Town of Atkinson
New Hampshire

NATURAL RESOURCES INVENTORY

Prepared for the Atkinson Conservation Commission
by the Rockingham Planning Commission
as part of the
I-93 Community Technical Assistance Program

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Cover Photo of Stewart Farm Pond provided courtesy of Paul Wainwright

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1.0 Introduction

1.1 Overview

The Town of Atkinson Natural Resources Inventory provides detailed descriptions, statistics and maps of significant natural resources in the community. This inventory is intended to be used for the following purposes:

- Provide information for natural resource based policy development and management plans
- Guide open space preservation plans, land acquisition, and voluntary stewardship initiatives, and citizen participation
- Guide development of zoning and development regulations that serve to protect, preserve and enhance natural resources
- Guide use of public funds and other financial resources aimed at land and natural resource preservation
- Inform residents, business owners, neighboring communities and organizations involved in land and resource protection, management and regulation of the town's goals relating to natural resources

This inventory and the maps contained herein may be particularly useful to the planning board and conservation commission in evaluating site plan review and subdivision applications, developing zoning ordinances and regulations, and updating the town's master plan.

1.2 Natural Resources of Atkinson

Forests are the dominant land cover in Atkinson, covering approximately 57 percent of the total area of town with nearly 41 percent retained as large unfragmented blocks. Preservation of large unfragmented blocks offers the many benefits:

- *Preserves rural character*
- *Attracts investment by residents and businesses seeking high quality of life*
- *Revitalizes town and village centers by promoting compact development using the principles of Smart Growth*
- ~~*Supports resource based tourism economy*~~
- *Helps prevent flooding and flood related damage*
- *Protects farms and agricultural lands*
- *Promotes sustainable development patterns*
- *Protects environmental resources (water, aquifers, air, forests)*
- *Provides recreational and educational opportunities*
- *Preserves wildlife habitat and corridors*

State and local agricultural soils are particularly prevalent. The town also contains significant acreage identified in the NH Wildlife Action Plan as High Quality Habitat.

Atkinson has close to 20 percent of its total land and water under some level of protection or conservation. This statistic is a common land preservation goal among many communities,

though some strive to exceed 20 percent conserved lands in order to protect sensitive resources, particularly water supply watersheds and aquifers and agricultural lands.

Table 1. Summary of natural resources and acreage in Atkinson

Resource	***Acres***	***% town***
Agricultural Soils	3,502.8	48.0%
Rivers and Streams	20.5 linear miles	--
Lakes and Ponds	109	1.5
Floodplain- Flood Hazard Areas	297	4.1
Freshwater Wetlands	589.6	8.1
Designated Prime Wetlands	255	3.5
Stratified Drift Aquifer	473	6.5
Forested Lands	4,137	56.7
NH Wildlife Action Plan - High Quality Habitat and Supporting Landscapes	4,382.4	60.1
Conservation Lands	1,439	19.7
Unfragmented Blocks	3,017	41.4
Land	7,168	98.6
Water	128	1.7

2.0 Natural Conditions and Landscape

2.1 Physiography

The U.S. Forest Service has classified various sections of the country based on ecological and environmental characteristics – the Ecoregional Subsections classification and the Watershed Group classification. The Ecoregional Subsections classification was based on land formations, geology, topography, regional climate, and dominant natural vegetation (see graphic below). The boundaries were refined based on how natural communities were more common in different groups of non-living factors. The U.S. Forest Service has divided New Hampshire into the following three principal biophysical or ecological regions and subsections:

Principal Regions ***Southern New England Coastal Plain - Hills Section (southeastern NH)***
Vermont-New Hampshire Upland Section (southwestern NH)
White Mountain Section (northern NH)

Subsections of the Southern New England Coastal Plain and Hills Section
Gulf of Maine Coastal Lowland (immediate coastal region)
Gulf of Maine Coastal Plain (southern portion)
Sebago-Ossipee Hills and Plain (northern portion)

Atkinson is part of the Southern New England Coastal Plain and Hills section and the Gulf of Maine Coastal Plain subsection.

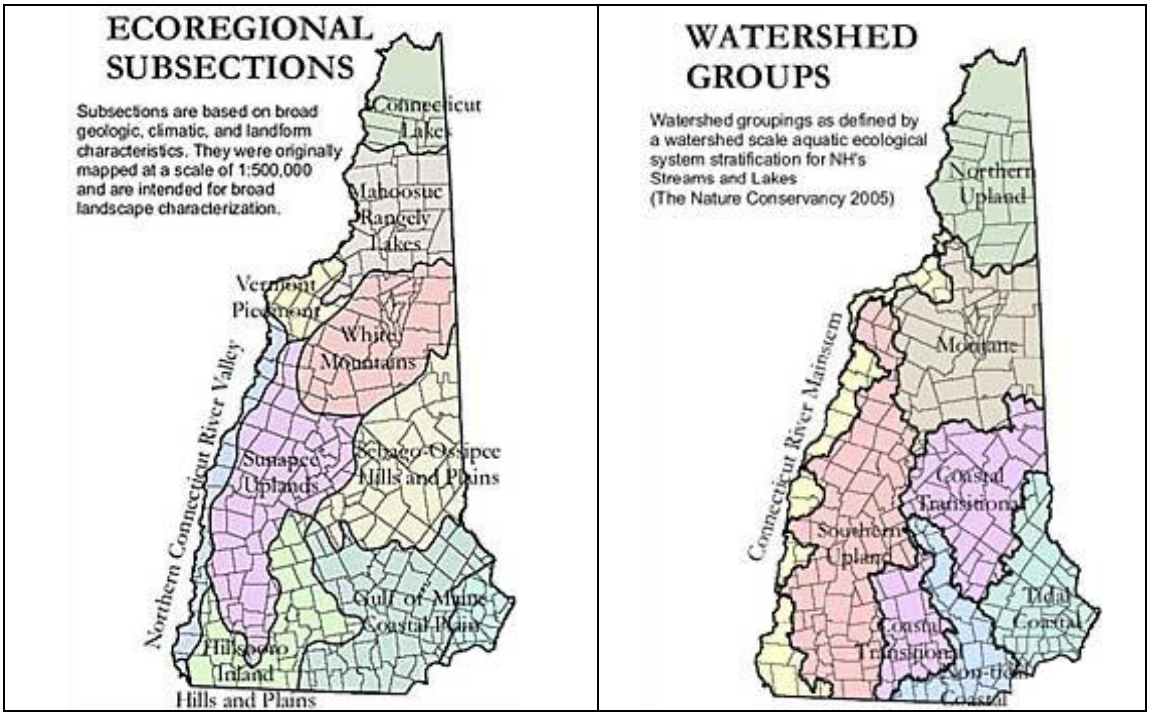


Figure 1. Ecoregional subsections and watershed group classifications of New Hampshire

Topography

The topography of Atkinson is variable throughout the town, with a scattering of hills separated by streams, brooks and large wetland complexes. Elevations range from a high of 426 feet to 295 feet above sea level.

Table 2. Major topographic features and elevations

Topographic Feature	*Elevation (feet)*
Hog Hill	426.5
Providence Hill	337.9
Pine Knoll	377.3
Bragg Hill	308.4
Poor's Hill	295.3

Steep Slopes

In general terms, the U.S. Department of Agriculture, Soil Conservation Service recommendations special management practices for certain activities on steep slopes based on specific properties of the overlying soil including erodibility, grain size and composition, aspect, slope and elevation.

For the purposes zoning and regulation, most communities define steep slopes in the range of 15 and 20 percent. The goals of limiting and/or regulating land base activities on steep slopes are to:

- Manage stormwater effectively
- Prevent erosion and sedimentation
- Control flooding of uplands and within drainage systems
- Minimize land disturbance
- Protect water quality and ecologically sensitive habitat

Development on steep slopes simply requires greater land disturbance to construct roads and buildings, and more infrastructure to manage runoff and prevent erosion.

2.2 New England Climate

New England weather and climate are among the most varied in the world, including extremes of both hot and cold temperatures, droughts, heavy rainfall, hurricanes, tornadoes, blizzards, and other severe weather. These great variations in New England weather are influenced by many factors relating to the physical geographical setting, including the region's latitude and coastal orientation.

There are four important components that dominate New England climate. First, the area is located about halfway between the equator and the North Pole, receiving both warm-moist air from the south and cold-dry air from the north, often in rapid succession. Second, the region is dominated by a cold water current along its east coast (Maine, New Hampshire, and eastern Massachusetts) and a warm water current along the south shore (Connecticut, Rhode Island, and southern Massachusetts). The sea breeze circulation, particularly along New England's east coast, tends to regulate frequencies and intensities of thunderstorms in the coastal zone, while

bringing relief of peak summer temperatures. In winter, coastal waters remain warm relative to land areas, influencing snow-rain boundaries, which are difficult for forecasters to predict. Third, since New England falls primarily in the zone of the westerly's, the area is dominated by drier continental airflow from various areas across North America, rather than having a prevailing flow from off of the Atlantic Ocean. Fourth, New England has mountainous topography which also influences weather patterns. Mountains can enhance precipitation on the windward side, and create drier conditions on the downwind slopes, known as the "rain shadow" effect.

As a result of New England's position relative to the polar front, its continental climate type, its coastal orientation, and the mountainous topography, the region's weather is notoriously variable seasonally.[1]

2.3 New Hampshire Geology

The geology of the Seacoast region consists of fractured metamorphic bedrock that is overlain by glacial materials deposited during the last glaciation, which ended between 12,000 and 5,000 years ago. Glacial stratified-drift aquifers (consisting of layers of sand, gravel, clay, and silt) cover about 18 percent of the Southern New Hampshire region and 6.5 percent of Atkinson. These deposits are generally more productive source of water than the local bedrock aquifer.

2.4 Soil Types and Conditions

General Soil Types

Atkinson's soils fall into five major soil groups which are characterized generally as well-drained loamy soils and soils derived from glacial and glacial outwash material. The dominant soil type is the Paxton-Woodbridge-Hollis group comprising 4,082.1 acres covering the central and eastern portions of town.

Table 3. General soil types and acreage

Soil Type	***Description***	***Acres***
Canton-Chatfield-Hollis	Well drained and somewhat excessively drained, very deep to shallow, mineral and loamy soils that are gently sloping to steep; form mountains, hills and ridges that have many basins and narrow drainageways	2,283.2
Hinckley-Windsor-Canton	Very deep excessively drained soils derived from glacial outwash; form eskers, kames, terraces, deltas and outwash plains	640.7
Canton-Montauk-Paxton	Well drained, loamy soils that are gently sloping to steep; form broad hills, and found in wide areas between hills, and in many narrow	44.9

[1] New Hampshire State Climate Office, University of New Hampshire Airmap website at http://airmap.unh.edu/background/ClimatePrimer.html

	drainageways	
Paxton-Woodbridge-Hollis	Well drained and somewhat excessively drained soils that formed in (compact) glacial till; form hills and ridges	4,082.1
Canton-Scituate-Montauk	Very deep, moderately well drained soils formed in compact glacial till	71.3

Soil Conditions

Soil is a significant yet often overlooked natural resource. It forms the landscape upon which land use happens. Because soil is the foundation for all land uses, the condition of the soil is an important factor in all land use decisions. Current and accurate soil information provides the Planning Board with a tool with which to make informed decisions regarding land use and natural resource protection.

The Rockingham County Soil Survey was completed in 1994 by the U.S. Department of Agriculture Soil Conservation Service in cooperation with the New Hampshire Agricultural Experiment Station. Developed according to the National Cooperative Soil Survey standards by soils scientists, the soil survey identifies distinct properties and characteristics of different soil types, from which certain predictions are made about the suitability of a soil for different uses. The soil survey also includes a soils map showing the distribution of soil types.

Soil Drainage Class
One important characteristic of a soil is its drainage class. The soil drainage class relates to the ability of water to pass through the soil (soil permeability). Drainage class can indicate the presence or absence of wetlands and poorly drained soils, the ability of soil to infiltrate stormwater runoff, and the capacity of soil to filter pollutants. This information is invaluable to the Planning Board in evaluating development proposals and planning for growth in areas where soil conditions are appropriate for development.

Soil Development Potential

The Rockingham County Conservation District (RCCD) with the Soil Conservation Service developed *Soil Potentials for Development, Rockingham County* (May 1987), a system for rating soil based on its development potential. This approach classifies soils on the basis of the relative quality of a soil for development when compared with other soils in the County. Soil potential ratings take into consideration the capability or difficulty of developing dwellings, septic systems, roads and streets, and other development on a given soil type. Ratings include five categories – very high, high, medium, low and very low potential. The RCCD promotes the retention of important farmland soils and the protection of wetlands.

Atkinson's soils with the highest development potential are located predominantly in southern and eastern areas of town. Soil potential ratings and corresponding soil acreage is summarized in Table 4 below. *Refer to Map 2-General Soils, and Soil Potential and Suitability for Development.*

Table 4. Summary of soil potential ratings

Soils Potential Rating	Acres	% total area
Very High	659.2	9.1
High	2,158.2	29.7
Medium	2,050.1	28.2
Low	865.0	11.9
Very Low	1,349.2	18.4
No Rating	171.5	2.4
Total	***7,253.2***	---

The soil development potential by category in Atkinson is described below:

659.2 acres are classified as having a *very high development potential*, meaning soil performance is at or above local standards. These soils are typically located in wide valleys between hills and in the lower portions of narrow drainages.

2,158.2 acres are classified as having *high development potential*, meaning soil performance is at or above local standards. The cost associated with overcoming development limitations are low due to favorable soils conditions. These soils are typically located in the upper portions of wide valleys between hills and narrow drainages.

2,050.1 acres are classified as having a *medium development potential*, meaning that soil limitations add significantly to the cost of development. These soils are typically located in on or surrounding areas of highest elevation and in the lower portions of narrow drainages.

865.0 acres are classified as having a *low development potential*, meaning that soil limitations are costly to overcome. These soils are typically comprised of poorly drained soils adjacent to wetlands.

1,349.2 acres are classified as having a *very low development potential*, meaning that wet soils or severe slopes cause development to be economically unfeasible. These soils typically comprise very poorly drained soils and wetlands.

The remaining 171.5 acres (2.4 percent) of Atkinson's land area is considered to be non-classified due to alterations of natural soil conditions. This land includes gravel pits, urban development, roads ~~and the municipal landfill.~~

The soil potential rating system can provide important information for determining the location and density of development whether it is served by municipal water and sewer services or not. Because Atkinson does not have municipal water and sewer systems, the value of the soil potential rating system is of particular importance for the siting of development and redevelopment in environmentally sensitive areas. As areas with highest development potential are developed, there will be a greater focus on developing the less desirable lands, including those areas without municipal water and sewer services.

With growth and increases in impervious surfaces and stormwater volume, the ability of soil to infiltrate runoff will become an important consideration in protecting public and environmental interests including: maintaining capacity of the municipal drainage infrastructure, recharging

groundwater and protecting the quality of surface waters. In order to protect these interests, the town may consider revisions to land use ordinances and regulations to address development on lands with limited potential and those areas not served by municipal water and sewer services.

2.5 Agricultural Activities and Farmland Soils

Agricultural Activities

Once considered to be a farming community, agriculture declined in Atkinson as economics and land values compromised the viability of the small farm throughout the southern New Hampshire region. Farmers have sold their land for development or stopped farming and allowed their fields to grow wild again. Since 1962, Atkinson has lost approximately 484 acres of active agricultural lands. However, since 1998, there has been a minor increase in the acreage of active agricultural lands and small farmsteads, as well as small scale hobby "farming" which produces a variety of products including maple syrup, hay, fruits, vegetables, flowers, and honey.

The U.S. Department of Agriculture defines a farm for data collection purposes as "any operation that sells at least one thousand dollars of agricultural commodities or that would have sold that amount of produce under normal circumstances."

Table 5. Summary of farmland types and changes in acreage from 1962 to 2005

	Statistics Reported in Acres			
Land Use	**1962**	**1974**	**1998**	**2005**
Active Agriculture	740.4	397.2	207.6	256.4
Farmsteads	23.4	22.1	12.8	36.6
Other Open Space/cultivated	147.4	307.9	227.7	92.3

Local Agricultural Activity and Farms

Atkinson has a number of active farms and other agricultural activities that take place on a smaller scale. Following is a listing of farms and other forms of active agriculture in the community and the products produced:

Farm/Property Owner	Products
Child	horses
Cogswell Farm	hay, open space lands
Debeche	hay, honey
Derby Talk Farm	horse riding lessons and training
Destiny Farm	vegetables, bedding plants
Fairbanks	honey
Hi-Wood Acres	cattle
Lewis Farm	cattle, hay, forage crops
Marow	race horses
Shannon Trails	horse boarding and training
Winchell	flowers, vegetables
Stewart property	tree farm
~~Witley property~~	~~tree farm~~

~~*Page Farm*~~

~~Page Farm is the oldest commercial agricultural operation in Atkinson. As documented in *Atkinson Then and Now* (1999, Atkinson Historical Society), the Page homestead has remained in the family for 250 years, currently owned by the Brown family. Through the 1800's and early 1900's farming activities consisted of several hundred apple trees, thirty milk cows, and production and sale of fire wood and lumber.~~

Farmland Soils

In NH, agricultural soils are identified in three categories: Prime Farmland Soils, Farmland Soils of Statewide Importance, and Farmland Soils of Local Importance. Atkinson has 2,109 acres of Prime Farmland soils, 1,023 acres of Farmland Soils of Statewide Importance, and 370 acres of Farmland Soils of Local Importance. Farmland soils in Atkinson comprise 48.3 percent of the total land area of the town and 2.8 percent of the total acres of farmland soils in Rockingham County. The farmland soil types are summarized in the table below and a list of farmland soil map units are on Map 3-Agricultural Soils in Appendix D.

