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Maggie Brooks
County Executive

Loads and Yields of Selected Constituents in Streams and Rivers of Monroe County, New York, 1984-2001

By Donald A. Sherwood

More than 20 years of hydrologic-data collection in Monroe County provides a basis for evaluation of the effects of urban growth and land-use changes on the chemical quality of streams and assessing the effectiveness of current water-resource-management practices. Since 1980, the Monroe County Department of Health has maintained a cooperative agreement with the U.S. Geological Survey (USGS) to collect and analyze hydrologic data from several sites and use the results to identify sources of contamination, quantify the annual loads and yields of selected chemical constituents, and identify temporal trends in these loads.

Monroe County encompasses 673 square miles in the Lake Ontario Plain region of New York (fig. 1) (Heffner and Goodman, 1973). Precipitation in this region is evenly distributed throughout the year, averaging about 2.7 inches per month and about 32 inches per year (National Oceanic and Atmospheric Administration, 1983-99) measured at the Rochester-Monroe County Airport (fig. 1). The even distribution of precipitation during the year is a result of the proximity to Lake Ontario and Lake Erie which affect local rain and snowfall patterns. The annual maximum precipitation during 1984-2001 (45.9 inches) occurred during 1998; the minimum (24.8 inches) occurred during 1985 (fig. 2).

Irondequoit Creek at Blossom Road

Genesee Falls at Driving Park Ave., Rochester

Irondequoit Wetlands

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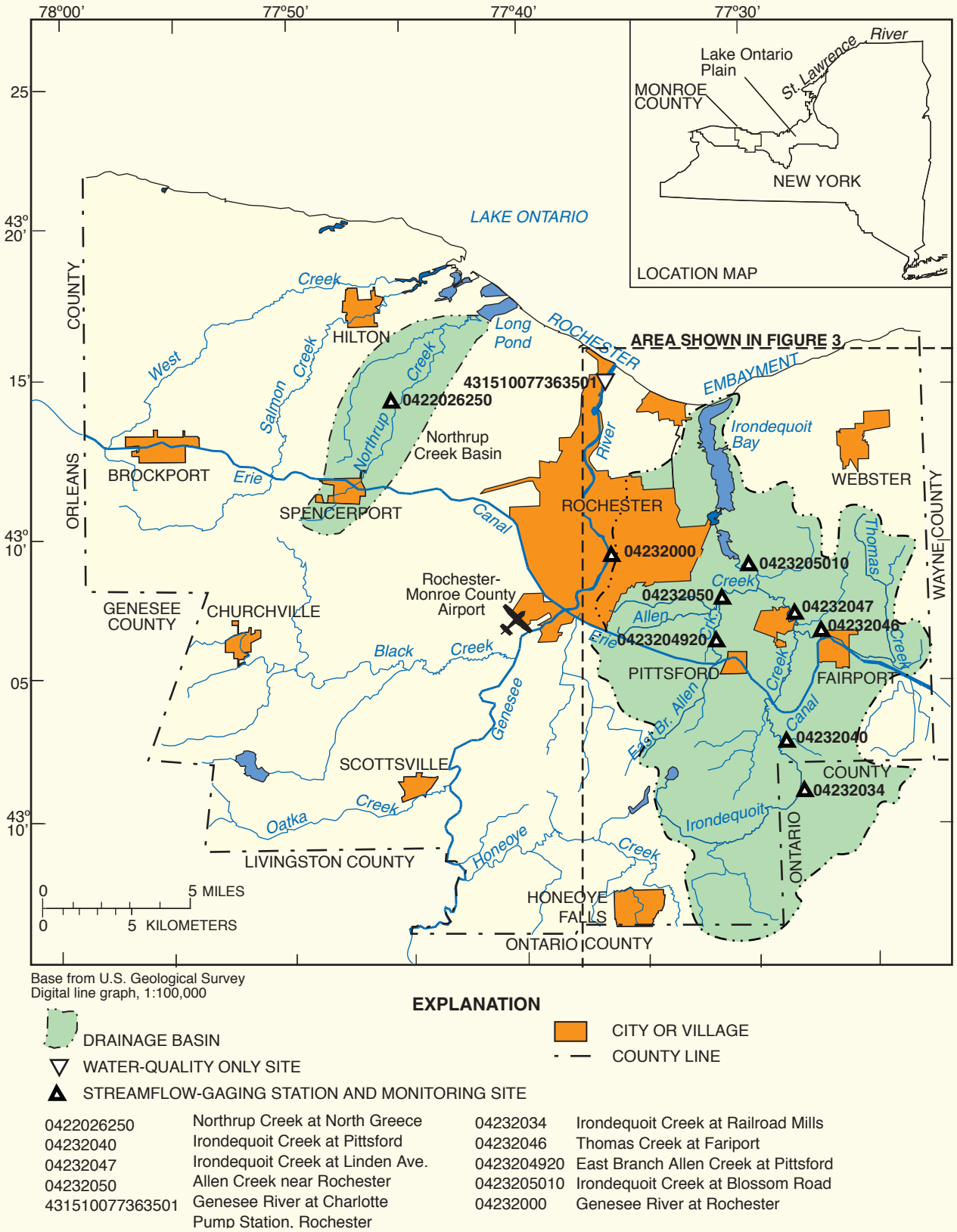
U.S. Department of the Interior
U.S. Geological Survey

