Chapter 2

GEOLOGY AND TOPOGRAPHY

Geologically, the State of New Jersey is comprised of four physiographic provinces running roughly from north to south: the Appalachian Valley and Ridge, the Highlands, the Piedmont Plain, and the Coastal Plain. Chatham Township lies within the Piedmont Plain in the mid-state region (Figure 3).

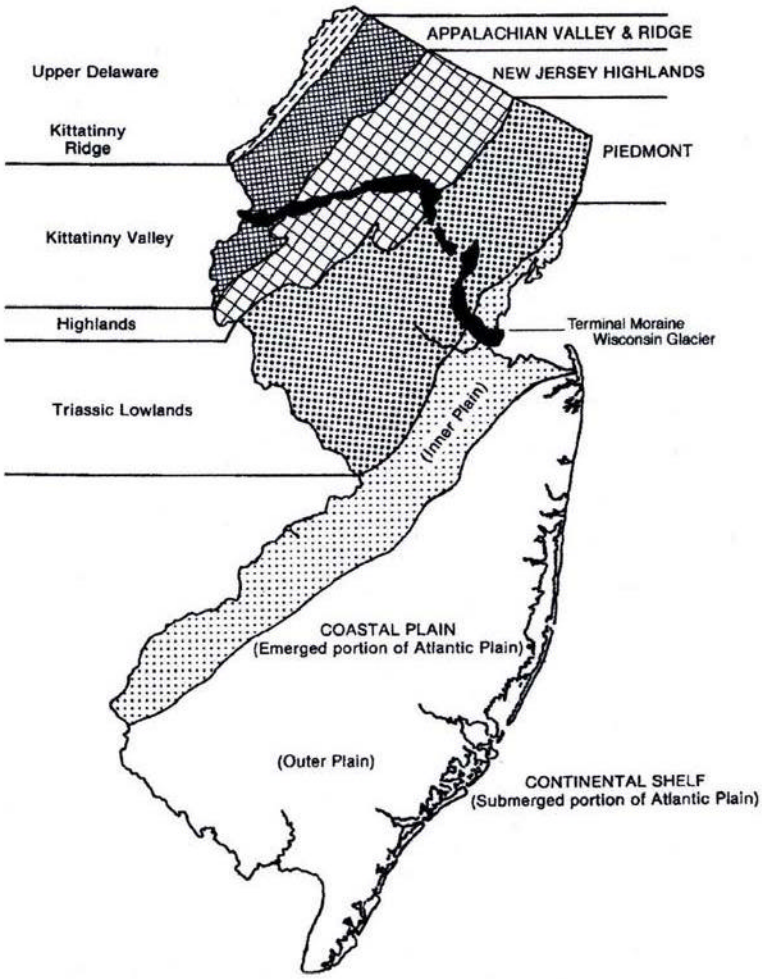

Figure 3—Physiographic Map of New Jersey

Source: Adapted from Map of Geomorphic Provinces of New Jersey, Peter E. Wolfe

Bedrock Geology/Geography

Chatham Township's physical features are dominated by Long Hill, the third and westernmost of three parallel ridges known as the Watchung Mountains, which rise from 200 to 400 feet above the neighboring terrain. These were formed during the Triassic Period of geological history. There were once extensive swamps and lakes in this area which were part of a general system extending from eastern Pennsylvania through northwestern New Jersey. Over time, thousands of feet of sediment settled in these lakes and swamps, eventually compressing into red colored sandstones and shales. From time to time, lava flowed from volcanic activity, which cooled into hard, dark colored rock called basalt, was extruded over the sedimentary material, and then was covered by more

sediment. The whole complex of softer layers of sandstone and shale and harder layers of basalt were slowly uplifted along one side so that it now slopes downward 8-10 degrees towards the northwest to a fault close to the present alignment of Route 202. The softer layers of sandstone and shale have weathered and eroded more quickly, leaving long broad valleys between the three ridges formed by the more resistant basalt. Long Hill, as it passes through Chatham Township, rises 250 to 300 feet directly and steeply up from the Passaic River floodplain, then slopes more gently down its north side toward the Great Swamp (Figure 4).

