming. These natural resources can help provide us with insight into the potential production within the working landscape.

Important Agricultural Soils

In response to the Farmland Protection Policy Act of 1981[2], agricultural soils were mapped by the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Based on a variety of physical and chemical properties (i.e., drainage, texture, hydric regime, pH, erodibility factor), soils considered "Important Agricultural Soils" are among the most productive lands for many types of farming practices. Important Agricultural Soils that are mapped consist of prime farmland, and farmland of statewide or local importance

Important agricultural soils cover approximately 10,937 acres, or roughly 60% of Bow (Table 8 and Figure 8). These soils are widely distributed throughout the town with notable assemblages in the vicinity of the Merrimack River and near the Dunbarton town line. Prime farmland soils make up about 2% of the total acreage of Bow's agricultural soils, while farmland soils of local and statewide significance represent roughly 58% of these soils. Other important agricultural resources include active farmlands. These total about 173 acres in Bow.

[2] As defined by the USDA NRCS: "The Farmland Protection Policy Act of 1981 was established to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses.

Table 8 Summary of important soils for farm production in Bow.

Important Soil Type	Size (acres)	% of Town
Prime Farmland Soils	358	2.0%
Farmland Soils of Statewide Significance	336	1.8%
Farmland Soils of Local Significance	10,243	56.1%

SOURCE: USDA Natural Resources Conservation Service soils (2009).

Prime Farmland

Prime Farmland Soils are those soils best suited to food, feed, forage, fiber, and oilseed crops. The soils are of the highest quality and can economically produce sustained high yields of crops when treated and managed according to acceptable farming methods (UNH Cooperative Extension 2021). The specific criteria for prime farmland soils are:

- Soils that have an aquic or udic moisture regime and sufficient available water capacity within a depth of 40 inches to produce the commonly grown cultivated crops adapted to New Hampshire in 7 or more years out of 10.
- Soils that are in the frigid or mesic temperature regime.
- Soils that have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches.
- Soils that have either no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to New Hampshire to be grown.
- Soils that have a saturation extract less than 4 mmhoc/cm and the exchangeable sodium percentage is less than 15 in all horizons within a depth of 40 inches.
- Soils that are not frequently flooded during the growing season (less than a 50% chance in any year or the soil floods less than 50 years out of 100).
- The product of the erodibility factor times the percent slope is less than 2.0 and the product of soil erodibility and the climate factor does not exceed 60.
- Soils that have a permeability rate of at least 0.06 inch per hour in the upper 20 inches.
- Soils that have less than 10 percent of the upper 6 inches consisting of rock fragments larger than 3 inches in diameter.

Farmland of Statewide Importance

These soils refer to land that is not prime or unique but is considered farmland of statewide importance for the production of food, feed, fiber, forage and oilseed crops. Soils of statewide importance are soils that are not prime or unique and:

- Have slopes of less than 15 percent
- Are not stony, very stony or boulder
- Are not somewhat poorly, poorly or very poorly drained
- Includes soil complexes comprised of less than 30 percent shallow soils and rock outcrop and slopes do not exceed 8 percent.
- Are not excessively drained soils developed in stratified glacial drift, generally having low available water holding capacity.

Farmland of Local Importance
Farmland of local importance is farmland that is not prime, unique or of statewide importance, but has local significance for the production of food, feed, fiber and forage. The criteria for soils of local importance in Bow and Merrimack County are as follows:

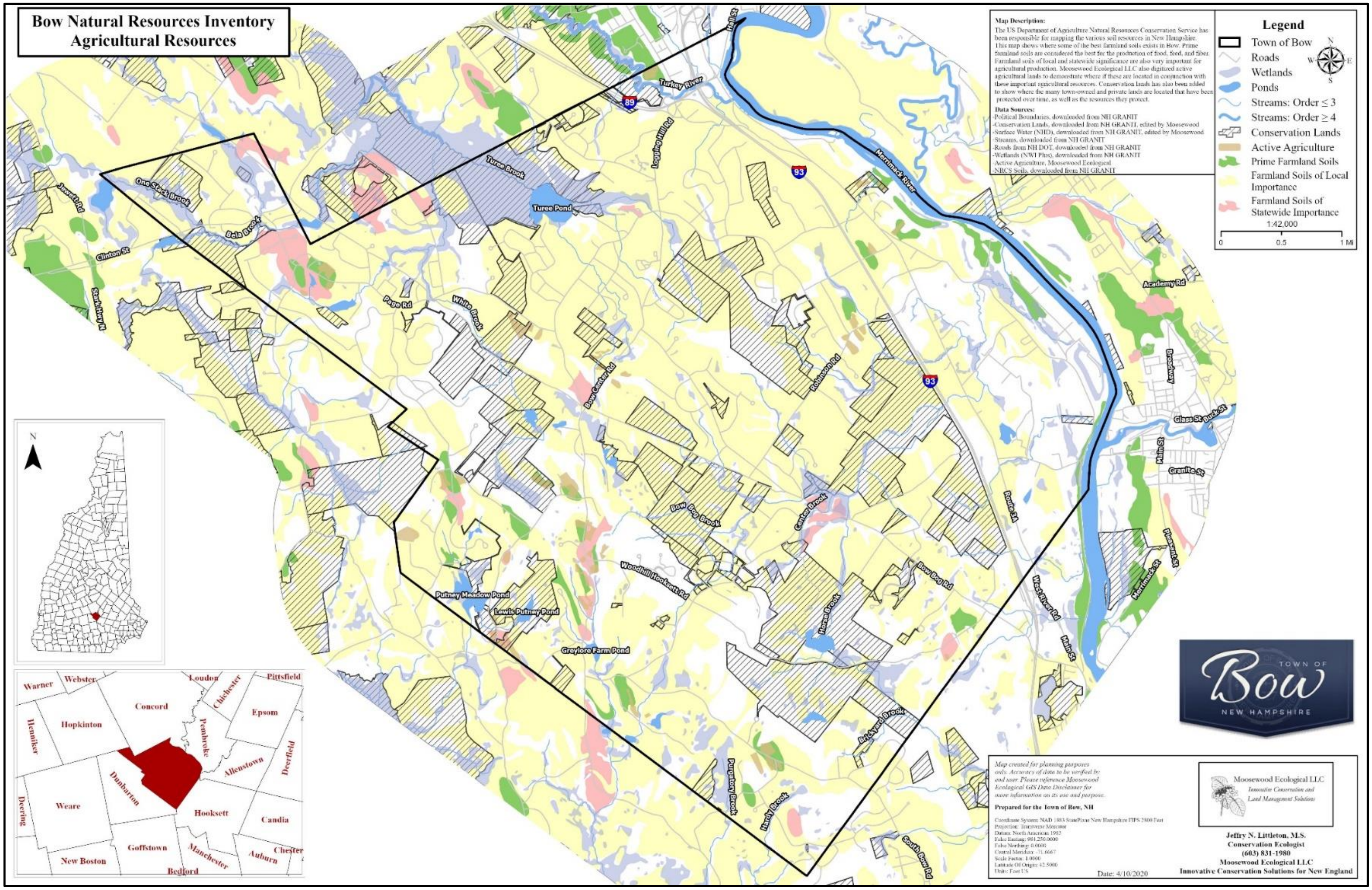
Soils that are not prime or unique farmland or soils of statewide importance and meet the following criteria:

- Have slopes less than 25%
- Are not extremely stony or bouldery
- Are not poorly or very poorly drained
- Complexes consisting of less than 40 percent shallow soils and rock outcrop and slopes do not exceed 25 percent.
- Maybe excessively drained soils developed in stratified glacial drift.

Aerial photography interpretation revealed 56 areas as active agriculture in Bow, totaling approximately 173 acres. Land use included one cropland, two nurseries (a horticultural nursery and a Christmas tree farm), three pastures, and 50 hayfields. These sites should be field checked for accuracy and to add other active farmlands.

Photograph 20 Hayfields serve as Bow's major land cover for agriculture. This one sits atop the hill at the Hammond Nature Preserve.

FIGURE 8


Bow Natural Resources Inventory
Agricultural Resources
Map Description:
The US Department of Agriculture Natural Resources Conservation Service has been responsible for mapping the various soil resources in New Hampshire. This map shows where some of the best farmland soils exists in Bow. Prime farmland soils are considered the best for the production of food, feed, and fiber. Farmland soils of local and statewide significance are also very important for agricultural production. Moosewood Ecological LLC also digitized active agricultural lands to demonstrate where if these are located in conjunction with these important agricultural resources. Conservation lands has also been added to show where the many town-owned and private lands are located that have been protected over time, as well as the resources they protect.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conservation Lands, downloaded from NH GRANIT, edited by Moosewood
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
-Wetlands (NWI Plus), downloaded from NH GRANIT
-Active Agriculture, Moosewood Ecological
-NRCS Soils, downloaded from NH GRANIT
Legend
Town of Bow
Roads
Wetlands
Ponds
Streams: Order ≤ 3
Streams: Order ≥ 4
Conservation Lands
Active Agriculture
Prime Farmland Soils
Farmland Soils of Local Importance
Farmland Soils of Statewide Importance
1:42,000
0
0.5
1 Mi
Hall St
Turkey River
Logging Hill Rd
Turee Brook
Turee Pond
One Stack Brook
Bela Brook
Clinton St
Page Rd
White Brook
Bow Center Rd
Robinson Rd
Merrimack River
Academy Rd
Broadway
Glass St
Buck St
Main St
Granite St
Bow Bog Brook
Carter Brook
Route 3A
Bow Bog Rd
Woodhill Hooksett Rd
Putney Meadow Pond
Lewis Putney Pond
Greylore Farm Pond
Horse Brook
White Rock Hill Rd
Brickyard Brook
Merrimack St
Pleasant St
Hardy Brook
Purgatory Brook
South Bow Rd
89
93
TOWN OF
Bow
NEW HAMPSHIRE
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US
Date: 4/10/2020
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England
Warner
Webster
Loudon
Pittsfield
Concord
Chichester
Epsom
Henniker
Hopkinton
Pembroke
Allenstown
Deerfield
Dunbarton
Weare
Hooksett
Candia
Deering
Goffstown
Manchester
Auburn
Chester
New Boston
Bedford

Important Forest Soils

Forest resources within New Hampshire are significant for many reasons. Forests provide sources of employment, many forest products, promote local economies, recreation and tourism, provide clean air, mitigate the effects of climate change, and provide substantial habitats for wildlife and plants, as well as diverse ecological functions (such as nutrient cycling, carbon sequestration, and water quality maintenance through sediment trapping). For these reasons, it is important to maintain large tracts of forests and to better understand where important and undeveloped forest soils exist in Bow.

New Hampshire soils are complex and highly variable due primarily to their glacial origins. The Natural Resource Conservation Service (NRCS) soil mapping recognizes and inventories these complex patterns and organized them into a useful and understandable planning tool, Important Forest Soil Groups. These groupings allow managers to evaluate the relative productivity of soils and to better understand patterns of plant succession and how soil and site interactions influence management decisions. All soils have been grouped into one of six categories.

The NRCS has mapped the distribution of important forest soils and has classified them according to their capacity to grow trees. These soils signify areas as providing the most productive lands for timber production. The NRCS has identified three soil groups within this category and has described each as follows:

Forest Soil Class IA

This group consists of the deeper, loamy textured, moderately well, and well-drained soils. Generally, these soils are more fertile and have the most favorable soil moisture relationships. The successional trends on these soils are toward stands of shade tolerant hardwoods, such as beech and sugar maple. Successional stands frequently contain a variety of hardwoods such as red oak, beech, sugar maple, red maple, white birch, yellow birch, aspen, and white ash in varying combinations with red spruce, hemlock, and white pine. Hardwood competition is severe on these soils. Softwood regeneration is usually dependent upon persistent hardwood control efforts.

Forest Soil Class IB

The soils in this group are generally sandy or loamy over sandy textures and slightly less fertile than those in group IA. These soils are moderately well-drained and well-drained. Soil moisture is adequate for good tree growth, but may not be quite as abundant as in group IA soils. Soils in this group tend to transition into late successional forests tolerant of hardwoods, predominantly beech. Forest growing on this soil group that are heavily cutover, are commonly composed of a variety of hardwood species such as red oak, red maple, aspen, paper birch, yellow birch, sugar maple, and beech, in combinations with white pine, red spruce, balsam fir, and hemlock. Hardwood competition is moderate to severe on these soils. Successful softwood regeneration is dependent upon hardwood control.

Forest Soil Class IC

The soils in this group are outwash sands and gravels. Soil drainage is somewhat excessively to excessively drained and moderately well-drained. Soil moisture is adequate for good softwood growth, but is limited for hardwoods. White pine, red maple, aspen, and paper birch are common in early and mid-successional stands. Successional trends on these coarse-textured, somewhat droughty and less fertile soils are toward stands of shade tolerant softwoods (i.e., hemlock and red spruce). Hardwood competition is moderate to slight on these soils. Due to less hardwood competition, these soils are ideally suited for softwood production. With modest levels of management, white pine can be maintained and reproduced on these soils. Because these soils are highly responsive to softwood production, especially white pine, they are ideally suited for forest management.

Important forest soils comprise nearly 13,175 acres, or approximately 72% of Bow (Table 9 and Figure 9). Forest soil groups IA and IB make up the majority of this resource and are most ideally suited for hardwood production. Soil group IC appears to be more restricted to stream drainages where outwash sands and gravels were deposited by glacial activity about 11,000 years ago. In Bow, these areas of forest soil group IC are near the Merrimack River, in the northwest corner of the town, and near the confluence of Bow Bog Brook and Horse Brook. Group IC soil types are suited for softwood production, mainly white pine.

Table 9 Summary of important forest soil groups for timber production in Bow.

Important Soil Type	Size (acres)	% of Town
Hardwood Production (Groups IA and IB)	11,858	64.9%
Softwood Production (Group IC)	1,317	7.2%

SOURCE: USDA Natural Resources Conservation Service soils (2009).