Water-Resources Investigations Report 03-4197
June 2004



Base from U.S. Geological Survey
Digital line graph, 1:100,000

EXPLANATION

- DRAINAGE BASIN
- WATER-QUALITY ONLY SITE
- STREAMFLOW-GAGING STATION AND MONITORING SITE
- CITY OR VILLAGE
- COUNTY LINE

0422026250	Northrup Creek at North Greece
04232040	Irondequoit Creek at Pittsford
04232047	Irondequoit Creek at Linden Ave.
04232050	Allen Creek near Rochester
431510077363501	Genesee River at Charlotte Pump Station, Rochester
04232034	Irondequoit Creek at Railroad Mills
04232046	Thomas Creek at Fariport
0423204920	East Branch Allen Creek at Pittsford
0423205010	Irondequoit Creek at Blossom Road
04232000	Genesee River at Rochester

Figure 1. Principal geographic features of Monroe County, N.Y., and locations of selected monitoring sites in study area. (From Sherwood, 2003; fig. 1.)

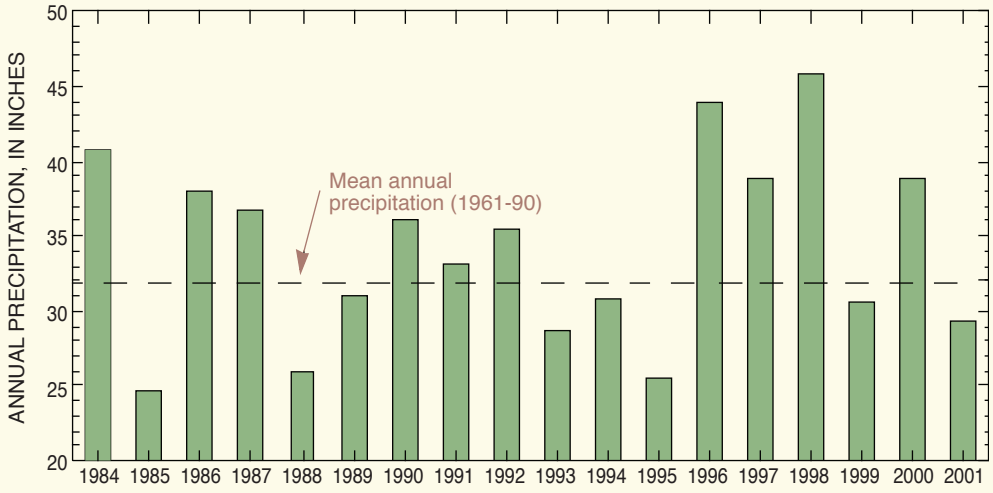


Figure 2. Annual total precipitation and long-term mean at Rochester-Monroe County Airport, N.Y., water years 1984-2001. (Location is shown in fig. 1.)

Chemical Loads and Yields

Streamflow samples have been collected at monitoring sites in Monroe County since 1984 and analyzed for nutrients (nitrogen and phosphorus), common ions (chloride and sulfate), and total suspended solids (Johnston and Sherwood, 1996; Sherwood, 1999a, 1999b, 2001, 2003). Concentration data from these samples are combined with streamflow (discharge) data to estimate the loads and yields of these constituents. Load represents the mass (usually in pounds or tons) of a given constituent moving past a given point per unit time and is calculated through a multivariate linear regression that provides a quantitative relation between measured constituent concentrations and daily stream discharge (Cohn and others, 1992). Yield is the load divided by the drainage area. Yields are helpful in comparisons between basins of differing size and streamflow characteristics; for example, a given stream may have a greater total load than another simply because it has a larger basin, yet it may have a smaller yield. Thus, the differences in yields of given streams can be more indicative of land-use differences among basins, or of changes in land use within a basin, than differences in loads.

Trend Analysis

A trend is an overall change in volume of streamflow or constituent load at a given site over a specified period of time (usually several years). Loads of constituents transported by a given stream are dependent on the volume of flow in that stream; thus, trends in streamflow are an important consideration when evaluating trends in constituent loading. Upward or downward trends in constituent loads may be due entirely or in part to an upward or downward trend in streamflow, rather than to an actual increase or decrease in concentration.

The total flow of streams generally varies from year to year, depending on the amount, intensity, and time of year of precipitation. Changes in land use also can affect streamflow volume; for example, converting agricultural or forested land to suburban development increases the amount of impervious or paved surface area, which in turn decreases the amount of stormwater infiltration and increases the volume of storm runoff that enters nearby streams. These factors can affect the short- and long-term trends in streamflow.

The effects of land-use changes and water-quality management practices on surface-water quality can best be examined through an analysis of water-quality trends—the overall changes in a chemical constituent loads at a specific site over a specified period of time. Annual loads of nine constituents at nine streamflow sites in Monroe County were tested for trends with a statistical routine called the Kendall slope estimator (Hirsch and others, 1982) to determine the direction and statistical significance of the trend. Annual loads were first normalized (annual load divided by annual mean discharge) to remove the effects of flow prior to trend analysis. These normalized loads (essentially annual mean concentrations) were then tested for trends. Annual mean loads of most constituents at Irondequoit basin sites show a long-term decrease over the period of record at all sites, although most are not statistically significant ($\alpha = 0.05$).

