Seneca Lake Watershed

Management Plan

Hobart and William Smith Colleges

Finger Lakes Institute
Hobart and William Smith Colleges

Genesee/Finger Lakes Regional Planning Council

Southern Tier Central Regional Planning & Development Board

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MANAGEMENT PLAN

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Components

1. Executive Summary
2. Characterization and Subwatershed Evaluation
3. Assessment of Local Laws, Programs, and Practices Affecting Water Quality
4. Identification and Description of Management Practices, Approaches, and Strategies for Watershed Protection and Restoration and Implementation Strategy and Schedule

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Executive Summary

Introduction

The purpose of this planning effort, the Seneca Lake Watershed Management Plan, was the formation of a long-term strategy to ensure the protection and restoration of Seneca Lake water quality and compatible land use and development. The result is this watershed management plan for the protection and enhancement of Seneca Lake. This briefing describes the Plan's discrete components and the project's process to develop strategies to protect and restore water quality within the Seneca Lake Watershed.

Seneca Lake is the largest of the eleven Finger Lakes. The lake's surface area is just over 66 square miles, and its watershed is 457 square miles. The watershed overlaps portions of 40 municipalities, located within five counties: Chemung, Ontario, Schuyler, Seneca and Yates. Seneca Lake is part of a larger, complex system of lakes and rivers in central New York State known as the Oswego River Basin. The Oswego River Basin has an area of 5,100 square miles and drains the hills and valleys of the Finger Lakes into the Oswego River, which flows north into Lake Ontario.

The Seneca Lake Watershed Management Plan was developed through a grant by the New York State Department of State (DOS) with funds provided to the City of Geneva under Title 11 of the Environmental Protection Fund.

History of Watershed Protection

The Seneca Lake watershed community has shown strong support for watershed planning; various partnerships and stakeholders have been cooperatively operating since the mid-1990's. Beginning in 1995, the citizen-based non-profit, Seneca Lake Pure Waters Association (SLPWA), received a grant which ultimately produced the report, *Seneca Lake Watershed Study: Developing an Understanding of an Important Natural Resource* (1996). Formation of the Seneca Lake Area Partners in Five Counties (SLAP-5) was an outcome of the study, and was formed July 3, 1996. SLAP-5 brings together area mayors, supervisors, state legislators, county agency staff, and others pledging to work together:

> *To develop a watershed management plan for Seneca Lake that will protect and improve water quality and is supported by the citizens and communities in the watershed. To provide representation of all important sectors in the Seneca Lake Watershed and to keep in contact with people in their areas of expertise to ensure the watershed program reflects and responds to the people represented.*

In 1999, *Setting a Course for Seneca Lake, the State of the Seneca Lake Watershed*, was developed to provide an in-depth description and analysis to determine the state of the watershed. This study describes the state of the watershed research, analysis and discussions, identifies current problems facing the watershed, and details public education and outreach efforts. This Seneca Lake Watershed Management Plan, developed from 2011 to 2014, builds upon these relationships and previous studies and reports.

Intermunicipal Cooperation

The basis for intermunicipal cooperation was founded in a Memorandum of Understanding (MoU) between the five counties and 40 municipal governments that geographically fall within the Seneca Lake Watershed. The MOU will link those municipalities with project partners, county and state officials, watershed groups, and local scientists in an intermunicipal watershed organization.

This “new” intermunicipal organization will replace SLAP-5. This group can further the Plan’s goals of preserving, restoring, and enhancing the health of Seneca Lake through efforts in adopting improved ordinances, greater code enforcement, water monitoring, and staff training.

Watershed Plan Components

Process of Preparing the Plan

The project began in August 2010 with a meeting between project partners including: Seneca Lake Area Partners in Five Counties (SLAP-5); Genesee/Finger Lakes Regional Planning Council (G/FLRPC); Southern Tier Central Regional Planning & Development Board (STCRP&DB); Hobart and William Smith (HWS) Colleges; Finger Lakes Institute (FLI); Ontario County Soil and Water Conservation District (OCSWCD); Schuyler County Watershed Protection Agency (WPA); and New York State Department of State (DOS).

Seneca Lake Area Partners in Five Counties (SLAP-5) served as the core of the Project Advisory Committee (PAC), responsible for reviewing draft documents, making revision suggestions, and generally overseeing the plan's development.

Regional Planning Councils are established pursuant to New York State General Municipal Law to address regional issues and assist with local planning efforts. G/FLRPC and STCRP&DB, respectively, support watershed planning in the Seneca Lake watershed directly through the acquisition of funding sources for specific projects and indirectly through ongoing land use and water resources planning projects. The two regional bodies cover twelve New York State counties.

HWS is very active in the Seneca Lake watershed, conducting various water quality and quantity monitoring studies in support of a variety of short- and long-term projects and programs. Their independent research has significantly advanced the knowledge base within the watershed. The Finger Lakes Institute, a program of HWS, promotes environmental research and education about the Finger Lakes and surrounding environments.

Soil and Water Conservation Districts within each county play a critical role in the management of natural resources and agricultural activities in the Seneca Lake watershed, including applying for funding and implementing projects related to erosion and sediment reduction, streambank remediation, and nonpoint source pollution control. They also have an important role in lending practical, on-the-ground knowledge to help prioritize the plan's management practices, approaches, and strategies. The Schuyler County Watershed Protection Agency is an agency within the Public Health and Community Services Agency of Schuyler County. They run the Water Supply Protection Program, provide water quality monitoring services, conduct property transfer inspections, further public watershed knowledge, and are a valuable local resource for environmental health issues.

The New York State Department of State helps protect and enhance coastal and inland water resources and encourage appropriate land use through technical assistance for plans and projects that expand public access, restore habitats, and strengthen local economies.

The following documents are components of the Seneca Lake Watershed Management Plan, and were prepared to ultimately determine recommendations and priority projects in order to enable decision makers, stakeholders, and residents to make decisions that will ultimately improve and protect the water quality of Seneca Lake, and its tributaries:

- A community education and outreach program on water quality and quantity and watershed protection issues, completed in 2011;

- A characterization of the watershed and its constituent sub-watersheds, land use and land cover, demographics, natural resources, and infrastructure, completed in 2012;
- An evaluation of existing water quality data, run-off characteristics, and pollutant loadings, completed in 2012;
- Establishment of a formal Intermunicipal Organization
- Assessment of Local Laws, Programs, and Practices Affecting Water Quality, completed in 2014;
- Identification of management strategies and prioritization of projects and other actions for watershed protection and restoration, paired with an implementation strategy, including the identification of watershed-wide and site-specific projects and other actions necessary to protect and restore water quality, completed in 2014.

A summary of each component, as well as the implementation strategy, can be found below. These documents can be found in their entirety at the websites listed in each summary section.

Community Outreach and Education

Community outreach was a significant part of the planning process. A *Community Outreach and Education Plan* was developed to clarify and define the variety of forums and outreach mechanisms used to engage people in the Seneca Lake Watershed Management Plan. Guided by the Project Advisory Committee (PAC), G/FLRPC, STCRP&DB, FLI, and the respective county Soil and Water Conservation District representatives managed the watershed's varied and vast geography by engaging important lake organizations such as the Seneca Lake Pure Waters Association (SLPWA) to reach out to a broad set of stakeholders.

The *Community Outreach and Education Plan* report includes brief guidance on the plan's structure and process:

- Project Overview & Watershed Description
- Project Organizational Structure
- Regular Project Advisory Committee (PAC) Meetings
- Project Website
- Identification of Watershed Stakeholders
- Consultations, Discussions, and Reporting
- Public Information Meetings
- Special Stakeholder Focus Groups, Meetings and Key Contact Interviews
- Publication and Review of Draft Materials

The Community Outreach and Education Plan designated Seneca Lake Area Partners in Five Counties (SLAP-5) to serve as the core of the PAC. It defined the role of the PAC: its purpose; membership; chairperson; public participation protocol; meeting notification, scheduling, format, and location. PAC meetings were held to manage the project's progress, prepare and review draft documents, and advise the participating members of the PAC of project business or materials. PAC meetings rotated around different locations across the five counties and were open to the public (and used the consensus form of decision-making) to encourage broad participation among all residents and municipal officials throughout the watershed. PAC meetings were scheduled in conjunction with SLAP-5 meetings.

In addition to SLAP-5, the PAC included various additional *ex officio* representatives from each watershed community, County Planning Departments, County Soil and Water Conservation Districts, the

NYS Department of Environmental Conservation, and environmental, recreational, historic preservation, and economic development interests such as lake associations, conservationists, boaters, anglers, and other Seneca Lake stakeholders such as SLPWA and the Finger Lakes/Lake Ontario Watershed Protection Alliance (FL-LOWPA).

The *Community Outreach and Education Plan* included the protocol for arranging at least two public meetings and for outreach to special focus groups such as property owners, business owners, farmers, local highway superintendents, and local code enforcement officers. These and all PAC meetings – along with meeting minutes, publications, and draft materials – were posted on the project's website, www.senecalakeplan.info.

The *Seneca Lake Watershed Management Plan: Community Outreach and Education Plan* is available at: http://www.stcplanning.org/usr/Program_Areas/Water_Resources/Seneca_Lake_Plan/Community%20Outreach%20%20Education%20Plan_Final.pdf

Characterization and Subwatershed Evaluation (2012)

Seneca Lake is the largest of the eleven Finger Lakes. Carved out of bedrock over 10,000 years ago by glaciers, Seneca Lake is the deepest freshwater lake east of the Mississippi River outside the Great Lakes. The lake's surface area is just over 66 square miles, and its watershed is 457 square miles. Seneca Lake is 38 miles long and has a volume of approximately 4.2 trillion gallons. The watershed overlaps portions of 40 municipalities, located within five counties: Chemung, Ontario, Schuyler, Seneca and Yates. Seneca Lake is part of a larger, complex system of lakes and rivers in central New York State known as the Oswego River Basin. The Oswego River Basin has an area of 5,100 square miles and drains the hills and valleys of the Finger Lakes into the Oswego River, which flows north into Lake Ontario.