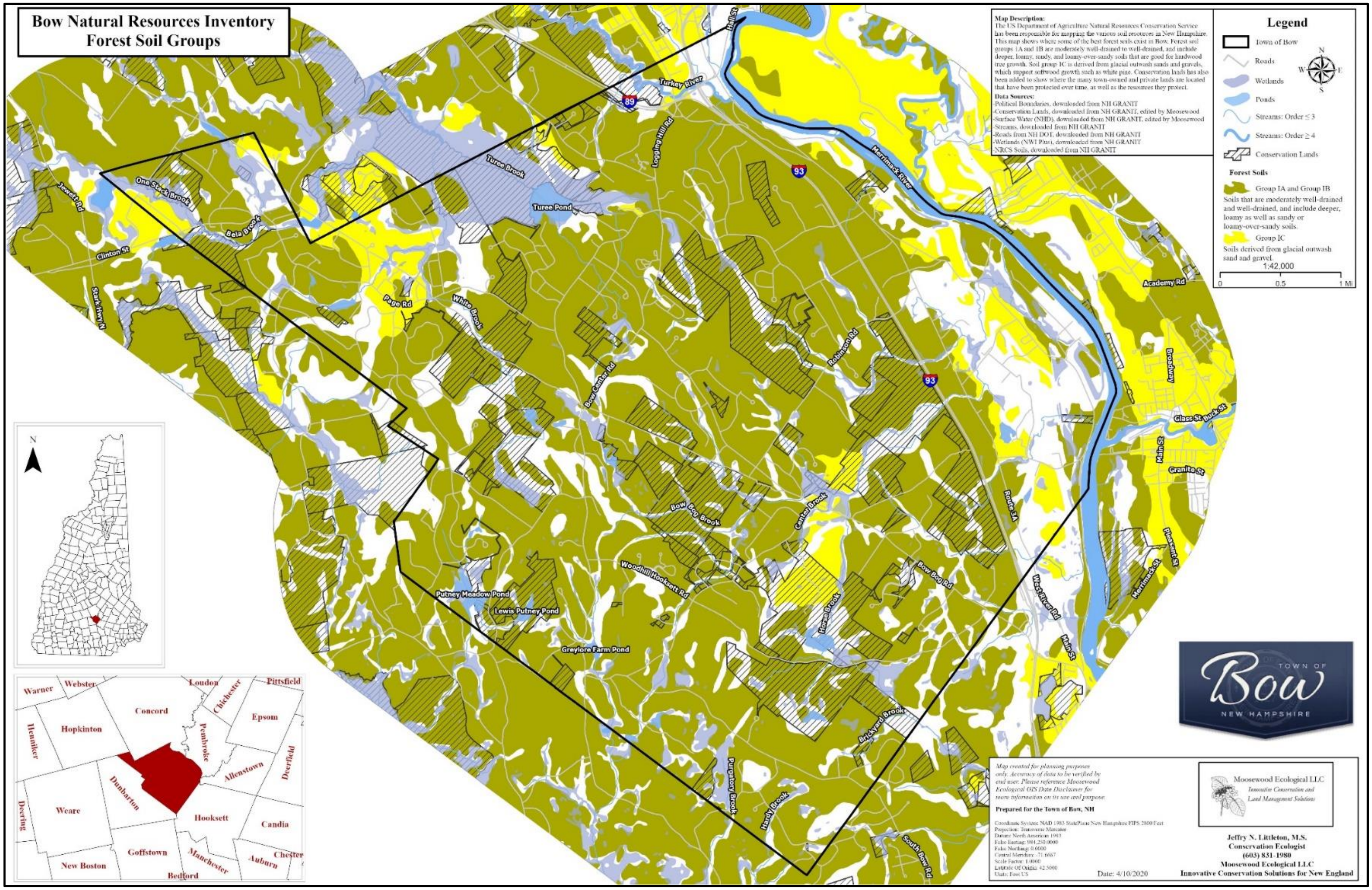
There are approximately four properties in Bow that are enrolled in the NH Tree Farm Program. The NH Tree Farm Program (2021) states that "A Tree Farmer is a forest landowner who is recognized by the American Forest Foundation for practicing forest management for timber, recreation, wildlife habitat and watershed values. Prospective Tree Farms are inspected by a professional forester at no charge to the landowner. A landowner must meet the certification standards established by the NH Tree Farm Performance Rating System. New Hampshire Tree Farms have traditionally met some of the highest standards for certification in the nation." Knox Forest is currently enrolled in the NH Tree Farm Program.

There are numerous resources to help landowners manage their forests responsibly. UNH Cooperative Extension has many publications on this topic. It is highly recommended that landowners work with a qualified, reputable licensed forester to develop a forest management plan, as well as use the recommended management practices found in Good Forestry in the Granite State (Bennett 2010). This guide can be found at the following website: www.extension.unh.edu/goodforestry

The Town of Bow has worked with Forest Resources Consultants (FORECO) to develop forest management plans for a variety of properties (Klemarczyk 2011). The *Timber Cruise and Forest Management Plan of the Bow Town Forest System* focused on 15 town-owned properties, covering 2,684 acres. This plan was originally created in 1997, and then revised in 2011. It describes the various goals and objectives for forest management, as well as covering topics on open space, timber production, wildlife, recreation, water resource protection, education, historic preservation, and invasive species.

Photograph 21 Forests provide us with many ecological services such wildlife habitat, clean air, and water quality protection for wetlands, streams, and ponds. Forests also provide opportunities for hiking, nature watching, hunting, and forest products.

FIGURE 9


Bow Natural Resources Inventory
Forest Soil Groups
Map Description:
The US Department of Agriculture Natural Resources Conservation Service has been responsible for mapping the various soil resources in New Hampshire. This map shows where some of the best forest soils exist in Bow. Forest soil groups 1A and 1B are moderately well-drained to well-drained, and include deeper, loamy, sandy, and loamy-over-sandy soils that are good for hardwood tree growth. Soil group 1C is derived from glacial outwash sands and gravels, which support softwood growth such as white pine. Conservation lands has also been added to show where the many town-owned and private lands are located that have been protected over time, as well as the resources they protect.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conservation Lands, downloaded from NH GRANIT, edited by Moosewood
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
-Wetlands (NWI Plus), downloaded from NH GRANIT
-NRCS Soils, downloaded from NH GRANIT
Legend
Town of Bow
Roads
Wetlands
Ponds
Streams: Order ≤ 3
Streams: Order ≥ 4
Conservation Lands
Forest Soils
Group IA and Group IB
Soils that are moderately well-drained and well-drained, and include deeper, loamy as well as sandy or loamy-over-sandy soils.
Group IC
Soils derived from glacial outwash sand and gravel.
1:42,000
0
0.5
1 Mi
N
S
E
W
Turkey River
Turee Brook
Turee Pond
One Stack Brook
Bela Brook
Jewett Rd
Clinton St
Page Rd
White Brook
Stark Hwy N
Logging Hill Rd
Merrimack River
Academy Rd
Robinson Rd
Bow Center Rd
Broadway
Glass St
Buck St
Main St
Granite St
Route 3A
Bow Bog Brook
Center Brook
Pleasant St
Merrimack St
Bow Bog Rd
West River Rd
Woodhill Hooksett Rd
Putney Meadow Pond
Lewis Putney Pond
Greylore Farm Pond
Horse Brook
Brickyard Brook
Purgatory Brook
Hardy Brook
South Bow Rd
89
93
TOWN OF
Bow
NEW HAMPSHIRE
Warner
Webster
Loudon
Chichester
Pittsfield
Concord
Epsom
Henniker
Hopkinton
Pembroke
Allenstown
Deerfield
Dunbarton
Weare
Hooksett
Candia
Deering
Goffstown
Manchester
Auburn
Chester
New Boston
Bedford
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US
Date: 4/10/2020
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England

CONSERVATION AND PUBLIC LANDS

The permanent protection offered by conservation easements and deed restrictions, and lands held by public entities for conservation, protect open space, natural resources, traditional uses, natural processes (i.e., protection of drinking water), and provide access to recreational resources that are essential to sustaining Bow's rural character and quality of life. These lands will remain undeveloped and in their natural state, often in perpetuity, to support important environmental or aesthetic functions. Some may also be used for agriculture, forestry, or outdoor recreation.

The authors reviewed existing sources of mapped conservation lands including NH GRANIT, the Bow Conservation Commission, and Bow Open Spaces. They also contacted other local conservation sources to verify the accuracy of the data, and to provide missing parcel information. Numerous conservation parcels were added to those provided by NH GRANIT. The parcel geography was rectified to match the digital tax parcel lines. Following the guidance provided by NH GRANIT, each parcel was assigned to one of five protection codes based on the nature of the ownership and conservation protection of the parcel. A dataset of parcels with some conservation purpose (such as Town Forest) or restrictions, including conservation easements, was produced and is displayed in each NRI map.

Bow's updated conservation and public lands are displayed in Figure 10. The history, nature, method, and parties involved with "conservation" in Bow are highly variable. A number of parcels are protected with legally binding conservation restrictions, including conservation easements held by non-governmental organizations. A number of town-owned parcels are not specifically protected by legal restrictions, but have a history of traditional open space land uses, and these are included as conservation lands. For instance, the Town of Bow has a forest management plan prepared for its Town Forest system (Klemarczyk 2011). Forest management has been a traditional land use of these properties; some have been protected through formal means, such as conservation easements while other Town Forests have no formal protection. The final conservation lands dataset is inclusive of not only natural open space areas and private lands, but also public lands that have a variety of active outdoor uses. Each parcel was assigned a code representing the nature of the conservation level, including type of protection and a brief description of each. Descriptions of land conservation types are provided in Table 10.

Based on this new dataset, Bow has a total of 4,052.9 acres of conservation and public lands. This represents 22% of the total area of the town. By way of comparison, the combined five boroughs of New York City have 21.2% of area within the municipal corporate boundary devoted to open space uses (Harnik et al. 2017). Table 11 lists the 74 conservation properties and open space in Bow, with their acreage and protection type. Table 12 shows total acreages of conservation lands in Bow by protection type.

Table 10 Descriptions of land conservation types in Bow listed in Table 11.

Code	Protection Type	Description
CE	Conservation Easement	Legal conservation restrictions enforced by an agency or land trust
FO	Fee Ownership	Property held in fee by a town, land trust, or agency as conservation land (may also have an easement)
DR	Deed Restriction	Property protected by restrictions in a fee deed
SA	Set Aside	Open space specified as conservation in a plan or subdivision approval
RW	Right of Way	A legal right to access or cross property of another for specified purposes

Table 11 Conservation lands in Bow (Use the Map ID number to locate the property in Figure 10 Conservation and Public Lands).

Property Name	Map ID	Acres	Type		Property Name	Map ID	Acres	Type
A. Richardson CE	1	45.7	CE		Mountain Farm Rd. OS	40	0.7	SA
Alexander Lane OS	2	8.4	FO		Nathaniel Drive OS	41	3.6	SA
Allen Road OS	3	6.7	CE		Nottingcook Forest	42	2.8	CE
Arrowhead Drive Wetlands	4	24.5	FO		Nottingcook Forest	42	3.1	CE
Beaver Brook Drive OS	5	11.7	DR		Nottingcook Forest	43	363.8	CE
Bela Brook Town Forest	6	72.7	FO		Nottingcook Forest	44	385.8	CE
Boucher CE	7	29.2	CE		NRCS_WRP	45	196.9	CE
Bow Bog #2	8	5.9	FO		P. Richardson CE	46	66.8	CE
Bow Bog #3	9	7.9	FO		Page Road Town Forest	47	56.2	FO
Bow Bog Brook - Robinson Rd. Forest	10	255.0	FO		Pages Corner State Forest	48	85.1	FO
Bow Bog Lot	11	128.3	FO		Parsons Way OS	49	13.5	SA
Bow Bog Rd. OS	12	8.7	SA		Parsons Way OS	49	25.7	SA
Bow Bog Rd. OS	12	8.8	SA		Peaslee Road OS	49	10.5	SA
Bow Bog Town Forest	13	11.3	FO		Peaslee Road OS	49	15.6	SA
Bow School Forest	14	105.0	FO		Public Service Co. of NH	50	10.0	CE
Bow Town Forest - Morgan Lot	15	61.0	FO		Richard Hanson Memorial Recreation Area	51	125.0	FO

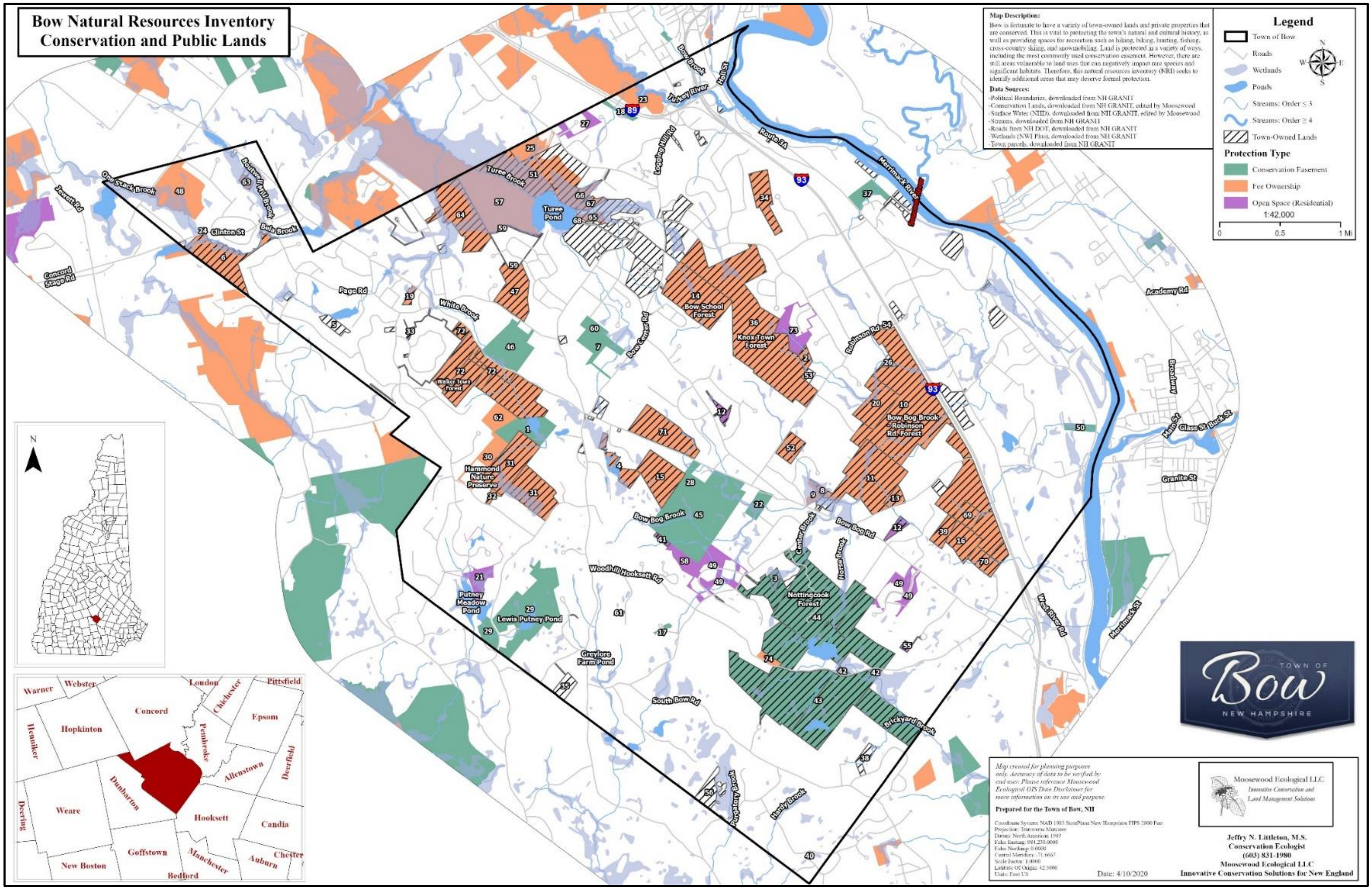
Bow Town Forest - Turnpike Lots	16	167.2	FO		Robinson Rd. Town Forest	52	21.3	FO
Bow03-0583	17	3.9	CE		Robinson Road OS	53	5.1	DR
Bow99-628	18	7.1	CE		Robinson Road/ I-93 Town Forest	54	1.8	FO
Branch Turnpike W	19	5.7	FO		Rosewood Dr. OS	55	3.8	SA
Briarwood Drive	20	51.9	FO		S. Bow Dunbarton OS	56	21.8	DR
Buckingham Dr. OS	21	25.7	SA		St. Paul's School Land - Bow	57	136.8	FO
Chadwick CE	22	31.9	CE		Stone Sled OS	58	19.2	SA
Cilley State Forest	23	33.5	FO		Surrey Coach Lane OS	59	4.6	SA
Clinton St. OS	24	0.6	SA		Surrey Coach Lane OS	59	0.7	SA
Fawn Court OS	25	26.1	FO		Three Stone Walls CE	60	14.5	CE
Fieldstone Drive	26	4.5	DR		Tower Hill Dr. OS	61	1.5	SA
Fox Meadow Drive OS	27	14.6	SA		Town of Bow Lot 4-117	62	24.1	FO
NRCS CE	28	24.0	CE		Town of Bow (Chadwick) Lot 4-14	63	5.4	FO
Hallinan CE	29	20.8	CE		Town of Bow Lot 4-50	64	97.7	FO
Hallinan CE	29	137.6	CE		Town of Bow Lot 4-67	65	9.9	FO
Hamilton Court OS	30	29.4	FO		Town of Bow Lot 4-76	66	18.1	FO
Hammond Nature Preserve	31	72.9	FO		Turee Pond #1	67	9.6	FO
Hammond Nature Preserve	31	65.4	FO		Turee Pond Boat Launch Facility	68	0.8	RW
Hammond Nature Preserve	32	4.2	FO		Turnpike #5	69	19.0	FO
Hampshire Hills Dr. OS	33	5.1	SA		Turnpike #6	70	21.4	FO
Heather Lane Town Forest	34	39.0	FO		Turnpike Road	71	71.5	FO
Hunter Drive OS	35	15.1	DR		Walker Town Forest	72	8.3	FO
Knox Town Forest	36	314.0	FO		Walker Town Forest	72	161.7	FO
Lindquist CE	37	22.6	CE		Walker Town Forest	72	26.8	FO
Merrill Crossing OS	38	11.6	DR		Whittier Drive OS	73	32.4	SA
Morgan Drive	39	18.1	FO		Woodhill Hooksett Rd.	74	7.0	FO

Table 12 Conservation lands in Bow by type and acreage.

