NATURAL FEATURES ANALYSIS

TABLE OF CONTENTS

MAPS **FOLLOWING PAGE**

NATURAL FEATURES

I. INTRODUCTION

The natural features chapter of the Master Plan uses the environmental criteria of topography, soils, and water resources to evaluate the town's land area and its potential for various types of development. Although natural features can often enhance a particular development site, they just as often pose significant barriers to development; this can be seen by examining locations where existing development has occurred. It is true that transportation routes are another factor in the location of development; however, to a great degree, the location of roads and railroads are also determined by the natural features of the land.

This section enables the Planning Board to address areas of the town that are most suitable for development and high intensity land uses, and evaluate the existing limitations of the land that would have to be accommodated. Environmental limitations may include steep slopes, seasonally wet soils, wetlands, floodplains, shallow bedrock, and underground aquifers.

This section also points out the areas of town that deserve special protection due to the environmental function of the land, for example, a specific wetland area that provides flood water storage during times of heavy rain. In addition, this section notes specific areas the Town may wish to conserve for future community use due to their aesthetic or historic qualities. Not all open spaces need to be steep slopes or wetlands. Some areas may be prime lands set aside for future school sites, parks, intensive farming operations, or other limited low intensity land uses that add value to the overall community.

Greenfield has many natural features that make the Town a very desirable place to live. Outside of the downtown area, the Town is still quite rural with many rolling hills, green fields, streams and waterbodies. Greenfield is also in close proximity to Peterborough and Milford, two regional economic and employment centers. Outside of the downtown area, lots are often five acres or more in size. As the value of land increases, there is greater motivation to subdivide larger parcels and sell smaller lots. This natural features analysis can assist the Town and the Planning Board in establishing appropriate locations for growth to occur, while at the same time preserving the natural environment that the residents currently enjoy.

II. TOPOGRAPHY

The topography of Greenfield is dominated by Crotched Mountain in the north and North Pack Monadnock in the south. Crotched Mountain lies in the three towns of Greenfield, Bennington, and Francestown. The mountain's highest elevation is actually in Francestown (2,020 feet above sea level); in Greenfield the highest elevation is 1,500 feet, in the northeasterly corner of the town, going down to 900 feet at Sunset Lake.

North Pack Monadnock has the highest elevation in town, ranging from 1,300 feet at Mountain Road up to over 2,200 feet at the highest point just north of the Temple town line.

Gould Hill in the south-central part of town and Blanchard Hill on the eastern side of town are two other concentrated areas of high elevation, although they do not exceed 1,200 feet. The

western and central parts of town have the lowest elevations, ranging from 700 to 900 feet above sea level.

III. SOILS

As mentioned earlier, soils information is an important consideration in land use planning since the various characteristics of soils can have such an impact on land use – such as steepness, wetness, flood susceptibility, etc. These various aspects are examined briefly below. Soil information for Greenfield was obtained from the following sources:

1) Soil descriptions and mapping: Soil Survey of Hillsborough County, New Hampshire, Western Part, published by the US Department of Agriculture Soil Conservation Service, October 1985.

2) Soil development capability: Soil Potential Ratings for Development; Hillsborough County, NH, prepared by the Hillsborough County Conservation District in August 1984.

According to the above-referenced soil surveys, the landscape in western Hillsborough County is hilly and characterized by large areas of loamy soils with numerous stones on the surface. The area in which Greenfield is located is drained by the Contoocook River and the Souhegan River, both of which flow into the Merrimack River. The generalized soil map for this area indicates that much of Greenfield's land area – in the south and west – is comprised of excessively drained soils.

A. STEEP SOILS

Generally speaking, the steeper the land the greater the possibility for erosion and sedimentation, and the more problems can be encountered in siting wells and septic systems.

Steepness is measured in terms of slope, which is defined as the change in elevation (vertical distance) over horizontal distance; the more abrupt the change in elevation, the steeper the slope. Slope is measured and expressed as a percentage that represents the relationship between elevation and horizontal distance.

Typical categories that might be seen on a slope map are 0-8%, 9-15%, 16-24%, and over 25%. Land in the 0-8% slope category is generally preferred for all types of development. Gradual slopes are most favorable for building roads, and public water and sewer facilities can be installed at the least cost to the community. Also, excavations for most structures can be done at a minimal cost and the erosion associated with such work can be reduced easily on-site. The exceptions to this would be wetland areas and floodplains because they occur primarily in the 0-5% slope range. An examination should be made as to the environmental function of such wetland and floodplain areas, as well as the risks that might be inherent in development before such lands are utilized for building sites.