IRONDEQUOIT CREEK BASIN

The Irondequoit Creek basin lies in the eastern part of Monroe county and drains northward into Irondequoit Bay (fig. 3). Irondequoit Creek receives drainage from the east side of the City of Rochester as well as from adjacent Ontario and Wayne counties. The Erie (Barge) Canal crosses the middle of the basin from east to west. During the navigation season, water from the canal is diverted into Irondequoit Creek and some of its tributaries to augment flow in those streams during low-flow conditions. The headwaters (southern parts) of the basin are generally rural and agricultural, whereas the central and northern parts are urbanized.

The Irondequoit Creek basin was the original focal point of long-term water-resources study because Irondequoit Bay has been eutrophic for several decades due to the adverse effects on water quality of the sewage, sediments, and nutrients that are transported to the Bay by Irondequoit Creek. The discharge of treated sewage to Irondequoit Creek was eliminated in 1979, when the County Wastewater Treatment Facility along the shore of Lake Ontario began operation.

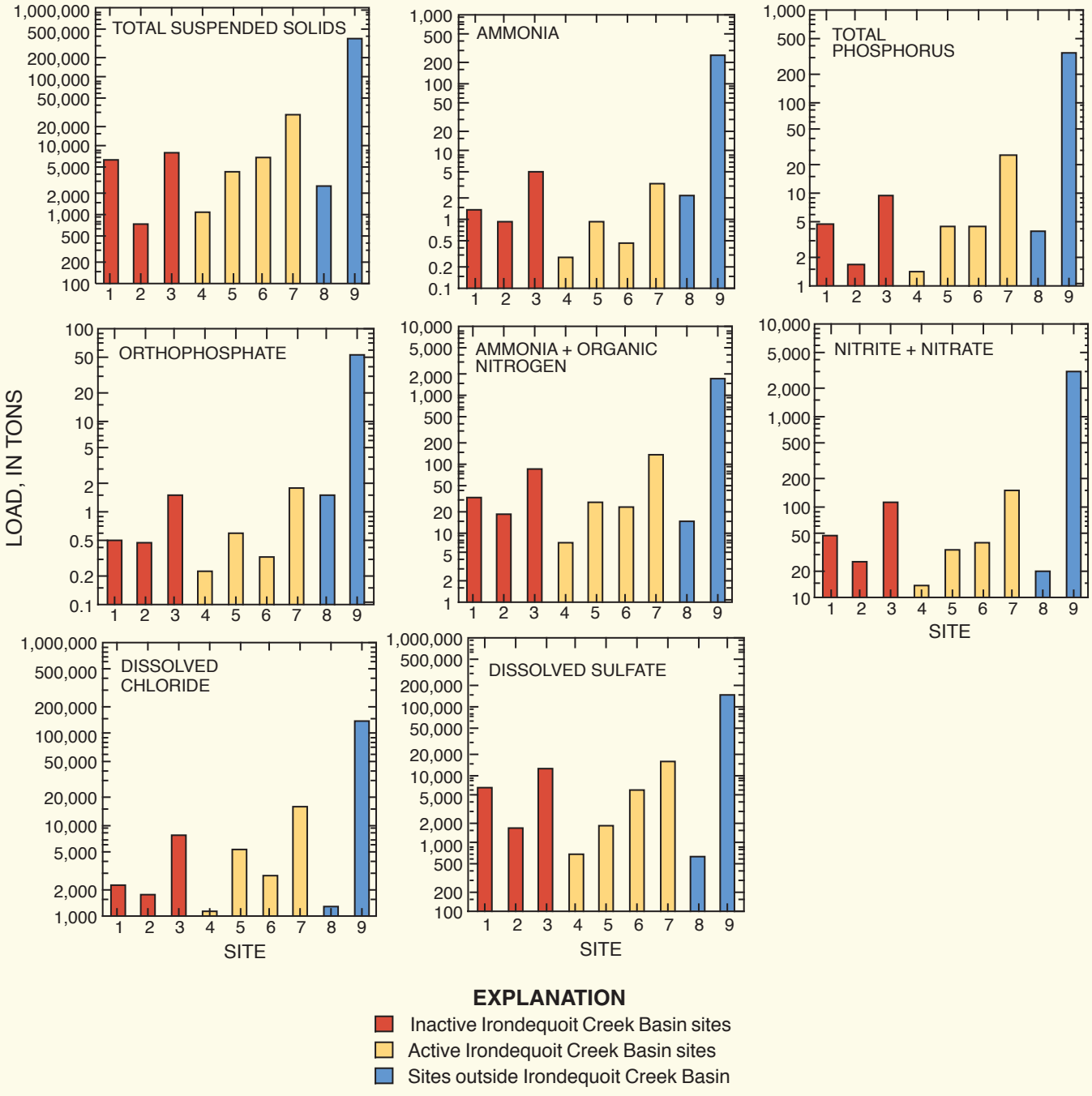
Streamflow and water-quality data have been collected at seven sites in the basin since 1984 (fig. 3). Four of the sites are currently active—Irondequoit Creek at Blossom Road (since 1984), Irondequoit Creek at Railroad Mills (streamflow since 1991 and water quality since 1992), Allen Creek near Rochester (streamflow since 1959 and water quality since 1984), and East Branch Allen Creek at Pittsford (since 1991); the three discontinued (inactive) sites are Irondequoit Creek at Pittsford (1984-90), Irondequoit Creek at Linden Ave. (1984-88), and Thomas Creek at Fairport (1984-88).

