Chapter VIII
Natural Resources

"The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased, and not impaired, in value."

~Theodore Roosevelt

Chapter 8
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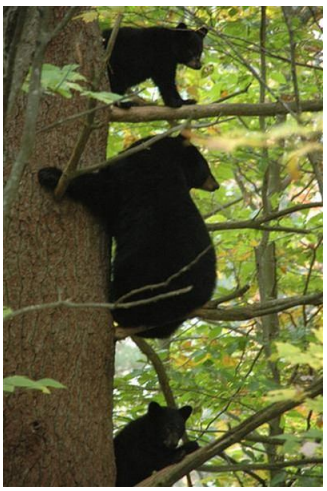
8.1 INTRODUCTION

In our present-day life of automobiles, big-box stores, and indoor jobs, it's easy to become disconnected from our natural environment. We often fail to acknowledge that our physical surroundings influence our actions and color our moods. Indeed, we may forget that the lay of the land and all its inherent components have shaped our infrastructure and dictated our livelihood. Tamworth's early settlers chose a centrally located, gently sloping hillside – frost-resistant for a long growing season – for building their new town center. Fifty years later, when water-powered industry came to rule the local economy, Tamworthians hitched the meeting house to 40 yoke of oxen and twitched it a mile down the road to the banks of the Swift River.



The locations of all the town's villages were decided more by the land than by the residents. South Tamworth and Whittier arose along the steepest drops in the Bearcamp River that supplied the hydraulic head needed to power mills and factories. Chocorua grew around the Iron Works, which took advantage of the river's water supply and proximity to bog iron ore. Bradbury Jewell chose his birch intervale for the flat, tillable soil; later on, Wonalancet thrived as sawmills exploited the neighboring Sandwich Range forests and vacationers spent their summers at Wonalancet Farm and Ferncroft.

Our natural resources continue to shape our lives: the forests provide building materials and jobs; abundant gravel deposits supply road-building materials; water is becoming a precious and marketable commodity, threatened by over-consumption and pollution; our lakes, streams, mountains, and wildlife draw thousands of visitors each year. We depend on nature for sustenance. A 1999 study commissioned by the Society for the Protection of New Hampshire Forests estimated that over $8 billion of revenue were generated each year by New Hampshire's open space, second only to manufacturing. More difficult to articulate is the environment's effect on our psyche; call it spirituality or simply peace of mind, Tamworth's residents cherish their connection to the land and its natural components.

This chapter identifies and inventories the natural features that contribute to the total essence of Tamworth. Any comprehensive plan for guiding the town's future must provide for the protection of these resources. Growth, both demographic and economic, is inevitable – it may even be desirable – but growth that depletes natural resources will degrade the economic potential as well as the quality of life in Tamworth. It is intended that adequate consideration be given to Tamworth's natural resources in all recommendations of the Master Plan.

"One can never study nature too much and too hard."
~ Vincent van Gogh

8.2 TOPOGRAPHY

Topography describes surface features of the land in terms of shape, relief and relative positions of natural features. Topography is usually expressed as elevation (height above mean sea level) and slope (change in vertical distance over horizontal distance). Topography affects several natural processes, such as climate, drainage, erosion, wind patterns and vegetative growth, in turn affecting human activities. The following excerpt, taken with permission from *Tamworth Today*, published by the Tamworth Civic Association, May 2000, provides a concise description of Tamworth's topography:

> "Tamworth can be divided into three east-west-trending physiographic zones. The northern two-thirds of the town encompasses the glacier-carved bedrock foothills of the Sandwich Range: Great, McDaniel, Brown, Cleveland, and Bunker Hills, Lunt Ledge and Bickford Heights – a hummocky post-glacial terrain. These hills are covered with deciduous and mixed forests, large stands of pine, and scattered streams, wetlands, and a few ponds including Great Hill, Hemenway (*aka Duck*), and James, as well as Chocorua Lake. Overall, this region slopes southward 2 ½ miles from the flat glacial lakebed of the Wonalancet Intervale (elevation 1100 feet), at the base of the steep Sandwich Range, to the east-west valley of the Bearcamp River (elevation 400-500 feet). Through this zone flows the Swift River, Mill Brook, and the Chocorua River – three of Tamworth's largest streams.
>
> "The Swift begins where Paugus Brook (flowing from between Mounts Chocorua and Paugus) meets the Wonalancet River… It flows southward through Hemenway State Forest, along the Chinook Trail, by Tamworth Village and Remick and Behr Farms, then southeastward through forested wetlands to the Bearcamp. Its tributaries and main channel traverse a combined total of more than 55 miles. At Tamworth Village, its typical non-flood rate of flow is about 100 cubic feet per second.
>
> "Mill Brook flows southeastward from Sandwich, entering the wider glacially carved valley and farmlands near the junctions of Brown Hill, Cleveland Hill, and Bunker Hill Roads. From there it meanders through woods and by fields to join the (*Swift*) close to the confluence of the (*Bearcamp*). At the far eastern edge of town, Chocorua Lake and River drain southward to join the Bearcamp at West Ossipee…
>
> "Tamworth's central zone is the Bearcamp River Valley and White Lake area, both underlain by deep river and glacial meltwater sediments, on which, near the river, prime agricultural soils formed with repeated deposition from floods. Here, the river dramatically influences the communities of plants and animals – including numerous floodplain wetlands clearly visible from Route 25 and Depot Road. Here are mink, muskrat, great blue herons, kingfishers, and common mergansers. Silver maples line the banks as the river meanders into Ossipee Lake.
>
> "The southern-most physiographic zone in Tamworth is the steep north slope of the Ossipee Mountains. Black Snout, at Tamworth's southwest corner, is the highest point in town at 2689 feet. These steep and wild mountains remain largely undeveloped and provide northern hardwood (with abundant pine and hemlock) habitat for black bear, moose, bobcat, and possibly mountain lion."

"Nature does nothing in vain."
~Emanuel Lasker

8.3 SLOPE

Slope is the amount of rise or fall in feet for a given horizontal distance and is expressed in percent. A 6% slope means that for a 100-foot horizontal distance the rise or fall in height is 6 feet. The slope of the land can have a great effect on development, and percent slope can greatly impact the economic and physical feasibility of development. The steeper the slope, the more it will cost for septic systems, driveways, foundations, etc. Additionally, as the slope increases so does the potential for an increase in erosion, storm water runoff, and nutrient movement. Poor soil conditions combined with steep slopes can present significant development constraints.

Soil Survey of Carroll County, New Hampshire, published by the Soil Conservation Service (now known as Natural Resources Conservation Service) in 1977, classifies the slope of most soil types in five categories:

A = 0-3%
B = 3-8%
C = 8-15%
D = 15-25%
E = >25%

D and E slopes are considered to present severe limitations for the development of buildings, septic systems and roads. Quoting the 1995 Tamworth Master Plan:

> "Although lands in excess of 15% slope have a variety of development constraints such as soil erosion, storm water runoff, and sewage disposal, construction techniques can often alleviate some or all of the restrictions to development. When slopes in excess of 25% are encountered, these techniques are often not applicable."

Using the Carroll County Soils Maps as a source, Table 8.1 shows a breakdown of slopes in Tamworth and their limitations for development.

Slope	Limitation	Acres	% Total Area
0 – 15% (A, B, & C)	slight to moderate	24,219	63.1%
15 – 25% (D)	severe	5,758	15.0%
> 25% (E)	severe	8,405	21.9%

Table 8.1: Slopes and development Limitations in Tamworth
(adapted from 1995 Master Plan)

Greater than one third of the area of Tamworth has slopes steep enough to present severe limitations to development. Most of the E slopes are found in the Ossipee Mountains and predominate in that area, with the exception of the narrow valley of Cold Brook. Other significant areas of E slopes are found on the north slope of Bunker Hill, the Lunt Ledge area of Great Hill, Mount Katherine, and the foot of Mount Chocorua north of James Pond. D slopes are found in all these areas plus Hackett Hill, Ryan Hill, Page Hill, McDaniel Hill, and Washington Hill. D and E slopes are also found in Colton and Adams soils scattered throughout town. These represent glacial outwash features such as kames and eskers, and bluffs eroded by riverine systems, particularly along the Chocorua River.

8.4 GEOLOGY

The geologic history of any area is the basis for many of its natural characteristics such as topography, groundwater systems, drainage patterns, mineral resources, and origin of the soil. New Hampshire's geologic history has formed a variety of land features and mineral resources. Plate tectonics contributed to the formation of granite bedrock. Long periods of erosion shaped the hills and mountains. Most recently, repeated glacial activity provided some finishing touches to a land that had been evolving for perhaps 400 million years. Current landscape features remind us of this rich geologic history. Ring dykes indicate past volcanic activity, fault lines demonstrate where land was uplifted by tremendous forces, and eskers, kames, kettle holes, and many other features are evidence of glaciation.

In 1785, Abraham Morrill and Jacob Blaisdell began a business venture that bestowed the original name, Tamworth Iron Works, upon the community we now know as Chocorua. They built a foundry on the bank of Chocorua River and began dredging bog iron from Ossipee Lake and other local ponds and bogs. Henry Weed, who joined Blaisdell when Morrill left soon after establishment of the foundry, is credited with producing the first screw auger made in the United States – forged in Tamworth using local iron ore. (For more on the history of Tamworth Iron Works, read Marjory Gane Harkness's *The Tamworth Narrative*.)

Bog iron is a truly unique mineral resource because it is renewable. While most minerals are the result of intense heat and/or pressure created by geologic processes, bog iron is a product of biomineralization; iron-rich water flowing into sphagnum bogs and sandy, shallow lake bottoms is utilized by the bacteria *Gallionella* (and others) to form a protective sheath of iron oxide. Constant production of the pea-sized nodules of oxidized iron allow re-harvesting the same area every 30 years or so. In the event of any contingency requiring reversion to a truly local economy, it's reassuring to know that Tamworth possesses a sustainable resource useful for producing hardware and machinery.

Although New England is not celebrated as an area rich in mineral resources, Tamworth has been a source of useful mineral products from prehistory through the present. The following discussions present a chronologically based account of the geologic processes that produced the rocks and landforms we see and utilize today.

Bedrock Geology

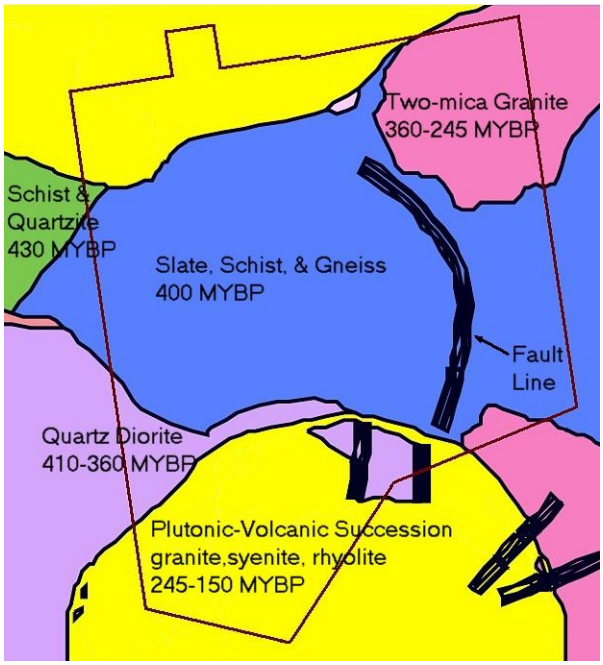
An excellent, concise account of Tamworth's geologic history is found in *Tamworth Today*. An excerpt:

> "About 350 million years ago, Tamworth was part of a zone of intense geologic activity: the ancient North American Continent was, according to theory, colliding with Africa, metamorphosing rock and thrusting up pre-Appalachian mountains. Some Tamworth bedrock – the swirly Littleton schists and gneisses – formed deep in the earth at this time. The ancient mountains eroded for more than 100 million years, during which time this piece of land we call Tamworth was in the middle of a supercontinent.
>
> "Then, from 200 to 110 million years ago, Tamworth's proximity to the east coast of North America was ensured when Africa drifted back to the east and the modern Atlantic Ocean began to form. The resultant stretching of the continental crust is thought to have caused upwelling of molten rock in this region – some of this magma spread across the

landscape as the Moat Mountain volcanics – basalt flows thousands of feet thick, most of which were subsequently eroded away. Some of the magmas solidified deep in the earth into large granite masses that would later be eroded down to the Sandwich Range – from the cliffs of Whiteface Mountain on the west, to the tooth of Mount Chocorua on the east.