Code	Protection Type		Acres
CE	Conservation Easement		1,373.0
DR	Deed Restriction		69.8
FO	Fee Ownership		2,414.1
RW	Right of Way (State boat ramp)		0.8
OS	Open Space (Residential)		195.2
		Total	4,052.9

Photograph 22 Nottingcook Forest is the largest conserved town-owned property. This panoramic picture looking northeast on top of Great Hill provides a great opportunity for hawk watching.

FIGURE 10


Bow Natural Resources Inventory
Conservation and Public Lands
Map Description:
Bow is fortunate to have a variety of town-owned lands and private properties that are conserved. This is vital to protecting the town's natural and cultural history, as well as providing spaces for recreation such as biking, hiking, hunting, fishing, cross-country skiing, and snowmobiling. Land is protected in a variety of ways, including the most commonly used conservation easement. However, there are still areas vulnerable to land uses that can negatively impact rare species and significant habitats. Therefore, this natural resources inventory (NRI) seeks to identify additional areas that may deserve formal protection.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conservation Lands, downloaded from NH GRANIT, edited by Moosewood
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
-Wetlands (NWI Plus), downloaded from NH GRANIT
-Town parcels, downloaded from NH GRANIT
Legend
Town of Bow
Roads
Wetlands
Ponds
Streams: Order ≤ 3
Streams: Order ≥ 4
Town-Owned Lands
Protection Type
Conservation Easement
Fee Ownership
Open Space (Residential)
1:42,000
0 0.5 1 Mi
Bow School Forest
Knox Town Forest
Bow Bog Brook Robinson Rd. Forest
Walker Town Forest
Hammond Nature Preserve
Nottingcook Forest
Putney Meadow Pond
Lewis Putney Pond
Greylore Farm Pond
Turee Pond
Merrimack River
Turee Brook
White Brook
Bow Bog Brook
Page Rd
Clinton St
Concord Stage Rd
Robinson Rd
Woodhill Hooksett Rd
South Bow Rd
Bow Bog Rd
Academy Rd
Granite St
TOWN OF Bow NEW HAMPSHIRE
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US
Date: 4/10/2020
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England
Warner
Webster
Concord
Hopkinton
Henniker
Pembroke
Epsom
Allenstown
Dunbarton
Weare
Hooksett
Candia
Goffstown
Manchester
Auburn
New Boston
Bedford
Deering
Chester
Pittsfield
London
Chichester
Deerfield

CLIMATE CHANGE and RESILIENT LANDSCAPES

In light of evidence of a changing climate, many communities are now incorporating the concept of resiliency into their proactive planning efforts. The concept of ecological resiliency refers to the capacity of wildlife and plants and the natural processes and physical conditions they depend on, to sustain change over time. Resiliency studies attempt to predict how the landscape may respond to a changing climate where extreme temperature and precipitation patterns, a higher annual base temperature, increasing intensity and frequency of storms, flooding, and rising sea levels are predicted.

When crafting a conservation and open space plan it is necessary to understand the distribution of the various natural resources and conserved lands within and adjacent to Bow. As part of this planning process, it is imperative to identify and capture climate-resilient landscapes. This provides a more inclusive approach, integrating significant natural resources with areas that are capable of recovering from major disturbance events (such as stronger storms, increased droughts, and floods) for long-term conservation success.

There are three major measures of resiliency at the landscape level that we can use to plan for this future change. The first characteristic is the *geophysical diversity* of a landscape. This aspect refers to the diversity of geology, soils, elevations, and landforms, including water features such as lakes and streams. Physical diversity promotes both habitat and species diversity due to a wide range of conditions, including elevations, sun exposure (temperature and moisture), soils, hydrology, and ecological processes that help define distinct ecosystems. In general, the more physical diversity there is in a landscape, the more likely that landscape is to recover from extreme disturbances – thus it is more resilient.

The second major characteristic is *connectedness*. This refers to the ability of species to freely move throughout the landscape unimpeded by major barriers such as human developments or human-altered ecosystems. Connectedness can be viewed at the local and regional levels. The goal is to connect conservation open space to promote free movement of wildlife and plant species.

Biological condition is the third and final consideration in planning for climate resilience. This characteristic takes into consideration the impact of stressors on the environment, including past land use, human development, invasive species, air and water pollution, and climate change. Biological condition also considers the presence of species of greatest conservation need.

A number of recent predictive models have shown that northeastern forests are likely to experience a greater loss in tree species diversity than other parts of the United States due to climate change. Climate change effects are a global threat, but also impact New Hampshire. Invasive species and introduced pathogens have been recognized as a significant threat, ever since the decimation of virtually all American chestnut trees in North America by the introduced Asian chestnut blight. The absence of this tree species, once a keystone forest species, has fundamentally altered forest composition in certain forested areas of Bow. In more recent years, invasive plants as well as introduced insects and diseases have become widespread. Major river valleys such as the Merrimack are especially susceptible to the introduction and spreading of such exotic plant species as Asian bittersweet, Japanese knotweed, and glossy buckthorn, due to the popularity as a food for migrating and resident birds which spread their seeds along these important migration routes.

According to the US Environmental Protection Agency (2021), the Northeast is experiencing the largest increase in the amount of rainfall measured during heavy precipitation events than any other region in the US. More frequent heat waves in the Northeast are also expected to increasingly threaten human health through more heat stress and air pollution. Sea level rise and more frequent heavy rains are

expected to increase flooding and storm surge, threatening infrastructure. And as temperatures rise, agriculture will likely face reduced yields, potentially damaging livelihoods and the regional economy.

A progressively warmer climate has been seen as one cause of the spread of many of these species. In the last 5 years alone, the emerald ash borer (EAB) and red pine scale have quickly spread to their respective host trees much in the way the American elm was once so drastically affected. As road maintenance, forestry, and recreational improvements are planned on open space, roads, and Town-owned lands, extra precautions need to be taken to minimize the introduction and spread of invasive plants.

NH Wildlife Action Plan

The 2015 NH Wildlife Action Plan (WAP) includes a risk assessment of 27 habitats and 157 species of greatest conservation need that was based on standards adopted by other northeastern states (NH Fish and Game 2015). The assessment assigned a number of risk factors to each of these species within each described habitat to determine which habitat types (and the species they support) appear to be most vulnerable to various effects including pollution, climate change, natural systems modification, invasive species, disease, and development. Table 13 includes a list of WAP habitats occurring in Bow that were determined to be the highest at risk from these factors.

Table 13 2015 NH Wildlife Action Plan - Habitats Critical for Species at Risk.

Forests	**Other Terrestrial Habitats**
Hemlock-Hardwood-Pine Forest	Pine Barrens
Appalachian Oak-Pine Forest	Grasslands
Freshwater Wetlands	Shrublands
Floodplain Forests	**Freshwater Aquatic**
Vernal Pools	Large Warmwater Rivers
Temperate Swamps	Warmwater Rivers and Streams
Peatlands	Warmwater Lakes and Ponds
Shrub Wetlands	

SOURCE: NH Fish and Game (2015).

TNC Resilient and Connected Landscapes Study

In 2016, The Nature Conservancy released the Resilient and Connected Landscapes study, which mapped climate-resilient sites, confirmed biodiversity locations, and species movement areas (zones and corridors) across Eastern North America. The study used the information to prioritize a conservation portfolio that naturally aligns these features into a network of resilient sites integrated with the species movement zones, and thus a blueprint for conservation that represents all habitats while allowing nature to adapt and change. The following brief concept descriptions come from The Nature Conservancy's online portal:

- Resilient Area: places buffered from climate change because they contain many connected micro-climates that create climate options for species.

- Flow: the movement of species populations over time in response to climate. Flow tends to concentrate in the zones and corridors described below.
- Climate Corridor: narrow zone of highly concentrated flow, often riparian corridors or ridgelines.
- Climate Flow Zone: broad areas of high flow that is less concentrated than in the corridors - typically intact forested regions.
- Confirmed Diversity: known locations of rare species or unique communities based on ground inventory. Unconfirmed areas may contain the same species.

Resilient sites are projected to retain high quality habitat and continue to support a diverse array of plants and animals. Sites that have both complex topography and connected land cover are places where conservation action is most likely to succeed in the long term. Permanent conservation of the resilient areas should be prioritized to ensure they can continue to provide habitat for species. Securing resilient sites safeguards natural benefits such as fresh drinking water and clean air for local communities now and into the future.

Figure 11 illustrates the resilient and connected landscapes of Bow and the surrounding region. To learn more about resilient and connected landscapes and to view the full maps developed by The Nature Conservancy and the process behind them, see: www.conservationgateway.org

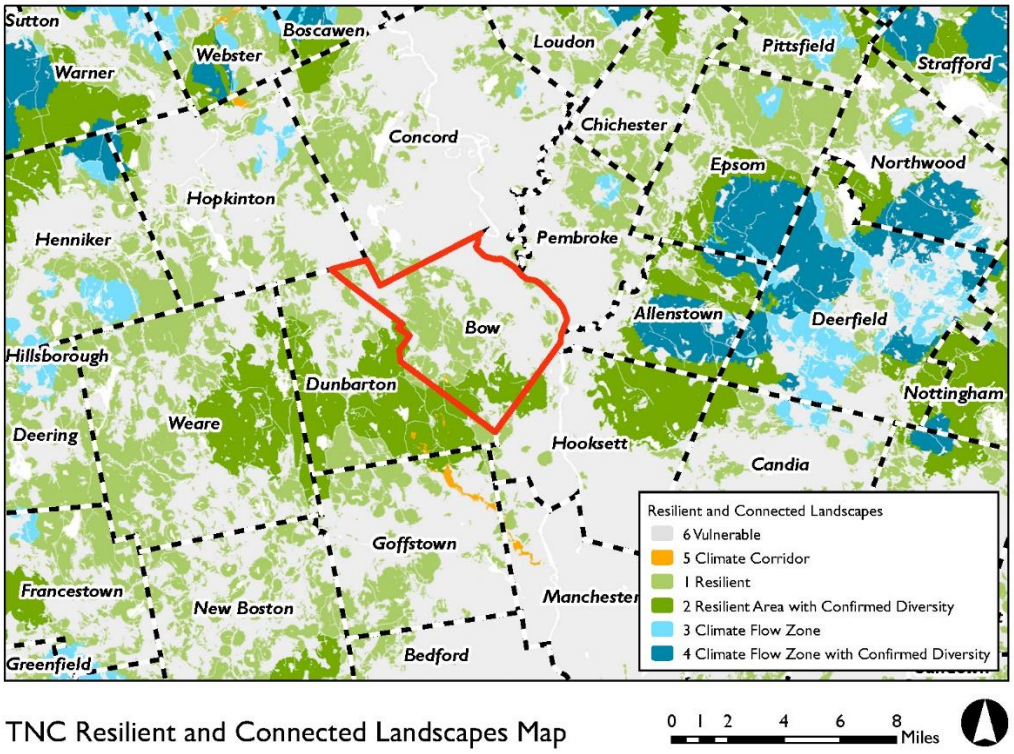


Figure 11 The Nature Conservancy resilient and connected landscapes map for Bow.

TRAILS

Existing Recreational Trails

One of the major quality of life assets in Bow is its significant and extensive network of recreational trails. Access to trails across the town promotes healthy lifestyles, a connection to nature, and the relief of stress through exercise. In the current environment under the influence of the Corona virus, the ability to be outside is one of the few public activities considered safe, making these amenities all the more important. Trails in the town are largely on conservation lands and Town-owned lands, although a number of trails and connectors cross private lands.

Trails are overseen by the Bow Open Spaces land trust and Bow Pioneers Snowmobile Club. Bow Open Spaces has an active trails committee that is involved with the siting, maintenance, and access to a large part of the trail network which currently totals 75 miles of hiking, bicycling, and/or snowmobile trails (Figure 12). Some of these trails connect to Class VI roads in the town. These 8.8 miles of un-maintained roads provide further access and connections for recreation.

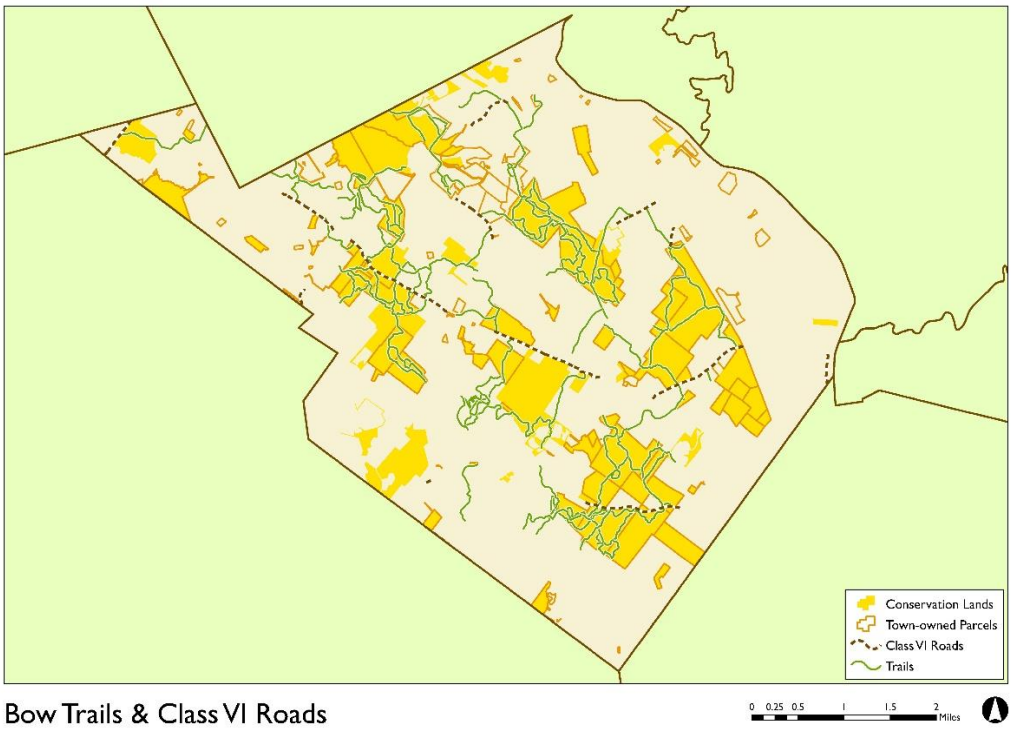


Figure 12 Bow trails and class VI roads.

