CHAPTER VI
NATURAL FEATURES

INTRODUCTION

The purpose of the NATURAL RESOURCES CHAPTER is to identify the natural features and resources found throughout Bradford's landscape. In addition, the intent of the chapter is to identify important natural resource related issues. This chapter will determine if the Town's natural features are adequately protected, and will offer suggestions of methods for their protection.

With a variety of forestry, farm, and soils types, numerous plants and wildlife species, and significant lakes, brooks, wetlands and other water resources, Bradford's 22,784 acres of land is rich in natural resources. In 2005, there were 357 acres of land in conservation and approximately 15,000 acres of land in current use. It is estimated that 80 to 90 percent of the Town's land area is forested. Wetlands are found scattered throughout the town, and many tracts of land remain undeveloped, providing wildlife habitat for a number of diverse species. Many hills exist in the Town, and two types of bedrock geology underlay Bradford. The Town boasts two prominent lakes, Lake Todd and Lake Massasecum, as well as the Warner River, and a number of brooks and streams, which not only provide resources for water recreation, but also provide additional habitat for the unique natural communities in the Town. An Inland New England Acidic Pond Shore Community is found on the southern shore of Lake Massasecum. This community is found in only 10 other locations in the State. The Bradford Bog conservation area is the site of a rare stand of Atlantic White Cedar, and the Bradford Pines boasts some of the oldest remaining white pines in the state. This rich diversity is one of the reasons people have been attracted to Bradford throughout its history.

The February 2004 Community Survey indicates that the people of Bradford view local natural resources as playing a very important role in the Town's quality of life. Nearly 60 percent of respondents indicated that the preservation of open space is very important. The survey reveals that the issues of highest concern are lakes, aquifers, forests, and protection of natural habitats. Many of the respondents also thought that there should be additional efforts to increase the amount of open space and conservation lands in the Town. Community members indicated a desire to improve the recreational opportunities in town, particularly walking trails and bike paths on Town property. These survey results suggest the need for the Town to continue its efforts to identify and carry out strategies to conserve Bradford's natural resources.

OBJECTIVES OF THE CHAPTER AND RECOMMENDATIONS

1. **To preserve the rural character of the Town by protecting scenic vistas and open spaces, including limiting or mitigating lights, noise and odor emission.**

    a. Pass municipal regulations and zoning ordinances to regulate light and noise pollution.
    b. Educate landowners about backyard burning laws.
    c. Include provisions for the retention of scenic vistas in the Subdivision Regulations.
    d. Continue to contact landowners about the benefits of open space and conservation easements.
    e. Coordinate regularly with the NH DES Air Resources Division to combat air pollution.

2. **To educate the citizens of the Town of Bradford regarding Bradford's natural resources.**

    a. Educate landowners on the merits of sustainable, active forests and the value of agricultural land as open space.
    b. Raise awareness of exotic species of plants and animals, and measures to prevent their spread.
    c. Provide information on topics including the natural resources in Town, habitats, forest management, exotic species, etc.
    d. Encourage the monitoring of potential exotic species by Boy Scouts or students fulfilling community service requirements.
    e. Recruit elementary, middle, and high school teachers to assign projects with the Conservation Commission (for example, exotic weed watch, wood duck program, roadside cleanup, surface water monitoring).
    f. Encourage local teachers to focus their curriculum on the local environment.

3. **To protect valuable resources; including water, agricultural, forestry and geologic resources.**
    a. Make the utilization of the land use change tax more effective in preserving the Town's prime natural resources.
    b. Develop a current listing of tree farms/managed forests by using current use forms and forest management plans as a starting point.
    c. Encourage native landscaping in housing development subdivisions and site plans.
    d. Increase awareness of the impact of development on stormwater and drainage.
    e. Continue to monitor for exotic weeds at the boat ramp and through the NH DES Weed Watcher program along the shoreline.

f. Encourage landowners to follow best management practices for proper water quality management practices of enterprises (for example, hairdressers, agriculture, livestock, junkyards)
g. Encourage diverse representation on the Conservation Commission, such as recruitment of hunting and fishing enthusiasts, members of the logging community, conservatives, etc.

4. To preserve valuable wildlife habitat in Town.

a. Maintain the inventory of threatened and endangered wildlife and plant species and their habitats in Town.
b. Require a wildlife management assessment inventory for major subdivisions, as appropriate.
c. Coordinate with the NH Fish and Game to draw on their local knowledge of wildlife and preservation.

5. To preserve and enhance natural recreational resources.

a. Promote knowledge of trails and encourage responsible use of the walking and hiking trails in Town.

COMMUNITY SURVEY RESULTS

The February 2004 Community Survey yielded 330 responses from 1,424 surveys distributed, equaling a response rate of 23%. The following questions were pertinent to the NATURAL FEATURES CHAPTER. Full survey results are displayed in the appendix.

The results of the community survey indicated that the preservation of natural resources is an important issue to the Bradford community. Of the survey respondents, 77% felt that preserving open space was a "Very Important" or "Important" objective (Table VI-1). Respondents who indicated that preservation is important suggested that the preferred methods for funding the preservation of open space are through the Current Use Change Tax (56%), donations (59%) and grants (61%), as presented in Table VI-2.

