Natural Resources Inventory

Bradford, New Hampshire

photo credit – Bill Duffy

View from Rowe Mountain Road overlooking Lake Massasecum

Prepared by the Bradford Conservation Commission
With mapping by Northern Geomantics
PO Box 436
Bradford, NH
03221

Winter 2012

Table of Contents

1. Introduction

A Natural Resources Inventory (NRI) in its simplest terms is a detailed collection of available data on the important naturally occurring resources within a town. Natural resources are irreplaceable or very expensive to replace once damaged or removed. The benefits of good drinking water, clean air, access to local fuel and lumber, and potential for local food and forage crops are more measurable than scenic views and wildlife but all are important. Maintaining and supporting Bradford's natural resources and rural character has been a high priority in all of the town's Master Plan surveys. (1986, 1996, 2006)

New Hampshire has had the fastest growing population in the Northeast for the past fifty years and this challenges towns in their efforts to conserve their resources. A Natural Resources Inventory provides the town with a foundation for informed decision-making based on available data. It provides specific recommendations for future planning. The information and maps contained here are available to the public and to all town boards and departments in hard copy and digital format.

An NRI is also the primary document on which a comprehensive Conservation Plan is based. A Conservation Plan highlights the most significant resources that the town should maintain in terms of water quality, flood and erosion control, a viable forestry industry, local agriculture, views, recreation and hunting, wildlife habitat, and rare species protection.

Bradford's first NRI was created by the Conservation Commission in 1998 with mapping provided by Commission member and resident Perry Teele. More information has become available in the past decade and the uses of some of the landscape have changed. For this update, the services of Northern Geomantics, a professional Geographic Information Systems (GIS) contractor, were engaged.

This document, begun in 2009 and completed in 2012, describes the town as it currently exists. It provides a foundation for observations on trends and changes over time. The Conservation Commission welcomes public input and suggestions toward making this 'living document' as accurate as possible and toward amending it into the future.

Further information: *New Hampshire's Changing Landscape* report of the Society for the Protection of New Hampshire Forests, 2005
www.spnhf.org/research/papers/nhclsummary.pdf

1.1 Acknowledgements:

The following people and organizations assisted in the production of this Natural Resources Inventory:

Members of the Conservation Commission (2009-2012)
- Nathanial Bruss, chair
- Meg Fearnley, treasurer
- J. Ann Eldridge, secretary/chair
- Amy Blitzer
- Brooks McCandlish
- Andrea LaMoreaux
- Carol Meise
- Perry Teele
- Seth Benowitz
- Patty Furness, secretary
- George Beaton

NH Cooperative Extension - Wildlife Action Plan, Frank Mitchell and Amanda Lindley Stone.
Northern Geomantics – (maps and most of the photographs) Bill Duffy
Ausbon Sargent Land Preservation Trust – Beth McGuinn, Land Protection Specialist
Bradford Fire Department and Rescue Squad
Emergency Management Director – Bruce Edwards
Bradford Fish and Game Club
Lake Sunapee Snowmobile Club
Oct 2009 - public forum on the draft maps
Summer 2009 - Survey to all Bradford residents

2. Overview:

Land Grant 1771 Incorporated 1787

Population: 1790 = 217
1850 = 1341
1920 = 580
2012 = 1536 (approximate)

Land Use – 2011

Residential	600 acres	2.6%
Commercial	35	0.2
Industrial	35	0.2
Excavation	35	0.2
Agriculture	295	1.3
Wet Land	920	4.0
Public Recreation	25	0.1
Public Institutions (includes highways, cemeteries, etc.)	45	0.2
Forest	20,584	89.4
Water	445	1.9

Land: 22,574 acres Water: 445 acres Total: 23,019 acres

Square miles: 35.92

Bradford in 2012 has much in common with neighboring towns and a few significant differences. The land use patterns we see today originated in the early formation of the town.

As with neighboring towns, the early settlers of the 1700s quickly located the best soils with the most level terrain and with easy access to water for farming and for powering mills for grain and lumber. The sheep and wool industry was largely responsible for the clearing of approximately 90% of the forested landscape in southern New Hampshire and the construction of most of its stone walls. When this industry moved west in the mid - 1800s, farms were abandoned and the forests regenerated making way for a viable timber industry to follow.

In 1850, the railroad, located roughly where Route 103 now lies, connected Bradford to Concord and points beyond. Because of this, the commercial and cultural center of Bradford relocated from its geographical center to the northern edge of town. A new church was built and in 1863 the meeting house was moved and expanded as the current town hall on the new Main Street.

Like many towns in New England, Bradford's population declined after the Civil War. People left the hillside farms for new land in the West or for work that allowed them to purchase goods and food rather than make their own. Because the center of Bradford's population and commerce now lay on the northern edge of town, many of the unused older roads to the south, east and west were abandoned: Liberty Hill, Carter Hill, Rowe Mountain, Day Pond, County, Deer Valley, Old Coach, Mountain, and Alder Plains roads. Only the East Washington Road remains as an exit from town to the southwest.

The railroad was abandoned in 1960 and in 1969 Route 103 took its place. Because most of the population is now living near town services in the north, the southern half of town is largely a rural, unfragmented landscape benefiting timber and recreation industries and supporting some small agricultural operations.

In 2012, with the current pause in housing development, the town has an opportunity to examine its resources and plan for the future.

photo: JA Eldridge

Battles Farm Easement

3. Topography

Refer to *Habitats and Land Cover* map

Sharing geological history with the rest of the northeast, Bradford was covered by a mile thick sheet of ice and snow until 12-14,000 years ago. Glaciations have been the most important factors in forging the character of the landscape.

In some places it is possible to gauge the direction of ice movement by the shapes of the hills, by 'boulder trains' fanning out from their parent ledges, and by the striations across ledge outcrops. Glacial erratics, large boulders far removed from their original locations, litter the landscape in some areas. Examples of erratics include 'Tipping Rock' on Avery's Ledge on the western edge of town and a lonesome boulder in a field by the private Penhallow Road in the Southwest part of town. Bedrock lies just beneath most soils and most elevations are knobs and ridges of this bedrock. Bradford's southern hills are part of a larger system that includes Lovewell and Sunapee mountains. The larger lakes and rivers reflect water courses that were once much larger and cut through this base layer of stone.

Most of New England's earlier soils were scraped, eroded, and deposited in Long Island Sound or the Gulf of Maine. Virtually all the soils we see today were created after the melting of the glaciers within the last 10-14,000 years by organic processes. Soils are seldom deeper than 20 feet except along the major rivers and the uneven movement of ice resulted in New England's wide range of soil textures, depths, acidity, and fertility. The more level, arable soils of Bradford were deposited by ancient river systems.

The most recent ice event created sand and gravel deposited as eskers, outwash plains and kame terraces. The sand and gravel deposits around Lake Massasecum and along Route 103 and 114 are the result of glacial outwash and are the locations of important stratified drift aquifers. Elevations in town run from the highest point of Durrell or Moon Mountain at 2096 feet to the lowest at 625 feet on the Warner river at the Warner town line.

Because of these varied soil characteristics, the patterns and composition of vegetation also vary widely. The historic patterns of settlement and land use are reflected ultimately in the soils.

3.1 Slope and the Conservation Zone

At the time of this writing, the Conservation Zone comprises all land above 1200 feet in elevation and the land use regulations are slightly different than in the Rural Residential Zone. The reasoning behind this ordinance when it was made in 1990 was that these areas (approximately 25.4 % of the town) are generally not well-suited for development and are located far from town services. The soils are shallow and fragile, the contours are most often steep, and the land is relatively inaccessible. This type of land is valuable for its open spaces, forest resources, recreational opportunities, and scenery.

Steep slopes with a vertical change in elevation greater than 20 feet at a slope of 33% (one foot rise in three feet) covering more than 5,000 contiguous square feet are withdrawn from calculations of buildable acreage in determining acreage of new lots.

It would be difficult to calculate an accurate percentage of severe steep slope in this town -- vertical change in elevation greater than 20 feet at a slope of 50% (one foot rise in two feet). Approximately 17% of Bradford has a slope of 25% or greater.

3.2 Major Hills of Bradford

- Avery Ledge [1920 feet] The glacial erratic known as 'Tipping Rock' sits on ledge on top of this hill southwest of Durrell(Moon) Mountain and Ayer's Pond.

- Cedar Hill [1050 feet] This hill was known for its red cedar, much of which has now been overshadowed by taller trees. This hill is prominent, watching over Lake Massasecum north of Guild Hill.

- Durrell (Moon) Mountain [2096 feet] Though unnamed on most maps, this is the highest point in town. It is named for families that worked the land in this area. The top is densely covered with spruce.

- Goodwin Hill [1330 feet] The Goodwin farm was located here, overlooking Meadowbrook Farm (now the Battles Farm easement). There are remnants of a fox blind that was used to guard sheep in the 1800s.

- Guild Hill [1153 feet] The northern half is preserved by the Nelson Family Easement. Overlooking Lake Massasecum, this area was once owned by the prominent Pierce family, related to President Franklin Pierce.

- Haystack Mountain [1709 feet] A hike is rewarded with ledge lookouts in three directions. An impressive stone wall curves over the top and a stone chair with footstool was positioned here decades ago. Bobcat and porcupine abound.

- Hogg Hill [1150 feet] This hill was named for an early farming family. An odd cairn of smooth rocks sits near the top of this hill.

- Knight's Hill [1910 feet] This hill was named for Jonathan Knight, a soldier in the Revolutionary war who farmed here, see photo on page 238 of the Bradford history book, 'Two Hundred Plus'. Between its double peak lies a vernal pool graced by wood lilies.

- Pickett Hill [1601 feet] A steep double peak overlooks Alder Plains Road.

- Rowe Hills [1945] This is really three heights in a ridge running east/west and intersecting with Knight's Hill. It also is laced with stone walls, evidence of sheep farming, apple trees, and former hill farms.

- Silver Hill [1745] On the east side of County Road, people have used this steep hill for rock climbing experience.

- Many other hills in town are known by the roads that climb them: Marshall Hill Road, Johnson Hill Road, Cheney Hill Road, Sunset Hill Road, Breezy Hill Road, Ring Hill Road. In remembering these hills, we pay tribute to the early farmers and the hardships they endured while riding, walking and hauling material up and down them.

3.3 Recommendations:

- Review the definition of the Conservation Zone - consider Conservation overlays that would protect other important resources such as surface water, views, agricultural and forestry soils.

4. Soils

The map of *Farmland and Forest Soils* displays the most valuable agricultural soils on top of important forest soils groups. Note that this map indicates the *underlying soil types* and not necessarily the current use of the land.

4.1 Soils of Bradford

Soils are the medium which supports all land plant and animal life. Healthy, productive soils are essential to our wellbeing. Currently, more than 90% of Bradford's food and fuel comes from beyond New Hampshire's borders. The future is uncertain; identifying the best arable land and forest soils in Bradford is a high priority of this survey.

Soils are a dynamic complex, a matrix of mineral and organic particles of different sizes, with a wide spectrum of living organisms, and varying amounts of water and air in the gaps between.

The soils of Bradford formed on deposits left when the glaciers receded after the last ice age, about 10,000 years ago. The most common type of deposit is known as *glacial till*, an unsorted mix of all sizes of material - from rocks and boulders to coarse sands and gravels, to the finest clay particles. As the glaciers melted, rivers of meltwater washed away some of this material, taking the finest particles away to the ocean, but depositing the heavier gravels and sands wherever the current slowed, creating sorted deposits of sand and gravel known as *glacial outwash* or *stratified drift*.

4.2 Soil Surveys

The National Cooperative Soil Survey, a cooperative effort led by the US Department of Agriculture's Natural Resources Conservation Service (NRCS), is charged with identifying and mapping soil types. Soils maps for Bradford have been recently updated as part of the Merrimack/Belknap County Soil Survey. This survey is not available in printed form, but it is available online through the NRCS website: http://websoilsurvey.nrcs.usda.gov/app/ as well as through the UNH GRANIT database: www.granit.unh.edu. Individual maps may be obtained from the Merrimack County NRCS field office. As part of the current Soil Survey, Bradford's soils are classified according to their suitability both as farmland and as forest land.

4.3 Agricultural Soils

In New Hampshire, the soils most suitable for agriculture are classified as: *Prime Farmland*, *Farmland of Statewide Importance*, and *Farmland of Local Importance*.

Prime Farmland soils can produce the highest yields of crops and food with minimal expenditure of energy and economic resources and the least environmental impact. They are permeable to water and air but they are not saturated with water for a long period of time and are not subject to flooding. Prime farmland soils are not excessively prone to erosion. They have an adequate and dependable water supply, a favorable temperature and growing season, acceptable pH, and few or no rocks.

Prime farmlands are not common; statewide, excluding the White Mountain National Forest, only about 2% of New Hampshire soils fall into this category. Yet because they are generally open and well drained, they are tempting to build on. Between 1982 and 1997, nearly 1,200 acres of Prime Farmland in NH was developed and is now unavailable for agriculture.

Farmland of Statewide Importance includes soils that nearly qualify as Prime Farmland and may produce high yields under favorable circumstances. They have the following criteria:

- Slopes of 15% or less
- Not stony or bouldery (some of these areas were formerly stony fields from which rocks have been "picked" and removed)
- Well drained or moderately well drained
- Not too shallow to bedrock
- Not excessively drained with low available water holding capacity.