NH Fish & Game - Trails for People and Wildlife

NH Fish and Game developed a methodology that uses GIS mapping to analyze how and where trail use by people may negatively impact wildlife (Stevens and Oehler 2019). This report reviewed some 63 scholarly studies on the subject, identified thresholds of effect by the human use of a linear trail, which they call the "corridor of influence." According to the report, different species and classes of wildlife react to trail use differently.

While trails are developed for use by people, this use can negatively impact wildlife, especially if the trails are not designed appropriately. The 2019 report, *Trails for People and Wildlife*, identified

thresholds of impacts by the human use of a linear trail, which was referred to as the "corridor of influence." Different species and classes of wildlife react to trail use differently. For amphibians and reptiles, the awareness and potential disturbance distance is an average of 60 feet from a trail. For birds, the average distance is 150 feet, and for mammals the average distance is 400 feet. In instances where trails are sited in close proximity to each other, there can be areas between trails where the corridor of influence overlaps, continuously discouraging the presence of wildlife. An example of this overlapping corridor of influence may be observed in the map of trails in Nottingcook Forest (Figure 13).

The NH Fish & Game study produced data that displays various significant natural resource areas and ranks them on the landscape. These data inputs included wet areas, steep slopes, rare species locations, habitat edges, and special habitats. When trail buffer corridors are superimposed on these sensitive natural resources, areas of potential conflict, as well as overlapping buffers are revealed. Figure 13 below illustrates an example using Nottingcook Forest and its trail network. As the example indicates, there are various areas where conflicts may exist between trail use and protection of wildlife resources. This method can be a useful tool in planning new trail locations, as well as evaluating potential shortcomings of the location of existing trails and considering the removal of trails with potential negative impacts to wildlife.

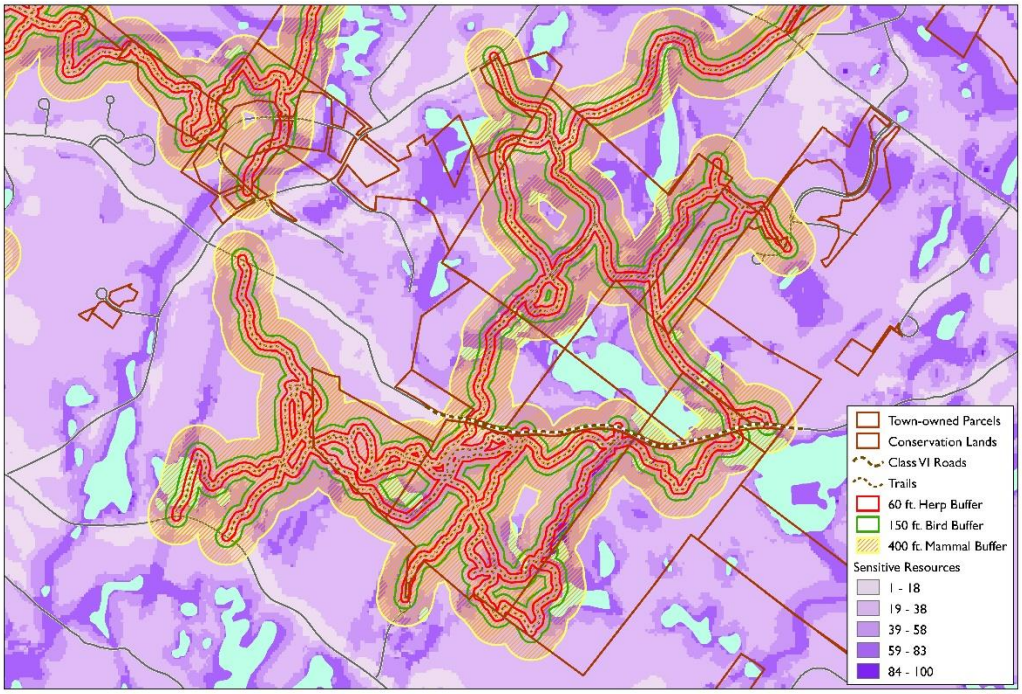


Figure 13 Trails for People and Wildlife (Stevens and Oehler 2019) analysis for Nottingcook Forest.

CONSERVATION FOCUS AREAS

Areas of largely undeveloped and unprotected open space were identified and delineated to display geographic areas of Bow that contain high natural resource values. These Conservation Focus Areas (CFA's) were identified based on the evaluation of the Water Resources, Ecological Resources, and Agricultural and Forest Resources using parcel-based co-occurrence models (Appendix E). Initial focus areas were identified using an assessment of the overlap of highest natural resource values determined by these three co-occurrence models. The final CFAs were then refined to include the *selection criteria* described below, incorporating the special attributes within the surrounding landscape. This resulted in a more comprehensive approach to identify specific areas of high natural resource values. CFAs were assigned cultural/geographical place names based on their locations.

The selection criteria listed below captures a diversity and range of importance values that taken together clearly differentiated high quality areas or the landscape from developed and lower quality areas. This process was used to sort and prioritize the importance of unprotected open space lands in Bow for protection by acquisition or other means of land protection (e.g., conservation easement) while working with willing landowners interested in conserving natural resources.

Selection Criteria

Conservation priority criteria were developed to guide the location and delineation of proposed CFAs. The criteria were organized under four headings to capture the multiple considerations that support selection of a particular area: Natural Resources, Landscape Context, Human/Cultural Importance, and Concurrence. The criteria are as follows:

<u>Natural Resources</u>

- Resources Present: The specific type of important resources present including drinking water (stratified drift aquifers), low degree of fragmentation, productive soils, rare biological elements, and active agriculture.
- Rarity: How uncommon or widespread a resource is locally and regionally.
- Rare Biological Elements: Presence, number, and significance of rare plant, animal, or natural community elements.
- Threats: How vulnerable an area is to degradation, conversion, or development.
- Quality: Ranking of general quality and natural condition.
- Adjacent Conservation: How protection would connect to, enhance, and/or augment existing conservation areas to strengthen protection of natural resources.

<u>Landscape Context</u>

- Size: Relative size of entire CFA area (the larger the better).
- Contribution to Existing Conservation Base: Proximity to protected land.
- Physical Diversity: Variety of geology and landform types and hydrological features.
- Ecological Integrity: Biological condition including rarity, stress, and degradation.
- Strategic Location on Landscape: How well this area benefits the ecological integrity of surrounding areas.
- Connectedness: How well this area provides connectivity with adjacent habitats.
- Resiliency Value: Overall resiliency based on physical diversity, ecological integrity, and connectedness.

<u>Human / Cultural Importance</u>

- Essential Needs: Provides or has potential to provide essential resources such as drinking water, flood control and storage, food crops, livestock grazing, timber products, etc.

- Quality of Life: Provides or supports recreational opportunities, scenic views, historical context, etc.
- Connection: Strategic location provides walkable/bikeable connections to and between open space areas.

Concurrence

- Identified by other Study or Informed Input: Studies corroborate the selection of an area (e.g., NH Wildlife Action Plan, Merrimack Watershed Plan).
- Meets Established Criteria: How well conservation of an area achieves Bow's conservation goals.

Conservation Focus Areas

Sixteen CFAs were identified in Bow (Figure 14). Each CFA described below corresponds to the number listed on the map at the end of this section. The criteria listed below summarize the significant aspects of each CFA. Appendix F provides a table to easily compare the special attributes of each CFA.

CFA #1: Turee Pond Wetland Complex

- Total Area: 223 acres.
- Most of this CFA has been ranked high for ecological resources and a portion ranked high for water resources.
- Abuts contiguous conservation lands to the east associated with Turee Pond, totaling 418 acres.
- Includes and adjacent to 2 exemplary wetland ecosystems whereby affording additional protection to these significant habitats.
- 50% of area underlain by significant aquifer system and sites identified in the favorable gravel well analysis with potential yield of 75 gallons per minute.
- Most of the area has been designated as prime wetlands.
- Most of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- Most of the area identified as Tier 2 and 3 WAP habitat.
- Eastern side of CFA associated with a 1,243-acre unfragmented block while the western section is associated with a 291-acre unfragmented block.
- About 50% of this block is ranked as Resilient Landscape by TNC.

CFA #2: Turee Pond South

- Total Area: 57.8 acres.
- 100% of this CFA has been ranked high for ecological resources and at least 75% has been ranked high for water resources and agriculture and forest resources.
- Abuts contiguous conservation lands to the west and north associated with Turee Pond, totaling 418 acres.
- Adjacent to an exemplary wetland ecosystem whereby affording additional protection to these significant habitats.
- Includes portions of 3 wellhead protection areas.
- Adjacent to designated prime wetlands.
- Completes protection of the shoreline of Turee Pond. This shoreline is part of a homeowner's association. This area may not have a formal conservation easement, but it may have some deed restrictions.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.

- Most of the area identified as Tier 3 WAP habitat.
- CFA associated with a 1,243-acre unfragmented block.
- About 50% of this block is ranked as Resilient Landscape by TNC.

CFA #3: Turee Pond Inlet

- Total Area: 18.1 acres.
- Abuts contiguous conservation lands to the west associated with Turee Pond, totaling 418 acres.
- Includes portions of 2 wellhead protection areas.
- Adjacent to designated prime wetlands.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- Most of the area identified as Tier 3 WAP habitat.
- CFA associated with a 1,243-acre unfragmented block.
- Provides upland buffer to Turee Pond wetlands and a major tributary stream.
- About 50% of this block is ranked as Resilient Landscape by TNC.

CFA #4: White Brook Wetlands

- Total Area: 278.9 acres (in 2 parts).
- 75% of this CFA has been ranked high for ecological resources and 50% has been ranked high for agriculture and forest resources.
- Contains designated prime wetlands.
- This CFA is made up of 2 areas that abuts contiguous conservation lands associated with Walker Town Forest and other protected lands, totaling 533 acres.
- Contains rare species habitat.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- Some of the area identified as Tier 3 WAP habitat.
- CFA associated with an 841-acre unfragmented block.
- 100% of this block is ranked as Resilient Landscape by TNC.

CFA #5: Three Stone Walls

- Total Area: 121.9 acres; however, part of this CFA was recently developed over the past year.
- Abuts and surrounds contiguous conservation lands totaling 44 acres.
- Rare species and rare habitat present, some of which could have been impacted by the recent development.
- Completes protection of headwaters of a major tributary stream to Turee Pond.
- 50% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- 25% of the area identified as Tier 3 WAP habitat.
- CFA associated with a 123-acre unfragmented block.
- About 80% of this block is ranked as Resilient Landscape by TNC.

CFA #6: Knox Forest Extension

- Total Area: 341.9 acres.
- Nearly 100% of this CFA has been ranked high for ecological resources and agriculture and forest resources.

- Abuts contiguous conservation lands such as Knox Town Forest, Bow School Forest, and Bow Bog Brook, totaling 921.4 acres.
- Supports rare species habitats, including vernal pools.
- Adjacent to designated prime wetlands.
- 90% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- 100% of the area identified as Tier 1, 2, and 3 WAP habitat.
- Associated with 2 large unfragmented blocks totaling 826 acres and 1,114 acres each.
- About 40% of this block is ranked as Resilient Landscape by TNC.

CFA #7: Bow Bog Brook East

- Total Area: 88.7 acres.
- Nearly 100% of this CFA has been ranked high for ecological resources and agriculture and forest resources, and about 50% ranked high for water resources.
- Abuts contiguous conservation lands totaling 1,237 acres.
- Supports rare species habitats, including vernal pools.
- Protects ½ mile of Bow Bog Brook as well a tributary.
- Supports protection of wellhead protection areas.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- 90% of the area identified as Tier 1, 2, and 3 WAP habitat.
- Associated with an 879-acre unfragmented block.

CFA #8: Bow Bog Brook West

- Total Area: 219.3 acres.
- Nearly 100% of this CFA has been ranked high for ecological resources and agriculture and forest resources, and about 50% ranked high for water resources.
- Abuts contiguous conservation lands totaling 1,237 acres.
- Supports rare species habitats, including vernal pools.
- Supports protection of wellhead protection areas.
- Protects the headwaters of two main tributaries of Bow Bog Brook.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- 90% of the area identified as Tier 1, 2, and 3 WAP habitat.
- Associated with an 879-acre unfragmented block.
- 80% of this block is ranked as Resilient Landscape by TNC.

CFA #9: Merrimack River

- Total Area: 463.6 acres.
- Nearly 100% of this CFA has been ranked high for ecological resources, about 50% ranked high for agriculture and forest resources, and about 75% ranked high for water resources.
- Supports various rare species of wildlife, plants, and insects.
- Supports rare habitat such as floodplain forests, river shoreline, and shrublands.
- Supports protection of wellhead protection areas.
- Includes and protects 1.5 miles of lower Bow Bog Brook.
- 100% of CFA underlain by aquifer and a new municipal water supply well is located within this area.

- 50% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- Consolidates and enhances protection of four Town parcels and an easement.
- Nearly 100% of the area identified as Tier 1, 2, and 3 WAP habitat.
- Associated with a large 2,522-acre unfragmented block.

CFA #10: Nottingcook Forest East

- Total Area: 342.5 acres.
- 100% of this CFA has been ranked high for ecological resources and agriculture and forest resources.
- Abuts contiguous conservation lands totaling 1,237 acres.
- Supports rare species habitat such as vernal pools and shrublands.
- Supports designated prime wetlands.
- Supports protection of wellhead protection areas.
- Completes protection of Hornbeam Swamp and The Meadow.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- 100% of the area identified as Tier 1, 2, and 3 WAP habitat.
- Associated with a large 2,621-acre unfragmented block.
- About 75% of this block is ranked as Resilient with Confirmed Diversity Landscape by TNC.

CFA #11: Nottingcook Forest South

- Total Area: 543.1 acres.
- 100% of this CFA has been ranked high for ecological resources and 95% ranked high for agriculture and forest resources; a small portion was ranked high for water resources.
- Abuts contiguous conservation lands totaling 1,237 acres.
- Supports rare species habitat such as vernal pools and shrublands.
- Supports protection of wellhead protection areas.
- Protects portions of Steer Brook and Brickyard Brook.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- 100% of the area identified as Tier 1, 2, or 3 WAP habitat.
- Associated with a large 2,621-acre unfragmented block.
- About 75% of this block is ranked as Resilient with Confirmed Diversity Landscape by TNC.