Table 6. Farmland soil types in Atkinson and Rockingham County

Farmland Soil Type	Acres in Atkinson	% total land area of Atkinson	Acres in Rockingham County
Prime Farmland Soils	2,109.3	29.4	36,347
Farmland Soils of Statewide Importance	1,023.1	14.3	38,767
Farmland Soils of Local Importance	370.4	5.2	51,658
Total	***3,503***	***48.9***	***126,772***

Total Land Area of Atkinson = 7,168 acres

Prime farmland soils and Farm Soils of Statewide Importance are predominantly concentrated in southern and central areas of town. Prime farmland soils comprise large tracts of land in the southern and central areas, with smaller areas of Farm Soils of Statewide Importance contiguous with and providing connections between them. Small tracts of Farmland of Local Importance are scattered throughout town. *Refer to Map 3-Agricultural Soils in Appendix D.*

Prime Farmland Soils

Prime Farmland is land which has the best combination of physical and chemical characteristics for the production of crops. It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops when treated and managed, including water management, according to current farming methods. Prime Farmland must have been used for the production of irrigated crops at some time during the two update cycles prior to the mapping date. It does not include publicly owned lands for which there is an adopted policy preventing agricultural use. Prime Farmland must meet all the following criteria: water, soil temperature range, acid-alkali balance, water table, soil sodium content, flooding, erodibility, permeability, rock fragment content, and rooting depth.[2]

[2] USDA-Soil Conservation Service, Land Inventory and Monitoring (LIM) System

Farmland Soils of Statewide Importance

Farmland of Statewide Importance is land other than Prime Farmland which has a good combination of physical and chemical characteristics for the production of crops. It must have been used for the production of irrigated crops at some time during the two update cycles prior to the mapping date. It does not include publicly owned lands for which there is an adopted policy preventing agricultural use. Farmland of Statewide Importance must meet all the following criteria: water, soil temperature range, acid-alkali balance, water table, soil sodium content, flooding, erodibility, and rock fragment content.[3]

Farmland Soils of Local Importance

Farmland of Local Importance is either currently producing crops, has the capability of production, or is used for the production of confined livestock. Farmland of Local Importance is land other than Prime Farmland or Farmland of Statewide Importance. This land may be important to the local economy due to its productivity or value. It does not include publicly owned lands for which there is an adopted policy preventing agricultural use.[4]

2.6 Recommendations

NCL1 Amend existing zoning ordinances (such as Article VI: Rural Cluster Residential Development ordinance) and land development regulations to encourage and provide incentives to preserve important farmland soils and existing agricultural activities.[5]

NCL2 Encourage and promote continued use and productivity of farmland soils by supporting farmers to maintain viable agricultural operations and activities that support agriculture. This may include organizing an Agricultural Committee or Commission, developing an agricultural based newsletter and calendar of annual events, or holding other agriculturally oriented civic and public events.

NCL3 Conduct an audit of zoning ordinances and land development regulations to evaluate whether barriers to agricultural activities exist (i.e. using the 'Farm Friendly Checklist').

NCL4 Draft performance standards for development on steep slopes (>15 percent) that address water quality, erosion, land stability and land disturbance.

[3] USDA-Soil Conservation Service, Land Inventory and Monitoring (LIM) System
[4] USDA-Soil Conservation Service, Land Inventory and Monitoring (LIM) System
[5] Refer to the NH Department of Environmental Services '*Innovative Land Use Planning Techniques Handbook: Chapter 1.4 Conservation Subdivision*' at http://des.nh.gov/organization/divisions/water/wmb/repp/innovative_land_use.htm

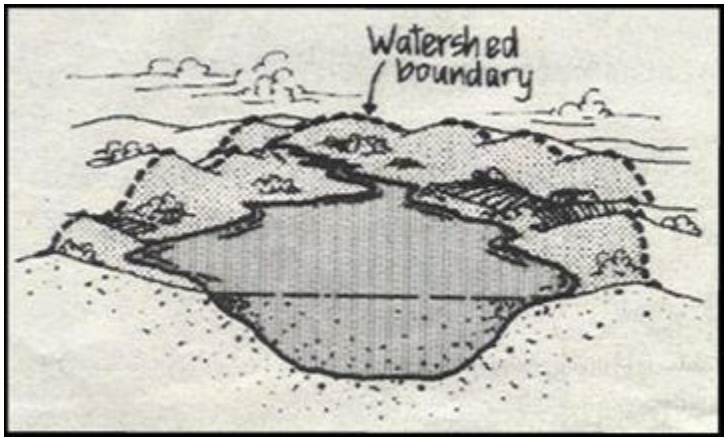
3.0 Surface Water Resources

3.1 Watersheds

What is a Watershed?

A watershed is the area of land that drains to a particular surface water body. "Watershed" is synonymous with other terms you may have heard such as "drainage basin" and "catchment area." All precipitation that falls within a watershed, but is not used by existing vegetation, will ultimately seek the lowest points. These low points are bodies of water such as rivers, lakes, and finally the ocean. The network formed by streams, rivers, lakes and ponds forms the surface drainage system of the watershed. Topography defines the boundary of a watershed. The boundary of a watershed is defined by the highest elevations surrounding the land area containing the drainage system.

Figure 2. Geography of a watershed



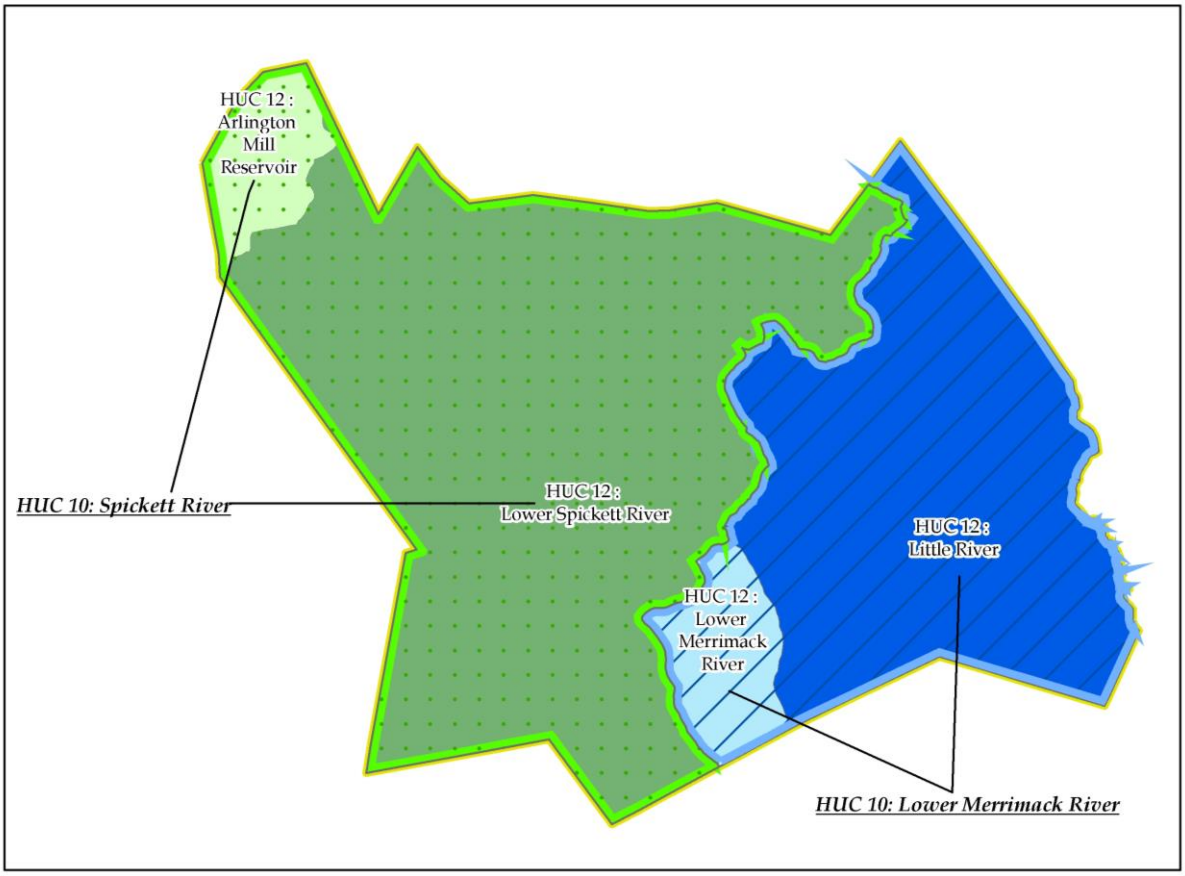
[Source: Lamprey River Advisory Committee website]

Salem is located entirely within the larger Merrimack River watershed (HUC 8). Within this watershed, Salem has 2 sub-watersheds – the Lower Merrimack River and Spickett River watersheds (HUC 10), and 4 yet smaller sub-watersheds – the Litte River, Lower Merrimack River, Lower Spickett River and Arlington Mill watersheds (HUC 12).

The location and acreage of Atkinson's major watersheds are shown in Figure 3 on the following page.

Hydrologic Unit Code (HUC) is a term used by the United States Geologic Survey to systemically divide and sub-divide drainage basins into successively smaller hydrologic units which are classified into four levels: regions, sub-regions, accounting units, and cataloging units. The hydrologic units are arranged within each other, from the smallest (cataloging units) to the largest (regions). Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system.

Figure 3. Major and minor watersheds in Atkinson



HUC 8 Watershed	Acres	HUC 10 Watershed	Acres	HUC 12 Watershed	Acres
Merrimack River	7,258.5	Spickett River	4,487.6	Lower Spickett	4,194.1
				Arlington Mill	293.5
		Lower Merrimack River	2,770.9	Little River	2,426,6
				Lower Merrimack	344.3

3.2 Surface Waters

Surficial Hydrology

Surface water systems are any type of standing or flowing body of water above the ground, including streams, rivers, ponds, lakes and freshwater and tidal wetlands. Surface water systems are dynamic, subject to seasonal climatic variability that produces a range of hydrologic conditions. Because surface waters collect runoff from adjacent land areas, they are highly susceptible to pollution from both point and nonpoint sources.

The hydrology of surface water systems can be highly disrupted as a result of development on the landscape and throughout a watershed. Impervious surfaces, diversion of runoff through stormwater management systems, and reduced infiltration all contribute to the alteration of the natural hydrologic regime that sustains surface water systems. These changes to the surficial

hydrology affect the volume and rate at which water moves through the system and, in the extreme case, removes water from the system through interbasin transfer (the diversion of water from one watershed to another).

Rivers and Tributaries

Atkinson has only seven named tributaries (brooks) within its boundaries, ranging in stream order classification from first order to third order. All of these tributaries discharge beyond the town boundaries to adjacent towns and/or states.

Table 7. List of named perennial streams

Order	***Name***	***Geographic Description***	***Drainage Area Description***
2nd	Bryant Brook	Headwaters in central/eastern areas with several unnamed tributaries; two small impoundments in headwaters; flows through Blunt's Pond in lower portion; drains east to Plaistow	Headwaters in heavily residential area; crosses several local roads; some forested unfragmented areas
1st	Camp Brook	Headwaters in extreme southern area; drains to Haverhill, MA	Forested unfragmented
1st to 2nd	Creek Brook	Headwaters in extreme southern area; joins unnamed tributary at town/state border; drains south to Haverhill, MA	Mostly forested unfragmented; headwaters in residential area
2nd	Foote Brook	Headwaters in southern area; small impoundment at mid-point; drains south to Haverhill, MA	Mostly forested unfragmented
3rd	Hog Hill Brook	Headwaters in the northwest corner; drains south to Salem	Headwaters in residential area; mostly forested unfragmented; crosses several local roads
1st	Line Brook	Headwaters in the northeast corner; drains to Plaistow	Mostly forested unfragmented; crosses several local roads
1st	Providence Hill Brook	Tributary of Hog Hill Brook; drains west to Salem	Mostly forested unfragmented

Table 8. Summary of miles of rivers, streams and brooks by stream order

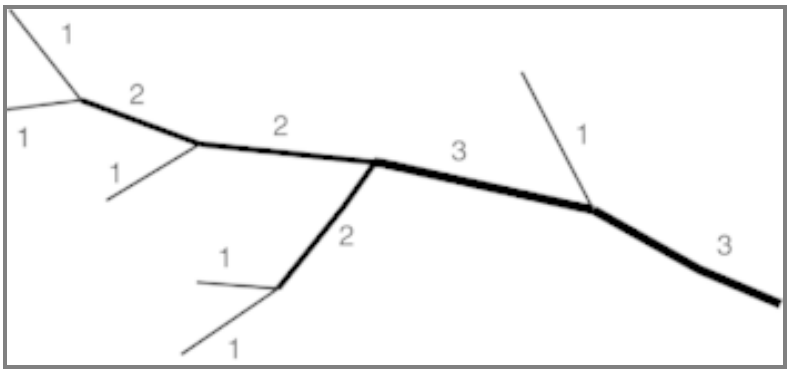
Stream Order	**Description**	**Linear Miles**	**% total miles**
First Order	Connect smaller wetland complexes and form headwater drainages from nearby hills	12.9	62.6
Second Order	Typically connect large wetland complexes located in wide valleys between hills	4.5	21.8
Third Order		3.2	15.5
Total		***20.6***	**--**

Of the named brooks, nearly 63 percent or 12.9 miles are first order streams, and the remaining 37 percent or 8 miles are second and third order streams. The headwaters of the majority of these brooks originate from central areas of town east and west of Route 121 and East Road.

First Order Streams

First order or headwater streams are located in the uppermost parts of a watershed, where overland flow and runoff first become concentrated in an organized and defined channel. Knowledge of influence of headwater streams on the water quality and flow conditions of downstream waters is essential to water resource management. Studies have demonstrated the intrinsic connections of headwater areas to landscape processes and downstream water quality through their influence on the supply, transport, and fate of water and the chemical makeup of water in watersheds. Other studies demonstrate the profound influence that headwater areas have on shaping downstream water quantity and water quality[6]. These results have relevance to water-resource management and regulatory decisions with respect to protecting headwater streams from degradation and the potentially negative impacts of development within sensitive riparian areas and within the watershed.

Figure 4. Strahler Stream Order System



[Source: U.S. Corps of Engineer diagram showing the Strahler stream order system]

NH Comprehensive Shoreland Protection Act

The NH DES Shoreland Program implements RSA 483-B, the Comprehensive Shoreland Protection Act (CSPA). The CSPA establishes minimum standards for activities within the Protected Shoreland – land within 250 feet of the state's larger water bodies - that are designed to protect the water quality and to fulfill the state's role as trustee of those waters. Effective July 1, 2008, the state legislature amended the CSPA to revise existing and include additional standards to protect water quality. These standards include new requirements for clearing trees and other vegetation within the Woodland and Waterfront Buffer, limitations on impervious surface coverage, restrictions on the use of fertilizer and pesticides, and setbacks for primary

[6] Alexander, Richard B., Boyer, Elizabeth W., Smith, Richard A., Schwarz, Gregory E., Moore, Richard, B. *The Role of Headwater Streams In Downstream Water Quality*, Journal of the American Water Resources Association (2007, Vol.43, N.1,pp.41-59)

structures. For more information, refer to the NHDES Shoreland Program website at http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm.

Lakes and Ponds

Atkinson has 109 acres of lakes and ponds. The only surface water bodies regulated in Atkinson under the Comprehensive Shoreland Protection Act is the portion of Big Island Pond located in the town. *Refer to Map 5-Comprehensive Shoreland Protection Act in Appendix D.* Big Island Pond is located in the extreme northwest corner of Atkinson, with a large portion of the lake located in the towns of Hampstead to the north and east and Derry to the west. Big Island Pond is 497.9 acres with a surface elevation of 203.3 feet.

Riparian Areas

Riparian zones or areas have been defined in several ways, but they are essentially the narrow strips of land that border creeks, rivers or other bodies of water. "Riparian" also refers to the unique ecosystems that surround the banks of river and streams. The individuals in a riparian community have specific adaptations for living in repeatedly flooded environments. Riparian ecosystems occupy the transitional area between the terrestrial (dry) and aquatic (wet) ecosystems. Typical examples would include floodplains, streambanks, lakeshores, and wetlands. Riparian areas may exist within any land use area, such as cropland, hayland, pastureland, rangeland, and forestland.

Because of their proximity to water, plant species and topography of riparian zones differ considerably from those of adjacent uplands. Although riparian areas may occupy only a small percentage of the area of a watershed, they represent an extremely important component of the overall landscape. A healthy, functioning riparian area and associated uplands dramatically increase benefits such as fish and wildlife habitat, erosion control, forage, late season streamflow, and water quality.

Riparian areas provide the following landscape and environmental functions:

1. *Sediment Removal/Retention – from stormwater runoff and flood waters*
2. *Bank Stablilization – by maintaining root systems of trees and other vegetation*
3. *Water Storage and Release – in floodplains, valleys and riverine wetlands*
4. *Aquifer Recharge – through infiltration of stormwater runoff, snow melt and precipitation*
5. *Water temperature moderation – by shading surface waters and wetlands*
6. *Wildlife habitat – water, food, shelter, nesting and breeding areas*

Riparian forests provide critical wildlife habitat for migratory songbirds, waterfowl, Chinook salmon, steelhead, and a host of other species. Riparian corridors are highly favorable for wildlife. They are the areas with the most water and the densest plant cover, providing predator protection, shade, breeding and nesting areas, and food sources. Intact rivers and riparian areas attract more than wildlife. People hike, boat, fish, hunt, and explore these areas, bringing tourism dollars into the local economy.