"The rocks of the Ossipee Mountains were formed at more or less the same time. This world-famous ring-dike complex is thought to be the eroded remnant of a magma chamber where the circular 'roof' settled downward as the magma flowed out around it, creating circular dykes of unique rocks around the Ossipee Mountain's core of basalt and granite. Cold Brook and the Bearcamp River in South Tamworth flow over exposures of ring-dyke rocks."

One of the distinctive rocks found in the Ossipee Mountains is hornfels, a dense, unfoliated, fine-grained rock produced in conditions of low pressure and high heat – exactly what geologists would expect to occur when magma flows around existing rock and volcanic ash near the earth's surface. The earliest human inhabitants recognized hornfels as a hard but workable material and fashioned numerous implements from it. The foot of the northern slopes of the Ossipee Mountains is dotted with ancient hornfels "mines". Concentrations of waste flakes and discarded hornfels tools have been found along and near the Bearcamp River. They serve as evidence of long-abandoned encampments and work areas. (Sarah Dunham's *SCRAP Fieldschool 2000: A Brief Summary of the Ossipee Survey*, published by New Hampshire Division of Historical Resources, provides an account of an archeological dig in South Tamworth.)



Map 8.2 Adapted from *Simplified Bedrock Geologic Map of New Hampshire.* NH-DES. MYBP = million years before present

A walk in the woods is apt to provide evidence of another local mineral resource. Split fragments of granite displaying drill-holes – occasionally with wedges and feathers still embedded in particularly obstinate boulders – serve to remind us of where our ancestors secured materials for building foundations and bridge abutments before the advent of concrete.

Surficial Geology

The tectonic processes described above created the basic landforms found in Tamworth. Weathering processes over the past 100 million years have sculpted, rearranged and refined the surface; of particular importance are the effects of numerous ice ages. We again turn to *Tamworth Today* for an historical account:

"Tamworth's northern latitude affected its geology during the most recent million years of Earth's history. It was far enough north to be part of the region where continental ice sheets spread southward, covering even the highest mountain peaks and burying Tamworth under almost a mile of ice. The last (Wisconsin) glaciation left Tamworth with bedrock hills and valleys plastered with a layer of till several inches to many feet thick. Till is the infamous stony soil of New England – a hard mix of sand, clay and rocks that has challenged Tamworth farmers since settlement. The ice also left boulders – erratics – often from distant places. The most significant erratics in Tamworth are found northwest of Chocorua Lake in the Clark-Bolles Reserves, as well as in Tamworth's many stone walls created by farmers clearing fields for crops and grazing animals.

"But the glaciers also left useful products: the zone of stagnant melting ice was relatively large in the Tamworth area, and as it melted, huge rivers washed along the slopes of the Sandwich Range and meandered around Tamworth's hills. These rivers carried vast quantities of sand and gravel, which they dumped in their beds, filling the Bearcamp Valley with tens of feet – and the White Lake/Ossipee Lake region with hundreds of feet – of sediment. North of Chocorua Lake, around Tamworth Village, north of Jackman Pond, and around White Lake are major sand and gravel deposits, some forming long, twisting eskers where rivers left sand in their channels beneath the glacial ice."

Map 8.3 Surficial geology caused by glaciers of the Wisconsin Ice Age. The channel-like separations between close-neighboring outwash soils are alluvial soils deposited on top of outwash. Source: Soil Survey of Carroll County, 1977, USDA.

Tamworth Today also provides a descriptive list of the resource values provided by the glacial outwash deposits in Tamworth:

"Today, perhaps a quarter of Tamworth's topography is covered by glacial meltwater deposits, and sand and gravel from them are a significant local natural resource:

- For mining: gravel pits dot the Tamworth landscape.
- For tourism: the favorite lakes of Tamworth – Chocorua and White – were formed when remnant chunks of ice kept 'kettle-holes' unfilled by sediments; when ice chunks melted, these kettle-holes filled with groundwater. (*CLRC note: Jackman Pond, Heron Pond, and the three bog ponds west of White Lake are also examples of kettle-hole formations.*)
- For water storage: Tamworth includes the northwestern edge of the vast Ossipee aquifer, a deep, slow-flowing groundwater reservoir considered the largest single store of groundwater in the state.
- For rare natural communities: the southeastern corner of Tamworth, around White Lake, is the western edge of one of the last large functioning Pine Barren communities in the Northeast. This kind of Pine Barren only forms on top of deep sand and gravel sediments that cause relatively dry growing conditions. In the

same area are found equally rare bog communities, including the Black Spruce Bogs west of White Lake."

Another benefaction bequeathed to us by the last ice age would hardly be considered a resource by most, yet it serves to add excitement to our lives on an infrequent basis. The massive weight of the mile-high Wisconsin ice sheet depressed the earth's surface; as the ice sheet retreated, the surface rebounded. It is thought that the rebound is still occurring to a lesser degree and may be the cause of the largest earthquake to occur in New England during the twentieth century. The epicenter of this earthquake (magnitude 5.8) was in South Tamworth and occurred on December 20, 1940, with a reprise of similar magnitude four days later. Chimneys and gravestones were toppled, walls cracked and water pipes ruptured. Store proprietor Charles Wiggin lamented in an interview conducted by a New York Times reporter, "Took a convulsion of nature to git us into the papers. Druther some one had discovered gold. That's geology, too, h'aint it?"

8.5 SOILS

The assortment of till and outwash material deposited by receding glaciers has been further modified by water, air and biologic activity during the past 10,000 years, resulting in thirty separate soils series found in Tamworth as classified by NRCS. Each soils series has a specific group of qualities based on origin, texture, structure, depth, and water content. NRCS divides each soil series into mapping units based on slope and stone quantity, and has published this information in the Soil Survey of Carroll County. Soils information is an intricate part of a natural resource analysis because it provides a wealth of data concerning the capability of land to support various land uses. Soils differ from one another in their physical, chemical and biological properties.

There are various methods used to identify subsets of NRCS soils series. The value of any one method is dependent on the purpose of the inventory. This section of the NRI will focus on the ability of different soils to support agriculture, silviculture (forestry) and development.

Agriculture

The best soils for supporting agriculture are loamy mixtures of moderate to well drained fine and medium textured grains created by alluvial deposition. Consequently, most of the best farmland soils are found along medium to large rivers. The occasional outlier will be found on uplands where a deep Marlow series, uncharacteristically level and free of stones, has developed (a good example is the Cave/Mock field on Great Hill Road). NRCS classifies all these soils as prime agricultural soils. NH GRANIT identifies 685.5 acres of prime agricultural soils in Tamworth. The vast majority of these soils are found along the Bearcamp River

east of Butler's Bridge and between the Swift River and Mill Brook south of Tamworth Village. About 50 acres of the total are equally divided between the Bearcamp River west of South Tamworth village and scattered outliers.

Soils of statewide importance are identified by a state committee chaired by the Commissioner, New Hampshire Department of Agriculture, Markets and Food. Soils of statewide importance are soils that are not prime and:

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

There are 248.6 acres of soils of statewide importance in Tamworth. They are mostly Hermon fine sandy loam; the majority are currently in open field, probably due to shallow slope and lack of stones.

Soils of local importance are determined on a county-wide basis by the individual County Conservation District Boards. In Carroll County, the criteria are:

- Soils that are poorly drained, have artificial drainage established and are being farmed.
- Specific soil map units identified from the NRCS county soil survey legend, as determined by the Conservation District Board.

Within Tamworth, soils of local importance include excessively drained outwash soils (sand and gravel) and stony soils with slopes less than 15% -- approximately 21,000 acres.

Silviculture

The New Hampshire Forest Soil Group system of classification was developed by NRCS to determine the types of timber production best suited for various soil conditions. Soils are grouped into six classification units:

- **IA** -- deeper, loamy textured, moderately well, and well-drained soils. Best suited for hardwoods.
- **IB** -- sandy or loamy over sandy textures and slightly less fertile than those in group IA. Good for hardwoods but readily managed for conifers.
- **IC** -- outwash sands and gravels. Best suited for conifers.
- **IIA** -- physical limitations which make forest management more difficult and costly, i.e., steep slopes, bedrock outcrops, erosive textures, surface boulders, and extreme rockiness. Difficult to generalize timber management strategies.
- **IIB** -- poorly drained. The seasonal high water table is generally within 12 inches of the surface. Generally desirable for red maple cordwood, hemlock saw timber, and production of spruce and balsam fir, especially pulpwood.
- **NC** – mapping units are either so variable or have such a limited potential for commercial production of forest products they have not been considered.

Table 8.4 shows the acreage in Tamworth of each forest soil group. Because this classification system is based on the natural succession forests tend to follow, the numbers show that most of Tamworth is best suited for growing hardwoods. However, forestry management practices can be and are used to encourage production of pine, which will do well on IA and IB soils if hardwood competition is discouraged.

Soil Group	Acreage
IA	14580
IB	7189
IC	5998
IIA	7168
IIB	2566
NC	1312

Table 8.4: New Hampshire Forest Soil Groups in Tamworth

It is important to consider that the Forest Soil Group does not rate each mapping unit against the others; it simply determines which tree species will grow best on each soil type. The Soil Survey of Carroll County rates each soils series for suitability of various timber species production using the descriptors good, fair and poor. It is possible to list all mapping units having a "good" rating for any commercial timber production and further rate the soil types by separating out hindrances to forest management such as steep slopes (> 15%) and presence of stones. Using this system, we can identify the best forest soils in Tamworth as shown in Table 8.5. These soils have high productivity and are easy to manage without risk of erosion due to slope.

Not surprisingly, the no/few stones soils are also the best agricultural soils, and are mostly found along the Bearcamp River. The remainder of these soil types are found on hillsides with moderate slopes. The largest areas are on Hackett Hill, Cleveland Hill, the southwest slope of Great Hill, and in the highlands between Wonalancet and Great Hill.

Soils Series	**No/few**	**Very stony**	**Acreage**
Winooski (floodplain)	Wn		669
Hadley (floodplain)	Ha		
Marlow (upland till, drumlins)	Ma		
Nicholville (alluvial; PA)	Nc		
Podunk (floodplain)	Po, Ps		
Salmon (alluvial, PA)	Sa		
Marlow (upland till, drumlins)		Md, MF	6146
Peru (upland depressions)		Pe, PL	
Skerry (upland depressions)		Se	
Berkshire (hillside till)		Bs, BV	

Table 8.5: Best forest soils for productivity and management ease.

Development

Development costs and probabilities of environmental degradation vary depending on soil characteristics. “Soil Potential Ratings for Low Density Development in Carroll County” rates the development potential of soils using factors such as slope, erosion, permeability and depth to water table. The development potential is expressed qualitatively in five categories ranging from Very High to Very Low. Soils with high development potential have level to moderate slopes, are substantially free of boulders and ledge, and are not subject to flooding, high seasonal water table, or low permeability.

Although the soil development potential rating is a useful guide for locating areas suitable for economical development with minimal soil related problems, it does not consider the effect of development on other natural resources. Most of the prime agricultural land has a high development potential but might be better used for farming. Outwash soils also rate high in this system but they often overlie stratified drift aquifers. Construction on the surface may be compatible with aquifer protection but some uses will jeopardize water quality. These uses include waste disposal facilities, storage of road salt, junkyards, snow dumps, septage lagoons and facilities using or storing regulated substances as listed in NH-DES Env-Ws 421.03(f).