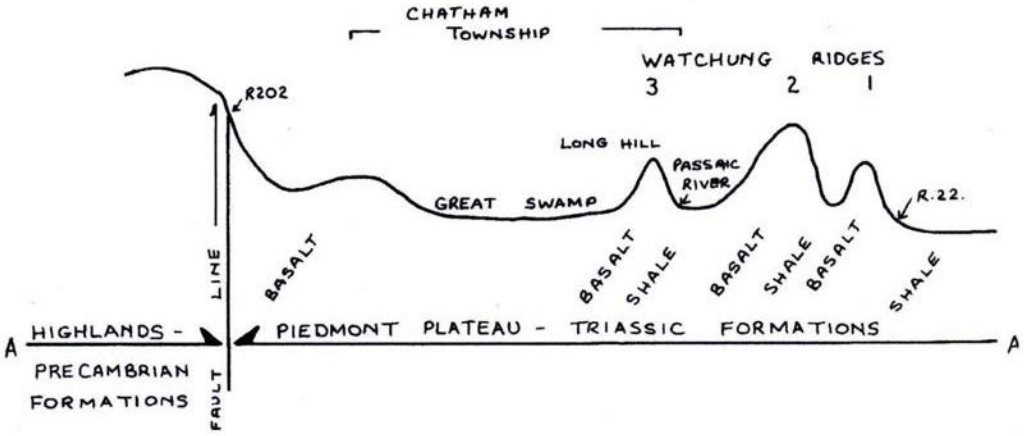

Figure 4—Geologic Cross-Section

Figure 4A below shows the bedrock formations within Chatham Township.