CFA #12: South Bow Road Wetlands Complex

- Total Area: 639.7 acres.
- Over 50% of this CFA has been ranked high for ecological resources, and a small portion was ranked high for water resources.
- Supports rare species habitat, including grasslands, shrublands, vernal pools, and other wetlands.
- Supports rare wildlife species.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- Over 50% of the area identified as Tier 1, 2, and 3 WAP habitat.
- Associated with 3 distinct large unfragmented blocks totaling 1,481 acres.

- About 75% of this block is ranked as Resilient with Confirmed Diversity Landscape and about 15% is ranked as Resilient Landscape by TNC.

CFA #13: Putney Meadow Pond

- Total Area: 148.8 acres.
- Nearly 100% of this CFA has been ranked high for ecological resources, and it supports high ranked water resources and forest and agricultural resources.
- Abuts conservation lands totaling 163 acres.
- Supports rare species habitat, including grasslands, vernal pools, and other wetlands.
- Protects 95% of Putney Meadow Pond and significant adjacent upland.
- Supports rare wildlife species.
- Provides habitat connection between conservation lands.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- Supports Tier 3 WAP habitat.
- Associated with 2 distinct unfragmented blocks totaling 755 acres.
- About 80% of this block is ranked as Resilient Landscape by TNC.

CFA #14: Robinson Road Forest South

- Total Area: 200.6 acres.
- 100% of this CFA has been ranked high for ecological resources and agriculture and forest resources; it also supports high ranked water resources.
- Abuts contiguous conservation lands such as Bow Bog Brook, totaling 661.1 acres.
- Supports rare species habitat such as shrublands, vernal pools, and marshes.
- Supports rare wildlife species.
- Supports designated prime wetlands.
- Enhances protection of Bow Bog Brook watershed and a tributary stream.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- 100% of the area identified as Tier 1, 2, and 3 WAP habitat.
- Associated with a large 1,114-acre unfragmented block.

CFA #15: Horse Brook

- Total Area: 142.5 acres.
- 100% of this CFA has been ranked high for ecological resources, agriculture and forest resources, and water resources.
- Protects 2/3 mile of Horse Brook.
- Abuts contiguous conservation lands totaling 1,237 acres.
- Supports rare species habitat such as shrublands and vernal pools.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- 100% of the area identified as Tier 1, 2, and 3 WAP habitat.
- Associated with a large 2,621-acre unfragmented block.
- About 30% of this block is ranked as Resilient with Confirmed Diversity Landscape and about 15% is ranked as Resilient Landscape by TNC.

CFA #16: Audley Divide Tract

- Total Area: 56.4 acres.
- Supports active agricultural lands.
- Support rare species habitat such as grasslands.
- Abuts conservation land in Dunbarton, enhancing its protection.
- 100% of the area identified in the Merrimack Valley Regional Conservation Plan as having high conservation value.
- Supports Tier 2 and 3 WAP habitat.
- Associated with a large 2,114-acre unfragmented block.
- 100% this block is ranked as Resilient with Confirmed Diversity Landscape by TNC.

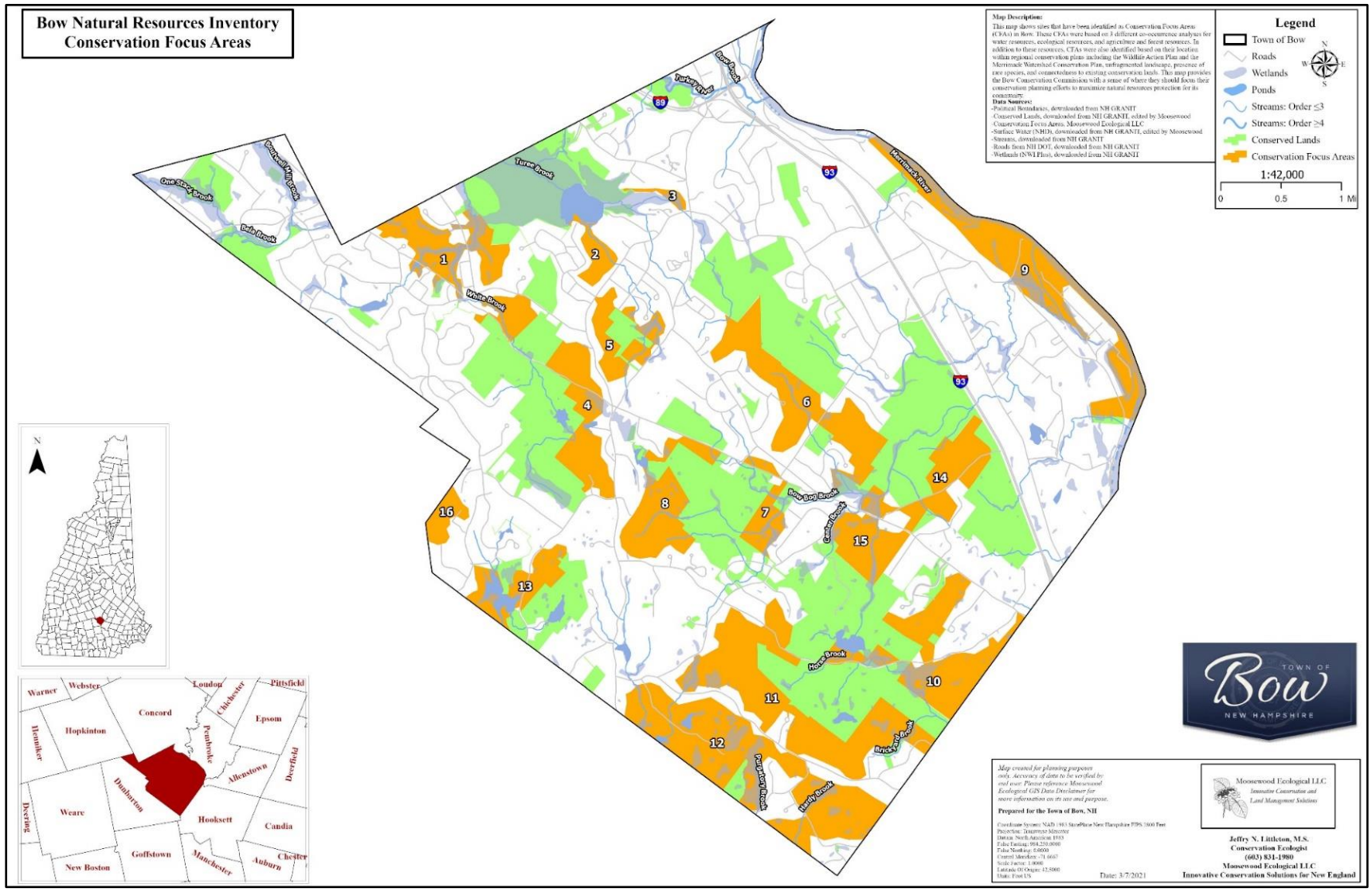
Criteria for Land Conservation Projects Outside of the Conservation Focus Areas

This project attempted to identify and delineate areas of Bow that represent the most significant natural resources in the town. These delineations were based on a GIS analysis, but also involved judgement calls and reasonable thresholds for consideration that by definition excluded other areas. However, numerous resources important to Bow do actually occur outside the selected Conservation Focus Areas. Some of these occur in the absence of other important resources, are unique for Bow, or are in areas of limited size.

This plan cannot predict what undocumented resources may be identified in the future. In addition, resources currently not considered critical for protection may in the future take on more significance than they do today. Finally, important lands that are now unavailable for acquisition and protection by Bow due to current ownership may become available in the future, and opportunities may present themselves in the future that would deserve serious conservation consideration.

For these reasons, it is recommended that such parcels and areas be considered on a case-by-case basis for protection using the same selection criteria that resulted in the proposed Conservation Focus Areas. These criteria recognize that a number of important resources are already known to occur outside the mapped focus areas, and that these other natural resource areas may someday be recognized as also worthy of protection.

FIGURE 14


Bow Natural Resources Inventory
Conservation Focus Areas
Map Description:
This map shows sites that have been identified as Conservation Focus Areas (CFAs) in Bow. These CFAs were based on 3 different co-occurrence analyses for water resources, ecological resources, and agriculture and forest resources. In addition to these resources, CFAs were also identified based on their location within regional conservation plans including the Wildlife Action Plan and the Merrimack Watershed Conservation Plan, unfragmented landscape, presence of rare species, and connectedness to existing conservation lands. This map provides the Bow Conservation Commission with a sense of where they should focus their conservation planning efforts to maximize natural resources protection for its community.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conserved Lands, downloaded from NH GRANIT, edited by Moosewood Conservation Focus Areas, Moosewood Ecological LLC
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
-Wetlands (NWI Plus), downloaded from NH GRANIT
Legend
Town of Bow
Roads
Wetlands
Ponds
Streams: Order ≤3
Streams: Order ≥4
Conserved Lands
Conservation Focus Areas
1:42,000
0
0.5
1 Mi
N
W
E
S
Turkey Pond
Bow Bog
Three Brook
Merrimack River
Dunklee Mill Brook
One Stage Brook
Bela Brook
White Brook
Bow Bog Brook
Central Brook
Rose Brook
Brickett Brook
Purgatory Brook
Hardy Brook
89
93
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Warner
Webster
Loudon
Pittsfield
Chichester
Concord
Epsom
Hopkinton
Henniker
Pembroke
Allenstown
Deerfield
Dunbarton
Weare
Deering
Hooksett
Candia
Goffstown
Manchester
Auburn
Chester
New Boston
TOWN OF
Bow
NEW HAMPSHIRE
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Feet US
Date: 3/7/2021
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England

RECOMMENDATIONS

The information provided herein, including the maps, can be used when considering the adoption of various land use planning techniques or when working with willing landowners on resource protection efforts. The data used to develop this information represent the most current, readily available data to better understand Bow's natural resources. As such, there are some basic guidelines that the town can use to promote innovative and informed land use planning.

- Protect large unfragmented blocks, especially those with high quality habitats located within close proximity of one another and with limited barriers for wildlife movement;
- Protect known rare species populations;
- Protect representative examples of critical habitats for known rare species;
- Protect rare and representative examples of natural communities;
- Protect intact wetland and stream riparian buffers and promote the restoration of degraded areas;
- Support voluntary and regulatory approaches at natural resources protection;
- Build upon existing contiguous protected lands;
- Protect drinking water resources for future community water supply;
- Connect protected lands and other critical habitats with upland, aquatic, and/or riparian corridors;
- Better understand wildlife movement patterns to identify and design the most effective conservation corridors; and
- Promote community education and outreach regarding Bow's biodiversity and the importance of long-term protection strategies.

The following general recommendations were based on the findings of the project. These are considered as the next *Actions Steps* for future work to be considered in Bow while proceeding with community land use planning and education.

1. Incorporate the NRI, especially the Conservation Focus Areas map, into the Bow Master Plan adopted in 2018. This provides a vision for the town from which land use planning can be adopted. Also, continue working on the objectives and recommendations in the Natural Resources section of the Master Plan.

2. Build public support for the NRI through informational sessions, published materials, social media, and other means of community education and outreach. This will help to inform the community about its natural resources and future planning.

3. Use the Conservation Focus Areas (CFAs) as a tool for future land protection efforts through multiple approaches, including landowners willing to engage in land conservation, resource mitigation projects as part of proposed developments or habitat alteration, and land use regulations and zoning ordinances. However, as noted above there are areas outside of these CFAs that could be significant for land protection currently or into the future. Therefore, it is recommended that areas not identified herein should be considered on a case-by-case basis.

4. Use *Trails for People and Wildlife* (Stevens and Oehler 2019) to help guide planning for future trails and assess existing trails and their potential impacts on wildlife.

5. Develop stewardship plans for town-owned lands, incorporating data from this NRI with other existing information on these properties such as forest management plans. Typical elements addressed in stewardship plans include wildlife and habitats, rare species, soils, natural communities, invasive plants and forest pathogens, recreation, forestry, and cultural features. However, since each property is different there may be other aspects to consider. Stewardship recommendations should clearly address management goals and specifically outline short and long-term resource protection measures, including appropriate buffers around sensitive habitats and natural communities, rare plant populations, and cultural features, as well as management activities to foster the proper utilization and enhancement of natural resources.

6. Future habitat ground-truthing efforts should focus on verifying agricultural lands and their types of land use (i.e., row crops, pastures, hayfields, orchards, etc.); verification of potential vernal pools; documentation of mammal corridors through roadside winter tracking and wildlife cameras; and documentation of amphibian and reptile corridors through roadside surveys as these species travel from their wintering grounds to feeding and mating habitats.

7. Conduct an audit of current zoning regulations to better understand if and how they protect critical natural resources. This effort can illuminate certain land use planning techniques that Bow might want to consider adopting in an effort to support informed land use decisions for a more sustainable future. This could identify ways to use land more efficiently, encourage more compact development (such as the Open Space Residential Development regulations outlined in the Bow Zoning Ordinance), and allocate specific areas for conservation and development. The Town may want to review *Innovative Land Use Planning Techniques* developed by the NH Dept. of Environmental Services (2008) when revising or adopting new land use regulations.

8. Continue to work with adjacent communities on similar conservation initiatives of common interest. It would be helpful to meet annually with the Conservation Commissions within each of the adjacent communities to build strong relationships and create open lines of communication, as well as to inform these communities about Bow's conservation planning efforts.

9. Continue with community outreach and landowner education regarding Bow's natural resources and conservation planning. This can be accomplished in many ways, including workshops, hikes, and informational resources such as maps, that can be posted on the Conservation Commission website or shared through social media to help landowners with resource protection and management. A subcommittee of the Conservation Commission could be established to focus on outreach and education efforts. Bow could also consider supporting citizen science (also known as community science) programs to support community engagement by its residents to learn more about the town's biodiversity. A series of trainings for the iNaturalist program could be developed to teach residents how to use this technology as a way to gather information on Bow's biodiversity, as well as host special workshops such as seasonal Bioblitz events for public lands.

SOURCES

Bennett. K. 2010. Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire (2nd edition). UNH Cooperative Extension, Durham, NH.

Bow Conservation Commission. 2019-2020. Personal observations. Bow, NH.

Carpenter, M. 2000. Turee Pond fish surveys. NH Fish and Game, Concord, NH.

Carpenter, M. 2017. Turee Pond fish surveys. NH Fish and Game, Concord, NH.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. US Dept. of Interior, Fish and Wildlife Service, Washington D.C.

Federal Geographic Data Committee. 2013. *Classification of wetlands and deepwater habitats of the United States*. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington, DC.

Harnik, P., C. McCabe, and A. Hiple. 2017. 2017 City Parks Facts. Center for City Park Excellence, The Trust for Public Land.

Hunt, P. 2002. *Urban Bird Project*. Audubon Society of New Hampshire, Concord, NH.

Johnson, K. 2020. New Hampshire's Estimated Population Gain is the Largest in New England. Carsey School of Public Policy, University of New Hampshire, Durham, NH.

Littleton, J., L. Deming, and C. Kane. 2019-2020. Personal observations of wildlife in Bow. Moosewood Ecological LLC, Chesterfield, NH.

Klemarczyk, R. 2011. *Timber Cruise and Forest Management Plan of the Bow Town Forest System*. Forest Resources Consultants, Contoocook, NH.