As the slope increases to the 8-15% category, the land is more suited to less intensive forms of development. Carefully placed residential dwellings and some agricultural uses (orchards and field crops) may be suitable for this terrain. As development approaches a

15% gradient, it requires more careful consideration for all types of development. Once a slope exceeds a 15% gradient, all forms of development are considered unsuitable, although it is really at the 25% slope and above that development becomes very problematic. These areas have benefits as conservation areas for low intensity recreational uses and wildlife habitats. Also, their disturbance can create serious erosion problems, washing out topsoil and even roadways downhill. Forestry practices on such slopes must be confined to low-impact operations, with proper erosion controls in place. Other important controls for forestry uses include minimal basal area cutting (definitely no clear cutting), and skid roads designed for steep slope harvesting.

When developing steep terrain, the potential for environmental damage increases as the slope gradient increases. Overly steep slopes consisting of sands and gravels left after the excavation of an area will quickly gully and erode. Erosion control barriers should be in place at the time of excavation and prompt reseeding and regrading should take place afterwards. Surface water run-off rates and erosion factors increase as the slope steepens. This will cause sedimentation of the surface waters downslope and will clog stream channels and rivers if no erosion controls are in place.

Greenfield has only six soil types associated with steep slopes, which are primarily found on the sides of hills, along ridgetops, and as rocky outcrops void of soil cover; they are listed below:

TABLE #1:
STEEP SLOPE SOIL TYPES

SYMBOL	SOIL TYPE	CHARACTERISTICS	SLOPE	SUITED FOR	NOT SUITED FOR
76D	Marlow Loam	Moderately steep, well drained	15-25%	Tree Farming	Building site development, septic systems, recreation
77D	Marlow Stone Loam	Moderately steep to steep, well drained	15-35%	Tree Farming	Building site development, septic systems, recreation
143D	Monadnock Stony Fine Sandy Loam	Moderately steep to steep, well drained	15-35%	Tree Farming; source of sand for construction	Building site development, septic systems, recreation
161D	Lyman-Tunbridge-Rock Outcrop	Moderately steep to steep, exposed bedrock	15-35%	Tree Farming	Building site development, septic systems, recreation

	Complex				
22E	Colton Loamy Sand	Moderately steep to very steep, excessively drained	15-50%	Tree Farming; source of sand and gravel for construction	Building site development, septic systems, recreation
36E	Adams Loamy Sand	Moderately steep to very steep, excessively drained	15-50%	Tree Farming; source of sand for construction	All types of recreation development

SOURCE: Soil Survey of Hillsborough County, New Hampshire,1985

Examination of the accompanying *Steep Slopes* map indicates that the northern, southern and eastern areas in Greenfield are the ones most affected by 15% or greater slopes. The northern area is of course Greenfield's part of Crotched Mountain, which also lies in Bennington and Francestown. The area in the south of town is part of North Pack Monadnock Mountain, with elevations rising from 1,300 feet above sea level at Mountain Road to 2,278 feet at the highest point – which is, in fact, the highest elevation in western Hillsborough County. Blanchard Hill and Gould Hill, on the eastern side of town, do not have the same elevations or steepness, but do have over 25% slopes.

B. WETLAND SOILS

Wetland soils in Greenfield are those that the soil survey categorizes as being poorly drained (Hydric A) and very poorly drained (Hydric B); the location of these soils is illustrated on the accompanying *Wetlands and Hydric Soils* map. The wetland areas in Greenfield are predominantly situated in the west central part of town, between Forest Road and the Peterborough town line. These wetlands are associated with Otter Brook and the surrounding area.

Directly abutting Powder Mill Pond is another fairly large deposit of wetland soils; and there are several, smaller, pockets of wetland soils distributed around town, mostly to the east of the Village area.

The soil types and characteristics that make up the wetland soils are described below in Table #2.

TABLE #2:
WETLAND SOIL TYPES

SYMBOL	SOIL TYPE	CHARACTERISTICS	SUITED FOR	NOT SUITED FOR
15	Searsport Muck	Nearly level and very poorly drained	Habitat for wetland wildlife. Probable source of sand for construction	Building site development, septic systems, recreation development, and farming