Base from U.S. Geological Survey
State base map, 1974, 1:500,000

Figure 3. Locations of selected streamflow-gaging stations within the Irondequoit Creek basin, Monroe County, N.Y.

Mean Annual Constituent Loads

Mean annual constituent loads calculated for the four active and three inactive sites in the Irondequoit Creek basin are given in table 1. The greatest mean annual loads for all constituents among the active sites, were at Irondequoit Creek at Blossom Road (fig. 4), although the mean annual load of ammonia at Irondequoit Creek at Linden Avenue (an inactive site) was higher during its period of record than at Blossom Road. Generally, the East Branch Allen Creek site (which has the smallest drainage area and the lowest mean annual flow) had the lowest mean annual loads of all constituents for all sites, but this site had the highest yields of orthophosphate and nitrite + nitrate.



Site number, name, and period of record

1. Irondequoit Creek at Pittsford (1984-90)
2. Thomas Creek at Fairport (1984-88)
3. Irondequoit Creek at Linden Ave. (1984-88)
4. East Branch Allen Creek at Pittsford (1991-2001)
5. Allen Creek near Rochester (1984-2001)
6. Irondequoit Creek at Railroad Mills (1992-2001)
7. Irondequoit Creek at Blossom Road (1984-2001)
8. Northrup Creek near North Greece (1990-2001)
9. Genesee River at Charlotte Pump Station at Rochester (1990-2001)

Figure 4. Mean annual loads of selected constituents at nine sites in Monroe County, N.Y., for period of record. (Locations are shown in fig. 1.)

Constituent Yields

Among the active sites, the highest yields of ammonia (0.03 tons per square mile), ammonia + organic nitrogen (0.93 tons per square mile), and chloride (175 tons per square mile) were at the Allen Creek site, and the highest yields of orthophosphate (0.024 tons per square mile) and nitrite + nitrate (1.44 tons per square mile) were at the East Branch Allen Creek site (fig 5). The highest yields of total phosphorus were at Irondequoit Creek at Blossom Road. The lowest yields of all constituents except suspended solids and dissolved sulfate were at the most upstream Irondequoit Creek site, Railroad Mills. Among the inactive sites, the highest yields of ammonia, ammonia + organic nitrogen, nitrite + nitrate, and chloride were at Irondequoit Creek at Linden Ave. The lowest yields of all constituents except ammonia, orthophosphate, and dissolved chloride were at Thomas Creek. The high yields of dissolved sulfate at Railroad Mills were reflected at the Pittsford site (inactive), about 2 miles downstream.

Table 1. Statistical summary of annual loads, and results of trend tests on loads of selected flow-adjusted constituents, at three inactive and four active sites in the Irondequoit Creek basin, Monroe County, N.Y., for period of record.

[Loads are in tons. Boldface type indicates trend is significant at $\alpha = 0.05$. *p*, level of significance. Site locations are shown in fig. 3.]

Discharge and constituent	Annual Load					Flow-adjusted trend		
	Mean annual	Maximum		Minimum		Units per year	percent per year	*p*
		Value	Year	Value	Year			
INACTIVE SITES								
Irondequoit Creek at Pittsford (1984-90)								
Discharge (cubic feet per second)	42.2	55.5	1984	30.3	1988	-2.17	-5.1	0.23
Total suspended solids	**6,190**	**9,400**	**1990**	**3,590**	**1989**	**18.9**	**12.8**	**.04**
Ammonia	1.35	2.54	1984	0.74	1988	-.003	-8.3	.23
Ammonia + organic nitrogen	32.8	42.5	1986	22.8	1988	.004	.6	.76
Nitrite + nitrate	47.2	62.8	1986	28.9	1988	-.06	-5.3	.23
Total phosphorus	4.60	6.44	1987	2.60	1985	.012	11.0	.23
Orthophosphate	0.50	0.75	1986	0.27	1989	--	--	--
Dissolved chloride	2,220	2,620	1984	1,740	1988	1.53	2.9	.07
Dissolved sulfate	6,610	8,030	1984	5,760	1988	2.94	1.8	1
Thomas Creek at Fairport (1984-88)								
Discharge (cubic feet per second)	16.7	23.9	1984	10.4	1988	-2.37	-14.2	.22
Total suspended solids	711	980	1984	421	1988	1.24	2.9	.46
Ammonia	**0.92**	**1.55**	**1984**	**0.37**	**1988**	**-.009**	**-16.7**	**.03**
Ammonia + organic nitrogen	18.4	25.6	1984	10.5	1988	-.017	-1.6	.81
Nitrite + nitrate	24.8	37.1	1984	8.98	1988	-.23	-16.1	.22
Total phosphorus	1.68	2.09	1986	1.16	1988	.007	6.9	.09
Orthophosphate	0.45	0.65	1984	0.26	1988	.001	3.3	.81
Dissolved chloride	1,780	2,240	1984	1,260	1988	5.33	4.8	.22
Dissolved sulfate	1,710	2,290	1984	1,280	1988	4.91	4.7	.22
Irondequoit Creek at Linden Ave. (1984-88)								
Discharge (cubic feet per second)	87.1	107	1984	66.1	1988	-3.76	-4.3	.46
Total suspended solids	7,890	11,700	1987	3,470	1985	6.73	7.7	.46
Ammonia	4.84	6.28	1984	2.56	1988	-.006	-11.6	.22
Ammonia + organic nitrogen	84.1	110	1984	55.2	1988	-.02	-2.3	.22
Nitrite + nitrate	114	139	1984	70.4	1988	-.10	-7.9	.22
Total phosphorus	9.28	12.5	1984	4.52	1985	.01	16.9	.09
Orthophosphate	1.55	2.03	1986	0.84	1985	<.001	1.4	1
Dissolved chloride	7,810	9,450	1986	6,500	1985	1.15	1.2	.81
Dissolved sulfate	12,200	13,700	1984	10,200	1985	5.77	4.0	.22