Farmland of Local Significance soils are ranked by the Merrimack County Conservation District. Most of these areas in Bradford were previously cleared for pasture in the early 19th century, but have since been allowed to grow back to woods. Some are stony, but they are well drained or moderately well drained, not too steep, and can produce good pasture, for instance, if appropriately managed. Note that these soils are not shown on the Farmland and Forest Soils Map, but they coincide to a large extent with Forest Soil Groups IA, IB, and IC (see Forest Soils section below).

Farmland Soils Classification	Acreage	percentage of Bradford
Prime Farmland Soils	50	0.2%
Farmland Soils of Statewide Importance	225	1%
Farmland Soils of Local Importance	11,960	52%
Other soils	10,765	47%

Source: University of New Hampshire GRANIT database: www.granit.unh.edu.

4.4 Forest Soils

To help people understand and make better decisions about the land they use and manage, soil scientists in New Hampshire have developed a system of five Forest Soil Groups.

Group IA consists of deeper, loamy, well drained, and moderately well drained soils. These tend to be the most fertile and are well suited for growing high quality hardwoods including demanding species such as sugar maple and white ash. Red oak grows very well on many of these soils in Bradford. Scattered white pine and other softwood species can also grow well but they are difficult to regenerate on these soils because of competition from hardwoods.

Group IB soils are also deep and well drained to moderately well drained, but have a sandier texture, and are somewhat less fertile than Group IA soils. Sugar maple and other demanding hardwoods do not grow as well on IB soils but less demanding species such as red oak and white birch can do very well. White pine, hemlock, and other softwoods can also grow well. Hardwood competition makes it difficult to regenerate pine stands on these soils but somewhat less so than on IA soils. This is the most common Forest Soil Group in Bradford, representing over 40% of the land area.

The sandy Group IC soils are found on glacial outwash deposits. Soil moisture and nutrient levels in IC soils are adequate for good growth of white pine but often limiting for hardwoods. Oak, white birch, red maple, and other hardwoods can grow on these soils but their quality and productivity tends to be lower. Hardwood competition is still a factor, but with modest levels of management, stands of white pine can be successfully maintained and reproduced.

The soils in Group IIA are limited by steepness, bedrock outcroppings, surface boulders, and/or extreme stoniness. Forest productivity may not be affected but harvesting, thinning, and other management activities are more difficult and more expensive on these soils.

Group IIB soils are poorly drained with a seasonal water table in the winter and spring less than 12 inches from the surface. While they can support forest stands, productivity and timber quality are generally lower than on IA, IB, and IC soils. Typical species on IIB soils in Bradford include red maple, hemlock, yellow birch, aspen, and balsam fir. White pine often may grow scattered on hummocks in some areas. Less common, black gum and Atlantic white cedar grow on particular IIB soils.

NH Forest Soil Groups	Bradford	percentage	Acreage
IA	*- deep, well drained and moderately well drained, loamy*	18%	4,140
IB	*- deep, well drained and moderately well drained, sandy loaml*	40%	9,430
IC	*- deep, well drained and moderately well drained, sandy outwash*	6%	1,430
IIA	*- limited by steepness, ledge and/or boulders*	18%	4,140
IIB	*- poorly drained forest soils*	8%	1,840
NC	*- not classified as forest soils*	10%	2,300
	(very poorly drained soils, rock outcrops, open water, urban land)		

source: University of New Hampshire GRANIT database: www.granit.unh.edu.

4.5 Sand and Gravel

Sand deposits along Route 114

The most significant sand and gravel deposits occur along Routes 114 and 103. As of this writing, there are two commercial gravel operations in town, both on Pleasant Valley Road. They coincide with the largest 'stratified drift aquifer' (see the *Water Resources and Wetlands* map.) In addition, the town uses material from the deposits near the Bement Bridge, from town-owned property on the corner of Jones Road and Route 114, and from behind the Transfer Station. There are numerous smaller, private sand and gravel pits around town. A few are still used by landowners within the bounds of their property. All are regulated by state and town ordinances. There were nine active pits in the 1990s.

4.6 Recommendations:

- The Conservation Commission will explore ways to protect topsoil and protect Prime Agricultural and important forestry soils.
- See also Chapter 5, *Agriculture in Bradford*

5. Agriculture in Bradford

Refer to map of *Lands of Special Importance* and *Farmland and Forest Soils*
This map was created in 2009 and there have been many changes. Refer to list below updated in 2012.

Kisakanari Farm photo JA Eldridge

By some measures, agricultural activities have declined in New Hampshire since the 1950s as farmland is steadily converted to other uses. Nearly 20% of this state's arable land was lost to development between 1982 and 1992, which matches the population spike in Bradford. Despite the loss of agricultural soils, the number of small farms has been increasing throughout the state. This indicates a trend in diversification - from more traditional larger-scale farming to smaller, custom farms selling specialty products or utilizing greenhouses for bedding plants and flowers. Increased interest in local agricultural products has resulted in a similar increase in Bradford despite its small amount of ideal agricultural soils. A farmer's market was begun by the Bradford Area Community Center in 2008.

The map indicates agricultural operations known to the Conservation Commission in 2009, when this project was begun. The list below has been updated to reflect information in 2012 and agricultural operations are identified by current owner, general location, acreage affected, and products offered.

Note: 'Agriculture' here is loosely defined. It includes those properties that are offering goods for sale or trade and it also includes properties which have an appreciable effect on land use. A berry farm on Sunset Hill Road, for example, uses little acreage, but can generate substantial income, and a horse farm may generate little income but might impact more than ten acres.

There are many more landowners who raise domestic animals for pets or who grow vegetables, fruits, livestock, and/or poultry in quantity solely for personal consumption. They have not been noted here unless they meet the general criteria above. Also not mapped are fields kept open for view potential but which could at some point be readily converted to agricultural uses.

Agricultural operations in 2012:

Stoneridge Farm (Troy) South end of Cressy Road 12 acres
Community Supported Agriculture – vegetables, maple syrup, orchard

Battles Farm (Erickson) Intersection of Center and Jewett Road 50 acres
Conservation Easement 2011 – pasture/meat/dairy/eggs/vegetables

Andy Anderson Scattered leased plots under cultivation 12 acres
Vegetables for market. Most visible locations have been by Box Corner, north side of Route 103 near Melvin Mills, and center road by Bement Bridge.

Sonny Harris Rowe Mountain Road near Jewett 8 acres
Poultry, beef, maple syrup

intersection of 103/114, hay. 12 acres

Robert Messer Fairgrounds Road/West Meadow Road 25 acres
Hay and horses

Jim Bibbo Deer Valley Road, south end 8 acres
Breeding horses and dogs.

Kisakanari West Road 10 acres
sheep for meat and wool. Duck and chicken eggs.

Sylvia Hasey East Washington Road 5 acres
llamas, horses and assorted creatures. A larger area is shown on the map – fields had been used by Eccardts for pasturing cows.

Nick Hasey Dunfield Road, north end 12 acres
Scottish Highland cattle

Barry Wheeler Center Road, north end 7 acres
Draft animals and hay

Silver Hill Farm -Nathanial and Pam Bruss Center Road/County Road 15 acres
Pasture, horses, and beef.

Jennifer Dow Fairgrounds Rd, west of Solitude Ridge Rd 1 +/-acre
Christmas trees

Meg Fearnley Deer Valley Road 6 acres
Sheep/wool. Conservation Easement

Webb Family Sherman's field, Pleasant View Road 20 acres
Hay

Laurie and Alan Brown Fairgrounds Road by N. Ridge Road 8 acres
Horses

Mountain Farm Kittredge property Old Warner Road/ Route 114 8 acres
Cows, turkeys, poultry eggs, local products

Payson West Road 4 acres
In 2009 - horses, sheep/goats – no longer in use, 2012

Tom Dunn Bible Hill Road 2-3 acres
Came into operation during this study and is not on the map. Mobile pizza oven, bread, chickens, eggs. Extensive fruit, nut trees, grapes, berries. 2-3 hoop houses.

Granite Rose Morgans Center Road 3 acres
Horses - boarding, training, breeding, lessons, trail riding

Chris Mock south side of Fairgrounds Road 12 acres
Hay, vegetables

Michelle Marson Fairgrounds Road less than 1 acre
Greenhouse, bedding plants, vegetables, poultry

Dickie and Sheila Moore Sunset Hill Rd / south of Old Warner Rd. total 5.5 acres
Was hayed in 2009, no longer in production

Herman and Fay Davison Sunset Hill Road ½ acre
Intensive fruit operation - raspberries, blueberries

McDonald/Fortune Fortune Road 10 acres
Maple syrup, expanding to cattle and vegetables in the future.

Tom and Joy Nowell Fortune Road and Newbury In Bradford - 4 acres
Hay and pasture

Old MacWylie's Farm Water Street 10-12 acres
Goat milk, meat, soap. Piglets, geese, rabbits

5.1 Recommendations:

- Determine whether there is interest in an Agricultural Commission;
- Complete an Agricultural Profile for the Town;
- Educate the public that when important farmland soils are built upon they are lost forever;
- Protect important farmland soils that are necessary for economically viable agricultural activities;
- Reduce conflict between agricultural and residential uses by requiring a buffer when land is developed adjacent to a farm;
- Support legislation on state and local level that is economically beneficial to small agriculture, provided that the legislation does not have a negative ecological impact;
- Encourage residents to "buy local";

- Educate farmers about the benefits of a conservation easement on their property;
- Encourage farmers to follow “Best Management Practices” in the management of their farm including soil management and livestock waste management;
- The Conservation Commission should identify and prioritize potential parcels of land that the Town feels should be protected based upon the agricultural value and develop a plan for the protection of these parcels.

Further information:

NH Department of Agriculture, Markets & Food: ‘Manual of Best Management Practices for Agriculture in New Hampshire’:
http://agriculture.nh.gov/divisions/markets/documents/bmp.pdf

Creating an Agricultural Commission in your Hometown Lorraine Merrill NH Agricultural Commissioner www.nh.gov/agric/documents/agcom.pdf

Capital Area Farm and Community Connections (CAFCC) – local food information through the Merrimack County Conservation District
www.merrimackccd.org

6. Forestry in Bradford

Refer to the following maps: *Farmland and Forest Soils, Habitat and Land Cover.*

Forests are the natural cover for nearly all of Bradford. Today they cover 90% of town. Our forests grow on wetlands, rocky hilltops, and on most of the land, richer and poorer, in between.

Starting a little more than 200 years ago, much of this forest was cleared for grazing and agriculture. By the mid 19th century about 2/3 of Bradford's forestland was gone. After the Civil War and through most of the 20th century, the land reverted to forest as farming and grazing slowed and trees reclaimed the land. In the last few decades some forest land has been developed for residences and cleared for fields, even as some of the remaining old farm land has continued to grow up to forest.

Forest cover in Bradford is classified in the 2010 update of the NH Wildlife Action Plan in five broad habitat types as follows:

- The Hemlock-Hardwood-Pine habitat type is the most extensive, covering about 15,775 acres, nearly 75% of the town.
- Lowland Spruce-Fir is found on the rocky hilltops in the southern and western part of town at elevations above 1,400 feet – comprising about 1,432 acres.
- The Northern Hardwood-Conifer habitat type covers about 1,619 acres on deeper soils on the upper slopes of the hills to the west and south at elevations above 1,300 feet.
- About 1,185 acres of Appalachian Oak-Pine habitat type can be found on droughty, south-facing hillsides in the northeast part of town at elevations below 900 feet.
- Along the Warner River and the outlet from Lake Massasecum are about 160 acres of Flood Plain Forest.

The forests of Bradford provide many benefits, directly and indirectly. Our forests:

- Produce useful and valuable products including, among others: lumber for homes, furniture, cabinetry, tools and utensils; maple syrup; firewood; fuel for locally produced electric power; fiber for paper used in books, newspapers, toilet paper, and paper towels.
- Protect watersheds and groundwater – holding soils in place and reducing runoff, recharging aquifers, and supplying clean water to our ponds, rivers, streams, and water supplies.

- Reduce flooding by slowing the release of stormwater and snowmelt to downstream areas.
- Provide habitat for wildlife.
- Contribute to soil formation.
- Mitigate the effects of extreme weather by cooling the air on hot summer days and reducing wind chill factors in the winter.
- Produce oxygen, capture carbon dioxide, and help clean the air of pollutants.
- Delight the eye and soul with ever-changing beauty.

6.1 Town and State Forests

Bradford currently has two town forests managed by the Bradford Conservation Commission. The 'Forest Maintenance Fund', administered by the Conservation Commission, was formed from sale of timber on the Pearl Town Forest. The funds are used to maintain the Bog Boardwalk, purchase trail-making supplies, and for similar purposes.

- **'Aiken Pasture'** Named for an early settler, this former pasture is now entirely wooded. It was taken by the town in 1979 for taxes due and became a town forest in 1995. It is a 136 acre parcel located between East Washington and County Road in the southwestern corner of Bradford. Currently the easiest access is on foot from the Penhallow Road, a private road that allows passive recreational traffic.

  A southeast-facing hillside runs south to north with gentle to moderately steep terrain. The forest is mixed conifer and hardwood with a small but impressive grove of older red oaks located near the central western border. Hunting is allowed.

  This property has been protected since 1999 with a conservation easement held by the Ausbon Sargent Land Preservation Trust. All future forestry operations will follow a management plan overseen by the town.

- **Pearl Town Forest** The Pearl Town Forest was donated to the town for conservation purposes in 1980 and was officially designated as a Town Forest at the 1993 Town Meeting. It is a tract of about 37 acres, located on the south side of West Road about ½ mile west of Bradford Center. It is bounded on the east by the former Butman Road, now a private access, and is cut by a brook that flows into the surrounding wetlands.

