CHAPTER ONE

GENERAL DESCRIPTION OF THE WATERSHED

PHYSICAL CHARACTERISTICS

The principal water resource of the Canandaigua Lake watershed is Canandaigua Lake, the westernmost Finger Lake to drain through the Oswego River system to Lake Ontario. Canandaigua is the third largest of the Finger Lakes in volume, containing about 429 billion gallons of water. The lake is 15.5 miles long, an average of 1.1 miles wide, a maximum of 276 feet deep and occupying about 10,553 acres.

Canandaigua Lake is drained by two outlet channels. Both are controlled by gates and regulated by the City of Canandaigua. The eastern channel is natural, and the western channel was excavated by the City at the turn of the century to convey and dilute sewage and storm water. A flow of 35 cubic feet per second for dilution of the waste in the "Feeder Canal" is required to operate the City's sewage treatment plant.

The quantity and quality of water in Canandaigua Lake depends on the water draining into the lake from surrounding land. The area around the lake which drains into the lake is called the watershed. The watershed boundary or divide is often far away from the lake itself, crossing many political boundaries. As viewed from the lake itself, the watershed is roughly defined by the hills surrounding the lake.

Most of the water reaching the lake arrives via the major tributaries. The tributaries further divide the watershed into definable hydrologic units or sub-watersheds. In this plan, the entire watershed and each of the sub-watersheds have been characterized and evaluated. The drainage basin of Canandaigua Lake, including the lake surface, measures 174 square miles or 111,360 acres. For the purpose of this plan, the watershed has been divided into 34 subwatersheds. Principal streams flowing into Canandaigua Lake include: Naples Creek, West River, Barnes Gully, Gage Gully Tichenor Gully, Sucker Brook, Deep Run Creek, Menteth Gully, Seneca Point Creek, Fall Brook, and Vine Valley Creek. The second part of this chapter breaks down the 34 subwatersheds and gives a general description of each subwatershed.

Many of the wetlands of the Canandaigua Lake watershed have been drained and/or filled for development and agricultural use. Upland, lakeside and streamside wetlands have been mostly eliminated, except for small remnants. A significant wetland system at the north end of the lake and along the outlet has been fragmented, channelized and developed for residential and commercial uses. Three lakeside wetlands, at Hi Tor, off East Lake Road, and at Atwater Meadows, exist today. A few wetlands exist in the West River, Sucker

Brook, Grimes Creek, and Menteth Creek subwatersheds. The 1,500 acres of Hi Tor marshes are even more significant given the overall loss of wetlands in the watershed.

Figure 1-1. Canandaigua Lake Watershed – subwatershed boundaries and stream locations.

BEDROCK GEOLOGY

The bedrock of the Canandaigua Lake watershed consists of sedimentary rock of the Upper and Middle Devonian age, 400 million years ago (Fisher et al., 1962). According to Von Englen, the beds consist of 2,450 meter thick layers of calcareous limestone, sandstone and shales, sloping gently to the south of the watershed. The southern half of the watershed is located in the hilly, dissected valleys of the Allegheny Plateau and the northern half is located in the glacial till plain of the Central Lowland provinces (Pearson and Cline, 1958). Bedrock consists of shales and siltstones of the Hamilton, Genesee, Sonyea, Java and West Falls groups and shales and sandstones of the Portage and Chemung groups.

Before the Pleistocene Era, approximately one million years ago, water flowed south through the Canandaigua basin into the Susquehanna and into the Chesapeake Bay. During the Pleistocene, a mile thick ice sheet advanced and retreated four times through the basin. The ice shaped and gouged the basin, further deepening the existing valley. More importantly, glacial ice transported and deposited large amounts of earthen material that ultimately created a terminal moraine at the south end of the lake near Naples. The moraine or "valley heads", effectively dammed the channel and created Canandaigua and the other Finger Lakes. The moraine dams also altered water drainage from a southward to a northward direction into the Great Lakes basin.

SURFICIAL GEOLOGY AND SOILS

Recent mapping of the surficial geology of the Finger Lakes region details eight types of surface conditions within the Canandaigua Lake watershed. At the north and south ends of the lake, in the City of Canandaigua, Hopewell, and Naples, are broad bans of lacustrine silts and clays. Close to the south end of the lake is a swamp deposit, characterized by unoxidized organic materials (muck) and alluvial deposits in the lake bed. A large area of glacial till deposits is present on the moderately sloping hillsides at the north end of the lake in the Towns of Canandaigua and Gorham. Small inclusions of till moraines, in which the till has been somewhat sorted, appear in the Towns of Canandaigua and Gorham. Further south in the watershed, the Towns of South Bristol, Middlesex, Italy and Naples have large areas of exposed bedrock (less than 1 meter of soil cover), particularly associated with the Bare, South, East, Hatch, Gannett and West Hills.