Table 1. Statistical summary of annual loads, and results of trend tests on loads of selected flow-adjusted constituents, at three inactive and four active sites in the Irondequoit Creek basin, for period of record (continued).

Discharge and constituent	Annual Load					Flow-adjusted trend		
	Mean annual	Maximum		Minimum		Units per year	percent per year	*p*
		Value	Year	Value	Year			
ACTIVE SITES								
East Branch Allen Creek at Pittsford (1991-2001)								
Discharge (cubic feet per second)	8.76	11.3	1998	5.28	1995	-.06	-.6	.70
Total suspended solids	**1,100**	**1,580**	**1998**	**475**	**2001**	**-5.7**	**-4.6**	**.03**
Ammonia	0.28	0.36	1994, 96, 98	0.02	1999	-.002	-.72	.64
Ammonia + organic nitrogen	**7.18**	**9.95**	**1993**	**3.32**	**1999**	**-.03**	**-3.4**	**<.01**
Nitrite + nitrate	13.7	19.9	1991	6.88	1995	-.04	-2.4	.21
Total phosphorus	1.41	2.32	1998	0.61	2001	-.01	-4.3	.24
Orthophosphate	0.23	0.42	1998	0.12	1999	<-.001	-2.4	.53
Dissolved chloride	**1,120**	**1,720**	**2000**	**692**	**1995**	**8.3**	**6.4**	**<.01**
Dissolved sulfate	673	812	2000	468	1999	.55	.71	.35
Allen Creek near Rochester (1984-2001)								
Discharge (cubic feet per second)	28.9	42.2	1984	16.1	1995	-.43	-1.5	.31
Total suspended solids	4,080	7,190	1998	1,930	1997	2.12	1.5	.26
Ammonia	**0.94**	**2.28**	**1984**	**0.21**	**1995**	**-.001**	**-5.3**	**.01**
Ammonia + organic nitrogen	**28.1**	**50.6**	**1984**	**10.5**	**1998**	**-.04**	**-4.4**	**<.01**
Nitrite + nitrate	33.3	55.9	1984	16.1	1995	-.13	-1.9	.11
Total phosphorus	4.24	9.02	1998	2.06	1995	<-.001	-.15	.82
Orthophosphate	0.58	1.28	1998	0.32	1988,2001	<.001	.36	.76
Dissolved chloride	**5,260**	**7,040**	**1996**	**3,520**	**1988**	**4.4**	**2.4**	**<.01**
Dissolved sulfate	**1,810**	**2,980**	**1994**	**1,170**	**1995**	**-0.97**	**-1.5**	**.01**
Irondequoit Creek at Railroad Mills (1992-2001)								
Discharge (cubic feet per second)	38.0	53.5	1993	24.7	1995	-0.99	-2. 6	059
Total suspended solids	7,040	10,100	1998	3,700	1995	--	--	--
Ammonia	0.45	1.02	1996	0.03	1995	-.001	-9.5	.47
Ammonia + organic nitrogen	**22.9**	**47.3**	**1993**	**11.9**	**1999**	**-.023**	**-.48**	**.02**
Nitrite + nitrate	39.6	48.8	1998	26.5	1995	.004	.37	.59
Total phosphorus	4.23	7.12	1998	2.01	1995	-.004	-4.2	.21
Orthophosphate	0.33	0.53	1998	0.14	1995	<.001	2.1	.47
Dissolved chloride	**2,750**	**3,420**	**1998**	**1,840**	**1995**	**4.6**	**6.2**	**<.01**
Dissolved sulfate	6,070	6,780	1998	4,970	1999	.79	.48	.72
Irondequoit Creek at Blossom Road (1984-2001)								
Discharge (cubic feet per second)	134	182	1993	80.1	1995	-.70	-.5	.76
Total suspended solids	29,100	71,000	1989	8,640	1995	-2.97	-1.4	.23
Ammonia	**3.44**	**9.02**	**1984**	**0.98**	**2001**	**-.002**	**-8.2**	**<.01**
Ammonia + organic nitrogen	**133**	**209**	**1986**	**52.6**	**1999**	**-.05**	**-4.6**	**<.01**
Nitrite + nitrate	149	213	1984	78.3	1995	-.014	-1.2	.06
Total phosphorus	25.9	54.9	1998	9.7	1995	<-.001	-.17	.94
Orthophosphate	1.83	3.14	1984	1.01	1988	<-.001	-.47	.54
Dissolved chloride	**16,400**	**21,000**	**1993**	**11,600**	**1988**	**2.24**	**1.8**	**<.01**
Dissolved sulfate	15,600	19,200	1993	12,200	1995	-.16	-.14	.88