105	Rumney Loam	Nearly level and poorly drained	Habitat for openland, woodland, and wetland wildlife. Probable source of sand for construction	Building site development, septic systems, some types of recreation development, and farming
197	Borohemists, ponded	Nearly level and very poorly drained	Habitat for wetland wildlife	Most uses
214A	Naumberg Fine Sandy Loam	Nearly level and somewhat poorly drained and poorly drained	Habitat for openland, woodland, and wetland wildlife. Probable source of sand for construction	Building site development, septic systems, recreation development, and farming
247B	Lyme Stony Loam	Nearly level to gently sloping and poorly drained	Habitat for woodland wildlife	Building site development, septic systems, recreation development, and farming
295	Greenwood Mucky Peat	Nearly level and very poorly drained	Habitat for wetland wildlife	Most uses
395	Chocorua Mucky Peat	Nearly level and very poorly drained	Habitat for wetland wildlife. Probable source of sand for construction	Most uses
495	Ossipee Peat	Nearly level and very poorly drained	Habitat for wetland wildlife	Most uses
549	Peacham Stony Muck	Nearly level and very poorly drained	Habitat for wetland wildlife	Building site development, septic systems, recreation development, and forest management
647B	Pillsbury Stony Loam	Nearly level to gently sloping, somewhat poorly drained and poorly drained	Habitat for woodland wildlife	Building site development, septic systems, and recreation development

SOURCE: Soil Survey of Hillsborough County, New Hampshire,1985

C. AGRICULTURAL SOILS

The 1985 Master Plan indicated that agriculture was still an important factor in Greenfield's land use, and a map was included that illustrated the soil types that are categorized as being suitable for farming.

The Hillsborough County Soil Survey also designates prime farmland, which is land of major importance in meeting the nation's needs for food and fiber. Of the nine soil types that are considered to be prime farmland, only four of them are found in Greenfield. Furthermore, they represent a very small area of land, and are scattered about the town in such a way as to preclude the possibility of any type of large-scale farming.

Agricultural soils, on the other hand, cover most of the town, but this does not mean that farming is conducted all over town. Some of these soils may be suitable for only specific crops. The LESA (Agricultural Lands Evaluation and Site Assessment) manual should be consulted when a choice needs to be made regarding the use of one particular farmland over another, depending on whether the use is for farming or general development.

IV. FLOODPLAINS

Floodplains are land areas that are susceptible to flooding. These areas actually have two parts: the floodway and floodway fringe. The floodway includes the channel and an additional area that often carries excess flow. The floodway fringe (more commonly known as the 100-year floodplain or the Special Flood Hazard Area) is a broader area over which floodwater may spread, but where the flow velocity is slower. This is an important distinction for land use planning, since some uses can safely occur in the Special Flood Hazard Area, but not in the floodway.

The Federal Emergency Management Agency (FEMA) has mapped the floodplains for all relevant municipalities; the boundaries of the floodplains were computed at cross sections interpolated between cross sections, based on hydraulic information and past experience of flooding. Flood Insurance Rate Maps (FIRM) define the 100-year floodplain (meaning there is a 1 out of 100 chance of flooding in any given year; over long periods of time, base floods will occur on the average once every 100 years), and an area of 500-year floodplain (a 1/5 out of 100 chance of flooding in any given year).

The Flood Insurance Rate Maps for Greenfield became effective May 1, 1980, and the Town then entered into the National Flood Insurance Program, which permits homeowners who live in the floodplain to purchase insurance for their property. However, in order for landowners to be able to purchase this insurance, the Town needed to adopt a Floodplain Management Ordinance, which it has done. This Ordinance requires the Town to keep track of all development in the Special Flood Hazard Areas (SFHA) and ensure that if any new construction or substantial improvements to a home are proposed for the SFHA, the lowest enclosed floor must be at or above the base flood elevation.

The purposes of this requirement are to minimize the potential for flood damage, to avoid damage-prone uses in the floodplains, and to reduce development pressure of flood hazard areas. Communities that do not maintain and/or enforce their floodplain regulations may be suspended from the insurance program, which could have serious consequences for any affected landowners if their mortgage holders wished to cancel the mortgage. For these reasons, it is very important for the Town to keep the Floodplain Management Ordinance up to date by amending it as necessary, and to monitor all development within these areas.

Greenfield has only a small amount of floodplain, primarily located in four distinct areas in town:

1. Abutting Powder Mill Pond, from Bennington to the Peterborough Town Line;

2. Along Otter Brook, from Otter Lake to Slip Road and down to Cornwell Road;

3. Along Rand Brook in the northeastern part of town; and

4. In the southeastern corner from Russell Station to Lyndeborough Mountain Road. These floodplain areas are also consistent with much of the wetland soils identified by the County Soil Survey.

V. WATER RESOURCES

Greenfield has a land area of approximately 26.2 square miles, or 16,778 acres. Surface water accounts for only approximately 350 acres. Aquifers, or groundwater, are also included in this analysis, since they provide an important source of water for private and community wells. A description of the town's watersheds, waterbodies, watercourses, and aquifers is presented below.

A. WATERSHEDS

The watershed is the principle focus in describing a surface water system. A watershed is the land area made up of a series of connecting higher ridges that drain surface water to the lowest point, which is where a stream or a river flows out of the watershed.