Tamworth has approximately 4000 acres rated high or very high and 13,000 acres rated medium for development potential out of a total of 38,000 acres. These areas are primarily in outwash soils and on moderate slopes where glaciers deposited deep layers of till with few boulders, often found around the south and east sides of hills in Tamworth. Omitting all conservation land, the most substantial aggregations of soils best suited for development are found between route 25 and the Bearcamp River (mostly prime agricultural soil), along and between Depot Road and Turkey Street, an area encompassing the southeast slopes of Great Hill and the south slopes of McDaniel Hill, and the sand plains east of Chocorua River. Smaller concentrations of high development potential are: the east slopes of Washington Hill, north of Hemenway State Forest, along Brown Hill and Pease Hill Roads, around Hackett Hill Road, and the lower third of Mountain Road.

"The goal of life is living in agreement with nature."
~Zeno

8.6 WETLANDS

The term “wetland” typically conjures an image of a marsh populated with sedges, reeds and scrubby bushes. Or perhaps we envision a murky swamp of buttressed cedar trees. Both of these ecosystems are indeed wetlands, but the term also applies to numerous, less obvious areas that support plants adapted to growing in anaerobic conditions caused by inundation or saturation of the soil during the growing season. The 1987 ACOE Wetlands Delineation Manual defines wetlands as: “Those areas that are inundated or saturated by surface or ground water 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.” This definition is currently used to delineate wetlands by federal agencies, state agencies and, as required by state statute, the Town of Tamworth. Wetlands serve many ecological functions including flood water retention, filtering, nutrient production and retention, and wildlife habitat. They are part of the mosaic of natural

communities that work in concert to support the biodiversity needed to sustain all life. There are a few different methods for producing town-wide inventories of wetlands. Two of these methods are discussed below.

Carroll County Soils Survey

The Carroll County Soils Survey places every soil unit into one of six drainage classes, which are based on the ability of a soil to allow free water to drain out. Hence, the drainage class is an indicator of moisture content. The two wettest drainage classes, "poorly drained" and "very poorly drained," are analogous to the former NH-DES classifications of hydric B and hydric A, respectively. A tally of soil drainage classes taken from the Carroll County soils maps shows that Tamworth has approximately 1600 acres of poorly drained soil and 1400 acres of very poorly drained soil. These soil units are fairly evenly distributed throughout town. Most are concentrated along rivers and brooks. There are two distinct areas with a high concentration of poorly and very poorly drained soils: the Jackman Pond area and the Pequaket area.

It is important to note that the Carroll County Soils Survey was a regional-scale survey and, consequently, does not show all inclusions of differing soils types within each unit. What this means is that there are likely to be uplands soils found within poorly drained soil mapping units and, more important, there are numerous small wetlands that do not appear in the soils maps.

National Wetlands Inventory

The National Wetlands Inventory was produced using aerial photography. All photo-interpretable wetlands were mapped. In forested areas, small open water and emergent wetlands were mapped. In general, the minimum mapping unit is from 1 to 3 acres depending on the wetland type and the scale and emulsion of the source aerial photography. Within Tamworth, only a small portion of Carroll County Soils Survey poorly drained soils were identified as wetlands by the NWI. Approximately half of the very poorly drained soils were identified as wetlands. The discrepancy between the two systems is mainly due to the poor ability of the NWI system to recognize wetlands under heavy tree cover.

However, the NWI is useful for identifying small, open wetlands (mainly 1 to 10 acres in extent) that are inclusions in upland soil mapping units of the Carroll County Soils Survey. This adds another 400 to 500 acres of identified wetlands in addition to the 3000 acres mapped as poorly and very poorly drained soil. Unlike the Soils Survey drainage class method, wetlands identified by NWI have a high degree of certainty. However, it is most probable that the greater amount of wetlands as defined above remain unidentified. Any area where moisture-loving plants grow, or which appears to be wet or feels spongy, could be a wetland and needs to be examined prior to terrain-altering work.

1979 Inventory and Evaluation – Prime Wetlands

In 1979, Barry H. Keith, then of the UNH Cooperative Extension Service, inventoried and evaluated 71 wetlands in Tamworth totaling 1,997 acres. Each wetland was evaluated for plant community diversity, size, cover, site type, connectivity, wildlife habitat, and adjacent land type/use. From this inventory, Keith identified 938 acres of significant wetlands and recommended that they be designated Prime Wetlands as authorized by state statute. The Town of Tamworth voted to designate ten areas totaling 573 acres as Prime Wetlands. These areas have been recorded at NH-DES and are protected by state authorized provisions going beyond town ordinances and standard state wetlands regulations. Table 8.6 shows the wetlands and acreages as determined from state records.

Keith ID	Wetland Name	Description	Acreage
3	Great Hill Pond	marsh in and surrounding Great Hill Pond	97
21	Jackman Pond	around Jackman Pd. and along Meadow Br.	68
24	Upper Bearcamp	along brook draining Beaver Pond	3
40	Swift River/Mill Brook	At confluence of Swift River and Mill Brook	92
41	Bearcamp River	two areas along Bearcamp near Oss. line	35
46B	Chocorua River	marsh north of Moores Pond	72
69	Upper Choc River – Lake	wetland at north shore of Chocorua Lake	39
70	Upper Choc River – West	west side of Route 16, Pequaket	20
71	Upper Choc River – East	east side of Route 16, Pequaket	147
		Total	**573**

Table 8.6: Prime Wetlands in Tamworth

Wetland Permitting

All wetlands in New Hampshire, as defined in the first paragraph of this section, are subject to regulations formulated by NH-DES. These regulations control land uses within wetlands. Any activity that involves alteration of existing conditions must get prior approval from NH-DES. The alteration of existing conditions usually involves the addition or removal of materials; hence the term, “dredge and fill permit.”

In addition to the state permit, Tamworth has the Wetlands Conservation Ordinance (WCO), which places further protection on wetlands. The WCO allows specific uses/activities in wetlands including certain residential development on lots of record prior to 1991, forestry and agriculture using best management practices, and a number of low impact uses consistent with the purpose and intent of the WCO. All other uses require an application for a special use permit which is administered by the Tamworth Planning Board. The WCO provides further protection to wetlands through the requirement of upland buffers for septic systems and all other construction activity.

> “There are two spiritual dangers in not owning a farm.
> One is the danger of supposing that breakfast comes from the grocery and the other that heat comes from the furnace.”
> *~Aldo Leopold*

8.7 WATER RESOURCES

Water is our most precious natural resource. Water moves continuously in an inter-dependent fashion known as the water cycle. With increased land use and human activity, the water cycle can become disrupted. Humans not only take water out of the cycle (drinking water, for example), but can introduce pollutants into the cycle (such as polluted runoff). Our land use practices can affect the quantity of available water by influencing water retention capacity, river flow rates and lake turnover rates. However, with good planning and conservation, plentiful clean water should be available for future uses. Tamworth's water resources are utilized by residents and businesses within the community.

Watersheds

As soon as precipitation hits the earth's surface, each molecule of water begins another phase in a never-ending hydrologic cycle (water constantly cycles from surface, to atmosphere, to surface). Most precipitation returns to the atmosphere by means of evaporation or transpiration (a product of plant uptake of water and of photosynthesis) but a significant amount remains as surface and groundwater. Gravity pulls this water downhill and topography dictates the direction of travel. In ravines and valleys, the downward flow of water results in the formation of streams and lakes. For any point on the earth's surface, the entire land area that serves as a source of downward moving water defines the watershed of that point. Watersheds are usually delineated in relation to waterbodies.

The entire town of Tamworth is within the Ossipee Lake watershed. Most of the town drains into the Bearcamp River. The two areas of exception are the east slope of Washington Hill, which is drained by Deer Brook, and the area around Jackson Brook in the Ossipee Mountains. These two areas ultimately drain into the Ossipee Lake via West Branch and Lovell River, respectively. Consequently, all the land area in Tamworth feeds the stratified drift aquifer associated with Ossipee Lake (see Aquifer section in this chapter). Table 8.7 quantifies the portions of watersheds and sub-watersheds in Tamworth.

Watershed:	Drains to:	Extent (Ac.)
Ossipee Lake	Ossipee River → Saco River	38,300
Bearcamp River	Ossipee Lake	37,100
Lower Bearcamp River	Ossipee Lake	12,800
Chocorua River	Bearcamp River	8,800
Swift River	Bearcamp River	10,300
Mill Brook	Bearcamp River	5,200
Other	Ossipee Lake	1,200
Jackson Brook	Lovell River → Ossipee Lake	800
Deer Brook	West Branch → Ossipee Lake	400

Table 8.7: Watersheds in Tamworth

"One touch of nature makes the whole world kin."
~William Shakespeare

Watershed location is very important for a community to consider in its planning efforts. Quite often a particular watershed lies entirely within a single community, while larger watersheds almost never do. Water resources management in a community up-watershed may have a substantial impact on the water resources of a neighboring community down-watershed. The watershed approach to water resources planning is important because watersheds are the main units of surface and groundwater recharge. The size and physical character of the watershed has a large influence on the amount of water that ultimately will end up as surface water and groundwater. Land use within a watershed may be an important factor in water quality. Therefore, it is very important for communities to work together in order to plan effectively for protection of water resources.

Surface Water

There are seven great ponds in Tamworth identified by NH-DES. Great Ponds generally include all ponds and lakes greater than 10 acres; they are considered to be owned by the State of NH. Trophic studies are occasionally performed by NH-DES. Table 8.8 shows selected attributes of ponds in Tamworth taken from the trophic studies. It includes James Pond, which is not listed as a great pond. Trophic classes are qualitative descriptions of available organic nutrients and biologic activity. A eutrophic condition (the highest trophic level) is not necessarily caused by pollution, but can be part of the natural succession in a pond. Over time – usually measured in millennia – ponds fill in, aquatic plants proliferate, nutrients build up, and biotic communities change composition.

Waterbody	Area (Ac.)	Max depth (')	Elev. (feet)	pH	Trophic Class
Chocorua Lake	222.6	28	573	6.0 – 6.6	mesotrophic
Duck Pond	14.8	6.9	963	5.5	eutrophic
Great Hill Pond	68	9.8	939	6.3	eutrophic
Jackman Pond	17.2	19	590	6	mesotrophic
James Pond	10	9.2	896	6	mesotrophic
Little Choc. Lake	18.5	20.7	573	6.5	mesotrophic
Moores Pond	50	37.1	440	6.3	mesotrophic
White Lake	123	47.9	439	6	oligotrophic

Table 8.8 Attributes of Ponds in Tamworth

Streams are classified by the State using the Strahler method, where year-round streams at the highest elevation in a watershed are first order streams, their juncture yields a second order stream, the juncture of two second order streams yields a third order, and the junction of third order streams yield a fourth order. Bearcamp River is the only fourth order stream in Tamworth, which makes it subject to the NH Shoreline Protection Act. Other significant streams are listed in Table 8.7.

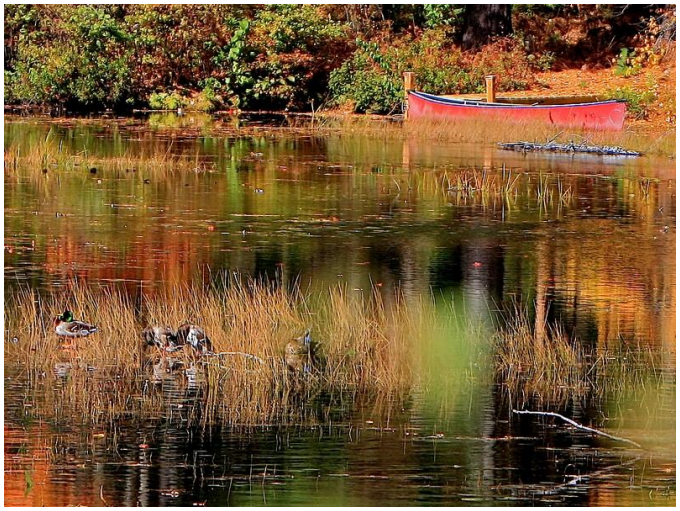
In addition to the trophic reports, surface water monitoring has been conducted by NH-DES (White Lake Acid Study), Chocorua Lake Conservation Foundation (Chocorua Lake salinity,

pH, etc.), and Green Mountain Conservation Group (watershed-wide chemical and biological monitoring). Most of these studies are ongoing and available from the individual agency or organization.

