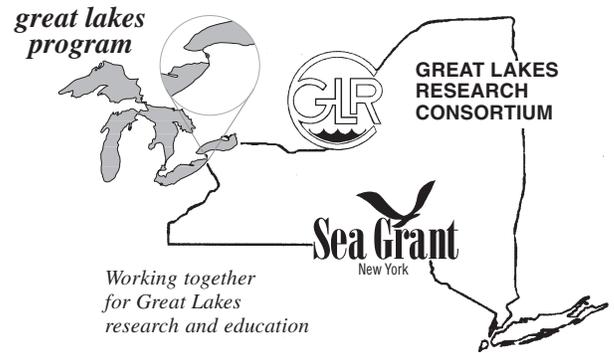
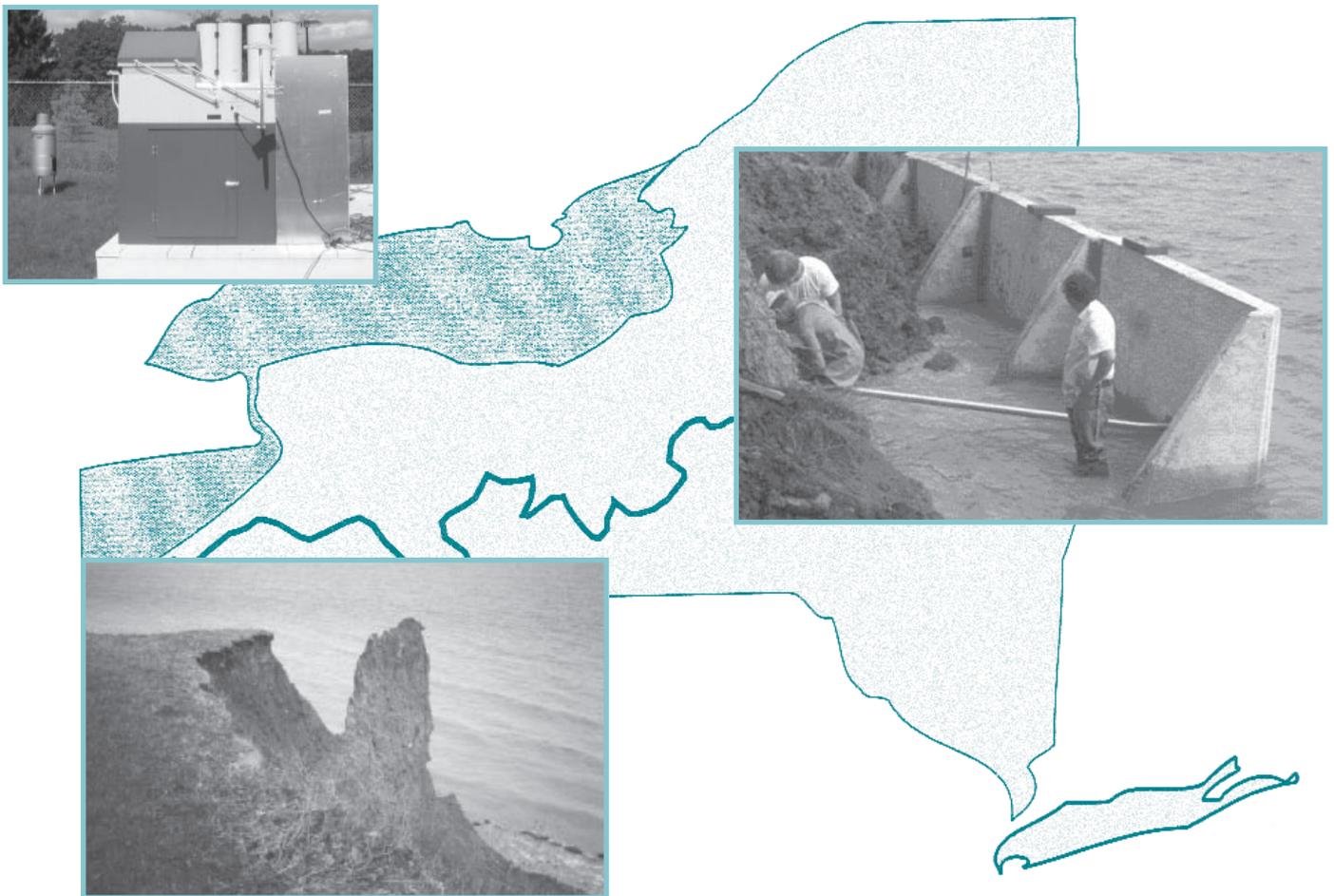


Great Lakes Research Review



New York State Great Lakes Protection Fund



In This Issue . . .

New York Great Lakes Protection Fund — Is it Working? . . . GIS Analysis of the Land Use Effect on Water Quality and Pollutant Discharge in the Cazenovia Creek Watershed, New York . . . Water Quality Opinion Survey 2000: Public Attitudes and Knowledge Regarding Water Quality in Monroe County, New York . . . Development of an Automated Dry Deposition Sampler . . . Great Lakes Coastal Erosion Processes and Control Educational Materials and Web Site Enhancement . . . Sewage Overflows: Information on Erie County's Urban Water Quality Problem

Great Lakes Research Review



*great lakes
program*

University at Buffalo

202 Jarvis Hall
Buffalo, NY 14260-4400

Voice: (716) 645-2088

Fax: (716) 645-3667

<http://www.buffalo.edu/glp>

Director: **Dr. Joseph F. Atkinson**

Associate Director: **Helen M. Domske**

Senior Staff Assistant: **Monica S. Moshenko**



*Great Lakes
Research
Consortium*

SUNY College of ESF

24 Bray Hall

Syracuse, NY 13210

Voice: (315) 470-6816

Fax: (315) 470-6970

<http://www.esf.edu/glrc>

Executive Director: **Jack Manno**

Co-Director: **Dr. Richard Smardon**

Research Co-Director: **Dr. James Haynes**



SUNY at Stony Brook

121 Discovery Hall

Stony Brook, NY 11794-5001

Voice: (631) 632-6905

Fax: (631) 632-6917

<http://www.seagrantsunysb.edu>

Director: **Dr. Jack Mattice**

Assistant Director: **Cornelia Schlenk**

ABOUT THIS PUBLICATION:

Eight years ago, staff from the Great Lakes Program, the Great Lakes Research Consortium, and New York Sea Grant realized an information gap existed between peer reviewed journal articles and newsletter type information related to Great Lakes research. The Great Lakes Research Review was created to fill that gap by providing a substantive overview of research being conducted throughout the basin. It is designed to inform researchers, policy-makers, educators, managers and stakeholders about Great Lakes research efforts, particularly but not exclusively being conducted by scientists affiliated with the Consortium and its member institutions.

Each issue has a special theme. Past issues have focused on the fate and transport of toxic substances, the effects of toxics, fisheries issues, and exotic species. The most recent volumes have focused on the Lake Ontario, St. Lawrence River and Lake Erie Ecosystems. The present issue is the first of two describing projects funded through the New York State Great Lakes Protection Fund. We gratefully acknowledge all of the contributing authors who willingly share their efforts for this publication.

THE UPCOMING ISSUE

The second issue of Volume Six will highlight other projects funded through the New York Great Lakes Protection Fund. The Fund was created to provide a perpetual and dependable source of research funds to support regional and state level projects within New York that protect, restore and improve the health of New York's Great Lakes Basin. It has been an important funding source since 1994, but it has had few ways of communicating its results to the public. For this reason, both issues of Volume Six of the Review focus on the outcomes of the New York Great Lakes Protection Fund. For more information on the Fund or to submit an article for the second issue, contact Jack Manno at jpmanno@mailbox.syr.edu.

Introduction . . . New York Great Lakes Protection Fund — Is it Working?

Dr. Richard C. Smardon

Co-Director

Great Lakes Research Consortium and member, Great Lakes Basin Advisory Council

INTRODUCTION

The regional Great Lakes Protection Fund is a \$97 million dollar endowment, formed by contributions from the eight Great Lakes states in order to provide a perpetual dependable source of funding to carry out research and protection programs under state auspices. The regional fund is administered by the U. S. Environmental Protection Agency's Great Lakes National Program Office. One third of the interest earnings from the fund are returned to the contributing states annually. With these returned funds the New York Great Lakes Protection Fund (Fund) was established by the New York State legislature to provide financial support to research and protective projects within New York State's Great Lakes Basin. Under Chapter 148, section 97ee clearly states the intention for uses of such funds.

"97-ee. New York Great Lakes Protection Fund

1. *There is hereby established in the joint custody of the state comptroller and the commissioner of taxation and finance a fund to be known as the New York Great Lakes protection fund. Such fund shall consist of revenues received from the Great Lakes protection fund and all other moneys, credited or transferred thereto from any other fund or source pursuant to law.*
 - (a) *Research on the economic, environmental and human health effects of contamination in the Great Lakes;*
 - (b) *The collection and analysis of data on the Great Lakes;*
 - (c) *The development of new or improved environmental cleanup technologies applicable to the Great Lakes;*
 - (d) *Research to assess the effectiveness of pollution control policies affecting the Great Lakes; and*
 - (e) *The assessment of the health of the Great Lakes fish, wildlife, waterfowl and other organisms.*
2. *Moneys of the New York Great Lakes protection fund, within amounts appropriated by the legislature, may be expended only for programs or grants to supplement existing Great Lakes research and protection programs consistent with the purposes of the Great Lakes protection fund agreement including the following:*
 3. *Moneys shall be paid out of the fund on the audit and warrant of the state comptroller on vouchers certified or approved by the commissioner of the department of environmental conservation, as the contract administrator for the New York Great Lakes protection program, for which the department will enter into contracts with qualified parties to carry out the program submitted by the Great Lakes Basin advisory council.*
 4. *Any income earned on moneys in the New York Great Lakes Protection Fund shall be added to and used for the purposes of such fund.*
5. *This act shall take effect immediately."*

Under this act the NYS Department of Environmental Conservation (DEC), the Great Lakes Basin Advisory Council (GLBAC), and the Great Lakes Research Consortium play specific roles. NYS DEC administers the fund, e.g. puts out the Call for Proposals, arranges for reviews of such proposals, and the Commissioner of NYSDEC makes the final awards with input from the GLBAC.

The council continues to provide input to the administration of the Fund by the DEC. Each year the council develops priority funding categories for the Small Grants and Full Grants Programs that reflect the council's annual emphasis and the current gaps in Great Lakes research and information, and reviews and recommends proposals for funding to the DEC Commissioner.

Under a Memorandum of Understanding (MOU) between DEC and the New York State Great Lakes Research Consortium (GLRC) funds will be made available for a small grants program and an assistant. Several years ago the State University of New York student research assistant compiled current and ongoing research topics, the results of the basin-wide State of the Lakes Ecosystem Conference and other known sources of research activities to identify the areas and specific topics most applicable to New York. The MOU, originally signed in 1994, was reauthorized this year to continue the five-year process for funding the Small Grants Program of the New York State Great Lakes Protection Fund and for the research assistant. This program provides small grants of up to \$10,000 as seed money for research and other activities related to the New York Great Lakes basin. This effort is unique among the state partners to the Great Lakes Protection Fund agreement and is intended to facilitate acquisition of grant funding from larger programs such as the regional Great Lakes Protection Fund, the National Science Foundation, and other federal and state sources.

The council reviewed the results for the research compilation and adopted four Priority Funding Categories for this year: A) Human Health and Populations at Risk, B) Contaminant Sources and Fate, C) Aquatic Habitats, and D) Public Participation and Policy. Specific objectives were developed for each category and topic in an attempt to focus the content of the proposals and resulting projects each year.