  The Pearl Town Forest includes excellent stands of white pine of different ages. An improvement harvest was conducted in 1993. The area to the south of the brook was reserved from cutting.

- **Low State Forest** The 'Low' comprises 1,760 acres managed by the New Hampshire Division of Forests and Lands. Approximately 900 acres are located in Bradford on the south central edge of town with the remainder in Hillsborough. The forest is managed for a wide range of resources. In recent

years, the State has created openings to increase wildlife diversity. It is most easily accessed at the west end of Dunfield Road where there is a parking area. Motorized vehicles are not allowed, all other uses are encouraged.

The Knights Hill Trail runs from the Dunfield Road, through part of Low State Forest, and through private land ending at Rowe Mountain Road. Trail signs have been posted to guide hikers.

6.2 Recommendations

- Forestry has long been an important part of this town's economy. Conservation easements are a method for maintaining the forest base, allowing long-term planning;
- Avoid ordinances and regulations that would create barriers to forest management.

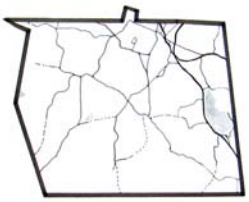
For more information:
New Hampshire Timberland Owners Association www.nhtoa.org

New Hampshire Tree Farm Program, a part of the American Tree Farm System, consists of privately owned forests managed for timber with consideration for improved wildlife habitat, water quality, scenic views, and recreational values. www.nhtreefarm.org

UNH Cooperative Extension: *Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire.* http://extension.unh.edu/goodforestry/index.htm

Society for the Protection of New Hampshire Forests www.forestsociety.org

7. Surface Water



Refer to *Water Resources and Wetlands* map
and *Drinking Water Threats* map.
Information on the *Drinking Water Threats* map comes from the NH Department of Environmental Services.

Town planning and landowner decisions regarding land use should take into account the hydrological connections and long term results of upstream actions. Landscape changes on the shores of streams, rivers, and lakes can have an immediate effect on local residents and towns downstream. Bradford is in large part responsible for the water quality of the Warner River. Control of flooding, erosion, and nutrient runoff are all important aspects of water resource management.

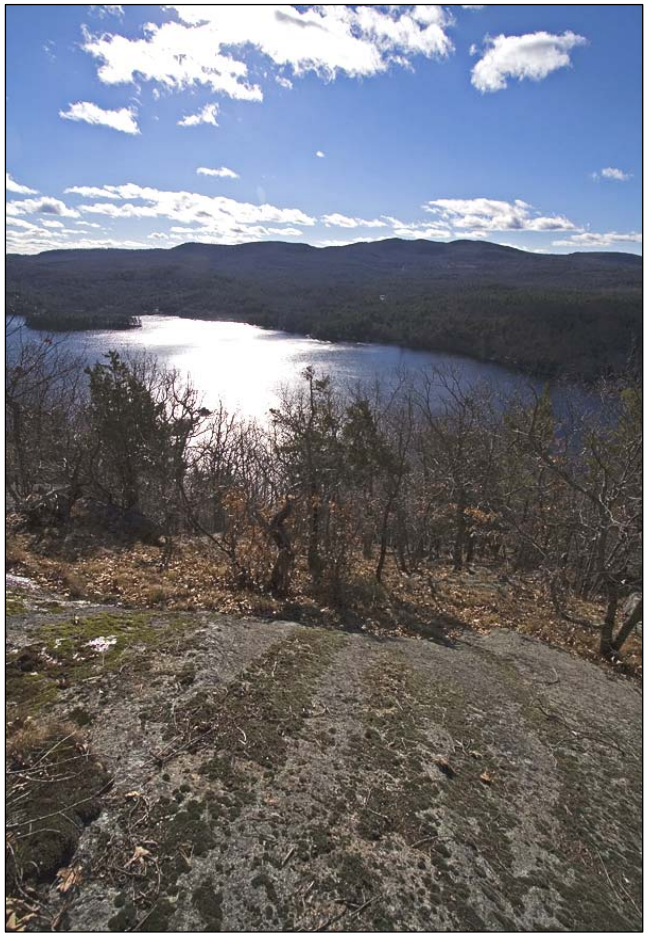
7.1 Watersheds:

Watersheds are delineated by connecting the highest points of land surrounding a basin that feeds surface water into a particular stream or river system. Bradford lies entirely within the greater watershed of the Contoocook/Merrimack River. This means that the water running off of our streets and properties eventually makes its way into these rivers and our wells.

Water running off the northern slopes of hills circling the southern half of town flows to either the West Branch Brook or to Hoyt Brook and from there to the Warner River. Water flowing from the commercial areas of town in the north are flowing quite directly into the Warner River.

Water running off the southern slopes of Haystack Mountain, Knights Hill, and the Rowe Hills flows to Beards Brook and from there to Hillsborough and the Contoocook River.

7.2 Lakes and Ponds



Lake Massasecum from Guild Hill
photo: B. Duffy

The town of Bradford has one large lake and part of a second large lake within its borders. The views provided by these two lakes are important to the identity of the town, according to local surveys. Bodies of water greater than ten acres are considered public waterways and are under the jurisdiction of the Shoreland Water Quality Protection Act (SWQPA). In this town, these would include Lake Massasecum, Lake Todd, and Ayers Pond.

- Lake Massasecum - 401.7 acres, lies on Bradford's eastern border below the Mink Hills of Warner. Named after a native American chieftain and sachem of the Penacook tribe, it was labeled as 'Bradford Pond' on early maps. This large lake is unusual for its natural ebb and flow unhampered by man-made dams. It is also unusual in New Hampshire for its predominantly sandy shoreline and attendant rare plant communities and species. [See also Chapter 15, Rare Species and Natural Communities – page 48.] In some years unusual freshwater jellyfish are noticed.

The average depth of Lake Massasecum is 10 feet but there are several locations that reach a depth of 50 feet. It is considered a warm water lake due to its relatively shallow depth. Species sought by fishermen include small mouth bass, large mouth bass, chain pickerel, and hornpout.

Long time residents report that a minor rock dam was once constructed by locals to keep the water level high in the lake. In recent years, however, lakeside homeowners and downtown areas of Routes 103 and 114 have experienced problems with flooding. Lake Massasecum is 633' above sea level. The Warner River at Melvin Mills is barely 6' lower. The increase in impervious surfaces over the years – roads, roofs, driveways, and lawns – and the fill of wetlands for commercial buildings and parking lots along Route 114 have exacerbated flooding issues. Water that used to soak slowly into the ground and be taken up by plants now runs in a more direct route to the lake.

The Lake Massasecum Improvement Association was established in 1920 to monitor the water quality and recreational usage of the lake. A boat landing off Route 114 was established by the State and French's Park was deeded to the town for use by residentslandowners and guests on the western shore. Contact the Lake Association at www.lakemassasecum.org.

A coalition of State, lake association, and town budget funding has been formed to combat, contain, and remove the invasive species *Myriophyllum spicatum* or Eurasian water milfoil which is established at the north end of the lake. A summer boat-landing attendant has been hired since 1997 to educate the public and inspect boats in order to avoid spreading milfoil to other parts of the lake or to other lakes and ponds.

- Lake Todd - is located at the northern entrance to town with a total of 168 acres. This lake mostly resides in Newbury. It was originally a smaller, perhaps 10 acre pond until a dam was constructed late in the 18th century which turned it into the larger lake it is today. It is fed by Andrew Brook, Beals Brook, and Loch Lyndon Reservoir. The dam at the 'Brick Mill' on East Main Street in Bradford is a visible reminder of early industry and is the outlet for Lake Todd. As of 2005, the dam is owned and managed by the Lake Todd Village District. Prior to this there was an association of landowners formed to oversee lake conditions and take responsibility for the dam. The dam was extensively renovated in 2012.

  Lake Todd is approximately 22 feet deep and is described as a 'warm water' lake harboring many large-mouth bass, pickerel, perch, and small mouth bass.

- Ayer's Pond - 27.8acres, is protected by the New Forestry private conservation easement on most of its shoreline. It is located below the town's highest point of Durrell/Moon Mountain and extends into East Washington on its western edge. There is one house site on the southern shore.

- Mud Pond - partially in Hillsborough. This small 'wild' pond is near the Bradford Bog on the Southwest edge of town.

- Brown's marsh - located north of Alder Plains Road. This shallow, emergent wetland is in some years the site of a heron rookery, a State monitored occurrence, and there are several man-made duck boxes. There is beaver activity.

- Pond on the Kisakanari Easement – is another 'wild' pond and is now protected by a private conservation easement. Beaver activity periodically expands this wetland into a pond.

- Lovewell Lake - created by the dam built for a tannery that was once located on East Washington Road. The Hermitage or Bradford Springs

Hotel used this pond for recreation. Except in high flood, this area appears as a chain of emergent marshes.

Numerous smaller 'wild' ponds and dozens of man-made ponds exist in town. The Department of Environmental Services now has a policy of discouraging the construction of ponds in natural wetland areas except for agricultural uses.

Bradford at this time relies on a volunteer Fire and Rescue squad. Pumper trucks use the dry hydrant next to the fire station and a landing at Lake Massasecum on Route 114, but rely on dry hydrants located throughout town. There are currently 26 of these ponds in Bradford, including a cistern at the Elementary School, two cisterns at the Solitude Ridge development, and one at the Chestnut Hollow subdivision.

7.3 Rivers and Streams

There are two third order streams, Hoyt Brook and West Branch Brook, that, along with the outlets of Lake Massasecum and Lake Todd, create the Warner River. The Warner River begins at its westernmost point just north of Cedar Hill and is visible from Route 103 before it leaves town and enters the town of Warner just beyond Melvin Mills.

- Hoyt Brook was named for an early farming family, and has its beginning in many small and unnamed permanent and transient streams flowing from the east slopes of Durrell /Moon Mountain, Avery's Ledge, Haystack Mountain, and the Pickett Hill and Silver Hill complex. These waterways gain volume and flow east, gathering and slowing in wetlands above the Pearl Town Forest, the West Meadow Wetland, wetlands east of Jewett Road and the lower fields of Battles Farm. Just below Battles Farm, Hoyt Brook falls quickly alongside Center Road and joins the West Branch Brook below the Bement Bridge. From here, and joined now with the outflow of Lake Massasecum, it tends to frequently flood the commercially zoned land along Routes 114 and 103.

- West Branch Brook originates in the northwest part of town. It feeds several wetland complexes along Fairgrounds Road and North Ridge Road before it narrows again and runs east. There has been frequent flooding by the intersection of Fairgrounds Road and West Meadow Road. Lake Todd adds its water at the Brick Mill dam on East Main Street and this is the brook that flows under the Bement bridge- often flooding Center Road at that location.

These brooks come together over Bradford's most accessible stratified drift aquifer – a possible source of public drinking water and also an area most susceptible to pollution issues.

Bog and Beard's Brooks associated with the Atlantic white cedar swamp and quaking bog in the southwest corner of town flow into Hillsborough. Sand Creek

also flows into Hillsborough by way of the Rowe Hills. Most of Bradford's many smaller brooks and streams are unnamed.

7.4 Recommendations:

- Continue efforts to prevent the spread of invasive species in lakes and rivers through education and monitoring at boat launches;
- As noted in the Wetlands chapter, require naturally vegetated buffers along streams, lakes, and ponds. Any removal of vegetation adjacent to water bodies should be avoided if at all possible. Incorporate this recommendation into the site plan review process;
- Encourage stabilization practices for any currently unvegetated or unstable stream banks. Establish construction setback requirements for streams and ponds using current Best Management Practices. Adjust as needed, taking into account soil type, bank, slope, and vegetation type;
- As noted in the Groundwater chapter, consider modifying the Zoning Ordinance to limit the maximum amount of impervious surface per lot. This will benefit surface waters as well;
- The development and adoption of an Aquifer Protection Overlay Zoning District, as recommended under Groundwater Chapter 10, will also benefit surface water;
- Educate the public about residential, commercial, and agricultural practices that contribute to surface water pollution. Promote alternative practices that reduce or prevent surface water pollution.

For further information:

Wetlands Bureau, Department of Environmental Services
http://des.nh.gov/organization/divisions/water/

UNH Cooperative Extension: 'Buffers for Wetlands and Surface Waters. A Guidebook for New Hampshire Municipalities':
http://extension.unh.edu/commdev/Buffers.pdf

Environmental Law Institute: 'Planner's Guide to Wetland Buffers for Local Governments':
http://www.elistore.org/Data/products/d18_01.pdf

7.5 Shoreland Water Quality Protection Act

The Comprehensive Shoreland Protection Act was established in 1991 by RSA 483-B. It was renamed and rewritten as the Shoreland Water Quality Protection Act in 2011 in an effort to streamline the process. It is implemented by a division of the Department of Environmental Services. It establishes minimum standards for activities within the area in its jurisdictional area. These rules are intended to offer some protection to the water quality of the state's larger water bodies and navigable waterways. It regulates what you can do within 250' of the 'reference line' of public waters. Those activities include: construction of new buildings and enlarging old ones, creating impervious areas, using fertilizers, cutting of trees and saplings, and new septic systems.

A Shoreland Impact permit may be required for:

- new construction or construction that modifies the footprint of existing impervious surfaces;
- using mechanized equipment to either excavate, remove, or form a cavity within the ground;
- filling any areas with rocks, soil, gravel, or sand.

The Shoreland Water Quality Protection Act only governs new development, and the opportunities for new development on our crowded lakes is limited. It has no provisions for the responsible use of existing structures. Existing dwellings also impact water quality, flooding, and erosion issues on lakes and rivers.