Floodplains

Floods are a natural and normal occurrence in an area of high rainfall. During normal stream flow, water is carried in a river channel. But in times of high runoff, water rises over the banks and flows onto the floodplain. Floods only become a problem when humans compete with nature for use of the land. Within Tamworth, the Bearcamp River is prone to flood at least once every ten years. Particularly susceptible areas include Jackman Pond Road, Old Route 25 and areas along Route 25.

According to the Flood Insurance Rate Map for Tamworth (FM330018INDO), prepared by the Federal Emergency Management Agency, there are many areas of Tamworth within the 100-year floodplain. These floodplain areas are associated with Chocorua River, Swift River, Mill Brook, Wonalancet River, Paugus Brook, Bryant Brook, Sanborn Brook, and other scattered areas. A 100-year flood plain is an area that has a 1% chance of flooding in any given year. Some areas with flood potential are shown on the floodplain maps as having incomplete data. These areas may be overlooked in applications for development with potentially unexpected results.



Dams

In the state of New Hampshire there are over 4,400 dams registered with the Department of Environmental Services. Twenty-three of these are in Tamworth**.** Some are in ruins, are exempt from NH-DES regulation, or have been removed**.** The most significant dams impound the flow of the Chocorua River. They are located at the outlet of Little Chocorua Lake and at the millpond in Chocorua Village. The table below lists the dams classified as “active” by NH-DES.

NAME	TYPE	IMPOUNDMENT (Acres)	HEIGHT (Feet)
Chocorua Lake Dam	Concrete	254	5.5
Chocorua River Dam	Timbercomb	4	15
Wonalancet River Dam	Earth	0.5	12
Tilton Pond Dam	Earth	3	7
Farm Pond Dam (owned by Cole)	Concrete	1	7
Duck Pond Dam	Earth	25	5
Fire Pond Dam (owned by English)	Earth	0.25	4
Bryant Pond Dam (on Bryant Brook)	Earth	0.12	6
Chocorua Meadows Dam (detention pond)	Earth	0.5	4

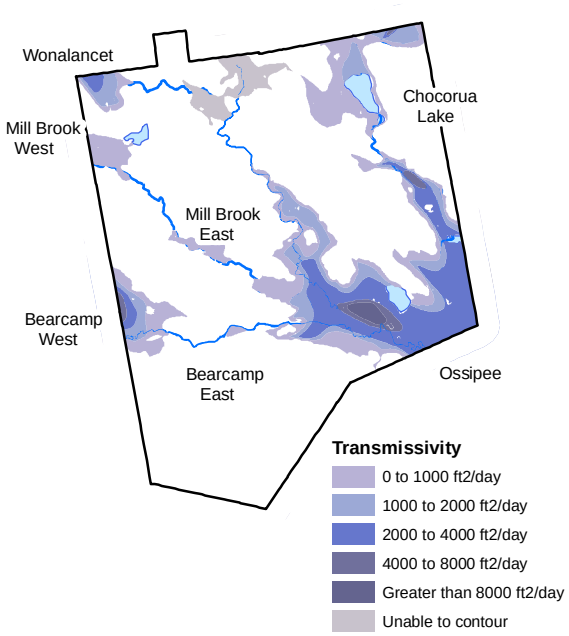
Table 8.9: Dams in Tamworth

Water Supply

Aquifers

An aquifer is an underground deposit of water-bearing earth material. It can occur in fractured bedrock or unconsolidated materials (gravel, sand, silt). Along the southern edge of the White Mountains, stratified drift aquifers formed when the melting glaciers deposited vast amounts of sand and gravel in low-lying areas. Tamworth contains approximately 6000 acres of the Ossipee Aquifer, the largest stratified drift aquifer in New Hampshire. This aquifer underlies the southeast corner of town and extends up the Bearcamp, Swift and Chocorua River valleys to include the villages of Whittier, Tamworth and Chocorua.

There are six other stratified drift aquifers partially or completely within Tamworth (see Map 8.10). The Bearcamp, Wonalancet and Chocorua Lake aquifers all have transmissivity values greater than 4000 ft^2/minute. Three smaller aquifers are located along the Bearcamp River (1) and Mill Brook (2). Table 8.11 lists Tamworth's seven stratified drift aquifers and areas based on transmissivity values.



Map 8.10 Aquifers

Aquifer Name	**Area of Aquifer** (Ac.) **for each Transmissivity Rate** (ft/min/ft)					
	< 1000	1000 - 2000	2000 - 4000	4000 - 8000	> 8000	total area
Bearcamp West	500	200	110	50	-	860
Bearcamp East	40	-	-	-	-	40
Chocorua Lake	1020	310	12	8	-	1350
Mill Brook West	350	-	-	-	-	350
Mill Brook East	200	-	-	-	-	200
Ossipee	1830	1230	2610	240	150	6060
Wonalancet	120	180	78	2	-	380
Totals	**4060**	**1920**	**2810**	**300**	**150**	**9240**

Table 8.11: Stratified Drift Aquifers in Tamworth

About Transmissivity

Transmissivity is a function of hydraulic conductivity and aquifer thickness (depth). It measures potential water movement. When the soil is saturated (the normal condition in an aquifer), hydraulic conductivity is synonymous with permeability; it's simply a means of measuring the ease with which water flows through soil. Porous soils (sand, gravel) more readily allow water movement than denser soils (silt, clay). Aquifer depth affects transmissivity because increased depth increases the area available for water movement.

Areas of exceptionally high transmissivity in Tamworth (> 4000 ft/min/ft) are located near White Lake, near Route 113 at the Sandwich town line, in Wonalancet, and near Pequaket along Route 16.

Beyond potential well capacity, transmissivity has little use as an indicator of water resource value. Some points to consider:

- Transmissivity does not predict sustainable yield. Sustainability is a function of the rates of extraction and recharge. If extraction exceeds recharge, transmissivity will decrease.
- Areas of low transmissivity are no less valuable, either ecologically or economically, than areas of higher transmissivity. Low transmissivity areas serve to directly recharge areas of high transmissivity.
- Pollutants entering low transmissivity areas will eventually disperse into the entire aquifer. Such areas require equal protection and management strategies.
- The entire town of Tamworth (in addition to a large portion of the surrounding towns) serves as a recharge area for the aquifers. Aquifer quantity and quality is dependent on upstream land-use decisions.

About Recharge

While transmissivity measures the amount of water that flow can through the aquifer, recharge describes how water gets into the aquifer:

- Primary recharge areas are where the aquifer joins the land surface. It is here that surface derived water sources, e.g., precipitation, can flow directly into the aquifer.
- Secondary recharge areas are the land adjacent to the primary recharge area, from which groundwater moves down gradient into the aquifer.
- Tertiary recharge areas are the region outside the primary and secondary recharge areas that contributes water to a stream that in turn has the potential to recharge the aquifer when it passes over a primary recharge area.

While 24% of Tamworth is mapped as aquifer, the maps showing transmissivity are all primary recharge areas. The entire town of Tamworth (in addition to a large portion of the surrounding towns) serves as a recharge area for the aquifers. Aquifer quantity and quality is dependent on upstream land-use decisions.

Public Water Supplies

Owners of public water supplies are required to register with the Water Division at NH Department of Environmental Services. There are 22 public water supplies registered in Tamworth. Twelve of these are non-community transient supplies (restaurants, inns, campgrounds) reported to serve up to 1518 persons daily, the largest being White Lake State Park. There are three schools in town reporting service to a total of 450 students and staffers. Tamworth has seven reported community water supplies serving 856 residents. Table 8.12 lists the community water supplies in Tamworth.

EPA ID	Site Name	Population Served
2312070	Chocorua Meadows	50
2312060	Chocorua Woods	16
2312050	Remick Acres	60
2313010	Tamworth Mobile Home Park	75
2313020	Tamworth Pines Coop	140
2311010	Tamworth Water Works	265
2312030	White Lake Estates	250
	Total:	**856**

Table 8.12 Public community water supplies in Tamworth registered with NH-DES

Wells

Most town residents depend on private domestic wells for their water supply. Since 1984, the year NH-DES began recording new well installations, there have been 584 wells reported in Tamworth (as of April 19, 2007). It should be noted that according to the NH-DES Water Division, the well database is known to be incomplete. The NH-DES estimates that it contains only an estimated 80% of wells drilled after 1984, even though those who drill wells (individual citizens, contractors) are required to report their activity.

Table 8.13 breaks down all wells reported in the past 10 years (n = 275) into types, depths and yields. 59% of the wells were drilled in bedrock. This is a much lower percentage than is typical for a New Hampshire town and can be attributed to the prevalence in Tamworth of water-bearing outwash soils. Wells drilled in bedrock had an average depth of 521' with a range of 105-1252'. Two notable points can be discerned in Table 8.7.6: First, although bedrock wells are generally known to be inferior producers compared to gravel wells, the average yields of bedrock wells and gravel wells are identical (19 gal/min.). This anomaly appears to be caused by a handful of bedrock wells with yields greater than 100 gal/min. (all registered as domestic). Median values tell a different story. The median yield for bedrock wells is 9 gal/min; drilled gravel wells have a median yield of 30 gal/min. Second, the average depth to ledge (87'; maximum 387') suggests that many of the wells drilled in bedrock were installed in areas of substantial outwash soils, implying that although most wells were drilled into bedrock, the majority of wells (and therefore residences) in town are located over or adjacent to stratified drift aquifers.

"The world is mud-luscious and puddle-wonderful."
~e. e. cummings

Tamworth Wells recorded at NH-DES; 1997 to April, 2007				
Type	**#**	**Depth** (ft.) min.-mean-max.	**To ledge** (ft) min.-mean-max.	**Yield** (gal/min) min.-mean-max.
Bedrock (drilled)	163	105 - 521 - 1252	2 - 87 - 387	0.75 - 19 - 200
Sand and Gravel	112	10 - 59 - 100	-	4 - 19 - 100
Drilled	29	22 - 69 - 100	-	6 - 30 - 100
Driven	6	22 - 46 - 70	-	5.5 - 13 - 30
Dug	2	10 - 10 - 10	-	15 - 28 - 40
Wash	75	26 - 58 - 80	-	4 - 16 - 20
Totals	**275**	**10 - 333 - 1252**	**2 - 87 - 387**	**0.75 - 19 - 200**

Table 8.13 Tamworth Wells

8.8 POINT AND NON-POINT SOURCE POLLUTION

Within every watershed, the uses of the land and of the water have the potential to impact water quality. Water pollution can occur from two major sources: point and non-point. Point source pollution is one that can be linked to a specific pollutant or discharge point that can be identified and physically located. Non-point sources are more difficult to document, trace, or identify since there is generally not a specific point of discharge.

The need to protect waterbodies from the danger of accelerated eutrophication and other forms of pollution was recognized by the New Hampshire Legislature in 1991 with the passage of the Comprehensive Shoreland Protection Act (RSA 483-B). Eutrophication is the natural, gradual nutrification, oxygen deprivation, and warming of a water body that changes the biological make-up of the waterbody. Eutrophication can be dramatically accelerated by pollution, leading to a dying lake or pond having algal blooms and other problems. The final implementation of the Comprehensive Shoreland Protection Act was put into effect on July 1, 1994, and revised as of July 1, 2008. This act creates a protected shoreline for public waters, but states:

> *"Municipalities may adopt land use control ordinances relative to all protected shorelands which are more stringent than the minimum standards contained in [the Comprehensive Shoreland Protection Act]..." RSA 483-B:8, I.*
>
> *"Municipalities are encouraged to adopt land use control ordinances for shorelands of waterbodies and watercourses other than public waters." RSA 483- B:8, II.*

Point Sources, Ground Water and Surface Water

In New Hampshire, NH DES regulates industrial and municipal discharges and privately-owned wastewater management and wastewater treatment facilities which may have a potential impact on water quality due to a direct discharge to groundwater. A groundwater discharge permit is required for such activity.