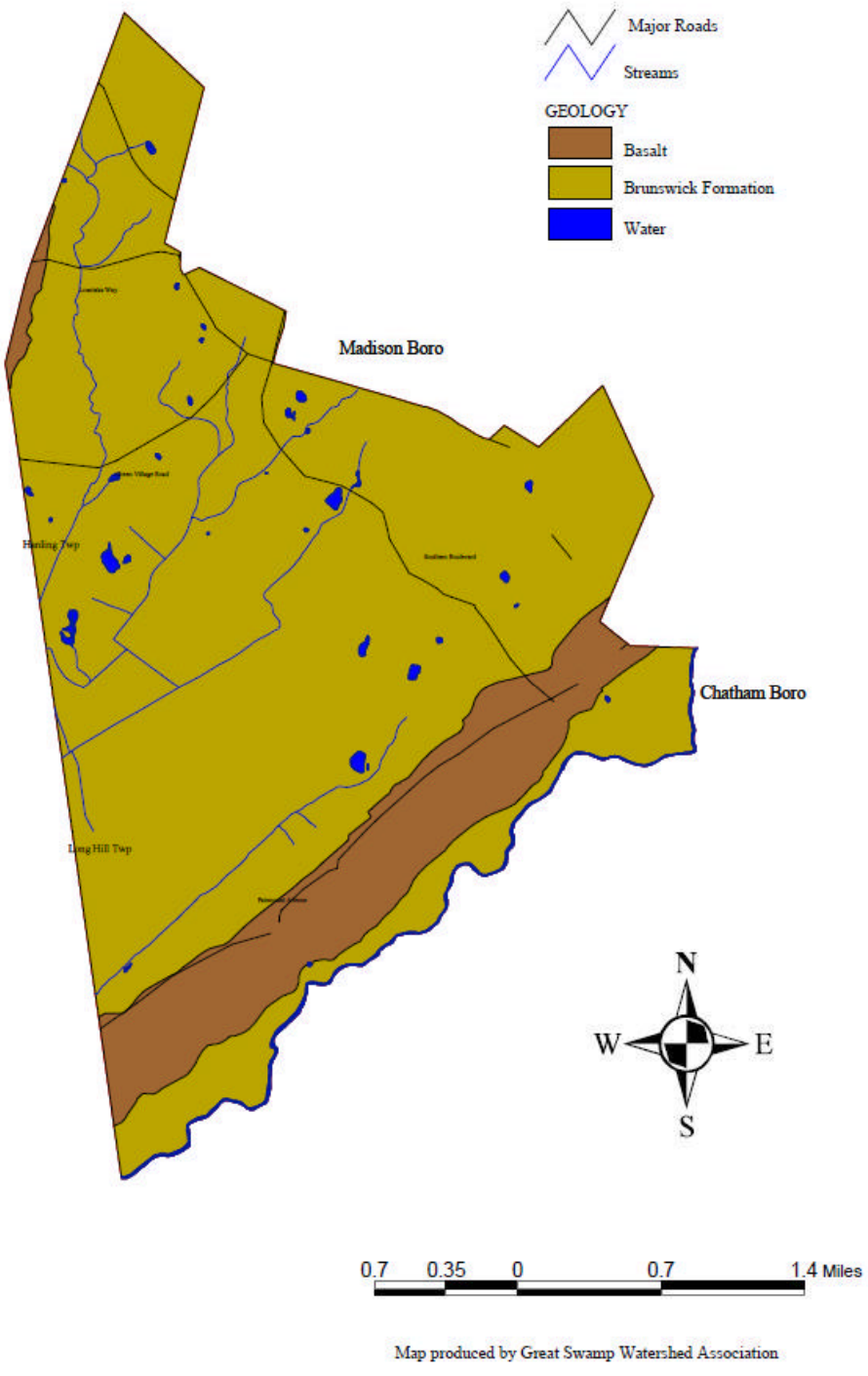

Figure 4A Map produced by the Great Swamp Watershed Association

The Wisconsin Glacier

Superimposed on this bedrock foundation of basalt, shale, and sandstone are extensive deposits left by the last glaciation. The "Wisconsin Stage" of the glacial epoch, which lasted 56,000 years, is largely responsible for much of our current topography. The Wisconsin, or most recent glacier, reached its southernmost advance in Chatham Township.

Temporary lakes were formed during this period, the largest of which was the Glacial Lake Passaic. Our Great Swamp is a vestige of this lake, which drained long ago. The forward edge of the advancing glacier brought enormous amounts of rocky rubble and finer material, which the melting ice then deposited as a long, low ridge of debris called a "moraine." Present day Route 124 now runs through Chatham Borough, Madison, and into Morris Township along, or close to, the top of this terminal moraine (Figure 5). The moraine's surface appearance is now that of a wide, gently rolling, wooded hill or ridge with occasional deep potholes, often filled with water, where glacial ice blocks melted while material was being deposited around them. Kelly's Pond, in the eastern part of the Township, is an example of such a pond.