The Great Lakes Basin Advisory Council (Council) was established in the Laws of New York State of 1988 (ECL Section 21-0917). In the statute creating the Council, the New York State Legislature declared that the Great Lakes Basin is in need of state programs to protect its water quality against toxic pollution, to control interbasin diversions of Great Lakes water, to ensure sound coastal zone management, and to promote compatible economic growth and utilization throughout its watershed. The Legislature further noted that New York State has a duty to protect, conserve and manage its portion of the Great Lakes basin in coordination with the Legislature, state governmental agencies, local government, private sector, labor representatives and environmental organizations in order to ensure ecological stability, economic growth and beneficial use and enjoyment for present and future residents. The Council continues to work with the Governor and Legislature to achieve our mutual goals of protecting and restoring New York's Great Lakes resources, as well as providing input on the Great Lakes Protection fund.

Aside for the cooperative work of the NYSDEC, the Council and the GLRC — there continues to be problems in timely processing and making awards for the New York Great Lakes Protection Fund — even with a new Great Lakes coordinator for NYSDEC who is funded from the fund.

Due to DEC's staff resource limitations and changes made to the administrative process,

grant awards for the 1999-2000 Full Grants Program cycle were delayed in 2000, and the previous four years. Awards are typically granted six months after their announcement. This causes delays for applicants in completing subcontracts for the research projects awarded and causes some applicants to wait until late spring and summer for sampling and fieldwork. No-cost one-year time extensions of these contracts will automatically be necessary. Delays of this nature should be avoided in the future with the hiring of a new GLPC and with the changes made in the grant administrative process. Among the GLPC's primary responsibilities are overseeing administration of the Fund and implementing the Full Grants Program. A new call has just been issued for 2002. The good news is that the new coordinator is working well with NYSDEC, the council and the GLRC. The bad news is that for whatever reason, we are still experiencing aggravating delays in the issuing of calls for proposals and the actual awarding of proposals after the review process is completed.

Nevertheless, when grants have been awarded and work has been done — it has been good work! In this issue of Great Lakes research there are some good examples of that work. This includes the piece on “GIS analysis of Land Use Effect on Water Quality in the Cazenovia Creek Watershed” by Tao Tang, “Water Quality Opinion Survey 2000: Public Attitudes and Knowledge Regarding Water Quality in Monroe County” by Margit Poirier, “Development of an Automated Dry Deposition Sampler by Tom Holsen and Seung-Muk Yi, “Great Lakes Coastal Erosion Processes and Control Educational Materials and Web Site Enhancement” by Charles R. O’Neill, Jr., and “Great Lakes Pollution Discharge Mapping and Education Project” by Sarah Meyland. Some of these are student projects that have been supported by GLRC’s small grants program as part of the New York Great Lakes Protection Fund.

GIS Analysis of the Land Use Effect on Water Quality and Pollutant Discharge in the Cazenovia Creek Watershed, New York

Dr. Tao Tang and Dr. Kim Irvine

Department of Geography and Planning

The Great Lakes Center for Environmental Research and Education

State University of New York College at Buffalo

1300 Elmwood Avenue

Buffalo, NY 14222-1095

ABSTRACT

The Buffalo River in Western New York was designated as one of the Areas of Concern by the Great Lakes Water Quality Board of the International Joint Commission due to its poor water quality and contaminated sediments. Cazenovia Creek is one of the three major tributaries of the Buffalo River (see Figure 1). This research utilized remote sensing data and Geographic Information Systems (GIS) to analyze land use patterns in the Cazenovia Creek watershed and to relate land use patterns to the water quality index (WQI) and two metals (iron — Fe and lead — Pb) along the creek. The results indicated that: 1.) farm and forest mainly occupy the upper reach, mixed urban residential, commercial, and farmland occupy the middle reach, and urban, commercial, and industrial land dominate the lower reach of the watershed. 2.) Low water quality index (WQI) sites of both rainfall events and dry weather periods were located in the urban residential and business or shopping center areas close to the public transportation routes or oil and gas related industries (such as oil tanks and terminals). 3.) The sites where iron (Fe) content exceeded the NYS regulation limit are located either in the City of Buffalo, or in the Village of East Aurora. The major land use within 0.25 mile range of these sites is high-density and mid-density residence. 4.) The lead (Pb) content of the water samples is generally well below the NYS regulation limit. There is no distinct difference of lead (Pb) content between rainfall events and dry weather periods.

INTRODUCTION

Cazenovia Creek is one of the three major tributaries of the Buffalo River. Owing to the poor water quality and contaminated sediments, the Great Lakes Water Quality Board of the International Joint Commission (IJC) has designated the Buffalo River as one of the Areas of Concern (AOC) in the Great Lakes Region (International Joint Commission, 1988; New York State Department of Environmental Conserva-

tion, 1989). Previous studies (Atkinson et al., 1994; Erie and Niagara Counties Regional Planning Board, 1978; Irvine and Pettibone, 1993, 1996; Irvine, 1996; Pettibone and Irvine, 1994; Wills and Irvine, 1996) identified the levels of pollutant loading both for the Buffalo River and its tributaries. Research on sediment levels and loads to the Buffalo River and its tributaries were also conducted (Erie County Department of Environment and Planning, 1978; Meredith

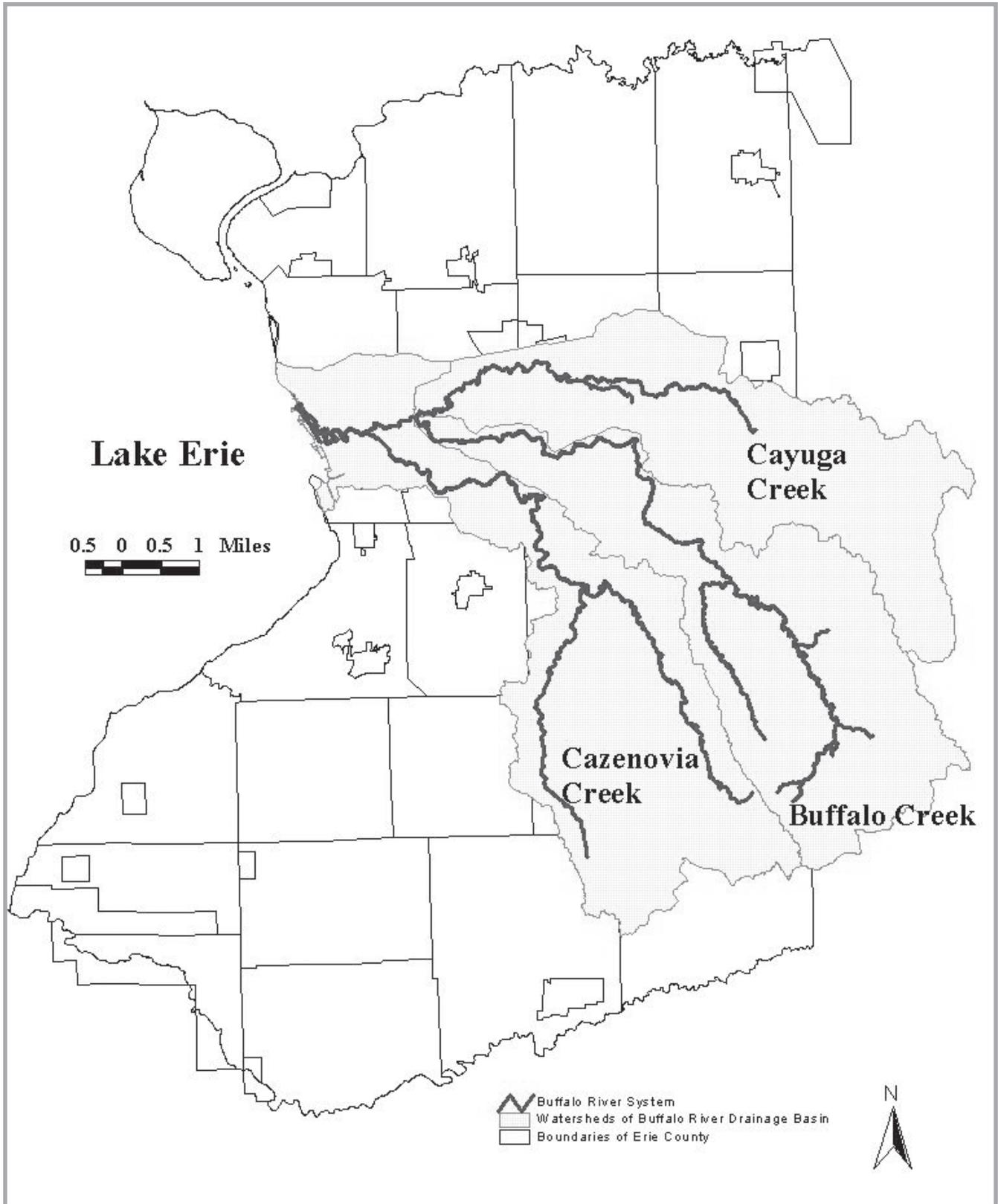


Figure 1. General Map of Buffalo River Drainage Basin

and Rumer, 1987; Monahan et al., 1995). A great amount of hydrological, sedimentary, and chemical pollutant data have been collected and the New York State Department of Environmental Conservation (NYSDEC) also completed a Stage I Remedial Action Plan (RAP) for the Buffalo River (NYDEC, 1989).

The ultimate goal of the RAP was to restore the chemical, physical, and biological integrity of the Buffalo River drainage system using the criteria established by IJC in the U.S. – Canada Great Lakes Water Quality Agreement. In order to achieve the objective of the RAP, it is important to continue the effort of identifying and monitoring the pollutant and sediment levels and loads of the river. In addition, it is necessary to identify the impacts of land use, in particular urban land use in the watershed, to the water quality and pollutant discharge in the river. The current study attempts to analyze the impact of different types of land use in the watershed to the water quality and pollutant contents in the river. First, remote sensing data and Geographic Information Systems (GIS) were utilized to analyze land use patterns in the watershed. Second, water samples were collected along the river and analyzed for water quality and chemical content. Finally, land use patterns were related to the water quality levels and metal contents along the river.

METHODOLOGY

SAMPLE SITE SELECTION, SAMPLE COLLECTION, AND GIS DATA ACQUISITION

Seven water-sampling sites were selected along Cazenovia Creek in this research. Four of the sites were inherited from a previous study (Irvine, 1996), and three additional sites were established in the Village of East Aurora. Data from eight additional sampling sites in 1996 were also applied in the analysis for comparison with the results of the current study (Irvine

and Pettibone, 1996; Irvine, 1996). The sampling locations are presented in Figure 2. The major criteria for site selection were accessibility and representation of upper, middle, and lower reaches of the river system.

Parcel level data were collected from the Erie County Water Authority and soils and watershed boundaries data were collected from the USDA Natural Resources Conservation, East Aurora office for establishing the Cazenovia Creek GIS database. The different map layers were compiled into the State Plane Coordinate (SPC) system with NAD 83 datum. The US Census block groups were merged with the parcel data to fill gaps not covered by the parcel data. A pair of GeoExplorer II GPS units from Trimble Navigation Inc. were used to collect location data of the water sampling sites in the field. The location of sampling points measured in the field was geocoded into ArcView GIS. Sediment concentration and water quality data were input into the GIS database as attributes for each of the sampling points.

ANALYSES OF LAND USE, WATER QUALITY INDEX, AND METALS

Two types of land use classification schemes were identified: (1) urban land use planning and property tax assessment, such as land use classification of the Erie County Real Property Information System (Erie County of Environment and Planning, 1997); (2) natural resource inventory and environmental conservation, such as LUNR-New York State Land Use and Natural Resource Inventory (Hardy et al., 1971). The land use classification scheme established in this study bridges the above two approaches. The major characteristic of this classification scheme is to group urban land use and tax assessors parcel level code to fulfill the requirements of environmental impact assessments. The land use classification scheme of this study is shown in Table 1.