The Seneca Lake *Characterization and Subwatershed Evaluation* describes, or characterizes, the condition of natural resources and the built environment in the watershed. It contains a wealth of data on the watershed's character, including the 28 different drainage areas and subwatersheds that make up Seneca Lake. The 154-page *Characterization and Subwatershed Evaluation* report contains over 50 maps and tables produced by project staff at FLI, HWS, STCRP&DB, and G/FLRPC. It is the most comprehensive report on Seneca Lake to date.

The primary water quality issues in Seneca Lake are nutrients, invasive species and contaminants. Based on the annual results of water samples analyzed for chlorophyll-a, total phosphate, soluble reactive phosphate, nitrate, and total suspended solids, Seneca Lake's water quality is one of the worst of the Finger Lakes. Differences in water quality across the Finger Lakes are due to the degree of water quality protection, the percentage of agricultural land, the amount of precipitation, and other factors in each watershed.

The *Characterization and Subwatershed Evaluation* report is comprised of the following sections:

- Introduction and Project Background
- General Description of the Watershed and Subwatersheds
- Watershed and Subwatershed Habitats
- Seneca Lake Limnology and Stream Hydrochemistry
- Potential Sources of Pollution due to Human Activities
- Watershed and Subwatershed Information Gaps

Introduction and Project Background

This section describes the history of past Seneca Lake watershed planning efforts and the background of the current plan. The *Characterization* report is intended to facilitate the development of an overall strategy to protect and restore water quality within the Seneca Lake watershed by establishing a reliable inventory of existing vital and accurate information, identifying any significant knowledge gaps, and building on previous work already begun through the formation of SLAP-5 in 1996, followed by the *Setting a Course for the Lake* report in 1999.

General Description of the Watershed and Subwatersheds

This section also provides an overview of the study area and explains how a watershed can be defined and delineated. A watershed may be described as a geographic area of land drained by a river and its tributaries to a single point. A watershed's boundaries are generally defined by the highest ridgeline around the stream channels that meet at the lowest point of the land; at this point, water flows out of the watershed into a larger river, lake, or ocean. Watersheds can be small and represent a single river or stream within a larger drainage network or be quite large and cover thousands of square miles.

The Seneca Lake watershed lies within the Oswego River Basin – part of the larger Lake Ontario Drainage Basin – and occupies 341,119 acres (457 sq. mi.) across portions of Chemung, Ontario, Schuyler, Seneca, and Yates Counties. Seneca Lake is part of a larger, complex system of lakes and rivers in central New York State known as the Oswego River Basin. The Oswego River Basin has an area of 5,100 square miles and drains the hills and valleys of the Finger Lakes into the Oswego River, which flows north into Lake Ontario. The watershed overlaps portions of 40 municipalities:

Chemung County

- Towns of: Catlin, Horseheads, Veteran
- Villages of: Horseheads, Millport

Ontario County

- City of: Geneva
- Towns of: Geneva, Gorham, Phelps, Seneca

Schuyler County

- Towns of: Catharine, Cayuta, Dix, Hector, Montour, Orange, Reading, Tyrone
- Villages of: Burdett, Montour Falls, Odessa, Watkins Glen

Seneca County

- Towns of: Fayette, Lodi, Ovid, Romulus, Varick, Waterloo
- Villages of: Lodi, Ovid

Yates County

- Towns of: Barrington, Benton, Milo, Potter, Torrey, Starkey, Jerusalem
- Villages of: Dresden, Dundee, Penn Yan

The physical makeup of the Seneca Lake watershed is explained through bedrock and surficial geology, location of mines, geomorphology, geography, hydrology, climate, soils, elevation, demographics, and land use (including a build-out analysis). Much of the physical form of the Seneca Lake watershed is owed to the long-ago advancement and retreat of glaciers, and the modern streams that resulted still flow in low floodplain areas and nourish wetland swamps and deposit alluvial sediments. The watershed has complex assemblages of soils, some moderately coarse-textured soil with calcareous substrata and other more acidic, less drained soils.

The climate in and around the Seneca Lake watershed is characterized by cold, snowy winters and warm, dry summers and the average annual precipitation in the watershed is 32.5 inches per year. Most of the soils in the north end of Seneca Lake have a low to moderately low runoff potential; the south end of the lake has soils with both moderately low and high runoff potential. After heavy rains and the subsequent ground saturation, Seneca Lake can take a week or more to fully drain into the Barge Canal as the lake level can be lowered by only a tenth of a foot per day, further illustrating the importance of watershed planning in a future of higher estimated levels of precipitation.

Almost half (42.2%) of the land in the Seneca Lake watershed – over 122,000 acres – is used for agricultural purposes, largely pasture hay and cultivated crops. The watershed is 27.5% residential, 14.4% vacant, and 1.2% commercial property. The watershed has a relatively low percentage of impervious cover, though more research is needed to quantify the areas of effective impervious cover in its urbanized areas.

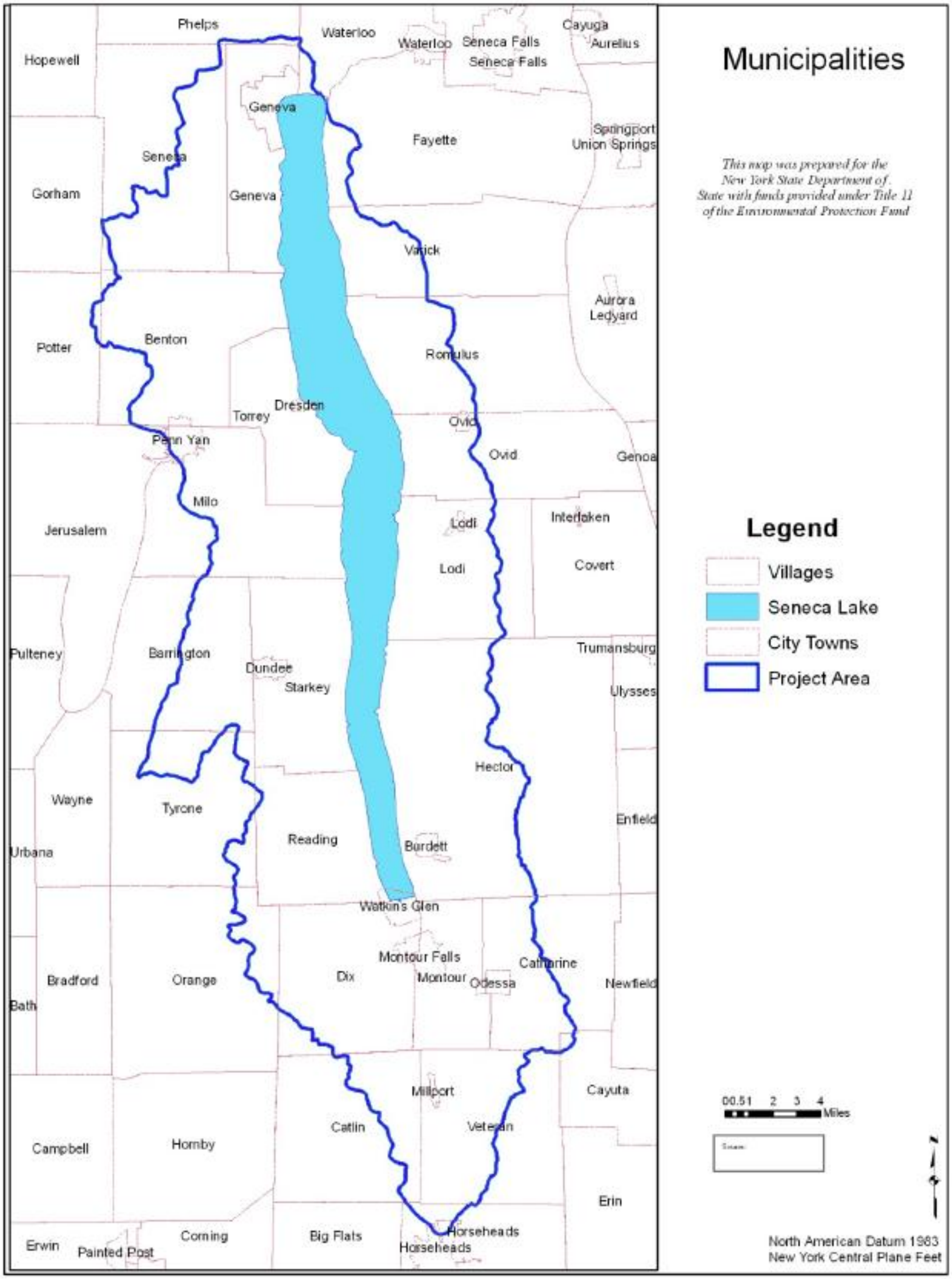
The watershed's estimated population range is between 54,114 and 58,897 people, with the majority (20,840) residing in the City of Geneva and the Village of Penn Yan. An estimated build-out analysis is available in Table 14 of the *Characterization* with a full methodology included in Appendix A. While it is unlikely that all or most of the farmland in the watershed focus areas will be developed, if communities believe that preserving farmland is a priority, then this build-out analysis can be used as a gauge to determine whether existing land use regulations and practices are adequate. This section also provides an overview of land uses and regulatory measures relevant to environmental planning in the Seneca Lake watershed, including a brief history of research, planning, and assessment, a topic further explored in the subsequent *Assessment of Local Laws, Programs, and Practices Report.*

Of the 40 municipalities in the Seneca Lake watershed, 11 use surface water for their municipal public water systems. The remaining 29 municipalities have no public water service. There are over 1,270 miles of roads in the Seneca Lake watershed. Nearly all the public acreage in the watershed is in a land trust or easement, with the majority of the holdings classified as state or national forests or state park. Approximately 7,484 acres of the 16,212 acre Finger Lakes National Forest lies within the Seneca Lake watershed and 2,440 acres of Sugar Hill State Forest lie within the watershed. The Keuka Outlet Trail, owned and maintained by the Friends of the Outlet, holds 277 acres of land in the Towns of Milo and Torrey and the Village of Penn Yan.

