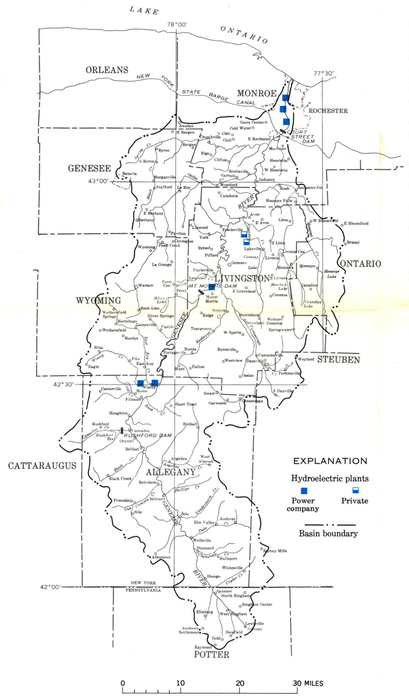
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
NEW YORK STATE DEPARTMENT OF CONSERVATION
DIVISION OF WATER RESOURCES

HYDROLOGIC INVESTIGATIONS
ATLAS HA-368 (SHEET 1 OF 4)

PHYSICAL AND CLIMATIC SETTING

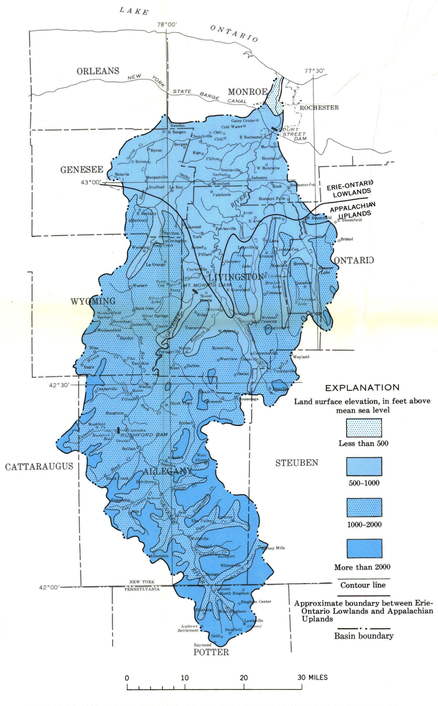


THE GENESEE RIVER FLOWS NORTHWARD FROM ITS HEADWATERS IN NORTH-CENTRAL PENNSYLVANIA, ACROSS 90 MILES OF WESTERN NEW YORK INTO LAKE ONTARIO.

About 400,000 people live in the 2,500-square-mile Genesee River basin, of whom 70 percent are in or near Rochester. Other than the cities of Rochester and Batavia (on the northwestern boundary of the basin), both of which are partly outside the basin, no communities have a population greater than 7,000 people. Including all of Monroe County in the basin service area, brings the total population to about 720,000 people, with an area-wide per capita water use of about 375 gpd (gallons per day).

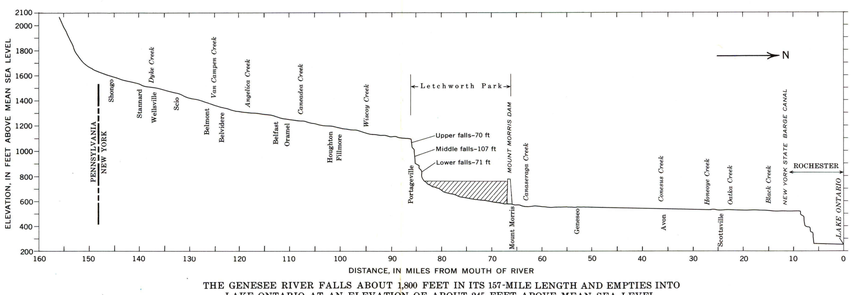
Mount Morris Dam was put into operation in November 1951 and, with a usable capacity of 337,000 acre-feet, has accomplished its purpose of diminishing flood hazards downstream. The eight hydroelectric plants in the basin do not materially affect the stream regimen because they are the run-of-river type with small pondage capacity. Rushford Reservoir is controlled so as to supplement flows in the Genesee River for power generation.

The New York State Barge Canal is an important waterway for commercial barge traffic and is in use during the ice-free season (May through mid-November). Water diverted from the canal supplements the flow in the lower reach of the Genesee River from the canal northward to Lake Ontario. This diversion amounts to a maximum of about 375 cfs (cubic feet per second) and is primarily for hydroelectric plant operation, but provides a secondary benefit in the dilution of wastes both from Rochester's industries and from an expanding population.



