SLOPE AND TOPOGRAPHY

What are Slope and Topography?

Slope and topography describe the shape and relief of the land. Topography is a measurement of elevation, and slope is the percent change in that elevation over a certain distance. Topography may be measured with lines that connect points representing the same elevation; these are called topographic contours. Slope is measured by calculating the difference in the elevation from one point to another divided by the lateral distance between those points.

Why are Slope and Topography Important?

Topography and slope should be considered when drawing up site plans for any construction project. Consideration of the slope of the land is important to reduce construction costs, minimize risks from natural hazards such as flooding and landslides, and to minimize the impacts of proposed development on natural resources such as soils, vegetation, and water systems.

Topographic data can also be used to create a model of the land's surface called a digital elevation model (DEM). A hill-shade relief map created from a DEM is depicted on the cover of this Natural Resources Inventory.

Slope and Topography in Tompkins County

Tompkins County is characterized by diverse topography. The northern regions of the County consist of medium to high elevation areas that are fairly flat. The flatness of these areas makes them ideal for farming. Segments of creeks in this area flow through gorges which have extremely steep slopes. Many of the more urbanized areas of the County are in the lowland areas, including most of the City of Ithaca, which lies in the flat floodplain at the southern end of Cayuga Lake. Although that area is ideal for development due to its flat terrain, areas of the City have become increasingly flood-prone as the watershed becomes more developed. While storm sewers help divert the increased flow of water from the impervious surfaces to Cayuga Lake, flooding downslope is still a problem. The Villages of Trumansburg, Groton, Freeville, and Dryden are also located in flat floodplains adjacent to creeks that are often subjected to flooding.

The southern portion of the County has the highest elevations and the most relief. The highest point in Tompkins County is the top of Connecticut Hill at 2200 feet. There are several hills in the towns of Newfield, Danby, and Caroline that have elevations in the 1600-1880 foot range.

Maps and Data

Historically, the U.S. Geological Survey (USGS) has been the purveyor of topographic maps for the County. The 7.5 minute, 1:24,000 scale quadrangle series is the most commonly used topographic map. These paper maps can be purchased at many bookstores and outfitters, as well as directly from USGS, or they may be downloaded as digital files from the USGS's website. Digital GIS data sets of the topographic contours may also be obtained from the USGS.

Tompkins County has a digital data set of 20-foot contour intervals for the entire County. For some towns, 10-foot contours are available.

For a map of this information, in paper or digital format, contact the Tompkins County Planning Department.

Resources/References

Tompkins County Planning Department, 121 East Court Street, Ithaca, NY 14850, 607-274-5560.

New York State Geological Survey: http://www.nysm.nysed.gov/gis.html

United States Geological Survey, 30 Brown Road, Ithaca, NY 14850, 607-266-0217 http://mapping.usgs.gov

SOILS

What are Soils?
Soil is a mixture of mineral particles, organic matter, water, and air. Soils are usually described in terms of their texture, e.g., sand, silt, and clay.

Why are Soils Important?
Soils affect a variety of human activities from agriculture to the engineering and construction of roads, buildings, and sewage disposal systems. They are critical in determining the productivity and viability of agricultural operations. The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) evaluates soils in terms of their capability to support agriculture. These range from Class I soils, which are productive and easy to work, to Class VIII soils, which are not suitable for growing crops, pasture, or trees for profit.

Planning boards, elected officials, zoning officers, developers, etc., can use soil maps to identify areas suitable for future development of homes, industry, agriculture, and recreation. For example, a soil map may indicate poorly drained areas, which should not be used for residential development because of the need for costly drainage facilities. Soil maps can also be used to assess the likelihood of finding suitable sites for individual, on-site, sewage disposal systems.

Classification of Soils
NRCS (and its predecessor, the Soil Conservation Service) was the agency responsible for preparation of maps showing soil series containing soils that share common profiles. Soil series are further divided into soil types that share common physical features, general properties that affect the use of the soil, and properties that limit suitability for cultivation.

In addition to being evaluated in terms of agricultural viability, soil types have been assessed by the NRCS in terms of their suitability for various types of development. Soil characteristics that are considered in this assessment are depth to seasonal high water table, depth to bedrock, flood potential, and permeability. Depth to seasonal high water table affects both building foundation and septic system siting. A seasonal high water table can cause flooding in basements or cause a septic system to malfunction. A high water table can also affect the ability of a soil to support weighty structures.