3.3 Water Quality

Very little data exists at the state and local level to document the quality of surface waters in Atkinson. Water quality is routinely tested in Island Pond as part of the NH Department of Environmental Services Volunteer Lake Monitoring program (VLAP). However, none of Atkinson's streams and tributaries are monitored for water quality. Given the density of development in the region, particularly development occurring in neighboring communities bordering Massachusetts, and the presence of a water supply watershed in Atkinson and the surrounding region, obtaining water quality data could have multiple benefits.

Impervious Surface Coverage and Water Quality

Studies conducted in the northeast have documented that by converting as little as ten percent of a watershed to impervious surfaces, stream water quality, stream channel structures, and species habitat begins to deteriorate. Above 25 percent impervious surface, water quality can be seriously degraded (see Section E below for information about impervious surface and water quality).

Pavement cannot absorb water and thus water flows in sheets more quickly to streams, rivers, and lakes than it would over forested, wetland, or grassed landscapes which slow down water flows, act as filters and serve as water recharge areas for groundwater (Forest Service, 2005; CEP, 2003; Biodiversity Project, 2005).

EPA General Permit for MS4 Communities

National Pollutant Discharge Elimination System (NPDES) Storm Water Permit Program
http://www.epa.gov/region1/npdes/stormwater/

The Phase II Final Rule covers all small municipal separate storm sewer systems (MS4s) located within an "urbanized area" (UA). UAs constitute the largest and most dense areas of settlement. Refer to Figure 5 at right for a map of regulated MS4 communities in NH with small municipal separate storm sewer systems that are regulated under the EPA Phase II General Permit.

Communities may consider evaluating their development regulations to address impervious surface coverage by requiring site design standards and stormwater management requirements to mitigate any future potential impacts to water quality.

NPDES Phase II Small MS4 General Permit – Annual Report

The Small MS4 General Permit Annual Report must address and report on progress toward the following required activities:
- Part II – Self Assessment of progress made during the year
- Part II – Summary of Minimum Control Measures:
    1) Public education and outreach;
    2) Public involvement and participation;
    3) Illicit discharge detection and elimination;
    4) Construction site stormwater runoff control;
    5) Post-Construction stormwater management for new development and redevelopment;
    6) Pollution prevention and good housekeeping in municipal operations; and

7) BMPs for meeting total maximum daily load (TMDL) waste load allocations (if required)
- Part IV – Summary of Information Collected and Analyzed
- Part V – Program Outputs and Accomplishments

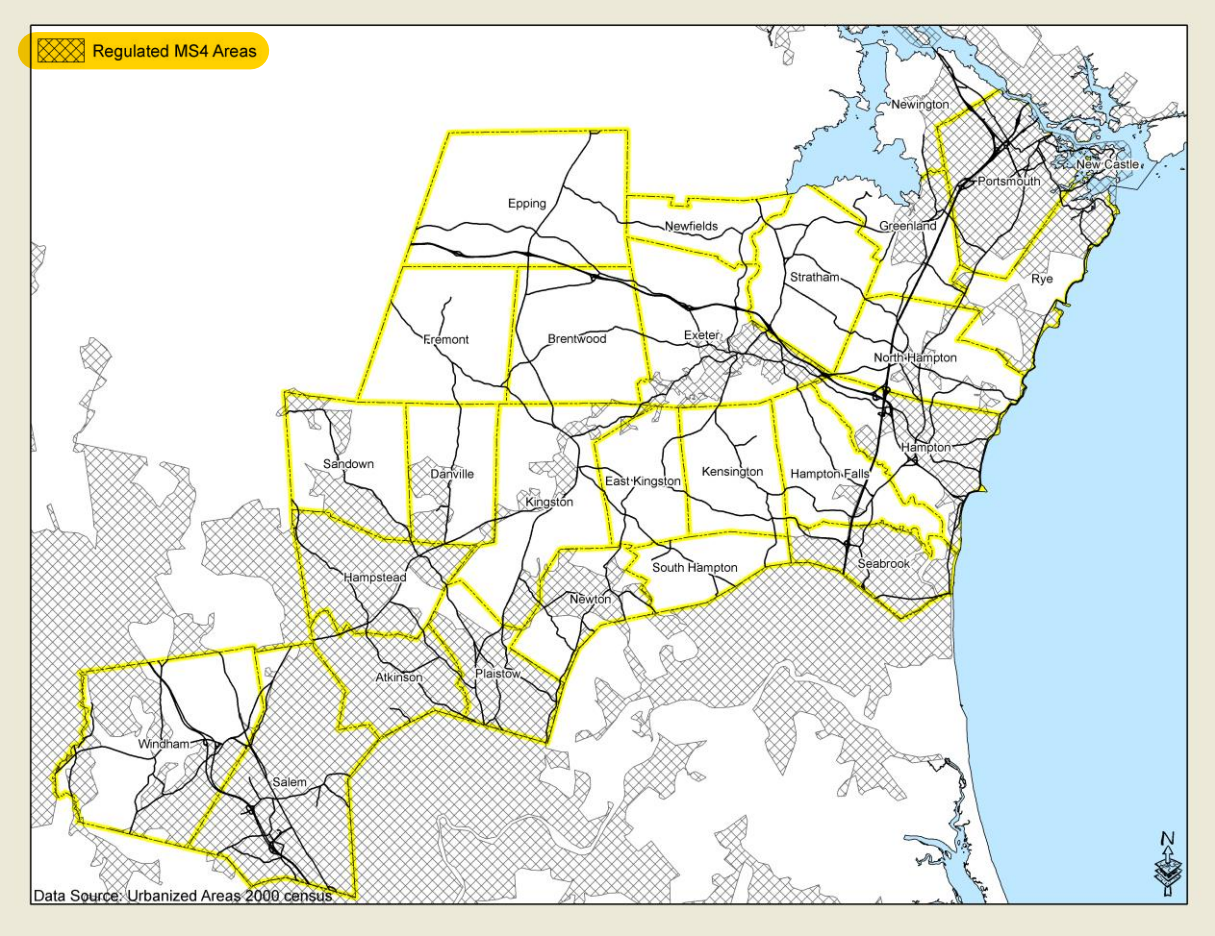


Figure 5. Regulated MS4 communities in New Hampshire

Urbanized Areas (UAs)

UA calculations delineate boundaries around these dense areas of settlement and, in doing so, identify the areas of concentrated development. UA designations are used for several purposes in both the public and private sectors. For example, the Federal Government has used UAs to calculate allocations for transportation funding, and some planning agencies and development firms use UA boundaries to help ascertain current, and predict future, growth areas.

The Bureau of the Census determines UAs by applying a detailed set of published UA criteria (see 55 *Federal Register* 42592, October 22, 1990) to the latest decennial census data. The Bureau of the Census' general definition of a UA, based on population and population density, is provided below.

*An **urbanized area** is a land area comprising one or more places - central place(s) - and the adjacent densely settled surrounding area - urban fringe - that together have a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile.*

The basic unit for delineating the UA boundary is the census block. Census blocks are based on visible physical boundaries, such as the city block, when possible, or on invisible political boundaries, when not.

3.4 Floodplains and Flood Hazard Areas

Floodplains and Flood Hazard Areas

As reported in Table 9 below, Atkinson has 297 acres of land within the 100-year floodplain with an additional 2.33 acres within the 500-year floodplain (Zone X500).

In Atkinson, the primary flood hazard areas are within the 100 year floodplain of major drainage systems, as identified on the 1986 Flood Insurance Rate Map (FIRM).
Although few homes and businesses are located in these flood prone areas, flooding still affects many roadways throughout the town during large storm events. Development in flood prone areas is problematic as it:

- risks damage to life and property;
- reduces flood storage capacity of the floodplain, thus intensifying flood conditions elsewhere; and
- contributes to water quality problems.

These problems can be controlled or alleviated through the adoption of floodplain regulations as part of the National Flood Insurance Program. Atkinson has adopted such standards in its zoning ordinance in Section 420 Floodplain Management Ordinance. The ordinance requires any development to meet strict federal building codes specific to construction in flood hazard areas. These regulations discourage unsound development in special flood hazard areas (zones A and AE) by protecting the functions of the 100-year floodplain.

Table 9. Flood hazard zones identified on the FEMA Flood Insurance Rate Maps (FIRMs)

Description of Flood Hazard Zone	Flood Hazard Zone
Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.	Zone A
Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.	Zone AE
River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.	Zone AO
Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed	Zone VE

analyses are shown at selected intervals within these zones.	
Total Acres	
Areas outside the 1-percent annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone. Insurance purchase is not required in this zone.	Zone X
Areas within the 500-year Floodplain, or areas within the 2-percent chance of flooding each year. Insurance purchase is not required in this zone.	Zone X500

3.5 Recommendations

SWR1 Consider developing recommendations to incorporate into the zoning ordinance requirements for a minimum water quality buffer to perennial streams and brooks.[7] [Note: First order streams represent nearly 63 percent of the total linear stream miles in town. For this reason, protection of first order streams is key to preserving high quality watersheds.]

SWR2 Organize a volunteer group to participate in the NH Department of Environmental Services, Volunteer River Assessment Program (VRAP) to gather surface water quality data. (See Appendix C for additional information about VRAP.)

SWR3 Conduct a professional planning audit of zoning ordinances and land development regulations to evaluate the effectiveness of existing water quality protection measures in place and, if necessary, develop recommendations to improve them.

SWR4 Amend existing zoning ordinances (such as Article VI: Rural Cluster Residential Development and Article IV: General Provisions, Section 402 Floodplain Management Ordinance) and land development regulations to encourage and provide incentives to preserve riparian areas and provide water quality treatment of stormwater runoff.[8]

SWR5 Conduct a professional planning audit of zoning ordinances and land development regulations to identify where new requirements and standards may be incorporated to mitigate existing conditions and prevent flooding in the future. [Note: The town may also consider developing an inventory of sites that currently have flooding problems.]

[7] Refer to the Piscataqua Region Estuaries Partnership (PREP) website for information and technical guidance about buffers at http://www.prep.unh.edu/resources/buffers.htm

[8] Refer to the Department of Environmental Services '*The NH Stormwater Manual Volumes 1-3*' (2008, as amended) at http://des.nh.gov/organization/divisions/water/stormwater/manual.htm and The Center for Watershed Protection stormwater information resources at http://www.cwp.org/

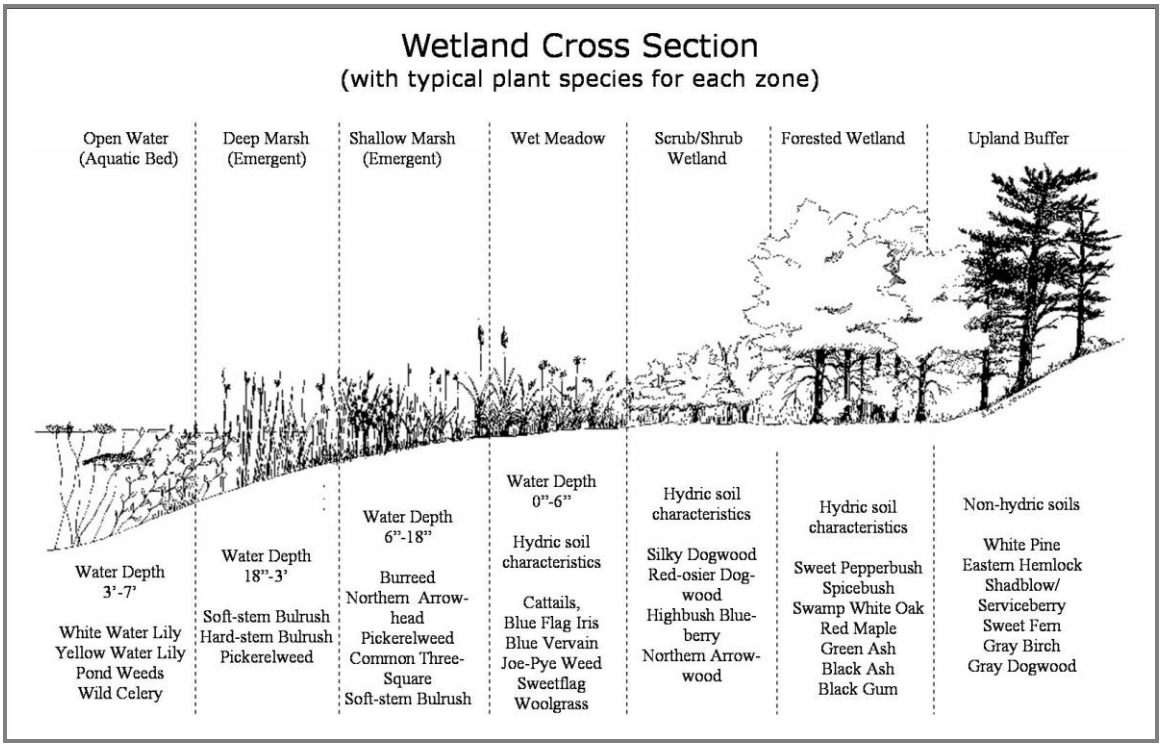
4.0 Wetlands

4.1 Functions and Values of Wetlands

RSA 482-A:2 defines a wetland as an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

The different types of wetlands and plant communities are indicative of specific physical and environmental conditions including topography, hydrologic regime and soil materials.

Figure 6. Diagram of wetland types based on landscape position and hydrology



[Source: New England Wetland Plants, Inc. website]

Functions and Values

Wetlands are valuable resources and worthy of protection from degradation or inappropriate uses. Wetlands provide critical ecological and socially valuable functions including:

- Flood water and stormwater storage areas;
- Removal and storage of silt and other sediments;
- Removal and uptake of nutrients and pollutants from surface waters; and
- Habitat and reproductive areas for plants, fish and wildlife.

As reported in Table 15 below, wetlands occupy roughly 590 acres or 8 percent of the total area of Atkinson. Most wetlands are situated at the headwaters of the major drainage systems and as

small isolated wetlands throughout town. *Refer to Map4-Surface Water Resources in Appendix D.*

4.2 Freshwater Wetlands

In Atkinson, forested wetlands are by far the most prevalent type of wetland. Floodplain forested wetlands are typically found growing on alluvial soils associated with riverine systems. Hardwood swamps are typically found growing on poorly-drained mineral or peat/muck soils, often associated with ancient lake basins. Scrub-shrub wetlands are a type of wetland community in transition. Scrub-shrub wetlands are a highly dynamic type of emergent wetland, which if left undisturbed, will gradually be replaced through the process of succession by forested wetlands or forests.

Table 10. Summary of wetlands by type and acreage

Wetland Type	***Description***	***Acres***
Emergent	Dominated by erect, rooted herbaceous hydrophytes; includes marsh, fen, swale and wet meadow	90.3
Forested	Dominated by trees greater than twenty feet in height (red maple, ash, spruce)	227.3
Lacustrine	Open water wetlands situated in topographic depressions with less than 30% vegetative cover and greater than 20 acres in size (lakes and large ponds)	63.1
Palustrine	All non-tidal wetlands dominated by trees, shrubs, and persistent emergent vegetation; includes areas adjacent to freshwater rivers and their tributaries	39.4
Scrub-Shrub	Dominated by shrubs and tree saplings less than twenty feet in height (buttonbush, alders and red maple saplings); includes swamp and bog	169.5
Total		***589.6***

[Source: Classification of Wetlands and Deepwater Habitats of the United States, 1979, by *Cowardin, Lewis et al.]*

4.3 Prime Wetlands

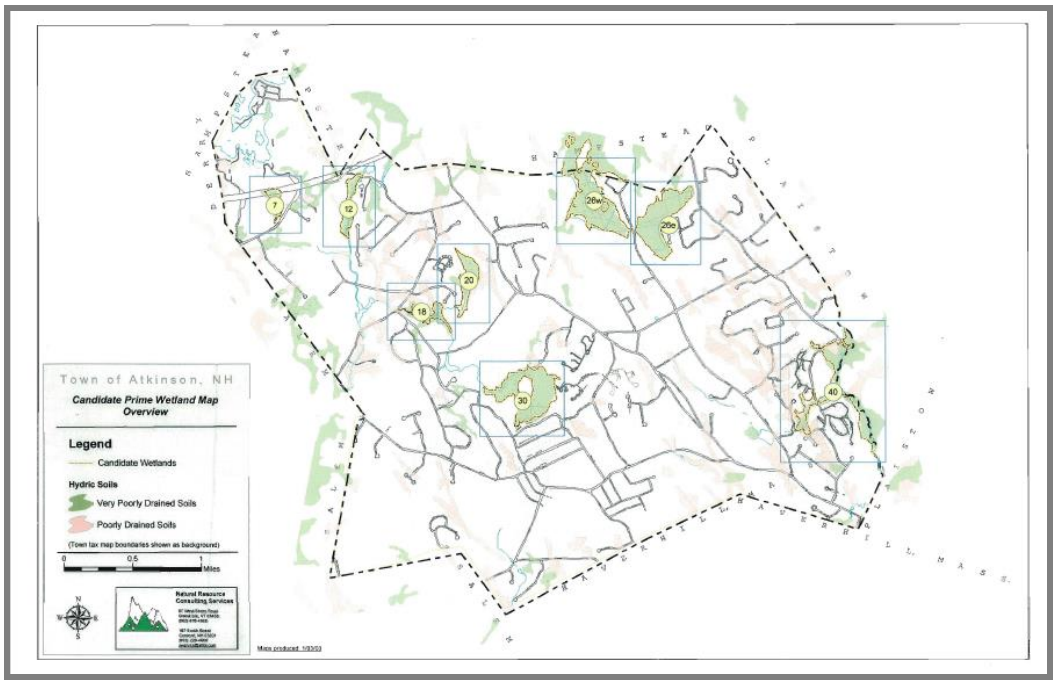
Prime wetlands were identified in the study *Town of Atkinson Prime Wetland Study* (2003) by Natural Resource Consulting Services. The study was conducted in three phases.