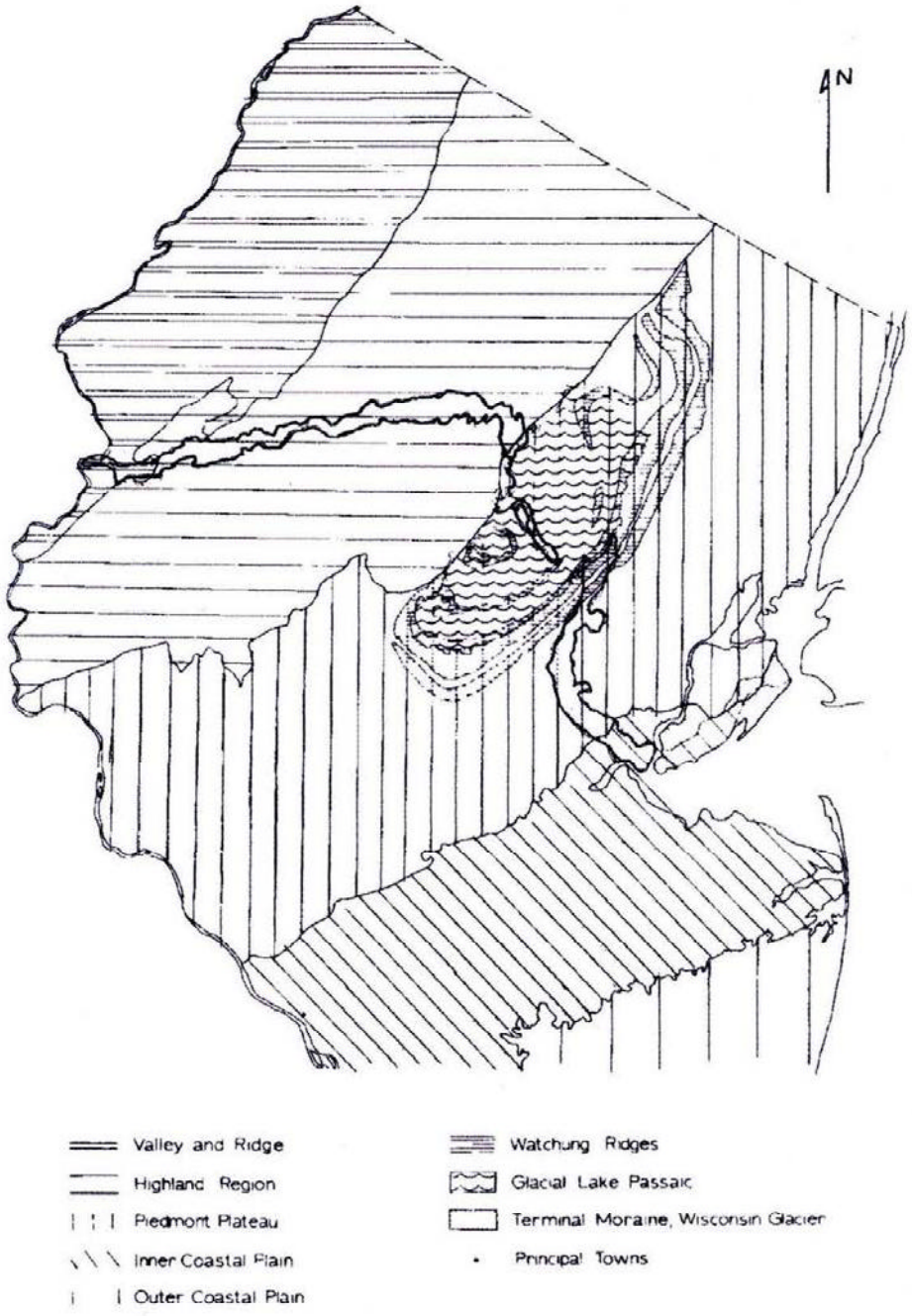

Figure 5—Geologic Map of Northern New Jersey

The meltwater of the glacier washed material from the terminal moraine into the basin to the west, now known as the Great Swamp. Coarser stones and sands were deposited in irregularly shaped patches and mounds near the moraine. The meltwater was caught in a natural basin formed by the Second Watchung Ridge and eventually filled in. For thousands of years the region was inundated by a lake whose size and depth fluctuated with time. Fine particles of sediment carried by the water settled to the bottom of the lake, forming a thick layer of clay (Figure 6).

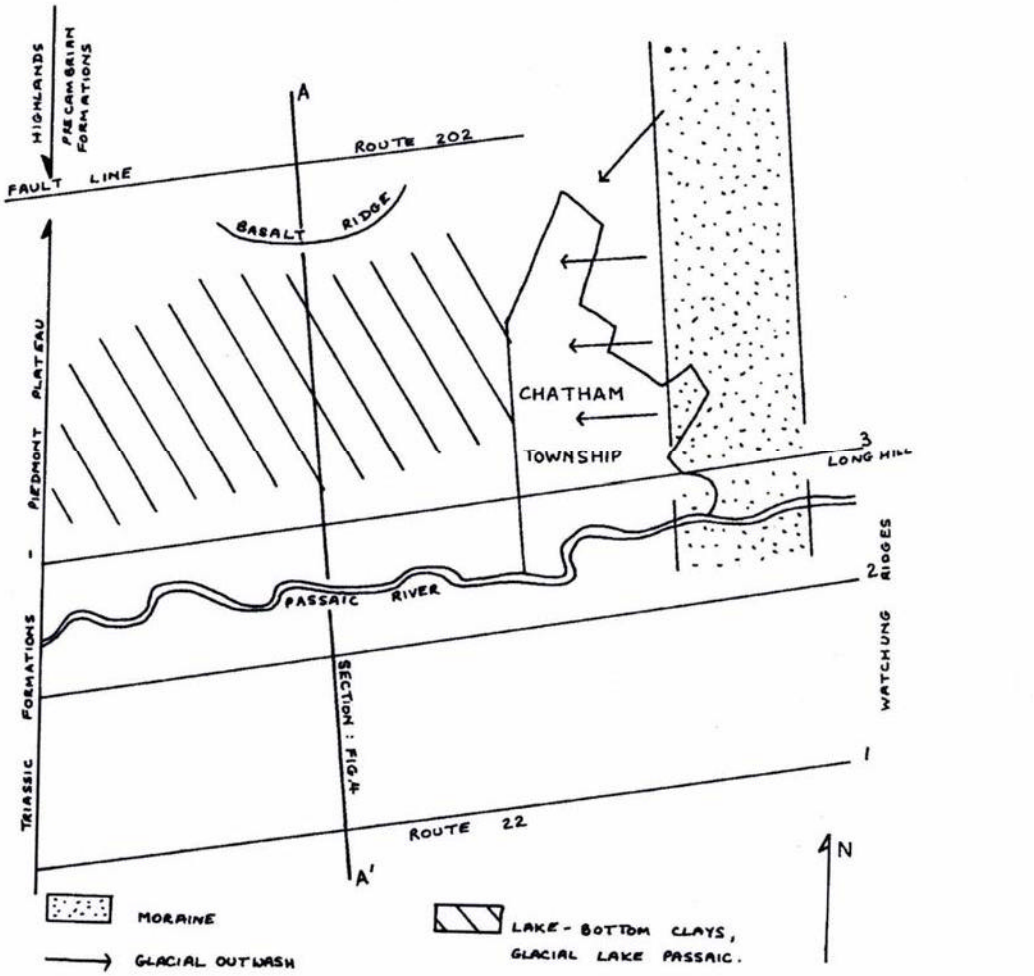

Figure 6—Geologic Map of Chatham Township

These geologic occurrences have determined the shape and form of the local landscape. The flow and storage of water on and beneath the surface of the land and the physical properties of the local soils also result from them.