Maps and Data
Soils are mapped at various levels of detail, the two most common being general soil maps and soil surveys.

General soil maps show soil associations that share a characteristic landscape and pattern of soils. The soils within any one association may be somewhat similar, but they commonly differ in many important characteristics. These maps are suitable for planning large areas such as multi-county regions and large drainage basins. A General Soil Map is published in the *Soil Survey: Tompkins County, New York* at a scale of 1:126,720 (or 1 inch = 2 miles). This map divides Tompkins County into ten soil associations.

Soil survey maps are more detailed. The area of soil delineated on these maps can be as small as one or two acres. These maps can be used for planning at the county or municipal level. The *Soil Survey: Tompkins County, New York* was published in 1965 by the Soil Conservation Service and includes detailed maps (at a scale of 1:20,000) overlaid on aerial photographs. It was one of the first soil surveys published in New York State. The *Soil Survey* also includes descriptions of the soil types and tables showing the characteristics of the soils. Soon after it was published, the Soil Conservation Service revamped the soil categories for New York State. They are expecting to update the old 1965 data, compiled for Tompkins County and some surrounding counties, within the next decade and release it in digital format.

In the meantime, the Tompkins County GIS Program has digitized and rectified the 1965 *Soil Survey* maps so that they may be used digitally until the new soil survey is published. The map on the following page is a section of one of the soil survey maps from the *Soil Survey: Tompkins County, New York*.

For a map of soil information, in paper or digital format, contact the Tompkins County Planning Department or the Tompkins County Soil and Water Conservation District. Information from, or copies of, the *Soil Survey: Tompkins County, New York* (published in 1965) can be obtained from the Tompkins County Soil and Water Conservation District.