The *Characterization* also reviews New York State's State Pollution Discharge Elimination System (SPDES) program and permittees governed by SPDES. Following this is an examination of regulated potential pollutants in the watershed, including high-volume hydraulic fracturing and mining.

The NYSDEC Oswego River / Finger Lakes Waterbody Inventory and Priority Waterbodies List (PWL) in 2008 divides Seneca Lake into three sections: the extreme northern, middle, and extreme southern, portions of the lake. The northern and southern sections have no known use impairment; the middle has possible threats to the water supply due to the amount of agricultural lands in the assessment area resulting in an elevated potential for phosphorus, disinfectant bi-product precursors, and pesticide contamination.

Figure1: Municipalities of the Seneca Lake Watershed



Watershed and Subwatershed Habitats

This section describes the fish that call Seneca Lake home, as well as the invasive species and the techniques used to control them. Seneca Lake is the 8th most fished lake in New York State, and the plentiful supply of native lake trout has earned the City of Geneva the nickname “Lake Trout Capital of the World.” In addition to lake trout *Salvelinus namaycush*, the lake also includes significant populations of salmonine fishes such as brown trout *Salmo trutta*, Atlantic salmon *Salmo salar,* and rainbow trout (*Oncorhynchus mykiss*). Methodologies used to control the population of invasive sea lampreys (a freshwater parasite on the lake’s fishes) have been refined over many years based on research and practice, resulting in scheduled stream treatments every three years to maintain adequate control of the sea lamprey populations.

Seneca Lake Limnology and Stream Hydrochemistry

Limnology and stream hydrochemistry makes up the bulk of the report, explaining the science and behind limnology, or ‘freshwater science,’ (the study of inland waters) and the techniques used for deep lake data collection and its subsequent analysis. This section summarizes information compiled by HWS researchers for a 2012 Seneca Lake volume, the update to the 1999 *Setting a Course for Seneca Lake* report. This section also explains the science behind water quality indicators, data collection, and its subsequent analysis in relation to the classification of surface waters in the state (precluded, impaired, stressed, or threatened). It also presents data on phytoplankton, zooplankton, macrophytes, macroinvertebrates, fish, and other species that live in the lake.

This section also includes a water quality data summary which further explains the data collection and monitoring results over many decades in Seneca Lake, including statistics for concentrations of chlorophyll-a, total phosphate, soluble reactive phosphate, nitrate and total suspended solids (TSS) following standard limnological techniques. All of the nutrient and TSS concentrations were larger in the streams than the lake, and annual mean nutrient concentrations vary from stream to stream. The largest nutrient fluxes were from streams with the largest basin areas. Concentrations and fluxes of phosphorus in streams suggest that a nutrient loading problem exists; also adding to the lake’s phosphorus budget: atmospheric loading, lakeshore lawn care fertilizers, lakeshore septic systems, and municipal wastewater treatment facilities.

Also included are other water quality indicators such as herbicides, coliform bacteria from human and animal effluent, and the presence and quantity of benthic macroinveterbrates, an important biotic indicator as they differ in their sensitivities to pollution, represent stream conditions over long time periods, and are relatively easy to collect. Based on the Percent Model Affinity (PMA), a biological indicator developed for New York’s streams, scores ranged from no impact in some areas to a moderate water quality impact in other areas, particularly Reeder Creek, Wilson Creek, and Kashong Creek.

Potential Sources of Pollution due to Human Activities

This section describes the range of pollution sources that affect Seneca Lake: agriculture; chemical bulk storage; forestry practices; landfills, dumps, and inactive hazardous waste sites; mined lands; petroleum bulk storage facilities; roadbank erosion; salt storage and deicing materials; shore residences environmental health risks; State Pollution Discharge Elimination System (SPDES) Permits; spills; and streambank erosion.

Watershed and Subwatershed Information Gaps

This section briefly summarizes a complex and varied group of watershed "issues" organized into specific categories that lay the groundwork for a completed watershed strategy and subsequent implementation program, in addition to future areas of study for Seneca Lake, including agricultural activities, forestry, urban landscapes, chemical and petroleum storage, spills, landfills and solid waste disposal, mining activities, road salt, road-bank erosion, boating activities, onsite and municipal liquid waste disposal, stormwater runoff, construction activities, energy development, and air quality.

The *Seneca Lake Watershed Management Plan: Characterization and Subwatershed Evaluation.* is available at:
http://stcplanning.org/usr/Program_Areas/Water_Resources/Seneca_Lake_Plan/SenecaCharacterizationSubwatershedEval.pdf

Assessment of Local Laws, Programs, and Practices Affecting Water Quality (2014)

An assessment of local laws, programs, and practices that affect water quality was conducted for the entire watershed, in order to determine gaps between present laws/practices and model best management practices (BMPs), and to provide specific recommendations to each watershed municipality to address those gaps and improve water quality. Each municipality was provided with its own individual assessment based on a review and evaluation of laws, practices, and plans.

Many of the gaps in local laws and practices across the watershed are similar. Recommendations are specifically presented for each municipality based on the *Assessment*, but also refer to recommendations that are applicable to multiple municipalities, such as developing a comprehensive plan or amending subdivision regulations. These recommendations may be used as a starting point to help municipalities and counties hone in on top priorities, determine what additional information is needed, and what steps are needed for implementation.

Generally, the regulatory deficiencies found in the *Assessment of Local Laws, Programs, and Practices Affecting Water Quality* are related to on-site wastewater management and lack of stream or riparian buffers. Additionally, a number of municipalities within the watershed either do not have comprehensive plans or are utilizing obsolete or incomplete comprehensive plans. This is directly reflected in the planning matrix, in both the sections on Wastewater Treatment Systems and Management as well as Regulatory Management. One of the highest overall recommendations for the Seneca Lake watershed is to adopt a uniform sanitary law throughout the Seneca Lake watershed. And two of the highest regulatory recommendations pertain to these building blocks of local land use: zoning and comprehensive plans, respectively. The highest recommendation is to adopt stream buffer setbacks to reduce the amount of harmful runoff and sedimentation into the lake caused by land use activities, achieved through an environmental protection overlay district (EPOD) or setbacks from waterbodies within the zoning code. The other highly prioritized action is the drafting (or revision) of comprehensive plans, emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality.

Water quality management is a regional issue and thus collaboration and standardization of strategies can be beneficial to all. The inclusion of some standardized recommendations is intended to facilitate the sharing of information between counties and municipalities; collaboration and standardization can make initial efforts more efficient and allow groups to focus on implementation work. Some examples of recommendations proposed to improve water quality through the reduction of nonpoint source pollution focus on increased participation in the Agricultural Environmental Management Program, creation of riparian buffers; strengthened floodplain, onsite wastewater treatment, and subdivision regulations; development of green infrastructure standards, updating site review procedures; and recommendations based on stream monitoring, best management practices, and education and outreach. Recommendations found in the local laws assessments are grouped together by municipality, and can also be cross-referenced in the overall implementation matrix.

To read more about the regulatory and programmatic environment in the Seneca Lake watershed as well as specific analysis of the land use laws governing its 40 municipalities and five counties, the *Assessment of Local Laws, Programs, and Practices Affecting Water Quality* can be found at the link below.

The assessment contains:

- Description and analysis of federal and state laws, programs, and practices that impact water quality in the watershed;
- Description and analysis of local laws, plans, programs, and practices affecting the watershed:
    - Including zoning, site plan review, subdivision regulations, stormwater management, and wetlands, watercourse, and flooding regulations;
- Analysis of strengths and weaknesses of local laws, plans, programs, and practices as they relate to management of point and nonpoint source pollution and protection of aquatic habitat
- Recommendations for priority additions or amendments to local laws, plans, programs, and practices, based on planning and water quality best management practices (BMPs)

The complete *Assessment of Local Laws, Programs, and Practices Affecting Water Quality* report is available at:
http://www.stcplanning.org/usr/Program_Areas/Water_Resources/Seneca_Lake_Plan/Seneca%20Lake%20Watershed%20ASSESSMENT%20OF%20LOCAL%20LAWS,%20PROGRAMS,%20AND%20PRACTICES%20REPORT_rev.pdf)

Identification and Description of Management Practices, Approaches and Strategies for Watershed Protection and Restoration & Implementation Strategy and Schedule

Recommendations were developed in order to address a number of areas of concern. These recommendations are presented in the *Assessment of Local Laws, Programs, and Practices Affecting Water Quality*, and in a matrix, known more formally as the *Identification and Description of Management Practices, Approaches and Strategies for Watershed Protection and Restoration & Implementation Strategy and Schedule*. The matrix represents the culmination of nearly four years of deep research into the current conditions of Seneca Lake, both in the lake itself and across its surrounding watershed. The matrix includes recommendations that are presented in the *Assessment of Local Laws, Programs, and Practices Affecting Water Quality*, and shows specific steps and strategies needed to complete an action, the groups responsible for completing the actions, and the timeline by which the tasks must be completed.

The matrix includes priority assignments, actions, objectives, steps, strategies, anticipated reductions and water quality improvements, benefits, related issues, lead organizations, potential funding sources, long- and short-term measures, approximate cost, and regulatory approvals in the following areas of concern for Seneca Lake:

Coordination, Collaboration & Partnership Recommendations – This set of recommendations addresses the need for improved collaboration amongst watershed municipalities, citizens and stakeholders; addresses the need for continuous water resource related monitoring activities; and identifies specific educational opportunities. One of the strongest recommendations is to increase collaboration between groups; collaboration and standardization can make initial efforts more efficient and allow groups to focus on implementation work. Shared practice allows for better design, better maintenance, and economic incentives that can deliver higher performance and lower cost. Specific recommendations pertaining to Coordination, Collaboration & Partnership opportunities can be found in the matrix.