Martin, C. 2021. Annual bald eagle surveys. NH Audubon, Concord, NH.

Mehrhoff, L. J., J. A. Silander, Jr., S. A. Leicht, E. S. Mosher and N. M. Tabak. 2003. *IPANE: Invasive Plant Atlas of New England*. Department of Ecology & Evolutionary Biology, University of Connecticut, Storrs, CT, USA.

New Hampshire Department of Environmental Services. 2008. *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development.* New Hampshire Department of Environmental Services, Concord, New Hampshire.

New Hampshire Department of Environmental Services. 2016. *Long term Variable Milfoil Management Plan, Turee Pond, Bow, NH.* New Hampshire Department of Environmental Services, Concord, New Hampshire.

New Hampshire Department of Environmental Services. 2020. *Volunteer Lake Assessment Program Individual Lake Reports: Turee Pond, Bow, NH.* New Hampshire Department of Environmental Services, Concord, New Hampshire.

New Hampshire Employment Security. 2021. Community Profiles Bow, NH. https://www.nhes.nh.gov/elmi/products/cp/profiles-htm/bow.htm

New Hampshire Fish and Game Department. 2015. *New Hampshire Wildlife Action Plan*. New Hampshire Fish and Game Department, Concord, New Hampshire.

New Hampshire Natural Heritage Bureau. 2020. *Rare Plants, Rare Animals, and Exemplary Natural Communities in New Hampshire Towns*. Concord, NH. www.nh.gov/nhdfl/documents/town-lists.pdf

NH Tree Farm Program. 2021. Map of Certified Tree farms in NH. www.nhtreefarm.org

RLS Demographics, Inc. 2016. State of New Hampshire Regional Planning Commissions: 2016 County Population Projections by Age and Sex. RLS Demographics, Inc., Rensselaerville, NY.

Rendall, N.B. 1989. Bow Wetlands Study and Prime Wetlands: A User's Guide. New England Environmental Associates, Inc., Concord, NH.

Scott M.J., G.R. Bilyard, S.O. Link, C.A. Ulibarri, H.E. Westerdahl, P.F. Ricci, and H.E Seely. 1998. Valuation of Ecological Resources and Functions. *Environ Manage*. 22(1):49-68.

Society for the Protection of New Hampshire Forests (SPNHF). 2005. *New Hampshire's Changing Landscape - Population Growth and Land Use Changes: What They Mean for the Granite State.* SPNHF, Concord, NH.

Sperduto, D.D. 2011. *Natural Community Systems of New Hampshire*. New Hampshire Natural Heritage Bureau, Concord, New Hampshire.

Sperduto, D.D. and William F. Nichols. 2011. *Natural Communities of New Hampshire.* UNH Cooperative Extension, Durham, New Hampshire.

Stekl, P.J. and S.M. Flanagan. 1997. Geohydrology and Water Quality of the Stratified Drift Aquifers in the Merrimack River Basin, South-Central New Hampshire. Water Resources Investigation Report 95-4123, US Geological Survey, Pembroke, NH.

Stevens, R. and J. Oehler. 2019. *Trails for People and Wildlife*. NH Fish and Game Department, Concord, NH.

Stone, A.J.L. 2016. *Natural Resources Inventory – A Guide for New Hampshire Communities and Conservation Groups.* UNH Cooperative Extension, Durham, New Hampshire.

Town of Bow. 2017. Bow Master Plan. Bow Planning Board, Bow, NH.

UNH Cooperative Extension. 2021. Farmlands. UNH Cooperative Extension, Durham, New Hampshire. https://extension.unh.edu/nhnriguide/nri-components/farmlands

US Environmental Protection Agency. 2021. Adapting to Climate Change: Northeast. www.epa.gov/sites/default/files/2016-07/documents/northeast_fact_sheet.pdf

APPENDIX A: GIS DATA AND USE DISCLAIMER

Moosewood Ecological LLC GIS Data Disclaimer

A variety of existing and newly created data layers were used to prepare the Natural Resources Inventory (NRI) maps. These existing data have been developed by numerous government agencies and other sources. They have been produced specifically for the town, the state of New Hampshire, or the entire United States using *remote data*. These sources of remote data were developed from the interpretation of satellite imagery, aerial photography, or LiDAR (Light Detection and Ranging) technology. The data were produced at various scales and therefore, represent different degrees of errors, omissions, and inaccuracies.

The NRI maps are for education and planning purposes only. They are suitable for general land use planning. However, they are not suitable for detailed site planning and design. The identification of wetlands requires a field delineation by a certified natural resources professional. As such, boundaries of all habitats, including wetlands and parcels are approximate locations and should be field verified. The accuracy of the data is the end user's responsibility, and Moosewood Ecological LLC cannot be responsible for the accuracy and completeness of the data. Moosewood Ecological LLC makes no warranty, expressed or implied, as to the accuracy or completeness of the data. Furthermore, Moosewood Ecological LLC shall assume no responsibility for any errors, omissions, or inaccuracies in the information provided.

GIS Data Layer	Source/Notes	Date
Town Boundary	NH GRANIT	2013
Tax Parcels	NH GRANIT	2014
Roads	NH Dept. of Transportation	2013
Streams	NH National Hydrography Dataset	2019
Ponds	NH National Hydrography Dataset edited by Moosewood Ecological LLC	2019 2019
NWI Wetlands	National Wetlands Inventory Plus reviewed accuracy from aerial photography by Moosewood Ecological LLC	2017 2019
Prime Wetlands	New England Environmental Associates	1989
Hydric Soils	USDA Natural Resources Conservation Service	2009
Watersheds	USDA Natural Resources Conservation Service/NH Dept. Environmental Services	2002
Conservation Lands	NH GRANIT Moosewood Ecological LLC/Kane Conservation/Bow Conservation Commission	2018 2020
Town-owned Lands	Town of Bow	2019
Aerial Photography	NH GRANIT	2015
Stratified Drift Aquifers	US Geological Survey	2000
Favorable Gravel Well Analysis	NH Dept. of Environmental Services	2010
Wildlife Habitats	NH Wildlife Action Plan field checked and verified by Moosewood Ecological LLC	2015 2019

GIS Data Layer	Source/Notes	Date
Highest Ranked Habitats in NH	NH Wildlife Action Plan	2015
Grasslands	Moosewood Ecological LLC/Kane Conservation	2019
	created from field work and aerial photography interpretation	
Vernal Pools	Moosewood Ecological LLC/Bow Conservation Commission	2019-2020
	created from field work and aerial photography interpretation	
Shrublands	Moosewood Ecological LLC/Kane Conservation	2019
	created from field work and aerial photography interpretation	
Transmission Lines	US Geological Survey	2003
	mapped as utility corridor shrublands	
Unfragmented Lands	NH Wildlife Action Plan	2015
Agricultural Soils	USDA Natural Resources Conservation Service	2009
Active Agriculture	Moosewood Ecological LLC/Kane Conservation	2019
	created from field work and aerial photography interpretation	
Forest Soils	USDA Natural Resources Conservation Service	2009
Conservation Focus Areas	Moosewood Ecological LLC/Kane Conservation	2020
	created from field work and GIS analyses	
Planning Trails for People and Wildlife	NH Fish and Game Department	2017
Resilient and Connected Landscapes	The Nature Conservancy	2016
Trails	Town of Bow	2019
Topography	US Geological Survey	2009

APPENDIX B: WILDLIFE SPECIES OF BOW

Birds

Scientific Name	Common Name
Anas platyrhynchos	Mallard
Archilochus colubris	Ruby-throated hummingbird
Ardea herodias	Great blue heron
Baeolophus bicolor	Tufted titmouse
Bombycilla cedrorum	Cedar waxwing
Bonasa umbellus	**Ruffed grouse**
Buteo jamaicensis	Red-tailed hawk
Buteo lineatus	Red-shouldered hawk
Buteo platypterus	Broad-winged hawk
Cardinalis cardinalis	Northern cardinal
Carduelis tristis	American goldfinch
Cathartes aura	Turkey vulture
Catharus fuscescens	**Veery**
Catharus guttatus	Hermit thrush
Certhia americana	Brown creeper
Ceryle alcyon	Belted kingfisher
Chaetura pelagica	**Chimney swift**
Colaptes auratus	Northern flicker
Contopus virens	Eastern wood-pewee
Corvus brachyrhynchos	American crow
Corvus corax	Common raven
Cyanocitta cristata	Blue jay
Dryocopus pileatus	Pileated woodpecker
Dumetella carolinensis	Gray catbird
Falco peregrinus anatum	**Peregrine falcon****
Geothlypis trichas	Common yellowthroat
Haemorhous mexicanus	House finch
Haemorhous purpureus	Purple finch
Haliaeetus leucocephalus	**Bald eagle*****
Hylocichla mustelina	**Wood thrush**
Icterus galbula	Baltimore oriole
Melanerpes carolinus	Red-bellied woodpecker
Meleagris gallopavo	Wild turkey
Melospiza melodia	Song sparrow
Mniotilta varia	Black-and-white warbler
Molothrus ater	Brown-headed cowbird
Myiarchus crinitus	Great-crested flycatcher
Parkesia motacilla	Louisiana waterthrush
Parkesia noveboracensis	Northern waterthrush
Pheucticus ludovicianus	Rose-breasted grosbeak
Picoides pubescens	Downy woodpecker
Picoides villosus	Hairy woodpecker

Bold = NH Species of Greatest Conservation Need
***** = NH Endangered
****** = NH Threatened
******* = NH Species of Special Concern

Birds (cont'd.)

Scientific Name	Common Name
Pipilo erythrophthalmus	**Eastern towhee**
Piranga olivacea	**Scarlet tanager**
Poecile atricapilla	Black-capped chickadee
Polioptila caerulea	Blue-gray gnatcatcher
Quiscalus quiscula	Common grackle
Regulus calendula	Ruby-crowned kinglet
Regulus satrapa	Golden-crowned kinglet
Sayornis phoebe	Eastern phoebe
Seiurus aurocapillus	Ovenbird
Setophaga caerulescens	Black-throated blue warbler
Setophaga coronata	Yellow-rumped warbler
Setophaga fuscus	Blackburnian warbler
Setophaga pensylvanica	Chestnut-sided warbler
Setophaga pinus	Pine warbler
Setophaga ruticilla	American redstart
Setophaga virens	Black-throated green warbler
Sitta canadensis	Red-breasted nuthatch
Sitta carolinensis	White-breasted nuthatch
Sphyrapicus varius	Yellow-bellied sapsucker
Spizella passerina	Chipping sparrow
Strix varia	Barred owl
Sturnus vulgaris	European starling
Tachycineta bicolor	Tree swallow
Troglodytes troglodytes	Winter wren
Turdus migratorius	American robin
Tyrannus tyrannus	Eastern kingbird
Vireo olivaceus	Red-eyed vireo
Vireo solitarius	Blue-headed vireo
Zenaida macroura	Mourning dove
Zonotrichia albicollis	White-throated sparrow

Bold = NH Species of Greatest Conservation Need
***** = NH Endangered
****** = NH Threatened
******* = NH Species of Special Concern

Mammals

Scientific Name	Common Name
Alces alces	**Moose**
Canis latrans	Eastern coyote
Castor canadiensis	American beaver
Erethizon dorsatum	North American porcupine
Felis rufus	Bobcat
Martes pennanti	Fisher
Mustela vison	Mink
Odocoileus virginianus	White-tailed deer
Peromyscus spp.	Deer or White-footed mouse
Procyon lotor	Raccoon
Sciurus carolinensis	Gray squirrel
Sylvilagus transitionalis	**New England cottontail***
Tamias striatus	Eastern chipmunk
Tamiasciurus hudsonicus	Red squirrel
Ursus americanus	Black bear
Vulpes vulpes	Red fox

Bold = NH Species of Greatest Conservation Need
***** = NH Endangered

Amphibians

Scientific Name	Common Name
Ambystoma maculatum	Spotted salamander
Bufo americanus	American toad
Eurycea bislineata	Northern two-lined salamander
Hyla versicolor	Grey tree frog
Lithobates catesbeiana	Bullfrog
Lithobates clamitans	Green frog
Lithobates palustris	Pickerel frog
Lithobates sylvatica	Wood frog
Notophthalmus v. viridescens	Red-spotted newt
Plethodon cinereus	Redback salamander
Pseudacris crucifer	Spring peeper

Bold = NH Species of Greatest Conservation Need
***** = NH Endangered
****** = NH Threatened
******* = NH Species of Special Concern

Reptiles

Scientific Name	Common Name
Chelydra serpentina	Common snapping turtle
Chrysemys p. picta	Eastern painted turtle
Clemmys guttata	**Spotted turtle****
Coluber constrictor constrictor	**Northern black racer****
Emydoidea blandingii	**Blanding's turtle***
Glyptemys insculpta	**Wood turtle*****
Heterodon platirhinos	**Eastern hognose snake***
Thamnophis s. sirtalis	Eastern garter snake

Fish

Scientific Name	Common Name
Anguilla rostrata	**American eel*****
Esox niger	Chain pickerel
Lepomis gibbosus	Pumpkinseed
Lepomis macrochirus	Bluegill
Micropterus salmoides	Largemouth bass
Notemigonus crysoleucas	Golden shiner
Perca flavescens	Yellow perch
Pomoxis nigromaculatus	Black crappie

Dragonfly

Scientific Name	Common Name
Gomphus quadricolor	**Rapids Clubtail*****

Bold = NH Species of Greatest Conservation Need
***** = NH Endangered
****** = NH Threatened
******* = NH Species of Special Concern

APPENDIX C: REPORTING WILDLIFE AND PLANT OBSERVATIONS

Citizen Science: A Role for Everyone

Citizen science, also known as community science, certainly has a role for everyone in the community to actively participate to better understand and document Bow's natural resources. Now more than ever, citizen science has taken on a more significant role in helping collect data on biodiversity. Residents of Bow are encouraged to report wildlife observations, as well as potential rare plants and invasive species, found on public properties or their own property. These observations can be reported in a variety of ways listed below. There is some critical initial information that residents should be aware of as part of the documentation process; however, each of the following sources for reporting will have their own requirements for submitting observations.

- Date and time of observation(s)
- Location (in general or GPS coordinates)
- Photographic documentation
- Species observed and abundance
- Diagnostic features that helped to identify species
- Basic habitat type
- Evidence of breeding, if applicable
- Any other pertinent notes

Bow Conservation Commission – Wildlife and Rare Plants
10 Grandview Road
Bow, NH 03304
conservation@bownh.gov

Bow Open Spaces – Wildlife
www.facebook.com/bowopenspaces

iNaturalist
www.iNaturalist.org

New Hampshire Fish and Game
General Wildlife
New Hampshire Wildlife Sightings

- nhwildlifesightings.unh.edu – online reporting; need to set up an account for submissions
- wildlife.state.nh.us/nongame – email and mail-in reporting; scroll to "Have a Wildlife Sighting to Report?"