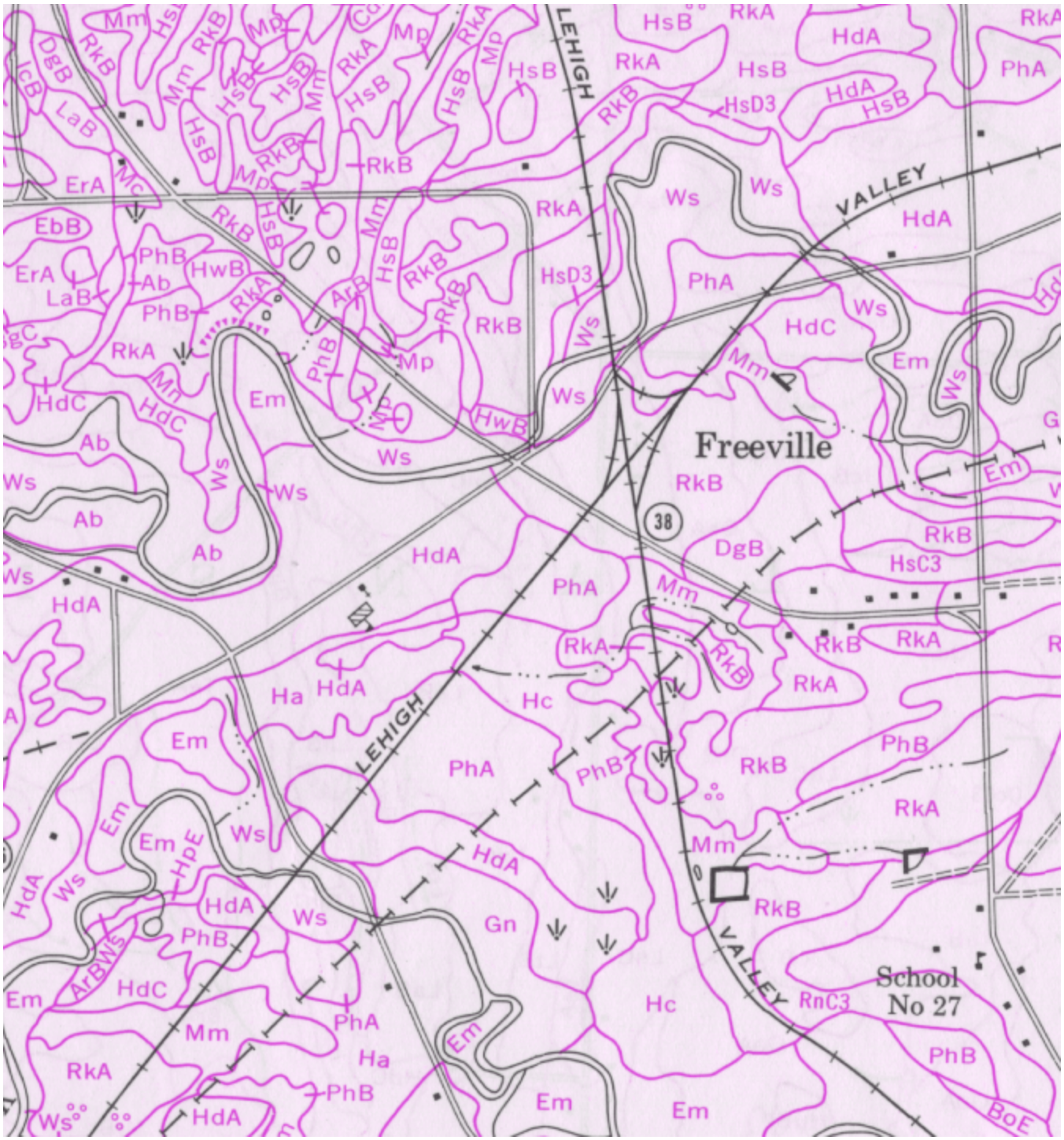
Resources/References

Tompkins County Planning Department, 121 East Court Street, Ithaca, NY 14850, 607-274-5560.

Tompkins County GIS Program, Information Technical Services, 128 East Buffalo Street, Ithaca, NY 14850, 607-274-5418. http://www.tompkins-co.org/gis

Tompkins County Soil and Water Conservation District, 903 Hanshaw Rd, Ithaca, NY 14850, 607-257-2340.

United States Department of Agriculture, Soil Conservation Service – in cooperation with the Cornell University Agricultural Experiment Station. *Soil Survey: Tompkins County, New York*. U.S. Government Printing Office, Washington, DC. 1965.



Sample of Soil Survey Map

2 0 2 4 Miles

New York State Plane
North American Datum 1983

References:
The data contained in this map were provided by the USDA Soil Conservation Service Soils Survey and the Tompkins County Planning Department.

Tompkins County Planning Department
Natural Resources Inventory

BEDROCK GEOLOGY

What is Bedrock Geology?
Bedrock geology describes the basic rock formations that underlie soils and unconsolidated materials (see *Surficial Geology* section). Bedrock occasionally protrudes through these materials or may be exposed alongside roads and creek beds. These rocks, formed millions of years ago, constitute the foundation of materials and topography in a region. Bedrock is found beneath the soils and may, in Tompkins County, be buried beneath glacial till, composed of rock fragments of various sizes that were released from glaciers as they receded.

Why is Bedrock Geology Important?
In Tompkins County, the depth to bedrock is relatively shallow, sometimes only 5 to 10 feet below the surface of the soil. Shallow depth to bedrock significantly impacts the location, development, maintenance, and cost of public services, such as sewers, water supply systems, and roads. Construction feasibility and costs for private investments, such as building foundations, septic tanks, and private roads, are partially dependent on the depth to bedrock. Shallow bedrock may also be subject to frost heaving and deformation. Determination of bedrock qualities must be made on a site-specific basis.

How was Bedrock Formed?
Approximately 550 million years ago, the land that is now Tompkins County and the surrounding region was submerged under an ancient sea. Over the course of 325 million years, layers of sediment (sand, mud, salt, and lime) were deposited on the lake bottom and slowly hardened into beds of sedimentary rocks that we now know as sandstone, shale, and limestone.

Bedrock Geology in Tompkins County
There are four major groupings of bedrock in Tompkins County. The formations found within a group are shown in parentheses. The following are listed from oldest to youngest formations:

1. **Hamilton Group** (**Dhmo, Dhld**) – These blackish to bluish-gray shales and thin beds of limestone are found at elevations of 600 to 1500 feet in the Moscow formation **(Dhmo)** which runs along both sides of Cayuga Lake, as well as the Ludlowville formation (**Dhld)** which juts out into the lake below the Moscow formation near Salmon Creek. These bedrock formations can be seen along East Shore Drive from Ithaca to Ludlowville. The tall bedrock cliffs that are visible along the east side of the lake are the Moscow formation.