The southern and central parts of the basin are in the Appalachian Uplands physiographic province, which consists of moderately to steeply sloping hillsides and deep, narrow valleys. The northern part of the basin is in the Erie-Ontario Lowlands province. This area is marked by wide valleys, nearly level terraces, and low hills which usually have gentle slopes.

LAND-SURFACE ELEVATIONS IN THE BASIN RANGE FROM ABOUT 250 TO 2,500 FEET ABOVE MEAN SEA LEVEL.

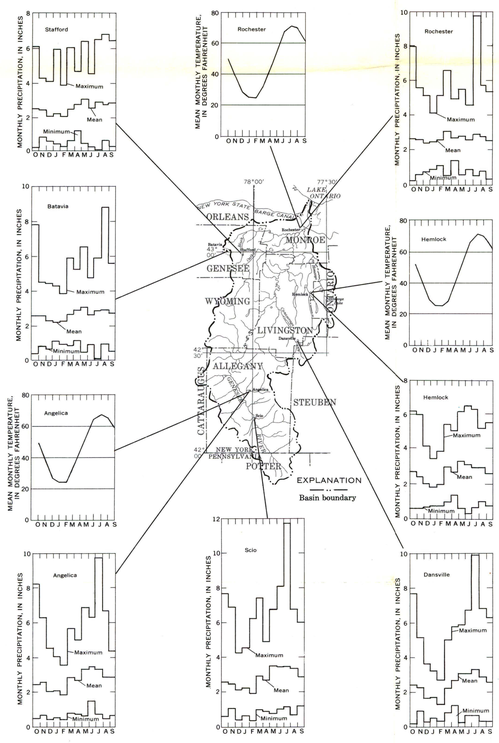


THE GENESEE RIVER FALLS ABOUT 1,800 FEET IN ITS 157-MILE LENGTH AND EMPTIES INTO LAKE ONTARIO AT AN ELEVATION OF ABOUT 245 FEET ABOVE MEAN SEA LEVEL.

Table 1.—*Physical characteristics of Lake Ontario and the principal lakes within the Genesee River basin*

Name	Elevation of lake surface above mean sea level (feet)	Drainage area at outlet (sq mi)	Surface area of lake (sq mi)	Maximum measured depth (feet)	Volume (million cu ft)	Principal uses of lake	Name of outlet
Lake Ontario	[1] 246	290,000	[2] 7,540	[2] 778	[3] 60,700,000	Navigation, water supply, recreation.	St. Lawrence River.
Canadice Lake	1,096	12.4	[4] 1.0	[4] 83	[5] 1,503	Water supply, recreation.	Canadice Lake Outlet.
Hemlock Lake	905	43.6	2.9	90	[6] 2,400	Water supply, recreation.	Hemlock Lake Outlet.
Honeoye Lake	803	41.1	2.6	30	[6] 720	Recreation	Honeoye Creek.
Conesus Lake	818	69.7	5.1	66	[6] 3,100	Water supply	Conesus Creek.
Silver Lake	1,356	17.3	1.2	37	[6] 410	Water supply, recreation.	Silver Lake Outlet.
Rushford Reservoir.	1,440	61.1	.9	120	1,106	Power, recreation.	Caneadea Creek.

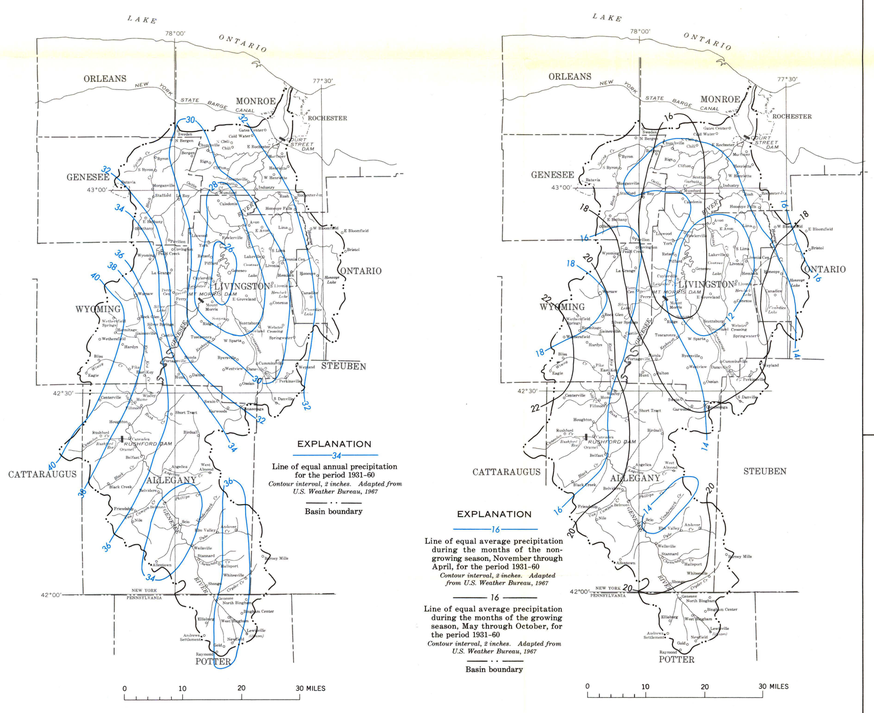
[1] Ranges from about 241 to 246 in the past decade.
[2] From U.S. Lake Survey, 1952; includes 3,980 square miles in Canada.
[3] From Hutchinson (1957, p. 169).
[4] Surveyed by city of Rochester.
[5] From Birge and Juday (1914, p. 537).
[6] Computed by the formula: Volume = ⅓ max. depth × surface area.