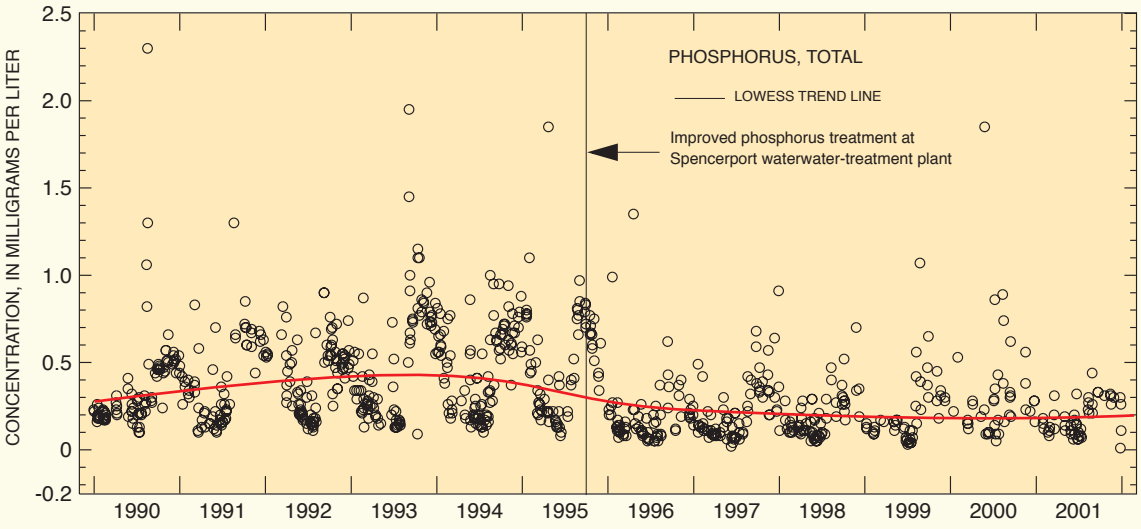


Figure 5. Concentrations of total phosphorus in samples from Northrup Creek with LOWESS trend line before and after implementation of improved phosphorus treatment at the Spencerport wastewater-treatment plant, Monroe County, N.Y., during August 1995. (Locations are shown in fig. 1.)

Trends

All active sites in the Irondequoit Creek basin showed significant downward trends in flow-adjusted loads of ammonia + organic nitrogen (table 1), probably as a result of the gradual loss of agricultural lands to suburban development. Annual loads of ammonia showed a significant downward trend at the Allen Creek and Blossom Road sites, as did suspended solids at the East Branch Allen Creek site. The downward trend in suspended solids at this site is a result of a stormwater-detention basin that was constructed upstream during the summer of 1995 to allow settling (removal) of suspended material. Annual loads of chloride showed an upward trend at all sites.

Two of the three inactive sites had the minimum recommended period of record (5 years) for trend analysis. Only two statistically significant trends were noted at these sites—Thomas Creek, which showed a downward trend in ammonia, and Irondequoit Creek at Pittsford, which showed an upward trend in suspended solids.

NORTHRUP CREEK

Long Pond, a shallow embayment along the southern edge of Lake Ontario (fig. 1) has become hypereutrophic (overly enriched with nutrients) in recent years as a result of nitrogen and phosphorus transported to those waters by Northrup Creek. An overabundance of these nutrients has resulted in the development of algal mats and decaying algal clumps that cause odors, discolor the water, and interfere with the esthetic quality of the pond and its recreational uses.

In 1989, the Monroe County Department of Health and the Town of Greece, in cooperation with the USGS, began a monitoring program on Northrup Creek at a site about 5 mi north of the Spencerport wastewater-treatment plant to assess nutrient loads being delivered to Long Pond by Northrup Creek (Sherwood, 1999a). The program entailed the collection and analysis of water samples and streamflow data for calculation of chemical loads. Northrup Creek begins just south of the village of Spencerport and flows about 10.5 miles northward into Long Pond. Northrup Creek's 23.5-square-mile basin contains agricultural land, housing developments, and a small amount of urban land. The major contributor of nutrients (particularly phosphorus) to Northrup Creek is the Spencerport wastewater-treatment plant. In 1995, the plant began a program to improve the removal of phosphorus from the effluent.

Total phosphorus loads in Northrup Creek during 1990-2001 averaged 3.80 tons per year, whereas orthophosphate loads averaged 1.54 tons per year (table 2). Yields of nutrients in the Northrup Creek basin were considerably higher than any of those in Irondequoit Creek or the Genesee River (fig. 6). Trend testing of flow-adjusted loads indicated one constituent (total phosphorus) with a significant downward trend (fig. 5), which is attributed to the improved wastewater treatment (Sherwood, 2003), and two constituents (dissolved chloride and dissolved sulfate) with significant upward trends.

Table 2. Statistical summary of annual loads and results of trend tests on loads of selected flow-adjusted constituents at Northrup Creek at North Greece, Monroe County, N.Y., 1990 through 2001.

[Loads are in tons. Boldface type indicates trend is significant at $\alpha = 0.05$. *p*, level of significance. Site location is shown in fig. 1.]