2. **Genesee Group** (**Dg, Dt**) – This grouping of limestone, shale, and siltstone is the bedrock visible in the gorges surrounding the City of Ithaca at elevations of 400 to 1000 ft. The Ithaca Formation (**Dg)** comprises most of the northern section of the County, with greater representation in the northeast, and is the most predominant bedrock formation in the County. Tully Limestone (**Dt**) is located near Cayuga Lake.

3. **Sonyea Group** (**Ds)** – These siltstones and shales can be found between 200 and 1,000 feet in elevation.

4. **West Falls Group (Dwm, Dwrg - Gardeau Formation)** – These shales and siltstones are found at elevations between 1,100 and 1,600 feet and are located in the southern portion of Tompkins County.

Maps and Data
The New York State Geological Survey has produced a geographic data set of bedrock geology. The Bedrock Geology map was created at a scale of 1:250,000, and depicts general locations of various rock formations; it should not be used for any site-specific analyses.

For a map of this information, in paper or digital format, contact the Tompkins County Planning Department or U.S. Geological Survey.

For more detail on New York State Bedrock formations, go to the following website: http://www.nysm.nysed.gov/data/bedrock.txt

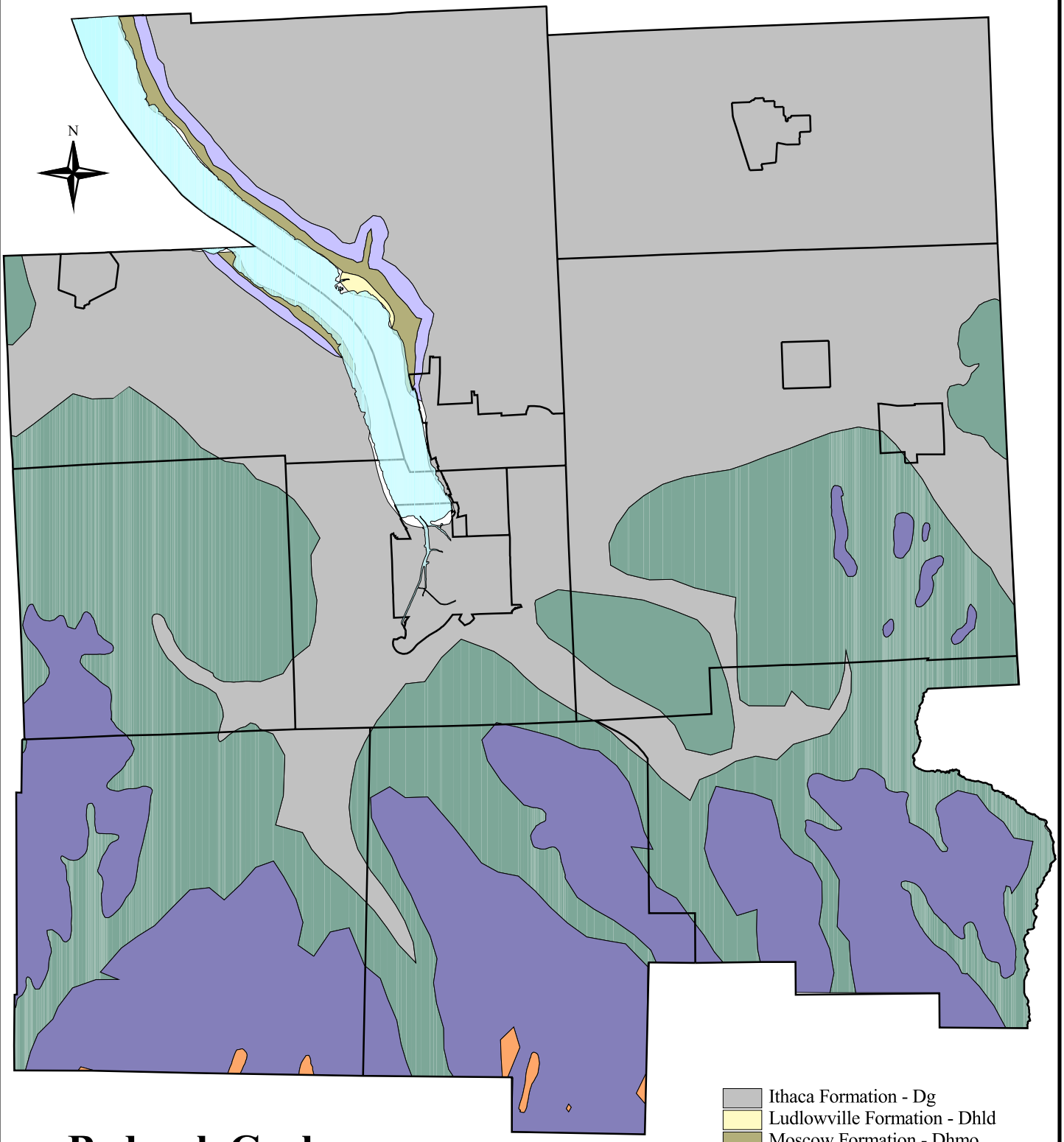
Resources/References

Tompkins County Planning Department, 121 East Court Street, Ithaca, NY 14850, 607-274-5560.

New York State Geological Survey: http://www.nysm.nysed.gov/gis.html

United States Geological Survey: http://www.usgs.gov/pubprod/index.html

Von Englen, O.D. *The Fingerlakes Region: Its Origin and Nature*. 1961. Ithaca, NY: Cornell University Press.



Bedrock Geology

2 0 2 4 Miles

New York State Plane
North American Datum 1983

References:
The data contained in this map were provided by the New York State Geological Survey and the Tompkins County Planning Department.

Tompkins County Planning Department
Natural Resources Inventory

SURFICIAL GEOLOGY

What is Surficial Geology?
Surficial geology describes the rocks and unconsolidated materials that lie between bedrock and the surface of the land. While "soils" refers to the organic components in these materials, "surficial geology" refers to the rock and mineral components of these materials. Glaciers receding 12,000 to 25,000 years ago deposited these materials. When the glaciers receded, the rock and debris frozen within the ice were left behind in various formations depending upon how fast or slow the glacier receded. These formations contain various sized particles and are classified by the shape of formation, the thickness, and the type and size of particles found.