1. An initial screening of all wetlands in town in order to develop a list of prime wetland "candidates".
2. A field study to assess comparative functional values of the candidate wetlands.
3. Gathering of GPS data to establish the prime wetland boundaries, analysis of field data and functional values of the candidate wetlands, and production of maps and charts.

The candidate wetlands were evaluated using the Method for Comparative Evaluation of Nontidal Wetlands in New Hampshire (1991, the NH Method). The fourteen functions and values outlined in the NH Method were evaluated, including: Ecological integrity, wetland wildlife habitat, finish habitat, education potential, visual/aesthetic quality, water-based recreation, flood control potential, groundwater use potential, sediment trapping, nutrient

attenuation, shoreline anchoring and dissipation of erosive forces, urban quality of life, historical site potential, and noteworthiness.

Figure 7. Map of prime wetlands from Town of Atkinson Prime Wetland Study (2003) by Natural Resource Consulting Services



The study identified the following eight wetlands as having met the minimum criteria for candidates for designation as prime wetlands.

Table 11. Eight wetlands identified as candidates for designation as prime wetlands in the study Town of Atkinson Prime Wetland Study (2003) by Natural Resource Consulting Services

ID#	*Name*	*NWI Class*	*Acres**	*Prime Designation*	*Comments*
7	Hall Farm Pond	OW, SS1, EM1	10	Yes	
12	Hog Hill Brook	OW, SSW, EM1	36	Yes	113 acres located outside town
18	Hovey Meadow Wetland	OW, SS1, EM1, FO1	13	Yes	
20	Steward Pond Farm	OW, SS1, EM1, FO1	21	Yes	
26E	Sawmill Swamp East	OW, SS1, EM1, FO1	135	Yes	65 acres located outside town
26W	Sawmill Swamp West			Yes	
30	Wright Farm Pond	OW, SS1, EM1, FO1	75	--	
40	Bryant Brook	OW, SS1, EM1, FO1	40	Yes	29 acres located outside town
Total			***330***	***255 acres of prime wetlands***	

** Acreage located within Atkinson*
OW-open water, EM1-emergent persistent, SS1-scrub shrub broad-leaved deciduous,
FO1-forested broad-leaved deciduous

Atkinson has designated 255 acres of prime wetlands. The following wetlands were approved for prime designation at town meeting in 2009: Hall Farm Pond, Hog Hill Brook, Stewart Farm Pond, and Bryant Brook. The following wetlands were approved for prime designation at town meeting in 2010: East and West Sawmill Swamp and Hovey Meadow Swamp.

4.4 Recommendations

WTL1 Consider adopting in the zoning ordinance (Article IV: General Provisions, Section 410 Wetland Zoning) a mandatory minimum buffer to wetlands not designated as prime wetlands to help preserve their hydrologic and ecological functions and prevent impacts from development and other land based activities. *Refer to Section 4.1 Functions and Values of Wetlands.*

5.0 Groundwater Resources and Water Supply

5.1 Groundwater Resources

Stratified Drift Aquifer
Unconsolidated materials, called stratified drift deposits, contain sorted layers of gravel, sand, silt and clay. These deposits have high potential groundwater yield due to their permeability, or the abundance of interconnected pore spaces where water is stored. Drinking water wells located in these deposits are typically shallow and can often be affected by seasonal changes in the groundwater table and contamination from land based activities.

Table 12. Transmissivity and acreage of stratified drift aquifers

Transmissivity	***Acres***
<2,000 square feet per day (low yield)	455
2,000-4,000 square feet per day (moderate to high yield)	18

Definition of Terms

Aquifer transmissivity is a measure of how much water can be transmitted horizontally, such as to a pumping well. Transmissivity is directly proportional to horizontal hydraulic conductivity (Kh_i) and thickness (d_i). Expressing Kh_i in units/day and d_i in units, the transmissivity (T_i) is found in units^2/day.

Horizontal Flow
Hydraulic conductivity is the ease with which water can move through pore spaces or fractures, and depends on the intrinsic permeability of the material and on the degree of saturation. Saturated hydraulic conductivity, K_{sat}, describes water movement through saturated media.

Influence of the Water Table
When a soil layer is above the water table, it is not saturated and does not contribute to the transmissivity. When the soil layer is entirely below the water table, its saturated thickness corresponds to the thickness of the soil layer itself. When the water table is inside a soil layer, the saturated thickness corresponds to the distance of the water table to the bottom of the layer. As the water table may behave dynamically, this thickness may change from place to place or from time to time, so that the transmissivity may vary accordingly.

In Atkinson, stratified drift aquifer deposits are limited, found along West Side Drive at the Salem border and as isolated patches along the Plaistow border. The remainder of the town is covered by glacial materials called till, consisting of unsorted deposits of mud, sand, gravel and boulders.

Bedrock Aquifer
Fractured bedrock typically does not yield high quantities of groundwater compared with stratified drift deposits. Bedrock aquifers are more productive when the bedrock is covered by a layer of sand and gravel, which allows recharge to occur directly from the surface.

Bedrock aquifers are usually adequate for domestic wells serving a small population, and therefore should not be overlooked as a contributing source of a community's water supply needs.

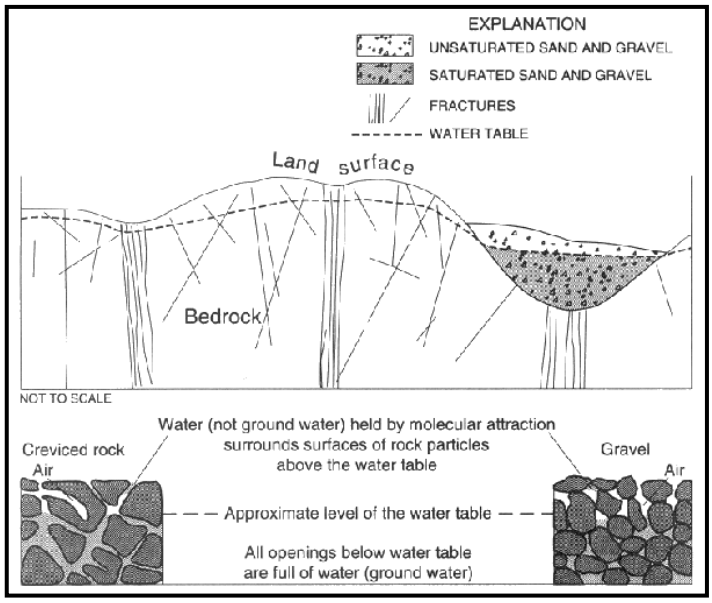


Figure 8: Illustration of groundwater interaction between stratified drift aquifers and bedrock aquifers

[Source: NH DES Environmental Fact Sheet GEO-6 New Hampshire Bedrock Aquifer Resource Assessments]

5.2 Drinking Water Supplies

Public Water Systems

A Public Water Supply (PWS) is a system for the provision to the public of piped water for human consumption, and has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. Non-transient non-community water supply (not a municipal water system) is a system which serves the same 25 people or more, over 6 months per year, such as schools, or private businesses that have their own drinking water supply. A Non-community Transient water supply is a system that serves less than 25 people for less than 6 months of the year, such as at restaurants, campgrounds, and other types of service-related businesses or facilities.[9]

Table 13. Summary of active Public Water Supplies

Type	***Category/Use***	***Number***	***Population Served***	***Total Connections***
Community	Condominium, large Community Water Supply	6	3,158	1,263
Non-Transient / Non-Community	Schools, restaurant, industrial, day care, commercial property	5	1,172	9
Non-Community/Transient	Restaurant	1	200	1

[Source: NHDES One Stop Data Center]

[9] RSA 485:1-a Public Drinking Water Protection Program

Local and State Protections

Atkinson has not adopted zoning overlays or land use regulations that establish specific performance based standards to protect the quality and quantity of its aquifers and drinking water sources, with the exception of a 100 foot setback from wetlands for waste disposal systems, structures that generate human or animal waste, and residential and commercial garages (see Atkinson Zoning Ordinance Section 410:8).

The NH Department of Environmental Services implements many programs that provide communities the opportunity to strengthen at the local level protection of aquifers and drinking water sources.

The Groundwater Protection Act, RSA Ch. 485-C expressly recognizes that "groundwater is primarily a local resource, cities and towns should have the first opportunity to institute programs for groundwater protection" or "to enact local ordinances or regulations affecting groundwater, other than groundwater withdrawals" and providing that requirements imposed under the chapter be adopted as minimum requirements of any local ordinance or regulation. Although Chapter 485-C *recognizes* the right of municipalities to protect groundwater, it does not actually *grant* that authority. Instead, it refers to the authority of municipalities to enact ordinances under *other* statutes. Such local protection measures may include:

- As specified in RSA 4-C:22, the natural resources section of the master plan should include a *local water resources management and protection plan*. Although this plan is not required it is strongly recommended to establish the scientific basis and support for zoning ordinance provisions.
- The Groundwater Protection Act allows a municipality to request reclassification of groundwater resources by submitting a written request to DES local regulation. Reclassification offers additional protection through local inspection of potential contamination sources and enforcement of best management practices. The Act establishes four classes of groundwater (in order of most protected to least protected):
  - GAA Wellhead protection area for wells presently used or well sites identified for future use as public drinking water supplies.
  - GA1 Defined zone of high value for present or future drinking water supply.
  - GA2 Aquifers identified as highly productive for potential use as public water supply by US Geological Survey regional studies or other regional studies.
  - GB All other groundwater.
- When supported by the master plan, zoning ordinances may include environmental characteristics zoning through the Innovative Land Use Controls statute in RSA 674:36 and 674:44.
- Site Plan Review and Subdivision regulations can include provisions for limiting land based activities such as stormwater discharges and infiltration, water quality standards and earth excavation. [10]

[10] *Groundwater Protection: What Can Municipalities Do?* by Cordell Johnston, Government Affairs Attorney, Local Government Center/New Hampshire Municipal Association as presented at the NHDES Watershed Conference, November 13, 2004

5.3 Recommendations

GW1 Amend zoning ordinances and land development regulations to provide protection of groundwater resources by requiring infiltration of stormwater runoff in aquifers and groundwater recharge areas (i.e. adoption of stormwater standards and/or regulations).

GW2 Consider limiting high risk uses (those that have a high potential to contaminate water supplies) in aquifers and groundwater recharge areas.

GW3 Update the Town of Atkinson W*ater Resource Management and Protection Plan* (1991, Rockingham Planning Commission)

6.0 Wildlife and Ecological Resources

6.1 Wildlife and Ecological Resources

Natural Heritage Bureau

The NH Natural Heritage Bureau (NHB) finds, tracks, and facilitates the protection of New Hampshire's rare plants and exemplary natural communities (types of forests, wetlands, grasslands, etc.). As a bureau within the Division of Forests & Lands, we are fundamentally a service to New Hampshire landowners and land managers. The NHB is not a regulatory agency; instead their focus is working with landowners, land managers and land use boards to help them protect the State's natural heritage while meeting their land-use needs.

The NHB's mission, as mandated by the Native Plant Protection Act of 1987 (RSA 217-A), is to determine protective measures and requirements necessary for the survival of native plant species in the state, to investigate the condition and degree of rarity of plant species, and to distribute information regarding the condition and protection of these species and their habitats. The NHB maintains information on rare wildlife in cooperation with the NH Fish & Game Department's Nongame & Endangered Wildlife Program, which has legal jurisdiction over New Hampshire wildlife.

Types of Listings: federal and state lists, and expert rankings

What species are rare enough to be tracked in the NH Natural Heritage database?

- All species federally listed as Threatened or Endangered.
- All species officially listed as Threatened or Endangered in New Hampshire.
- Species that are not (yet) officially listed by the state, but that are judged by experts to be at risk of extinction in New Hampshire.

NH Natural Heritage considers all species in the database to be important candidates for conservation. However, listing status and conservation rank can be used to judge relative priorities. Also, regulatory protections are different for these different categories.

Table 14. Species and community status of wildlife and plant resources

Species/Community	Federal	State	Quality Rank	Precision	Last Observed
Vertebrate					
Spotted Turtle (*Clemmy's guttata*)	--	T	BC	S	2007
Blandings Turtle (*Embydoidea blandingii*)	--	E	C	S	2008
Smooth Green Snake (*Opheodrys vernalis*)	--	SC	--	S	1993
Plants					
Six Weeks Fescue *Vulpia octoflora var. glauca*)	--	E	NR	G	1858

[Source: New Hampshire Natural heritage Bureau, June 2010]

Listing Status	Ranks	Precision
T = Threatened	A-D = Excellent (A) to poor (D)	S = Location known to within ca. 300 feet
E = Endangered	H = Historical (last seen > 20 years	M = Location known to within ca. 1.5 mile
M = Monitored	X = Extirpated	G = Location known only to place name (ca. 5
-- = Special Concern	NR = Not Ranked	

Natural Communities

The NHB programs keep track of "exemplary" natural communities and natural community systems, as well as rare plants and animals.

- Natural communities are collections of species that tend to occur together, given certain landscape conditions, e.g., a hemlock - white pine forest.
- Natural community systems (also referred to as ecological systems) are particular collections of natural communities that recur in the landscape and are linked by common underlying conditions. An "exemplary" natural community system is one that is unusual in its size, quality, or type. Most examples of rare types are considered to be exemplary. So are large and undisturbed examples of common types.

6.2 Fishery

Atkinson's streams and brooks do not support cold water fisheries and little historic documentation or current sampling data exists of species found locally.

6.3 Beneficial and Invasive Species

Native and Beneficial Plant Species

In 1987, the New Hampshire legislature passed the Native Plant Protection Act (RSA 217-A) which formally recognized that "for human needs and enjoyment, the interests of science, and the economy of our state, native plants throughout this state should be protected and conserved; and their numbers should be maintained and enhanced to insure their continuation as viable components of their ecosystems for the benefit of the people of New Hampshire." Through the Native Plant Protection Act, the NH Natural Heritage Bureau compiles data and maintains lists to identify and protect threatened and endangered plant species, and develop recommendations to ensure that populations are recovered and sustained. Refer to Section 7.2 for a list of threatened and endangered species identified by the Natural Heritage Bureau in Atkinson.[11]

[11] New Hampshire Department of Resource and Economic Development, Division of Forests and Lands, Natural Heritage Bureau. Website at http://www.dred.state.nh.us/divisions/forestandlands/

Table 15. Native and beneficial species by habitat and environmental conditions

Habitat-Environmental Conditions	Associated Native Plants
Dry Sites	Pitch Pine, Native Lupine, Bayberry, Butterfly-weed, Stiff Aster, Red Pine, Scrub Oak, Lowbush Blueberry, Bracken Fern, Sweetfern, Little Bluestem, Switch Grass, Big Bluestem, Wild Rye
Moist Sites	White Pine, Beech, Red Oak, Hemlock, White Ash, Sugar Maple, Yellow Birch, Flowering Dogwood, Sassafras, Basswood, Solomon's Seal, Black Cherry, Elderberry, Wood Fern, Wild Yellow Lilly, Virgin's-bower, Highbush Blueberry, Bee-Balm, Columbine, Jewelweed
Wet Sites	Jack-in-the-pulpit, Cardinal Flower, Prairie Cordgrass, Ostrich Fern, Rushes, Sedges, Red Osier Dogwood, Silky Dogwood, Turtlehead, Balsam Fir, Red Spruce, Red Maple, Hemlock, Northern Arrowwood, Winterberry, Atlantic White Cedar, New England Aster, Blue Flag Iris, Sweet Flag
Streambanks and Shorelands	Willow, Silver Maple, Speckled Alder, Smooth Alder, Sycamore, Monkey Flower, Switch Grass, Pussy Willow
Shallow Ponds	Bur-reed, Buttonbush, Pondweed, Sedges, Rushes, Duck Potato, Fragrant Water Lily, Yellow Water Lilly, Pickerelweed, Wild Rice, Duck Weed

[Source: U.S. Department of Agriculture, New Hampshire Natural Resources Conservation Service]

New Hampshire's existing native plant communities have developed and evolved since the end of the last ice age, adapting to variations in climate and nature succession. Native plants form the structure of our natural landscapes – the canopy, understory and groundcover of forests, riparian areas adjacent to rivers and streams, and open meadows. Native plant communities provide vital and specific habitat for wildlife that depend on them for food and shelter.

It is important to note that certain types of native plants thrive when planted or maintained in their natural landscapes. The table below lists native plants commonly found in certain habitat and environmental settings.