Discharge and constituent	Annual Load					Flow-adjusted trend		
	Mean	Maximum		Minimum		Units per year	percent per year	*p*
		Value	Year	Value	Year			
Discharge (cubic feet per second)	13.4	18.7	1998	7.33	1995	0.07	0.55	0.89
Total suspended solids	2,610	4,690	1996	862	1995	-.48	-.24	.95
Ammonia	2.23	4.19	1996	1.07	1992	.003	1.6	.45
Ammonia + organic nitrogen	14.0	18.1	1993	7.7	1995	-.04	-3.5	.09
Nitrite + nitrate	19.7	25.2	1996	13.0	1995	.02	1.6	.37
Total phosphorus	**3.80**	**4.79**	**1993**	**2.35**	**2001**	**-.01**	**-3.9**	**.03**
Orthophosphate	1.54	2.14	1991	0.89	2001	-.01	-8.1	.11
Dissolved chloride	**1,260**	**1,750**	**2001**	**821**	**1995**	**4.68**	**4.9**	**.02**
Dissolved sulfate	**657**	**920**	**1998**	**421**	**1995**	**1.24**	**2.6**	**.02**

Table 3. Statistical summary of annual loads and results of trend tests on loads of selected flow-adjusted constituents at Genesee River at Charlotte Pump Station, Rochester, N.Y., 1990 through 2001.

[Loads are in tons. Boldface type indicates trend is significant at $\alpha = 0.05$. *p*, level of significance. Site location is shown in fig. 1.]

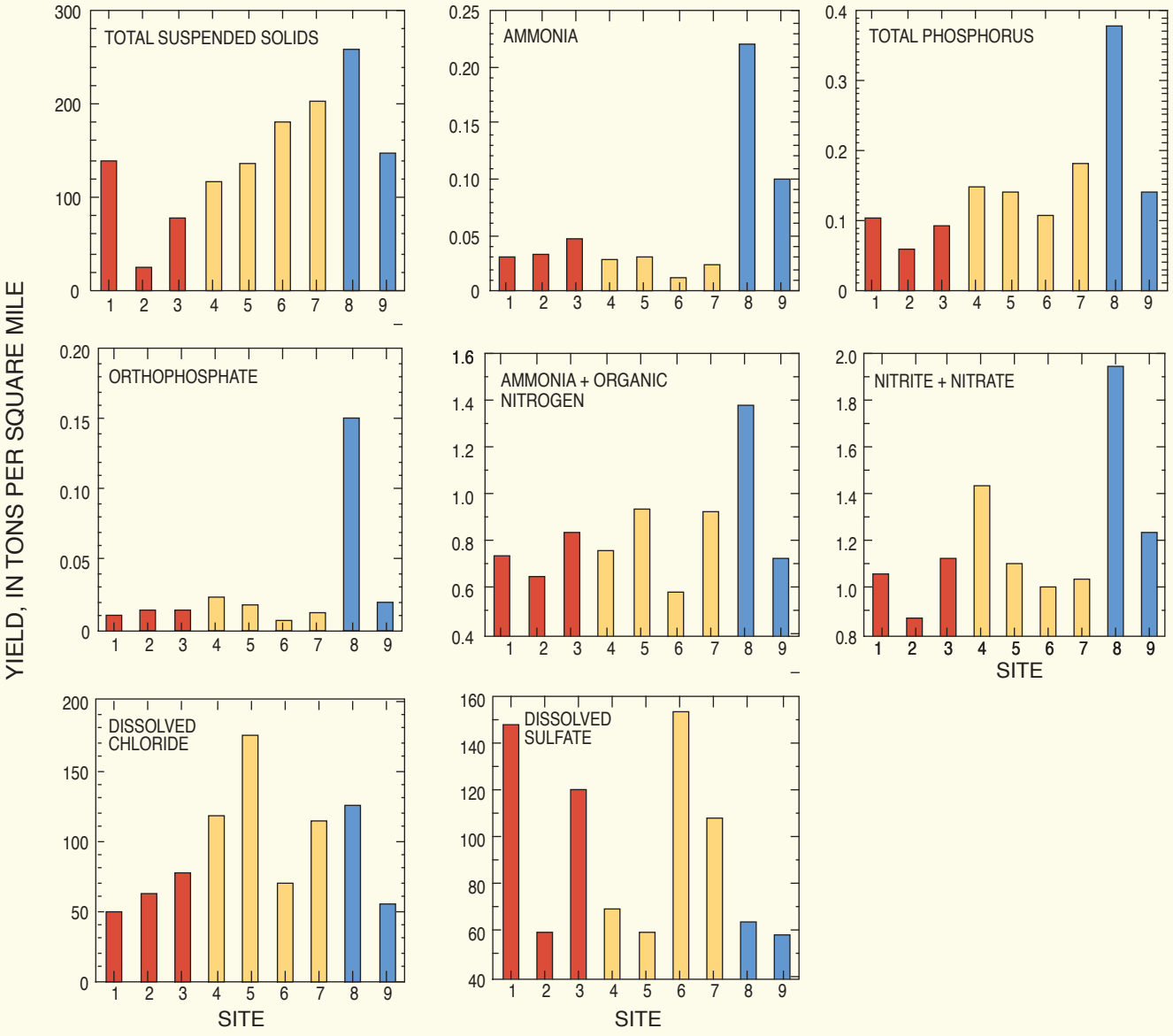
Discharge and constituent	Annual Load					Flow-adjusted trend		
	Mean	Maximum		Minimum		Units per year	percent per year	*p*
		Value	Year	Value	Year			
Discharge (cubic feet per second)	2,750	3,500	1993	1,660	1999	-21.5	-0.8	0.58
Total suspended solids	362,000	713,000	1996	160,000	1992	-2.25	-1.8	.30
Ammonia	250	330	1991	158	1999	-.002	-2.2	.10
Ammonia + organic nitrogen	**1,780**	**2,420**	**1993**	**830**	**1999**	**-.025**	**-3.9**	**<.01**
Nitrite + nitrate	3,060	4,160	1996	1,710	1999	-.005	-.42	.50
Total phosphorus	347	530	1998	160	1995	-.002	-1.3	.36
Orthophosphate	**51**	**77**	**1998**	**31**	**1989**	**.001**	**3.6**	**<.01**
Dissolved chloride	**134,000**	**186,000**	**1991**	**71,400**	**1999**	**-1.70**	**-3.5**	**.01**
Dissolved sulfate	147,000	181,000	1996	99,100	1999	-.07	-.13	.85