A pipe discharging waste into a stream is an example of a point pollution source. Since the Clean Water Act of 1971, most discharges have to be treated prior to discharge and all discharges require a National Pollution Discharge Elimination System (NPDES) permit. DES issues NPDES permits after review and approval. Current point source discharge permits are available from NH-DES.

Potential Non-Point Pollution Sources

General and specific land use practices that are widespread throughout the study area can impact water quality. Some potential sources of pollution are the result of temporary or short-term land uses that require disturbing the soil, such as logging, construction, road maintenance, or agricultural operations. Others, such as stormwater runoff, may be short in duration but are continuous in nature. Non-point sources are more difficult to quantify than point sources because they impact water quality through unmonitored, intermittent, or incremental contamination, and their impacts may be felt only over a long period of time. Other sources include waste disposal facilities (septic systems, landfills, junkyards, etc.), highway maintenance (sand, salt, and snow dumping), and hazardous waste.

Buffer strips along ponds and streams intercept and store surface runoff, allowing it to infiltrate rather than continue off site as runoff. This can reduce impacts from a variety of pollutants including phosphorus, sediment, pathogens, nitrates, and pesticides. A buffer's capacity to tie up pollutants depends on its width, vegetation type, slope, and soil type. Studies have shown that the ability to evaluate these factors is usually beyond the ability of communities without relying on expensive studies. Instead, authorities have determined that a realistic rule of thumb is to assume that wider buffers remove more pollutants. Tamworth currently requires a 125' buffer from surface water and "hydric A" wetlands for construction of new septic systems. For all other construction, a 25' buffer of undisturbed natural vegetation is specified by the Wetlands Conservation Ordinance. This is a minimal filter strip for mitigating erosion problems and is far less than filter strip width recommended by state agencies such as the Division of Parks and Recreation (Best Management Practices for Trail Building and Maintenance, 1994).

Within Tamworth, potential non-point pollution sources are somewhat limited because most of the lakes and ponds are surrounded by conservation land. However, some areas, such as Moores Pond, have high-density development on excessively drained soil. Perhaps the highest risk of non-point pollution comes from roadways adjacent to ponds and streams. This is the case for Route 16 at Chocorua Lake and Route 25 at various points along the Bearcamp River, as well as a few town roads (e.g.: Old Route 25, Bryant Road, Union Hall Road, Tamworth Village). In the case of Chocorua Lake, CLCF has worked with the State of NH to mitigate effects of road runoff. This type of cooperative work should be encouraged in other areas of town.

"We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."

~Aldo Leopold

8.9 FOREST & AGRICULTURE LAND USE

Predicting the future is always a gamble. Tamworth's nineteenth century farmers, surrounded by their pastures of grazing sheep, orchards of apples and groves of sugar bush, could not have foreseen the eventual shift to midwest and west coast corporate agribusiness, much less the current trend toward a world economy saturated with South American beef and tropical produce. Likewise, when in the 1930s the Brown Paper Company of Berlin concentrated on diverse and innovative uses of wood-based composite products such as rope, photographic film, tableware and culverts, the mill owners failed to see the age of plastics looming on the horizon.

It is an inherent component of human frailty to assume that what is now is what shall always be. Presently, our economy – our sustenance – is based on a finite resource: petroleum. Petroleum permeates agriculture. Farm equipment, fertilizer, pesticides, herbicides, and trans-continental product transport all depend on petroleum. Our standard for durable goods has followed a similar path. Wood and steel have been replaced by petroleum-based plastics. We can't ignore the fact that eventually we will need to establish a new model for agriculture and reinvestigate the available resources for construction and manufacturing. Predicting the new model may be difficult at present, but prudence demands that we consider and protect the local resources that have served us in the past and may be crucial in the future.

Existing Agricultural Land Use

Section 5 of this chapter defined, listed and tallied the soils in Tamworth most favorable for agricultural use. This section provides an inventory of land currently in agricultural use or, at minimum, being maintained as open fields. The inventory was conducted using aerial photographs, tax maps, and local knowledge. Those familiar with local fields (mowing contractors, long-time farmers) were consulted. Field inspections (windshield surveys) were used to verify the status of some of the fields. Fields were grouped into three categories: productive-crops (row crops, orchards, berries, etc.), productive-hay (pasture, harvested hay fields), and mown (field kept open; not sure of status).

150 parcels were identified as containing land actively managed for agriculture or open fields. The total managed area of all these lots approximates 1000 acres. A number of parcels contained more than one category of use. Overall, the active agricultural land is widely distributed throughout the town. Areas of highest concentration are found along the Bearcamp River, Mountain Road, and Cleveland Hill Road. Table 8.14 lists the three categories and shows areas, including the amount of active agricultural land on prime agricultural soils and soils of statewide importance.

Grouping	Acreage	Prime Ag	SSI
Productive - Crops (row crops, orchards, berries, etc.)	40	0	3
Productive - Hay (pasture, harvested hay fields)	547	117	16
Mown (Field kept open; not sure of status)	414	40	48
Totals	**1001**	**157**	**67**

Table 8.14: Active Agricultural Land and Open Fields

The 587 acres of productive agricultural land represent 1.5% of Tamworth's total land area. However, the 224 acres of crops and fields found in prime agricultural soils and soils of statewide importance represent 24% of the best agricultural soils in Tamworth. These numbers demonstrate the value of good agricultural soil. Not only do prime soils increase

productivity, they are easier to manage for agriculture (fewer stones, better moisture retention).

Forest Lands

The majority of Tamworth's forests are a mosaic of hardwoods, pine and hemlock in various successional stages. Most forests are second or third growth, meaning they have regenerated after prior timber harvests or abandonment of fields. There are very few patches of primary or old-growth forests in Tamworth. When old-growth areas are identified, it is advisable to maintain their pristine condition. Old-growth forests provide an increasingly rare habitat that contributes to biodiversity. New Hampshire Fish & Game and The Nature Conservancy, in their land cover habitat database produced for the Wildlife Action Plan, have identified other notable forest types in Tamworth. In order to maintain diversity, they should be actively managed for perpetuation if possible. Table 8.15 lists these forest types, total areas, and locations.

Forest Type	Approx. Area	Locations
Spruce-fir: most examples in Tamworth do not produce saw-grade lumber; they provide important habitat for species such as moose, snowshoe hare, and fisher.	2500 Ac.	Northwest corner of town and higher elevations of the Ossipee Mountains.
Northern Hardwoods: maple, beech, and yellow birch. Tamworth is on the southern boundary of the northern hardwood biome. This forest type produces high-quality hardwood saw timber and substantial mast utilized by numerous wildlife species.	2700 Ac.	Mostly in the Ossipee Mountains, also on Brown Hill, the south slopes of Mt. Mexico, and the highlands north of Great Hill.
Floodplain: mostly hardwoods; red maple, silver maple, basswood.	1800 Ac.	Along the Bearcamp River and lower section of Swift River.
Pitch Pine: pitch pine/scrub oak barrens are not commercially valuable but they provide a rare habitat that harbors seven species of special concern in Tamworth.	400 Ac.?	Southeast corner of town; much of the area would need intensive management to restore the barrens.

Table 8.15: Notable forest types in Tamworth

From a planning perspective, woodlands are not just a source of wood products and tax revenue. The forest industry also provides many area jobs. Woodlands also play an important role in providing areas for outdoor recreation, wildlife habitat, and scenic enjoyment. They play a role in the water quality of Tamworth's ponds and streams. All of these uses are sustainable and each can co-exist. Timber harvesting, while having dramatic visual impacts in some cases, is rather short-term. However, subdividing large woodland parcels into small lots for development can have a long term, nearly irreversible impact.

Considerable care should be taken during harvesting to ensure the conservation of soils by mitigating erosion. Because large forested tracts are another aspect of the rural character of the community, visible clear cuts, either for commercial harvests or for development, should be carefully avoided or buffered. "Viewsheds," the views available to residents and tourists while driving, hiking, etc, and the impact of large clearcut areas on a viewshed are an important consideration when the stated goal of the community is to maintain rural

character. The maintenance of important forested and agricultural views should be promoted by encouraging group selection or smaller patch cuts.

New Hampshire's Vanishing Forests (2001) found that while New Hampshire remains predominately forested, the amount of forest cover will decline to 80% statewide within the next 20 years, and of that, less and less will be committed to long term forest management in large tracts. Additionally, most landowners no longer rank timber production as their main reason for owning the land. Only 10% of the landowners include timber production as the primary management goal, with aesthetic enjoyment now more than 50% of the landowners' reason for owning the land.

With regard to the short-term impacts of logging, the town has a built-in mechanism to monitor logging operations – the notice of 'Intent to Cut.' Once an 'Intent to Cut' is filed, it is reviewed to determine if the logging operation is going to impact sensitive or critical natural resource areas, such as wetlands, deer yards, fragile biotic communities, etc. It is important that landowners understand the need to carry out logging operations in a manner sensitive to important natural resources. There are numerous professional foresters and certified loggers in the area who can provide assistance.

8.10 CONSERVATION LANDS

Land protection in Tamworth has impressive roots. It was Augustus Hemenway Jr. and his wife, Harriet (Lawrence), who bequeathed 2000 acres to the State of New Hampshire in the first half of the 20th century. The son and successor of a prominent Boston maritime trader, Augustus was a benefactor to Harvard University, public libraries and land preservation throughout eastern Massachusetts. Harriet was even more impressive as a philanthropist and activist. Among her many accomplishments, she is credited with being the inspiration and driving force in forming the National Audubon Society. Other well-known Tamworth names, such as Bowditch, Runnells and Thompson, appear on deeds granting the earliest conservation properties in Tamworth. Our conserved lands are the legacy of many foresighted individuals who cherished the natural character and beauty that have drawn so many of us here.

Tamworth's conservation lands are held by numerous government agencies and private trusts. The following three tables, each dealing with one category (State and Federal, Private, Town), list the conservation land, acreage, and type of protection.

State of New Hampshire:	**Acreage**	**Protection Type**
Bowditch-Runnells State Forest	137	fee-simple ownership
Hemenway State Forest	1998	fee-simple ownership
White Lake State Park	756.1	fee-simple ownership
Hackett Hill Wildlife Management Area	223	fee-simple ownership
Ossipee Mountains Tract	1030	conservation easement
Bearcamp River (attached to HHWMA)	17.5	conservation easement
State Totals	4161.6	
Federal Government:		
White Mountain National Forest	220	fee-simple ownership
Other Governmental Agencies:		
Town of Ossipee (Schroeder Parcel)	108.3	fee-simple ownership
Category Total	**4489.9**	

Table 8.16: State and Federal Conservation Lands

Name of Trust	Acreage	Protection Type
Black Bear Conservation Foundation	28.5	fee-simple ownership
Chocorua Lake Conservation Foundation	591.1	fee-simple ownership
Chocorua Lake Conservation Foundation	2294	conservation easement
Green Mountain Conservation Group	199	conservation easement
Lakes Region Conservation Trust	2400.2	fee-simple ownership
The Nature Conservancy	325.1	fee-simple ownership
Society for the Protection of NH Forests	203	fee-simple ownership
Society for the Protection of NH Forests	1052.3	conservation easement
Category Total	**7093.2**	

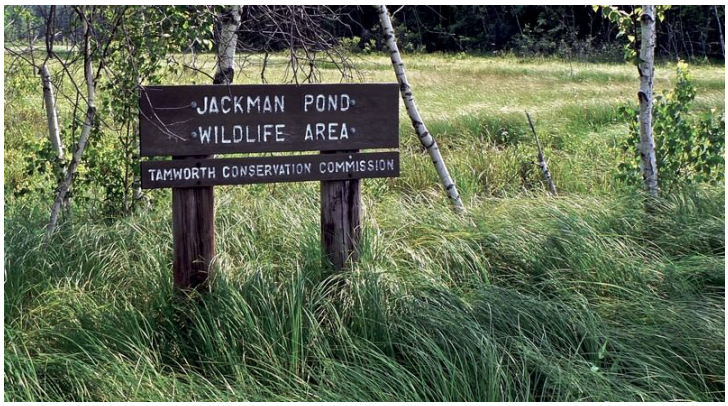
Table 8.17: Private Trust Conservation Lands