Native plants have several advantages over exotic or introduced species, including seasonal hardiness, resistance to pests (fewer chemical treatments), and low maintenance needs (less water and fertilizer). These advantages are due to the adaptation by native plants to local climate and environmental conditions. For these reasons, native plants are often:

- ✓ easier and less costly to care for;
- ✓ reduce potential sources of water pollution; and
- ✓ reduce potential negative effects of pesticides and insecticides on wildlife and humans.

Statewide Invasive Species

What Are Invasive Species

An invasive species is a plant, insect, and/or fungal species that is not naturally present in a particular region and has the ability to thrive and spread aggressively outside its natural habitat or climatic range. It is important that residents be informed about and aware of invasive species of plants, insects and fungi because of their potential to displace native species that are vital to sustain local ecosystems and biodiversity. Rich, diverse plant communities can become monocultures of invasive plants with limited value to sustain native wildlife. The public must be educated to control existing invasive plants, especially when purchasing landscaping plants and materials.

Why and Where Are Invasive Species A Problem?

Invasive species typically possess certain traits that give them an advantage over many native species, including the production of many offspring, early and rapid development, easily and efficiently spread, adaptability, tolerance of a broad range of environmental conditions, resistance to disease, and absence of natural controls to keep them in check (disease, competition, predators). These traits allow invasive species to be highly competitive and, under certain conditions, suppress or completely replace native species. In this manner, invasive species can reduce natural diversity, impact endangered or threatened species, reduce wildlife habitat, create water quality impacts, stress and reduce forest and agricultural crop production, damage personal property, and cause health problems.[12]

In 2000, the State of New Hampshire enacted legislation (House Bill 1258-FN) which required the state to conduct research and educational activities which address the effects of invasive plant, insect and fungal species upon the state, and to publish annual lists of invasive species that present potential or immediate danger to the environmental and economic interests of the state. From this legislation, the New Hampshire Invasive Species Committee was formed with representatives from the Department of Agriculture, Department of Environmental Services, Department of Resources and Economic Development, Department of Transportation, NH Fish and Game, the University of New Hampshire, The Nature Conservancy, the horticultural community, and the general public. The Committee is a volunteer group that considers and evaluates the adverse environmental and economic effects of invasive terrestrial plants, insects, and fungal species upon the state.[13]

NH Prohibited Invasive Species List

The list of Prohibited Species below is reported annually by the NH Department of Agriculture. The list includes invasive species considered to present an immediate danger to the health of native species, to the environment, to commercial agricultural or forest crop production or to human health. These species are prohibited from sale, transport, distribution, propagation or transplantation in New Hampshire.

[12] NH Department of Agriculture, Division of Plant Industry, http://agriculture.nh.gov/divisions/plant_industry/index.htm
[13] Final Version HB 1258-FN.

Table 16. Prohibited plant and tree species in New Hampshire

Acer platinoides	Norway Maple
Ailanthus altissima	Tree of Heaven
Alliaria petiolata	Garlic Mustard
Berberis thunbergii	Japanese Barberry
Berberis vulgaris	European Barberry
*Butomous umbellate**	Flowering Rush
Celastrus orbiculatus	Oriental Bittersweet
Cynanchum nigrum	Black Swallow-wort
Cynanchum rossicum	Pale Swallow-wort
*Egeria densa**	Brazilian Elodea
Elaeagnus umbellate	Autumn Olive
Euonmyous alatus	Burning Bush
Heracleum mantegazzianum	Giant Hogweed
*Hydrilla verticillata**	Hydrilla
*Hydrocharis morsus-ranae**	European Frogbit
Iris pseudacorus	Water-flag
Ligustrum obtusifolium	Blunt-leaved Privet
Lonicera x bella	Showy Bush Honeysuckle
Lonicera japonica	Japanese Honeysuckle
Lonicera morrowii	Morrow's Honeysuckle
Lonicera tatarica	Tartarian Honeysuckle
*Najas minor**	European Naiad
*Nymphoides peltata**	Yellow Floating Heart
Polygonum cuspidatum	Japanese Knotweed
*Potomogeton crispus**	Curly-leaf Pondweed
Rhamnus cathartica	Common Buckthorn
Rhamnus frangula	Glossy Buckthorn
Rosa multiflora	Multiflora Rose
*Trapa nutans**	Water Chestnut
Aquatic Species	
*Cabomba caroliniana**	Fanwort
*Myriophyllum aquaticum**	Parrot Feather
*Myriophyllum heterophyllum**	Variable Milfoil
*Myriophyllum spicatum**	European Water-Milfoil
*Lythrum salicaria**	Purple Loosestrife
*Phragmites australis**	Common Reed

* Indicates that the species is currently regulated by the Department of Environmental Services [DES]

[Source: NH Natural Heritage Bureau, 2008)

The Atkinson Conservation Commission identifies the following species as being problematic:

Oriental Bittersweet – hedge rows, road side, forested areas
Japanese Knotweed – road side, residential areas
Milfoil – Big Island Pond

NH Restricted Species List

Species that present the potential for environmental or economic harm, but such potential may be reduced or eliminated by cultural or biological practices. These species exhibit invasive tendencies, but do not meet all the criteria to be listed as Prohibited.

Table 17. Restricted plant and tree species in New Hampshire

Ampelopsis brevipedunculata	Porcelain-berry
Centaurea maculosa	Spotted Knapweed
Circium arvens	Canada Thistle
Coronilla varia	Crown Vetch
Eleagnus angustifolia	Russian Olive
Euonymus fortunei	Wintercreeper
Glyceria maxima	Sweet Reedgrass
Ligustrum vulgare	Common Privet
Lonicera maakii	Amur Honeysuckle
Lysmachia nummularia	Moneywort
Microstegium vimineum	Japanese Stilt Grass
Phalaris arundinacea	Reed Canary Grass
Populus alba	White Poplar
Pueraria lobata	Kudzu
Robinia pseudoacacia	Black Locust
Ulmus pumila	Siberian Elm

[Source: NH Natural Heritage Bureau, 2008)

6.4 Recommendations

WER1 Include strategies for controlling invasive species as part of management plans for town owned properties.

WER2 Provide informational materials for distribution to residents and businesses about invasive species and how to control them.

7.0 Forest Resources and Forestry

7.1 Forests Resources

Historic Forested Areas

The native inhabitants of Rockingham County maintained the area in a dominantly forested condition, consisting of hemlock, red oak, and white pine. Wet soil conditions, wind, natural fires, and land clearing by the native tribes resulted in some openings throughout the forested areas. By the 1600's, early European settlers exploited the forest resource and created vast expanses of open land. The open land generally was used as pasture for livestock and horses. The land was unmanaged, and resource and soil conservation practices were not used for many years later. By the mid 1800's, only about 50 percent of the county remained forested. During this period, agriculture flourished and, at the same time, a shift from farm life to town life began as manufacturing became a more important part of the local economy. By 1952, about 74 percent of the county was forested, 17 percent was used for agricultural purposes and 2 percent was used for urban development.[14]

7.2 Forests

Atkinson has 4,127 acres of forested lands (56.7 of the total town area) which are generally equally distributed across town between the major roadway systems. The dominant types are beech/oak, hardwood and mixed forests. These forested lands comprise significant portions of larger blocks of unfragmented lands, which include natural areas, open space and undeveloped lands. Refer to *Map 8 – Open Space and Unfragmented Lands*. Contiguous forest blocks function as prime habitat for all local species and connections between them provide species access to important breeding, hunting and foraging.

Since 1962, Atkinson has lost nearly 2,218 acres of forests primarily to residential and non-residential development and to a lesser degree to roads and recreational areas.

Table 18. Dominant forest types and acreage

Forest Type	***Acres***	***% total forest***
Beech/Oak	1,200.7	29.0
Hardwood	1,306.4	31.6
Hemlock	27.0	0.65
Mixed (hardwood/softwood)	1,481.5	35.8
Red/White Pine	121.6	2.9
Total	***4,137.2***	--

[14] Rockingham County Soil Survey, U.S. Department of Agriculture Soil Conservation Service in cooperation with the New Hampshire Agricultural Experiment Station, 1994.

NH Big Tree Program

In an effort to find, record, and recognize individual landmark specimen trees, the New Hampshire Big Tree Program was started in 1950, and works cooperatively with the National Register of Big Trees. The list of recorded champions now includes more than 200 giant trees. Community Tree Steward volunteers help identify, measure, and record these giant trees at the state, county and national levels. The NH Community Tree Steward Volunteer Program publishes a list of the biggest trees of each species throughout the state (available at http://extension.unh.edu/forestry/BigTree.htm). The list reports information about the largest specimen of each species including: height, circumference, average crown diameter, year of measurement, location by city and county, and health status. Note: The location of individual trees is not published to protect the integrity of the resource.

Table 19 below lists the inventory of Big Trees in Atkinson; however, it is feared that this willow tree may have been severely injured during a recent storm in 2009.

Table 19: Inventory of Big (Champion) Tree species

Species	Latin Name	CBH (inches)	Status	Year	Condition
Willow	Quercas phellos	69	State	1996	Good

[Source: State and County Listing of NH Big Trees]
CBH = Circumference at Breast Height; forestry convention for measuring tree circumference

Benefits of Forests

Forest resources provide economic, recreational and aesthetic functions and values to the community. Atkinson's forest resources provide the following: fire wood and wood products, wildlife habitat, scenic beauty, stabilization of land, removal of pollutants, maintenance of stream quality and habitat, improvements to air quality and temperature, and research opportunities. Forests and woodlands provide recreational functions including scenic trails for hiking, walking, biking and horseback riding, hunting grounds for bird and game species, and a natural laboratory for botanists, bird watchers and scientific research. Forest and woodland buffers along roads and between properties provide aesthetic benefits such as visual screening, and reduce sound, noise and air pollution from developed areas.

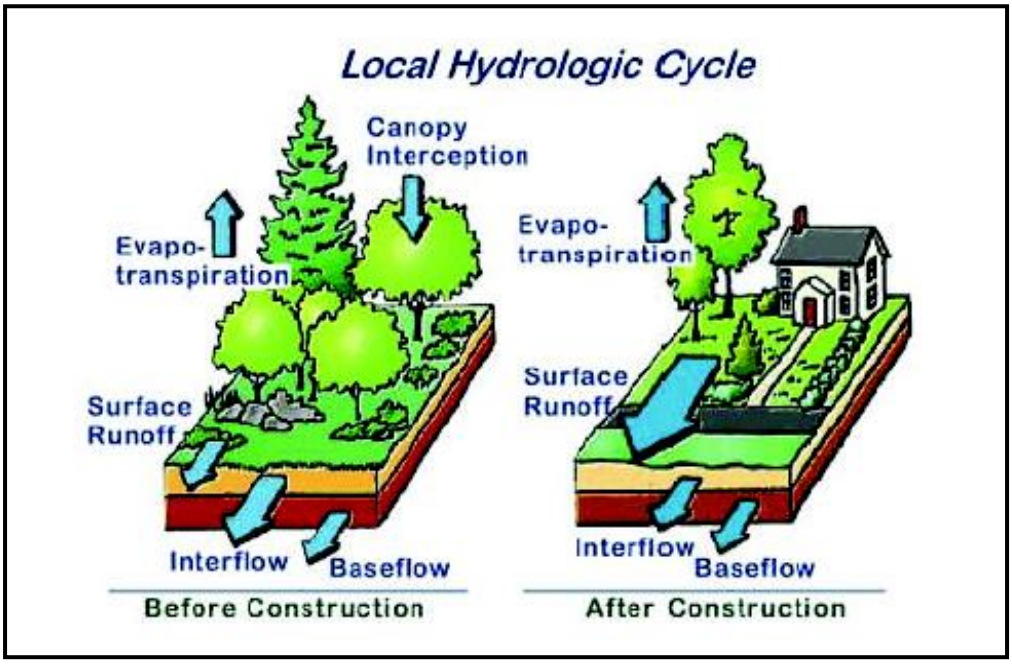
Forests provide various social, health, ecological, and economic benefits on local, regional and national levels. Forests process rainwater through absorption and evapotranspiration, reduce carbon dioxide in the atmosphere, increase groundwater infiltration, and improve surface water quality by removing pollutants and nutrients from runoff, and serve as buffers to protect wetlands from sedimentation and contamination. Near surface water bodies, homes, roads and urban areas, trees cool summer temperatures, break winter winds, and filter dust and pollutants from the air. American Forests (a national non-profit forestry research and advocacy group) estimates that many cities nationwide have seen a decline in natural tree cover by as much as 30 percent over the last several decades while impervious surface coverage has increased rapidly. As urban areas expand and populations move outward to suburban areas, there is ecological and economic value to evaluating this important conservation issue.

Large mature trees and forests provide more cooling shade and more places for wildlife to perch and nest, and sequester more carbon dioxide, trap more pollutants, and purify more water than small immature trees and forests. Although many tree species can outlive humans - 100 to 200 years is not unusual – trees naturally succumb to age, disease and insects, and environmental conditions such as wind, rain, and drought. Today these valuable mature trees are often lost to development. All trees contribute to the improvement our environment in various ways. It is society's responsibility to maintain a healthy environment that allows trees to grow to champion status in order to continue providing their valuable ecological and societal benefits.

Urban Tree Canopy

Urban tree canopy is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above. The function of the urban tree canopy is to improve water quality in urban areas by increasing canopy cover and reducing surface runoff (refer to Figure 9 below).

Figure 9: Role of urban tree canopy in managing stormwater runoff



[Source: Maryland Department of Natural Resources, Urban & Community Forestry Program]

Trees provide two stormwater management functions: first, by leaves and branches intercepting and absorbing some rainfall, and second, by reducing the size and velocity of intercepted raindrops before they reach the ground. Maintaining and restoring riparian forests is an effective method to manage and treat runoff before it reaches surface waters and wetlands. In urban areas, stormwater is efficiently collected from an impervious surface to a conveyance (like a curb and gutter) to an inlet to a pipe and into surface waters and wetlands. Disconnecting this conveyance

"train" to allow interception of rainfall and runoff is a critical step to restoring the stormwater management function of the urban tree canopy.[15]

Town Forest

The Atkinson Town Forest consists of numerous properties varying in size totaling approximately 384.4 acres. The Town Forest itself is also a registered tree farm.

The Town routinely consults with professional foresters to maintain the health and viability of Town Forest properties through implementation of forest best management practices. The Conservation Commission is currently working with a consulting forester to update the management plans for several properties in the Town Forest. These reports and plans shall be incorporated in this inventory when completed.

7.3 Recommendations

FR1 Reference the Forest Management Plan update by the Town's consulting forester, including recommendations contained in the plan.

FR2 Complete one Forest Management Plan per year until plans are completed for all town forests; update the Forest Management Plans on a regular basis (i.e. approximately every 10 years).

FR3 Participate in the NH Community Tree Steward Volunteer Program to update the New Hampshire Big Tree Program inventory for Atkinson.

[15] Maryland DNR, Urban & Community Forestry Program: *http://www.dnr.state.md.us/forests/programs/urban/urbantreecanopygoals.asp*

8.0 Open Space and Land Conservation

What is Open Space?

For the purpose of this report, open space is defined as any lands that remain in a natural and undeveloped condition that contribute ecological, scenic or recreational value. The definition of open space may be expanded to include working lands (forests, agriculture, field corners, fence rows and abandoned pastures) and managed green space such as golf ranges, parks, and recreation areas. The terms 'natural environment' and 'natural resources' are used to broadly describe Atkinson's air, water, and land resources including, but not limited to, the town's scenery, air quality, aquifers, streams, soils, plants and animals. These features form an integrated natural network or "green infrastructure" in which the town's built environment and its key cultural and historic resources are embedded. The opens space and green infrastructure provides the ecosystem services required to sustain a vibrant and healthy community.

8.1 Benefits of Open Space Preservation

Studies from across the nation have demonstrated that farmland open space preservation can provide more revenue to a community than is incurred in expenditures, resulting in a net fiscal benefit. In many instances, the costs associated with support of residential and commercial development often exceed the costs to support farmland and open space. Tax benefits are maximized when a conservation easement is placed on land already enrolled in current use.

Open space preservation serves multiple goals within a community and provides the following benefits:

- ✓ *Attracts investment by residents and businesses seeking high quality of life*
- ✓ *Revitalizes town and village centers*
- ✓ *Supports of resource based tourism economy*
- ✓ *Helps prevent flooding and flood related damage*
- ✓ *Protects farms and agricultural lands*
- ✓ *Promotes sustainable development patterns*
- ✓ *Protects environmental resources (water, aquifers, air, forests)*
- ✓ *Provides recreational and educational opportunities*

A study conducted by the Trust for Public Land (see below *Managing Growth: The Impact of Conservation and Development on Property Taxes in New Hampshire, 2005*) concluded that towns that have the most permanently protected land have slightly lower tax bills on average. It is unlikely that land conservation alone is responsible for these tax benefits. However, land conservation is a tool that shapes the landscape of a community by:

- ✓ helping maintain the rural character of a community,
- ✓ creating more centralized, dense development patterns,
- ✓ creating more efficient municipal service areas, and
- ✓ providing multiple environmental and aesthetic benefits.

Thus, the resulting landscape is a direct result and reflection of the community's support of open space preservation.

8.2 Conservation Lands

Conservation Lands

For the purpose of this document, conservation lands means lands that have a permanent easement or other legal restriction preventing them from being developed in the future. Most conservation lands are protected through fee-simple purchase by the town or other land protection organization/agency, or by voluntary placement of a conservation easement by the landowner.