Shoreland Protection Areas in Bradford - Fourth order or greater rivers, streams, and designated river segments and water bodies over 10 acres in size.

Name	Jurisdiction Area
Unnamed steam	outflow of Lake Todd
Warner River	juncture of W. Branch and Hoyt Brook
W. Branch Warner River	juncture of unnamed 3rd order stream
Lake Massasecum	401.7 acres
Lake Todd	168 acres
Ayer's Pond	27.8 acres

7.6 Recommendations:

- Education, with the assistance of the Lake associations of Lake Massasecum and Lake Todd, is the most important tool for protection of lake shores and other navigable waterways;
- Encourage property owners in the Shoreland Zone to revegetate their property with native plantings to reduce the amount of stormwater runoff to the lake;
- Reduce the use of salt and sand on town roads near waterbodies and their tributaries;
- No fertilizers, herbicides, or other household toxins should be used within the 250 foot Shoreland Zone except for establishing new plantings.

For further information:

Shoreland Water Quality Protection Act
http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm

Lake Massasecum Improvement Association www.lakemassasecum.org

8. Wetlands

Refer to *Water Resources and Wetlands* map.
Data from National Wetlands Inventory and Town of Bradford Zoning ordinance

Wetlands are a common feature of the New Hampshire landscape. An intact, healthy wetland benefits our drinking water by recharging aquifers, slowing sediments, and by controlling nutrient excesses such as nitrogen and phosphorus. They minimize and prevent shoreline erosion by stabilizing the banks of lakes and streams and allow for storm and flood water storage. They provide critical habitat for many animal species and are hotspots of plant and animal biodiversity. Subsequently, they are important for hunting and fishing enthusiasts. Most people notice them for the scenic views they provide in otherwise forested or populated landscapes.

Wetlands are defined by the Environmental Protection Agency, the NH Department of Environmental Services and the Bradford Wetlands Ordinance as those areas that are inundated or saturated by surface or groundwaters at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions. Thus a wetland is defined by three features: hydrology, hydric soils, and wetland vegetation.

Currently, Bradford's Wetland Ordinance defines wetlands and requires buffers to certain wetlands. It defines what uses might be permitted in wetlands and buffers (i.e. agriculture) and allows for 'conditional uses' such as for the construction of roads, pipelines, or power lines (for example).

In the years 1992 to 1995, the Bradford Conservation Commission undertook a Wetlands Inventory using the NH Method. This study examined twenty two major wetlands in town, those covering a minimum of ten acres. They were studied and rated by thirteen 'functional values':

Ecological Integrity
Wetland Wildlife Habitat
Finfish Habitat
Educational Potential
Visual/Aesthetic Quality
Water-based Recreation
Flood Control Potential
Groundwater Use Potential
Sediment Trapping
Nutrient Attenuation
Shoreline Anchoring
Historical Site Potential
Noteworthiness

The majority of Bradford's wetlands are in good condition. Those that are showing signs of degradation are predictably located in the northern part of town where commerce and residential development has intruded (wetlands on Old Sutton Road, Routes 103/114, and the south end of Blaisdell Lake Road) and on Fairgrounds Road where agriculture has altered the habitat considerably.

The full ten pound report of the Wetland Inventory is available through the Conservation Commission or at Brown Memorial Library.

8.1 Buffers:

Buffers surround undeveloped uplands and are essential for healthy wetlands. Maintaining a buffer of naturally vegetated upland adjacent to wetlands and surface waters is important to reduce adverse effects of human activity on these water resources. Vegetation in buffers intercepts rainfall, slowing meltwater and promotes infiltration. Buffers are important habitat for species dependant on the wetland system and act as travel corridors.

Note that buffers should be wider if the adjacent land is sloped, if the land use is intensive, if the soils are easily eroded, if the land is a floodplain, or if the stream or river naturally meanders.

Recommended buffer requirements, source: Buffers for Wetlands and Surface Waters: A Guidebook for NH Municipalities. Audubon Society of NH. Revised 1997. Chase, V.P., L.S. Deming, F. Latawiec, 1995.

Function	**Buffer width, in feet**
Stabilize riparian banks	35-50'
Filter sediment	35', if slopes less than 15%
Filter to dissolve nutrients & pesticides	100-500'. 100' removes approx. 60% of pollutants.
Protect fisheries	at least 100'
Protect wildlife	300' minimum
Flood control	varies

8.2 Recommendations:

- Educate the public about what they can do to protect wetlands and why;
- Educate town boards and residents about the importance of reducing 'non-point source pollution' from sedimentation, fertilizers, pesticides, and hazardous wastes;
- Education is also needed on the importance of buffers, explaining damage potential of excessive landscaping, impervious surfaces, and other factors;
- Review the current town wetland ordinance: include wetland buffers to surface waters in the Wetland Ordinance and investigate optimal buffers for each situation.

Further information:

The latest version of Bradford's Zoning Ordinance can be found by going to: www.Bradfordnh.org, then to → 'Town Services', then to → 'Forms/Documents', then to latest year of 'Zoning Ordinance'

Buffer recommendations :
Buffers for Wetlands and Surface Waters: A Guidebook for NH Municipalities
Chase, V.P., L.S. Deming, F. Latawiec, 1995. Audubon Society of NH. Revised 1997. http://extension.unh.edu/commdev/Buffers.pdf

Natural Resource Conservation Service www.nhnrcs.usda.gov/
This organization administers the Environmental Quality Incentives Program (EQUIP) and the Wetlands Reserve Program (WRP), 'organic initiative' program, and others.

National Wetlands Inventory is at: http://www.fws.gov/wetlands/index.html
('FWS' is Federal Fish & Wildlife Service)

For information on wildlife that uses wetlands:
http://extension.unh.edu/resources/files/Resource000416_Rep438.pdf

Environmental Law Institute: 'Planner's Guide to Wetland Buffers for Local Governments
http://www.elistore.org/Data/products/d18_01.pdf

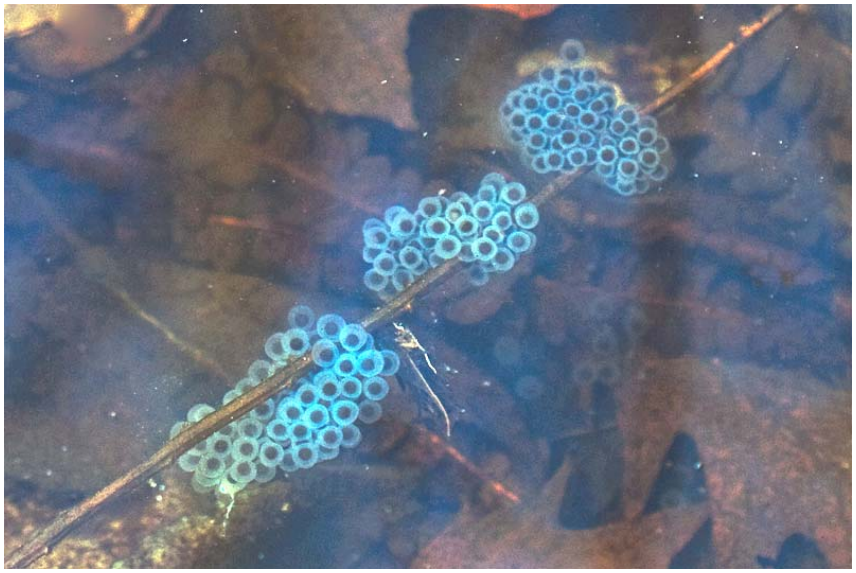
9. Vernal Pools

Vernal pools are temporary bodies of water that often retain water long enough to support the breeding cycles of some of our most common amphibians and invertebrates. Vernal pools, because of their generally small size and ephemeral nature, are the most vulnerable and fastest disappearing of wetland types anywhere. In neighboring states, though not New Hampshire at this time, these wetlands are offered regulatory protection.

Vernal pools are most often isolated from other water bodies and because they usually go dry for a part of every year, fish are unable to become established. This factor is essential for the survival of some species. A vernal pool must have intact upland habitat to support these species in their summer feeding areas and wintering sites.

The following is a list of the most common vernal pool 'indicator species' in our area:
Wood frog
Spotted salamander
Blue-spotted salamander
Jefferson salamander (and hybrids)
Fairy shrimp
Fingernail Clam

Many other plant and animal species also use vernal pools but may not be as critically dependant on them. In addition, these pools often provide valuable links as wetland 'corridors' for wildlife which might otherwise remain isolated and thus more vulnerable to disturbance.



Yellow Spotted Salamander Eggs photo:B.Duffy

For more information: 'Identification and Documentation of Vernal Pools in New Hampshire'
http://www.wildlife.state.nh.us/Wildlife/Nongame/RAARP/Vernal_pool_manual.pdf

9.1 Recommendations:

- Increase awareness and encourage protection. Through education, landowners learn to protect vernal pools from unnecessary destruction or disturbance from logging, excessive landscaping projects, or culvert placement;
- Increase involvement by residents and landowners to assist the scientific community by providing valuable data on population density and health of local species;
- Individuals or groups may contact the New Hampshire Reptile and Amphibian Reporting Program (RAARP) through the Non-Game and Endangered Wildlife Program, NH Fish and Game Department, 2 Hazen Drive, Concord NH 03301 (tel.: 271-2462) www.wildnh.com

For further information**:**

Buffers for Wetlands and Surface Waters: A Guidebook for NH Municipalities Chase, V.P., L.S. Deming, F. Latawiec, 1995. Audubon Society of New Hampshire. Revised 1997. http://extension.unh.edu/commdev/Buffers.pdf

For a complete list of vernal pool species and for information on the New Hampshire Reptile and Amphibian Reporting Program (RAARP) http://www.wildlife.state.nh.us/Wildlife/Nongame/RAARP/Vernal_pool_manual.pdf

10. Groundwater

Refer to *Water Resources and Wetlands* map
And *Drinking Water Threats* Map

All of Bradford's residents rely on groundwater or surface water for their drinking water. Bradford at this time has no municipal septic services and relies on private systems. There were no regulations on septic design or installation prior to 1967.

Bradford selectmen in past years have discussed the possibility of town septic and water supply for residences and businesses in the Main Street area and around Lake Massasecum – both of these areas have had water quality issues.

Protecting groundwater is thus an important aspect of this report and is listed as a priority in the town's Master Plans.

10.1 Aquifers

An aquifer is an underground layer of water-bearing, permeable rock, sediment or soil from which significant amounts of groundwater can be extracted. Sand and gravel aquifers are the most productive. These are glacial deposits that hold water between the particles.

The 'Drinking Water Threats' map shows the aquifers in Bradford, their transmissivity rates, and threats to water quality that are known to New Hampshire Department of Environmental Services (NHDES). 'Transmissivity' is a measure of how much water can be transmitted horizontally, such as to a pumping well. On this map, the darker the blue color, the better the transmissivity, and for this reason sensitivity to contamination is also greater.

Aquifers are recharged, or refilled, by rainwater and snowmelt. There are many factors affecting this recharge including the presence and quality of plant cover, how much runs off as surface water to other water bodies such as streams and ponds, and how much impervious surface covers the aquifer.

Aquifers, especially sand and gravel aquifers, are vulnerable to contamination due to their permeability. Unfortunately, land over these aquifers tends to be favored for development because it is often relatively level and easily excavated. This is also the best location for sand and gravel operations which can also affect the quality of the aquifers.

Bradford's important aquifers occur in the northern part of town. Areas in town that are most susceptible to flooding (along Fairgrounds Road and State Routes 114 and 103) are located over these aquifers.

- The most accessible source of water for a potential future public water supply stretches from the western side of Lake Todd through to the southern inlet surface waters of Lake Massasecum. It underlies Route 103 and 114 in these areas. There is already significant development over this aquifer. This aquifer covers approximately 1324 acres and lies mostly in Bradford. It has 35 acres of high transmissivity – 4000-8000sq ft per day.

- The second, and largest aquifer is primarily in Newbury but enters Bradford with two areas of high transmissivity: along Box Corner and along Fairgrounds Road. There are no apparent pollution threats to this aquifer at this time within town. Approximately 800 acres of this aquifer underlie Bradford.

- There is a large area of 'glacial lake deposit aquifer' on the east side of East Washington Road with low transmissivity and nearly two hundred acres of stratified drift aquifer beneath the Bradford Bog Conservation area in the southwest corner of town of unknown transmissivity.

10.2 Public Water Supplies

As of February 2012, there are four public water supply sources in town: Bradford Elementary School, Fisherfield Townhouses, NFI school, and the Bradford Area Community Center.

In addition, there are a number of 'transient water systems' listed at NHDES, which are non-residential sources which annually serve 25 or more people for 60 days or more. These include:

Lake Massasecum Casino and Park (Campground) with 2 wells
Camp Piesaule (Latvian Camp)
Bradford Junction (restaurant)
Bradford Town Hall
Appleseed Restaurant
Pizza Chef/Dunkin Donuts
Kearsarge Fitness
Bradford Marketplace
Brown Memorial Library

All of these public water supplies take their water from the 'downtown' aquifer.

10.3 Potential Contamination Sources

The New Hampshire Department of Environmental Services (NHDES) has assessed the threats to and vulnerability of each of the public drinking water sources in Bradford. The resulting report, titled 'Assessment of Public Water Supply Sources – Bradford' can be found at http://des.nh.gov/organization/divisions/water/dwgb/dwspp/reports/documents/Bradford. PDF

NHDES has also published a guide for using such reports, titled 'Protecting Public Drinking Water Sources Based on Source Assessment Reports.' This can be found at http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/documents/dwgb-12-8.pdf

Known incidents of potential contamination have been mapped by NHDES and are shown on the map 'Drinking Water Threats'.