Table VI-1
Please indicate how important the preservation of open space (undeveloped land) in Bradford is to you:

	Total	Percent
Very Important	194	58.6%
Important	61	18.4%
Somewhat Important	54	16.3%
Not Important	17	5.1%
No Opinion	5	1.5%
Grand total	331	100.0%

Table VI-2
If Important, how should this preservation of open space be funded?

	Total	Percent*
Through the Current Use Change Tax Fund	186	56.4%
Through General Tax Revenues	66	20.0%
Through a Bond Issue (Town borrowing)	56	17.0%
Through Donations	197	59.7%
Through Grants	203	61.5%
Other	20	6.1%
*based on 330 returned surveys		

Survey respondents were divided in their support of a change to the Current Use Change Tax to be allocated to the Conservation Commission. 45% indicated a desire to keep the tax at its current level (Table VI-3).

Table VI-3
Would you support an increase or decrease in the portion of the Current Use Change Tax, currently at 50%, to be allocated to the Conservation Commission for land protection and acquisition?

	Total	Percent
Yes, increase	95	30.8%
No, decrease	34	11.0%
Keep the Same	138	44.8%
No Opinion	41	13.3%
Grand total	308	100.0%

Table VI-4 displays the natural features that respondents feel are the most important to preserve. Area lakes, aquifers and forests ranked at the top of this list.

Table VI-4
Please indicate which three (3) of the following features you feel are most important to preserve:

	Total	Percent
Lakes	200	60.6%
Aquifers (ground water)	180	54.5%
Forests	159	48.2%
Natural Habitat	136	41.2%
Wetlands	102	30.9%
Fields/Agriculture	83	25.2%
Fish/Wildlife Management	72	21.8%
Streams	61	18.5%
Ponds	54	16.4%
Recreation	39	11.8%
Other	11	3.3%

Though split on the percentage of land which should be permanently protected for conservation and recreation purposed, a significant majority of survey respondents do feel that the percentage of protected land in Bradford should increase (Table VI-5).

Table VI-5
There are 22,874 acres of land in Bradford, of which, 269 acres or 1.18%, are permanently protected for public conservation/recreation purposes. What do you feel is the ideal goal for permanent conservation land in Bradford?

	Total	Percent
No Change	51	16.2%
5%	58	18.4%
10%	70	22.2%
20%	47	14.9%
Over 20%	65	20.6%
No Opinion	24	7.6%
Grand total	315	100.0%

Very few respondents stated that they never use the public lands in Bradford for recreation. Approximately 35% report using public lands for recreation 1-5 times per year.

Table VI-6
How many times per year do you use public lands in Bradford for recreation?

	Total	Percent
None	50	16.5%
1-5	105	34.7%
6-10	52	17.2%
11-25	40	13.2%
26-50	31	10.2%
Over 50	25	8.3%
Grand total	303	100.0%

When asked which recreational opportunities the Town should develop or improve, over 65% of respondents feel that walking paths are important. Other responses include bike paths (48%), lake access (28 percent), and athletic fields (26%).

Table VI-7
Please indicate which of the following recreational opportunities you would like the Town to develop and/or improve

	Total	Percent
Walking trails on Town property	216	65.5%
Bike Paths	159	48.2%
Expanded lake access	93	28.2%
Athletic fields (baseball, soccer, etc.)	88	26.7%
Town recreation center	81	24.5%
Town recreational programs	80	24.2%
Ice rink	68	20.6%
Expanded river access	63	19.1%
Tennis courts	56	17.0%
Basketball courts	50	15.2%
Outdoor shooting range	41	12.4%
Skateboard park	34	10.3%
No new recreation facilities	30	9.1%
Archery range	28	8.5%
Other	24	7.3%
Volleyball courts	22	6.7%
Swimming pool	21	6.4%

INVENTORY OF NATURAL RESOURCES

A majority of the resource information presented in this Chapter came from the 1998 Central New Hampshire Regional Planning Commission document, *Natural, Cultural and Historic Resources Inventory*, as well as the *1998 Bradford, NH Natural Resources Inventory*, compiled by the Bradford Conservation Commission. Additional information was gathered from the *Report of Wetland Evaluations Using the NH Method for Bradford, NH: 1992-1995* which was prepared by the Bradford Conservation Commission with assistance from the Community Environmental Outreach Program and New Hampshire Cooperative Extension. Town maps and records, other mapping sources, and Conservation Commission data all contributed to this Chapter.

Water Resources

The *Water Resources Map* depicts the location of the best known water features within the Town. Included on this map are lakes, ponds, rivers, brooks, wetlands, water supplies and aquifers. A detailed description of each resource follows.

Watersheds

Bradford lies in the Contoocook River sub-basin. Its principal watershed is that of the Warner River. A small portion of the Town's south-west corner also lies in the Beard's Brook watershed.