Managed by Conservation Commission	Acreage	Protection Type
Black Spruce Bog Ponds	65	fee-simple ownership
Emerson Natural Area	5	fee-simple ownership
Hobbs Natural Area	4.1	fee-simple ownership
Jackman Pond Wildlife Area	38	fee-simple ownership
Kennett Triangle	7	fee-simple ownership
Earle H. Remick Natural Area	14.6	fee-simple ownership
Charles & Alice Thompson Natural Area	9.3	fee-simple ownership
Thompson Field	1	fee-simple ownership
Waterfowl Haven	18.1	fee-simple ownership
Monitored by Conservation Commission		
Alt #1	20	conservation easement
Alt #3	4.2	"
Alt C. et al	17.2	"
Alt - Damon Lot	38	"
Alt - Mahoney Lot	14.4	"
Alt - West Moody Lot	22.1	"
Alt - Mill Brook Northeast	87.3	"
Alt - Mill Brook Southeast	71.4	"
Alt - Dow Southwest	6.15	"
Aspinall	64.4	"
Cave	742	"
Freeto	8.8	"
Hayfield Realty Trust	27	"
Homestead Trust II	1.43	"
Irwin	4.2	"
Lindsey	4.3	"
Olton, Percy & Eleanor	5.5	"
Olton, Percy & Eleanor	7	"
Perkins	297	"
Rhodes Realty Corporation	8.7	"
Category Total	**1613.2**	

Table 8.18: Town Conservation Lands

Not all conservation land is equal. Land held in fee-simple ownership by government agencies or private trusts may be utilized for purposes other than conservation unless there is also a conservation easement held by a second party. For instance, although the 38 acres managed as the Jackman Pond Wildlife Area by the Tamworth Conservation Commission is considered protected land, the town could vote to use the property for municipal facilities or sell it with no restrictions. Most properties owned by conservation organizations do not have an easement held by a second party; the Sanger lot owned by Lakes Region Conservation Trust and having a conservation easement held by SPNHF is a notable exception.

Conservation easements provide various levels of protection. Most easements held by Chocorua Lake Conservation Foundation restrict development but do not prohibit it. The Wonalancet Preservation Association covenant which is renewed at 30-year intervals restricts subdivision and some aspects of land use. Other easements may be as basic as prohibiting buildings within 150' of shorelines. The typical easement allows agriculture and forestry practices but prohibits any residential or commercial development. The most restrictive protection has "forever wild" provisions, which allow nature to be the only controlling factor on the parcel. Much of the land in the Ossipee Mountains is in this category. The property is owned by Lakes Region Conservation Trust and was purchased with funds provided by Sweetwater Trust, an organization that concentrates on preserving large tracts of unspoiled land.



During the past few decades, the Tamworth Conservation Commission has focused much of its effort toward protecting shorelines and uplands surrounding waterbodies, including lakes, ponds and streams. The result of the efforts of TCC and others is that currently Moores Pond is the only great pond (as identified by NH-DES) without significant protection. Numerous smaller ponds (< 10 acres) such as James Pond, Lonely Lake, and Black Spruce Bog Ponds are now surrounded by conservation land. Significant named ponds lacking any conservation protection include Beaver Pond, Moores Pond, and Tilton Pond. Much of TCC's riparian corridor protection efforts have focused on Mill Brook. Over half of the length of Mill Brook from the Sandwich town line to the confluence at Swift River has been protected. Mill Brook provides the longest riparian corridor in town that is not significantly impacted by development. It passes through three large, contiguous, sparsely developed forest blocks (see Unfragmented Lands section below) containing conservation land. Further protection along this stream is desirable. A considerable portion of Bearcamp River passes along the edge of various conservation lands, mostly upstream of Whittier. Land conservation efforts along Bearcamp River are problematic due to small parcel sizes, development, and proximity to Route 25; but future protection opportunities are likely to occur and should be considered, as should opportunities along the other major streams in Tamworth: Chocorua River, Swift River, Wonalancet River, Paugus Brook and Cold Brook.

A look at the totals for each category in the tables above shows the small role the town plays in land protection. The town holds a legal interest in only 12.2% of all the conservation land in Tamworth. The use of conservation easements has been growing and continues to grow in New Hampshire. At the time of writing this report, there was one 100 acre parcel headed toward finalizing a conservation easement and a number of known

parcels totaling hundreds of acres in some stage of negotiation. The creation of new conservation land will continue to occur in Tamworth whether or not the town assumes an active planning role. Each land trust and government agency has its own specific goals and priorities in land protection, and for the most part, each works independently of the others. The town, through the conservation commission, should develop a good working relationship with all land trusts doing business in Tamworth, share visions and goals, and strive to function as coordinator and facilitator toward a holistic land conservation plan.

Unfragmented Lands

Habitat loss and fragmentation are the two leading threats to wildlife and ecosystem function according to the Wildlife Action Plan published by New Hampshire Fish and Game in 2005. In the northern part of the state, fragmentation caused by roads can exceed habitat loss due to development. The effect of any one road is a function of traffic volume and design features (clearing width, fences, berms, fill slopes, etc.). By far, the greatest fragmentation effect in Tamworth is Route 16 and the development along it. NH-DOT traffic counts place Route 16 at 7,000-9,000 vehicles per day. Lowest fragmentation effects along route 16 occur near Chocorua Lake, where fortunately there is a preponderance of conservation land. Route 25 contributes the second largest fragmentation effect with an average traffic count of 5000 vehicles per day . Other major contributors are Route 41 (3700 vpd), Route 113 between Whittier and Chocorua (1700-2500 vpd), and Depot Road (700 vpd). Most other roads in town are under 500 vpd. Chinook Trail (Route 113A) near Wonalancet is 200-250 vpd.

Regardless of traffic volume, conservation biologists classify unfragmented lands as blocks of land devoid of and beyond a buffer distance from roads. Three hundred feet is a common buffer distance and was used in the NH Wildlife Action Plan analysis. Using NH WAP figures, the area of Tamworth north of Chinook Trail, Fowler's Mill Road and Chocorua Lake Road is part of the 137,000 acre Sandwich Range block. This is one of the largest unfragmented land blocks in the State. The area south of Route 25 is part of the 35,000 acre Ossipee Mountain block, one of the largest forest blocks south of the White Mountains. Between these two extensive blocks, the largest unfragmented block, at 2300 acres, is the area bounded by Route 25, Bunker Hill Road, Cleveland Hill Road, and Hollow Hill Road. Other sizable unfragmented blocks of 1600 acres or more (as identified by geographical features) include the area on and north of Great Hill, the White Lake area, and McDaniel Hill.

Large tracts of undeveloped land provide suitable habitat for our wider-ranging wildlife such as bear, bobcat and moose. An unbroken mosaic of plant communities provides for a full range of ecosystem functions which provide services such as climate control and water resource protection. Connected chains of sizable forest blocks allow species movement and promote biodiversity. The town of Tamworth should incorporate the preservation of large forest tracts and connectivity between tracts into its planning strategy.

Current Use

NH RSA 79A allows landowners to place certain types and sizes of land in a tax abatement program based on their current land use. There are 22,318 acres in current use in the town of Tamworth (58% of total area). Most current use land is classified as forest land; 963 acres are in farmland and 803 acres are unproductive. Of the area in current use, 11,271 acres (51%) receive the 20% recreation adjustment. Total valuation for current use land in 2006 was $2,191,575, resulting in $41,728 in property taxes: 0.7% of the total town

budget. Land in current use generates more tax revenue than the cost of town services it requires.

While current use reduces the burden for landowners, land can be taken out of current use with payment of a penalty. Therefore, it does not provide absolute assurance of continued open space. The penalty is 10% of the assessed value of the lands. Under state law, towns can vote to have all or a portion of the money collected for taking land out of current use (the land use change tax) placed in a conservation fund administered by the Conservation Commission. Over 120 towns in the state have voted to do this in order to provide a source of revenue for conservation studies and land protection efforts. Tamworth currently collects 100% of the penalty each year for the conservation fund with a cap of $5,000 and any remainder going to the town general fund. For 2006, the total land use change tax collected by the town was $28,451.

8.11 WILDLIFE RESOURCES

Game was a necessity for Tamworth's eighteenth century settlers. Food, clothing, and sundry household items such as soap and candles were produced from the bountiful wildlife found by the earliest pioneers. A steady supply of game was important enough that neighbors tended to Hezekiah Hackett's farm in exchange for Tamworth's best shot keeping meat on everyone's table. A century later, John Sanborn kept tabs on the regular circuits of the local bears, enabling him to harvest three or four every year. Yet he hardly cleaned them out. Even today, Hemenway State Forest is known by NH Fish & Game as a hotspot of bear activity.

Two and a half centuries of development have taken a toll, but Tamworth still consists of enough large, intact habitats to support populations of moose, bear, bobcat, otter and fisher. Conservation biologists call these wide-ranging animals "umbrella species," the reasoning being that if there is enough habitat integrity to support these animals, there will be adequate habitat for the rest of the wildlife. The varied areas used on an annual basis, particularly by moose and bear, constitute all the habitat types required by less nomadic species.

Habitat loss and fragmentation are the two leading causes of decline in wildlife populations. Fragmentation is a result of linear development, more commonly known as sprawl. Roads and the buildings that spring up along them create obstacles to wildlife movement necessary for seasonal food requirements, reproduction, dispersal and gene flow between populations. In much of New Hampshire today, unfragmented forest blocks greater than 2500 acres are becoming a rarity. In comparison, bear, moose and bobcat typically have home ranges in excess of 5000 acres, requiring frequent road crossings to meet their needs. Road crossings increase stress and the likelihood of fatalities, as well as jeopardize public safety. Some native species, including lynx and fisher, avoid open areas whenever possible and are consequently limited in movement by major highways and developed areas.

Tamworth is fortunate in that it has the Ossipee Mountains – a 35,000 acre forest block – to the south, and the Sandwich Range – well over 100,000 acres – to the north. Between these two substantial unfragmented blocks, the largest forest block (the Hackett and Bunker Hill area) is 2300 acres. There are a minimum of four road crossings between the Ossipees and the Sandwich Range. The future development patterns of these roads and of our largest forest blocks (e.g. Hackett/Bunker Hill, Great Hill/Great Hill Pond, White Lake, McDaniel Hill) will decide the fate of our local wildlife.

Wildlife is a money-maker. It brings hunters and fishermen to the area and is an integral part of the charm that entices tourists to the White Mountain region. Wildlife is a necessary component of an intact ecosystem and a central theme in most residents' definition of and connection to "place." Having wild animals as neighbors grounds us to the land and reminds us that we are all interdependently connected to the natural process.

Habitat

Roger Powell, a noted zoologist and ecologist, recently wrote of the twists and turns found in the evolution of the term 'habitat' as used in wildlife management. Originally used by Aldo Leopold in 1933, habitat meant the collection of resources and conditions necessary for an animal's occupancy. It was a species-specific term and defined needs for food, shelter, cover and reproductive functions. Each species has unique habitat needs. Otherwise, Gause's competitive exclusion principle would predict the extinction of all but one species having identical habitat requirements.

Today, 'habitat' has taken on a generic quality. It denotes a plant community type where one might expect to find specific plant species, microclimate, soil and hydrologic conditions. A better term would be 'habitat type' or, to revive a term from early ecology, 'plant association.' The point is: No animal's *habitat needs* exactly correspond to any one *habitat type*. Some animals may only require a small portion of one habitat type, while most large animals (bigger than a breadbox) and many small animals (e.g. salamanders, wood frogs, monarch butterflies) require different habitat types at different times. Habitats work in concert. A mosaic of habitats is required to support a healthy wildlife community and, in fact, to sustain each individual habitat.

Generally speaking, the prevalent habitat type today is second-growth hemlock-hardwood-pine forest. This is a product of clearing for agriculture in the nineteenth century, later abandonment of farms, and a present-day rotation cycle of forest harvesting. The result is a scarcity of early-succession and old-growth habitats. UNH-CE biologists are quick to point out that the best grouse and cottontail habitats are found in power line rights-of-way and abandoned gravel pits. Old-growth habitat (over-mature in the parlance of foresters) is only found in scattered patches usually too small to overcome edge effects. However, these pockets of old-growth can provide denning opportunities for numerous species and a unique mix of woody debris and microclimate conducive to habitation by small fossorial animals (animals living in and beneath the forest litter).