The most productive soils are located in the northern portion of the watershed. The northern area is dominated by Odessa-Schoharie (OS) and Honeoye-Lima (HL) soils. The Odessa-Schoharie soils are formed from glacial lake and marine clays on slight to moderate slopes and are generally fair for agricultural crop production. The Honeoye-Lima soils are formed in high-lime glacial till of sand, silt and clay. The soils are moist and deep and generally of low gradient. According to Smith and Cline, the soils are good to excellent for agricultural crop production (Eaton and Kardos, 1978).

In the northeastern portion of the watershed near Reed Corners, Darien-Romulus (DR) soils are common. These soils are formed in glacial till shales on gentle slopes and are moderately fine textured. Because of water management problems associated with these soils, they are fair to poor for crop production.

Along the west shore in the vicinity of Cheshire and from Vine Valley to Middlesex, Lansing-Darien (LD) soils are common. These soils are similar to Honeoye soils; however, LD soils have a lower base status, requiring lime addition for agricultural production.

Much of Bare Hill, South Hill and the West River Valley downstream of Middlesex contains Lordstown-Manlius (LM) soils. They also occur near Woodville and on the hillsides around Naples. These soils are moderately deep and low base status formed in glacial till. LM soils occur on steep slopes and are highly erodible. The best use of these soils is for forestry. Where the soils have been used for grape production, severe erosion has occurred (Eaton and Kardos, 1978).

Mardin-Fremont-Volusia (MF) soils are found from Black Point south to Bristol Springs. The soils are variable in quality for cropping and have fertility and drainage problems associated with their use. The soils are generally deep and acidic and are formed in glacial till material. These soils also have a dense fragipan layer at about 20" below the surface.

In the Naples Valley, Valois-Howard (VH) soils are common. These soils are formed in coarse glacial outwash materials of sand and gravel and have a moderate to low base status. South of Naples Village, particularly along Naples Creek, is a large kame moraine area, materials pushed into place during one of the last glaciations and sorted by streams in and around the glacier. The fertility of the soils is moderate and they require liming for crop production. Grapes are grown on these soils along with pasture. Lobdell-Wayland (LW) soils are also found in the Naples Valley. These coarse-loamy, medium to high base status soils are formed in recent alluvium and have a high water table. With proper drainage, these soils have been successfully used for grape production.

At the inlet of the lake in the area of the Hi Tor Wildlife Refuge, Carlisle-Muck (CM) soils are common. These soils are continuously wet and provide excellent soils for wetland and wildlife habitat.

TOPOGRAPHY

The broad, U-shaped valley which contains the lake is flanked by steep side slopes which project upward for several hundred feet and are capped by rounded to gently rolling hilltops. The topographic variation gradually decreases to the north to relatively low relief characteristic of the Erie-Ontario Lake Plain.

The southern half of the watershed is characterized by higher elevations, reaching 2,256 feet above mean sea level along the western edge (at Gannett Hill). The hillsides are severely dissected by steep walled valleys, with slopes often exceeding 45%, particularly along the lakeshore. The northern portion of the watershed has much lower elevations and slopes. The mean elevation of the Canandaigua outlet(s) is 688 feet above sea level.

A north-south line halfway between Seneca and Cayuga Lakes separates the province of the Finger Lakes "east" from that of the Finger Lakes "west". The common characteristic of

western Finger Lakes is the branching Y form with the broad stem of the Y directed to the south. The creation of the lake basins of the Finger Lakes "west" was caused by down-valley glacial erosion. The West River or Middlesex Valley occupies the basin which contributes to this formation.

CLIMATE

The climate of the Canandaigua Lake watershed is classified as humid continental with cool summers. The region is marked by a highly variable climate, with the possibility of rapid, frequent and extreme weather changes. The geographic location of the region contributes significantly to the unusual weather patterns affecting it. The center of the lake lies at 42 degrees, 46 minutes latitude and 77 degrees, 18 minutes longitude.

Mean annual temperature is 45.9 degrees F., ranging from 21.1 degrees F. for the month of February to 69.7 degrees F. for July. Average annual precipitation is 32 inches, with about 2/3 as rain and 1/3 as snow. There is a strong minimum of precipitation at mid-winter and a secondary minimum at mid-summer.

Air masses, having entered North America from the Pacific, travel eastward and are modified while crossing the western mountains, the Gulf of Mexico, the Atlantic Gulf Stream, Lake Erie and Lake Ontario. Any one of these sources of rain water can completely dominate a weather pattern at one time or another. The Finger Lakes do not influence weather patterns over the eastern United States, but do affect the southern portions of this region.