Because all surface water within a particular watershed drains as a unified hydrologic system separate from any other neighboring watershed area, knowledge of watershed locations and how their drainage system works, combined with knowledge about underlying water-bearing aquifers, plays a large role in helping town planners locate and protect town wells and regulate those surface land uses which could contaminate water resources.

Water Supplies

A majority of Bradford's well sites are private wells, but public water supply sites are present in the Town. These locations can be seen on the *Water Resources Map*. As defined by the NH Department of Environmental Services, public water systems are "systems that serve at least 25 people or 15 service connections for at least 60 days each year". Presently, Bradford has a total of 10 public water supply sites, most of which are situated along Main Street at the Bradford Town Hall, as well as the Appleseed and Bradford Inns.

Between 1984 and 1997, the NH DES issued 232 private well permits to Bradford residents.

Aquifers

Aquifers are geologic formations, such as fractured bedrock, glacial sands or gravels, which contain water and yield significant quantities of water to springs and wells. A stratified drift aquifer, typically an aquifer with layers of sand, gravel and silt, is a source of water for towns and other large volume water users. Several of these aquifers exist in

Bradford, the largest of which is located mostly in neighboring Newbury, but extends under Pleasant View Road and Fairgrounds Road. There are no obvious pollution threats to this aquifer. The most accessible aquifer is under Lake Todd, to Main Street and Route 103, into Warner at Melvin Mills and down to the northern shore of Lake Massasecum. The purity of this aquifer is threatened by pollution from underground gas storage, inadequate septic systems, chemicals, and pollution from the landfill. A small aquifer also exists under Blood Meadow and Bradford Bog.

Lakes and Ponds

Lake Massasecum is the largest water body in the immediate area, spanning over 400 acres, with a maximum sounded depth of 50 feet at its deepest point. It serves as a major tributary to the Warner River, and is one of only two lakes in the state where the outlet become an inlet at times of heavy rain and snowmelt. Lake Massasecum is 633 feet above sea level and the Warner River at Melvin Mills is 627 feet above sea level. Numerous streams flow into the Lake and the largest is an unnamed brook which flows into the Lake's south shore.

The shores of Lake Massasecum contain a rare "Inland New England Acidic Pond Shore Community". Along the southern shore of the lake and in the associated wetlands, a small aquatic plant, *sclerolepis*, can be found. This is the only known site for this plant in New Hampshire. Unfortunately, the northern end of the Lake has been affected by the invasive aquatic plant *water milfoil*. The Lake Massasecum Improvement Association is working with the NH DES to control the spread of this pest.

Lake Todd shares its shores with both Newbury and Bradford, and its watershed extends into Sutton. This 168-acre lake has a maximum sounded depth of 22 feet. Because it is on the border of Bradford, and near the village area, it is extremely important for recreation and the view as one enters the Town. Lake Todd shore owners have formed a protective association to monitor the lake water and to care for the dam at Main Street.

The Town has many small ponds, some of which are manmade, and associated streams and wetlands. Two of the larger ponds in Bradford are Ayers Pond and Lovewell Lake. Ayers Pond is a small mountain lake on the border with the Town of Washington. It boasts a wild and unspoiled habitat with only one dwelling along the shore. Lovewell Lake was created by a dam erected in the 1800's to soak oak logs for a tannery. Later it was used by Bradford Springs Hotel for recreation. It is a marshy area that flows seasonally.

Rivers and Streams

The Warner River is the only 4th order stream located within the boundaries of Bradford. This river begins in the area north west of Lake Massasecum with the confluence of a few small streams. North of Lake Massasecum the river visually materializes as water from the lake is added to it. The Warner River then flows east and into the Town of Warner and on to the Contoocook River.

Bradford has two large streams which flow west to east in the Town, Hoyt Brook and the West Branch of the Warner River. Hoyt Brook begins at Avery Ledge and flows for several miles to the Warner River, with several large wetlands along its course which control annual flooding along the Brook. West Branch begins from the side of Mount Sunapee and joins the Warner River at the junction of Routes 103 and 114. The watershed of Lake Todd flows into West Branch. Melvin Brook connects Lake Massasecum with the Warner River.

Bog and Beard's Brooks are hydrologically associated with the Bradford Bog and flow south to Hillsborough. There are several other unnamed brooks which flow into Hoyt Brook and West Branch.

Brooks and streams are protected by wetlands regulations. The wetlands associated with the brooks in Bradford help in mitigating annual flooding by allowing flood waters to spread into the wetland areas surrounding them. Areas such as West Meadow, Fairgrounds Road wetland, Bradford Pines and Melvin Mills all flood annually. A major flooding issue is the filling of wetlands along Routes 114 and 103 which contributes to the back flow of Melvin Brook into Lake Massasecum. Impacts include the compromise of septic systems and wells.

Vernal Pools

Awareness of the importance and necessity of vernal pools is increasing. Vernal pools are temporary and usually small bodies of water, devoid of fish, that, in most years, retain enough water to act as the essential breeding habitat for some amphibians and invertebrates. These include wood frogs, spotted salamanders, Jefferson-type salamanders, fairy shrimp and some species of fingernail clams. Vernal pools vary in size, shape and location, but occur typically every spring in the same place except for very dry years. Usually the pool dries up in late summer.