Why is Surficial Geology Important?
Surficial geology is important because the characteristics of materials below the earth's surface influence the feasibility of constructing buildings and roads. Surficial deposits commonly determine soil composition and therefore may affect agricultural viability.

Surficial Geology Deposits in Tompkins County
There are eight types of surficial geology deposits in Tompkins County:

1. **Recent Alluvium** consists of recent deposits that range from fine sands to gravels and are generally confined to floodplains within a valley. They may be subject to frequent flooding and, in larger valleys, may be overlain by silt. Deposits range from 3 to 30 feet in thickness.

2. **Lacustrine Sands** are well sorted (particles are of similar size) and stratified sand deposits that settled out when lakes were formed by the melting glaciers. Deposits found today range from 6 to 60 feet in thickness.

3. **Lacustrine Silts** are generally laminated silt and clay, deposited in lakes formed during the melting of the glaciers. They are high in calcite, have low permeability, and form potentially unstable land. These are found in variable thickness of up to 160 feet.

4. **Outwash Sand and Gravel** is coarse to fine gravel mixed with sand. Location is restricted to valley bottoms and stream terrace. These deposits are of variable thickness of five to 65 feet.

5. **Kames** are glacial deposits of various forms which are called kames, eskers, kame terraces, and kame deltas. They are small, irregular hills and terraces deposited by glaciers and are typically found in valleys. These deposits are composed of coarse to fine gravels and/or sands in thicknesses of 30 to 100 feet.

6. **Kame Moraines** are glacial deposits of various sizes from boulders to sand deposited at an active ice margin during glacial retreat. Locally they may be laden with calcareous cement. These are found in thicknesses of 30 to 100 feet.

7. **Till** deposits are poorly sorted (particles of varying sizes) material of variable texture such as clay, silt-clay, or boulder clay that were deposited beneath the glacial ice. Permeability of these deposits varies with the amount of compaction. Thicknesses vary from 3 to 160 feet.

8. **Till Moraine** is much like till, but has a more variable sorting, and is generally more permeable than till. Deposits of till moraine were typically set down adjacent to glacial ice. Thicknesses vary from 30 to 100 feet.

Maps and Data

The New York State Geological Survey's Surficial Geology map was created at a scale of 1:250,000. For this reason, it should not be used for site specific analysis, but should only be used for general planning purposes.