Important Habitat Types in Tamworth

Riparian-Wetland Complex

Ninety per cent of Tamworth's wildlife species use riparian and wetland habitats at some point in their life history. Riparian areas offer essential habitat for otter, mink and beaver, among other species, and serve as travel corridors for wide-ranging species. Floodplains associated with riparian habitat support oxbows, ephemeral pools and distinctive plant communities contributing to biodiversity. The NH Wildlife Action Plan identified peat lands and marshes (emergent wetlands) as two important wetland habitat communities.

Riparian areas are found throughout Tamworth wherever brooks and rivers flow, and they are consistently associated with small marshes. The most extensive riparian-wetland complexes in Tamworth occur between Jackman Pond and Beaver Pond, north of Moores Pond, and in the Pequaket area. The Jackman Pond and Pequaket complexes are parts of larger habitat areas extending into adjacent towns. Land use planning for these areas should be coordinated with Sandwich, Albany and Madison. Floodplains associated with riparian-wetland complexes add significant value to the Bearcamp River corridor and the lower reaches of Swift River and Mill Brook. A wetlands study conducted by Barry Keith for the Town of Tamworth in 1979 identified all the above areas as significant wildlife habitat and, in addition, rated the wetlands associated with Great Hill Pond, Duck Pond, and southeast of Bunker Hill Road as having high wildlife habitat value.

Grasslands

Open fields in Tamworth have diminished significantly throughout the twentieth century, and with them have vanished numerous wildlife species, particularly grassland bird species. Species that use grasslands and that occur, have occurred, or could occur in Tamworth include kestrel, purple martin, northern harrier, leopard frog and wood turtle. A comprehensive list of fields in Tamworth is shown in the active agriculture section of this report. The NH Wildlife Action Plan inventoried contiguous grasslands greater than 25 acres in area. The report identifies 16 field complexes in Tamworth. Omitting unreclaimed gravel pits and the Chocorua Valley Lumber yard, these are shown in Table 8.19.

Wonalancet	117 ac.
Cave/Mock	33 ac.
Spaulding/Rich	54 ac.
Cleveland Hill	43 ac.
Alt/Jenkins	87 ac.
Cleveland Hill Rd. E of Lunt Ledge	72 ac.
Hackett Hill Road	32 ac.
Community School/Bickford	~ 95 ac.
Chinook Trail at Hemenway Road	43 ac.
Chocorua Village	101 ac.
Brass Heart Inn	36 ac.
Tamworth Village	~ 100 ac.
Tamworth Camping Area	33 ac.
Lower Bearcamp River	316 ac.
Route 16/Depot Road	~ 45 ac.
Total	**~ 1200 ac.**

Table 8.19: Grassland habitats greater than 25 acres in Tamworth (source: NH-WAP)

Spruce/Fir and Northern Hardwoods

Tamworth is positioned in a transition zone between two biomes. Exact boundaries and nomenclature vary between authorities but for explanatory purposes it can be said that we are at the northern extreme of the eastern temperate forest. Consequently, higher

elevations in Tamworth are apt to contain habitat types found in the northern forest. Lowland spruce/fir habitat supports northern goshawk, three-toed woodpecker, rusty blackbird, lynx and marten, among many more-common species. The northern hardwood forest is dominated by sugar maple, beech and yellow birch. This habitat supports a number of deep-forest warblers and thrushes, some uncommon bats, and gray wolf.
Within Tamworth, extensive areas of northern hardwoods and spruce/fir are found in the Ossipee Mountains. The northwestern quarter of town contains spruce/fir habitat in the Great Hill and Wonalancet areas. Scattered northern hardwood habitat has been identified on the north-facing slopes of Sanborn Brook and Wonalancet River, on Brown Hill, and in the Mt. Mexico panhandle. Because of the low abundance of these northern habitats, they contribute to biodiversity in Tamworth, produce important mast crops, and should be given special consideration in land management planning.

Pine Barrens

Pitch pine and scrub oak are the dominant tree species of pine barrens, which are found on glacial outwash plains. The Tamworth-Madison-Freedom area contains one of the largest intact pine barrens in New Hampshire. Pine barrens support a number of species listed as threatened or of special concern by NH Fish and Game (see Table 8.20). Within Tamworth, pine barrens are found near White Lake and in the area bounded by Chocorua River, Moores Pond and the Madison town line. All possible efforts should be made to protect and restore pine barrens.

Talus Slopes and Rocky Ridges

Extensive rock outcrops and steep boulder slopes at the base of cliffs create cliffy refuges used by rattlesnake, peregrine falcon, and bobcat. Although there are no cliffs in Tamworth likely to harbor peregrine falcons, the Ossipee Mountains contain a few ridges and talus slopes suitable for bobcat winter rest areas and natal dens. Lunt Ledge, the sole remaining sizable outcrop with a talus slope, has historically served as a refuge for bobcat. These habitat types are common in the Sandwich Range but very rare in the lowlands. They should be considered in land planning.

Vernal Pools

Small pools that occasionally dry up provide critical breeding habitat for mole salamanders and wood frogs, as well as life-long habitat for fairy shrimp and other invertebrates. Vernal pools may be located in floodplains or in upland depressions with a high water table or shallow restrictive layer. Fire ponds occasionally function as vernal pools if they are not stocked with fish. There are numerous vernal pools throughout Tamworth. An inventory should be done to identify pools that serve as productive amphibian breeding habitat.

"We know more about the movement of celestial bodies than about the soil underfoot."

~Leonardo Da Vinci

Species of Special Concern

New Hampshire Fish and Game and New Hampshire Natural Heritage Inventory maintain lists of endangered and threatened species and species of special concern. All these species are experiencing a threat or management concern. A list of special concern species that are, were, or could be found in Tamworth is shown in Table 8.20. A close look at the table will show that most of these species occur in habitats listed above, particularly wetlands and pine barrens.

Birds	**Status**		**Habitat**
Common Loon	known	ST	lakes 16-60 ac. or with islands and coves
Common Nighthawk	known	ST	pine barrens, riparian, agricultural, other open
Great Blue Heron rookeries	historic	SC	dead trees in wetlands, islands
Cooper's Hawk	known	ST	forests near edge
Golden Eagle	historic	SE	cliffs near wetlands, remote areas
Northern Goshawk	known	WAP	mature forest, large diameter, dense canopy, open understory
Northern Harrier	unknown	SE	fields and marshes
Pied-billed Grebe	unknown	SE	emergent wetlands > 10 ac.
Purple Martin	historic	SE	large open areas
Rusty Blackbird	unknown	WAP	spruce-fir & spr-fir-hdwd next to water, >1000'
Secretive wetland birds	unknown	SC	emergent/scrub-shrub wetlands >3ac.
American Bittern			
Common Moorhen			
King Rail			
Least Bittern			
Marsh Wren			
Sora			
Virginia Rail			
Whip-poor-will	unknown	SC	dry forests with openings for feeding
Reptiles			
Blanding's Turtle	Sand/Moult	SC	large wetlands, sandy open areas
Smooth Green Snake	unknown	WAP	open woods, marshes
Spotted Turtle	Ossipee	SC	heavily vegetated wetlands, vernal pools
Wood Turtle	unknown	SC	slow rivers/streams, sandy/gravelly substrate
Mammals			
American Marten	Alb/Sand	ST	mid-successional coniferous and deciduous, lots of structure
Bobcat	known	SC	rocky outcrops; anywhere snowshoe hares are found
Northern Bog Lemming	unknown	SC	most common >1000', spr/fir, hemlock/beech, bogs, meadows
Northern Myotis	Alb/Sand	SC	summer: mature deciduous forest
Insects			
Barrens xylotype	known	WAP	pitch pine barrens
Sleepy Duskywing	known	WAP	pitch pine barrens
Pine Barrens Itame	known	WAP	pitch pine barrens
Pine Pinion Moth	known	ST	closed canopy pitch pine barrens
Ringed Bog Haunter	Fryeburg	SE	bogs, acidic fens
Zanclognatha Moth	known	ST	closed canopy pitch pine barrens

Table 8.20: Species of Special Concern

Status:
Known: documented in Tamworth by NH Natural Heritage Inventory, NH F&G, or verified sighting
Unknown: not documented but Tamworth is within species range
Town listing: not documented, not in documented range, but known in listed towns
Historic: documented in the past
SE: state endangered
ST: state threatened
SC: special concern, tracked by NH NHI and/or NH F&G
WAP: species of concern in NH F&G Wildlife Action Plan

Table 8.21 Legend for Table 8.20

All unconfirmed species listed as "unknown" have a distribution range that could include Tamworth, have a high probability of occurrence at undocumented locations (Kanter, et al, 2001 or NH F&G, 2005), and require habitat that occurs in Tamworth.

Fishing

Tamworth's seven great ponds, numerous smaller ponds and abundant brooks and rivers provide a wide selection of fishing opportunities. Native trout can be caught in the smaller ponds and upper reaches of brooks. Bass, pickerel, hornpout, perch and sunfish abound in the smaller and weedy ponds. New Hampshire Fish and Game stocks seven waterbodies in town. The Bearcamp River gets brook, brown and rainbow trout. Chocorua Lake is stocked with brook and rainbow trout. Chocorua River, Forest Brook, Kid's Pond and White Lake get brook trout. The Swift River between Fowler's Mill Road and Tamworth Village is managed for exceptional trout fishing meant to provide a greater size per catch and catch per hour. It is stocked with larger brook and rainbow trout, is restricted to fly fishing only, and may have a smaller catch limit.

8.12 SCENIC/AESTHETIC RESOURCES

The story goes that not too far back in Tamworth's past the road agent decided it was time to fix a certain town road that was difficult to maintain. He and his crew cleared trees that kept the meager winter sun from melting the icy glaze plaguing motorists on the steep inclines. The crew widened and crowned the traveled way. They installed ditches and berms to prevent the annual spring runoff from carrying the roadway into the adjacent wetlands. Cut and fill slopes were graded and stabilized.

From an engineering standpoint, it was an excellent job. To this day, that certain town road is easy to maintain and a cinch to negotiate on the worst winter days. But some townsfolk rued the loss of the primitive character of the original narrow, winding, tree-lined lane. Hearsay attributes the petition at the following town meeting to a relative of the road

agent, but nevertheless, in order to keep a public eye on local road maintenance practices, an article was introduced and passed declaring all town roads to be scenic roads under RSA 231:157.

Not this road, not that road, but all roads. The universality of that decision speaks volumes about how Tamworthians view the natural beauty of our town. The character – the ambiance, if you will – is a package deal. To so many of us, the essence of Tamworth is experienced by all five senses. Is it the sight of the Ossipees rising above wind-whipped hay that causes us to slow down when we pass Remick's field on Depot Road? Or is it the late April song of wood frogs emanating from the irrigation ditch winding through the field? Or the mid-summer smell of fresh-cut hay so thick we can taste the chlorophyll? It is the synergy of these sensations – and the individualistic way we each perceive them – that make an objective inventory of Tamworth's scenic resources near impossible. So be it. But it has been tried in the past. Here we will attempt to list prior inventories, introduce an addendum of results from recent public surveys, and distill from the eclectic concoction a few useful generalities.

Prior Surveys and Recommendations

The 1980 Master Plan dealt with scenic resources in a general manner. In response to the survey question: "What do you like most about Tamworth?", 90% of the respondents chose "Rural atmosphere and scenic beauty" as their first choice. When asked if certain areas of town should be designated for specific uses, the use most chosen was "scenic and conservation preserves." In the goals section of the 1980 Master Plan, the easily predictable goals of "guide growth so that the predominantly rural character of the town will be preserved" and "preserve the town's rural atmosphere and scenic beauty" were included in the final draft.