Open space refers to lands have been permanently designated as undeveloped land as part of subdivision approval pursuant to the Atkinson Zoning Ordinance, Article VI Rural Cluster Residential Development. Open space may be privately or publically held and provide for public or private access.

Table 20. Summary of conserved lands and unfragmented blocks

Category	*Acres*	*% town area*
Conservation Lands*	1,325.4	18.2
Unfragmented Blocks (>50 acres)	3,017	41.4
Total Town Area (land and water)	***7,296***	---

*Conservation Lands include all parcels that have a conservation easement or other permanent form of protection (532.98 acres), and open space created by rural cluster subdivisions (792.41 acres), which include both publicly and privately held lands.

Land Use Change Tax (LUCT)

The Town of Atkinson currently allocates annually 100 percent of the total Land Use Change Tax collected (excluding interest). The Town has not compiled a summary of annual Land Use Change Tax contributions to the Conservation Fund.

Table 21. Land Use Change Tax (LUCT) history from 2000 to 2005

Year	*LUCT Collected*	*Year*	*LUCT Collected*
2000	68,280.00	2006	No data
2001	516,714.11	2007	No data
2002	296,025.89	2008	No data
2003	161,900	2009	21,900
2004	No data	2010	No data
2005	No data		

8.3 Goals for Land Protection

The Atkinson Conservation Commission identifies the following primary land protection goals:

- Update forest and land management plans regularly
- Encourage voluntary conservation through community education and outreach
- Encourage public participation in events on conservation lands and use of recreational opportunities/facilities
- Support policy of setting no financial or acreage cap on land preservation efforts
- Utilize Innovative Land Use Techniques to support land preservation
- Investigate use of transfer of development rights to support land preservation
- Establish a volunteer "warden" program to encourage stewardship of Town Forest lands

8.4 Land Preservation Strategies for Consideration

A variety of land preservation strategies should be implemented recognizing that acquisition alone will not achieve land preservation goals. Each strategy listed in the table below has specific benefits and associated costs ($ expenditure) which should be evaluated on a case by case basis to guide the best use of public funds and resources and ensure the functions and values of a given parcel are adequately protected.

Table 22. Land protection strategies and their benefits

Protection Strategy	Benefit	$ Expended*
Land Acquisition	Purchase of land at fair market value or as a bargain sale where the difference between fair market value and sale price becomes a tax-deductible donation; Public access, leverage for securing funding	High
Purchase of Easements/ Development Rights	Growth management tool; retain development density and tax base if rights transferred to growth areas	High
Regulatory Protection	Preservation of public resources and their functions and values to the community; federal, state and local implementation	Low/No
Land Use Regulations	Adoption of an incentive based Conservation Subdivision ordinance can provide large tracts of open space lands as part of development approval	Low/No
Voluntary Protection and Conservation Easements	Voluntary conservation easements involving donation of development rights; Private stewardship and management; public access permitted in some cases	Low/No
Land and Resource Management	Fosters public participation and stewardship	Low/No
Transfer of Development Rights	Voluntary transfer of development rights from designated open space areas to designated growth areas that allow greater development density	Low/No

* ***$ Expended*** refers to the use of municipal and/or public funds to implement a specific land protection strategy (i.e. use of Land Use Change Tax contributions, bonds, and other municipal funding sources).

8.5 Access to Public Lands, Trails and Water

The map on the following page is an excerpt from the Atkinson Conservation Trails brochure, which shows the location, access points and configuration of trails, and provides a general description of conserved lands and the natural features and resources found on them. Public trails are located at the following town owned conservation properties: Stickney Land, Marshall Land, Pope Road Land, Sawmill Swamp, Crown Hill-Noyes Rock, Carolyn Orr Conservation Land, and Sawyer Land.

Canoe and Kayak Launch at Island Pond

After five years without a public launch, and over 20 years since the first launch was opened, Atkinson has a canoe and kayak launch at Island Pond. The launch is on Stickney Road off Lake Shore Drive and has parking for up to ten cars.

Volunteer Stewardship

On their website, the Conservation Commission encourages residents and visitors to report the condition of the conservation properties, including items on the following list.

- *Overall Status of Trails, forest, vegetation and wildlife*
- *Type of Land (topography, vegetation or forest cover)*
- *Condition of Land (new or old growth (untouched, undeveloped), light or heavy use, signs of erosion)*
- *Access (trail head entrance, size and condition of parking area, trail marking system, trail condition)*
- *Human Use (dog walking, hiking, biking, ORHV, camping, picnicking, campfires)*

- *Plants (percent wooded and type (conifer, hardwood, softwood), percent grass and undergrowth (ground cover, mosses)*
- *Animals and Other Wildlife (insects (density and type), seen amphibians, mammals, reptiles, birds. Signs of wildlife: trails, scat, dens or burrows)*
- *Boundary Markers (present and condition, type)*
- *Approximate Acreage*
- *Points of Historical or Cultural Interest (old foundations, quarries, farmed areas, orchards, and known historical points. Special land formations: glacial boulder "erratics", ancient beaches, outcroppings)*
- *Environmental Changes (transition from pine to hardwood, wet to dry, unusual plants or animals)*
- *Special Features (anything that sets this area apart from other town lands)*

8.6 Recommendations

OS1 Amend zoning ordinances (Article VI: Rural Cluster Residential Development), site development plan regulations, and subdivision regulations to provide additional incentives for increased protection of and provisions for access to open space lands.

OS2 Organize an Open Space Committee to guide land protection efforts and use of town and other funding sources for protection of open space lands and resources, and other significant cultural and historic resources.

OS2 Develop an Open Space Plan to help plan future land acquisition and protection efforts and to guide future funding through the Capital Improvement Plan, bonds and allocation of Land Use Change Tax collections.

OS4 Consider securing a town bond and source other funding opportunities for purposes of land protection and acquisition.

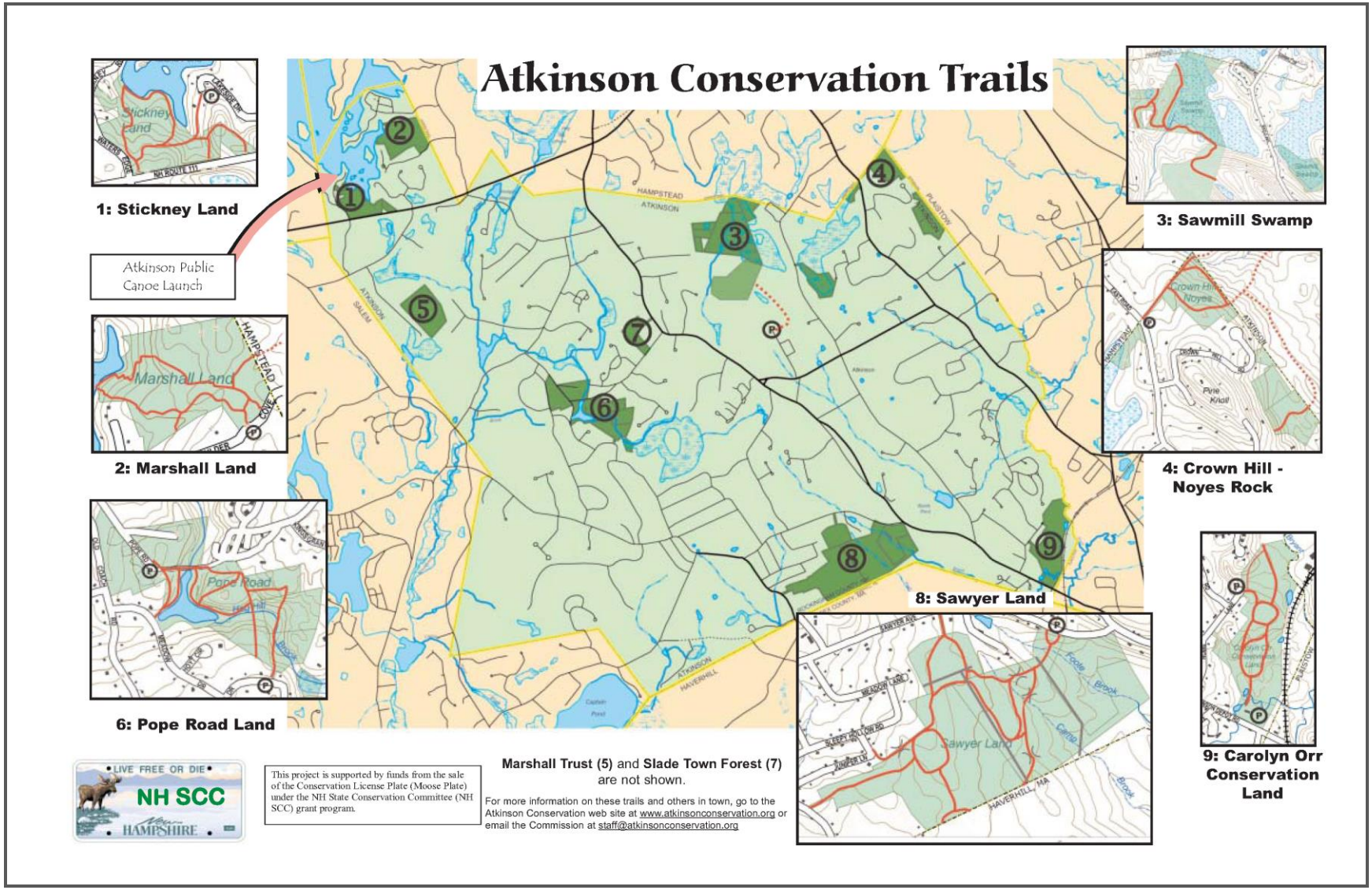


Figure 10. Map of trails on public conservation lands

9.0 Local, Regional and State Studies and Projects

9.1 New Hampshire Wildlife Action Plan

The New Hampshire Fish and Game Department collaborated with partners in the conservation community to create the state's first Wildlife Action Plan (2006). The Plan, which was mandated and funded by the federal government through the State Wildlife Grants program, provides New Hampshire decision-makers with important tools for restoring and maintaining critical habitats and populations of the state's species of conservation and management concern - those species identified by the Northeast Wildlife Diversity Technical Committee as a regional concern because of reduced populations or loss of habitat. It is a pro-active effort to define and implement a strategy that will help keep species off of rare species lists, in the process saving taxpayers millions of dollars. The New Hampshire plan is a comprehensive wildlife conservation strategy that examines the health of wildlife. The plan prescribes specific actions to conserve wildlife and vital habitat before they become scarce and more costly to protect.

The *New Hampshire Wildlife Action Plan* is available at http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm. Refer to Table 11 below for a summary of natural habitat communities and protected lands and as shown on *Map 7-New Hampshire's Wildlife Action Plan* (see Appendix D.).

Table 23. Important ecological communities identified in the NH Wildlife Action Plan (NH Fish & Game, 2007)

Wildlife Action Plan	Acres	% total area
Highest ranked habitat in biological region	1,065.6	14.6
Highest ranked habitat in NH (by condition)	5.0	0.07
Supporting Landscapes	3,311.7	45.4
Total	***4,382.4***	***60.0***

NHWAP Definitions

Highest ranked habitat in NH. NHFG biologists developed condition filters to provide data and maps that show which habitats are in the best ecological condition in the state. These filters are a set of GIS data that indicate to what degree a particular patch of habitat has good biological diversity (particularly in terms of rare species), is connected to other similar patches in the landscape, and is negatively impacted by humans. All 16 habitat types were assessed for condition as well as all surface waters. For each category (biological, landscape and human impact), a single score was calculated by weighting all factors equally. Then the scores from each category were weighted evenly to come up with a single condition score called the.

Highest Ranking in Biological Region. Since NH is so ecologically diverse, the highest ranked habitats were then ranked within their ecoregional subsection (based on 9 ecoregions developed by The Nature Conservancy) which are geographical areas with similar physical characteristics that influence biology. The top 15% by area of forests and the top 50% of other terrestrial

habitats in each ecoregion are considered Highest Ranking in the Biological Region. If these were not already top ranked in the state (pink), they are colored green on the map.

As reported in the *New Hampshire Wildlife Action Plan*, Atkinson has the following natural habitat communities. Collectively these natural habitat communities comprise nearly 60 percent of the total land area of Atkinson.

Table 24. Natural habitat communities from the NH Wildlife Action Plan

Natural Habitat Community	Acres	% all habitats
Appalachian Oak Pine Forest	2,092.0	29.1
Floodplain Forest	0.59	0.008
Grasslands	697.0	9.7
Hemlock Pine Forest*	4,078.0	56.8
Peat Swamp	20.3	0.3
Wet Meadow	296.0	4.1
Total	***7,183.9***	--

* Comprise nearly 56% of the total land area of Atkinson

Appalachian Oak Pine Forest. Appalachian oak-pine forests are found mostly below 900 ft. elevation in southern New Hampshire. These forests include oak, hickory, mountain laurel, and sugar maple, and are typically associated with warmer and drier climatic conditions. Appalachian oak-pine forests are fire-influenced landscapes with nutrient-poor, dry, sandy soils. They are home to hognose snakes, whip-poor-wills, silver-haired bats and other species of concern. Intense development has dramatically reduced the area of this forest type, which comprises some 10% of the state's total land area, in New Hampshire's southern tier.

Floodplain Forest. Floodplain forests occur in valleys adjacent to river channels and are prone to periodic flooding. Also referred to as riparian forests, they support diverse natural communities, protect and enhance water quality by filtering and sequestering pollution, and control erosion and sediment. Their rich soils have been used in agriculture for centuries, such that many floodplains are no longer forested wildlife habitat.

Grasslands. Extensive grasslands are defined as areas greater than 10 hectares (~ 25 acres) that are dominated by grasses, wildflowers, and sedges with little shrub or tree cover. Some examples include hayfields, pastures, and cropland (cornfields and other row crops). Grasslands in NH must be mowed to prevent them from becoming shrublands or forests. Only 8% of NH grasslands are currently under conservation easements.

Hemlock Hardwood Pine Forest. Hemlock hardwood pine forests are transitional forests, occurring between hardwood conifer and oak-pine forests. This common forest type is comprised of dry, sandy soils with red oak and white pine. When hemlock-hardwood-pine forests have been burned regularly over time, they may be able to support a pitch-pine sand plains system.

Peatlands. Peatlands have water with low nutrient content and higher acidity caused by limited groundwater input and surface runoff. Conservation of the 11 different natural communities that comprise peatlands is vital to the continued existence of many rare plant and wildlife species in New Hampshire. The most challenging issues facing peatlands habitat are development; altered hydrology (amount and flow of water); non-point source pollutants such as road salt, lawn fertilizers, and pesticides; and unsustainable forest harvesting.

Wet Meadow/Shrub Wetland. Emergent marsh and shrub swamp systems have a broad range of flood regimes, often controlled by the presence or departure of beavers. This system, which is an important food source for many species, is often grouped into three broad habitat categories: wet meadows, emergent marshes, and scrub-shrub wetlands. Marsh and wetlands filter pollutants, preventing them from getting into local streams, and help hold water to reduce flooding.

9.2 New Hampshire's Climate Action Plan

Appointed by Governor John Lynch in 2008, the 29 members of the Climate Change Policy Task Force developed New Hampshire's Climate Action Plan which focuses on those actions that are expected to achieve the greatest reductions in greenhouse gas emissions while providing the greatest net medium- to long-term economic benefits. The Task Force identified 10 overarching strategies necessary to reduce New Hampshire's annual greenhouse gas emissions and position the state to achieve long-term emissions reductions of 80 percent below 1990 levels by 2050. These strategies are necessary to comprehensively address the causes and the impacts of climate change and include:

1. Maximize energy efficiency in buildings.
2. Increase renewable and low-CO2-emitting sources of energy in a long-term sustainable manner.
3. Support regional and national actions to reduce greenhouse gas emissions.
4. Reduce vehicle emissions through state actions.
5. Encourage appropriate land use patterns that enable fewer vehicle-miles traveled.
6. Reduce vehicle-miles traveled through an integrated multimodal transportation system.
7. Protect natural resources (land, water, wildlife) to maintain the amount of carbon fixed or sequestered.
8. Lead by example in government operations.
9. Plan for how to address existing and potential climate change impacts.
10. Develop an integrated education, outreach and workforce training program.

Forest Preservation

Preserving our working forests and avoiding conversion of our forest lands to other purposes will be critical to the success of New Hampshire's Climate Action Plan. New Hampshire is currently 84 percent forested, and the forest products industry has been and will continue to be a key component of our state's economy. In addition, our tourism and outdoor recreation economies are heavily dependent on the health of our forests. Sustainably managed forests in New Hampshire provide a broad range of benefits, including: the ability to absorb and store large amounts of carbon; renewable supply of wood for heating, lumber, and a variety of forest products; and recreational opportunities.

To achieve the goals in the Plan, the Task Force recommends the formation of a public/private partnership – the New Hampshire Energy and Climate Collaborative – to oversee and guide early implementation of the NH Climate Action Plan. Effectively, the Collaborative will be "the keeper of the Plan." The primary purpose of the Collaborative will be to track and facilitate

implementation of the Plan's recommendations, and to report to the Governor, Legislature, and general public on progress toward achieving the desired outcomes.[16]

9.3 Recommendations

LRS1 Utilize information from the NH Wildlife Action Plan in developing land protection priorities, amending zoning ordinances and land development and subdivision regulations, and acquisition of open space lands.