Buried Valley Aquifer

Chatham Township is one of the thirty-one towns that are in the 80 square mile area of the Buried Valley Aquifer. This is one of the valley fill aquifers created by glacial action. The valley aquifer systems are composed of buried, pre-glacial valleys filled with sediments of glacial and postglacial origin that contain large quantities of water. (See Figure 7.) This aquifer system is extremely productive. Because over half a million people, or ninety percent of the thirty-one municipalities in the Buried Valley Aquifer region, rely on the aquifer for their water supply, the U.S. Environmental Protection Agency designated it as a sole source aquifer. This designation recognizes the rimary dependence of these towns on this drinking water source. Towns depending on the Buried Valley Aquifer include Madison, Chatham Borough, Florham Park, and East Orange.

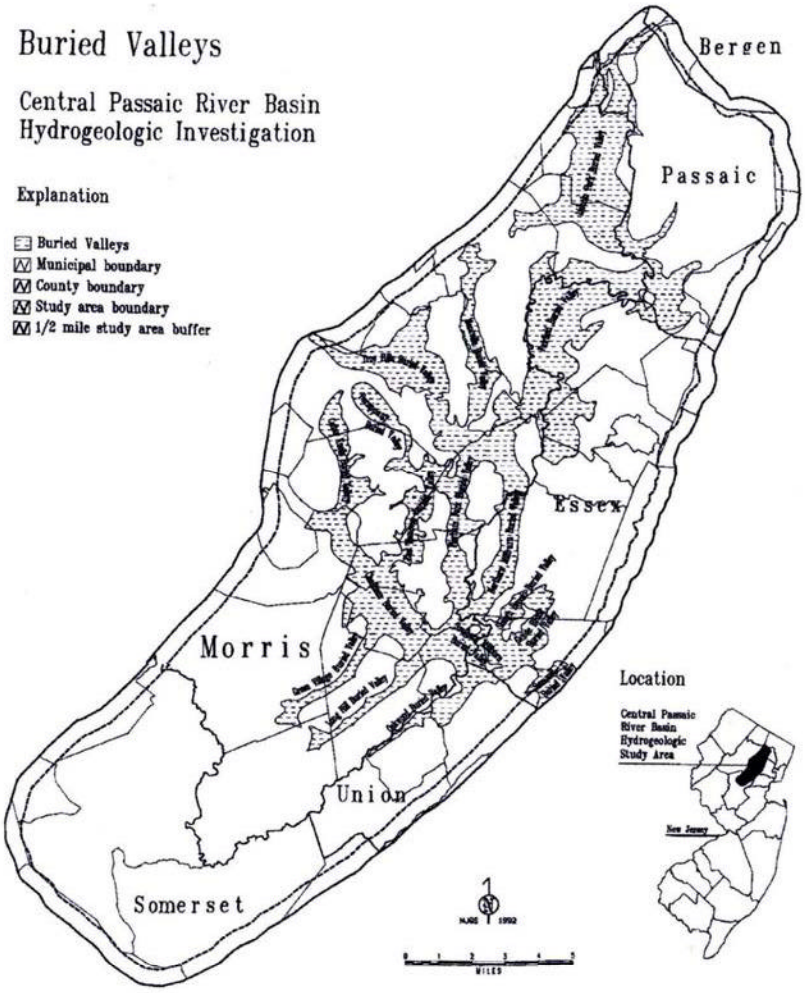

Figure 7 — Buried Valleys

Recharge for the Buried Valley Aquifer

In the early 1990's, the New Jersey Geologic Survey conducted studies to locate the recharge area where precipitation infiltrates the surface for the Buried Valley Aquifer. Locally, the Survey identified, as a prime recharge area, a band of land running roughly across the northerly part of Chatham Township between Southern Boulevard and Shunpike Road, extending to the west, on either side of Woodland Road. (See Figure 8.)

Chatham Township and Madison have designated a 50 acre tract of land bounded by Woodland Road and Loantaka Way as the "Loantaka Moraine" that is located in the recharge zone. The area contains recharge soils as well as wetlands and both towns have worked for its preservation. The twenty-six acres in Madison was purchased by the Morris County Park Commission. The twenty-four acres in Chatham Township remain in private hands as of the end of 2012.