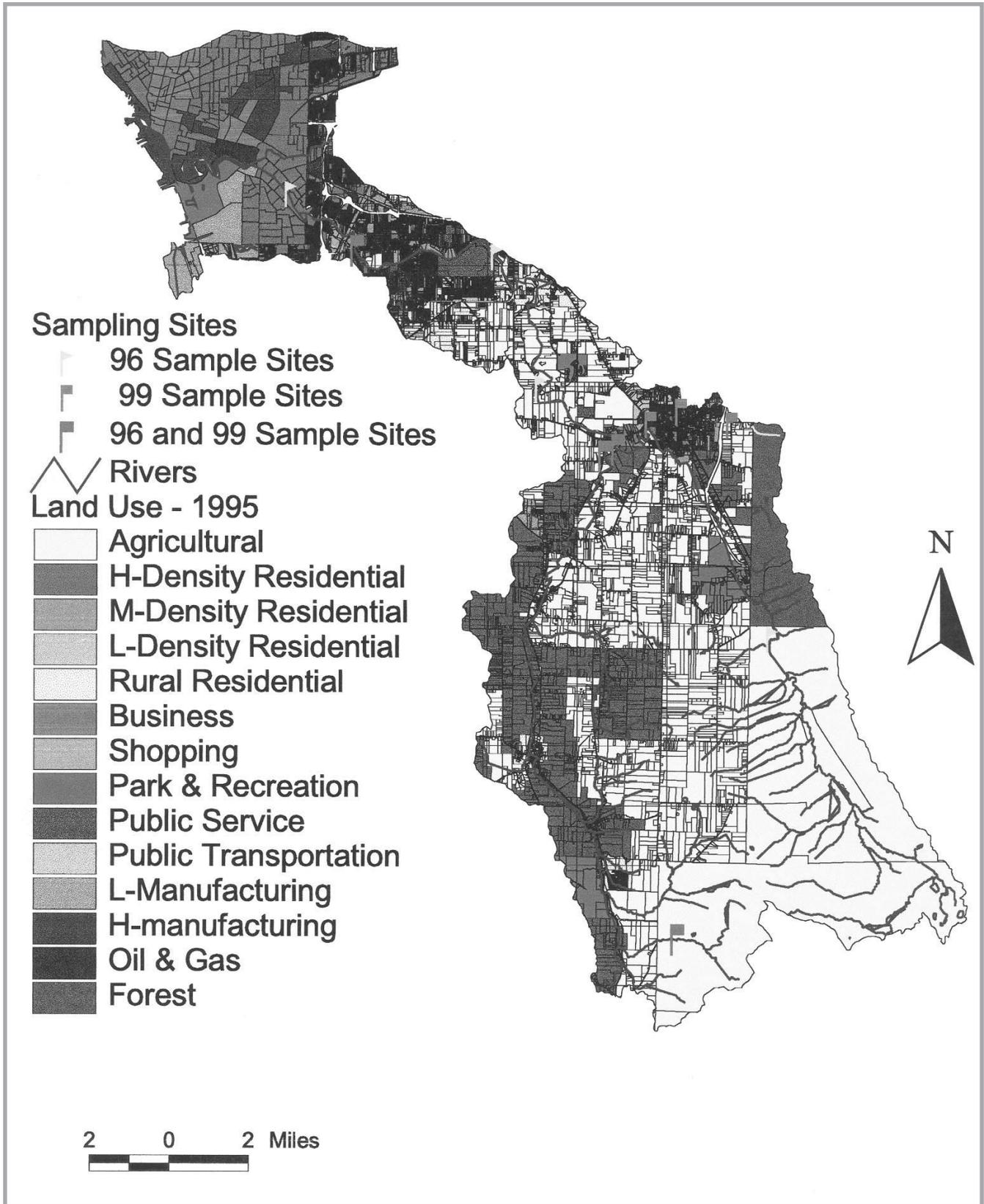


Figure 2. Land use and sampling sites in the Cazenovia Watershed (including lower Buffalo River).

Table 1. Land Use Classification Scheme

Land Use Description	Abbreviation	Land Use Code
Agricultural Land	AGR	100
Residential Land	RES	200
a. High-Density Residential	HDR	210
b. Medium-Density Residential	MDR	220
c. Low-Density Residential	LDR	230
d. Rural Residential	RR	240
Mixed Land Use Types	MLT	300
a. Transition Land from Rural to Urban	TLRU	310
b. Transition Land from Forest to Agriculture	TLFA	320
Commercial Land Use	COM	400
a. Business Center	BUS	410
b. Shopping Center	SHOP	420
Parks and Urban Recreation Land	PARE	500
Public Services	PS	600
a. Public Service Institutions	PSI	610
b. Transportation	TRAN	620
Industrial Land	IND	700
a. Light Manufacturing	LM	710
b. Heavy Manufacturing	HM	720
c. Mining	MIN	730
d. Oil and Gas Industry	OGI	740
Forest Land	FOR	800

Types of land use were visually identified from the USDA/USGS 1995 National Atmospheric Pollution Program (NAPP) air photos (hard copy and Digital Ortho Quarter Quad — DOQQ) and coded into the parcel polygon database. The land use within the watershed was then thematically mapped. Water quality factors were summarized using the National Sanitation Foundation Water Quality Index (WQI) developed by Brown et al. (1970). Wills and Irvine (1996) conducted detailed WQI evaluations and analyses. The nine WQI components are dissolved oxygen, fecal coliform density, pH, BOD5 (biochemical oxygen demand), nitrates, total phosphates, Dt °C from equilibrium, turbidity, and total solids.

Dissolved oxygen was measured in the field using a Dissolved Oxygen Meter (Model 508,

YSI, Inc., Ohio, 45387). Fecal coliform density of water samples was analyzed by membrane filtration method following the Standard Methods 9222D (APHA, 1989). pH and water temperature (°C) were measured in the field using a pH meter (Model 5985-80, Cole-Parmer Instrument, Inc., Chicago, IL, 60648). BOD5 of each water sample was determined using the oxygen depletion approach, following Standard Method 5210 B (APHA, 1992). Nitrate/nitrite for each sample was analyzed using the Cadmium Reduction method listed by Standard Methods 4500-NO3-E (APHA 1992). Total phosphate of each sample was analyzed using the combined ascorbic reagent method, Standard Method 4500-PE (PHA1992). Turbidity for each of the water samples was measured using a turbidity meter (H. F. Scientific, Inc., Model DRT-15B). The descriptions of water

Table 2. Water Quality Description by WQI Value Range.

Water Quality Description	WQI Value Range
Very Bad	0-25
Bad	26-50
Medium	51-70
Good	71-90
Excellent	91-100

quality with WQI value ranges were proposed by Mitchell and Stapp (1995) and are listed in Table 2.

Low water quality sites along the river were queried for each of the sampling rounds according to the following criteria:

- (1) Select the sites with $WQI \leq 70$.
- (2) If the lowest WQI value is > 70 , select those sites with $WQI \leq 75$.

Total iron (Fe) and lead (Pb) of the water samples were analyzed at the Erie County Public Health Laboratory, Buffalo, NY. The metals were analyzed by atomic absorption (AA) method. All the metal sampling bottles were new polyethylene containers, and were only used for one sample. Two or three laboratory analytical blanks were done for each of the sample batches. The blanks contained distilled water and all the reagents. They were processed with the sample batch to identify the level of metals in a particular analytical environment. The results of each of the analytes were subtracted by the average of the blanks of the batch.

The New York State Water Quality Regulations (New York State Department of Environmental Conservation (NYSDEC), 1989) identify the

general conditions of water by contents of a variety of chemical substances and metals. A quantitative perimeter was established for each of the concerned contents in the water samples. The standards for iron (Fe) and lead (Pb) are as follows:

- (1) Iron (Fe) $< 300 \mu\text{g/L}$
- (2) Lead (Pb) $< 50 \mu\text{g/L}$.

Distance themes were created for the selected sites of WQI and the sites where metals exceeded the standards. This process used the distance analysis function in Spatial Analyst of ArcView GIS. The distance theme was then reclassified using 0.25 miles (1320 feet) as the first zone and 0.5 miles (2640 feet) as the second zone surrounding the selected sites. The land use theme was converted to a grid theme. The selected 0.25 mile and 0.5 mile zones were overlaid onto the land use grid theme to identify the land use types within the above ranges. The final results are presented as histograms (Figure 3).

RESULTS AND DISCUSSION

Results of land use analysis suggest that (1) farmland and forest mainly occupy the upper reach of the Cazenovia Creek watershed. (2) The mixed urban and suburban residential, commercial, and farmland mainly occupy the middle reach of the watershed. (3) The urban residential, commercial, and industrial land uses mainly occupy the lower reach of the watershed (Figure 2).

WQIs of three sampling sites were less than or equal to 70 during rainfall event #1 of 1999. All these sites are located along the Tannery Brook in the Village of East Aurora, which is a major tributary of Cazenovia Creek. The distribution of land use from highest to lowest within the 0.25 mile range are mid-density residential, high-density residential, rural residential, parks and recreation, oil and gas related industries,

and business centers for the three selected sites (Figure 3). The land use distribution within the 0.5 mile range decreases from mid-density residential to high-density residential and to business, shopping centers, and parks for the three sites (Figure 3).

There was one site with WQI < 70 during dry weather sampling of 1999. It is located in the middle reach of the Tannery Creek in the Village of East Aurora. The major land use within 0.25 mile range is high-density residential with minor areas of oil and gas related industries, such as oil tanks and terminals (Figure 4). Extending the search range to 0.5 mile, it was found that the largest land use remains as high-density residential, while the second changes

to low-density residential and the third is the rural residential (Figure 4).

Results of metal analysis indicated that the average iron (Fe) content during the rainfall events (377 mg/L) is higher than that of dry weather samples (157 mg/L). However, there is no clear pattern of lead (Pb) distribution between rainfall events and dry weather. The sites where iron content exceeded the New York State regulation limit (300 mg/L) during dry weather periods in 1999, are the locations either in the Village of East Aurora or just below the village. During the rainfall events, iron (Fe) content of the sites both in the village and in the City of Buffalo, at the lower reach of the Cazenovia Creek, exceeded the standard limit.