THE BASIN HAS A COOL, HUMID CLIMATE AND THE AVERAGE MONTHLY PRECIPITATION IS RATHER EVENLY DISTRIBUTED, RANGING FROM ABOUT 1.3 TO 3.5 INCHES.

Although the range in average monthly precipitation is small, in any one year there may be large differences from month to month and from place to place, especially during the summer when most rain is produced by localized showers and thunderstorms. On the average, the northern half of the basin receives its maximum monthly precipitation during the spring months and the southern half receives its maximum monthly precipitation during the summer months. Throughout the basin, minimum monthly precipitation tends to occur during the winter months.

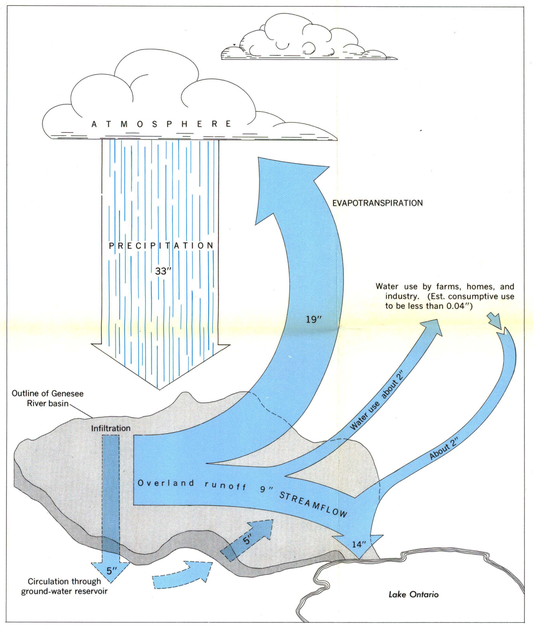
The average mid-winter and mid-summer temperatures are 25° and 70°F; respectively. The range between the two temperatures would probably be greater but Lakes Ontario and Erie tend to have a moderating effect on the temperatures in this area. Lake Erie is directly in the path of the prevailing westerly winds and Lake Ontario sometimes acts as a buffer to the invasion of cold air from the north. Nonetheless, some days of below-zero temperature occur each winter and temperatures reach the upper 90's each summer. The frost-free season usually lasts from mid-May to late September or early October.



ANNUAL PRECIPITATION AVERAGES 33 INCHES WITHIN THE BASIN.

Compared with the statewide average of 39 inches per year, average annual precipitation in the Genesee River basin ranges from less than 26 inches in the north-central part of the basin to more than 40 inches along sections of the more elevated western border. Precipitation during the growing season averages approximately 4 inches more than in the nongrowing season. The difference probably reflects more the increased occurrence of local showers and thunderstorms during the growing seasons rather than any general increase in area-wide storms. Average annual snowfall ranges from about 50 to 75 inches (equivalent to about 6 inches of water), being heaviest near Lake Ontario and along the western boundary of the basin.

WATER BUDGET



MAN USES ONLY A SMALL AMOUNT OF THE AVAILABLE WATER WITHIN THE BASIN.