[16] The New Hampshire Climate Action Plan: A Plan for New Hampshire's Energy, Environmental and Economic Development Future (2009)

10.0 Environmental and Land Use Impacts to Natural Resources

10.1 Population Growth

Population Growth

New Hampshire is the fastest growing state in New England. The impact of increased population growth on our natural resources is compounded by the increase in the amount of land occupied by new residents. While population growth averaged 71 percent from 1974 to 1992, the area of developed land increased nearly twice as fast, by 137 percent (Center for Environment and Population and National Wildlife Federation, 2003).

The Rockingham Planning region in southeastern New Hampshire has experienced a net population increase of 12,978 during 2000 to 2010 (NH Office of Energy and Planning, Census 2010), an average annual growth rate of 0.70 percent. As indicated by the data below, the region continues to experience a slowing trend in growth from 1960's to present.

Years	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010
AAGR	3.11%	2.31%	1.83%	1.06%	0.70%
Net Population Change	28,487	27,686	26,926	17,926	12.978

As buildable lands decrease over time, it is important to consider the potential consequences when increased development pressures compete with natural resource protection. Communities may consider updating a growth and planning study to evaluate build-out conditions under current zoning, and alternative buildout scenarios that would provide necessary protection of important natural resources while accommodating project growth and associated development.

Table 25. Housing statistics for Atkinson and Rockingham County

	Total	Net Change in Units								
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Atkinson	2431	88	25	24	6	18	6	8	3	3
Single-family	1826	34	11	16	4	10	6	8	3	5
Multi-family	595	54	14	8	2	8	0	0	0	-2
Manufactured	10	0	0	0	0	0	0	0	0	0
Rockingham County	113,023	1576	1579	2071	2019	1583	944	733	635	432

[Source: Current Estimates and Trends in New Hampshire's Housing Supply: Update 2009", NH Office of Energy and Planning]

Table 26. Population from 1990 and projected through 2030 for Atkinson

1990	2000	OEP Estimate 2009	2009 persons Per square mile	OEP Projection 2030
5,188	6,178	6,466	577.3	7,790

[Source: NH Office of Energy and Planning, 2009 Population Estimates of NH Cities and Towns and 2010 - 2030 Population Projections for New Hampshire Municipalities]

The impacts of population growth and increasing land consumption include fragmentation of wildlife habitat and other environmentally sensitive lands, climate change, loss of farmland, loss of forest land, increase in costs of infrastructure and municipal services, decline in air quality, increase of contamination of fisheries, decline in water quality, and increase in demand for fossil fuels and other energy sources.

Resource Consumption

In order to effectively manage our natural resources, we must first assess the significant threats, analyze the current data available, and formulate policies and strategies to address those threats to natural resources based on the available data. In examining the threats to our natural resources, it becomes apparent that our resources, which we may call "the green infrastructure," interact with our built infrastructure through the impacts of development.

10.2. Land Use Change

Tables 27 and 28 below show the changes of land use from 1962 to 2005 and the conversion of natural landscapes and resources – predominantly forested lands - to residential development. The data shows a marked increase in residential development in the 20 year period from 1978 to 1998.

Table 27. Summary of land use/land cover types and change from 1962 to 2005

Land Use/ Land Cover Type	1962		1974		1998		2005	
	Acres	% total area	Acres	% Total	Acres	% total area	Acres	% total area
Residential	574.0	7.9	1,062.8	14.6	2,228.2	30.7	2,571.1	35.4
Industrial/Commercial	5.4	0.1	23.5	0.3	116.5	1.6	86.2	1.2
Mixed Urban	0.0	0.0	7.5	0.1	6.7	0.1	6.9	0.1
Transportation/Roads	75.9	1.0	99.5	1.4	159.5	2.2	215.3	3.0
Rail Transportation	0.9	0.0	0.9	0.0	0.9	0.0	24.6	0.3
Auxiliary Transportation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Playing Fields	0.0	0.0	2.0	0.0	95.6	1.3	197.8	2.7
Active Agriculture	740.4	10.2	397.2	5.5	207.6	2.9	256.4	3.5
Farmsteads	23.4	0.3	22.1	0.3	12.8	0.2	36.6	0.5
Forested	5,445.0	75.0	5,098.0	70.2	3,996.7	55.1	3,227.4	44.5
Water	125.9	1.7	110.8	1.5	157.8	2.2	179.9	2.5
Wetlands	120.0	1.7	126.2	1.7	48.6	0.7	363.7	5.0
Idle/Open Land	147.4	2.0	307.9	4.2	227.7	3.1	92.3	1.3

Note: Gains and losses in acreage may be influenced by environmental conditions, mapping protocols and improved accuracy, or data collection methods.

Table 28. Summary of natural resources and developed lands change from 1962 to 2005

Land Use Type	***Loss or Gain (reported in acres)***			
	1962 - 1974	***1974 - 1998***	***1998 – 2005***	***Total***
Natural Resources				
Agricultural	-343.2	-189.6	48.8	-484.0
Forests	-347.1	-1,101.3	-769.2	-2,217.6
Ide/Open land	307.9	-80.3	-135.3	-55.1
Natural Resources Change (acres)				***-2,756.7***
Developed Lands				
Residential	488.8	1,165.4	343.0	1,997.2
Industrial/Commercial	18.1	93.0	-30.2	80.9
Transportation/Roads/Rail	23.6	60.0	55.8	139.4
Developed Lands Change (acres)				***2,217.4***

10.3 Fragmentation and Sprawl

According to the Society for the Protection of New Hampshire Forests, New Hampshire is the second most forested state in the nation, after Maine. Forest cover has been steadily declining since the early 1980s however, at a rate of 17,500 acres a year. This decline is largely due to increased land development (SPNHF, 2005). A major consequence of land development and threat to forested areas is fragmentation.

41 percent of Atkinson is comprised of unfragmented lands.

Unfragmented Lands Statistics

Unfragmented Lands	3,017 acres	41 % total area of town
Conserved Unfragmented Lands	acres	% of total area of town

Fragmentation occurs when large, contiguous parcels of undeveloped land are broken up into smaller or non-contiguous tracts of land. This process occurs as large parcels of undeveloped land including farmland are subdivided for residential or commercial development. Parcelization occurs when land is divided into smaller units of ownership. (Sundquist and Stevens, 1999). Fragmentation occurs hand-in-hand with a sprawling development pattern (i.e. a pattern that consumes a high percentage of land per person): "A typical subdivision in northern New England requires 1 or 2 acre lots. Twenty houses can consume 40 acres, leaving little open space. Placing the same 20 homes on ¼ acre lots and using attractive landscaping and design elements to create privacy consumes only 5 acres, leaving room for 35 acres of open space." (Forest Service, 2005; CEP, 2003)

In the 1950s, the average single-family home lot in the United States covered 1.05 acres, but by 1997, the average had risen to 1.82 acres (Peterson, 2000). According to one recent report, "Each New Hampshire resident effectively occupies one-third more land area for housing, schools, shopping, roads, and other uses than s/he did twenty years ago." (CEP, 2003)

Fragmentation and sprawl lead to several negative impacts on natural resources, the economy, and society. Fragmentation impacts flood retention and storage as more impervious surfaces such as pavement are added in the course of development. A one-acre parking lot generates 16 times more runoff than a one-acre meadow, and the runoff from the parking lot carries pollutants such as nutrients and toxic metals (EPA, 2001).

Invasive plant and animal species can invade local environments more easily in an altered or fragmented landscape as such species are sometimes early colonizers or are introduced through residential landscaping. Species that require large tracts of unfragmented land cannot thrive in fragmented areas and often decline in population. Fragmentation disrupts wildlife corridors used by animals as routes to food and water, and severs connections of habitat areas (Forest Service, 2005). The Society for the Protection of New Hampshire Forests observes that "the state's predicted growth of the next twenty years will fragment the large blocks of forests and wetlands that are crucial for providing wildlife habitat and sustaining critical ecological processes (SPNHF, 1999).

Economic impacts of fragmentation and sprawl include greater municipal costs for maintenance of roads, water supply, sewers, school bus routes, and fire and safety services as the population spreads out. As the community requires more services at greater cost, property taxes also rise, forcing landowners to make difficult decisions concerning future land use on their property (Forest Service, 2005). Automobile use increases with sprawled-out development patterns resulting in greater fossil fuel use, and increases in traffic congestion, noise, and pollution when work, residences, and goods and services are all in separate locations (Putnam, 1995).

Social impacts of fragmentation and sprawl result in changes to the community. Community culture can change, particularly in small New Hampshire towns where residents once had a close connection to the land through forestry, farming, hunting and fishing, and other recreational activities. The community may suffer as a whole through the loss of recreational activities and a shared natural heritage. Residents who are more widely dispersed often have lower levels of participation in civic affairs and community volunteerism, due to less frequent contact with neighbors and other residents, resulting in an overall loss of social capital for the town: "Each additional ten minutes in daily commuting time cuts involvement in community affairs by 10 percent" (Putnam, 1995).

As the pattern of fragmented development and sprawl continues over time, towns also may lose historic buildings and local businesses, as nationally-owned enterprises purchase property, construct franchise developments, and out-compete local markets through economies of scale. In this way, towns lose not only their local economic base and the local business class, but also lose the "sense of place" so important to the tourism, travel-based economy and local history of many towns in the region (Hiss, 1990; Putnam 1995).

10.4 Climate Change

According to the United States Environmental Protection Agency:

> The Earth's climate has changed many times during the planet's history, with events ranging from ice ages to long periods of warmth. Historically, natural factors such as volcanic eruptions, changes in the Earth's orbit, and the amount of energy released from the Sun have affected the Earth's climate. Beginning late in the 18th century, human activities associated with the Industrial Revolution have also changed the composition of the atmosphere and therefore very likely are influencing the Earth's climate. (EPA website, 2008).

Scientists agree that climate change is largely due to the release of greenhouse gases such as carbon dioxide to the atmosphere. The burning of fossil fuels and deforestation has caused concentrations of heat-trapping greenhouse gases to increase significantly in our atmosphere over the past 200 years. When present in adequate concentrations, greenhouse gases prevent heat from escaping to space, keeping the planet's atmosphere and surface at temperatures necessary to sustain life as we know it. As the concentrations of these gases continue to increase in the atmosphere, the Earth's temperature is steadily increasing above levels measured during our post-industrial and pre-industrial history.

According to NOAA and NASA data, the Earth's average surface temperature has increased by about 1.2 to 1.4ºF in the last 100 years. The eight warmest years on record (since 1850) have all occurred since 1998, with the warmest year being 2005. Most of the warming in recent decades is very likely the result of human activities. Other aspects of the climate are also changing such as rainfall patterns, snow and ice cover, and sea level. If greenhouse gas concentrations continue to increase, climate models predict that the average temperature at the Earth's surface could increase from 3.2 to 7.2ºF above 1990 levels by the end of this century. The overwhelming weight of scientific evidence supports the conclusion that human activities are changing the composition of the atmosphere, and that increasing the concentration of greenhouse gases may change the planet's climate dramatically in the future.

Land Use Climate Change Connection

Scientists agree that the main cause of climate change is due to the concentration of carbon dioxide released to the atmosphere as a result of burning fossil fuels. Most uses of fossil fuels result from the energy used to power factories, heat and light homes and businesses, and operate vehicles (CA-CP, 2008). Land consumption through sprawl development and inefficiency in planning communities, infrastructure and transportation systems result in ever higher land and resource consumption per person. This equates to increases in energy consumption and demand. As population and land consumption increase over time, demand for energy for buildings and vehicles will increase.

The choices made today in planning - for alternative energy use, efficient use of fuels for businesses and residences, building design and construction, land use patterns, road networks, vehicle fleets, and land conservation and stewardship - will have long-term implications for the region's response to the effects of climate change and the region's future economic prosperity and environmental health.

Impacts on Natural Resources Due to Climate Change

Recent studies predict that climate change will impact New Hampshire's natural resources negatively. These changes include impacts to: forest composition, wildlife species and their habitat, insect and pest infestations, sea level rise, coastal and estuarine ecosystems, agricultural

production, human health, air quality, and natural resource-based outdoor recreation and tourism (Clean Air Cool Planet, 2008, Carbon Coalition 2008).

Greenhouse Gas Emissions Reductions

The increasing trend of carbon dioxide emissions to our atmosphere in recent decades has caused concern over its effect on environmental ecosystems and climate worldwide. Concentrations of carbon dioxide, a byproduct of the burning of fossil fuels, have increased rapidly in the atmosphere as consumption of fossil based fuels has also increased. Alterations to our region's climate could result in changes or decline in certain sectors of the economy, including winter tourism, agriculture, maple syrup production, coastal real estate values (due to sea level rise and increased storm intensity), and health costs associated with respiratory health and heat related illnesses.

The NH Climate Action Plan calls for a reduction in emissions of 20 percent below 1990 levels by 2025, and 80 percent below 1990 levels by 2050. In order to meet these reduction goals statewide, NH communities must engage in local energy planning that includes strategies for decreasing their emissions overall.

10.5 Water Quality

Groundwater and surface water resources are plentiful and diverse in southeast New Hampshire, but are nevertheless prone to threats from a variety of sources. Water quality is threatened by six elements: pollution from point sources and non-point sources, septic systems, site development activity, atmospheric deposition of acid rain and mercury, and excessive withdrawals (CEP, 2003). Contaminants also affect wildlife species and degrade overall water quality required for ecosystem function, for example, through increased turbidity in freshwater streams due to erosion. Fish and shellfish consumption advisories due to contamination not only affect human health, but also have an economic impact on the fisheries economy and travel and tourism industry.

Surface Water Quality

The NH DES Surface Water Quality Assessment Program produces two surface water quality documents every two years, the "305(b) Report" and the "303(d) List". As the two documents use the same data, the 305(b) Report and 303(d) List were combined into one Integrated Report starting in 2002. The Integrated Report describes the quality of New Hampshire's surface waters and an analysis of the extent to which all such waters provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water.

Designated Uses

All surface waters of the State are either classified as Class A or B, with the majority of waters being Class B. NH DES maintains a list that includes a narrative description of all the legislative classified waters. Designated uses represent the uses that a waterbody should support. Below are the Classification Designated Uses for Class A and Class B waters as described in RSA 485A:8.

Class A — These are generally of the highest quality and are considered potentially usable for water supply after adequate treatment. Discharge of sewage or wastes is prohibited to waters of this classification.

Class B — Of the second highest quality, these waters are considered acceptable for fishing, swimming and other recreational purposes, and, after adequate treatment, for use as water supplies.

Criteria. The second major component of the water quality standards is the "criteria". Criteria are designed to protect the designated uses of all surface waters and may be expressed in either numeric or narrative form. A waterbody that meets the criteria for its assigned classification is considered to meet its intended use. Water quality criteria for each classification may be found in RSA 485A:8, IV and in the State's surface water quality regulations (NHDES, 1999).

Antidegradation. The third component of water quality standards is antidegradation which are provisions designed to preserve and protect the existing beneficial uses and to minimize degradation of the State's surface waters. Antidegradation regulations are included in Part Env Ws 1708 of the State's surface water quality regulations (NHDES, 1999). The NHDES is currently developing specific antidegradation standards for water quality, which may be released in 2010. According to Env Ws 1708.03, antidegradation applies to the following:

- any proposed new or increased activity, including point and nonpoint source discharges of pollutants that would lower water quality or affect the existing or designated uses;
- a proposed increase in loadings to a waterbody when the proposal is associated with existing activities;
- an increase in flow alteration over an existing alteration; and
- all hydrologic modifications, such as dam construction and water withdrawals.

Impervious Surface and Water Quality

Impervious or impermeable surfaces are areas covered by material that impedes the infiltration of water into the soil. Examples of impervious surfaces are paved roads, parking lots, buildings, concrete, pavement, and severely compacted soils (New Hampshire Estuaries Project, 2004). Pollutants in runoff include suspended carcinogens known as polycyclic aromatic hydrocarbons, which can leach from asphalt, coal tar-based sealants, oil and gasoline. Other pollutants often found in runoff include pesticides, nitrates, phosphates, and salt for de-icing roads (Science News, 2004).

The increase of impervious surfaces through land development affects water resources in several ways. Impervious surfaces combined with urban drainage systems - such as curbs and gutters and storm drain pipes - can alter the natural hydrology in a watershed by increasing the volume of stormwater, reducing groundwater recharge, and diverting water from surface water bodies. Impervious surfaces can also result in contamination of drinking water resources, loss of aquatic habitat, loss of biological diversity, and an overall decrease in water quality due to the accelerated delivery of pollutants into rivers, lakes, and estuaries (NHEP, 2004).

Recently scientists have reported that levels of impervious surface in excess of ten percent in a watershed can affect water quality. When the percentage of impervious surfaces in a watershed is ten percent or less, streams typically retain good water quality and stable channels. When the proportion is between ten to twenty-five percent, streams exhibit noticeable erosion (Science

News, 2004). More than twenty-five percent impervious surface coverage can lead to severe physical and ecological damage to streams in a watershed (Science News, 2004).

Impervious surfaces represent a threat not only to the green infrastructure of watersheds and water quality, but also to the social and built infrastructure components of municipal services. In other words, reducing impervious surface not only helps to improve water quality, it may also result in lower municipal costs for road and infrastructure maintenance and lower development costs. A 100-foot reduction in road length can result in a savings of about $15,000. This figure includes savings from reduction in pavement surface, curb and gutter installation, and stormwater management structures (Better Site Design, 1998). Well-planned street layouts effectively reduce impervious surfaces, help to alleviate traffic congestion, promote efficient development patterns, protect conservation areas, and create a street system that optimizes the ability of town fire and rescue officials to respond to emergencies in a timely and efficient fashion (Robinson, 2005).