Figure 8 - Recharge Area, Buried Valley Aquifer

TOPOGRAPHY

STEEP SLOPES IN CHATHAM TOWNSHIP

Slopes are important parts of the landscape from both an aesthetic and practical point of view. Practically, during development planning, attention must be given to slope stability. Stability of slopes is determined by:
- steepness
- length
- subsurface geology
- soil characteristics (erodibility, percolation rate)
- amount and type of vegetative cover
- climate (precipitation, wind, freezing and thawing)

The U.S. Natural Resources Conservation Service and the State Development and Redevelopment Plan (SDRP) provide the following characterizations of steep slopes:

Minor Slopes – Less than 10 percent
- minor slopes are best suited for development and less costly to develop;
- ponding, runoff, and erosion may be a problem on nearly level slopes from 0-2 percent, unless the soils are well drained;
- erosion can occur on slopes as slight as 2-3 percent, depending on soils. Soils that percolate readily tend to be less erodible than less pervious soils, such as clays;
- slopes of 5-10 percent present moderate septic problems because of possible seepage.

Steeper Slopes – Greater than 10 percent
- steeper slopes are more erodible, need special storm water management and roadway specifications, and raise costs for utilities, sewers, and other infrastructure;
- slopes greater than 15 percent have soils that tend to be thin and less fertile;
- slopes from 10-25 percent should be left in a natural condition, carefully maintained in grass or tree cover, or used as pastureland; construction on such areas can increase the sediment load of streams 100-fold;
- slopes greater than 25 percent should be left alone but can provide good sites for passive recreation or wildlife.

The Results of Disturbing Slopes

Disturbing the plant life, drainage patterns, topography or soils of slopes often increases the amount and speed of runoff and can cause erosion, soil creep, slumping (sections of soil shifting down and outward on the slope), and landslides. When a hillside is cleared, the usual result is more and faster runoff, especially when grading has smoothed a slope's natural roughness. Leaves and branches no longer shield the soil from wind and rain; roots no longer hold the soil in place; and the smoother slope allows the runoff to travel faster, increasing erosion and decreasing groundwater recharge. These problems become progressively worse as slopes get steeper.

Steep sloped lands are also often times characterized by other environmentally sensitive conditions including increased erosion, soil instability, and shallow depths to bedrock. The combination of these conditions contributes to the fact that highly sloping ground has the potential of being inherently unstable, thus increasing the potential problems associated with the development of such land (Legget and Karrow 1983). Specifically, development of steep slopes can also affect the ability of the prevailing soils to infiltrate precipitation. This occurs as a result of soil compaction, the disturbance of thin soils, the removal of vegetation or the exposure of bedrock. This promotes an increase in runoff and can lead to additional instability of the down gradient soil and rock.

Steep slopes in Chatham Township

In Chatham Township, steep slopes can be found in many areas. Most noticeable are those above the Passaic River along the third Watchung Ridge. Steep slopes exist also:
- west of the Hickory Tree shopping center and north of Shunpike Road

- west of Loantaka Way, north of Shunpike Road terminus
- along Spring Valley Road.
(See Figures 8A and 8B).