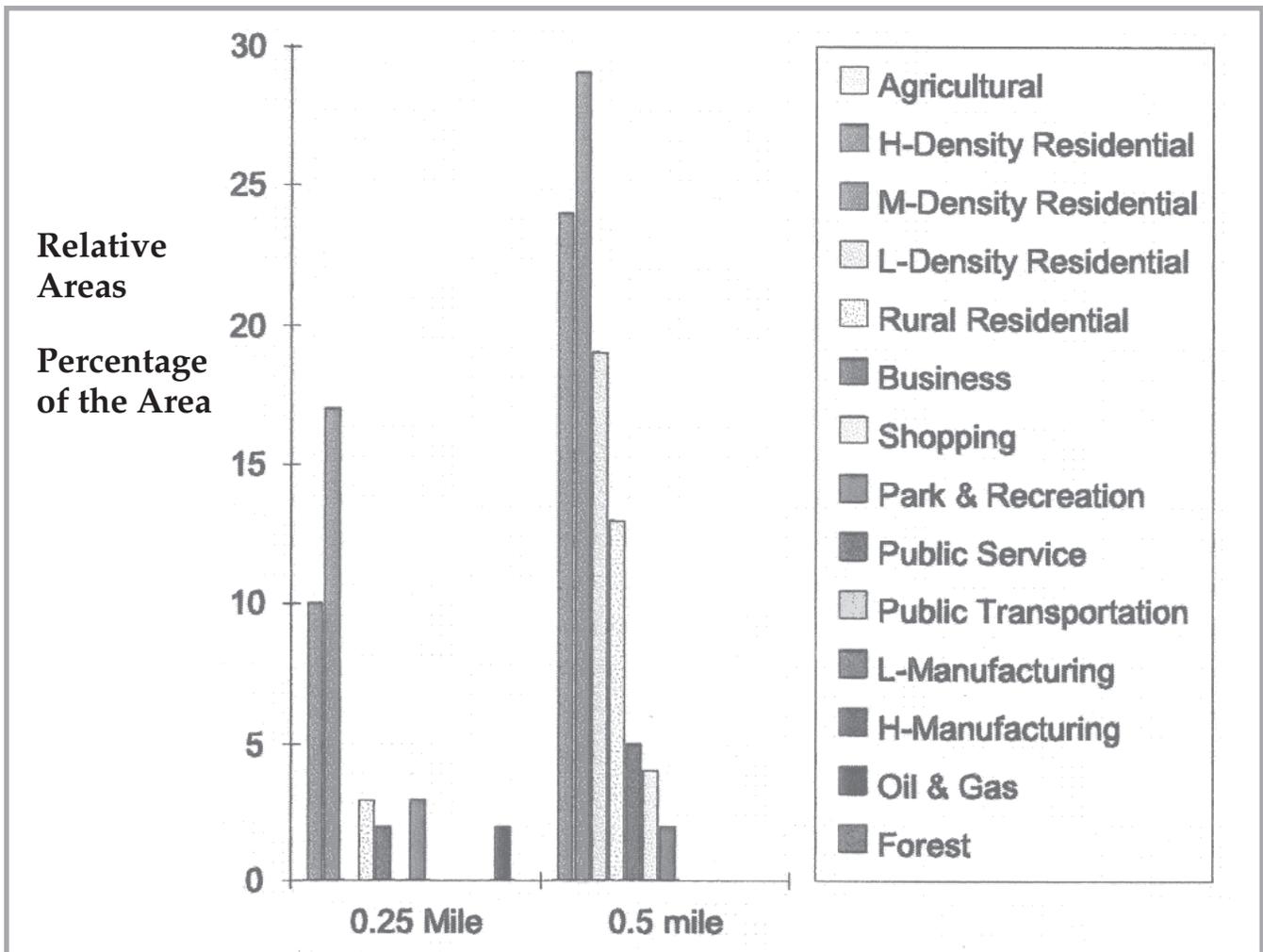


Figure 3. Land use within 0.25 and 0.5 mile of low WQI sites during 1999 events.

Lead (Pb) content of water samples is generally well below the New York State regulation limit (50 µg/L).

The major land use within 0.25 mile range of these high iron sites is high-density and mid-density residential as well as shopping and commercial types (Figure 5). Extending the search range to 0.5 mile, it was found that the largest land use remains as high-density and mid-density residential, while some proportions of agricultural land appear. (Figure 5). The results suggest that metals are mainly generated from urban and suburban areas. The distribution pattern may be related to the historical production and current use of the metals in the watershed area.

In summary, the results of relational analysis of WQI and land use patterns in the Cazenovia Creek watershed suggest:

- (1) The low water quality sites are either located in the lower reach urban area or middle reach Village of East Aurora area.
- (2) The low WQI sites of dry weather periods generally coincide with those of rainfall events. However, more low WQI sites usually occur during the rainfall events than the dry weather periods.
- (3) The distribution pattern suggests that low WQI sites of both rainfall events and dry weather periods are located in the urban

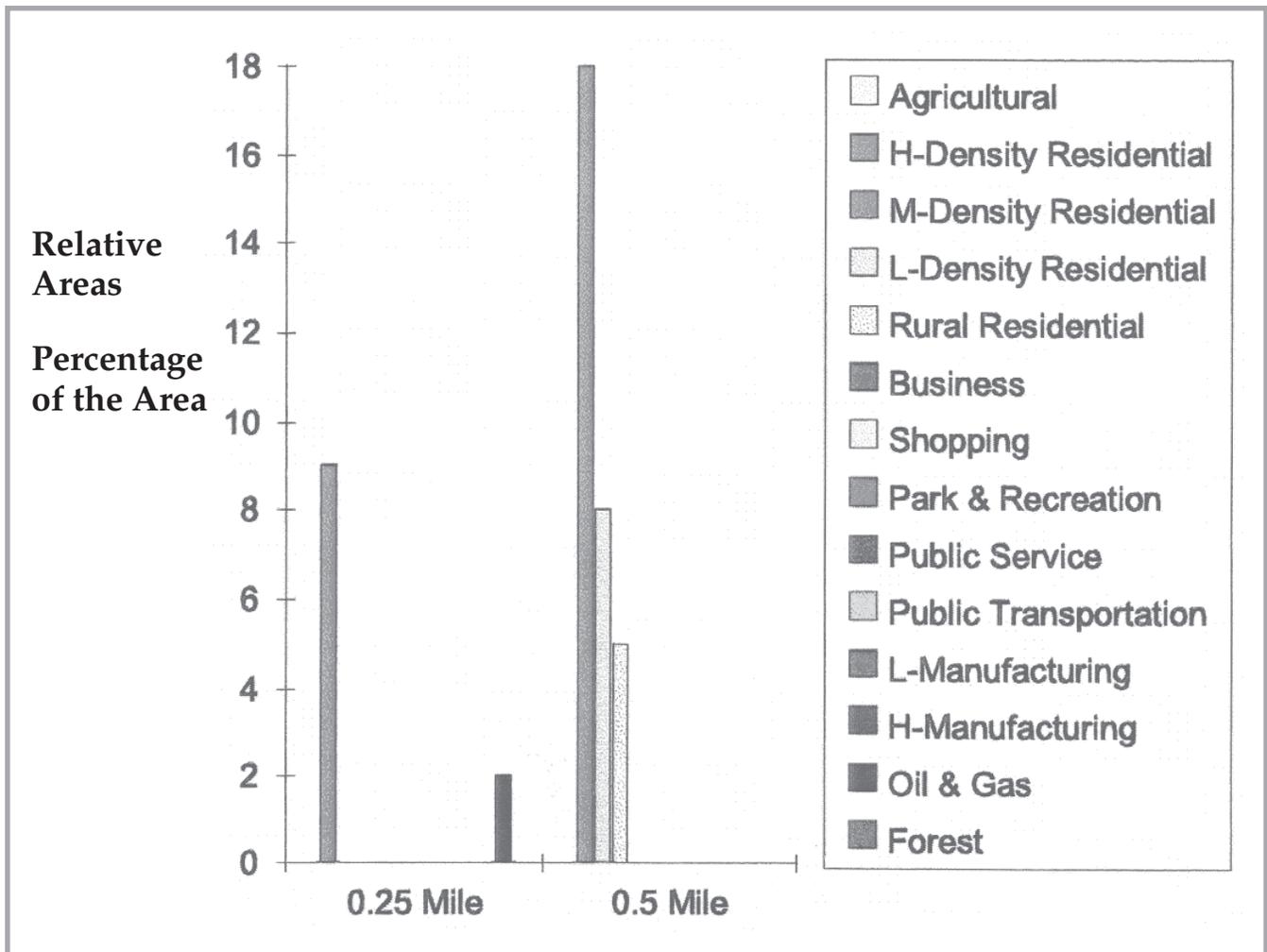


Figure 4. Land use within 0.25 and 0.5 mile of low WQI sites during 1999 non-event period.

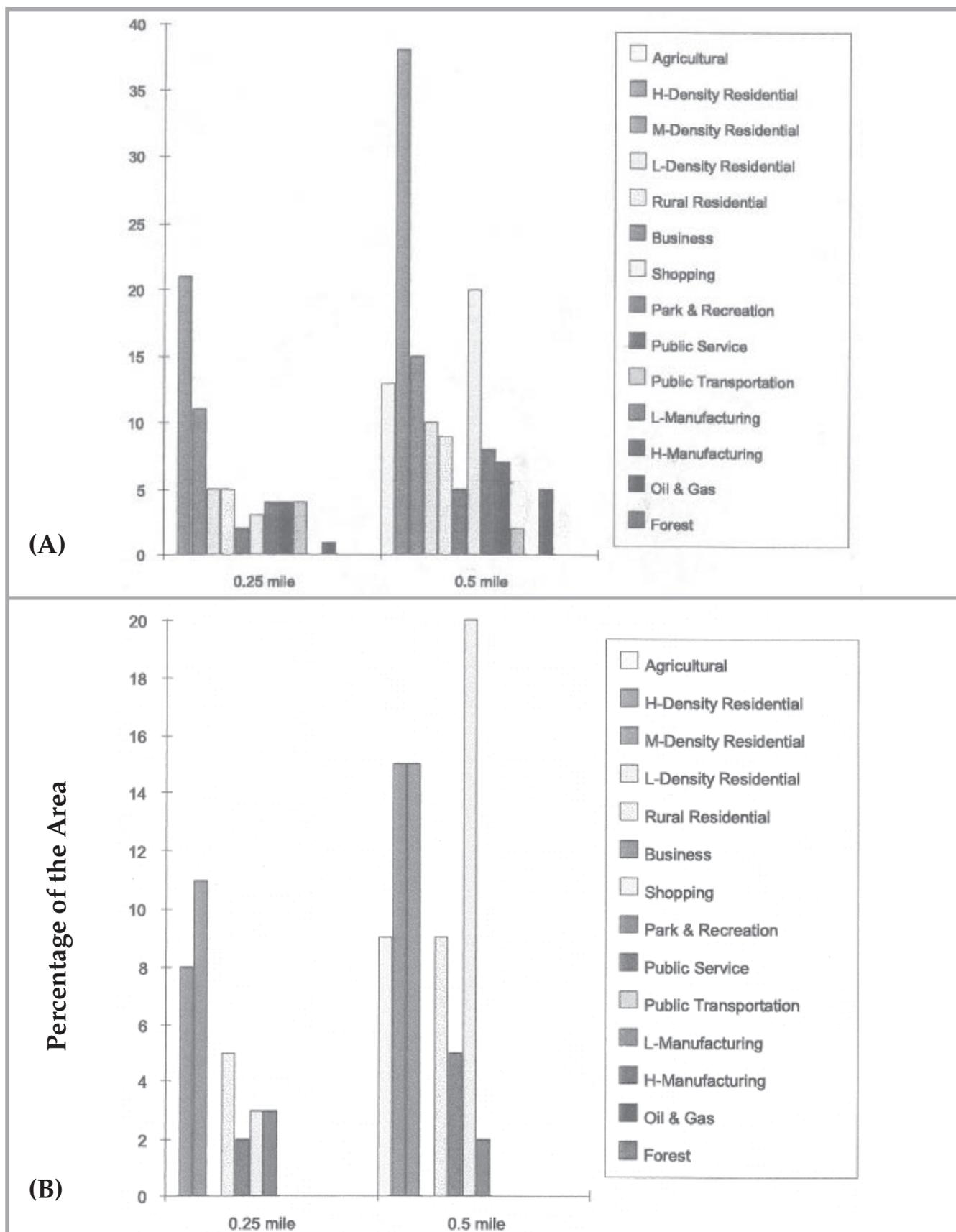


Figure 5. Land use within 0.25 and 0.5 mile of high Fe sites of events (A) and non-events (B).

residential and business or shopping center areas closest to public transportation routes or oil and gas related industries.

Relational analysis of metals and land use in the watershed indicates that:

- (1) The average iron (Fe) content of the water samples is higher during rainfall events than in dry weather.
- (2) The sites where iron (Fe) content exceeded the NYS regulation limit are located either in the City of Buffalo, or in the Village of East Aurora, for both event and dry weather periods.
- (3) The major land use within 0.25 mile range of the sites where iron (Fe) content exceeded the limit is high-density and mid-density residence.
- (4) The lead (Pb) content of the water samples is generally well below the NYS regulation limit.
- (5) There is no distinct pattern of lead (Pb) between rainfall events and dry weather periods.

MAJOR COLLABORATORS

Tom Hersey
Erie County Department of
Environment and Planning
95 Franklin Dr.
Buffalo, NY 14202

John R. Whitney
U.S. Department of Agriculture
Natural Resources Conservation Service
50 Commerce Way
East Aurora, NY 14052-2185

Mike Greer
US Army Corp of Engineers
Fort Worth District

ACKNOWLEDGEMENT

This research was supported by a small grant from the New York Great Lakes Protection Fund (NYGLPF).