Agriculture – Farming can have a negative effect on water quality through erosion of crop land, sedimentation, and runoff contaminated with fertilizers or animal wastes. This section includes some of the highest prioritized actions of all the recommendations in the watershed, including the creation of riparian buffer zones around streams adjacent to agricultural land and the development of Comprehensive Nutrient Management Plans (CNMPs) tailored to all farms in the watershed. Also highly recommended is additional research into collaborative anaerobic digesters – systems that convert manure into electricity – and the development of educational materials customized for the Seneca Lake watershed on nutrient management, manure handling, and erosion control. Further specific recommendations pertaining to agriculture can be found in the matrix.

Stormwater Management & Erosion Control – Stormwater runoff contains pollutants such as nutrients, pathogens, sediment, toxic contaminants, and oil and grease, resulting in water quality problems. This section's highest recommendation is to provide training to local officials on erosion controls and stormwater management in order to strengthen local capacity for successful management and protection of the Seneca Lake watershed by empowering decisionmakers. Streambank erosion within the watershed is the core source of sediment loading into Seneca Lake. Protecting these stream banks is vital to controlling sediment loading and maintaining the rock structures and vegetation that helps prevent erosion. Thus the other highest priority in this category is the revision of land use laws to limit development on slopes greater than 10%. Further specific recommendations pertaining to stormwater management and erosion control can be found in the matrix.

Forestry and silviculture management – Sustainable forestry balances preserving the integrity of our forests with economic development and maintaining our diverse wildlife population while minimizing damage to the agriculture and rural communities. An array of tools is available from the New York State Cooperative Forest Management Program; further details are available in the matrix.

Wastewater Treatment Systems and Management – The number one source of nonpoint source pollution in New York State is on-site wastewater treatment systems. One of the highest overall recommendations for the Seneca Lake watershed is to adopt a uniform sanitary law throughout the Seneca Lake watershed, based on the Ontario County model or the model Local Law for On-Site Individual Wastewater Treatment. Residences within 500 feet of the lake and 150 feet of tributaries should be considered critical environmental areas and subject to more frequent inspection. Another highly-ranked recommendation is to advance the education of the general public on the role, process, accomplishments, needs, and future strategy of sewer districts and wastewater treatment facilities. Further specific recommendations pertaining to wastewater treatment systems and management can be found in the matrix.

Hazardous Waste Management – Highly-ranked priorities in the Seneca Lake watershed are determining the location of inactive or unpermitted landfills; assessing the concentrations of contaminants in fish; providing outreach and education on pollution prevention practices; and implementing a watershed-wide hazardous waste pick-up or drop-off. Educating the public and providing an opportunity to safely dispose of hazardous products keeps dangerous wastes out of landfills, lowering the environmental risks associated with improper disposal. Further specific recommendations pertaining to hazardous waste management can be found in the matrix.

Roads and Highways – The highest-ranked priority in this section is educating municipal and county highway departments on ditch and culvert design and stream bank stabilization methods. Paved development has the highest coefficient of runoff, and thus highway departments have a very important role in preserving watershed quality. Further specific recommendations pertaining to highway department practices can be found in the matrix.

Wetlands – There are significant wetlands in the Seneca Lake Creek watershed; there are over 53,000 total acres of wetlands across the five counties. Thus one of the top recommendations for the watershed is the restoration of degraded wetlands in order to absorb the forces of flood and tidal erosion to prevent loss of upland soil. Preservation of wetlands as natural habitat for many species of plants and animals and for critical flood and stormwater control functions; wetlands are arguably among the most productive and economically valuable ecosystems in the world. Further specific recommendations pertaining to wetlands can be found in the matrix.

Regulatory management – Two of the highest regulatory recommendations pertain to the building blocks of local land use: zoning and comprehensive plans. The highest recommendation is to adopt stream buffer setbacks to reduce the amount of harmful runoff and sedimentation into the lake caused by land use activities, achieved through an environmental protection overlay district (EPOD) or setbacks from waterbodies within the zoning code. Another highly prioritized action is the drafting (or revision) of comprehensive plans, emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality. A number of municipalities within the watershed either do not have comprehensive plans or are utilizing obsolete or incomplete comprehensive plans. Further specific recommendations pertaining to regulatory management can be found in the matrix.

Invasive species management – The highest-ranked priorities are education and outreach initiatives on invasive species as well as support for further research and monitoring to improve early detection and management of invasive species. The Finger Lakes PRISM (Partnership for Regional Invasive Species Management) is a cooperative partnership in central New York focused on reducing the introduction, spread, and impact of invasive species through coordinated education, detection, prevention and control measures. A number of other related recommendations pertaining to invasive species can be found in the matrix.

The complete *Identification and Description of Management Practices, Approaches and Strategies for Watershed Protection and Restoration & Implementation Strategy and Schedule* can be found at http://www.stcplanning.org/index.asp?pageId=180.

Next Steps

The basis for intermunicipal cooperation was founded in a Memorandum of Understanding (MOU) between the five counties and 40 municipal governments that geographically fall within the Seneca Lake Watershed. The MOU will link those municipalities with project partners, county and state officials, watershed groups, and local scientists in an intermunicipal watershed organization (IO).

This "new" intermunicipal organization will replace SLAP-5. This group can further the Plan's goals of preserving, restoring, and enhancing the health of Seneca Lake through efforts in adopting improved ordinances, greater code enforcement, water monitoring, and staff training. The IO/MOU document has been circulated to all watershed municipalities and signed by all five Legislatures or Boards of Supervisors in Chemung, Ontario, Schuyler, Seneca and Yates Counties. Municipalities already signed include the Town of Seneca; the City of Geneva; the Town of Fayette; the Town of Milo; the Town of Starkey; the Town of Potter; and the Town of Hector.

Verbal agreements from other towns have been received. One Town has declined to sign; other towns are still in the process of deliberation. The Memorandum of Understanding document does not request or require funding from municipalities. SLAP-5 members (agencies, DEC, SLPWA, etc.) and municipalities not in the watershed but with interest in lake water quality may be non-voting *ex officio* members of the council. The importance of the formal watershed management plan adoption by a municipal council in accessing grant funding for implementation of water quality protection measures was emphasized.

The key next steps for the Seneca Lake Watershed Management Plan's advancement are:

- SLAP-5 and the PAC continuing to work with municipalities to sign the IO/MOU;
- An organizational meeting of the IO scheduled by the end of 2014;
- SLAP-5 continuing its mission to provide representation of all important sectors in the Seneca Lake Watershed and to keep in contact with people in their areas of expertise to ensure the watershed program reflects and responds to the people represented;
- Implementation of the *Seneca Lake Watershed Management Plan*
- Finding funding for the advancement of research in identified knowledge gaps, as delineated below.

As the data and related information reported in the *Characterization* is not exhaustive, pursuing funding to be able to close gaps in knowledge is essential. In addition to a better understanding of the water supply and waste disposal coverage and associated infrastructure within the watershed, a better delineation and characterization of wetlands and stream corridors, monitoring the physical, biological, chemical and other aspects of the lake's limnology and the biology and hydrogeochemistry of its major tributaries, the following specific gaps in research and monitoring criteria should be considered when seeking and applying for implementation funding:

- Surface and groundwater sources;
- Availability and water quality of groundwater resources;
- Linkages between the meteorology, heat fluxes of the dynamics (physical limnology) in the lake;
- Linkages between salt mining activities and the salinity of the lake;
- Detection, distribution, impact and potential control of exotic species with the lake and its watershed;
- The observed decline of the benthic communities in the lake and its impact on the lake's ecology;
- Monitoring of the initial fish and macroinvertebrate distributions, heavy metal concentrations, and other associations in the watershed's tributaries;
- Linkages between stream corridors, sediment transport, and habitat availability and quality;
- Maintenance of the active water quality monitoring program in the lake to document future changes in the lake's trophic status;
- Maintenance of efforts to determine its relationship to nutrient and sediment loading from the watershed and internal pressures by various exotic species; and
- Developing a historical record of heavy metals, organic, and other potentially toxic compounds for the watershed.

The Seneca Lake Watershed Intermunicipal Organization MOU is available at: http://www.stcplanning.org/usr/Program_Areas/Water_Resources/Seneca_Lake_Plan/1_3_12_SenecaLakeMOU.pdf and in Appendix A of the Identification and Description of Management Practices, Approaches and Strategies for Watershed Protection and Restoration and Implementation Strategy and Schedule section.

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Chapter 1: Introduction and Project Background

The *Seneca Lake Watershed Characterization and Subwatershed Evaluation* provides a description of Seneca Lake's watershed area and the condition of natural resources and the built environment within that area. This characterization is the first component of a comprehensive watershed management plan for the Seneca Lake watershed. Seneca Lake is the largest of the eleven Finger Lakes that make up a complex system of lakes and rivers in central New York State known as Oswego River Basin. The lake's surface area is 66.3 square miles, and the watershed is approximately 457 square miles. The Seneca Lake watershed encompasses 40 municipalities and five counties, including parts of Chemung, Ontario, Schuyler, Seneca, and Yates Counties.

The watershed community has shown strong support for watershed planning; various partnerships and stakeholders have been cooperatively operating since the mid-1990s. The watershed planning process built upon these relationships and previous studies and reports, including *Setting a Course for Seneca Lake, the State of the Seneca Lake Watershed* (1999). The Seneca Lake Watershed Management Plan process establishes a consensus among the watershed municipalities, State agencies, and non-governmental organizations on actions needed to protect the lake's water quality. The plan identifies characteristics of the watershed, sources of impairment, priority projects and necessary actions.