Greenfield is situated within portions of three major watersheds: the Upper Contoocook River, the Piscataquog River, and the Sougehan River Watersheds, all of which lie within the Merrimack River Basin; the location and extent of these watersheds can be seen on the accompanying *Stratified Drift Aquifers with Watersheds/Basins, Southwest Region* map.

B. WATERBODIES

Greenfield has six waterbodies, listed below:

1. Powder Mill Pond – 435 acres, on the border with Bennington and Hancock.

2. Otter Lake – 61.2 acres, located in the west central part of town, just north of Forest Road.

3. Sunset Lake – 30.9 acres, located to the north of the intersection of Sawmill and Crotched Mountain Roads.
4. Zephyr Lake – 30.9 acres, on the west side of Route 31 south.

5. Hogback Pond – 9.89 acres, situated between Sawmill and Forest Roads, just to the northwest of the Village.

6. Mud Pond.

The first five ponds on the list are classified by the NH Department of Environmental Services as Public Waters, which means that they are subject to the state Comprehensive

Shoreland Protection Act (RSA 483-B). This law was enacted in 1991, and establishes standards for the subdivision, use and development of the land around the state's public waters, defined as all land located within 250 feet of the water.

C. WATERCOURSES

Greenfield's most significant watercourse is the Contoocook River, which forms the Town's border with Hancock, and therefore shares the river. In addition, there is Otter Brook that runs south and east from Otter Lake into Zephyr Lake. Rand Brook runs east to west between Francestown and East Road, crossing into Lyndeborough.

D. AQUIFERS

Aquifers are concentrations of groundwater, found where saturated layers are permeable and the storage and transmission of water can take place. Aquifers are resupplied through precipitation, surface water, wetlands, lakes and streams. The water then moves to a saturated zone (aquifer) where the pore spaces between soil particles are filled by the water. It is very important that the surface of the earth be able to transmit water so that a certain percentage can be stored underground. Excessive compaction or extensive covering of the land surface reduces the volume of groundwater which, as stated earlier, affects the supply of water to wells.

Aquifers of medium to high potential occur in Southwest New Hampshire as unconsolidated deposits of sand and gravel, or in bedrock fractures (known as consolidated deposits). The unconsolidated deposits, also called stratified drift deposits, contain sorted layers of gravel, sand, silt and clay - occurring chiefly in valley bottoms. These materials have abundant pore space to store water, and pore space may amount to more than 30 percent of the total volume of the deposit. Consequently, these stratified deposits of sand and gravel have become good sources of medium to high volume aquifers.

The consolidated deposits, or bedrock fractures, are a more productive water source when the bedrock is overlaid by a layer of sand gravel, which allows the recharge to occur directly from above. They are usually adequate for domestic wells. In contrast, a till aquifer will typically have a lower-yielding well life. This is due to a mixture of clay, silt, gravel and boulders that tend to compact due to the different soil particle sizes. The transmission and storage of water is greatly decreased in this type of aquifer. The water table (the top of the saturated zone) can fluctuate, depending on the volume recharge to aquifer material.

Groundwater in saturated soils is generally vulnerable to pollution because surface contamination can infiltrate directly into it. It is possible, however, to trace the source of pollution by finding the watershed boundary. Once a pollutant enters an aquifer, it may remain in place for an indeterminate period of time. While pollutants can enter an aquifer easily because sand and gravel are porous and transmit water rapidly, once in the aquifer their movement is then governed by groundwater flow, which moves very slowly through the tiny pore spaces of the glacial till.

Sources of aquifer pollution are frequently located on the ground surface directly above or contiguous to the aquifer: septic tank effluent, landfill refuse, leakage from sewer lines

or ruptured fuel tanks, agricultural fertilizers and pesticides are among the many possible sources of pollution for an aquifer. In addition to these potential contaminants are the materials such as fuels, lubricants or other toxic materials associated with earth excavation, an activity that is, of course, directly associated with sand and gravel aquifers.

The US Geological Survey provides aquifer delineation maps for the entire state. The map is essentially a surficial geology map, showing the distribution of unconsolidated (not bedrock) geologic material on the land surface. There do exist bedrock aquifers, but these were not part of this particular study. This study identifies areas of sand and gravel and measures the rate of transmissivity - that is, the speed with which water passes through the materials, in increments of 1,000 feet squared per day.

The *Stratified Drift Aquifers with Watersheds/Basins* map for Greenfield identifies several areas of these groundwater deposits, with one particularly large area that covers the entire central part of Town. This is significant, considering the discussion above about the potential effects of covering over the ground under which aquifers lay.