10.6 Wildlife and Their Habitat

Fragmentation

Fragmentation and habitat loss threaten the continued viability of wildlife in the state. When landscapes are fragmented by development, species requiring large ranges for basic survival and reproduction needs are threatened. When only patches of habitat remain that are separated by great distances that make movement from one patch to another impossible, the ability of a species to reproduce and withstand stress is diminished. Small patches are also more vulnerable to severe disturbance, such as fires and ice storms. Fragmentation also changes predator/prey relationships, as fragmentation leads to higher numbers of generalist predators and thus increased predation on remaining species (DESFS, 2004). Fragmentation thus may lead to a decline in species population as well as an increase in human/wildlife conflicts as former habitat is replaced by development. Development may result in the elimination of habitat features such as native plant species, or the vegetative community may change. Invasive species are often the first to colonize a newly-developed site. (DES Fact Sheet , 2004).

Biodiversity

Wildlife losses can be measured not only in terms of individual species, but also in terms of an overall loss in biodiversity. Biodiversity is critical to ecosystem function, or green infrastructure, due to the interdependent relationships between animal and plant species. Biodiversity is also important to sustaining the built and social infrastructures, due to the importance of ecosystem function to science, economics, energy, and health.

The reduction of the earth's biodiversity is a major concern due to its importance to the fields of basic and applied medicinal research, biotechnology, ecological engineering, pollution control, alternative energy, and food science. For example, nearly 25 percent of prescription drugs in the U.S. are derived from plants, at an estimated market value of over 8 billion per year.

With increased development pressures, the environmental, economic, and social utility provided by New Hampshire's water resources, wetlands, forests, fields, and wildlife is severely compromised. Although ecosystems are made up of dynamic, adaptive processes that can

respond to many stressors, the recent impacts of growth and the loss of important resources has resulted in the loss of species and the degradation and loss of water resources, forests, wetlands, salt marshland, and farmlands.

Habitat Loss Effects

Development may also increase edge effects, which are defined as "changes in environmental conditions and animal behavior and well-being that result from being in close proximity to the border between habitat areas." Although edge habitats are critical to many species, human developments may result in harder edges, or more abrupt changes from one habitat type to another. Development may also change the proportion of interior habitat relative to edge habitat. Interior habitat that is relatively isolated is important to many species such as nesting birds, which require isolation for some period during their life cycle (DES Fact Sheet, 2004).

Aquatic Habitat

Development affects aquatic habitat in many ways. Increases in impervious surface result in less infiltration of rainwater into the soil which causes flooding, streambed erosion, and sedimentation (DESFS, 2004). Runoff may also change the temperature of bodies of water as it may be warmer, and may contain pollutants including household chemicals, metals, fertilizers, pesticides, oil and grease, and pathogens. Loss of vegetative buffers due to development or erosion can also alter the temperature of water bodies to a level at which species cannot persist (DEFS, 2004).

Human Activity

Everyday activities associated with development can have negative effects on wildlife. Lighting can affect the behavior and biological rhythms of species that are guided by cycles of light and dark. Domestic pets such as cats may become predators to ground-nesting birds. Household trash may attract certain species and allow them to thrive (DESFS, 2004) and may create nuisance conditions or human/wildlife conflicts.

10.7 Human Health

Increases in summer temperatures are a likely result of climate change. As temperatures increase, there will be more ground-level ozone formation, and more smog alerts. As air quality worsens, it could potentially impact both those with existing respiratory disorders such as asthma as well as impact human health of those who work, exercise, or travel outdoors. Climate change will also impact potentially the spread of diseases by mosquitoes and ticks, such as Lyme Disease and West Nile Virus.

Lyme disease, which is already prevalent in the region, has been increasing in NH overall. If undetected or untreated, the disease can lead to permanent neurological disability as well as a number of cardiac and nervous system impacts. Lyme Disease is passed to humans through ticks carried by deer and field mice, and thus it poses a threat to those who enjoy outdoor hiking, hunting, and fishing. Some recent research suggests that warmer winters could increase the incidence of the disease and push its potential range further into northern New England. Similarly, more frequent extreme weather events is likely to increase mosquito populations and

increase the size of recurrent outbreaks of viruses carried by mosquitoes such as West Nile Virus (Clean Air Cool Planet Fact Sheet 2008).

10.8 Tourism and Recreation Economy

Climate change will be a major future impact on tourism and recreation in New Hampshire. Continued warming is expected to result in a shorter and less predictable ski season. In addition to affecting ski areas and related winter recreation, climate change threatens forests of public lands in the region, including the Acadia National Park, the Allagash Wilderness Waterway, Baxter State Park, the White Mountains National Forest, and Mount Washington State Park (Clean Air Cool Planet Fact Sheet, 2008)

Climate change and changing precipitation patterns could also impact the New England fall foliage season and related tourism by muting fall colors or by decreasing the range of sugar maples in our state's forests.

More information on the impacts of Climate Change can be found in the publication "Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change, New England Regional Overview" prepared by the U.S. Global Change Research Program, University of New Hampshire.

10.9 Natural Resource Management and Protection – The Three Infastructures

The Three Infrastructures

The way we manage our natural resources also impacts our social infrastructure, because the landscape and natural resources of New Hampshire are central to the culture, tourism, and economy of the region. We call this relationship "The Three Infrastructures" based on the New Hampshire model developed by the New Hampshire Audubon Society and The Jordan Institute. This model is used as a method to help evaluate the relationships between the green, built, and social infrastructures. As strategies are developed to address threats and impacts to natural resources, the effects of these strategies on the built and social infrastructures are also considered.

The basic premise of this approach to planning is that the three infrastructures must be in balance in order to maintain our quality of life and ensure a sustainable future:

Built Infrastructure,

Green Infrastructure

Social Infrastructure

In 1999, a group of local, state and federal agencies, and non-governmental organizations under the leadership of The USDA Forest Service and the Conservation Fund developed the following definition for *Green Infrastructure*:

> ***Green Infrastructure*** in our nation's natural life support system—an interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas;

> greenways, parks and other conservation lands, working farms, ranches and forests; and wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources and contribute to the health and quality of life for America's communities and people. (Benedict and McMahon, 2001).

The NH Minimum Impact Development Partnership has adopted the following very similar definition:

> ***Green Infrastructure*** is the natural life support system which supports human life and economic activity. It is a network of interconnected lands and waters, providing ecological goods and services (such as clean air and water, food and fiber, waste decomposition, and climate moderation) and contributing to the health and quality of life for human communities. Green infrastructure includes working lands, ecological reserves, recreation lands, riparian buffers around wetlands and lakes, ponds, rivers, and streams; and streetside and backyard vegetation. (NHMID, 2001).
>
> ***Built Infrastructure*** "includes all human-made constructed elements, such as roads and rails, buildings and bridges, phone wires and sewer pipes, homes and offices and all the rest. A well-planned and developed built infrastructure integrates in a healthy way with the green infrastructure and the social infrastructure (NHMID, 2005).
>
> ***Social Infrastructure*** "is the network of the human relationships which form the basics of our private lives, our work lives, and our lives as members of our local communities. Part of this network includes employment, public health, education, the arts, recreation, and similar activities in our communities which contribute to-or detract from-our quality of life" (NMID, 2005).

The three infrastructures approach provides a way of thinking about the relationships between the different aspects of development as inter-related systems, but it also provides a starting-off point for developing policies and practices to ensure the integration and efficiency of these three spheres. While some organizations such as NHMID have focused on specific practices, others seek to use this approach to help planning boards and municipal officials develop and implement policies that promote sustainable development. The three infrastructures approach may be used to develop policies and practices to enhance the natural resources policies and protection mechanisms of the town.

See the text and Figure 10 on the following page for a description of Atkinson's Green Infrastructure.

Atkinson's Green Infrastructure is shown on the map below. The map depicts the collective geographic extent of forested areas, wetlands, lakes, streams and ponds. Note: Forested areas may contain some development but it is assumed that canopy cover is intact in areas where there are existing roads.

Figure 11. The Green Infrastructure of Atkinson including forested areas, wetlands, lakes, streams and ponds

Appendices

Appendix A Recommendations
Appendix B Conserved Lands Inventory
Appendix C Additional References
Appendix D Map Set

Appendix A Recommendations

2.0 Natural Conditions and Landscape

NCL1 Amend existing zoning ordinances (such as Article VI: Rural Cluster Residential Development ordinance) and land development regulations to encourage and provide incentives to preserve important farmland soils and existing agricultural activities.[17]

NCL2 Encourage and promote continued use and productivity of farmland soils by supporting farmers to maintain viable agricultural operations and activities that support agriculture. This may include organizing an Agricultural Committee or Commission, developing an agricultural based newsletter and calendar of annual events, or holding other agriculturally oriented civic and public events.

NCL3 Conduct an audit of zoning ordinances and land development regulations to evaluate whether barriers to agricultural activities exist (i.e. using the 'Farm Friendly Checklist').

NCL4 Draft performance standards for development on steep slopes (>15 percent) that address water quality, erosion, land stability and land disturbance.

3.0 Surface Water Resources

SWR1 Consider amending the zoning ordinance to require a minimum buffer to streams and brooks.[18] [Note: First order streams represent nearly 63 percent of the total linear stream miles in town. For this reason, protection of first order streams is key to preserving high quality watersheds.]

SWR2 Organize a volunteer group to participate in the NH Department of Environmental Services, Volunteer River Assessment Program (VRAP) to gather surface water quality data. (See Appendix C for additional information about VRAP.)

SWR3 Conduct a professional planning audit of zoning ordinances and land development regulations to evaluate the effectiveness of existing water quality protection measures in place and, if necessary, develop recommendations to improve them.

SWR4 Amend existing zoning ordinances (such as Article VI: Rural Cluster Residential Development and Article IV: General Provisions, Section 402 Floodplain Management Ordinance) and land development regulations to encourage and provide incentives to preserve riparian areas and provide water quality treatment of stormwater runoff.[19]

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[17] Refer to the NH Department of Environmental Services '*Innovative Land Use Planning Techniques Handbook: Chapter 1.4 Conservation Subdivision*' at http://des.nh.gov/organization/divisions/water/wmb/repp/innovative_land_use.htm

[18] Refer to the Piscataqua Region Estuaries Partnership (PREP) website for information and technical guidance about buffers at http://www.prep.unh.edu/resources/buffers.htm

[19] Refer to the Department of Environmental Services '*The NH Stormwater Manual Volumes 1-3*' (2008, as amended) at http://des.nh.gov/organization/divisions/water/stormwater/manual.htm and The Center for Watershed Protection stormwater information resources at http://www.cwp.org/

SWR5 Conduct a professional planning audit of zoning ordinances and land development regulations to identify where new requirements and standards may be incorporated to mitigate existing conditions and prevent flooding in the future. [Note: The town may also consider developing an inventory of sites that currently have flooding problems.]

4.0 Wetlands

WTL1 Consider adopting in the zoning ordinance (Article IV: General Provisions, Section 410 Wetland Zoning) a mandatory minimum buffer to wetlands not designated as prime wetlands to help preserve their hydrologic and ecological functions and prevent impacts from development and other land based activities. *Refer to Section 4.1 Functions and Values of Wetlands.*

5.0 Groundwater Resources and Water Supply

GW1 Amend zoning ordinances and land development regulations to provide protection of groundwater resources by requiring infiltration of stormwater runoff in aquifers and groundwater recharge areas (i.e. adoption of stormwater standards and/or regulations).

GW2 Consider limiting high risk uses (those that have a high potential to contaminate water supplies) in aquifers and groundwater recharge areas.

6.0 Wildlife and Ecological Resources

WER1 Include strategies for controlling invasive species as part of management plans for town owned properties.

WER2 Provide informational materials for distribution to residents and businesses about invasive species and how to control them.

7.0 Forest Resources and Forestry

FR1 Reference the Forest Management Plan update by the Town's consulting forester, including recommendations contained in the plan.

FR2 Complete one Forest Management Plan per year until plans are completed for all town forests; update the Forest Management Plans on a regular basis (i.e. approximately every 10 years).

FR3 Participate in the NH Community Tree Steward Volunteer Program to update the New Hampshire Big Tree Program inventory for Atkinson.

8.0 Open Space and Land Conservation

OS1 Amend zoning ordinances (Article VI: Rural Cluster Residential Development), site development plan regulations, and subdivision regulations to provide additional incentives for increased protection of and provisions for access to open space lands.

OS2 Organize an Open Space Committee to guide land protection efforts and use of town and other funding sources for protection of open space lands and resources, and other significant cultural and historic resources.

OS2 Develop an Open Space Plan to help plan future land acquisition and protection efforts and to guide future funding through the Capital Improvement Plan, bonds and allocation of Land Use Change Tax collections.

OS4 Consider securing a town bond and source other funding opportunities for purposes of land protection and acquisition.

9.0 Local, Regional and State Studies and Projects

LRS1 Utilize information from the NH Wildlife Action Plan in developing land protection priorities, amending zoning ordinances and land development and subdivision regulations, and acquisition of open space lands.

Appendix B List of Conserved and Open Space Lands in Atkinson

Conserved lands have a permanent easement or other legal restriction preventing them from being developed in the future. Open space lands have been permanently designated as undeveloped land as part of subdivision approval (Zoning Ordinance, Article VI Rural Cluster Residential Development).

Conserved Lands	***Map/Lot***	***Acreage***
	2-53	10.200
	3-108	13.980
	3-19	57.870
	4-11-1	48.380
	4-50	24.355
	4-46	4.200
	5-48	59.190
	12-2	29.570
	12-8-1	11.670
	16-12-1	31.200
	16-19	1.700
	18-109	7.700
	18-70	4.200
	18-77	17.430
	18-86	4.000
	18-78	45.740
	18-65	7.000
	18-41	7.000
	18-82	4.040
	18-83	3.850
	18-84	2.780
	19-80	4.070
	19-18	17.050
	19-76	2.000
	19-61	7.360
	19-62	12.000
	20-36	35.170
	20-13-1	3.910
	20-15-1	3.400
	20-15	1.000
	20-35	24.300
	20-31	1.500
	23-40	25.000
	23-91	0.161
	Total	***532.976***

Open Space Lands	***Map/Lot***	***Acreage***
Fieldstone Village	2-1	28.14
Twin Oaks	6-76	14.82
Eldon Way	7-139	12.84
Little River	9-33	7.90
Carriage Chase Estates	9-62-22	17.21
Bryant Woods	10-7	170.23
Millstream Crossing	11-39	3.25
	11-11	2.78
	11-54	5.88
	11-53	2.22
Settlers Ridge	12-1	83.26
Jesse Page Estates	13-22	26.55
Jamison Ridge	13-29	36.76
Centerview Hollow	13-96	47.94
Wright Farm I and II	13-94	43.09
Cogswell Farm	13-1-1	18.33
Ashford Drive	17-29-7	11.30
The Commons	17-86	67.84
Dearborn Ridge	18-74	14.59
Atkinson Woods	20-49	41.25
Waterwheel Estates	21-1	40.88
	Total	***697.07***

Appendix C Additional References

Volunteer River Assessment Program (VRAP)

In 1998, the New Hampshire Volunteer River Assessment Program (VRAP) was established to promote awareness and education of the importance of maintaining water quality in New Hampshire's rivers and streams. VRAP aims to educate people about river and stream water quality and ecology and to improve water quality monitoring coverage for the protection of water resources.

What does VRAP do?

VRAP loans water quality monitoring equipment, provides technical support, and facilitates educational programs to volunteer groups on numerous rivers and watersheds throughout the state. VRAP volunteers conduct water quality monitoring on an ongoing basis and increase the amount of river water quality information available to local, state and federal governments, which allows for better watershed planning.

Why is VRAP Important?

VRAP establishes a regular volunteer-driven water sampling program to assist DES in evaluating water quality throughout the state. VRAP empowers volunteers with information about the health of New Hampshire's rivers and streams. Regular collection of water quality data allows for early detection of water quality changes allowing DES to trace potential problems to their source. Data collected by VRAP volunteers are directly contributing to New Hampshire's obligations under the Clean Water Act. Measurements taken by volunteers are used in assessing the water quality of New Hampshire's river and streams, and are included in reporting to the US Environmental Protection Agency (EPA).

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The NH Stormwater Manual, Volumes I-II (2008)

The New Hampshire Stormwater Manual was developed by the NH Department of Environmental Services as a planning and design tool for the communities, developers, designers and members of regulatory boards, commissions, and agencies involved in stormwater programs in New Hampshire.

Volume 1: Stormwater and Antidegradation presents an overview of New Hampshire's stormwater program together with related federal program requirements, describes New Hampshire's antidegradation provision (Env-Wq 1708) with respect to controlling water quality impacts due to stormwater discharges, and provides an introduction to the non-structural and structural measures for managing stormwater.

Volume 2: Post-Construction Best Management Practices Selection and Design presents a detailed description of the structural BMPs applicable for use in New Hampshire for the prevention, control, and treatment of stormwater.

Volume 3: Erosion and Sediment Controls During Construction presents a selection of practices applicable during the construction of projects to prevent adverse impacts to water resources as a result of land-disturbance activities.

The manual is intended to be a "living" document and will be updated as new information becomes available. The revision number of the most recent version is included on the title page and the footer on each left-hand page. Copies are available for order or download at http://des.nh.gov/organization/divisions/water/stormwater/manual.htm.

NH Fish & Game

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