They are identified on the website by their owners at that time and the date of inclusion on this list:

- 7 leaking underground storage tanks in the area of Main Street as follows:
  8 West Main Street
  63 West Main Street
  102 East Main Street
  108 East Main Street
  126 East Main Street
  Cilley Lane, map 17, lot 63
  2201 Route 103
- 2 landfills overlie the Route 103 aquifer – one being the former landfill and septage lagoons at the town's current transfer station in three locations (1991), the other being at the 'brownfield' at the former Naughton property, now owned by the town. Map 17, lot 12.
- 1 hazardous contamination site, also at the 'Naughton property'. (1984 - Under remediation 1993.) Map 17, lot 12.
- 1 above ground petroleum storage tank at the Ayer and Goss station on Route 114, no problems reported.
- In Warner, on the eastern end of the aquifer that crosses the town line, there was one leaking above ground storage tank and one hazardous contamination site.
- There are additional sites listed by NHDES as 'inactive'

There are three underground injection wells (discharges of benign wastewaters not requiring a groundwater discharge permit or request to cease a discharge (i.e. floor drain closure requests), at the former Cressy gas station, the former Autocraft property – both on Main Street, and at the former Kearsarge Reel Co. at 10 Breezy Hill Road, currently OE Trucking. All of these are listed as 'inactive'. Two injection wells are active – at NFI North School, 2252 Route 103, and at Pizza Chef/Dunkin Donuts, 107/109 East Main Street.

In addition to the sites known to NHDES, there are several types of businesses or activities that may in the future or under future ownership create situations of concern due to their potential use of contaminating substances or by having large above or below ground fuel storage containers.

These potential sites would include:

- Any vehicle repair, storage, or restoration/painting.
- Inappropriate use of vehicle repair/restoration chemicals, paints, disposal of oils, fuels, etc by homeowners.
- Locations of automobile reclamation yards or other 'junk yards'.
- Businesses that handle or sell hazardous substances.
- Storage or use of road salt – town roads and state highways above aquifers that are treated in winter. Bradford's salt storage area is also over the aquifer. Run off from highways that is contaminated by exhaust and other materials.
- Town transfer station.
- Agriculture - chemicals and animal manures, inappropriate use of chemicals or collection of animal manures.
- Homeowner careless use of herbicides, insecticides, fertilizers, etc.
- Heavy equipment maintenance and repair.
- Gravel pits - town and private, particularly those that have opened the aquifer below water table.
- Graveyards – formaldehyde is a toxic chemical.
- Private underground oil storage tanks.
- Faulty septic systems.
- Snow removal (from parking lots and similar areas of high contaminates.)

10.4 Impervious Surfaces:

As a watershed is increasingly covered with pavement, buildings, and other compacted surfaces that are impervious to water, significant changes in water quality and quantity result. Rainfall and snowmelt runs off more quickly into surface waters, carrying with it sediment and pollutants from road surfaces, construction sites and parking lots, as well as fertilizers and herbicides from lawns and farms. Flooding, warming of the water, and channelization of streams can occur. Infiltration of rainfall into the ground to replenish the groundwater is reduced.

This type of run-off is known as 'non-point source pollution' and this is now the most serious threat to water quality in New Hampshire. Studies conducted in the northeast have documented that by converting as little as 10% of a watershed to impervious surfaces, water quality in streams begins to deteriorate noticeably.

10.5 Recommendations:

All Bradford residents, town offices, institutions, and commercial enterprises draw their drinking water from surface or groundwater. There are water quality problems in areas of Main Street and Lake Massasecum. If the town plans in the future to increase residential and/or commercial use of these areas, or needs sufficient water pressure to service taller buildings (for fire and rescue), developing a public water source will be required.

In the interest of a future public water supply, groundwater protection needs to be identified now with protections in place - before more sources of potential contamination are placed on the downtown aquifer.

Groundwater protection must be taken seriously in order to insure quality water for all residents and businesses, whether or not the town pursues a public water supply.

<u>To preserve the possibility of establishing a municipal water supply in the future, the town will need to:</u>

- Consult with NH Department of Environmental Services, and other qualified agencies, to evaluate the condition of the downtown aquifer;
- Pursue reclassification of the downtown aquifer to GAA or GA1 status as outlined in RSA 485-C. (This provides the town with the authority to implement protection.);
- Develop and adopt an Aquifer Protection Overlay District that will prohibit or restrict new potential contamination sources from locating in the district.

<u>To protect the quality and quantity of groundwater into the future, the town should:</u>

- Require that stormwater and melt water be retained on site during development and as a permanent feature of the site;
- Modify the Zoning Ordinance to limit the amount of impervious surface per lot;
- Encourage more compact development patterns, shrub and tree buffers to waterways, and narrower streets and driveways;
- Consider protecting land over and adjacent to productive aquifers.

<u>To develop the town wide support and participation needed for the long-term health of our aquifers, the town should:</u>

- Educate the public about practices that reduce non-point source pollution from fertilizers, pesticides, and other hazardous wastes;
- Establish hazardous waste programs that are easier for residents to access.
- Educate the public about the aquifer recharge process and the potential harms from increased paving and/or surface runoff;
- Work with the Road Agent and crew about runoff issues, erosion control, and stream protection. Investigate alternative de-icing methods to road salt, and their possible use in some or all parts of town.

For further information:

Wetlands Bureau, Department of Environmental Services
http://des.nh.gov/organization/divisions/water/

Environmental Fact Sheet on Protecting Public Drinking Water Sources
NH Department of Environmental Services (DES) Environmental Fact Sheet
WD-DWGB-12-8

NH DES has assessed the threats to and vulnerability of each of the public drinking water sources in Bradford. The resulting report, titled 'Assessment of Public Water Supply Sources – Bradford' can be found at
http://des.nh.gov/organization/divisions/water/dwgb/dwspp/reports/documents/Bradford. PDF

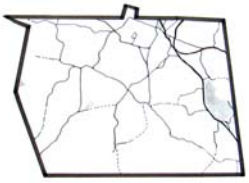
NH DES has also published a guide for using these reports titled 'Protecting Public Drinking Water Sources Based on Source Assessment Reports.' This can be found at:
http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/documents/dwgb-12-8.pdf

NH DES: 'Protecting Groundwater Resources Using Best Management Practices':
http://des.nh.gov/organization/divisions/water/dwgb/dwspp/documents/protecting_groundwater.pdf

NH DES: 'Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials':
http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-03-42.pdf

2012 – *A Guide to Groundwater Reclassification* available at www.des.nh.gov select 'groundwater reclassification'. Or contact Pierce Rigrod at 271-0688.

11. Climate Change



Refer to map *Water Resources and Wetlands*

Flooding at Intersection of Routes 103/114 photo: JAEldridge

Virtually all climate scientists and geologists in the past twenty years have agreed that the global climate is changing - driven by activities begun in the Industrial Revolution in the 1800s. There is still much disagreement in the scientific community about the complicated interaction of elements involved and timing. Predictions, thus, are difficult, but according to the New Hampshire State Government website, we are already experiencing warmer winters with reduced snowfall, increased rainfall, and rising sea levels. Severe weather events are increasing.

The effects on Bradford and its natural resources can be broken into several categories of concern:

- Flooding
- Drought
- Wind storms
- Snow/ice storms
- Invasive species

Flooding: There are two major tributaries in town: West Branch Brook and Hoyt Brook. These join in the north of town to form the Warner River. A major concern is how flooding impedes traffic and emergency services. Another is damage to residences and septic systems, especially around Lake Massasecum.

In 2012 the Hazard Mitigation Committee identified several areas in town as susceptible to flooding:

- Fairgrounds Road near the 'Dodge' corner
- South bridge on West Meadow and other locations on that road
- Jewett Road
- Water Street
- Jones Road
- Outlet of Lake Massasecum
- Route 103
- Flood damage possible in the entire downtown area

Drought:

Drought will likely have a greater adverse effect on wildlife and wildlife habitat than flooding. Aquatic wildlife will be first affected. The most severely impacted will be amphibians, reptiles, water birds, and mammals such as muskrat, beaver and mink.

Bradford residents are entirely reliant on private wells for drinking water. In addition, drought will increase the likelihood of forest fires. According to the Hazard Mitigation Plan, the entire southern half of town is an 'area susceptible to fire damage', due to the forest cover and difficulty in fighting fires in this location.

Bradford's volunteer fire department obtains water from the Hoyt and Warner Rivers, and from twenty eight 'dry hydrants' around town. All these would be affected by severe drought.

Snow and Ice, especially in association with Wind cause obvious difficulties for residents. These include:

- loss of electricity and the attendant loss of water and heat;
- destruction of valuable timber resources.

Invasive species are taking advantage of the warming of the climate. These include:

- plant, insect, and disease pests that decrease the value of timber and agricultural products;
- insect-borne diseases and other bacterial, viral, and fungal infections that affect animals, crops, and people. [See Chapter 14, Invasive Species -- page 51.]

11.1 Recommendations:

- Educate the public and town boards about the negative effects of increased impermeable surfaces (roads, roofs, lawns, parking lots, etc.) that prevent water from percolating into soil and increase flooding. The amount of contaminants flowing to wetlands and surface waters also increases;
- Educate the public and town boards about the importance of buffers alongside streams and wetlands. These areas prevent erosion and introduction of nutrients and chemicals into waterways;
- Educate the public and town boards about the importance of keeping intact all remaining wetlands and floodplains. Wetlands absorb water and hold it over time; floodplains provide huge storage areas for excess water. Wetlands and floodplains prevent flooding in residential and commercial areas. Important areas to be preserved include the fields below 'Battles Farm', West Meadow Road wetland, wetlands upstream and downstream of Lake Massasecum, and others adjacent to flood prone roadways.

For more information:

Hazard Mitigation Plan 2012, Emergency Management Director, Bradford

Climate change and NH: www.nh.gov/climate/

Federal Emergency Management Agency (FEMA): http://www.fema.gov

12. Wildlife Habitat

Refer to the following maps: *Unfragmented Blocks*, *Habitat and Land Cover*, and *Lands of Special Importance*

And also the Wildlife Action Plan map at end of this chapter.

Photo: B. Duffy

Warner native, longtime Bradford resident, and founding member of the Bradford Conservation Commission, Tilly Wheeler was 96 years old in 2010. She never saw beaver, fisher, turkey, coyote, or bear here in her youth. Later on she drove up to Colebrook to see her first moose. She did, however, know meadowlarks, bobolinks, black racer snakes, and whippoorwills – species that are no longer common here.

To live where one can hear and see wildlife large and small is a big part of what people mean when they refer to preserving the 'rural quality of life'. People who hunt and fish often feel particularly connected to a tradition stretching back many generations.

Bradford, by happenstance of geology and social history, retains a great deal of undeveloped land in the southern half of town with few roads bisecting it. This is in part why much of the land within our borders is highly rated in state and regional rankings of wildlife habitat.

Each species of wildlife has its own set of requirements and preferences. All parts of the natural environment (and some of our built environment) provide habitat for wildlife. Some species have very specific habitat requirements, while others are generalists.
Some habitats are uniquely important to wildlife. Unfortunately, many of these critical habitats are uncommon to begin with, and are easily damaged or destroyed.

12.1 Wildlife Action Plan

Late in 2006, the New Hampshire Fish and Game Department published a comprehensive study that mapped potential and known wildlife habitat. This study, known as the Wildlife Action Plan (WAP), undergoes constant revisions as new information becomes available. It is perhaps the most important tool towns and organizations have at this time for planning for the conservation of high quality and/or imperiled wildlife habitat, rare plant habitat, and exemplary natural

communities and systems. Bradford, in terms of the WAP, is in the Hillsborough Hills and Plains Ecoregion and the Coastal Transitional Watershed.

The WAP identifies critical habitat types in Bradford. Information on species likely to occur in each of these habitats is included on the WAP website at http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm . The 'Habitats and Land Cover' map at the end of this chapter indicates the location of these habitats. The full and frequently updated map can be found on the website.

The Wildlife Action Plan ranks habitats in various ways and on several scales: statewide, regional, and local**.** The map at the end of this chapter demonstrates that a great deal of Bradford's southern landscape is indicated as **Highest Ranked Habitat in the State**.

Areas of **Highest Ranked Habitat in the Biological Region** include the land in and around Low State Forest (Knight's Hill and Silver Hill), the area of Avery Ledge, and areas that include grasslands and marsh/shrub wetlands.

Supporting Landscapes surround the areas of Regional Ranking. These supporting landscapes are Bradford's major tracts of Northern Hardwood-Conifer and Lowland Spruce-Fir forests. Supporting landscapes provide buffers that are critical to protecting the core (or high ranked) habitat areas and often serve to connect them.

Twenty-five percent of Bradford is labeled by the state as a **Conservation Focus Area** – the highest category of importance. This area extends into Newbury, Washington, Hillsborough, and Warner. It represents some of the State's highest value critical habitat for species of concern.

Three of the major forest types, Hemlock/Hardwood/Pine, Lowland Spruce/Fir, and Northern Hardwood/Conifer, are common enough in New Hampshire but are included in the WAP because they support many of the habitat needs of species of concern as well as other species, especially where forests occur in large unfragmented blocks or in direct association with other critical habitat types.

There are small areas of Appalachian Oak-Pine Forest in the northeast part of town.

Areas of Floodplain Forest are found associated with the Warner River near the junction of 114 and 103.

Grassland habitats, in short supply with the abandonment and reforestation of the farms as well as their conversion to development, occur in three areas of significance in Bradford: along Pleasant View Road, at the north end of East Washington Road, and by the intersection of Cressy, Center, and Jewett roads.