Project History and Previous Report

Seneca Lake Area Partners in Five Counties (SLAP-5) was formed July 3, 1996 as area mayors, supervisors, state legislators, county agency staff and others pledged to work together:

> *To develop a watershed management plan for Seneca Lake that will protect and improve water quality and is supported by the citizens and communities in the watershed. To provide representation of all important sectors in the Seneca Lake Watershed and to keep in contact with people in their areas of expertise to ensure the watershed program reflects and responds to the people represented.*

The Seneca Lake management planning process began in 1996 with the development of a Seneca Lake Watershed Study. Designed to determine the state of the watershed lands that send water to the Lake, the Study identified the following factors to be investigated:

- Description of the Watershed
- Existing Land Uses and Trends
- Limnology and Water Quality
- Sources of Pollution: (listed alphabetically)
  - Agriculture
  - Chemical Bulk Storage
  - Forestry and Forest Practices
  - Landfills, Dumps, Inactive Hazardous Waste Sites
  - Mined Lands
  - Petroleum Bulk Storage
  - Roadbank Erosion
  - Salt Storage and Deicing materials
  - Shoreline Residences
  - SPDES Permits
  - Spills
  - Streambank Erosion

The study was funded by various sources including NYSDEC, NYS Soil and Water Conservation Committee, the NYS Environmental Bond Acts and Environmental Protection Funds, Finger Lakes-Lake Ontario Watershed Protection Alliance, Great Lakes Aquatic Habitat Fund, Open Space Institute, The Tripp Foundation, County SWCDs, Cornell Cooperative Extension Offices, Regional Planning Councils, Hobart and William Smith Colleges and Seneca Lake Pure Waters Association.

Marion Balyszak, SLPWA Executive Director provided leadership and coordination for the work. An Oversight Committee included representatives of funding sources, state and multicounty agency personnel, SLPWA staff and directors, the Farm Bureau, Hobart and William Smith Colleges, representatives of watershed municipalities, and citizen volunteers.

The extensive investigations required to compile necessary information took over two years to complete. Contributors to the work included Oversight Committee members, college interns, Cornell University staff and other interested parties.

Formation of Seneca Lake Area Partners in 5 Counties (SLAP-5) to conduct education and outreach activities, was an outcome of the Study, as well as publication of the two-volume report of findings: *Setting a Course for Seneca Lake: The State of the Seneca Lake Watershed 1999*. Barbara Demjanec served as the first SLAP-5 Coordinator.

The necessity for public education and outreach, research and analysis and response to new challenges to water quality within the watershed area continues. These efforts are currently being carried forward by SLAP-5 and the Seneca Lake Watershed Management Plan Project Advisory Committee through creation of the *Seneca Lake Watershed Management Plan* to address threats to water quality in Seneca Lake.

Project Oversight

The draft *Seneca Lake Watershed Characterization and Subwatershed Evaluation* was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund and prepared by the Project Partners including Genesee/Finger Lakes Regional Planning Council, the Finger Lakes Institute, Hobart and William Smith Colleges, and Southern Tier Central Regional Planning and Development Board through consultant services procured by the City of Geneva and overseen by the Project Advisory Committee. County agencies and organizations and others provided assistance with various project components.

Outreach and Education

In September 2010 an Outreach and Education sub-committee, composed of representatives of the project advisory committee, was created to draft a Community Outreach and Education Plan that would guide public outreach during preparation of the Seneca Lake Watershed Management Plan. The *Outreach and Education Plan* identified key individuals, organizations, and entities to involve in the planning process, and identified the visioning process and the roles and responsibilities in coordinating the entire outreach process, logistics, and the proposed schedule of public meetings and educational opportunities. Components of the Community Outreach and Education Plan included:

- regular Project Advisory Committee meetings;
- creation of a project website;
- identification of watershed stakeholders;
- consultations, discussions, and reporting;
- public information meetings; and
- stakeholder focus groups, meetings, and key contact interviews.

Chapter 2: General Description of the Watershed and Subwatersheds

Watershed and Subwatershed Delineation

A watershed is the geological, geomorphological and geographical area of land that contributes water through its springs, seeps, ditches, pools, culverts, marshes, swamps, and streams to a body of water. Seneca Lake's watershed is drained by a number of streams and overland runoff draining (known as "direct drainage") to the Lake. The subwatershed delineation appearing in this watershed characterization and Evaluation report follows the delineation used in *Setting a Course for Seneca Lake: The State of the Seneca Lake Watershed, 1999*.

Table 1. Subwatershed characteristics in the Seneca Lake Watershed.

Watershed/ Subwatershed	Area (km^2)	Residential & Urban (%)	Agriculture (%)	Forest & Shrubs (%)	Lakes & Wetlands (%)	Stream Length (km)	Stream Density (L/A)	Max Order (# Tribs)	Relief (m)
Catharine Creek Subwatershed	329.8	4.3	36.7	57.2	1.4	535.0	1.62	4 (1)	502
Reading Drainage	50.5	2.9	49.6	47.1	0.3	119.5	2.36	2 (30)	380
Rock Stream Drainage	20.1	0.0	49.1	50.9	0.0	34.0	1.69	3 (1)	401
Big Stream Drainage	96.3	1.8	53.1	45.0	0.2	135.7	1.41	4 (1)	378
Starkey Drainage	48.6	2.1	63.1	34.2	0.5	74.8	1.54	3 (13)	295
Plum Point Subwatershed	15.5	2.9	53.0	43.7	1.0	24.7	1.59	3 (1)	278
Long Point Drainage	38.3	2.9	72.8	24.3	0.0	77.7	2.03	2 (19)	220
Keuka Lake Outlet Subwatershed	80.1	7.4	76.9	15.6	0.1	119.9	1.50	4 (1)	266
Benton Drainage	21.3	2.6	82.6	14.8	0.0	23.9	1.12	1 (8)	136
Kashong Creek Subwatershed	80.5	0.9	83.3	15.7	0.1	105.4	1.31	4 (1)	236
Reed Point Drainage	22.2	2.3	87.0	10.6	0.0	25.2	1.13	1 (5)	142
Wilson Creek Subwatershed	46.7	1.3	78.6	18.4	1.6	59.0	1.26	3 (1)	203
Geneva Drainage	55.6	30.2	54.3	14.4	1.2	65.6	1.18	2 (5)	132
Sunset Bay Drainage	18.8	6.6	78.0	15.4	0.0	17.0	0.91	2 (11)	60
Reeder Creek Subwatershed	12.7	56.3	17.3	22.9	3.5	24.8	1.95	2 (1)	83
Wilcox Creek Drainage	13.7	5.8	51.0	41.9	1.2	15.7	1.15	1 (5)	77
Kendaia Subwatershed	10.1	61.6	9.9	27.3	1.2	9.1	0.90	1 (1)	96
Sampson State Park Drainage	14.0	17.4	9.1	49.4	24.0	12.3	0.88	1 (3)	76
Indian Creek Subwatershed	22.9	20.5	38.7	39.9	0.9	23.4	1.02	2 (2)	169
Simpson Creek Subwatershed	8.4	26.3	54.1	19.1	0.5	10.8	1.29	2 (1)	188
Sixteen Falls Creek Drainage	31.3	1.3	69.6	28.9	0.3	41.3	1.32	2 (8)	238
Lodi Point Subwatershed	5.0	9.6	62.4	28.0	0.0	9.7	1.94	1 (1)	255
Mill Creek Subwatershed	25.6	0.9	58.6	40.3	0.2	38.3	1.50	3 (1)	382
Lamoreaux Landing Drainage	26.7	1.5	59.4	38.3	0.0	51.3	1.92	2 (19)	276
Valois Drainage	28.4	2.3	51.1	43.5	1.4	51.2	1.80	3 (10)	432
Sawmill/Bullhorn Creek Subwatershed	17.2	1.4	36.2	62.4	0.0	33.3	1.93	3 (2)	433
Satterly Hill Drainage	22.5	0.4	38.5	60.6	0.5	52.1	2.32	2 (23)	303
Glen Eldridge Subwatershed	20.1	1.4	28.8	69.0	1.4	31.3	1.55	2 (1)	428
Hector Falls Creek Subwatershed	33.5	2.1	26.5	70.2	1.2	59.0	1.76	3 (1)	447
Keuka Lake Watershed*	415.6	2.9	39.0	46.8	11.3	*This watershed flows into Keuka Lake Outlet			

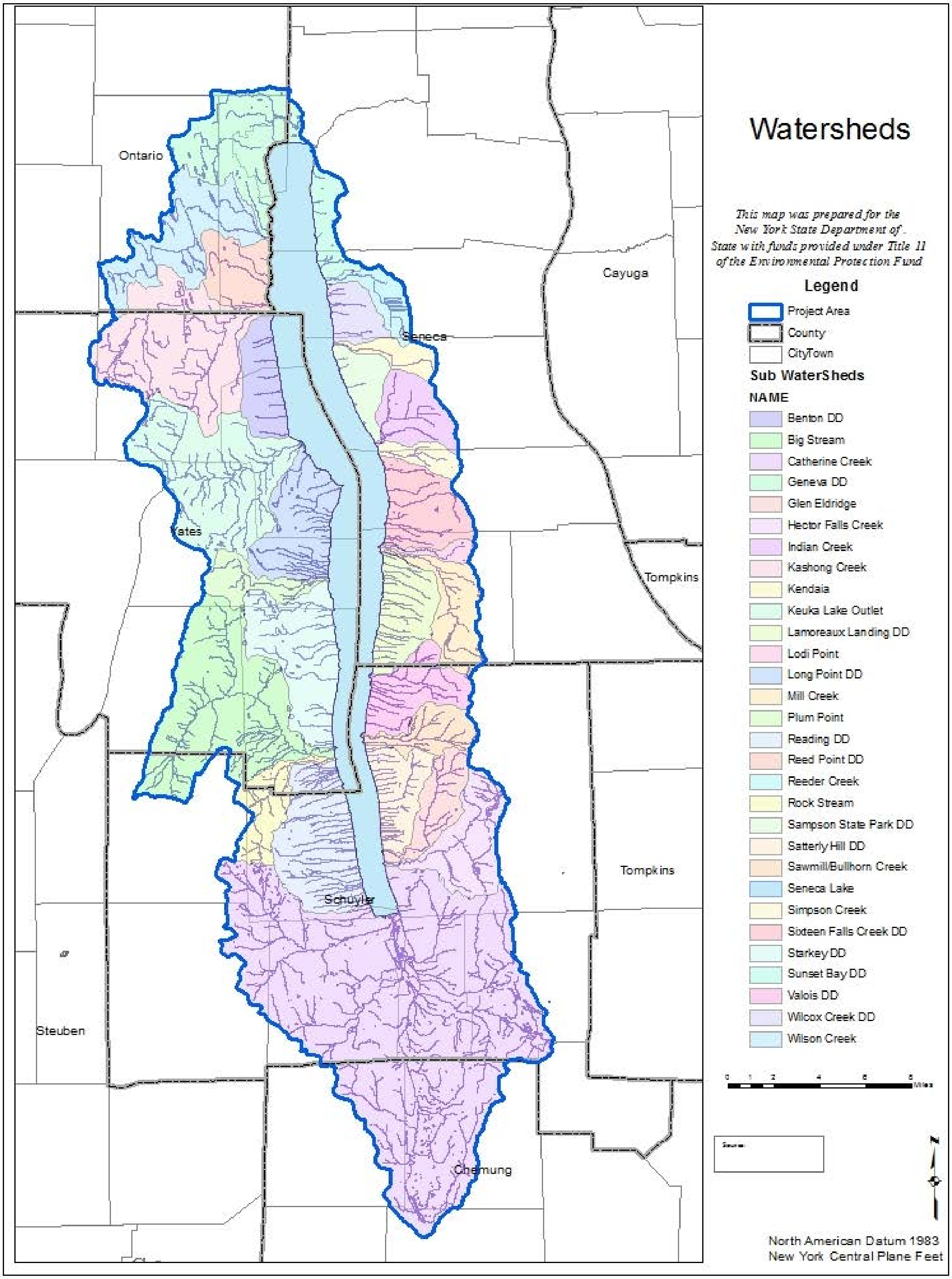


Fig. 1. Subwatersheds and drainages in the Seneca Lake watershed.