An abundance of other plant and animal species use these pools, but may not be as critically dependent as those specifically known as vernal pool indicator species. In addition to being vital as small individual habitats for local plants and animals, vernal pools often provide valuable links as wetland "corridors" for other wildlife which might otherwise remain isolated and therefore more vulnerable to disturbance.

Wetlands

Wetlands are identified by the type of plants, the presence of wet soils, and by flooding that occurs in an area. Wetlands consist of poorly drained and very poorly drained soils. Poorly drained soils are darker in color, have a 0%-8% slope, have a gray colored subsoil, and have water a table that stays at or near ground surface for 6 to 9 months of the year. Very poorly drained soils have a thick, dark colored surface layer, a gray subsoil, occupy level or depressed sites, and a water table that remains at or near ground surface for 9 to 10 months annually. The US Fish and Wildlife Service National Wetlands Inventory shows wetland areas scattered through the town. Concentrations of wetlands are found in the southwest corner of the Town (Bradford Bog and Springs) and the northeast section

of Town (Lake Massasecum, Lake Todd, and surrounding streams). Several others are found near the center of Town.

In a 1998 study, conducted by the Bradford Conservation Commission with assistance from the University of New Hampshire Cooperative Extension the Community Environmental Outreach program, 18 wetlands areas were identified using the New Hampshire Method. The NH Method is a technique for evaluation and comparison of wetlands areas, and not a tool for the delineation of wetlands. The wetlands areas identified include 4 sites recommended for designation as Prime Wetlands; Alder Plains, Bradford Bog, Smith Road, and West Meadow.

Alder Plains Marsh This wide and mostly grassy marsh provides a large area for runoff brooks from the mountain to spread out during the spring flood season. The Marsh has three small ponds at its southern end, and remains undisturbed by development. It offers spectacular views of Sunapee, Bald Sunapee and Picket Hill and is home to a wide range of wildlife, including a blue heron rookery, deer, moose, birds, coyotes and fish.

Bradford Bog and Springs Bradford Bog and Bradford Springs are considered together, as the two are hydrologically connected. The Bradford Bog is a quaking bog, with a thick mat of sphagnum moss. The Bradford Springs hold a particular historic significance as the foundations of a resort hotel can still be seen. The area is the site of a small stand of Atlantic White Cedar, a rare natural community. The Blue-Gray Gnatcatcher, a species of special concern in NH, has been sighted at the Bog.

West Meadow The West Meadow area is a wildlife reserve, but has been threatened by inappropriate septic systems in the neighboring rural residential zone. The Meadow has trees and shrubs along the road, and low shrubs and grass towards the middle of the wetland.

Hydric Soils

Hydric soils are those which are saturated or flooded long enough during the growing season to develop anaerobic conditions in the upper part of the soil. Hydric soils are generally either poorly or very poorly drained. Poorly drained soils are those in which water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Very poorly drained soils are those in which water is removed from the soil so slowly that free water remains at or on the surface for most of the growing season. Of the total land acreage of Bradford (22,784), 10.2% is comprised of hydric soils (Table VII-8).

Table VI-8
Hydric Soils

Hydric Soils	Acreage	Total Percentage of Town
Poorly Drained	1279	5.6
Very Poorly Drained – organic base	648	2.8
Very Poorly Drained- mineral base	231	1
Marsh	170	.7
Total	**2328**	**10.2**

SOURCE: Merrimack County Conservation District, Inventory of Soil erosion and Agricultural Waste, 1979

Land Resources

The *Conservation and Public Lands and Scenic Vistas Map* depicts the conservation lands, public and quasi-public lands, and scenic vistas noted in this section.

Protected Lands

Protected lands are parcels of land that have been protected from development in perpetuity. Protected lands may include state forests, town forests, and private conservation land or land under conservation easement.

Protected land ensures that valuable natural resources will be available for future generations. Bradford has six parcels that are publicly protected. The largest is the 1,700 acre Low State Forest that straddles the border with Hillsborough. Other parcels are the Bradford Bog, Bradford Springs, the Bradford Town Forrest, the Pearl Town Forest, the L. Dodge lot off East Washington Road and the Conservation Commission lot off West Meadow Road.

There are currently two privately conserved parcels in Town. The Conservation Commission encourages the public to become informed about private conservation easements.

Protected land may contain important wildlife features, or be working timberland that will continue to produce forest products in perpetuity. Protecting land in perpetuity is important in Bradford to ensure that valued scenic, agricultural, recreational, wildlife, or forestry resources will remain undeveloped. Existing protected land will form the basis of a future recreational trail network through the Town.

Scenic Vistas

Bradford is a beautiful, scenic community which offers views of the surrounding mountains, fields, and other natural areas. In Bradford, much of the land is forested, so that wetlands and agricultural lands provide open areas where the surrounding hills may be viewed. Alder Plains Marsh from either Country Road or Alder Plains Road provides spectacular views of Mount Sunapee above a red maple swamp. Other wetlands in town provide equally beautiful views. Messer's Farm, Battles' Farm and the Letvin's home on Rowe Mountain are some of the most noteworthy viewing areas from open fields. Blood

Meadow has been a pasture and wet meadow for 100 years. It is an open area with a view of Mount Kearsarge in the background.