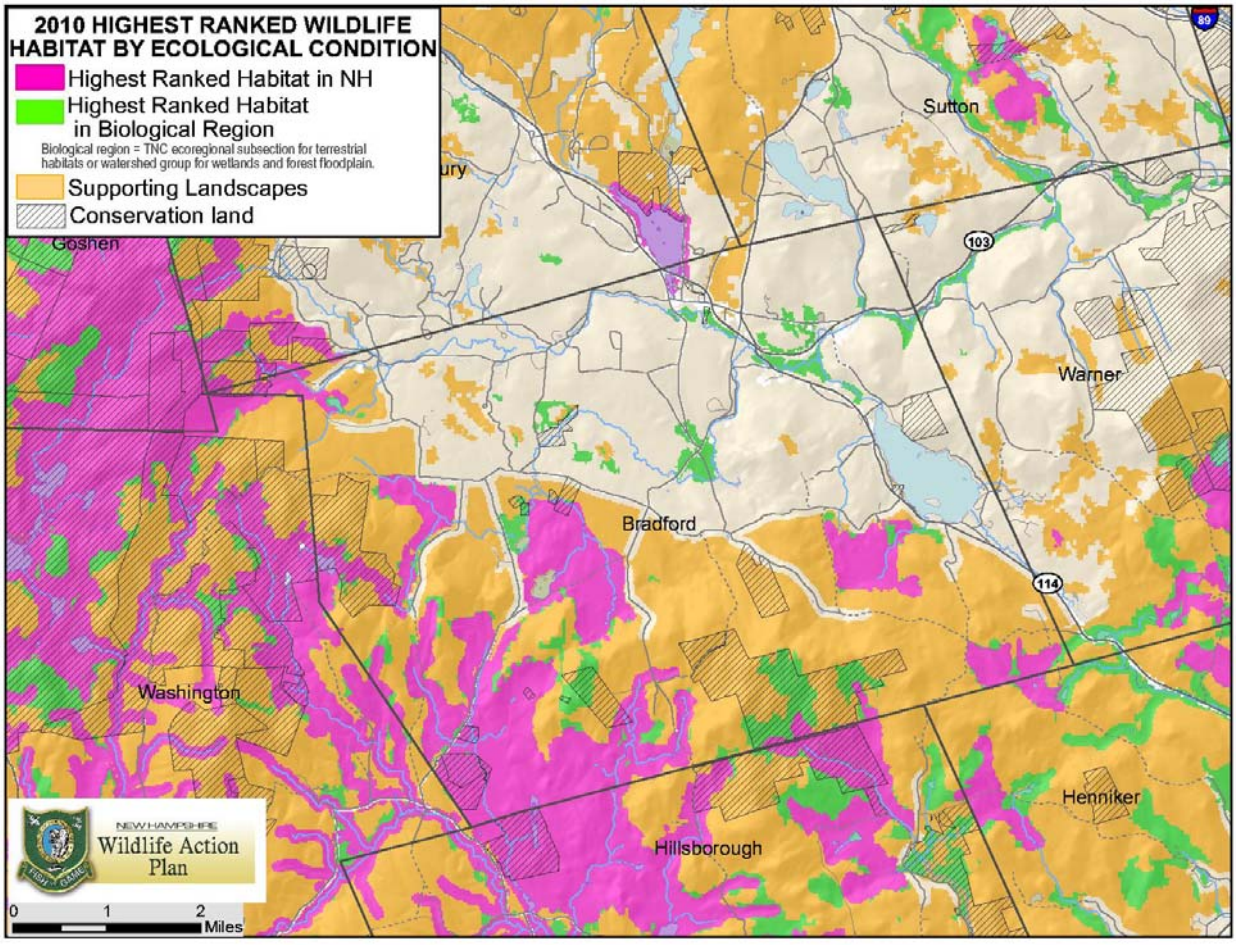
The most important wetlands from a habitat perspective are the Marsh and Shrub Wetlands and the Peatlands. The largest of these occur west of Pearl Town Forest, in the West Meadow Wetland, north of Center Road on the Hoyt Brook, and at the east end of Alder Plains Road. In addition, some marsh and shrub

wetlands abut the grassland areas in town. The most notable peatland area is, of course, the Bradford Bog, by far the largest peatland in Bradford and one of regional significance biologically. [see Rare Species page 49]

Lake habitats include Lake Massasecum and the outlet area of Lake Todd. [also see Rare Species page 49]

Riverine habitats occur mostly in the Warner River Watershed which covers most of town. The southwest part of town drains to other tributaries of the Contoocook River.

Vernal pools can only be mapped by ground-truthing due to their small size. They are however important because they are defined by a small set of amphibian and invertebrate species that are uniquely adapted to these conditions and can not exist without them.



12.2 Unfragmented Areas

Refer to map of *Unfragmented Blocks*
Also see *Wildlife Action Plan* map, page 42.

Short of outright habitat destruction, habitat fragmentation is the primary threat to plants and animals, their diversity and their abundance. Habitat fragmentation creates isolated or tenuously connected patches of the original habitat. The principal causes of this kind of fragmentation are roads, suburban sprawl, and some agricultural and forestry practices.

The term 'habitat fragmentation' refers to six different results that each have a negative effect on an ecosystem:

• Reduction in the total area of the habitat

• Increase in the amount of 'edge', see definition below

• Decrease in the amount of interior habitat

• Isolation of one habitat fragment from other areas of habitat

• Breakup of one patch of habitat into several smaller patches

• Decrease in the average size of each patch of habitat

Habitat fragmentation invariably involves some amount of habitat destruction. Some plants and localized animals are directly destroyed in the process with more mobile animals (especially birds and mammals) retreating into remnant patches of habitat. This can lead to crowding effects and increased competition.

Species that can move between fragments may need to use more than one fragment and those that cannot move between fragments must make do with what is available in the single fragment where they ended up.

Small fragments of habitat can only support small populations of plants and animals and small populations are more vulnerable to extirpation. Minor fluctuations in climate, resources, or other events that would be absorbed by large populations can be catastrophic to small, isolated populations. Thus, fragmentation of habitat can be an important cause of a species decline, especially those that were uncommon or rare to begin with.

Habitat fragmentation also leads to greater "edge effects". Resulting changes in light, temperature, and wind can alter the microclimates in and around the

fragmented area. Fires become more likely as humidity drops and temperature and wind levels rise. Habitat along the edge of a fragment has a different climate and favors different species from the interior habitat. Small fragments are therefore unfavorable for species which require interior habitat. Invasive species are easily established in disturbed environments.

A common response to the problem of habitat fragmentation is to attempt to link the fragments with protected corridors of native vegetation. Corridors may help mitigate the problem of isolation but not the loss of interior habitat. Another solution is to enlarge small remnants in order to increase the amount of interior habitat, however this type of restoration is often impractical.

Ultimately, the best solution to habitat fragmentation is to avoid or minimize it through conservation and effective land use planning.

12.3 Wildlife Corridors

Corridors are relatively narrow, linear strips of habitat that serve as established travel routes used by wildlife to move from one location to another. They may be the link to a seasonally used area, such as a nesting or over-wintering area, or they may interconnect larger blocks of breeding or foraging habitat.

Wildlife corridors provide environmental quality, as well as ecological values. They help to maintain biological diversity and genetic diversity, buffer the extremes of heat and wind, and absorb noise. Corridors help to resolve problems of interruption of wildlife travel lanes between fragmented habitat and populations caused by roads, utilities, and site development.

In general, wildlife corridors share several common characteristics:

• They follow water courses

• They provide cover

• They have relatively high prey abundance or opportunities to forage

• They present few physical barriers

• They are located away from human disturbances and lights

12.4 Recommendations:

- With advice from the Bradford Fish and Game Club, work with the town's Planning and Zoning Boards to protect deer yards, vernal pools, wildlife corridors, and important unfragmented blocks during site planning for residential and commercial development. Require that a wildlife study be conducted in sensitive areas;
- With the Planning Board, create a meaningful 'conservation development' ordinance that protects corridors, hiking trails, wetlands, and other important aspects within these larger residential development projects;
- Incorporate protection of riparian (river/stream side) corridors with buffers in the Wetland Ordinance;
- Educate the public on wildlife issues.

For further information:

Wildlife Action Plan information on habitats found in Bradford:
http://www.wildlife.state.nh.us/Wildlife/Wildlife_Plan/habitat_types.htm

Audubon Society of NH for information on birds: www.nhbirdrecords.org

Volunteer data collection www.wildnh.com

University of NH Wildlife program: www.nhcoverts.org

13. Rare Species and Natural Communities:

Refer to the map of *Lands of Special Importance*
Protecting elements of biodiversity is important. Publicizing exact locations can lead to loss of the species through habitat destruction or illegal collection. In addition, the privacy and rights of the landowner must be protected. Each occurrence has been shifted a random distance and direction within a 500 foot radius circle of its actual observed location. This protects both the species and landowner by making it harder to infer exact locations. Mapped locations in the Heritage Bureau database should be used only as starting points for conservation decisions.

Smooth Green Snake Photo: B. Duffy

Bradford is home to several known rare species and a few unusual 'natural communities' (distinct combinations of plants and animals found in particular physical environments – the Bradford Bog and Atlantic white cedar swamp are good examples). It is likely that there are many more undiscovered rare and interesting species among us – and it is also likely that rare species are in decline here as they are throughout the region.

The New Hampshire Natural Heritage Bureau, part of the New Hampshire Division of Forests and Lands, tracks exemplary natural communities and rare plant and animal species in the state. To qualify as exemplary, a natural community must be of a rare type or must be a high-quality example of a common community type

Plants and animals are listed by State or Federal government as 'endangered' or 'threatened' because of the present or threatened loss of habitat or a number of other factors that affect their survival.

The reasons a plant or animal may be considered 'rare' or a 'species of special concern' are because:

- it occurs only in a relatively small area;
- its populations occur in widely separated areas;
- it was more common when the state's climate or land use was different;
- it is at the northern or southern extent of its range;
- it has very specific habitat requirements;
- it is declining significantly in numbers due to human activities and is restricted to isolated fragments of remaining habitat.

13.1 NH Natural Heritage Bureau

The chart below shows rare species and exemplary natural communities known by the New Hampshire Natural Heritage Bureau (NHNHB) to occur or to have occurred in Bradford. The NHNHB notes that very little of New Hampshire has been thoroughly inventoried for its biodiversity and new information is being added constantly.

	Species or Community Name	Listing		# reported last 20 years	
		Federal	State	in Bradford	in state
	Natural Communities				
**	Emergent marsh – shrub swamp system	-	-	1	13
**	Inland Atlantic white cedar swamp	-	-	1	5
**	Medium level fen system	-	-	1	59
***	Sandy pond shore system	-	-	2	12
	Plants				
	Awlwort *(Sublaria aquatica var. Americana)*	-	T	Historical	4
	Green Adder's Mouth *(Malaxis unifolia)*	-	T	Historical	57
***	Sclerolepis *(Sclerolepis uniflora)*	-	E	1	1
	Vertebrates – Reptiles				
**	Smooth Green Snake *(Opheodrys vernalis)*	-	SC	1	37
**	Wood Turtle *(Glyptemys insculpta)*	-	SC	2	149

T = Threatened E = Endangered SC = Species of Concern
*=High importance **=Very high importance ***=Extremely high importance ****=Highest importance

Information not yet published in the Natural Heritage Bureau database:

- Two documented occurrences of wood turtle
- Two documented occurrences of green snakes.
- Two black gum swamps (*Nyssa sylvatica*)

Also of interest has been the occurrence of a few mature and seed-producing American chestnut trees (*Castanea dentata*) not damaged by the fungal blight that caused their near total erasure from North America in the 1930s. These trees may not have survived the Chestnut Hollow subdivision, however. Saplings have been found and are being monitored.

Two locations in town have supported great blue heron rookeries in the recent past and in 2010, 2011, and 2012, herons returned to at least one of them on Alder Plains Road. Take extreme care in viewing these rookeries as they are sensitive to disturbance.

The activities of loons and bald eagles are monitored on Lakes Todd and Massasecum by volunteers reporting to New Hampshire Fish and Game, New Hampshire Audubon Society, and the Loon Preservation Committee. The Rural

Heritage Connection of Bradford* has installed a loon nesting platform on Lake Massasecum in 2010 with the assistance of the Loon Preservation Committee.

In 2009, a nighthawk nesting pad was installed on the roof of the Bradford Elementary School by the Rural Heritage Connection. It is being monitored through a program sponsored by the Audubon Society of New Hampshire.

13.2 Recommendations:

Education is likely the best method of protecting Bradford's rare species and unusual natural plant communities.

- Many landowners would be interested to know if they had species of interest on their properties and may be interested in protecting them with private conservation easements;
- Reports of unusual sightings of plants or animals may be sent to the Conservation Commission (e-mail BCC@bradfordnh.org) or directly to the New Hampshire Natural Heritage Bureau at www.nhdfl.org or by calling 271-2215;
- New Hampshire Fish and Game also has a program for reporting sightings of species that they are tracking. For more information: www.nhwildlifesightings.unh.edu

*The Rural Heritage Connection of Bradford, Inc. is a non-profit organization, founded in 2003, whose mission is to promote the preservation of properties that have historic, recreational, or environmental significance

For further information:

NH Natural Heritage Bureau
http://www.nhdfl.org/about-forests-and-lands/bureaus/natural-heritage-bureau/

Database to report wildlife sightings for significant species:
www.nhwildlifesightings.unh.edu

14. Invasive Species

The term 'invasive species' can refer to plants, animals, or other organisms such as microbes. Human actions are the primary means of transport for species. 'Invasives' can be defined as non-natives (aliens whose native habitat is not local) whose introduction to an environment causes economic or environmental harm, and/or direct harm to human health.