Cool dry air usually arrives from the northwest, but occasionally it retrogrades from the northeast. Warmer and more humid air enters from the Gulf of Mexico, steered by the Sub-Tropical Jet. The Sub-Tropical Jet may rejuvenate remnant Pacific lows into powerful rain or snow and wind-makers, even tornadoes.

Mixing of cold polar air with warm tropical air develops a strong Polar Jet that reinforces the Sub-Tropical Jet. Together they aspirate new waves on the frontal surface. Stormtrack frontal cyclones, juvenile, mature and senescent, pass through at an average rate of two or three per week, more frequently in winter than in summer (Mooney, 1987).

LAND USE

The Canandaigua Lake watershed has undergone a series of changing land uses over the two hundred years since first colonial settlements were established in 1788-89. In the early years (1790 to 1820), the area was properly considered "the wild west" of the colonies. Pioneer colonists led isolated and largely self-sufficient lives on the frontier. Economic activities were curtailed by a lack of cash and an inability to transport goods to market.

After the opening of the Erie Canal, building of railroad lines, and improvement of water transportation (steam boats on Canandaigua Lake) and roads, farmers and merchants in the area were able to trade more easily and participate in coastal markets.

The watershed was increasingly used for agricultural purposes, due to its relatively mild climate and good soils. During the Civil War, markets for commodities produced in this area were particularly lucrative. By 1885, about 85% of the land had been cleared for farm tillage and pastures.

Agricultural activity was particularly hard hit by the Great Depression. From 1930 until 1940, farmers left the land in record numbers; only the advent of World War II brought improvements in agricultural earnings.

Industrialization did not much effect Canandaigua Lake watershed. Generally, the only industries of the watershed were processing agricultural produce: cheese-making, basketry, wine-making, and fruit-drying. Only in the City of Canandaigua and the Village of Naples have a few small industries developed.

Agricultural land use has been declining since the early 1950s. Fewer farmers work more land each; however, the net amount of agricultural land has declined.

Since the 1920s, the shoreline of the lake has been increasingly used for cottages and second homes. Most available parcels around the lake have been developed for residential and recreational uses. In recent years, several other trends are apparent: development of "difficult" sites (steep and wet), summer cottage conversion to year-round use, re-development of sites (demolish existing structure and re-build), and development of woodland and lake-view parcels. The density of development and the existing utilities and services around the perimeter of the lake result in a "urban" corridor that rings the lake. The pace of development is exacerbated by the watershed's proximity to Rochester (about 25 miles distant) and the availability of relatively good connecting highways. Development pressure on land used for agriculture has also increased, particularly at the northern end of the watershed.

Forty-five to fifty percent of the watershed land is covered with shrubs, early successional trees, and/or mature forests. Thirty to thirty-five percent of the watershed land is used for agriculture. Ten to fifteen percent of watershed land is between agricultural use and residential use, sold by farmers to developers who are waiting for market changes. Three to five percent of watershed land is used for residential, commercial and industrial purposes.

VEGETATION

At the time of settlement in the 1780s and 90s, the land was heavily forested. The only openings in the forest were flooded areas such as marshes, lakes, and streamsides, burned areas, or areas kept clear by the Iroquois for their trails, villages and fields. The original forests were principally sugar maple, beech, hickory, red and white oaks, tulip poplar, and

black walnut. On the higher hills, white pine was common. Chestnut, ash, butternut and basswood grew on the drier sites. On the alluvial soils of the valleys, elm, black ash, willow, poplar and soft maple were common. In the shaded areas, such as gullies, hemlock and grey birch were common.

No virgin timber or relic forest remain in the watershed. The present forests consist of second and third-growth stands of the original species. Chestnut and elm are missing as a result of disease. Locust and pine/spruce plantations are added to the mix of the original forest species. Most of the remaining mature forests are on wet or steep sites.

The land was progressively cleared of forests beginning in the 1790s and reached a maximum of cleared land in the late 1880s. 85-90% of the land was cleared and farmed; though some was but poor pasture.

Since 1880, there has been a gradual abandonment of farmland and corresponding re-growth of wooded land. Since the abandoned lands were generally the least productive for agriculture, the woods on these lands are of very low quality. At present, about 45-50% of the watershed land is forested. Much of this forest is in an early stage of succession: pines, poplar, red maple, hawthorn, pin cherry, and various dogwoods predominate. Forested areas in the watershed, particularly on steeper slopes to the south, provide many water quality benefits including stormwater retention and erosion and sediment control.