Amphibians and Reptiles
New Hampshire Reptile and Amphibian Reporting Program (RAARP)
www.wildlife.state.nh.us/nongame/raarp-reporting.html

APPENDIX D: HABITAT BLOCK SIZE REQUIREMENTS FOR WILDLIFE

1-19 Acres	20-99 Acres	100-499 Acres	500-2,500 Acres	>2,500 Acres
raccoon	**raccoon**	**raccoon**	**raccoon**	**raccoon**
	hare	hare	hare	hare
				coyote
small rodent	**small rodent**	**small rodent**	**small rodent**	**small rodent**
	porcupine	**porcupine**	**porcupine**	**porcupine**
				bobcat
cottontail	**cottontail**	**cottontail**	**cottontail**	**cottontail**
	beaver	**beaver**	**beaver**	**beaver**
				black bear
squirrel	**squirrel**	**squirrel**	**squirrel**	**squirrel**
	weasel	weasel	weasel	weasel
		mink	**mink**	**mink**
				fisher
	woodchuck	woodchuck	woodchuck	woodchuck
		deer	**deer**	**deer**
muskrat	muskrat	muskrat	muskrat	muskrat
			moose	**moose**
red fox	**red fox**	**red fox**	**red fox**	**red fox**
songbirds	**songbirds**	**songbirds**	**songbirds**	**songbirds**
		sharp-shinned hawk	sharp-shinned hawk	sharp-shinned hawk
			bald eagle	**bald eagle**
skunk	skunk	skunk	skunk	skunk
		Cooper's hawk	Cooper's hawk	Cooper's hawk
		harrier	harrier	harrier
		broad-winged hawk	**broad-winged hawk**	**broad-winged hawk**
			goshawk	goshawk
		kestrel	kestrel	kestrel
			red-tailed hawk	**red-tailed hawk**
		great-horned owl	great-horned owl	great-horned owl
			raven	**raven**
		barred owl	**barred owl**	**barred owl**
		osprey	**osprey**	**osprey**
		turkey vulture	**turkey vulture**	**turkey vulture**
		turkey	**turkey**	**turkey**
most reptiles	**most reptiles**	**reptiles**	**reptiles**	**reptiles**
	garter snake	**garter snake**	**garter snake**	**garter snake**
	ring-necked snake	ring-necked snake	ring-necked snake	ring-necked snake
most amphibians	**most amphibians**	**most amphibians**	**amphibians**	**amphibians**
		wood frog	**wood frog**	**wood frog**

Wildlife noted in bold type have been documented in Bow as part of the Natural Resources Inventory project.

APPENDIX E: GIS ECOLOGICAL ASSESSMENT MODELS

Model Descriptions

The GIS models developed for the Bow NRI were centered around three themes: *water resources*, *ecological resources*, and *forest and agricultural resources*. These co-occurrence models rank all parcels in the same manner. They are based on a point system that is cumulative, providing a final overall rank for each parcel based on the input data. These three models were then combined to determine areas of highest natural resource value. This affords the opportunity to directly compare one parcel with another based on the three themes. A description of the maps and data used for each theme are provided below, followed by the three maps generated by each model. See pages 57-58 for more details on the selection criteria for Conservation Focus Areas.

Water Resources

This parcel-based GIS assessment model provides a sense of the relative water resources value for each parcel in Bow. It is one tool that helps the Bow Conservation Commission and other Town boards to identify conservation priorities. It also provides a basis from which the Town may proceed with conservation projects with willing landowners that are interested in protecting their property.

This assessment model ranks all parcels in the same manner. It is based on a point system that is cumulative, proving a final overall rank for each parcel. This affords the opportunity to directly compare one parcel with another. The assessment for each parcel included many attributes, including wetlands, hydric soils, ponds, streams, aquifers, favorable gravel well analysis, wellhead protection areas, NH designated corridor of the Merrimack River, regional conservation plans, size of the property, fragmentation, proximity to conserved lands, and rare species.

Ecological Resources

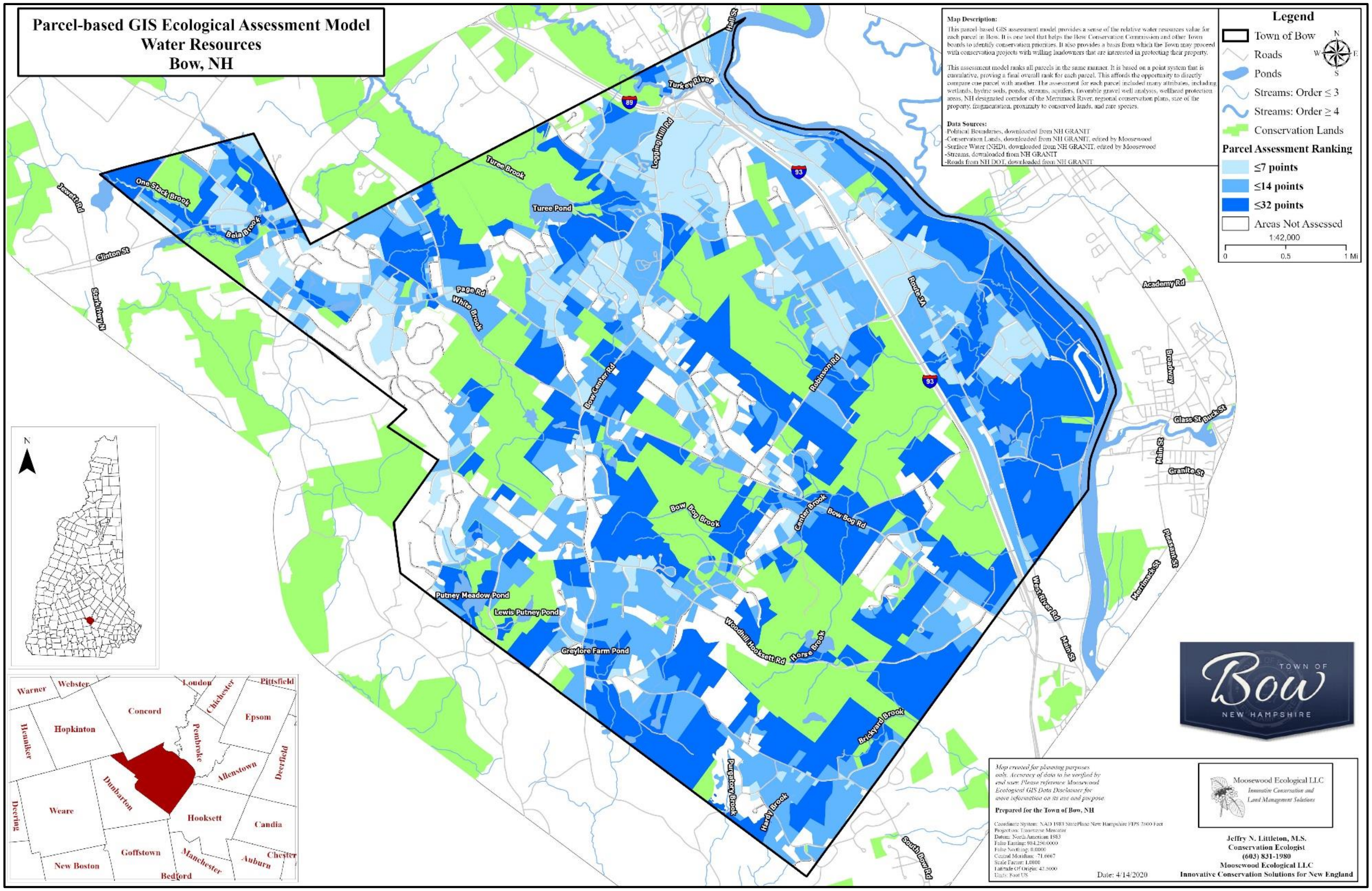
This parcel-based GIS assessment model provides a sense of the relative ecological resources value for each parcel in Bow. It is one tool that helps the Bow Conservation Commission and other Town boards to identify conservation priorities. It also provides a basis from which the Town may proceed with conservation projects with willing landowners that are interested in protecting their property.

This assessment model ranks all parcels in the same manner. It is based on a point system that is cumulative, proving a final overall rank for each parcel. This affords the opportunity to directly compare one parcel with another. The assessment for each parcel included many attributes, including wildlife habitats, declining/vulnerable habitats, rare/unique forest communities, regional conservation plans, size of the property, fragmentation, proximity to conserved lands, and rare species.

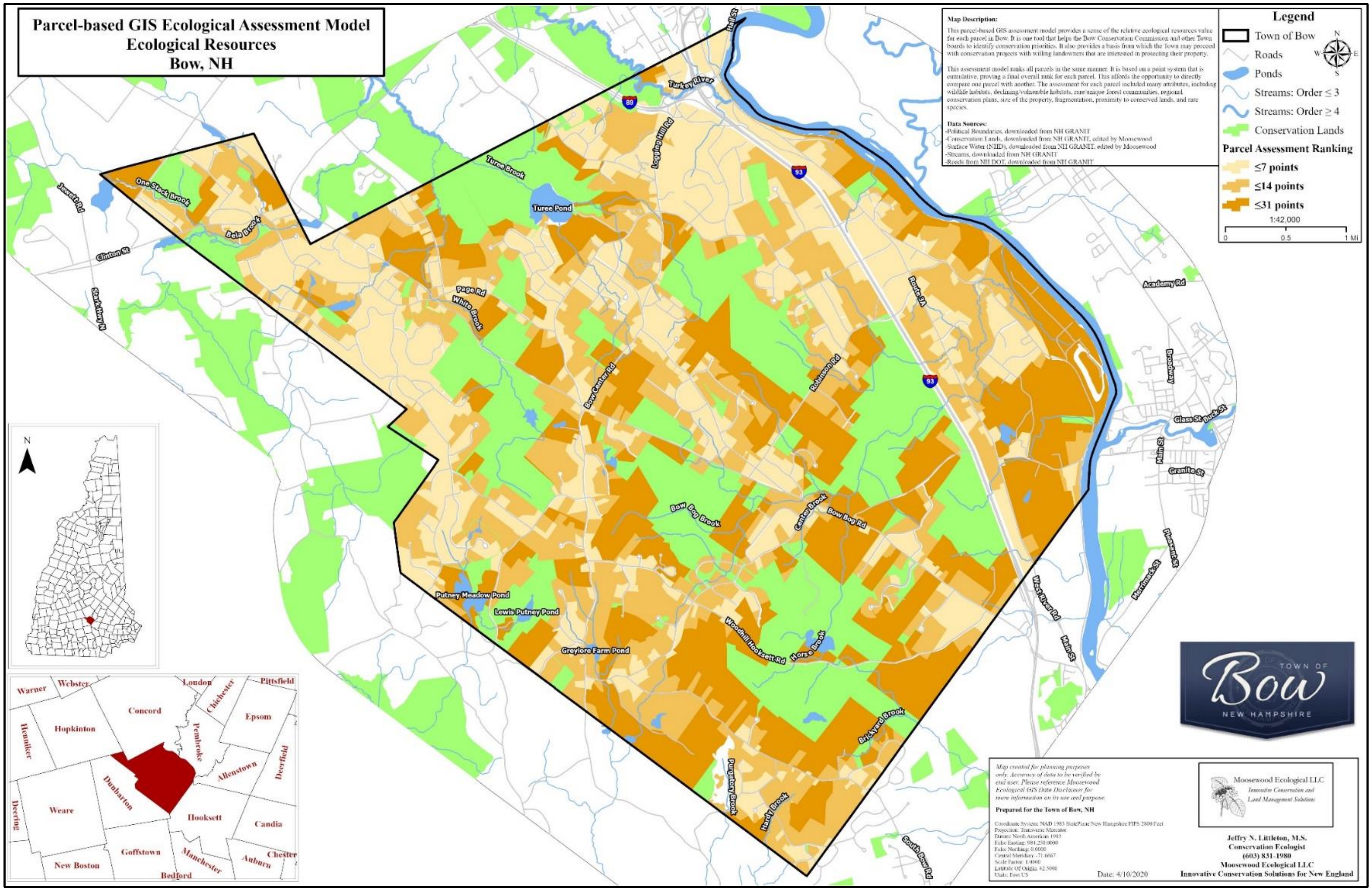
Forest and Agricultural Resouorces

This parcel-based GIS assessment model provides a sense of the relative agricultural and forest resources value for each parcel in Bow. It is one tool that helps the Bow Conservation Commission and other Town boards to identify conservation priorities. It also provides a basis from which the Town may proceed with conservation projects with willing landowners that are interested in protecting their property.

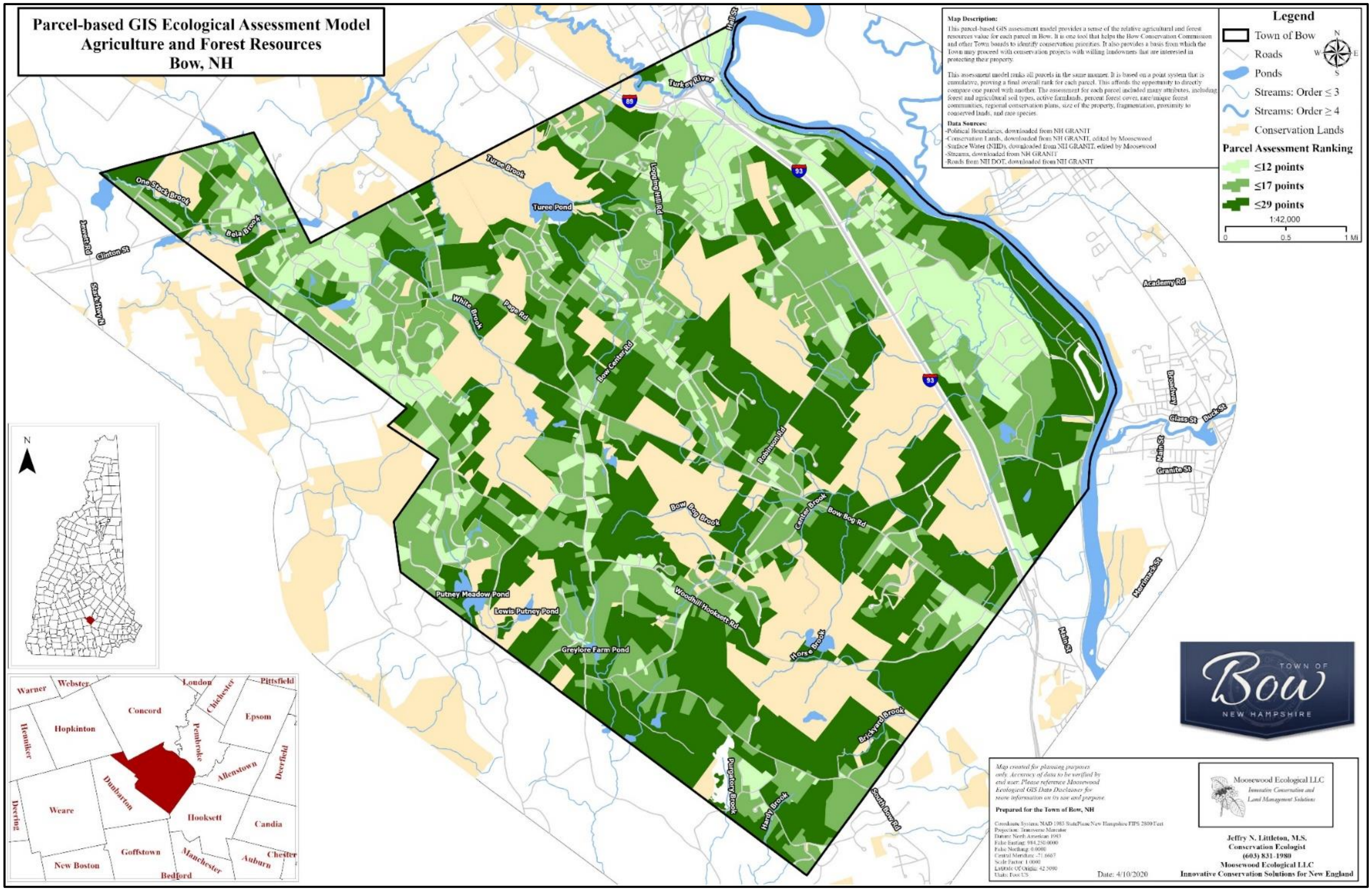
The assessment for each parcel included many attributes, including forest and agricultural soil types, active farmlands, percent forest cover, rare/unique forest communities, regional conservation plans, size of the property, fragmentation, proximity to conserved lands, and rare species.