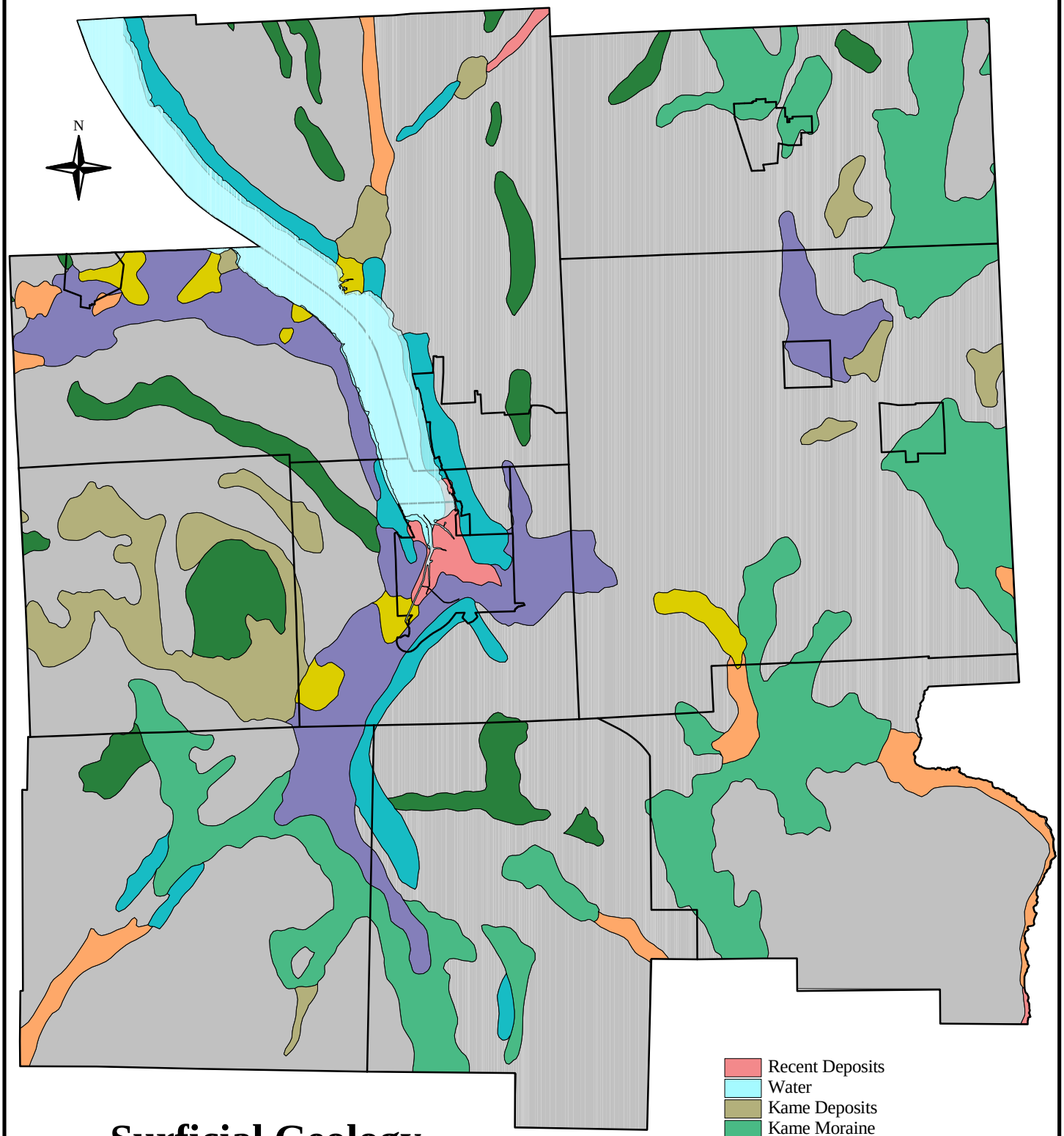
For a map of this information, in paper or digital format, contact the Tompkins County Planning Department or USGS.

Resources and References

Tompkins County Planning Department, 121 East Court Street, Ithaca, NY 14850, 607-274-5560.

New York State Geological Survey: http://www.nysm.nysed.gov/gis.html

U.S. Geological Survey (USGS), 30 Brown Road, Ithaca, New York 14850, 607-266-0217.



Surficial Geology

2 0 2 4 Miles

New York State Plane
North American Datum 1983

References:
The data contained in this map were provided by the New York State Geological Survey and the Tompkins County Planning Department.

Tompkins County Planning Department
Natural Resources Inventory