The 1995 Master Plan took a more specific approach. In the public survey, 83% of respondents agreed with the statement: "Scenic views and viewpoints should be protected." The final question in the survey was in essay format: "Please list what you think are or will be the most important issues in town." Fifty-nine respondents mentioned scenic and rural quality concerns in their lists, second only to "zoning" at 65 mentions. The final draft of the 1995 Master Plan listed 15 areas with "significant views." They are listed in Table 8.21.

#	Subject/Observation Point	Direction
SV-1	Wonalancet Intervale - Rte. 113A, S. Side Intervale	N
SV-2	Ossipee Range View - Rte. 113A, W of Wonalancet Fire Station	SE
SV-3	Sandwich Range View - Rte 113A, 1/4 mi. NW of inter. of Fowlers Mill Rd.	NW
SV-4	Panorama - Great Hill Watchtower	360°
SV-5	Tamworth Village - Church and Ossipee Mtns., Great Hill Rd.	SE
SV-6	Ossipee Range - Gardner Hill Rd.	S
SV-7	Mt. Chocorua/Lake - Rte. 16 N of Village	N
SV-8	Chocorua River Dam - Rte. 16 at Village	NW
SV-9	Mt. Chocorua - Rte. 16 S of Village	N
SV-10	Ossipee Range - Cleveland Hill Rd. E of Bradbury Jewell cellar hole	S
SV-11	Sandwich Range - Cleveland Hill Rd.	N
SV-12	Sandwich Range - Rte. 25 E of Sandwich Line	N
SV-13	Bearcamp River - 500' W of Butler's Bridge	NW
SV-14	Mt. Whittier - Rte 113 N of Butler's Bridge	S
SV-15	Sandwich Range/Ossipee Mtns. - Bunker Hill Rd.	W-S-E

Table 8.22: 1995 Master Plan View List

After identifying specific views, the 1995 Master Plan neglected to propose what actions should be taken to preserve the views. However, the "overall goal of the Tamworth Master Plan" was to "preserve Tamworth's rural atmosphere and scenic beauty, to preserve historic sites and buildings, and to maintain and improve the visual quality of the town's landscape."

The Route 16 corridor protection study implemented by the Federal Highway Administration in the 1990s identified two views listed in the 1995 Master Plan as being important: Mount Chocorua and Lake viewed from Route 16 north of Chocorua Village, and the millpond and dam in Chocorua Village. This designation can be interpreted to confer a regionally significant status on these two views. But then, long-term exposure to a multitude of generic calendars and postcard collections will convince anyone that the view of the Lake and Mountain has international significance.

The Conservation Lands Review Committee (a sub-committee of TCC) conducted a public survey in 2005-2006 that took a broader approach to the "scenic" issue, relabeled it "aesthetic", and let respondents use their own words on most of the questions. When rated against seven other conservation issues, the importance of aesthetics scored slightly lower than aquifers, wetlands and wildlife; and scored higher than agriculture, timber, "forever wild" and vernal pools. People said "Tamworth wouldn't be Tamworth without. . ." peace and quiet, rural atmosphere, views of Mt Chocorua, winding dirt roads, clear night skies, clean water, pine scent, natural beauty, Behr and Remick farms in the village, canopied roads, big trees, glacial erratics, eskers . . . These qualities – many very difficult to pinpoint on a map of scenic sites – came up repeatedly.

"My favorite view" drew an equally diverse range of responses. However, when we separate the view focus (what we're looking at) from the view point (from where we are looking) a few winners appear. Of the 70 respondents, the absolute most favorite thing to look at was Mount Chocorua (25), with Sandwich Range and Tamworth Village tied for a distant second (7). Results were less definitive for where we like to be when taking in the scenery. The fire tower eked out the number one spot with a paltry 6 votes, beating out the two responses, "from my own yard" and "too many to choose from" by one vote. Many answers were

unique: “the brook behind the library,” “Hemenway (Duck) Pond,” “secret,” “the path up Page Hill,” “Wonalancet Brook Trail,” “Pease Hill.”

General Observations

“Beauty is in the eye of the beholder.” We would be hard pressed to find a spot in town where there wouldn’t be someone who could appreciate the gnarly tree or the starflower sheltered by a stone wall. Rural atmosphere and scenic beauty have been top concerns voiced by townspeople for the past thirty years. Preservation of aesthetic resources should be a part of every ordinance and policy of the town.

Most of the popular views in town depend on and/or consist of maintained openings. Programs encouraging these openings (current use, agricultural easements, community based agriculture) will help ensure perpetuation of our vistas and rural quality.

Rural character goes beyond scenery. It includes air quality, water quality and noise issues. Proper management of these qualities is just as important as protecting vistas.

8.13 SUMMARY

The primary focus of this Chapter is to identify the natural resources in Tamworth, recognize the role they play in giving the town its character, and acknowledge the economic and ecologic services they provide the town. A few of these resources are finite. The outwash soils used to sand our roads and build our driveways can only be mined once. The prime agricultural soils constitute a precious few acres. Many of our resources are renewable. Our forests are capable of regeneration after harvesting. The steady flow of the hydrologic cycle promises that our aquifers will be constantly recharged.

Whether finite or renewable, it is imperative that we look toward the future when managing our resources and planning for the inevitable population growth the coming years will bring. Our natural resources, whether finite or renewable, are needed to sustain our economy, our health, and our sense of place and well being. Sustainability requires a holistic approach. Everything is connected. A master plan that provides for conservation of our natural resources will ensure an environment capable of sustaining the community outlined in the vision statement.

A Scenic View of Tamworth

Everybody agrees: “The best view is from my house.” Unless it’s the view of Tamworth itself from the Sandwich Range or the Ossipees, or the view from Great Hill Fire Tower, or the view of everything from Stevenson Hill. Or perhaps it’s the view of Wonalancet Chapel across Birch Intervale, or the view from Great Hill Road of the Remick fields and the Tamworth steeple in front of Mount Whittier. Or that view of “the most photographed mountain,” looking over the Narrows Bridge and Chocorua Lake to Mount Chocorua.

But it takes more than views to make the “rural atmosphere and scenic beauty” Tamworth’s Master Plan seeks to preserve.

Tamworth is foliage that bursts into flames in October, the taste of Harry Thompson’s sweet corn, and blueberry pie still warm from the oven. It’s skiing the Tower to Town Trail, the smell of new cut hay curing in the field. Cloudless, 50-cent “Mountain Days” that demand you go hiking, and then cool off swimming in White Lake, Chocorua Lake, or skinny-dipping (I won’t say where).

Tamworth is square dancing, spring peepers, and the smell of wood smoke in late November, or during sugaring time in March. It’s black flies, sleeping porches, and a cone from the Dam Ice Cream Shop or The Other Store. Tamworth is cord wood neatly stacked, “No Trespassing with Bear Dogs” signs, political signs that spring up like too early crocuses in March, and sirens of the Rescue Squad and Fire Department speeding to save someone’s bacon.

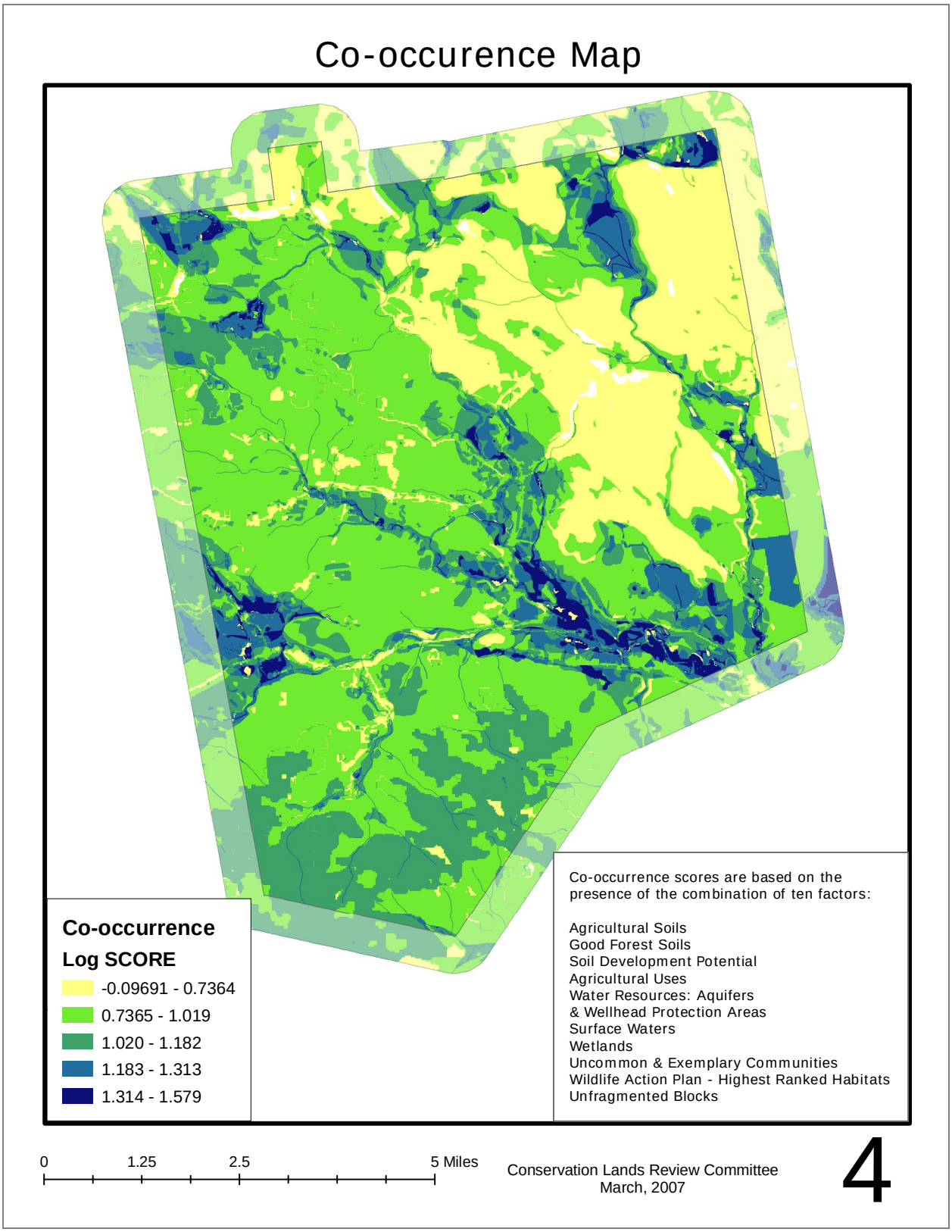
Tamworth is quiet enough to hear thrush song, the echo of loons, applause coming from the Barnstormers on late summer nights, and birdsongs on one of Ned Beecher’s Wednesday morning bird walks. Or the church bell chiming the hour in the village, the a cappella sounds of Potluck singers, bobcats yapping, the buzz of a chain saw deep in the woods, and “Music Without Boundaries” playing in the background.

And thank your lucky galaxies that Tamworth‘s night sky is dark enough to view the Milky Way, the Perseid meteor showers, and the Northern Lights.

Tamworth gets its vitality, wisdom and talent from the mix of tourists, visitors, seasonal residents, and year-rounders who make up the town. The charm comes from its libraries, theater, schools, churches, and the many organizations that make a town civilized.

Tamworth is not having to drive miles to find open space, or signs of wildlife. It’s a neighbor stopping to help, no matter what you need. It’s car wheels stuttering on a washboard road, kicking up dust in late August. It’s the smell of balsam Christmas trees and horse manure, hornfels, well water, and vegetables from the Behr’s farm or the Community School. It’s whitewater on the Bearcamp in spring, glacial erratics, fireflies, and a mud season that can swallow cars whole.

Tamworth is the smell of lilacs in your dooryard, trees sparkling when everything is covered in ice, trail signs, mosquitoes, and the smell of fresh cut timber. It’s fresh tomatoes, fiddleheads, the Big Pines Natural Area, sled dog races, succulent blackberries found in some clearing, and the sound of skaters cutting across black ice. It’s wind in the pines, granite outcrops, and old alternating green and white “Scenic” license plates nailed to a barn wall. All this and more. . . .



Map 8.23 Co-Occurrence Map