As noted in Figure 1, the Seneca Lake watershed has been divided into twenty-nine subwatersheds and direct drainages (Table 1). The Lake's principal tributaries are Catharine Creek and Keuka Lake

Outlet. Catharine Creek is located at the southern end of Seneca Lake and drains more than one quarter of the entire watershed. Keuka Lake Outlet enters Seneca Lake in the middle of the western shore. Keuka Lake Outlet drains the Keuka Lake watershed, a different watershed, and thus is subject to a separate watershed plan, but mentioned here as it still influences the hydrology and water quality of Seneca Lake. Table 1 also includes the areas, land use percentages, stream lengths, stream densities, max stream order (and number of tributaries in drainages), and topographic relief for each delineated subwatershed and direct drainages (boundaries initially defined in the Setting a Course for Seneca Lake: The State of the Seneca Lake Watershed, 1999).

Geographic Setting

Seneca Lake, located in the Finger Lakes region of central New York, is the largest of the eleven Finger Lakes. These Finger Lakes and the systems of rivers and streams that feed into the Finger Lakes are part of the Oswego River Basin (Fig. 2). Water flows from uplands, into streams and rivers to the Finger Lakes, then out to low-gradient rivers, which are part of the New York State Barge Canal and then ultimately to Lake Ontario.

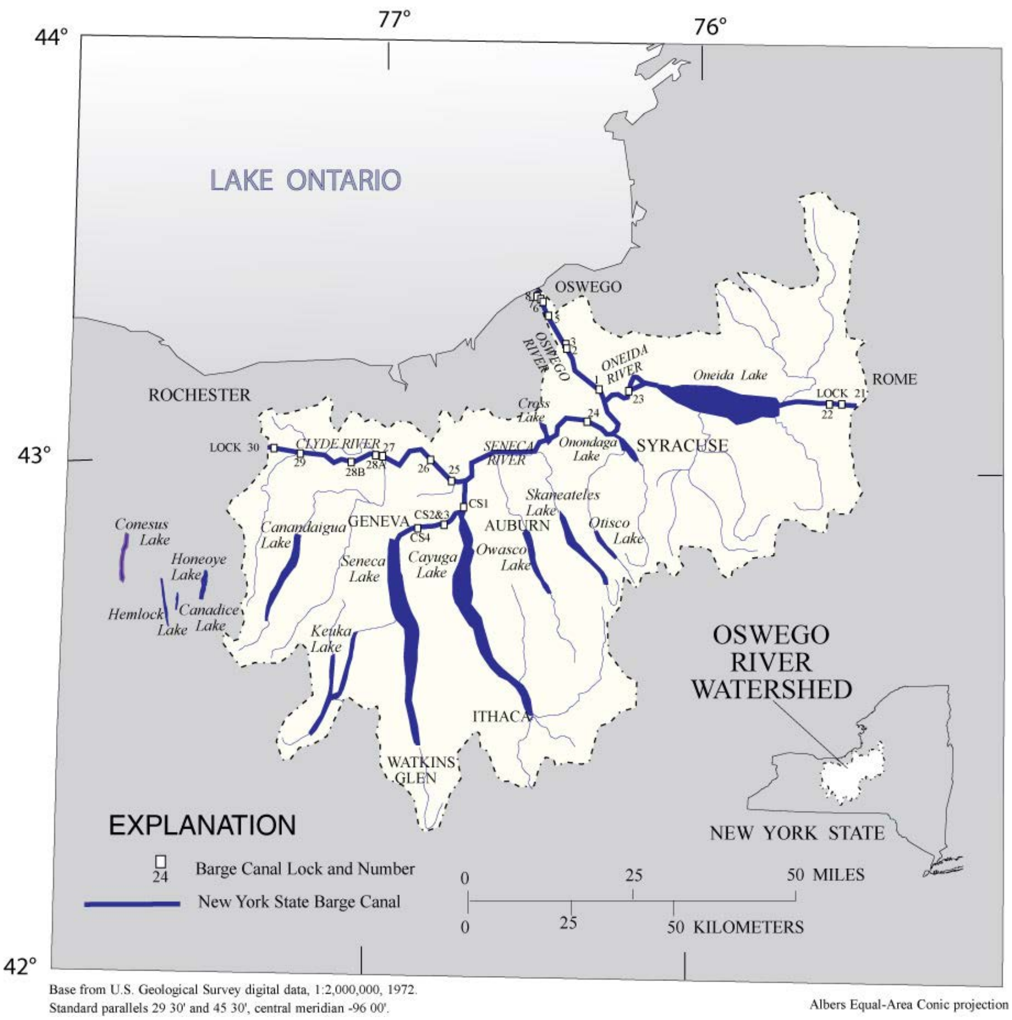


Fig. 2. The Oswego River Basin – Finger Lakes Watershed.

Affecting this flow of water are three physiographic features:

- Appalachian plateau, located to the south of the Finger Lakes
- Tug Hill Plateau, located directly northeast of the Finger Lakes

- Lake Ontario Plain located between the northern end of the Finger Lakes and Lake Ontario

A total of 5,100 square miles makes up the Oswego River Basin. Critical to the flow of water is the Clyde/Seneca River and Oneida Lake Troughs. These areas of lowlands run west-to-east and collect the water from the lakes and deliver it to Lake Ontario. This area was first carved out by glaciers during the last Ice Age and then filled with clay, silt, sand and gravel from receding glaciers. In the 1800s the New York State Barge Canal was constructed within these troughs due to their low grade. All of the eastern Finger Lakes drain into this trough and water in the Barge Canal is very slow moving due to the low gradient, occasionally causing flooding issues at the confluence of the Seneca, Oneida and Oswego Rivers (Fig.2, 3, and 4).

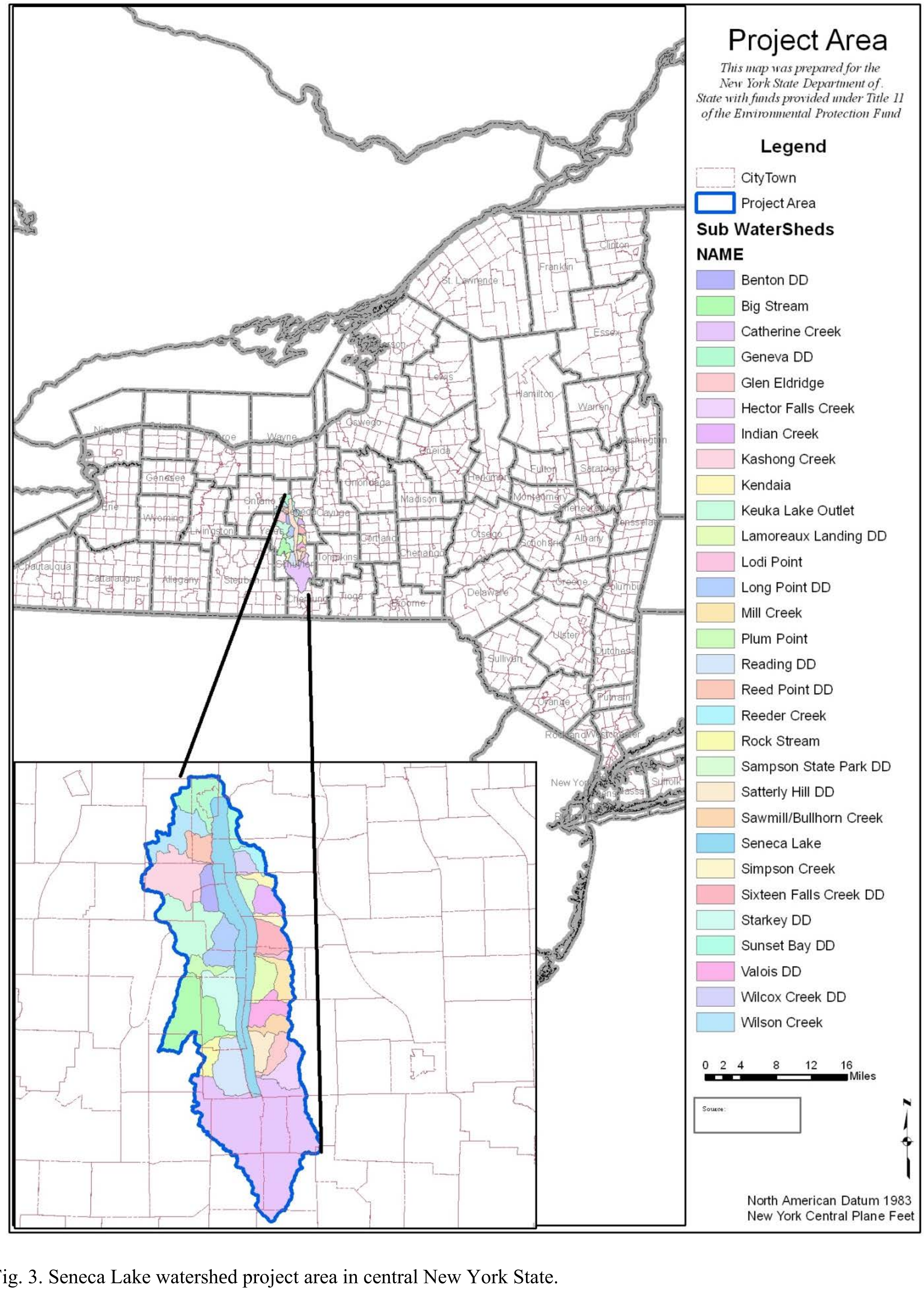


Fig. 3. Seneca Lake watershed project area in central New York State.