REFERENCES

American Public Health Association, American Water Works Association, and Water Pollution Control Federation. 1989. *Standard Methods for the Examination of Water and Wastewater*. 17th Edition. 538p.

American Public Health Association, American Water Works Association, and Water Pollution Control Federation. 1992. *Standard Methods for the Examination of Water and Wastewater*. 18th Edition. 623p.

Atkinson, J.F., Bajak, T., Morgante, M., Marshall, S. and DePinto, J. V. 1994. *Model Data Requirements and Mass Loading Estimates for the Buffalo River Mass Balance Study*. U.S. EPA Report, EPA 905-R94-005, Chicago, IL.

Brown, R. M., McLelland, N. I., Deininger, R. A. and Tozer, R. G. 1970. *A Water Quality Index – Do We Dare?* Water & Sewage Works, October: 339-343.

DePinto, J. V. and Sibiga, B. M. 1998. *Cazenovia Creek Pilot Watershed Management Project: Phase III Report – Application of GEO-WAMS to the Cazenovia Creek Watershed*. 46p.

Erie County Department of Environment and Planning. 1978. *1977-1978 Stream Survey Project 050*. Erie County Department of Environment and Planning, Buffalo, NY.

Erie County Department of Environment and Planning. 1997. *Cazenovia Creek Watershed Management Program – Phase I Report: “Identify and Map Land Use Activities and Potential Non-Point Pollution Sources in the Cazenovia Creek Subbasin”*. 63p.

- Erie and Niagara Counties Regional Planning Board. 1978. *Water Quality Management Program 208, Report 4, Environmental Inventory*. Buffalo, NY.
- Hardy, E. E., Shelton, R. L., Belcher, D. J. and Roach, J. T. 1971. *New York State Land Use and Natural Resources Inventory Final Report – Volume II*. 199p
- International Joint Commission. 1988. *Procedures for the Assessment of Contaminated Sediments in the Great Lakes. Report to the Water Quality Board, Windsor, Ont.* 140p.
- Irvine, K. N. 1996. Cazenovia Creek Watershed Management Program: *Baseline water Quality Analysis, 1996*. County of Erie Department of Environment and Planning. 61p.
- Irvine, K. N., Paluca, G. and Piccione, R. 1996. *Quality Assurance Plan (QAPP) for Cazenovia Creek Pilot Watershed Management Project*. EPA grant no. GL995960-01-1.
- Irvine, K. N. and Pettibone, G. W. 1993. *Dynamics of Indicator Bacteria Population in Sediment and River Water near a Combined Sewer Outfall*. Environmental Technology, 14:531-542.
- Irvine, K. N. and Pettibone, G. W. 1996. *Planning Level Evaluation of Densities and Sources of Indicator Bacteria in a Mixed land Use Watershed*. Environmental Technology 17: 1-12.
- Meredith, D. D. and Rumer, R. R. 1987. *Sediment Dynamics in the Buffalo River*. Department of Civil Engineering, State University of New York at Buffalo.
- Mitchell, M. K. and Stapp, W. B. 1995. *Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools, Ninth Edition*. Green Project, Ann Arbor, MI 272p.
- Monahan, K. N., Fischer, S. and Irvine, K. N. 1995. *Spatial Analysis of Suspended Sediment Concentrations, Buffalo River Watershed, NY*. Middle States Geographer, 27:1-9.
- New York State Department of Environmental Conservation. 1989. *Buffalo River Remedial Action Plan*. NYSDEC, Buffalo, NY.
- New York State Department of Environmental Conservation. 1989. *Water Quality Regulations – Surface water and groundwater Classifications and Standards*. NYSDEC, NY.
- Wills, M. and Irvine, K. N. 1996. *Application of the National Sanitation Foundation Water Quality Index in the Cazenovia Creek, NY, Pilot Watershed Management Project*. Middle States Geographer, 29: 95-104.

Water Quality Opinion Survey 2000: Public Attitudes and Knowledge Regarding Water Quality in Monroe County, New York

Margit Brazda Poirier
Water Education Collaborative
at the Rochester Museum & Science Center
Email: margit_brazda@rmsc.org

Robert Rutzen, Ph.D.
SUNY Brockport

Jack Antinore
SUNY Brockport

ABSTRACT

Monroe County, in partnership with the State University of New York (SUNY) at Brockport, designed a survey to determine public attitudes and knowledge regarding water quality in Monroe County. Randomly selected registered voters were contacted by telephone and asked several questions. A total of 516 responses were received. The telephone interviews were completed over three evenings thanks to the generous participation of 84 volunteers from the Monroe County Health Department, SUNY Brockport, and various water quality committees. Funding was provided by a grant from the New York Great Lakes Protection Fund. Some of the results from the full report are described below.

INTRODUCTION

Clean water is essential for public health and enjoyment. The purpose of the survey was to explore public perceptions and knowledge of water quality. Community attitudes and knowledge about water quality issues in 2000 were explored through a random sample phone survey of 516 registered voters in Monroe County, New York.

The study was initiated by the Monroe County Health Department. The New York Great Lakes Protection Fund provided basic funding. The grant was, by request, administered by the Research Foundation of the State University of New York College at Brockport. The survey was a cooperative venture between the Monroe County Health Department and the State University of New York College at Brockport.

METHODOLOGY

The decision was made to use registered voters in Monroe County as the sampling group for this study. This population has been used previously to explore social issues and includes most (76%) of the adults in Monroe County. This allowed a true random sample to be drawn from a specified population within Monroe County, the registered voters, enabling scientifically valid generalizations from the sample findings to that population with a certain identifiable probability.

The current telephone interviews were completed over three evenings with the participation of 84 volunteers: 17 Monroe County Health Department staff persons, 26 volunteers from Monroe County water quality community committees and 41 SUNY Brockport student vol-

unteers from sociology statistics and methods courses. A side benefit was a positive field experience for the all volunteers. Each volunteer attended a one-hour training session before conducting the phone survey to ensure consistency.

Health Department sponsorship of the survey was identified at the beginning of each phone interview. All interviewed respondents provided informed consent before proceeding with the interview. The refusal rate was 36%; therefore, 64% of the contacted eligible persons were successfully interviewed. In summary, 516 persons were successfully interviewed by telephone, exceeding the target of 500.

The confidence limits, set at $\pm 5\%$, indicate the range of values around a sample finding with a 95% probability of containing the value that exists in the population from which the sample is drawn. For the current sample of 516, the confidence limits for the findings are $\pm 5\%$.

FINDINGS

DEMOGRAPHICS

The interviewed random sample of registered voters is approximately equally divided by gender, with 52% females and 48% males, which is not significantly different from the 54% females and 46% males reported for the entire population of registered voters in Monroe County. About 22% are 18-39 years of age, 50% are 40-59, and 26% are 60 and older. The mean age of the interviewed random sample of registered voters is 52, which is slightly, but significantly, older than the mean age of 49 for the entire population of registered voters from which the sample is drawn. Most respondents (56%) have college degrees: 16% associates, 22% bachelors and 19% with masters or doctoral degrees. Most persons in the registered voter sample are long-time residents of Monroe County. Nearly half (43%) are life-long residents and another third (37%) have lived here

for more than 20 years. Only 20% have lived here 20 years or less, only 7% have lived here less than 10 years.

PERCEPTIONS OF WATER QUALITY

Most persons, over half, regard the waters of Lake Ontario (54%) and the Genesee River (69%) as somewhat or severely polluted. More often than not, they regard Lake Ontario as having improved over time: (40% improved, 22% worse), but they are divided over whether the Genesee River has improved or gotten worse (22% improved, 18% worse). The perceptions are quite different for Lake Ontario and the Genesee River. The Genesee River is more often regarded as polluted and less likely to be seen as improved than Lake Ontario.

Industrial pollution is selected most often (51%) as the main cause of pollution from a choice of seven options, with sewage a distant second (12%), and lawn chemicals third (8%). Contamination from farms is selected as a main cause of water pollution by only 3% of the respondents.

Respondents are remarkably positive about water quality in the future: 62% expect it to be better in 20 years, as compared to 13% who expect water quality to be worse.

WATER-RELATED KNOWLEDGE AND AWARENESS

Newspapers are the single communication medium cited most often (33%) as the source of information about water quality, followed by television (11%). All other media, including radio (0.4%) and the Internet (0.4%), trail well behind.

When asked about the source of tap water, 9% report their water comes from wells or groundwater. Of the others, there are approximately equal numbers identifying Lake Ontario and Hemlock Lake as the source of tap water. In Monroe County, the water supplied to many residents from these two sources varies from

time to time throughout the year because the systems are interconnected. Residents are supplied with water from Lake Ontario by the Monroe County's Shoremont and Brockport Water Treatment Plants and with Hemlock Lake water by the City of Rochester's treatment plant.

Most people report being aware of the health advisory about eating fish caught in Lake Ontario (76%). The advisory is complex and people were not questioned about specific details. Most people select high bacteria count as a main reason for Ontario Beach closings (71%), with algae a distant second cause (14%). When asked if they thought they know the meaning of five water-related terms seen as important in water quality management, most report that they know the meaning of wetlands (87%), stormwater runoff (84%), and groundwater (83%). About half (55%) report that they know the meaning of a watershed, but only a small number (22%) report that they know the meaning of a Remedial Action Plan. In summary, only 17% report knowing the meaning of all five terms; 36% 4 of 5; 27% 3; 19% 2 or fewer. The respondents were not asked to specifically define these terms. After these questions, almost all (93%) of the respondents agree that people need to learn more about water quality.

WATER-RELATED ACTIVITIES

Almost all persons drink tap water (83%), but a substantial number do not (16%). Fully a third (33%) filter their tap water, although this may signify a wide range of practices. In the last year, 34% report wading or swimming in Lake Ontario, 30% report boating on Lake Ontario in one form or another, and 20% report fishing in Lake Ontario.

COMMUNITY INVOLVEMENT

Only a small number report that they have ever volunteered for any project involving water

quality (8%). The respondents are equally divided about whether they would, or might be interested in volunteering for projects to protect water quality (49%) and those who indicated that they would not be interested (47%).

Most people (64%) respond that they would be willing to reduce the use of lawn fertilizers and pesticides to improve water quality. Another 7% indicate that they may be willing to reduce the use of lawn fertilizers and pesticides. A substantial number (17%) report that they do not use fertilizer or pesticide on their lawns. A small number of respondents (4%) report not having a lawn. Only 4% responded that they would not be willing to reduce use of lawn fertilizers and pesticides.

Most persons (88%) say that they are willing to be contacted with further questions in the future, which suggests that being interviewed is generally a positive experience.

COMPARISONS OF PUBLIC PERCEPTIONS, 1983 AND 2000

Some topics from another water quality opinion survey conducted in 1983 were selected for inclusion in the current survey, enabling comparisons over time. The earlier survey had 308 completed telephone-interviews of area residents using random digit telephone numbers. The patterns observed for area residents in 1983 may be legitimately compared to the patterns observed in 2000 to see how these patterns differ. The observed frequency in 2000 was compared to the expected frequency based on the 1983 findings. All comparisons over time show differences that are statistically significant, using the Chi-square statistic, at the .05 level of probability.

People are more likely to regard Lake Ontario as polluted now (54%), than they did in 1983 (41%). They are slightly more likely to regard the Genesee River as polluted (69%) now, than in 1983 (62%).

Rating of water quality for Lake Ontario in 1983 and 2000.

Q1a – 1983: How would you rate water quality today in Lake Ontario?

Q2 – 2000: Same as 1983 question.

Values	1983 percent	2000 percent
Very good	5.8%	5.2%
Acceptable	35.4%	27.5%
Somewhat polluted	35.1%	46.3%
Severely polluted	4.5%	7.8%
Don't know	19.2%	12.2%
No answer	n/a	1.0%
Totals Total Number	100.0% (308)	100.0% (516)
Statistically significant difference, $p < .05$		

People more often regard the Genesee River as polluted than Lake Ontario at both points in time.