WILDLIFE

The Canandaigua Lake watershed encompasses a wide variety of wildlife habitats which support very diverse wildlife communities. Habitats range from wetlands to large blocks of unbroken forests. Agricultural areas provide food sources for wildlife and the many transitional areas provide cover and nesting areas.

The diversity of wildlife includes game species such as deer, turkey, pheasant, grouse, squirrel, rabbit, opossum, coyote and fox. Many non-game species such as song birds, hawks, accipiters, owls and occasionally ospreys and eagles visit the watershed. The watershed contains many small and one large wetland. The wetlands are important habitats that support waterfowl, mink, muskrats, beaver and amphibian production.

Well managed fish and wildlife populations provide residents and visitors with tremendous opportunities for nature study, hunting, fishing and trapping. Many people have established rural residences and manage their properties to enhance the opportunities to view wildlife in their backyards.

Protecting our water resources will help to ensure healthy and dynamic wildlife populations for residents and visitors of the watershed to enjoy.

FISHERIES

The lake trout is the primary coldwater game fish in Canandaigua Lake. Rainbow trout produced by natural reproduction in Naples Creek support an excellent tributary fishery and a fair to good lake fishery. Stocked domestic brown trout also provide a significant contribution to the fishery and add species diversity.

Important warmwater species include smallmouth bass, largemouth bass, bluegills, black crappies, and brown bullheads. Smelt and alewives are the primary forage fish and are considered abundant. Lake whitefish, ciscoes, and walleyes are all present, but very uncommon. Yellow perch numbers have increased during the past decade and now support a popular fishery.

In the past, lake trout were always the dominant species. Prior to 1900, the lake trout's primary forage was the cisco. Since the introduction of the smelt and alewife by an unknown source in the 1950s, the alewife has substantially improved the condition of adult lake trout population. Today, lake trout are still the primary game fish in Canandaigua and their numbers are supported almost entirely by stocking.

Rainbow trout were introduced from the western US around the turn of the century, but did not become well established until the 1930s. Today, a naturally reproducing population is being maintained in the lake. Naples Creek is the single significant spawning tributary for the rainbow fishery. Fish begin to enter the creek in late fall and spawning occurs when the correct water temperature and day length is reached in March. The April 1st opening fishing day at Naples Creek has become a very popular and productive fishing site.

Brown Trout introductions occurred in the early 1970s and a good fishery is maintained today with annual stocking of hatchery-reared fish. There is no brown trout reproduction in Canandaigua Lake. The historical lake trout-cisco association has now been replaced by a lake trout, brown trout, rainbow trout-alewife, smelt association.

Smelt were introduced in 1925 by the State Conservation Department and dramatically increased from 1935 to 1940. At one time, they were found in such abundance that they were removed by the barrel-full to feed trout at the Bath Fish Hatchery. Today, spring smelt runs occur in several of the smaller lake tributaries and Naples Creek, but they are not plentiful.

The lake presently supports an excellent smallmouth bass fishery. Rocky-gravelly substrate, an essential element for spawning success of smallmouths, is moderately abundant.

Largemouth bass and chain pickerel are found in good numbers at both the north and south ends of Canandaigua. Rooted aquatic plants there provide excellent habitat for these fish. Yellow perch, bluegills, sunfish, and rock bass are available along shoreline weedbeds throughout the summer. The West River, at the lake's southend, provides an excellent fishery for largemouth bass, lake crappies, and brown bullheads.

Source: *A Strategic Fisheries Management Plan for Canandaigua Lake*, Thomas L. Chiotti, Bureau of Fisheries, Division of Fish and Wildlife, NYSDEC, March 23, 1981.

POLITICAL SUBDIVISIONS

There are 15 municipalities and 4 Counties within the Canandaigua Lake Watershed. Table 1-1 provides statistics on all 15 of the municipalities that have a portion of their land areas within the Canandaigua Lake watershed (see Figure 1-1). The municipalities with the largest percentage of their land areas within the watershed boundary, those over 50 percent, include: Gorham (town) with 52 percent, Naples (town & village) with 81 percent, and the Town of Middlesex with 85.9 percent. The municipalities within Livingston and Steuben Counties have a very small portion of their municipal land areas within the watershed.

Table 1-1 summarizes statistics on the portion of each municipality within the Canandaigua Lake watershed. The total land area for the Canandaigua Lake Watershed is just over 101,000 acres, or 157.84 square miles. There are four municipalities that have the largest percentage of land area within the watershed, including: the Town of Canandaigua with 16,096 acres, or 16.0 percent; Gorham (t) with 17,625, acres or 17.5 percent; Middlesex with 18,496 acres, or 18.4 percent; and Naples with 19,304 acres, or 19.2 percent. The balance of the municipalities range from less than one percent to approximately 10 percent. Four municipalities have a negligible amount of land area within the watershed, those with less than 1,000 acres, including: the Towns of Bristol, Springwater, Cohocton, Prattsburg, and the City of Canandaigua. While the City of Canandaigua has less than 1,000 acres of land within the watershed, it is the most urbanized and in close proximity to the Lake.