Table 2.—*Estimated average water budget for the period 1931–60, by months, for the Genesee River basin*

[P (precipitation) = R (runoff) + E (evapotranspiration) + change (+ gain or − loss) in soil moisture + change (+ gain or − loss) in ground-water storage; in this region, changes in ground-water storage are assumed to be negligible]

Month	Mean air temperature [1] (°F)	Precipitation [1] (inches)	Runoff (inches)	Evapotranspiration (inches)	Gain (+) or loss (−) in soil moisture [2] (inches)
January	25	2.2	1.4	0.0	+0.8
February	25	1.9	1.3	.0	+.6
March	32	2.7	3.0	.0	[3]−.3
April	45	2.9	2.9	1.1	−1.1
May	56	3.3	1.5	2.6	−.8
June	66	3.1	.7	3.8	−1.4
July	70	3.4	.4	3.9	−.9
August	68	3.2	.2	3.2	−.2
September	61	2.8	.2	2.5	+.1
October	51	2.7	.4	1.5	+.8
November	39	2.5	.7	.3	+1.5
December	28	2.1	1.1	.1	+.9
Yearly average (rounded)	47	33	14	19	0

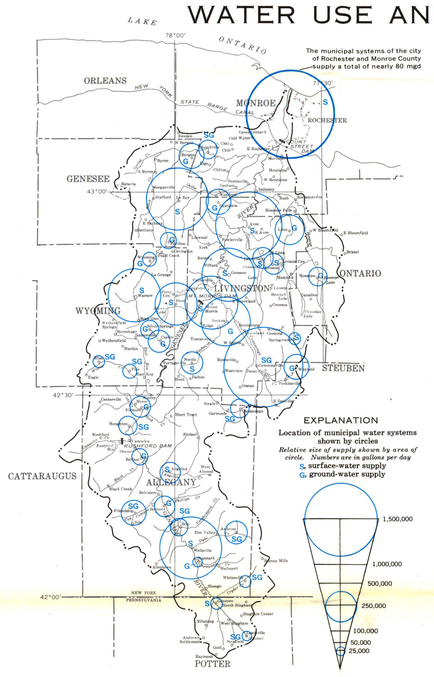
[1] Based on long-term averages of temperature and precipitation data for Angelica, Hemlock, and Stafford. Data for Angelica were multiplied by two (to represent the entire southern area of the basin) and the combined totals then divided by four.
[2] Includes water temporarily stored above ground as snow and ice when ground is frozen.
[3] Melted snow or ice resulting from part of snowfall during preceding month.

Precipitation is the primary source of all water in the basin. Much of the precipitation strikes the land surface and immediately begins to flow away as runoff. Some of the precipitation will seep into the ground below the level of the water table and become part of the storage in the ground-water reservoir. When the water table intercepts the land surface, this ground water will be discharged through springs, lakes, marshes, and streams, and may become part of the runoff or part of surface storage. Water is lost from the basin and returned to the atmosphere by evapotranspiration, predominantly during the growing season (May through October) when plant transpiration is an important factor.

Monthly average quantities of water moved by these processes can be estimated by application of water-budget "accounting" methods developed by Thornthwaite and Mather (1957). Assuming that storage remains constant, the average yearly water budget for the basin can be shown simply by the expression: Precipitation (P) = Runoff (R) + Evapotranspiration (E). For the period 1931–60, these average annual quantities have been estimated as follows:

P = 33 inches = 190 billion cubic feet = 1,400 billion gallons
R = 14 inches = 80 billion cubic feet = 600 billion gallons
E = 19 inches = 110 billion cubic feet = 800 billion gallons.

WATER USE AND WATER PROBLEMS



TOTAL WITHDRAWALS OF WATER FOR ALL PURPOSES IN THE RIVER BASIN (INCLUDING THE PARTS OF MONROE COUNTY OUTSIDE THE BASIN) AVERAGE ABOUT 290 MGD (MILLION GALLONS PER DAY).

Of the 290 mgd withdrawn in the basin, more than 90 percent comes from lakes and streams. The remainder, about 12 mgd, is withdrawn from wells and springs. The combined withdrawals of surface and ground water sustain the domestic, industrial, commercial, and agricultural needs of about 720,000 people.

The two largest municipal water systems, serving areas both within and outside the Genesee River basin, are those of the city of Rochester and the Monroe County Water Authority. Both draw water from Lake Ontario; the Rochester system also draws as much as 36 mgd from Hemlock and Canadice Lakes. The combined Rochester and Monroe County systems deliver an average of nearly 80 mgd to about 550,000 people. Another large municipal supply, Batavia, draws its water supply from, and discharges its sewage to, the Tonawanda Creek valley to the west of the Genesee River basin.