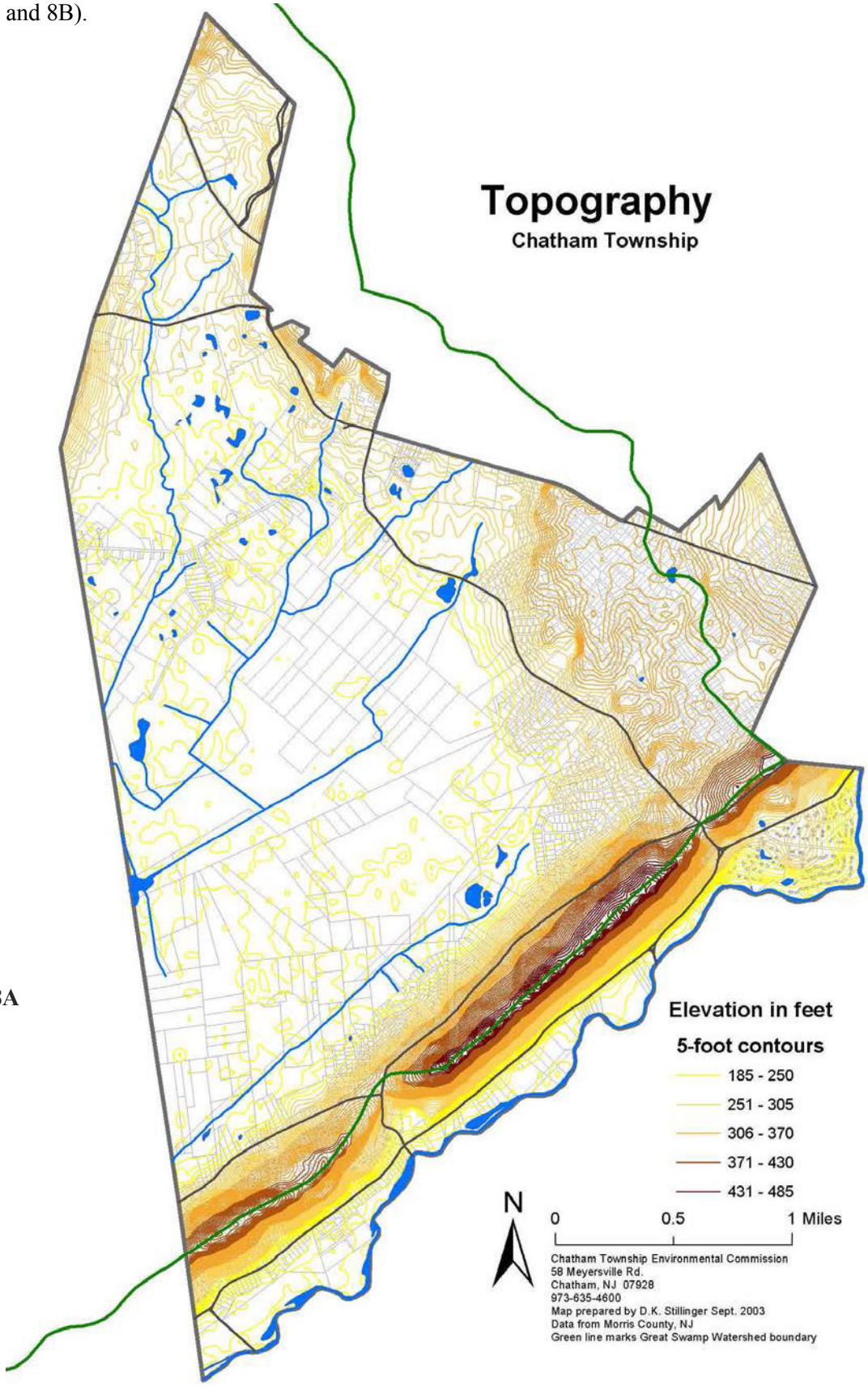

Figure 8A

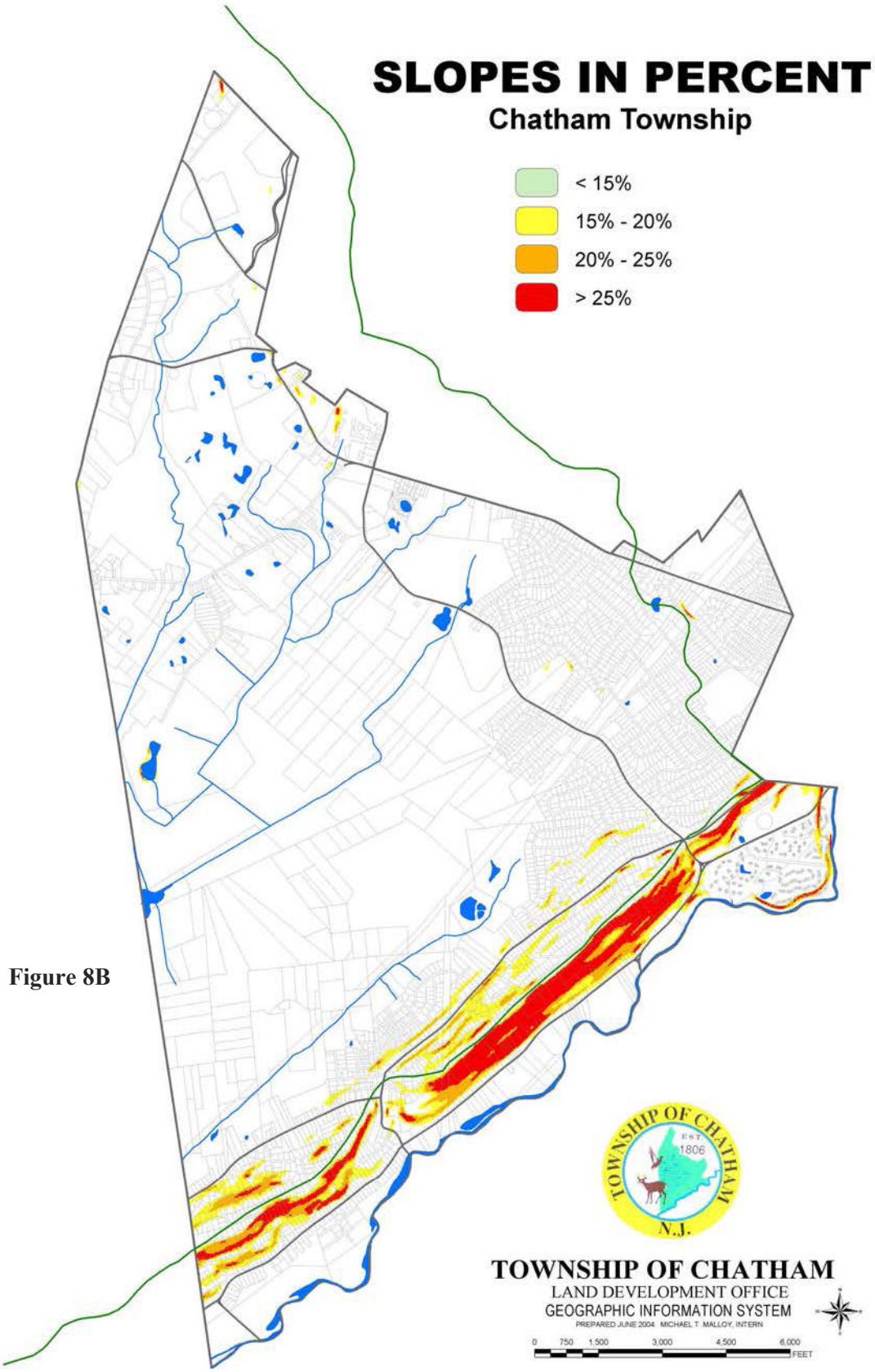
SLOPES IN PERCENT
Chatham Township
< 15%
15% - 20%
20% - 25%
> 25%
TOWNSHIP OF CHATHAM
LAND DEVELOPMENT OFFICE
GEOGRAPHIC INFORMATION SYSTEM
PREPARED JUNE 2004 MICHAEL T. MALLOY, INTERN
0 750 1,500 3,000 4,500 6,000
FEET
TOWNSHIP OF CHATHAM
EST 1806
N.J.