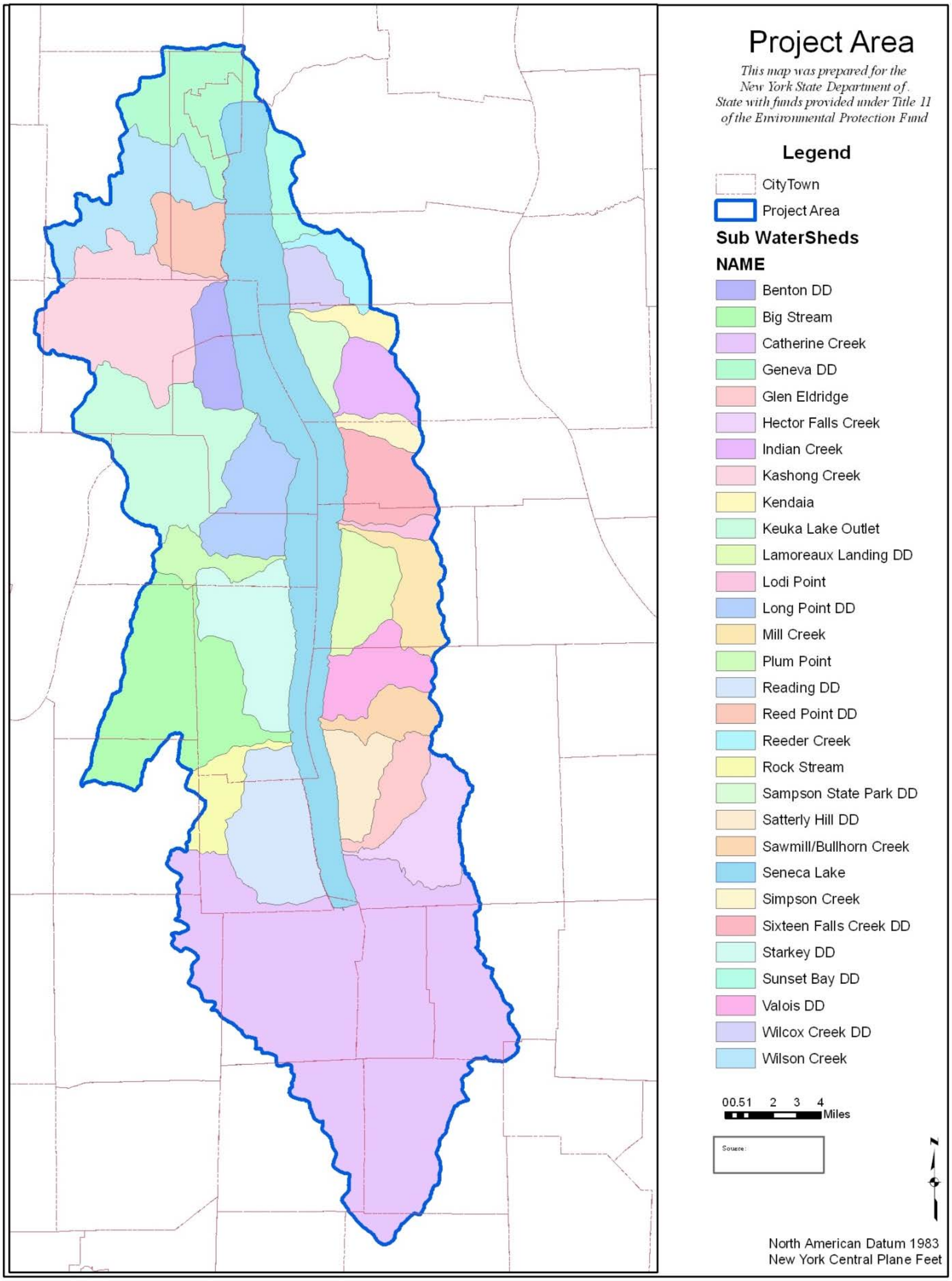


Fig. 4. Seneca Lake watershed project area.

The elevations of each of the lakes, rivers and the locks along the Barge Canal are show in Figure 5. This diagram illustrates the topographic relationships of the lakes to one another and to their receiving streams and summarizes the cumulative percentages of watershed that drains into the Oswego River basin. The physiography of the basin, combined with human settlement and related activities, has resulted in flooding and navigational problems that prompted the establishment of programs which attempt to control lake levels and alleviate flooding.

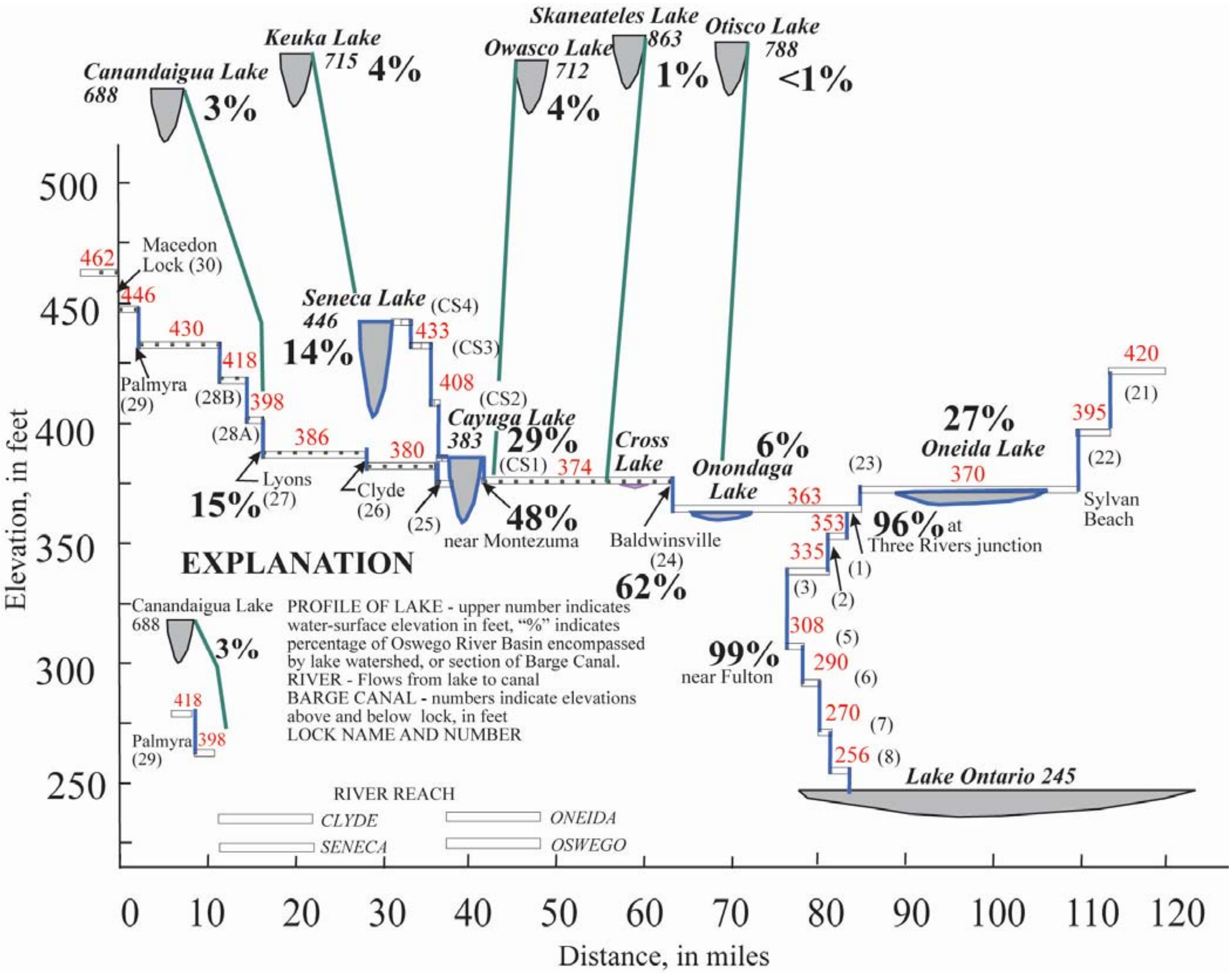


Fig.5. Elevations and flood potential in the Oswego River watershed.

According to Seneca Lakes Pure Waters Association, in 2008 and 2009 Seneca Lake water levels were very low. This low water lever caused health and safety issues, as well as endangered the wildlife and fish of the lake. Low water levels directly impact residents that rely on the lake for drinking water, fish and wildlife, loss of revenue from marinas, damage to residents' boats and additional erosion and down-cutting of existing stream channels.

Municipalities
The Seneca Lake watershed contains forty municipalities, located within five counties. Chemung, Ontario, Schuyler, Seneca and Yates County surround Seneca Lake (Fig. 6).