GENESEE RIVER

The Genesee River flows northward from the New York-Pennsylvania border through Monroe County and Rochester into Lake Ontario. Its basin contains 2,480 square miles and is primarily agricultural except in the City of Rochester, where it is urban. Flow of the Genesee River at Rochester has been monitored since 1919, and water-quality monitoring began in 1971 at Charlotte Docks under the USGS National Stream Quality Accounting Network (NASQAN) program. In 1989, Monroe County began collection and analysis of water-quality data from the Genesee River at the Charlotte Pump Station, about 1 mile north (downstream) from the NASQAN site (fig. 1). The annual constituent loads (table 3) are based on data collected by Monroe County at the Charlotte Pump Station.

The Genesee River annually transports 362,000 tons of suspended solids, 134,000 tons of dissolved chloride, and 147,000 tons of dissolved sulfate to Lake Ontario (fig. 4). Nutrients are transported at the rate of 1,780 tons per year for ammonia + organic nitrogen, 3,060 tons per year for nitrite + nitrate, and 347 tons per year for total phosphorus. Yields of all constituents in the Genesee River basin were within the range of those found in the Irondequoit Creek basin (fig. 6). Ammonia + organic nitrogen and dissolved chloride showed significant downward trends, whereas orthophosphate showed a significant upward trend.

Water-quality monitoring has been started on three tributaries to the Genesee River—Black Creek, Honeoye Creek, and Oatka Creek (fig. 1). The period of record is too short at present for statistical analysis, however.



Site number, name, and period of record

1. Irondequoit Creek at Pittsford (1984-90)
2. Thomas Creek at Fairport (1984-88)
3. Irondequoit Creek at Linden Ave. (1984-88)
4. East Branch Allen Creek at Pittsford (1991-2001)
5. Allen Creek near Rochester (1984-2001)
6. Irondequoit Creek at Railroad Mills (1992-2001)
7. Irondequoit Creek at Blossom Road (1984-2001)
8. Northrup Creek near North Greece (1990-2001)
9. Genesee River at Charlotte Pump Station at Rochester (1990-2001)

Figure 6. Mean annual yield of selected constituents at nine sites in Monroe County, N.Y., for period of record. (Locations are shown in fig. 1.)

SUMMARY

Hydrologic data collected in Monroe County since the 1980's and earlier, including long-term records of streamflow and chemical loads, provide a basis for assessment of water-management practices. All monitored streams except Northrup Creek showed a slight (nonsignificant) overall decrease in annual streamflow over their period of record; Northrup Creek showed a slight increase.

The highest yields of all constituents except chloride and sulfate were at Northrup Creek; these values exceeded those of the seven Irondequoit Creek basin sites and the Genesee River site. The highest yields of dissolved chloride were at the most highly urbanized site (Allen Creek), whereas the highest yields of dissolved sulfate were at the most upstream Irondequoit Creek sites—Railroad Mills (active) and Pittsford (inactive). Yields of all constituents in the Genesee River at the Charlotte Pump Station were within the range of those at the Irondequoit Creek basin sites.

The four active Irondequoit Creek basin sites showed significant downward trends in flow-adjusted loads of ammonia + organic nitrogen, possibly from the conversion of agricultural land to suburban land. Two active sites (Allen Creek and Blossom Road) and one inactive site (Thomas Creek) showed downward trends in loads of ammonia. All active sites showed significant upward trends in dissolved chloride loads. Northrup Creek showed a significant downward trend in total phosphorus load since the improvement in phosphorus removal at the Spencerport wastewater-treatment plant, and upward trends in dissolved chloride and sulfate loads. The Genesee River at the Charlotte Pump Station showed significant downward trends in loads of ammonia + organic nitrogen and chloride, and an upward trend in loads of orthophosphate.

The improved treatment or diversion of sewage-treatment-plant-effluent has produced decreased yields of some constituents throughout the county, particularly in the Irondequoit Creek basin, where the loads of nutrients delivered to Irondequoit Bay have been decreased.

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Irondequoit Bay

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