Figure 8B

Slopes of the Third Watchung Ridge in Chatham Township range from 10 to over 25 percent. The ridge west of River Road and the Passaic River measures approximately 4 miles. This area has remained largely undeveloped due to the development constraints posed by the slopes.

The soils along this ridge reflect severe development constraints for town and country planning according to the Morris County Soil District Soil Survey. The dominant soil groups include:
- Boonton gravelly loam on 8-15 percent slopes and are characterized as having severe limitations for local roads, streets, and parking lots.
- Ellington fine sandy loam on 8-25 percent slopes and are characterized as having severe limitations of foundations lawns, landscaping, septic tank fields, local roads, streets and parking lots, picnic and play areas.
- Holyoke-Rock outcrop complex on 15-35% slopes with severe constraints for all categories of town and country planning because of the hard, steep bedrock at a depth of less than 1½ feet and rock outcrop.
- Klinesville shaley silt loam, on 25-35 percent slopes with severe constraints for all categories of town and country planning because of bedrock at a depth of less than 1½ feet.

Slopes north of Shunpike Road and west of Loantaka Way are characterized by highly permeable sandy soil and are included in a recharge zone identified by the NJ Geological Survey. They are dominated by Riverhead soils which have moderate development constraints with erosion and ground-water pollution potential.

Slopes along Spring Valley Road are characterized by wet soils. The slopes are dotted with spring and seeps and are fairly shallow. The soil groups include:
- Preakness, characterized by high water table soils and severe limitations for all categories of development.
- Pompton, characterized by frequent flooding, seasonal high water table and severe limitations for all categories of development.

BIBLIOGRAPHY

Acting Locally: Municipal Tools for Environmental Protection, ANJEC, 2002.

Environmental Resources Inventory, Madison Environmental Commission, 1982.

Fay, Elaine and Charles A. Stansfield, Jr. *New Jersey, Yesterday and Today*
New Jersey: Silver Burdett and Ginn, 1990.

Hoffman, Jeffrey. Presentation, New Jersey Geologic Survey, 1997

Kummel, HB. *The Geology of New Jersey*. New Jersey Geological Survey, 1940.

Lucey, Carol S. *Geology of Morris County in Brief.* New Jersey Bureau of Geology and Topography, 1972.

Natural Resource Inventory, Union Township (New Jersey), 2003.

Plan of Study for the Central Passaic River Basin, Hydrogeologic Investigation. NJ Geologic Society, NJ Department of Environmental Protection

Salisbury, R.D. *The Glacial Geology of New Jersey*. New Jersey Geological Survey, 1902.

Soil Survey, Morris County (New Jersey) Soil Conservation District.

Van Abs, Daniel J. *The Hydrogeology of the Buried Valley Aquifer System,* Passaic River Coalition, 1983.

Widmer, Kemble. *The Geology and Geography of New Jersey,* 1964.

Wolfe, Peter E. *The Geology and Landscapes of New Jersey,* 1977.