Current Use

Property owners of undeveloped land totally 10 acres or more may file for reduced property taxes though the Current Use Taxation program. The current use value is the assessed per acre value of open space land based on its income-producing capabilities, not its market value as developable real estate. The legislature passed Current Use to encourage the retention of open space, which makes few demands on Town services and contributes to the state's and a community's rural character. Although current use does not provide for a permanent form of land protection, it is important to recognize that it helps to maintain open space throughout the Town.

Current Use valuations are determined by the Town assessor in accordance with a range of current use values established by the State Current Use Board (CUB) and considering class, type, grade, and location of land. Current Use categories are as follows:

- "Farm land" means any cleared land devoted to or capable of agricultural or horticultural use as determined and classified by criteria developed by the Commissioner of Agriculture, Markets, and Food and adopted by the CUB.

- "Forest land" means any land growing trees as determined and classified by criteria developed by the State Forester and adopted by the CUB. For the purposes of this paragraph, the CUB shall recognize the cost of responsible land stewardship in the determination of assessment ranges.

- "Open space land" means any or all farm land, forest land, or unproductive land as defined by this section. However, "open space land" shall not include any property held by a city, town or district in another city or town for the purpose of a water supply or flood control, for which a payment in place of taxes is made in accordance with RSA 72:11.

- "Unproductive land" means land, including wetlands, which by its nature is incapable of producing agricultural or forest products due to poor soil or site characteristics, or the location of which renders it inaccessible or impractical to harvest agricultural or forest products, as determined and classified by criteria developed by the CUB. The CUB shall develop only one category for all unproductive land, setting its current use value equal to that of the lowest current use value established by the CUB for any other category.

- "Wetlands" means those areas of farm, forest and unproductive land that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

The Town levies a land use change tax when the land use changes from open space use to a non-qualifying use. In Bradford, approximately 15,000 acres are under Current Use (Table VI- 9)

Table VI-9
Current Use Lands in Bradford

Type	2000	2001	2002	2003	2004
Farm Land	543	547	554	562	672
Forest Land	8,848	8,857	9,097	9,297	10,986
Forest Land/Stewardship	4,535	4,673	4,582	4,362	2,868
Unproductive Land	1,095	852	852	803	663
Wet Land	615	553	560	565	484
Total Acres	15,683	15,485	15,646	15,591	15,675

Source: Bradford Town Report

Agricultural Resources
Bradford's first settlers were subsistence farmers. They had only a few cows or oxen, and scratched out a living off the land. Many of the old farms were abandoned because the soil was too steep and rocky. Cellar holes along many old roads attest to these old farms. However, the hills were good pastures for sheep, and apples could be grown on the hillsides. Small dairies thrived on the alluvial soils along the two main streams. Messer's farm and Battles' farm are all that remain today, and they produce hay, but not milk. Wool, apples and milk were the main agricultural products from about 1840 to the death of the woolen mills in New England. The railroad could bring milk and apples from Bradford to Boston in half a day.

Many small farms still remain in Bradford. Some sheep pastures remain and pleasure horses are becoming more common. Hay is produced on various meadows, and a few truck gardens and nurseries have sprung up. These activities are not significant to the economy, but add a great deal to the quality of life in town. They provide views over open fields, wildlife habitat and a connection to our agrarian past.

Forestry Resources
Forest resources are parcels of land greater than 10 acres in size that are devoted to growing trees. The ten-acre minimum was chosen because it represents the lower limit for the current use program and the national Tree Farm system.

Forest resources cover between 80 and 87 percent of the State of New Hampshire. The amount of forestland in the state dropped by over 100,000 acres between 1982 and 1992 as rapid commercial and residential development swept the state.

Bradford has eight operational Tree Farms, and much of Bradford's land is enrolled in the current use program. The largest undivided block of forestland is 1,700 acres, and is owned by the state (Low State Forest).

Maintaining forestland is important to both the ecology and economy of Bradford. Forests provide wildlife habitat, clean ground water, and scenery. In addition, timber harvested from these lands helps landowners pay their taxes, and creates jobs for foresters, loggers, truckers and sawmill workers. Forests furnish the backdrop for Bradford's tourism businesses and provide recreation areas for residents and visitors.

Ecological Resources

Natural landscape communities and wildlife abound in Bradford. This section will inventory known ecological assets to the community, existing programs, and areas of concern.

NH Natural Heritage Inventory

The NHI identifies flora and fauna that are either threatened or endangered on the State or Federal level. Several outstanding plant species have been located in Bradford since the 1930's, as well as two outstanding natural communities.