County	Municipality	Square Miles	Acres	Percent of Total Watershed
Ontario	Bristol (t)	.50	320.0	.3
	Canandaigua (c)	2.26	1,446.4	1.4
	Canandaigua (t)	25.15	16,096.0	16.0
	Gorham (t)	27.54	17,625.6	17.3
	Hopewell (t)	2.77	1,772.8	1.8
	Naples (t)	31.12	19,916.8	19.2
	Naples (v)	.95	611.8	0.8
	South Bristol (t)	15.55	9,952.0	9.9
	Rushville (v)	0.64	409.6	0.4
Livingston	Springwater (t)	.34	217.6	.2
Steuben	Cohocton (t)	1.19	761.6	.8
	Prattsburg (t)	1.77	1,132.8	1.1

Yates	Italy (t)	15.00	9,600.0	9.5
	Middlesex (t)	28.90	18,496.0	18.2
	Potter (t)	5.11	3,270.4	3.3
	TOTAL	157.84	101,017.6	100.0

Table 1-1. Land areas within the watershed by municipality.

POPULATION

Of the 15 municipalities which have a portion of their boundaries within the watershed there are 12 primary municipalities. Springwater, Cohocton, and Prattsburg have been excluded from the analysis. The 12 primary municipalities had a total population in 1990 of 35,085 which represents a 22.95 percent increase since 1970.

Considering that a different proportion of each of the 12 municipalities actually lies within the watershed boundary, an estimate of the population within the watershed was computed by determining the percent of land area of each municipality that is within the boundary and applying that percent to the total population. It is recognized that some error may be inherent in this method because of the uneven physical distribution of population. However, since census data is not available on a sub-municipal level for all years analyzed, the error is considered acceptable.

The twelve municipalities total 368.63 square miles, with approximately 43 percent or 157.84 square miles of land area, being within the watershed. The estimated population (based on 43% of the total land area) residing in the watershed in 1990 is 15,704. There was a slightly larger increase during the 1980's as compared to the 1970's. Based on the 2000 Census, the watershed population increased 5% to 16,553 individuals.

Municipality	**1990 Population**	**2000 Population**	**Pop. Change**	**Percent Change**
Bristol	2,071	2,421	350	16.9%
Canandaigua City	10,725	11,264	539	5.0%
Canandaigua T.	7,160	7,649	489	6.8%
Gorham	3,497	3,776	279	8.0%
Rushville	609	621	12	1.0%
Hopewell	3,016	3,346	330	10.9%
Naples T.	2,559	2,441	-118	-4.6%
Naples V.	1,237	1,072	-165	-13.3%
South Bristol	1,663	1,645	-18	-1.1%
Middlesex	1,249	1,345	96	7.7%
Italy	1,120	1,087	-33	-2.9%
Potter	1,617	1,830	213	13.2%

Table 1-2. Population levels in watershed municipalities

HOUSING

There were 15,496 housing units in the 12 municipalities in 1990, which represents a 40.04 percent increase since 1970. The increase in housing units was almost double that of the population. It is hypothesized that some of this is due to smaller household size and some due to seasonal, non-primary residences. The housing unit increase (both in percent and in raw numbers) were greater during the 1970's than in the 1980's.

Calculation of the number of housing units lying within the watershed followed the same method utilized for population described earlier in the preceding section. Of the 15,496 total housing units in 1990, 8,137 fall within the watershed. That represents a 40.99 percent increase since 1970. Again, more of the increase occurred during the 1970's than in the 1980's.

ECONOMIC PROFILE

Approximately 1/3 of the work force commutes outside the county for employment. For many, the commute is to the Rochester metropolitan area in Monroe County, an industrial manufacturing center with large employers including Eastman Kodak, Xerox, and Bausch and Lomb. A current publication by the Ontario County Office of Industrial Development lists the major industrial employers in the Ontario County area of the watershed.

Tourism is the second largest industry in Ontario County, with over one and a half million tourists visiting each year, according to the Ontario County Tourism Department. In 1988, 13% of the labor force were employed in tourism. As of 1996, tourism related jobs topped 4,000 and payrolls exceeded $40 million. Yates County is a small rural county in which the manufacturing base is small and has a much larger service sector.