Invasives typically have certain traits that give them an advantage over most native species. With animals and insects this advantage is often lack of predators. In New Hampshire, 329 exotic species have been reported. The issue of invasives is complicated by the fact that a single plant may be valued differently from different perspectives. For example, dandelions, the bane of lawn-lovers, may be thought of as an invasive species by some (they are an Old World plant), but to others, the dandelion is a welcomed medicinal plant.

Plants:
Next to habitat loss from development and other transformation, invasive plant species pose the greatest threat to native plant species. The most common traits of invasive plants, besides lack of native control species, are vast seed or root/shoot production, early and rapid development, and adaptability and high tolerance to many environmental conditions. Invasives reduce natural biodiversity, impact rare species, reduce wildlife habitat, impact water quality, and stress and reduce forest and agricultural production. They cost the United States and other countries billions of dollars per year in lost agricultural and forestry crops and additional billions in efforts to control their impacts and spread.

In Bradford, Eurasian milfoil is a serious concern. Its identification in Lake Massasecum was made in 1997. Attempts to eradicate this invasive plant have been met with limited success and much expense born by the State, the Town, and Lake Association members. Herbicidal treatment has been utilized with unfortunate consequences for native animal and plant species. The Keller milfoiler was used for 10 years to harvest milfoil and dispose of the viable plant fragments. For the past 3 years, control has been done through combined efforts of boat inspectors at the boat ramp, a volunteer weed watcher group to identify new infestation, and the hand-pulling of plants by State divers.

USDA Invasive and Noxious Weeds in NH, 2012
The following species are <u>prohibited invasive plant species</u> and can not be sold or planted in NH.

Acer platanoides	Norway maple
Ailanthus altissima	tree of heaven
Alliaria petiolata	garlic mustard
Berberis vulgaris	European barberry
Celastrus orbiculatus	Oriental bittersweet
Cynanchum louiseae	Louise's swallow-wort
Cynanchum nigrum	black swallow-wort
Cynanchum rossicum	pale swallow-wort
Elaeagnus umbellata	autumn olive

Euonymous alatus	burning bush
Frangula alnus/*Rhamnus frangula*	glossy buckthorn
Heracleum mantegazzianum	giant hogweed
Iris pseudacorus	water-flag
Ligustrum obtusifolium	blunt-leaved privet
Lonicera bella	showy bush honeysuckle
Lonicera japonica	Japanese honeysuckle
Lonicera morrowii	Morrow's honeysuckle
Lonicera tatarica	Tartarian honeysuckle
Polygonum cuspidatum	Japanese knotweed
Rhamnus cathartica	common buckthorn
Rosa multiflora	multiflora rose

Invasive aquatic plants:

Cabomba caroliniana	Fanwort
Myriophyllum heterophyllum	Variable milfoil
Lythrum salicaria	Purple loosestrife
Phragmites australis	Common reed

Watch list (plants that may be prohibited in the future):

Centaurea maculosa	Spotted Knapweed
Cirsium arvense	Canada thistle
Coronilla varia	Crown vetch
Elaeagnus angustifolia	Russian olive
Euonymus fortunei	Wintercreeper
Glyceria maxima	Sweet reedgrass
Ligustrum vulgare	Common Privet
Lonicera maackii	Amur Honeysuckle
Lysimachia nummularia	Moneywort
Microstegium vimineum	Japanese stilt grass
Phalaris arundinacea	Reed canary grass
Populus alba	White Poplar
Pueraria lobata	Kudzu
Robinia pseudoacacia L.	Black Locust
Ulmus pumila	Siberian Elm
Ampelopsis brevipedunclata	Porcelain-berry

Insects:

Insects and insects as vectors for foreign pathogens are perhaps the second most well-known invasives. Some we have lived with for a long time are endemic, for instance, Gypsy moth or codling moth. Other insects more recently introduced and causing harm to forest or agricultural crops include:

hemlock woolly adelgid
beech bark scale and related fungus
European elm bark beetle and related fungus
spotted wing drosophila
brown marmorated stink bug

Asian longhorn beetle and emerald ash borer are not in New Hampshire at this time but can be found in neighboring states.

Microbes:

The following is a partial list of pathogens introduced to New Hampshire:

Dutch elm disease
Chestnut blight fungus
Eastern equine encephalitis
West Nile virus
Tick-borne diseases
Pathogens related to 'bee colony collapse'
White-nose syndrome – a fungus that kills many bat species
Butternut canker, a fungus

Mammals/Birds/Amphibians/Reptiles:

Animals are mobile almost by definition. Some birds introduced in the 1800s are accepted as natives, such as the English sparrow, starlings, and house finch. Cowbirds were happy to leave the buffalo herds and join the introduced cows and horses of the east, parasitizing the nests of eastern songbirds. The eastern coyote, currently believed to be a crossing of the western coyote and the red wolf, took the place of the extirpated wolf. Released red-eared slider turtles could become a breeding reptile if introduced in numbers, possibly affecting the native populations.

14.1 Recommendations:

- Education is the best tool for combating invasive species. Landowners can assist state agencies by identifying dangerous plants and insects new to the area;
- Invasive plants love disturbed ground. By enlisting the cooperation of developers to limit the amount of disturbed ground and reseeding immediately, opportunities for invasive species to take hold could be limited;
- Education will require publicizing the list of restricted plants above and information on how to identify these plants and insects;
- Many landowners are unaware that as of July 2011, there is a statewide ban on importing untreated firewood without a commercial or home heating compliance agreement;
  For more information on this: http://www.nhdfl.org/forest-health/firewood/
- Continued education on the identification of Eurasian water milfoil and continued efforts to stop its spread into and out of Lake Massasecum.

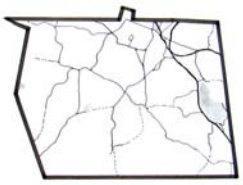
For further information:

http://extension.unh.edu/forestry/Docs/invasive.pdf

http://www.invasivespeciesinfo.gov/unitedstates/nh.shtml

The Division of Plant Industry: www.nh.gov/agric/

15. Conserved Land



Refer to map of *Lands of Special Importance*

Fearnley Easement *photo:JAEldridge*

Compared to neighboring towns, Bradford's percentage of permanently protected land is low, but growing.

The following chart outlines land that has been **permanently protected with conservation easements.** An easement is a permanent attachment to a deed, overseen by a qualified organization, such as a land trust, that allows for specified uses of the land (agriculture or forestry, for example) while limiting or excluding its development potential.

There were no permanently conserved parcels in Bradford at the time of the1998 Natural Resources Inventory.

Land protected by conservation easements as of 2012:

	acreage	ownership	easement holder
Aiken Pasture Town Forest	136	town of Bradford	ASLPT
Battles Farm	143	private	ASLPT
Blitzer Easement	148.8	private	ASLPT
Fearnley Easement	158	private	ASLPT
Kisakanari Easement	318	private	ASLPT
Nelson Family Easement	89	private	ASLPT
New Forestry Easement	451	private	SPNHF
Govener's Grant Easement	30	private	SPNHF
Bog/Spring Hotel/Goodridge- combined	177.9	town of Bradford	ASLPT
Total	1651.7		

ASLPT = Ausbon Sargent Land Protection Trust
SPNHF = Society for the Protection of NH Forests

Total acreage Bradford = 22,549.14 (land only)
Percentage of permanently protected land = 7.3%

The chart below lists public lands that are currently used for forestry, public recreation, and wetland protection. They are **not permanently conserved** and could potentially be sold for other uses.

Low State Forest – in Bradford	900 acres	State of NH	restrictions
Bradford Pines	2.2 acres	State of NH	
Pearl Town Forest	37 acres	town owned	deed restrictions
Tilly Wheeler Trail/Whitman Park	1.8 acres	town owned	
West Meadow Wetland	42.8 acres	town owned	
Dodge Meadow	6.8 acres	town owned	
French's Park	6 acres	town owned	deed restrictions
Lot abutting Bradford Bog	20.2 acres	town owned	
Lot abutting Dodge lot	8.7 acres	town owned	
Lot abutting Pearl Town Forest	6.5 acres	town owned	

Total =1032 acres or 4.6% of town acreage

The Bradford Conservation Commission has identified the following five primary areas for the focus of conservation efforts based on occurrences of valued habitat and local knowledge:

- Lake Massasecum - rare species and exemplary plant communities and co-occurrence of seven of the wildlife habitats of interest.
- Rowes Hill/Knight's Hill/Low State Forest/Silver Hill to Durrell Mountain. Important for its connection between conserved areas and eight known important wildlife habitats.
- Bradford Bog/Atlantic white cedar swamp. Noted primarily for its rare and exemplary plant communities.
- Central Bradford wetlands/grasslands. Seven habitats of importance within this area. A working agricultural landscape.
- Fairgrounds Road grasslands. Open grasslands and agricultural lands are becoming more rare as are the farmers and wildlife species dependant on these habitats.

15.1 Recommendations:

- The Conservation Commission promotes private easements as a method of protecting special places in Bradford;
- If a property is clearly important to residents and a private easement is not possible, the town should assist with protection through an appropriate entity.

For further information on land trusts that hold easements in this area:

Ausbon Sargent Land Preservation Trust www.ausbonsargent.org

Society for the Protection of New Hampshire Forests www.forestsociety.org

The Nature Conservancy, New Hampshire office:
http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/newhampshire/index.htm

16. Current Use Land in Bradford

"It is hereby declared to be in the public interest to encourage preservation of open space, thus providing a healthful and attractive outdoor environment for work and recreation of the state's citizen's, maintaining the character of the state's landscape, and conserving the land, water, forest, agricultural and wildlife resources."

- ***NH Current Use law RSA 79-A***

(enacted July 1, 1973)

The Current Use Assessment system bases property tax on the 'current use' of the land and not on its development potential. This program has enabled many landowners to afford to keep their land in traditional uses rather than convert to house lots and commercial development. It provides a property tax incentive to all qualifying landowners who agree to maintain their land in an undeveloped condition. This assessment is based on the capacity of the land to produce income in its current use.

Current Use is the cornerstone of the state's land conservation efforts, with over half the land in New Hampshire enrolled in this valuable program. Current Use provides a wide variety of benefits for landowners, municipalities, the State and the general public

'Cost of Community Services' studies have demonstrated that land in the current use program and other undeveloped lands send more tax income to the town than they use in services (such as schools, fire and rescue, etc.) *even at the lower tax rate.* They thus have a positive effect on the tax rate compared to residential housing which requires more in services than is realized in property tax payments.

When land is changed from 'open space' land to other uses, a penalty tax is paid to the town as compensation for previous tax reductions. Since a vote at the town meeting in 1992, half of this penalty fee has been placed in the town's Conservation Fund to be used for protection of remaining valuable open space land in town. The other half is deposited in the town's general fund.

Land in the Current Use program (2010 statistics):

Type	Acres	
Farm Land	**687.01**	
Forest Land	**11,354.70**	
Forest Land/Stewardship	**2793.79**	
Unproductive Land	**572.71**	
Wet Land	**512.42**	
Total number of acres exempt under Current Use:		**15,920.63 acres**
Total number of acres receiving 20% recreation adjustment:		**4,226.95 acres**

There were eight Tree Farms in 1998 - there are five as of 2012. Source: NH Tree Farm Program www.nhtreefarm.org

16.1 Recommendations:

- Recommend to voters that 100% of the Current Use Penalty Tax goes to the town's Conservation Fund, allowing the town to assist with private easements or the protection of significant parcels;
- Complete a 'Cost of Community Services' study which would demonstrate how different property tax categories affect the tax rate;
- Disseminate information about the Current Use Program.

For further information:

Statewide Program of Action to Conserve Our Environment (SPACE) current use handbook *Understanding How Current Use Works in New Hampshire* www.nhspace.org

New Hampshire Fish and Game *Operation Land Share* – assists landowners with issues experienced in sharing land with hunters and other outdoor users. http://www.wildlife.state.nh.us/landshare/welcome_to_OLS.html

17. Trails and Recreation

Refer to *Habitats and Land Cover* map
And map of *Unfragmented Blocks*

Bradford Bog Boardwalk photo:B. Duffy

Many residents make their strongest connections with Bradford's natural resources through recreation, particularly with its trails. Hunting, hiking, horseback riding, skiing, snowmobiling - all would benefit from a more extensive trail system in town that connects to trail systems in neighboring towns.

To that end, the Conservation Commission worked with the Central NH Regional Planning Commission through funds from the NHDES Regional Environmental Planning Program to create an Open Space Trail System Plan in 2000. The larger vision is to create a trail system that circumnavigates the town and connects to the Sunapee/ Ragged / Kearsarge Greenway. This trail would connect Low State Forest, Aiken Pasture Town Forest, the Bog conservation area, the Pillsbury/Sunapee Highlands easements, and the Fairgrounds Road snowmobile trails with the downtown services. Many of the recommendations of this study are incorporated at the end of this section.

A trail map has been published. A trail guide to the Bradford Bog is available at the entrance to the Bog. Both maps can also be obtained at Brown Memorial Library. There is an underutilized 'Fitness Trail' downtown, begun in the 1970s, that extends behind the library to Route 103. It is now known as the Tillie Wheeler Trail for one of its main supporters.