An Atlantic White Cedar Basin Swamp is present in Bradford, and only 26 other locations around the State. This rare community creates a unique habitat for species of plants and animals that cannot survive well elsewhere. The Atlantic White Cedar (*Chamaecyparis thyoides*) is found in only a few communities in New Hampshire. The tree is not listed in the state as threatened since there are 32 listed locations of the species.

Green Adder's Mouth (*Malaxis unifolia*) is listed as threatened in the State of New Hampshire, but not federally. There are 11 locations in New Hampshire, and only a historical presence in Bradford.

Sclerolepis (*Sclerolepis uniflora*) is listed as endangered in the State of New Hampshire, but not federally. Lake Massasecum is the only location state-wide where this rare plant is known to be found.

The Inland New England Acidic Pond Shore/Lake Shore Community is found in Bradford, and is present only in 10 other locations in the State. Lake Massasecum is unusual in that it has sandy shores that are unimpounded by man-made structures. There remain only two small sites of this unique community on the Lake, one at the inlet end, and one across from the Mountain Lake Inn.

Wildlife Habitat and Corridors

A diversity of wildlife habitat helps to ensure the quality of life in New Hampshire and fuels a strong economy based on wildlife observation, hunting and fishing. Bradford is host to a number of rare natural communities and species. The shore of Lake Massasecum contains a rare Inland New England Acidic Pond Shore Community, and the western edge of Bradford, near the East Washington border, contains an important Atlantic White Cedar Basin Swamp and Atlantic White Cedar Stand. An uncommon form of aster, Sclerolepis, grows in town, and in the 1940's a plant known as green adder's mouth was documented. The blue-gray gnatcatcher, a bird listed as a state rare species, has been seen in the Bradford Bog area.

Wildlife corridors, which play an important role in the conservation and preservation of wildlife species, are normally made up of unfragmented or minimally developed stretches of land which serve to provide animal species with safe travel and sustenance as they move from one location to another. Quite often, such a corridor will be water based such as when wildlife uses the riparian edge of a river or stream as a passage for travel.

Bradford has a large riparian corridor that is located along the Warner River, which flows through the north eastern part of Bradford. Other corridors are located between large wetlands, tree stands, and open fields.

With respect to their long-term conservation, these water-based wildlife corridors face a wide variety of threats which are primarily related to disruptive land-development activities. These corridors may be preserved for the long term if the town considers adopting strategies to mitigate the established threats to these corridors.

Exemplary Natural Communities

Other special, undisturbed lands are essential for the biological diversity of plants and animals. The more bio-diversity found within an area, the more valuable and self-sustaining the community becomes from both ecological and economic perspectives.

Currently, Bradford enjoys a variety of exemplary natural communities that have not been significantly disturbed. Two that should be mentioned include the Low State Forest, which included 717 acres in Bradford, which is undisturbed and protected land in the southern part of Bradford. Also, a heron rookery of 5 to 6 nests is located on Brown's Marsh.

In addition to the rare natural community to which Bradford plays host, the Town is also the home to moose, black bear, fisher, loons, bobcat and vast number of other wildlife species. This diversity in wildlife ensures the quality of life in the Town, and contributes to a strong economy based on wildlife observation, hunting and fishing.

Geologic Resources

The state of New Hampshire lies within the Appalachian Highlands, which extends from Georgia to Nova Scotia. Formed millions of years ago, this area is characterized by folded and faulted Paleozoic sedimentary and igneous rock. Large and small bodies of plutonic rock penetrated these rock structures. Metamorphic rock, schist and gneiss were formed by extreme temperatures generated by the pressures of land rising and folding the layers of sandstone and shale of earlier times.

After these cataclysmic events, glaciers covered Bradford, like the rest of New Hampshire. As the glaciers moved south, they scoured the tops of mountains with the stones and boulders they pushed ahead of them. This action smoothed the tops of hills and left scratch marks along the tops and sides of ledges. These scratches can be seen

where the rock is bare, as at Avery Ledge. Sometimes the glaciers left behind boulders on top of hills. "Tippin' Rock" is a dramatic example of glacial action.

When the glaciers melted, they left behind piles of debris in the form of sand and gravel. The advancing and retreating of the glaciers took place over a long period of time, and because of this the sand, gravel and clay deposits are layered and varied in different areas. In places where the earth has not been disturbed, it is possible to find eskers (mounds of sand or gravel) formed by the melt waters of the glaciers. There is an esker in the southwest corner of the Pearl Town Forest. Gravel deposits have an economic value for Bradford; they provide essential building material for roads.

During glacial times, and still occurring, water seeps into cracks in rock, freezes, expands, and cracks ledges and boulders. When pieces of rock break off a ledge, they frequently form a sort of cave. Devil's Cave at the north side of Low State Forest was formed in this way. Other caves are located on the west side of Avery Ledge.

The most easily recognizable geologic formations in Bradford are its 10 hills and mountains, identified in Table VII-9.