The other 38 municipal water systems provide between 15,000 and 1,500,000 gallons per day to populations that number between 200 and 6,000 people. Per capita use of these municipal supplies is between 40 and 260 gallons per person per day, the larger values representing villages that supply substantial quantities of water to local industries. The largest of these water systems are at Avon, Dansville, Geneseo, LeRoy, Mount Morris, Perry, Warsaw, Wellsville, and the institutional water supply of Craig Colony and Hospital at Sonyea.

Basinwide rural domestic use (from nonmunicipal supplies) may average about 2.5 mgd. This assumes a rural population of about 50,000 people, and a per capita use for all household, sanitary, and farm purposes (other than for livestock) of 50 gpd. The basinwide use of water by livestock is estimated by the U.S. Soil Conservation Service to be about 3.2 mgd. When averaged for an entire year, water use for irrigation amounts to no more than 1 or 2 mgd. This use is expected to increase substantially during the next 10 years, especially near marketing areas or canneries in the northern and central parts of the basin. Throughout the basin the consumptive use of water is estimated to be less than 5 mgd.

The river basin will probably continue to show a marked north-south contrast of water use, in large measure because the largest water resources of the basin are within and adjacent to the northern part. Major increases in water use in the central and southern parts of the basin most likely will be associated with industrial centers established along future superhighways, or possibly with future developments of supplemental irrigation in flat or nearly flat lowlands and valleys.

The Genesee River basin is one of the less polluted river basins in the northeastern United States because of the relatively small population and lack of industrialization of most of the southern two-thirds of the basin. The largest and most costly problems concern pollution in the immediate vicinity of Rochester, especially in Lake Ontario, which receives the water and wastes from the entire river basin. Many of the problems in the basin are being solved or greatly reduced as sewage and waste-treatment plants are built or expanded in accordance with New York's Pure Waters Program of 1965. (Reports on pollution were published by the New York State Department of Health in 1955, 1961, and 1967.)

Polluted water is most commonly considered to be water which is unfit for culinary and some industrial or recreation, fish and wildlife purposes; it may be characterized by an offensive odor or appearance. Polluted water may, however, be clear and free from odor yet contain poisonous chemicals or deadly disease organisms too small to see. New York State has established standards of water quality in order to classify water for various uses, such as for domestic water supply. Note that the table includes biological, physical, and chemical characteristics.

Ground water is susceptible to pollution wherever the water table lies close to the land surface and the overlying materials are permeable enough to allow rapid infiltration. Carbonate rocks, such as dolomite and limestone, are the most pollution-prone types of bedrock because polluted water can travel relatively rapidly and often to great distances in solution-widened joints and openings. There are some places in the northern one-quarter of the basin where carbonate rocks occur at or extremely close to the land surface. In such areas, pollution from surface sources may be a problem.

Pollution of ground and surface water by oil-field wastes has occurred in the Genesee River basin, especially in Allegany County. Some of the pollution results from oil and brines leaking from holes in the casings of abandoned oil and gas wells. The damaging effects of oil-field pollution (most of which probably occurred some years ago) are still present in parts of the region because of the long time required for natural fresh-water movement to flush out the wastes once they have entered the soil and reached the water table. The presence of the wastes at shallow depths is indicated by the high chloride content of water in streams at low and moderate flows (times when the flows are being sustained mainly by ground water).

Occasionally, new wells drilled into the gypsum-shale bedrock unit will yield methane (natural gas), a colorless and odorless but highly flammable gas. Normally, the flow of methane from a well will decline rapidly because the gas usually occurs in small quantities in isolated cavities in the bedrock. Sometimes, however, a large source of methane is tapped and the flow of gas is more persistent.

Table 3.—*New York State's drinking water standards*

[From New York State Department of Health (1966); except as indicated, all results are in milligrams per liter which are approximately equivalent to parts per million]

Constituent	Maximum allowable
Coliform organisms, in MPN (most probable number) per 100 ml of sample:	
a. Arithmetic average of all samples in any month	1.1
b. Any two consecutive samples	
c. More than one sample when less than 20 samples are examined per month	8.8
d. More than 5 percent of the samples when 20 or more are examined per month	
Turbidity, in turbidity units	5
Color, in color units	15
Threshold odor, in odor units	3
Alkyl benzene sulfonate	.5
Arsenic	.05
Barium	1.0
Cadmium	.01
Carbon chloroform extract	.2
Chloride	250
Chromium (hexavalent)	.05
Copper	1.0
Cyanide	.2
Fluoride	1.5
Iron	.3
Lead	.05
Manganese	.3
Nitrate	10
Phenols	.001
Selenium	.01
Silver	.05
Sulfate	250
Total dissolved solids	500
Zinc	5

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1971

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