The Lake Sunapee Snowmobile Club deserves thanks for their efforts in both trail maintenance and acquiring landowner permission. Through this permission and the cooperation of many resident and non-resident land owners, the trail system exists for the benefit of all to use and enjoy responsibly. The club maintains over

85 miles of trails in Bradford, Newbury, and the Sunapee region. Their maps are available on their website at http://www.lakesunapeesnowmobileclub.com/.

Key to a coherent trail system is the continued use of Class 6 roads or their conversion to Class A or Class B trails. In conflict with this very real public benefit is the financial benefit to developers to utilize these roads as a way to reduce land development costs.

The trail systems that exist today and those planned for the future are a valued part of the quality of life in Bradford - a component often overlooked by town planners. Because many residents and some town businesses benefit from these trails, town planners should consider these town assets when reviewing projects that may impact them adversely.

Roads and Trails that are important for recreation:

Liberty Hill Road	class 6 road
Day Pond Road	class 6 section
Rowe Mountain Road	class 6 section
Massasecum Avenue	class 6 section
Smith Road	class 6 road
Forest Street	Class 5, not maintained in winter
Jewett Road	Class 5, not maintained in winter
Jackson Road	class 6 road
Pierce Road	class 6 section
Dunfield Road	class 6 section
County Road	class 6 section
Alder Plains Road	class 6 road
Deer Valley Road	class 6 section
Old Mountain Road	class 6 road
Penhallow Road	private road
Knights Hill	hiking trail
Blitzer Easement	hiking trails
Bradford Bog Easement	hiking trails
Battles Farm Easement	hiking trails

Lakes and other public waterways are another great source of recreation. In this town, this largely refers to Lake Massasecum, Lake Todd, and to a lesser extent, Ayer's Pond, the Warner River, Hoyt Brook and the West Branch Brook. These resources are also covered in Chapter 7, page 21.

17.1 Recommendations:

- Continue to develop an interconnected trail system. A recreational 'Master Plan' should be developed with assistance of hunting clubs, snowmobile clubs, hiking clubs, et cetera that would involve all types of users in this planning process. One trail use must not destroy the trail for other users or impinge on the rights and use of landowners;
- Educate landowners as to their rights and protection from lawsuit when allowing trail use of their property. RSA 212:34 ;
- Create a team to work on maintaining and constructing pedestrian trails;
- Conservation easements can be a useful tool to preserve and create trail systems;
- Update trail guides as necessary and make available to the public.
- Maintain trail connectivity during the subdivision process;
- Changes to the status of Class 6 roads should consider the recreational Master Plan above and only be opened to traffic if an alternative trail system suitable for all trail uses has been developed.

For further information:

For information about landowner's rights and trails RSA 212:34
http://www.gencourt.state.nh.us/rsa/html/XVIII/212/212-34.htm

Trails.com: New Hampshire Trails and New Hampshire Trail Maps:
http://www.trails.com/findarea.aspx?state=NH

New Hampshire Division of Parks and Recreation, Bureau of Trails:
http://www.nhstateparks.org/explore/bureau-of-trails

Sunapee-Ragged-Kearsarge Greenway Coalition: http://www.srkg.com

New Hampshire Trailwrights: http://www.trailwrights.org

18. Scenic Views

Refer to *Habitats and Land Cover* map
And *Unfragmented Blocks* map

Bradford's diverse topography of wooded hills to the south, neighboring heights of Sunapee and Kearsarge mountains, views of lakes, wetlands, and open fields have been counted as important aspects of Bradford in the town's Master Plans and are included on the list of Cornerstones – the features in town that residents selected as priorities to maintain into the future.

Following is an attempt to list the favored scenic resources in town. Only those that can be observed from a public road or are easily accessible are included, though a climb to the view from the ledges of Haystack Mountain, the Blitzer easement, Guild Hill, or the sight of secluded Ayer's Pond should not be overlooked by the adventurous.

This list is necessarily fluid and has changed over time as land use changes, beaver activity alters wetlands, agricultural and forestry uses fluctuate or disappear with development. One hundred years ago, much of Bradford was deforested with the rise of sheep farming, for instance.

Public views of 2012:
Hay fields, Fairgrounds Road
Hay fields, Pleasant View Road
Battles Farm, Center Road. The easement guarantees the view will remain
Rowe Mountain Road, height of land looking east
View west from Route 103
Farm on Fortunes Road
Deer Valley Road, upper end
Fearnley Easement, wetland, Deer Valley Road
Forest Street wetland
West Road at Hoyt Brook
Bradford Bog, from trail and from Spring Hotel site
East Washington Road wetlands, northern end
Flood plain at Routes103/114

Alder Plains Road
Lake Massasecum, from Rte 114
Lake Todd, from High Street and Route 103
West Branch Brook, along Fairgrounds Road and by the Bement Bridge
Hoyt Brook, along Center Road, West Meadow Road, and West Road
Warner River, from Route 103
Lake Massasecum, by the outlet at Breezy Hill Road
And one final scenic view, much overlooked, is the night sky.

18.1 Recommendations:

- Scenic beauty is a valuable asset for the town and should be considered in all site planning of development projects;
- Some of Bradford's best scenery is the result of unobstructed views of the hills of abutting towns. Working with neighboring towns would benefit all.
- Take into account the effects of excessive or inappropriate lighting in the planning of subdivisions, roads, and businesses;
- Conservation easements can be an important tool for protecting special places;
- Work with the Planning Board when communications towers are sited with regard to their impact on views and on the recreational value of higher elevations in town.

19. Constraints to Development

Refer to maps on *Constraints to Development, Wetlands and Water Resources, Lands of Special Importance*, *Drinking Water Threats*, *Unfragmented Blocks*, and FEMA (Federal Emergency Management Agency) information.

Introduction:

Development of any kind (roads, houses, commercial, or industrial) has effects on natural resource values – from water quality to wildlife habitat to forest health to agricultural potential. Factors include increases in impervious surfaces, degradation of buffers to wetlands, removal of soils, and accidental contamination.

The population of Bradford has increased between 1950 and 2012 from 606 to1536 residents. The introduction to the Society for the Protection of New Hampshire Forests 2005 report on New Hampshire Changing Landscape reads: "The pace, location, and types of growth that New Hampshire is likely to experience in the next 20 years will have profound and irreversible impacts on the character, economic diversity, and environmental health of the state."

To plan for inevitable growth, keep quality drinking water resources, and conserve the best of the remaining natural features, it is critical to consider

- Use and location of existing developed areas
- Current and future location of services
- Suitability of undeveloped land for specific uses.

Development of any kind should be considered irreversible.

Developed land in Bradford is predominantly in the northern section of town by Routes 103 and 114 where the railroad originally passed. Schools, childcare, stores, fire and rescue services, road services, transfer station, and the most likely source for a public water supply are located here. This is also the area most susceptible to aquifer contamination and to flooding.

The areas indicated on the 'Constraints to Development' map are generally considered to be places where development can not occur because of physical limitations or regulatory restrictions.

Wetlands: Wetlands over ½ acre are restricted from development, including all surface water, forested wetlands, and riverine wetlands that are part of the US Fish and Wildlife Service's National Wetlands Inventory. In addition, the town's wetland ordinance require that naturally vegetated buffer be retained or created. See Wetlands, Chapter 8.

Steep Slopes: Defined in this town as greater than 15% slope, steep slopes are areas of steep, thin, and rocky soils which are not natively suitable for septic systems or wells. These areas are usually cost-prohibitive to development, and their development may have serious consequences for the surrounding landscape. These slopes have more expensive requirements for approved septic designs, are at higher risk for erosion, and may not have ideal access. These areas are valued by residents for their scenic values.

FEMA Floodplains: Areas prone to flooding are mapped by the Federal Emergency Management Agency (FEMA) in cooperation with NH Granit (the statewide geographic information system clearinghouse based at the University of NH). Of particular interest are areas designated as the 100 year floodplain. The most extensive areas of flooding are: the intersection of Routes 103/114, Fairgrounds Road, East Washington Road, Battles Farm fields, West Meadow Wetland, Box Corner, West Road at Hoyt Brook, and Water Street.
The most current FEMA maps are available at the Town Offices.

Shoreland Water Quality Protection Act: At this time, certain new development is prohibited within 250' of any waterbody of 10 acres or more or certain streams of the 4th order or greater. Development is subject to stricter oversight regarding erosion control, lot size, septic standards, landscaping practices, retention of vegetation, and buffers. See Chapter 7.5 page 26.

Well Head Protection Areas: These are mapped by the NH Department of Environmental Services to protect areas that influence drinking water quality for concentrated populations, (for instance, at schools, restaurants, or motels). See Chapter 10.2 for a list, page 33.

Class 6 Roads: These roads are predominantly on the outskirts of town where the costs of services (road maintenance, school busing, fire/police/rescue) to far-flung development will negatively affect the tax rate. Additionally, the destruction of important recreational opportunities will negatively impact residents and the tourist industry.

Permanently Protected Lands: These are lands, private or owned by town, state, or federal government which are deed-protected by conservation easements or deed restrictions. See Chapter 15 on 'Conserved Lands'.

Cemeteries, Schoolyards, and other Town-Owned Lands: It is assumed that these parcels will not be converted to other uses.

19.1 Recommendations:

- Constraints to development should be considered when revising ordinances and in site planning;
- The Planning Board and the Conservation Commission recommend a 'build out' analysis be performed with every Master Plan revision. A 'build out' analysis is a study that allows a community to test out its existing regulations -- to glimpse its possible future when all land is developed to the maximum extent allowed under law. It is a tool that shows the consequences of existing land-use regulations and helps officials make better decisions in planning for the future.

For more information:

On buildout analysis: http://www.epa.gov/greenkit/build_out.htm

On flooding:
Federal Emergency Management Agency (FEMA): http://www.fema.gov

On shoreland protection issues: Shoreland Water Quality Protection Act (SWQPA) http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm

20. Conclusions and Areas of Concern

Battles Farm

It is the hope of the Bradford Conservation Commission that the results of this updated Natural Resource Inventory provides a new perspective. We believe that the protection of our natural resources should take top priority in Bradford. This will require a balanced approach of education and regulation.

We recommend that the town institute a Conservation Plan consisting of zoning overlays that protect high priority resources. By incorporating the most recent GIS data, the information in this Inventory provides a basis for long-range town planning.

A balanced approach to resource protection will be most successful if the needs and vision of residents are taken into consideration when managing the natural resources upon which we depend. Prioritization of these needs will be an ongoing discussion.

The following is a preliminary list of findings that are noteworthy. Some of the resources listed are significant not just to this town, but on state and regional levels as well:

- There are two large, high quality, high-yield groundwater aquifers in town. One of these is located in the most densely populated area of town and could possibly be used as a source of public water. However, there are many specific and non-point source groundwater hazards located on or near it. The Conservation Commission agrees with previous recommendations which called for investigating DES reclassification of the area provided by RSA 485-C. This would give more power to local authorities in protecting this resource.

- Surface waters and vernal pools are not protected by the current Wetlands Ordinance. The Conservation Commission recommends that surface waters be protected with a zoning overlay.

- Consideration should be given to protection of the watershed of the largest lake and river, Lake Massasecum and the Warner River.

- The main commercial and residential areas of town – parts of Routes 103/114 and the Lake Massasecum area - are prone to flooding. Professional studies should be sought to guide any development in these areas. Fill of wetlands or increase in impervious surfaces would adversely impact the flooding.

- A high percentage of Bradford is a priority focus area for the State's Wildlife Action Plan. This must be considered when planning for future town growth.

- Bradford, as most towns in this area, has only a small percentage of 'Prime Agricultural Soils' and 'Soils of Statewide Importance'. Few of the above soil types or remaining agricultural operations in town are protected with easements or deed restrictions.

- Removal of topsoil is not specifically governed. The Conservation Commission recommends regulation prohibiting removal of topsoil from town.

- Although conservation easements are increasing in number in Bradford, this town has a lower percentage of permanently protected land than in neighboring towns.

- The Conservation Commission recognizes that conservation is not only ecologically important to the town, but is also economically important. Forestry, agriculture, tourism, and clean water all contribute to the economy.

- Bradford is interconnected with 85 miles of established snowmobile trails of the Lake Sunapee Snowmobile Club and the State system. Hikers, skiers, horseback riders, and others use these trails and there is potential for many more trails.

- Cost of Community Services studies in New Hampshire towns, including one done in Sutton, have confirmed that 'open space' land costs the town less in services than it pays in property taxes. Residential properties cost towns more than they return to the town in property taxes.

- A Build-Out Analysis should be part of Bradford's Master Plan. This allows the town to visualize whether its ordinances truly protect the natural resources it wishes to conserve, and also whether the town can afford the services that would be required by future development.

Appendix A: Maps and Map Sources

- Habitats and Land Cover
- Farmland and Forest Soils
- Lands of Special Importance
- Water Resources and Wetlands
- Drinking Water Threats
- Unfragmented Blocks
- Constraints to Development

New Hampshire's Geographically Referenced Analysis and Information Transfer System (NH GRANIT) http://www.granit.unh.edu/

New Hampshire Wildlife Action Plan
http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm

New Hampshire Natural Heritage Bureau
http://www.nhdfl.org/about-forests-and-lands/bureaus/natural-heritage-bureau/

United States Department of Agriculture Natural Resource Conservation Service (NRCS) soils http://websoilsurvey.nrcs.usda.gov/app/

Department of Environmental Services - drinking water
http://des.nh.gov/organization/divisions/water/

US Fish and Wildlife Service National Wetlands Inventory
http://www.fws.gov/wetlands/

New Hampshire Office of Energy and Planning (NHOEP) http://www.nh.gov/oep/