Rating of water quality for the Genesee River in 1983 and 2000.

Q2a – 1983: Would you tell me how you would rate water quality today in the Genesee River?

Q4 – 2000: How would you rate water quality today in the Genesee River?

Values	1983 percent	2000 percent
Very good	1.9%	0.6%
Acceptable	16.2%	12.6%
Somewhat polluted	35.4%	44.6%
Severely polluted	26.3%	24.2%
Don't know	19.2%	16.1%
No answer	1.0%	1.9%
Totals Total Number	100.0% (308)	100.0% (516)
Statistically significant difference, $p < .05$		

In 2000, the patterns of perceived improvement for Lake Ontario and the Genesee River are similar to what was observed in 1983.

Perceived improvement of the water quality of Lake Ontario in 1983 and 2000.

Q1b – 1983: Do you think that the lakes water quality has:

Q3 – 2000: Since you've lived in Monroe County, do you think that Lake Ontario water quality has:

Values	1983 percent	2000 percent
Improved substantially	16.9%	8.7%
Improved somewhat	40.5%	31.0%
Stayed the same	13.3%	26.2%
Gotten worse	7.5%	21.5%
Don't know	21.8%	11.0%
No answer	n/a	1.6%
Totals Total Number	100.0% (308)	100.0% (516)
Statistically significant difference, $p < .05$		

The perceptions of improvement of water quality are quite different for the two bodies of water. More people regard the water quality of Lake Ontario as improved than the Genesee River at both points in time.

Perceived improvement of the water quality of the Genesee River in 1983 and 2000.

Q2b – 1983: Do you think that the rivers quality has:

Q5 – 2000: Since you've lived in Monroe County, do you think the Genesee River's quality has:

Values	1983 percent	2000 percent
Improved substantially	2.6%	2.1%
Improved somewhat	16.9%	19.6%
Stayed the same	41.2%	39.1%
Gotten worse	14.3%	18.4%
Don't know	23.4%	18.8%
No answer	1.6%	1.9%
Totals	100.0%	100.0%
Total Number	(308)	(516)
Statistically significant difference, $p = < .05$		

SURVEY QUESTIONS

Questions

- Q 1 – Informed consent given by respondent?
- Q 2 – How would you rate water quality today in Lake Ontario?
- Q 3 – Since you've lived in Monroe County, do you think that Lake Ontario water quality has:
- Q 4 – How would you rate water quality today in the Genesee River?
- Q 5 – Since you've lived in Monroe County, do you think the Genesee River's water quality has:
- Q 6 – Twenty years from now, do you think the water quality in Monroe County will probably be:
- Q 7 – What do you think is the main cause of water pollution in Monroe County today?
- Q 8 – Have you, or anyone in your household, fished in Lake Ontario in the last year?
- Q 9 – Are you aware that there is a health advisory about eating fish caught in Lake Ontario?
- Q 10 – Have you, or anyone in your household, been boating on Lake Ontario in the last year?
- Q 11 – Have you, or anyone in your household, used Lake Ontario for wading or swimming in the last year?
- Q 12 – What do you think is the main reason that Ontario Beach at Charlotte is closed for swimming on some days in the summer?
- Q 13 – Where does your tap water come from?
- Q 14 – Do you drink water from the tap in your home?
- Q 15 – Do you filter your tap water?
- Q 16 – Would you be willing to reduce applications of fertilizer and pesticides to your lawn if it would improve water quality?
- Q 17 – Where do you get your information about local water quality?
- Q 18 – Do you know the meaning of the term watershed?
- Q 19 – Do you know the meaning of the term wetlands?
- Q 20 – Do you know the meaning of the term groundwater?
- Q 21 – Do you know the meaning of the term stormwater runoff?
- Q 22 – Do you know the meaning of the term Remedial Action Plan?
- Q 23 – Total number of yes answers to the five term questions.
- Q 24 – Do you think people in the community need to learn more about how to keep water clean?
- Q 25 & Q 26 – How long have you lived in Monroe County?

- Q 27 – How much formal education have you completed?
- Q 28 – Do you have any questions about water quality for me?
- Q 29 – May we contact you in the future with additional questions about water quality?
- Q 30 – Have you ever volunteered for any projects that help protect water quality?
- Q 31 – Would you be interested in possibly volunteering for any projects to protect water quality?
- Q 32 – Gender of respondent.
- Q 33 – Age of respondent.

gest that voters in our community are generally willing to learn about water quality issues and to have contact with water quality program personnel. The survey provides existing data that may be used, without re-sampling, to explore additional questions with multivariate analyses in future research.

Plans have been implemented to disseminate the findings to interested individuals and organizations. Community educational efforts are being redefined, based on survey findings. The results of the survey are currently being used to: 1) guide public education efforts about water quality; 2) improve upon existing public outreach and education programs that address water quality; and 3) guide the work of the Water Education Collaborative, a group whose purpose is community-wide water quality outreach and education.

CONCLUSION

We have a picture of how Monroe County voters perceive water quality in the year 2000. The survey responses to specific items indicate respondents' perceptions and knowledge about water quality. The survey findings sug-

For additional information or to obtain a copy of the Monroe County Water Quality Opinion Survey, contact the Water Education Collaborative at (585) 271-4552, ext. 320 or email: margit_brazda@rmssc.org.

Development of an Automated Dry Deposition Sampler

Dr. Thomas M. Holsen and Seung-Muk Yi
Clarkson University
Department of Civil and Environmental Engineering
Potsdam N.Y. 13699
315-268-3851
holsen@clarkson.edu

Dr. Michael S. Milligan
Department of Chemistry
SUNY at Fredonia
Fredonia, New York 14063

INTRODUCTION

The International Joint Commission's (IJC) Great Lakes Water Quality Agreement specifies that the significance of atmospheric inputs of toxic chemicals to the Great Lakes should be determined and that modeling of the transport, deposition and fate of the critical pollutants should be performed. In addition, the 1990 Amendments to the U.S. Clean Air Act include a provision requiring the U.S. Environmental Protection Agency (EPA) to assess the atmospheric deposition of hazardous air pollutants to the Great Lakes and other water bodies. The "Great Waters" program was mandated to include, among other things, an investigation of the sources and deposition rates of hazardous air pollutants (U.S. EPA, 1991).

Deposition can be divided into three separate processes. Wet deposition is the amount of chemical deposited on a surface associated with rain or snow. There are two primary mechanisms by which pollutants can become associated with rain or snow. Pollutants present in the atmosphere as a gas can dissolve into a raindrop or condense on a snowflake, or pollutants associated with particles can become associated with a raindrop or snowflake by impaction or diffusion. Air-surface exchange is the transfer of a pollutant from the gas phase in the atmosphere to the earth's surface, (for example, a water body, vegetative surface, soil

or man-made surface). This process can be very dynamic and the transfer can reverse direction, for example when the temperature increases, and the pollutant can be released from the surface back into the atmosphere. Dry deposition is the transfer of a pollutant associated with a particle in the atmosphere to the earth's surface. These particle associated pollutants can be released to the atmosphere as particles (for example, zinc emitted from metal process facilities), or can be released as gases that condense onto particles present in the atmosphere. (For example, some PAHs emitted from coal fired power plants condensing on a soil particle suspended in the atmosphere).

Among the three types of deposition, dry deposition is one of the most difficult to quantify. Typically, dry deposition estimation techniques use average total or partially size segregated particle concentrations and average deposition velocities to calculate dry deposition fluxes. These techniques have been shown to greatly underestimate the contribution of coarse particles, particularly those $> 10 \mu\text{m}$, to dry deposition (Davidson *et al.*, 1985, Holsen *et al.*, 1991; Noll *et al.* 1992; Holsen *et al.*, 1992) and as a consequence many estimates of dry deposition may be underestimated.

Even though an accurate determination of the dry deposition of contaminants is critical

in understanding their movement in the environment, there is still no generally acceptable technology for sampling and analyzing dry deposition flux. The quantification of dry deposition flux is difficult because of large spatial and temporal variations. The use of a surrogate surface to collect dry deposition is a technique that allows a comparison to be made of measured and modeled data, because it can be used to directly assess deposited material. Surrogate surfaces can be used: 1) over extended periods of time and at different locations to provide qualitative information on temporal and spatial variations in dry deposition of a species, 2) to estimate lower limits to aerosol dry deposition to rougher, natural surfaces if they are smooth horizontal collectors that do not appreciably disturb airflow and 3) as research instruments for investigating the influence of surface geometry, atmospheric properties, and characteristics of the depositing species on dry deposition (Davidson *et al.*,

1985). Measurements made with a smooth surrogate surface with a sharp leading edge have been shown to agree well with results of modeled dry deposition in an urban area if complete atmospheric size distributions are measured (Holsen and Noll, 1992).

In this project, a new automated wet and dry deposition sampler was developed (Figure 1). The dry deposition sampler module is attached to a conventional MIC-B precipitation collector so that dry deposition is collected when the sensor is dry. When it is not raining, the rain shield covers the wet deposition collection funnel and the knife-edge surrogate surface (KSS) (Figure 2) moves up to expose the dry deposition collection media. When the sensor is wet due to rain, fog or snow, the KSS is retracted and the cover automatically moves to cover the KSS. The KSS is made of acrylic, is 40 cm in diameter and has 12 filter holder positions. The dry deposition collection media is placed into

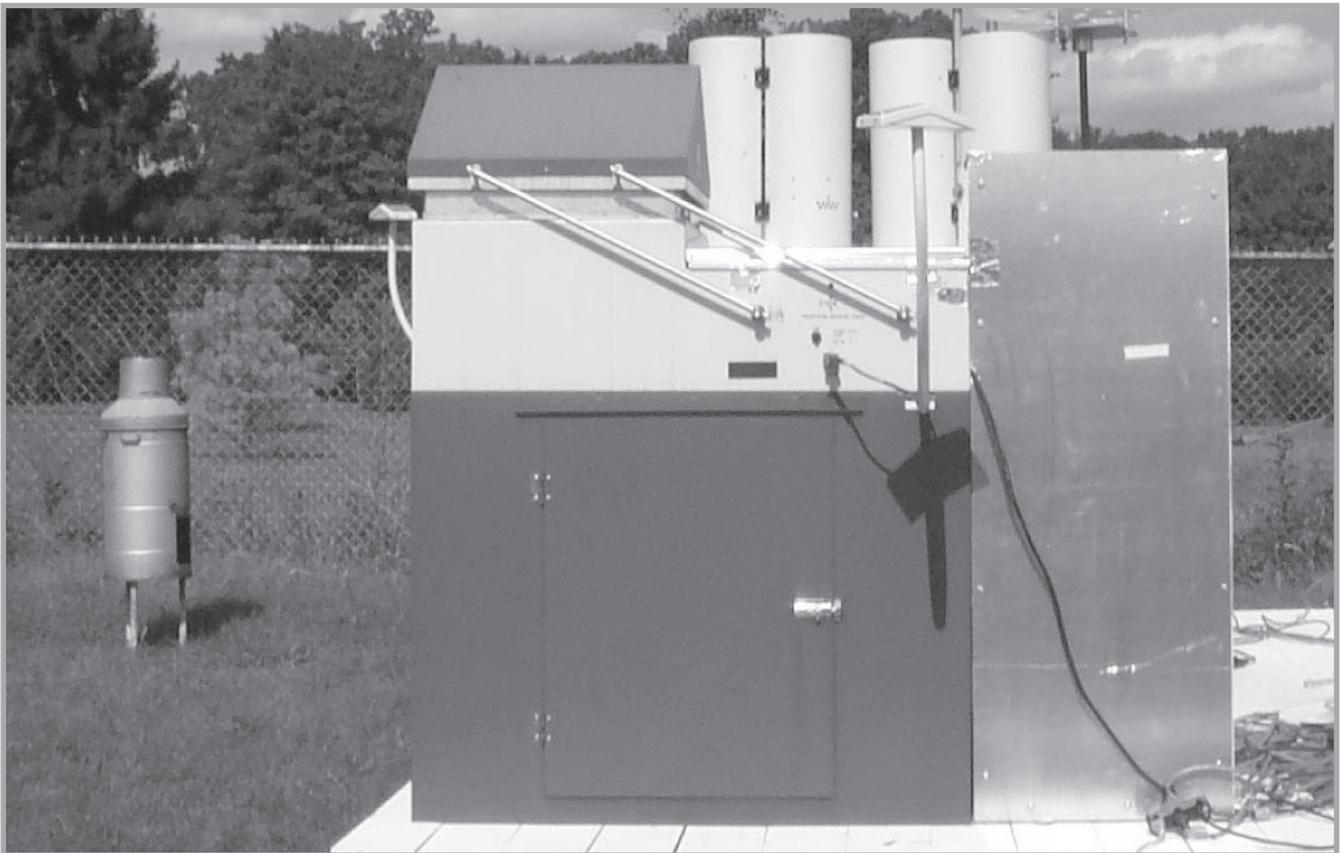


Figure 1. Modified MIC-B precipitation collector containing the dry deposition module and surrogate surface.