Parcel-based GIS Ecological Assessment Model
Water Resources
Bow, NH
Map Description:
This parcel-based GIS assessment model provides a sense of the relative water resources value for each parcel in Bow. It is one tool that helps the Bow Conservation Commission and other Town boards to identify conservation priorities. It also provides a basis from which the Town may proceed with conservation projects with willing landowners that are interested in protecting their property.
This assessment model ranks all parcels in the same manner. It is based on a point system that is cumulative, proving a final overall rank for each parcel. This affords the opportunity to directly compare one parcel with another. The assessment for each parcel included many attributes, including wetlands, hydric soils, ponds, streams, aquifers, favorable gravel well analysis, wellhead protection areas, NH designated corridor of the Merrimack River, regional conservation plans, size of the property, fragmentation, proximity to conserved lands, and rare species.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conservation Lands, downloaded from NH GRANIT, edited by Moosewood
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
Legend
Town of Bow
Roads
Ponds
Streams: Order ≤ 3
Streams: Order ≥ 4
Conservation Lands
Parcel Assessment Ranking
≤7 points
≤14 points
≤32 points
Areas Not Assessed
1:42,000
0
0.5
1 Mi
N
S
E
W
Turkey River
One Stack Brook
Bela Brook
Turee Brook
Turee Pond
Logging Hill Rd
Hall St
Jewett Rd
Clinton St
Stark Hwy N
Page Rd
White Brook
Bow Center Rd
Robinson Rd
Route 3A
Academy Rd
Broadway
Glass St
Buck St
Main St
Granite St
Bow Bog Brook
Center Brook
Bow Bog Rd
Putney Meadow Pond
Lewis Putney Pond
Greylore Farm Pond
Woodhill Hooksett Rd
Horse Brook
West River Rd
Main St
Merrimack St
Pleasant St
Brickyard Brook
Purgatory Brook
Hardy Brook
South Bow Rd
89
93
Warner
Webster
London
Chichester
Pittsfield
Concord
Epsom
Henniker
Hopkinton
Pembroke
Allenstown
Deerfield
Dunbarton
Weare
Hooksett
Candia
Deering
Goffstown
Manchester
Auburn
Chester
New Boston
Bedford
TOWN OF
Bow
NEW HAMPSHIRE
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US
Date: 4/14/2020
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England



Parcel-based GIS Ecological Assessment Model
Ecological Resources
Bow, NH
Map Description:
This parcel-based GIS assessment model provides a sense of the relative ecological resources value for each parcel in Bow. It is one tool that helps the Bow Conservation Commission and other Town boards to identify conservation priorities. It also provides a basis from which the Town may proceed with conservation projects with willing landowners that are interested in protecting their property.
This assessment model ranks all parcels in the same manner. It is based on a point system that is cumulative, proving a final overall rank for each parcel. This affords the opportunity to directly compare one parcel with another. The assessment for each parcel included many attributes, including wildlife habitats, declining/vulnerable habitats, rare/unique forest communities, regional conservation plans, size of the property, fragmentation, proximity to conserved lands, and rare species.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conservation Lands, downloaded from NH GRANIT, edited by Moosewood
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
Legend
Town of Bow
Roads
Ponds
Streams: Order ≤ 3
Streams: Order ≥ 4
Conservation Lands
Parcel Assessment Ranking
≤7 points
≤14 points
≤31 points
1:42,000
0
0.5
1 Mi
N
S
E
W
Turkey River
Turee Brook
Turee Pond
One Stack Brook
Bela Brook
Jewett Rd
Clinton St
Stark Hwy N
Page Rd
White Brook
Logging Hill Rd
Route 3A
Robinson Rd
Bow Center Rd
Bow Bog Brook
Center Brook
Bow Bog Rd
Academy Rd
Broadway
Glass St
Bow St
Main St
Granite St
Pleasant St
Merrimack St
West River Rd
Putney Meadow Pond
Lewis Putney Pond
Greylore Farm Pond
Woodhill Hooksett Rd
Horse Brook
Brickyard Brook
Purgatory Brook
Hardy Brook
South Bow Rd
Hall St
Main St
89
93
N
Warner
Webster
Loudon
Chichester
Pittsfield
Concord
Epsom
Henniker
Hopkinton
Pembroke
Allenstown
Deerfield
Dunbarton
Weare
Hooksett
Candia
Deering
Goffstown
Manchester
Auburn
Chester
New Boston
Bedford
TOWN OF
Bow
NEW HAMPSHIRE
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US
Date: 4/10/2020
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England


Parcel-based GIS Ecological Assessment Model
Agriculture and Forest Resources
Bow, NH
Map Description:
This parcel-based GIS assessment model provides a sense of the relative agricultural and forest resources value for each parcel in Bow. It is one tool that helps the Bow Conservation Commission and other Town boards to identify conservation priorities. It also provides a basis from which the Town may proceed with conservation projects with willing landowners that are interested in protecting their property.
This assessment model ranks all parcels in the same manner. It is based on a point system that is cumulative, proving a final overall rank for each parcel. This affords the opportunity to directly compare one parcel with another. The assessment for each parcel included many attributes, including forest and agricultural soil types, active farmlands, percent forest cover, rare/unique forest communities, regional conservation plans, size of the property, fragmentation, proximity to conserved lands, and rare species.
Data Sources:
-Political Boundaries, downloaded from NH GRANIT
-Conservation Lands, downloaded from NH GRANIT, edited by Moosewood
-Surface Water (NHD), downloaded from NH GRANIT, edited by Moosewood
-Streams, downloaded from NH GRANIT
-Roads from NH DOT, downloaded from NH GRANIT
Legend
Town of Bow
Roads
Ponds
Streams: Order ≤ 3
Streams: Order ≥ 4
Conservation Lands
Parcel Assessment Ranking
≤12 points
≤17 points
≤29 points
1:42,000
0 0.5 1 Mi
Turkey River
Turee Brook
Turee Pond
One Stack Brook
Bela Brook
White Brook
Page Rd
Bow Center Rd
Robinson Rd
Bow Bog Brook
Center Brook
Bow Bog Rd
Woodhill Hooksett Rd
Putney Meadow Pond
Lewis Putney Pond
Greylore Farm Pond
Horse Brook
Brickyard Brook
Hardy Brook
South Bow Rd
Clinton St
Academy Rd
Broadway
Glass St
Main St
Granite St
Merrimack St
Warner
Webster
Loudon
Chichester
Pittsfield
Concord
Epsom
Hopkinton
Henniker
Pembroke
Allenstown
Deerfield
Dunbarton
Weare
Hooksett
Candia
Deering
Goffstown
Manchester
Auburn
Chester
New Boston
Bedford
TOWN OF Bow NEW HAMPSHIRE
Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on its use and purpose.
Prepared for the Town of Bow, NH
Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US
Date: 4/10/2020
Moosewood Ecological LLC
Innovative Conservation and Land Management Solutions
Jeffry N. Littleton, M.S.
Conservation Ecologist
(603) 831-1980
Moosewood Ecological LLC
Innovative Conservation Solutions for New England

APPENDIX F: TABLE OF CONSERVATION FOCUS AREAS

	Conservation Focus Area (CFA)	Size (ac)	Ecological Resources	Water Resources	Forestry & Ag Resources	Exemplary Comms/ Rare Species Supported	Aquifer/ Drinking Water	Prime Wetland	MVRCP	WAP Tier	Adjacent Conservation Land	Associated Unfragmented Block	TNC-resilience	Additional Notes
1	Turee Pond Wetland Complex	233	most-H	portion- H		Includes and adjacent to two wetland systems, providing addition protection to them	50% underlain by significant aquifer system; potential yield 75gpm	Most of the area	Most identified as High conservation value	Most of area Tier 2 & 3	Abuts contiguous conservation lands to the east associated with Turee Pond, totaling 418 acres	Eastern side associated with a 1,243-acre unfragmented block while the western section is associated with a 291-acre unfragmented block	50% Resilient Landscape	
2	Turee Pond South	57.8	100% H	75% H	75% H	Adjacent to exemplary wetland system, affords protection	Portions of 3 wellhead protection areas	Adjacent to prime wetland, protection of Turee Pond shoreline	100% High conservation value	Most Tier 3	Abuts contiguous conservation lands to the east associated with Turee Pond, totaling 418 acres	Associated with a 1,243-acre unfragmented block	50% Resilient Landscape	
3	Turee Pond Inlet	18.1					Portions of 2 wellhead protection areas	Adjacent to prime wetland, protection of Turee Pond shoreline	100% high conservation value	Tier 3 (most)	Abuts contiguous conservation lands to the west associated with Turee Pond, totaling 418 acres	Associated with a 1,243-acre unfragmented block	50% Resilient Landscape	Provides upland buffer to Turee Pond wetlands and a major tributary stream

	Conserva-tion Focus Area (CFA)	Size (ac)	Ecological Resources	Water Resources	Forestry & Ag Resources	Exemplary Comms/ Rare Species Supported	Aquifer/ Drinking Water	Prime Wetland	MVRCP	WAP Tier	Adjacent Conserva-tion Land	Associated Unfrag-mented Block	TNC-resilience	Additional Notes
4	White Brook Wetlands	278.9	75% H		50% H	Rare species habitat		Prime wetland	100% H	Some Tier 3	Made up of 2 areas that abut contiguous conserva-tion lands associated w/Walker Town Forest and other protected lands, totaling 533 acres	Associated with an 841-acre unfragmented block	100% as resilient	
5	Three Stone Walls	121.9				Rare species and rare habitat			50% high	25% Tier 3	Abuts and surrounds contiguous conserva-tion lands totaling 44 acres	Associated with a 123-acre unfragmented block	80%	Completes protection of headwaters of a major Turee Pond tributary stream
6	Knox Forest Extension	341.9	100% H		100% H	Rare spp habitat incl vernal pools		Adjacent to prime wetland	90%		Yes		40%	
7	Bow Bog Brook East	88.7	100% H	50% H	100% H	Rare species habitat including vernal pools	Supports wellhead protection area		100%	90% T1,2,3	Yes			½ mile of Bow Bog Brook & tributary

	Conserva-tion Focus Area (CFA)	Size (ac)	Ecological Resources	Water Resources	Forestry & Ag Resources	Exemplary Comms/ Rare Species Supported	Aquifer/ Drinking Water	Prime Wetland	MVRCP	WAP Tier	Adjacent Conserva-tion Land	Associated Unfrag-mented Block	TNC-resilience	Additional Notes
8	Bow Bog Brook West	219.3	Nearly 100% high	50% H	Nearly 100% high	Supports rare species habitats, incl vernal pools	Supports wellhead protection area		100% H	90% of the area identi-fied as Tier 1, 2, and 3	Yes; 1,237 acres	879 ac	80%	Protects the headwaters of two main tributaries of Bow Bog Brook
9	Merrimack River	463.6	Nearly 100% H	75% H	50% H	Rare habitat such as floodplain forests, river shoreline, and shrublands	Supports wellhead protection areas 100% aquifer for future comm water supplies		50% H	100% of the area identifie d as Tier 1, 2, and 3	Consoli-dates and enhances protection of 4 Town parcels and an easement	2,522 ac		Protects 1.5 mi of lower Bow Bog Brook
10	Nottingcook Forest East	342.5	100% H		100% H	Rare species habitat such as vernal pools and shrublands	Supports wellhead protection area	Supports prime wetland	100%	100% of the area identifie d as Tier 1, 2, and 3	Abuts contiguous conservatio n lands totaling 1,237 acres	2621 ac	75%	Completes protection of Hornbeam Swamp and The Meadow
11	Nottingcook Forest South	543.1	100% H	Small portion H	95% H	Rare species habitat such as vernal pools and shrublands;	Supports wellhead protection area		100% H	100% of the area identifie d as Tier 1, 2, and 3		2,621-acre	73%	Protects portions of Steer Brook and Brickyard Brook

	Conserva-tion Focus Area (CFA)	Size (ac)	Ecological Resources	Water Resources	Forestry & Ag Resources	Exemplary Comms/ Rare Species Supported	Aquifer/ Drinking Water	Prime Wetland	MVRCP	WAP Tier	Adjacent Conserva-tion Land	Associated Unfrag-mented Block	TNC-resilience	Additional Notes
12	South Bow Road Wetlands Complex	639.7	50% H	Small H		Rare wildlife species; rare species habitat, including grasslands, shrublands, vernal pools, and other wetlands				50% of the area identi-fied as Tier 1, 2, and 3 WAP		3 distinct large unfragmented blocks totaling 1,481 acres	75% Resilient with Confirmed Diversity Landscape; 15% is ranked as Resilient Landscape	
13	Putney Meadow Pond	148.8	100% H	100% H	100% H	Rare wildlife species; rare species habitat, including grasslands, vernal pools, and other wetlands			100% H	Supports Tier 3	Abuts conserva-tion lands totaling 163 acres; Protects 95% of Putney Meadow Pond and significant adjacent upland;	Associated with 2 distinct unfragmented blocks totaling 755 acres	80% resilient	Provides habitat connection between conservation lands.
14	Robinson Road Forest South	200.6	100% H	Supports high-ranked water resources	100% H	Rare wildlife species habitat, including shrublands vp and marshes; and rare wildlife		Supports prime wetland	100% H	100% Tier 1,2,3	Abuts contiguous conservatio n lands such as Bow Bog Brook, totaling 661.1 acres	1,114-acre unfragmented block		Enhances protection of Bow Bog Brook watershed and a tributary stream

	Conserva-tion Focus Area (CFA)	Size (ac)	Ecological Resources	Water Resources	Forestry & Ag Resources	Exemplary Comms/ Rare Species Supported	Aquifer/ Drinking Water	Prime Wetland	MVRCP	WAP Tier	Adjacent Conserva-tion Land	Associated Unfrag-mented Block	TNC-resilience	Additional Notes
15	Horse Brook	142.5	100% H	100% H	100%H	Rare species habitat such as shrublands and vernal pools			100% H	100% Tier 1, 2, and 3	Abuts contiguous conserva-tion lands totaling 1,237 acres	Associated with a large 2,621-acre unfragmented block	30% Resilient with Confirmed Diversity Landscape; 15% Resilient Landscape	Protects 2/3 mile of Horse Brook
16	Audley Divide Tract	56.4			Supports active ag lands	Rare species habitat such as grasslands			100% H	Supports Tier 2 and 3 WAP habitat	Abuts conserva-tion land in Dunbarton, enhancing its protection	Associated with a large 2,114-acre unfragmented block	100% Resilient with Confirmed Diversity Landscape	