Table VI-10
Hills and Mountains

Name	Elevation
Avery Ledge	1921'
Cedar Hill	1060'
Goodwin Hill	1320'
Guild Hill	1140'
Haystack Mountain	1700'
Hogg Hill	1140'
Knight's Hill	1940'
Moon Mountain	2096'
Pickett Hill	1560'
Rowes Hill	1920'
Silver Hill	1760'

SOURCE: CNHRPC 1998 Natural, Cultural, and Historical Resources Inventory of the Central NH Region

Kames and kame terraces lie beside the Warner River and along Lake Massasecum. Isolated organic deposits lie in scattered wetlands.

NATURAL RESOURCE CONCERNS

Potential Threats to Water Resources

The need to identify and mitigate potential threats to water resources is very important. The largest source of Bradford's water supply is drawn from aquifers underlying the town's land surface. Also, surface water is used for a wide variety of recreational purposes and also provides habitat and a drinking water supply for natural fauna and is an important food supply for plant and vegetative life.

Threats to water supplies may stem from many different potential contaminant sources and each pollutant threat may affect water at a different stage of its movement from being water vapor in the atmosphere to being liquid groundwater. Simply put, water is not static or stays in a single place; it collects in the atmosphere and may be released to the ground as rain or fog after which it is either absorbed into the ground, collected by plants or begins to move across the ground surface until it is collected into a water body.

Ultimately, water flowing across the earth's surface becomes absorbed into underground aquifers or settles into rivers, streams and ponds where, if it is not impounded for a local purpose, will continue downstream eventually winding up in the ocean. Rainwater which reaches underground aquifer catchment areas may be pumped to the surface by public or private wells for use as a public water supply resource. Surface water may also be converted back to water vapor either by a process of evaporation or released from plants by a process of plant transpiration. In this way, through these "evapotranspiration" processes, ground water is returned to the atmosphere.

Water in the atmosphere or collected on the earth's surface often has many opportunities to encounter a large variety of potential contamination sources which could dramatically affect its quality. Mercury and other air-borne pollutants emitted into the atmosphere by coal-fired power plants may affect water vapor collected in clouds and be widely scattered, fertilizer runoff from agricultural fields can run into nearby streams, fecal material released from nonfunctional septic systems and gasoline or other chemicals spilled from commercial and industrial sites can leach into aquifer recharge and filtration areas and eventually reach and contaminate ground water. Thus, there is an essential need to identify, analyze, monitor and appropriately control potential point and non-point water pollution sources throughout the Town of Bradford. Part of this identification and control process is carried out by the New Hampshire Department of Environmental Services (NHDES) who are presently responsible for monitoring all public water supplies. There are, however, no regulations which scrutinize private water wells or the quality of private well water. Thus, this chapter was developed in part to provide guidance so that the Town may have an accurate record of where local water resources are located, how these resources may be threatened, and what actions and programs should be put into place which will remove or mitigate the perceived sources of pollution.

Development Sprawl

The increase in population growth in Bradford and other surrounding towns reflect the changing social and economic trends which directly impact our community landscape. Bradford residents express the desire to maintain a rural atmosphere by supporting the conservation of open space and the development of small village areas. More stringent regulations should be developed to concentrate development in appropriate areas and allow the large lots in the forested areas to remain open for forestry practices or agriculture.

Loss of Open Space

As discussed elsewhere in this Chapter, Bradford's existing open spaces serve a number of important roles. For example, they act as critical wildlife habitat, they provide room for recreational fields and other leisure activities, and to the extent in which the wooded and exposed open spaces can be maintained and fostered into the future, they act to sustain the town's remaining rural character and quality of life.

Invasive Species

Bradford is fortunate to have a diversity of fauna and flora, but invasive species present a threat to the many of the plants and animals in the region and also to the economic value of property. "Invasive species means an alien species whose introduction causes or is likely to cause economic or environmental harm or harm to human health" (NH Department of Agriculture). There are several alien invasive plant species present in the Town of Bradford that are of particular concern, including milfoil which may pose potential problems in Lake Massasecum.

REGULATORY PRESERVATION TECHNIQUES

Bradford currently employs many regulatory techniques that can aid in the conservation of its natural resources. By reviewing its existing regulations while also considering added regulatory measures, the Town can provide supplementary methods of natural resource conservation.

Cluster Development Zoning

Cluster development allows for grouping of dwellings, while restricting development on the remainder of a property. It results in a concentration of houses on smaller parcels, while the remainder of the parcel is allocated to open space. Frontage, lot size and other regulations are redefined in a cluster development to permit the developer to preserve ecologically sensitive areas, historic sites, or other unique characteristics of the land being subdivided.

Large Lot Forestry and Agricultural Zoning

Planning theory states that dividing developing land, or potentially developing land, into larger lots will slow development and preserve open space and rural character. The goal of these two types of zoning is to provide large enough blocks of land that they can be managed for a specific resource value. If this technique is used, lot sizes that truly reflect the amount of land needed to allow for commercially viable use of the land and are related to the reality of the use of the land in the area must be established.

Overlay Districts
The creation of overlay zoning districts is a technique which is already used by the Town of Bradford to protect existing natural, historical and architectural resources. Typically, overlay zoning involves the targeting (or "overlaying") of certain resources in a geographical area with added land use or design protections to achieve a positive social good. An example of this would be the protection of important wetlands from destruction or the prevention of buildings and structures being constructed in known flood hazard areas.