Figure 2. Knife-edge surrogate surface on top of the actuator. The white disks are the sampling media.

filter holders and positioned on the KSS so the media surface is at the same level as the plate surface.

This sampler is currently in use near the Hudson River Estuary to measure the wet and dry deposition of PCBs, PAHs and several other organic compounds, and trace metals. In spring 2002, one has been deployed at Sterling, New York, on the shore of Lake Ontario, to measure the wet and dry deposition of PCBs and pesticides.

REFERENCES:

Davidson, C.I.; Lindberg, S.E.; Schmidt, J.A.; Cartwright, L.G.; Landis, L.R. *J. of Geophysical Res.* 1985, 90, 2123-2130.

Holsen, T.M.; Noll, K.E.; Liu, S.P.; Lee, W.J.; *Environ. Sci. Technol.*, 1991, 25, 1075-1081.

Hicks, B.B.; Williams, R.M. In Potential Environmental and Health Effects of Atmospheric Sulfur Deposition, ORNL Life Sciences Symp. Ser., 10-14 Oct, 1979

Holsen, T.M.; Noll, K.E. *Environ. Sci. Technol.*, 1992, 26, 1807-1814

Holsen, T.M., Noll, K.E., Fang, G.C., Lee, W.J., Lin, J.M., Keeler G.J. *Environ. Sci. Technol.*, 1993, 27, 1327-1333.

Holsen, T.M.; Noll, K.E.; Liu, S.P.; Lee, W.J.; *Environ. Sci. Technol.*, 1991, 25, 1075-1081.

Li, Y.H. MS Thesis, Illinois Institute of Technology, 1992

Noll, K.E., Holsen, T.M. and Lee, W.-J. *Dry Deposition Velocities of Atmospheric Gases and Particles to a Smooth Surface*, Precipitation, Scavenging and Surface Exchange Coordinated by Swartz, S.E. and Slinn, W.G.N. Hemisphere Publishing Corp., Washington, D.C. 1992, Vol. 2 p 683 - 693.

Slinn, S.A.; Slinn, W.G.N.; *Atmos. Environ.* 1980, 14, 1013-1016.

U.S. EPA. 1991. Report of the Great Lakes Air Toxics Research Priorities Workshop. Office of Modeling, Monitoring Systems and Quality Research, Research Triangle Park, NC. 42 pp.

Williams, R.M.; *Atmos. Environ.* 1982, 16, 1933-1938.

Great Lakes Coastal Erosion Processes and Control Educational Materials and Web Site Enhancement

Charles R. O'Neill, Jr.
Senior Extension Associate/Coastal Resource Specialist
New York Sea Grant
Morgan II
State University of New York College at Brockport
Brockport, New York 14420
Telephone: 716-395-2638

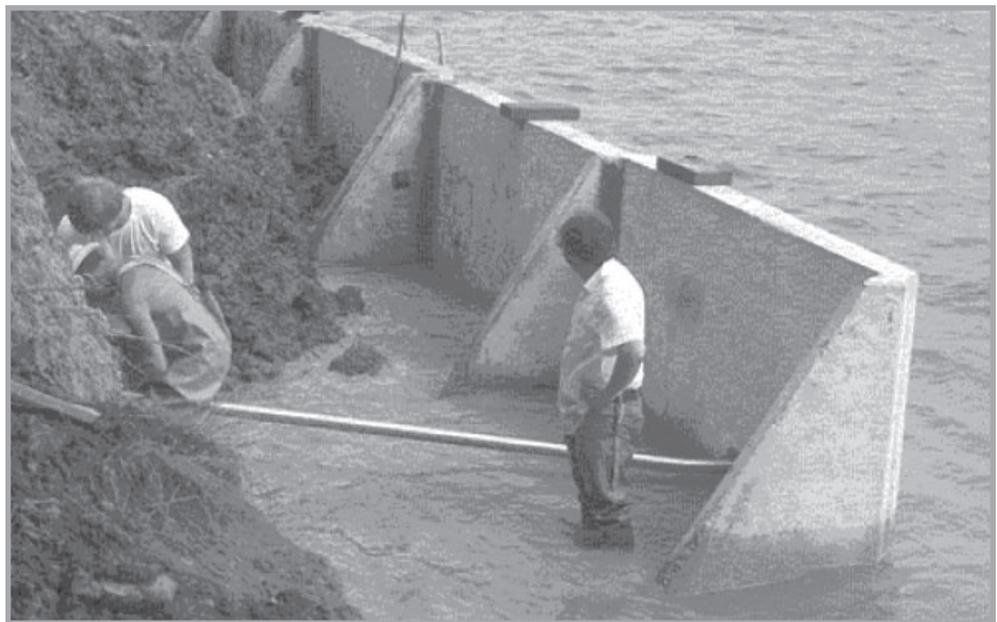
ABSTRACT

This article highlights the work of New York Sea Grant to update its coastal processes and erosion control educational materials for the Great Lakes. In order to enhance and increase the dissemination of educational information, New York Sea Grant prepared downloadable, locally printable versions of educational materials and added them to their New York Great Lakes coastal processes and lake level web site. This information can be found at the following Internet address: <http://www.nysgcoastalprocesses.org/>

PROJECT OVERVIEW:

The *Great Lakes Coastal Erosion Processes and Control Educational Materials and Web Site Enhancement* project fell under the New York Great Lakes Protection Fund's Priority Funding Category of Public Attitudes and Knowledge on Great Lakes Issues. The objective of this project was to gather and interpret information on attitudes and knowledge on Great Lakes issues to be used in the development of school and adult educational efforts. This project duration ran from October 1, 2000 to March 31, 2002.

This project responded to continued inquiries from numerous audience members throughout New York's Lake Erie and Lake Ontario coastal



Information on maintaining coastal erosion control structures is provided on the Coastal Processes/Erosion Control Publications web page developed by New York Sea Grant.

region for continuing up-to-date information on Great Lakes water levels fluctuations and the causes and control of shoreline erosion and flooding. The project enabled New York Sea Grant to update its coastal processes and erosion control educational materials, some of which were more than a decade old. This provided for a wider dissemination of these materials, and enabled Sea Grant to place downloadable, locally printable versions of these educational materials onto our New York Great Lakes coastal processes and lake level web site.

The geographic area served by this project includes the entire New York Great Lakes (Lake Erie and Lake Ontario) and St. Lawrence River coast, including all embayments, lower tributaries and islands. The audience who could potentially benefit from this project has been estimated at approximately 15,000 to 25,000 individuals.

Objectives:

I. To educate 1,500 coastal resource users, landowners, marine facility owners, businesspeople, elected and appointed officials, media representatives, special interests, and other decision makers on Lake Ontario and Lake Erie lake level fluctuations and causes of coastal erosion and flooding. The educational process utilizes such traditional extension education techniques as fact sheets, information bulletins, service letters and workshops and such newer information/education technologies as the Internet and

World Wide Web. The objective is to have stakeholders use that knowledge to make better shoreline development, erosion control, and flooding control decisions. *Outcome: An average of 165 individuals per month make use of the coastal processes and lake level web site, for a total of approximately 2,000 individuals educated during the first year of the grant period. An additional 200± individuals have received New York Sea Grant educational materials via the mail and/or were otherwise provided with educational information pertaining to coastal processes and lake level during that time period.*

II. Enhance New York Sea Grant’s capability to respond immediately to rapidly-developing coastal high water, flooding, and/or erosion events to assist our coastal landowner, public and private decision-maker, marine contractor, and marine facility owner audiences to deal with such hazardous situations. *Outcome: The media has made use of New York Sea Grant as an information source regarding low lake levels on Lakes Ontario and Erie during approximately a half dozen interviews during this time period.*



The damaging impacts of coastal erosion can be seen in this photograph from the New York Sea Grant coastal processes web site.

Activities:

1. The fact sheets "Maintaining Erosion Control Structures," "Improving Bluff Drainage," and "Selecting a Marine Contractor" were reviewed and updated. The decision was made that, based upon the level of demand for these publications and the turn-over time for printed fact sheets (which often means that large press runs are outdated before they have all been distributed), these publications have been rewritten as on-line and "print-on-demand" brochures instead of formal fact sheets. The cost saving allowed the layout using color photographs in addition to black and white graphics and a more limited initial press run; additional copies will be printed as needed in-house (in color) eliminating waste and increasing the quality of product. Adobe Acrobat versions of these publications have been posted on New York Sea Grant's coastal processes website.
2. New York's Great Lakes region marine contractors were surveyed in order to update the "New York Sea Grant Directory of Great Lakes Marine Contractors" and our "Shoreline Protection Costs" information sheet.

The updated directory and cost sheet has been loaded onto New York Sea Grant's coastal processes website. Copies will be printed on demand for those audience members who are unable to download the directory or cost sheet from the World Wide Web.