Aesthetics-Based Land Use Regulations
These types of planning regulations may be established whenever there is an important need to address aesthetic design issues within the community. Typical aesthetics-based land use policies can be used to regulate the visual look, feel and placement of new buildings and roadways, the design consequence of lot fragmentation that takes place during the subdivision process, judge the design and placement of signage and lighting, and regulate design changes which are proposed for historic residential and commercial structures. The Bradford Planning Board currently employs a variety of aesthetics-based rules throughout its land use ordinances and regulations. In particular, aesthetically-based rules are currently found in the Cluster Subdivision Zoning provisions and the Site Plan Review regulations, which provide the Planning Board with the ability to regulate appropriate aesthetic concerns.

Environmental Science-Based Regulations
Environmental science-based land use regulations are based directly upon measurable characteristics of the land-base of the community, rather than on possibly arbitrary standards established by people. Regulations based on the characteristics of the land may reflect the actual ability of the land base to sustain development and are often easier to defend against legal challenges than those arbitrarily created.

Phased Growth Plan
New Hampshire towns may adopt phased growth-related regulations whose purpose is to control the rate at which a development project is constructed. In certain rapid growth situations, a town's capacity to slow the speed at which certain developments are constructed (by spacing, for example, the construction of a large project over a multi-year period) could provide the time needed for the town to adequately cope with the impact which that development would have on the town.

Limitations to the Number of Building Permits
One way for a community to cope with unusual circumstances requiring prompt attention and for the purpose of developing or altering a growth management process under RSA 674:22, or a master plan or capital improvement program, is to adopt a growth management ordinance. One effect of such an ordinance could be to limit the number of new building permits that will be allowed in any given year until such a time that the goals of the ordinance are satisfied or the ordinance expires. Typically, the number of building permits which are annually allowed under a growth management ordinance must be rationally correlated to the rate at which subdivision growth is occurring and building permits are being issued in the community.

Open Space/Village Design Planning
Rather than filling all available space with similar-sized houses centered on uniformly sized lots, this development strategy focuses the construction in a smaller portion of the total land being developed, and provides for permanent protection of the open space not used for construction. The land selected for permanent open space protection should be designed to fulfill the open space interests of the entire community.

NON-REGULATORY PRESERVATION TECHNIQUES

Volunteer efforts to conserve land are recognizable and are often more appreciated than regulatory requirements. Hand in hand, regulatory and non-regulatory methods work together to serve the community's preservation interests.

Conservation Easement
A conservation easement is a permanent, legally binding, agreement that ensures that certain uses will never be allowed on that property. Typically conservation easements prevent development of land uses such as construction, subdivision and mining while at the same time promoting uses such as agriculture, forestry, wildlife habitat, scenic views, watershed protection and education. A conservation easement typically exists between a willing landowner and a qualified recipient, which can be the Town or State government or an appropriate conservation organization. Each such easement is tailored to the interests of the landowner, the receiving entity and the unique characteristics of the property. Land affected by a conservation easement can be sold or deeded by the original owner and subsequent owners but the easement is binding on all future owners.

Management Agreement
Management agreements primarily focus on a particular feature of open space administration and such an agreement can be custom tailored to any specific situation, such as the following:

Right-of-Way for Trails - The Town may protect open spaces along a recreational trail corridor through the use of this type of management agreement. The right-of-way could be arranged and exist as a legal agreement between the Town or nonprofit organization and the owner(s) of the land where the trail is located.

Wildlife Corridors - Local private and public management plans which strive to protect open spaces associated with the natural movement and migration of wildlife is another practical use for management agreements. Typically, a management agreement for the protection or administration of a recognized wildlife corridor seeks to regulate how land in that corridor is used.

Buffers Between Uses - Written agreements which relate to the establishment and maintenance of buffer areas between incompatible land uses can be used to ensure that issues related to development and growth do not have a negative impact on the rural and scenic qualities that a valued by the Town.

SUMMARY

The primary focus of this Chapter is to identify the natural resources in Bradford, recognize the role they play in giving the Town its character, and decide what strategies would best maintain the character of the Town and conservation of its natural resources. Most of the Town's resources are interconnected and any change to one may have a significant impact on the others. As the population increases, demands on many of these resources will increase, some to the point of threatening the quality and quantity of the resource. It is the goal of this chapter to help develop a balance between development and resource protection within the Town.

The Town's existing open space consists of forests, fields, and wetlands and surface waters. Most of the development pressure that is currently being felt by the Town is focused on privately owned open space. Because such lands are being targeted for development, it is important that the Town identify critical habitats, greenways, and corridors that should be protected through purchase, easements, or other means. These actions will help to reduce land fragmentation and help maintain the rural, cultural, scenic, and historic character of the Town that makes Bradford the place it is today and the vision of what it wants to be tomorrow.

MAPS

There are four maps that accompany this chapter, the Agricultural Soils Map, Forestry Soils Map, Conservation and Public Lands Map and the Wetlands and Topography Map.