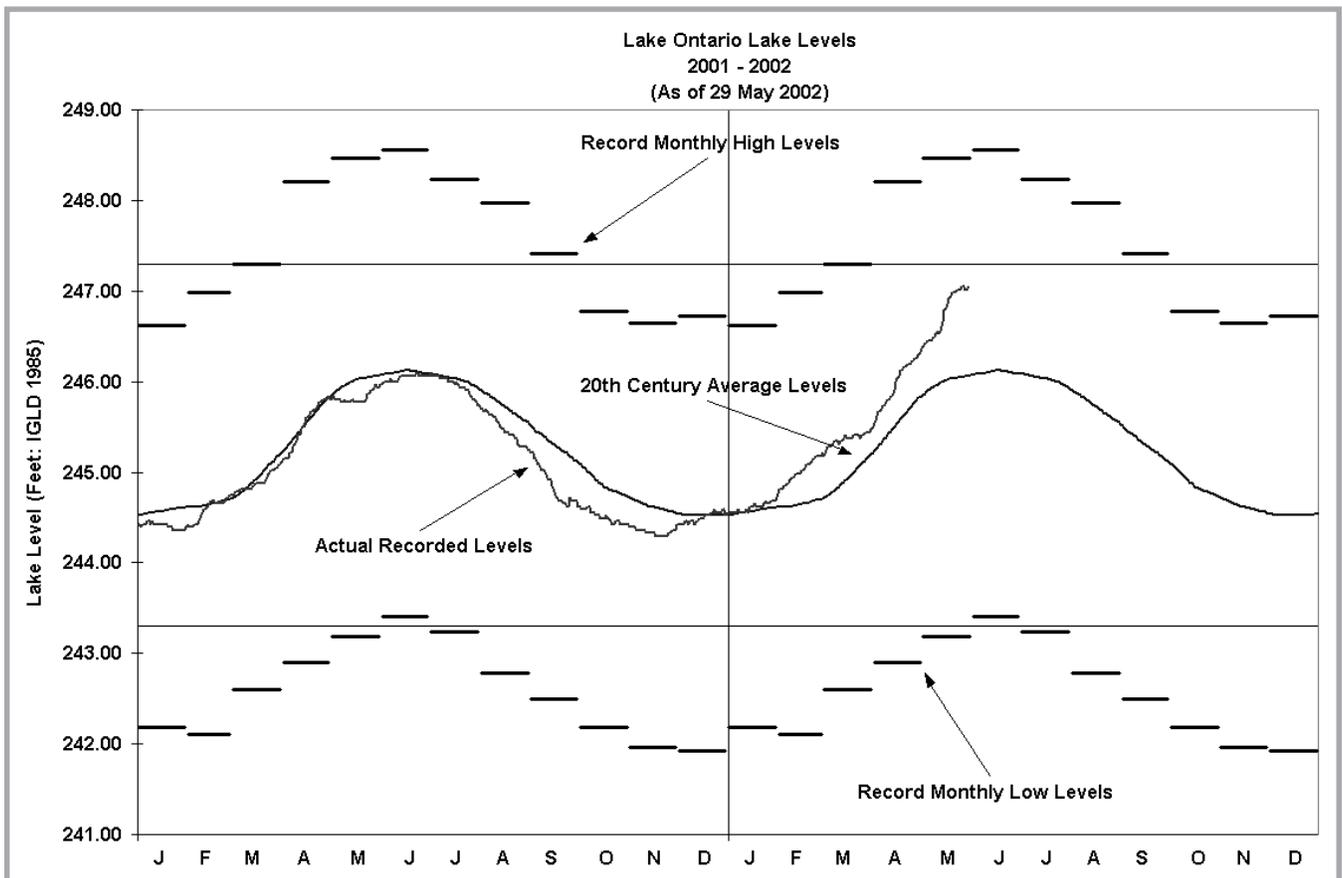
3. New York Sea Grant's listings of coastal erosion control product manufacturers and erosion control plant materials sources were updated and formatted as on-line and "print-on-demand" brochures. A limited color press run of each has been printed; additional copies will be run on-demand, allowing us to keep the information (particularly addresses and telephone numbers up-to-date). Adobe Acrobat versions of these publications have been posted on New York Sea Grant's coastal processes website.
4. A publication on buying and owning shoreline property, targeted to prospective shoreline landowners and realtors listing coastal properties was developed, formatted as an on-line and "print-on-demand" brochure, and loaded in Acrobat format onto New York Sea Grant's coastal processes website; a limited color print run was undertaken.



Information on Great Lakes contractors and shoreline protection costs have been included on the coastal processes website.

5. Three existing New York Sea Grant/Cornell Cooperative Extension information bulletins, "A Guide to Coastal Erosion Processes," "Structural Methods for Controlling Coastal Erosion," and "Vegetation Use in Coastal Ecosystems" were scanned into Adobe Acrobat format and loaded onto New York Sea Grant's coastal processes web site.

6. New York Sea Grant's 35mm slide file of coastal processes and coastal erosion control structures photographs were professionally scanned into Kodak PhotoCD format for use on New York Sea Grant's coastal processes web site.
7. "New York's Great Lakes Water Levels Update" was redesigned into a web format and has been loaded, along with historical background data and charts, onto the coastal process web site.
8. New York Sea Grant has expanded its marketing of these coastal processes and erosion control educational materials to the public and private audiences by enhancing and redesigning our coastal processes web site. The web site was also hot-linked from a greater number of other lake level, coastal process, and erosion control web sites.



Information on water levels in Lake Ontario can be found on the New York Sea Grant web site — <http://www.cce.cornell.edu/seagrant/gl-levels/levels.html>

Sewage Overflows: Information on Erie County's Urban Water Quality Problem

Sarah J. Meyland
Executive Director
Citizens Environmental Research Institute

ABSTRACT

For thousands of years, humans have understood that exposure to sewage can make other humans ill. Even Roman villas and English castles had simple systems to collect and convey human waste. Cities in the U.S. began building urban sewage treatment and collection systems in the early twentieth century. The Clean Water Act of 1972 set clear federal standards for sewage regulation, treatment plant performance and water quality protection. At the same time, the federal government began providing generous financial assistance for municipalities to improve and expand their sewage systems.

INTRODUCTION

With today's knowledge, it is indisputable that sewage is an inherently dangerous substance. The CSO (combined sewer overflows) policy of the early 1990s imposed limits on the unlimited release of raw sewage from combined sewer systems that co-mingled sewage and storm water in the same piping system. CSOs are found primarily in older cities of the East Coast. In western New York State, this includes cities such as Buffalo and Rochester. A similar federal effort to stop SSOs (sanitary sewer overflows) began in 1994, for sewer systems that have separate piping systems for raw sewage and storm water.

SANITARY SEWER OVERFLOWS

The United State Environmental Protection Agency (US EPA) began work in 1994 to develop a national policy to address the problems of overflowing sewers. During the 6 years, 1994-2000, a Federal Advisory Committee (FAC) worked with EPA. The FAC was established at the request of sewer system opera-

tors around the nation who wanted EPA to develop a consistent national approach to the sewer overflow issue. The FAC has served as a sounding board for EPA ideas and to provide reactions to a wide assortment of issues that have been identified as a more detailed understanding of the sewer overflow problem evolved.

The problem of overflowing sewers has come to be known as "sanitary sewer overflows," or SSOs. It is distinguished from a similar problem, sewage releases from "combined sewers," which came to be known as the "CSO", or combined sewer overflow, problem. EPA addressed the CSO issue in the early 1990s, and a formal policy known as the "Nine Minimum Measures" was adopted.

Separate Sanitary Sewers are the piping systems designed to collect residential, municipal and industrial wastewater from individual homes and businesses and carry it to a wastewater treatment plant. Unlike Combined Sanitary Sewer Systems, separate sanitary collection systems are not intended to carry

significant volumes of extraneous water, such as storm water or street runoff.

It has been estimated that there are between 2 to 3 billion linear feet, or 500,000 miles, of sewer lines in the United States. There are around 20,000 separate sewer systems municipally operated in the U.S. By contrast, there are only 920 combined sewer systems nation-wide. Separate sanitary systems serve 147 million people, while combined sewer systems serve only 42.7 million people. These figures do not include all those sewer systems that are privately owned or operated. The total number of separate sewer systems, including both municipal and private operators, is approximately 42,600.

Separate sanitary sewers are fundamentally different from combined sewer systems. While combined sewers are expected to carry a combination of storm water and raw sewage during wet weather, separate sewer systems are not. All sewer systems are designed to carry a specific "peak flow" volume of wastewater to the treatment plant. Within this design parameter, separate sanitary collection systems are not expected to overflow, surcharge or otherwise release sewage before their waste load is successfully delivered.

A combination of factors, however, including community growth, infiltration and inflow (I/I), age of the system, poor maintenance and weather pattern changes can all contribute to system overflows during both dry and wet weather. A further complicating factor is that, as storm events intensify with the changing climate, the peak flow design criteria may no longer be adequate for present and future weather conditions. These changes will inevitably impact the normal flow-conveyance functions of the collection system.

Citizens Environmental Research Institute (CERI) was interested in the extent to which raw sewage was being released into the tribu-

taries and waters of the Great Lakes. With assistance from the Great Lakes Research Consortium, CERI researched CSO and SSO discharges in Erie County New York. CERI's project resulted in a publication entitled, *Sewage Overflows: A Discharge Map and Information on Erie County's Foremost Urban Water Quality Problem* (December, 1999). The purpose of the study was to identify and map discharge locations where raw sewage was known to be released.

WHAT CERI FOUND

CERI found that raw sewage was being released throughout the Erie County. Usually, SSOs are illegal discharges because they represent raw sewage that has not received at least secondary treatment. Many SSOs were occurring at designated overflow points in the system as a way to ease the amount of sewage that actually reaches the sewage treatment plant. The volume of waste entering the sewage system, especially during rainy weather, exceeded the capacity of the plants or the collection system.

CERI documented 89 CSO discharge locations and 172 SSO discharge locations in Erie County. The largest number of CSO sites were found in the City of Buffalo. These discharges flowed directly into the Buffalo and Niagara Rivers. All together, CERI documented over 300 permitted wastewater discharges in Erie County. The CERI report included a map of the discharge locations and a list of the permitted dischargers. The map itself provides a dramatic picture of the extreme dimensions of this problem in western New York.

WHY IS THE CONTROL OF SEWAGE IMPORTANT?

While people understand that sewage is a complex mixture of waste materials, they rarely stop to think about all the components that are

found in raw sewage, thereby making it so dangerous. First and foremost, sewage is full of pathogens, microorganisms that cause illness. Sewage pollutes drinking water, bathing beaches, recreational waters and shellfish and fishing areas.

THE CONSEQUENCES OF THE PROJECT

CERI distributed the map and publication widely, including to local policy makers and state and federal regulatory officials. Local newspapers covered the topic following the publication release. CERI continued to document the impacts of raw sewage.

Based upon the mapping project and other information gathered by CERI, state legislation was introduced by Assemblyman Thomas DiNapoli (Great Neck) and State Senator Michael Balboni (Albertson), known as the Sanitary Sewer Overflow Act, in the Spring of 2002. The legislation (A-11019/S-7317) requires the implementation of best management practices, known as CMOM (capacity, management, operation and maintenance), for sewer systems across the state.

Responding to the work of CERI and the discharge mapping project, the NYS DEC has agreed to make SSOs a high priority for regu-

latory reform. State legislation may soon make SSOs a thing of the past. Enforcement actions may soon follow as state and federal regulators get a clearer picture of the extreme SSO problems present in Western New York.

ABOUT CERI

Citizens Environmental Research Institute (CERI) was founded in 1989 to advance and promote the application of sound science in the setting of public policy, the enforcement of environmental laws and the application of environmental regulations. CERI is the research and education affiliate of Citizens Campaign for the Environment (CCE) and works to increase public education, to undertake environmental and public health research, to disseminate sound information and to promote prudent policies on issues affecting land and water resources.

CERI has members in communities from across New York State and coastal Connecticut and regularly communicates with its members on important issues affecting land and water resources. CERI has published numerous educational documents, brochures and reports on a variety of environmental and public health issues and carries out environmental education programs. Additional information about this issue and others can be found on the CERI web site which is: www.ceriworld.org

Notes

Great Lakes Research Review

New York State Great Lakes Protection Fund

TABLE OF CONTENTS

New York Great Lakes Protection Fund — Is it Working?
Dr. Richard C. Smardon *i*

GIS Analysis of the Land Use Effect on Water Quality and Pollutant Discharge in the Cazenovia Creek Watershed, New York
Dr. Tao Tang and Dr. Kim Irvine *1*

Water Quality Opinion Survey 2000: Public Attitudes and Knowledge Regarding Water Quality in Monroe County, New York
Margit Brazda Poirier, Robert Rutzen, Ph.D. and Jack Antinore *12*

Development of an Automated Dry Deposition Sampler
Dr. Thomas M. Holsen, Seung-Muk Yi and Dr. Michael S. Milligan *18*

Great Lakes Coastal Erosion Processes and Control Educational Materials and Web Site Enhancement
Charles R. O'Neill, Jr. *21*

Sewage Overflows: Information on Erie County's Urban Water Quality Problem
Sarah J. Meyland *25*

Produced by: Great Lakes Program, University at Buffalo, 202 Jarvis Hall, Buffalo, NY 14260-4400

Editor: Helen M. Domske

Design/Layout Editor: Monica S. Moshenko



great lakes program

STATE UNIVERSITY OF NEW YORK AT BUFFALO
202 JARVIS HALL
BUFFALO, NY 14260-4400

Non-Profit Org.
U.S. Postage
PAID
Buffalo, NY
Permit #311