- Chemung County
    - Towns of: Catlin, Horseheads, Veteran
    - Villages of: Horseheads, Millport
- Ontario County
    - City of: Geneva
    - Towns of: Geneva, Gorham, Phelps, Seneca
- Schuyler County
    - Towns of: Catharine, Cayuta, Dix, Hector, Montour, Orange, Reading, Tyrone
    - Villages of: Burdett, Montour Falls, Odessa, Watkins Glen
- Seneca County
    - Towns of: Fayette, Lodi, Ovid, Romulus, Varick, Waterloo
    - Villages of: Lodi, Ovid
- Yates County
    - Towns of: Barrington, Benton, Milo, Potter, Torrey, Starkey, Jerusalem
    - Villages of: Dresden, Dundee, Penn Yan

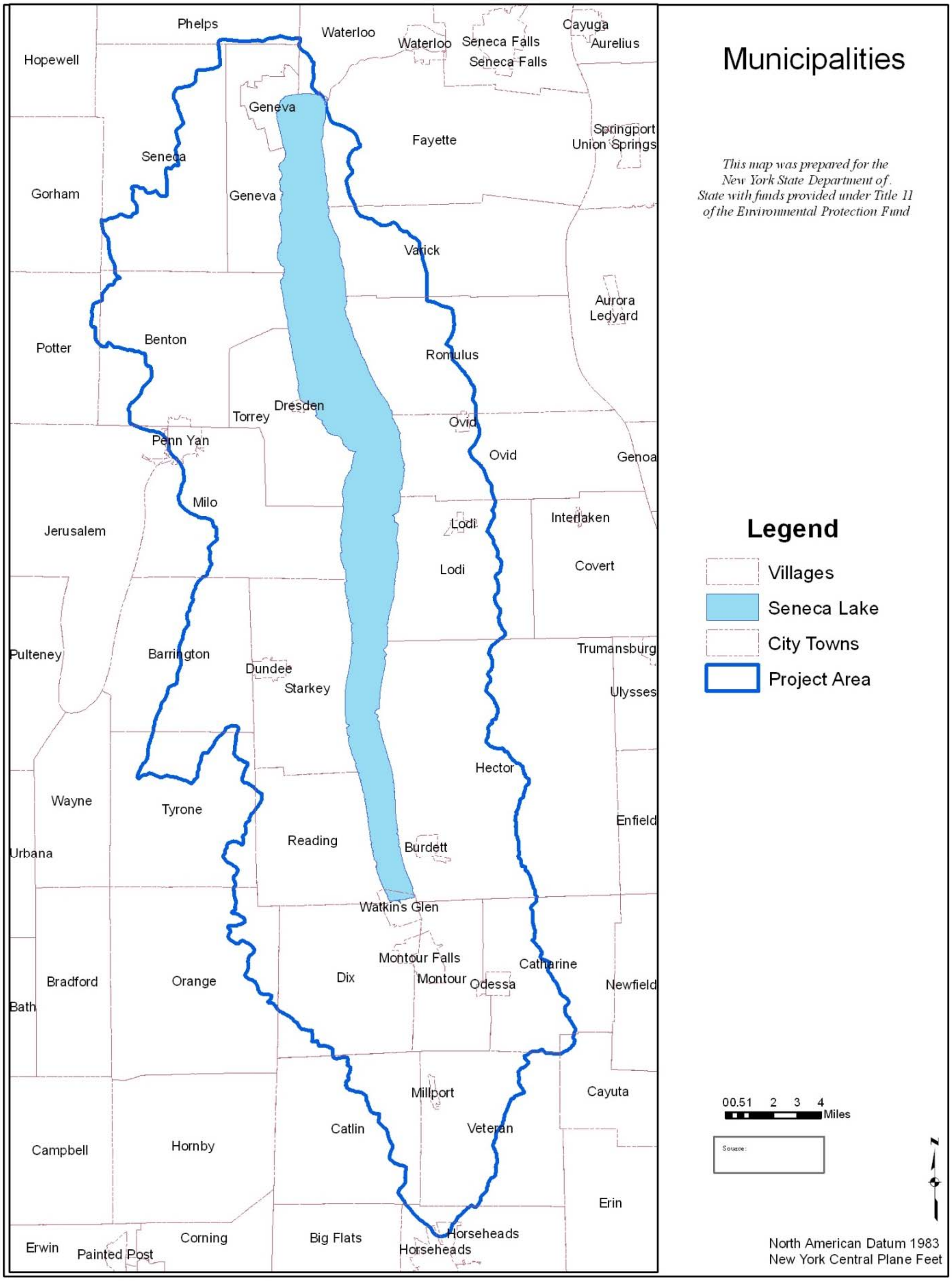


Fig. 6. Municipalities in the Seneca Lake watershed.

Since the late 1990s these municipalities have banded together, acknowledging they are inevitably linked by being located within the Seneca Lake watershed. Currently two multi-jurisdictional organizations exist. SLAP-5 (Seneca Lake Area Partners – 5 Counties), which began with the *Setting a Course for the Seneca Lake Watershed* and consist of all five county Soil and Water Conservation Districts and municipal representatives. Another organization located within the watershed is, Seneca Lake Pure Waters Association, which is made up of lake association members, water quality advocates and municipal representatives. These and other organizations (Appendix A) are vital in educating the public about water quality issues. They work to advocate for better policy within their respective counties, as well as New York State and encourage research throughout the region.

Climate

The Finger Lakes climatic region is characterized by cold, snowy winters and warm, dry summers. Major flooding events may occur at any time, usually the product of tropical storm remnants entering the region from the south or rapid snow pack melt in the spring. At the extreme, flooding has been known to raise the Lake level to a maximum of 450.2 feet. As a whole the central Finger Lakes is one of New York State's driest regions; however, precipitation is adequate to support most horticulture, especially that of deep rooted plants such as grapes.

Average precipitation for the Seneca Lake watershed is 32.5 inches per year throughout most of the watershed. (Fig. 7) The southeastern corner of the watershed receives slightly higher amounts of precipitation with an average of 37.5 inches per year. The smallest amount of precipitation falls in the December to March period (Fig. 8, Table 2). Winter snowmelt commonly occurs in late March to early April. Air temperature averages are consistent throughout the watershed (Fig. 8, Table 2). The average July temperature is 70.4 degrees Fahrenheit and a 22.4 degree average in January. From the mid-nineteenth century to early twentieth century local records indicate that Seneca Lake froze over during February-March on four different years. Since 1912, ice has apparently covered only localized, near shore areas.

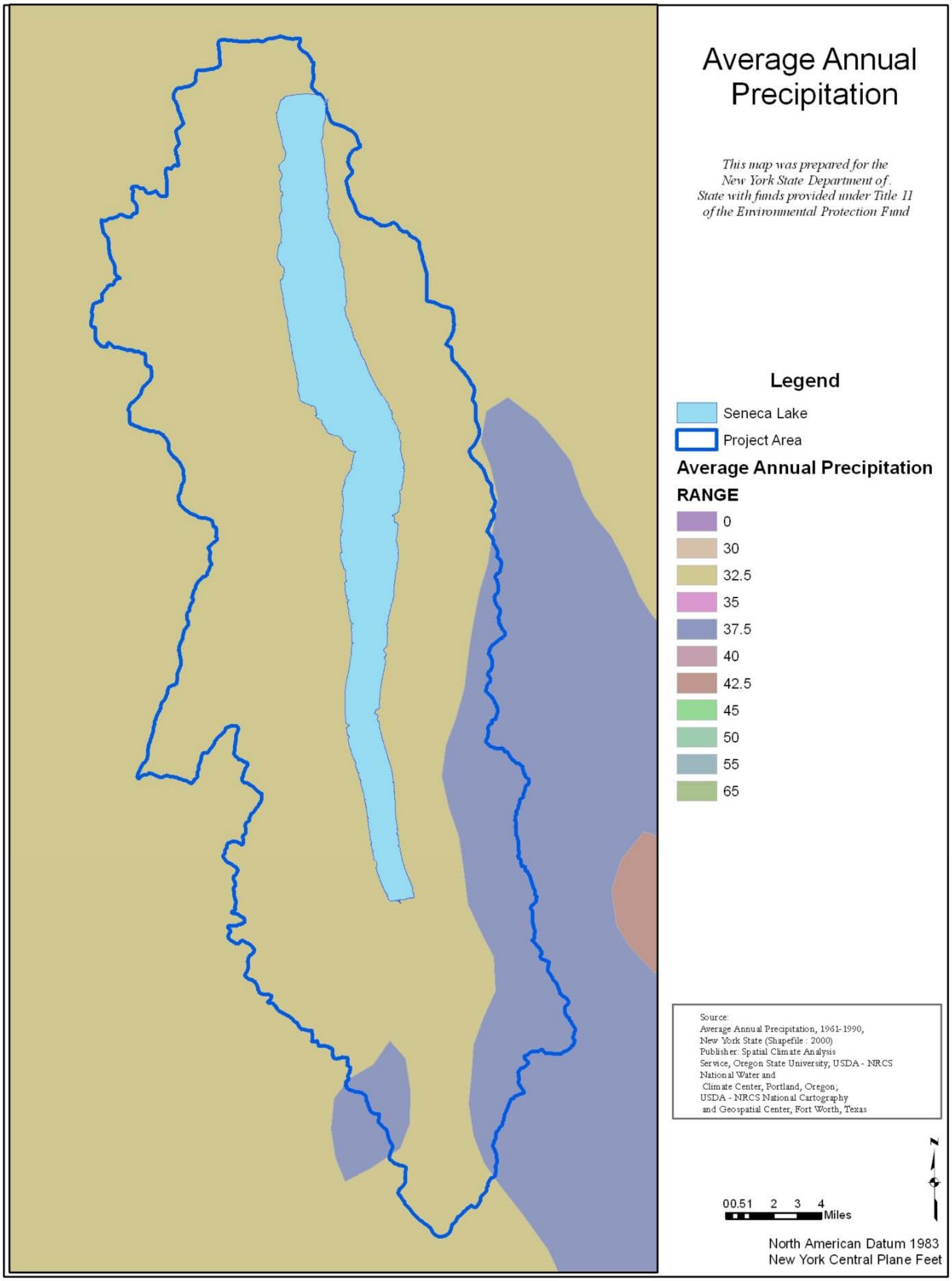
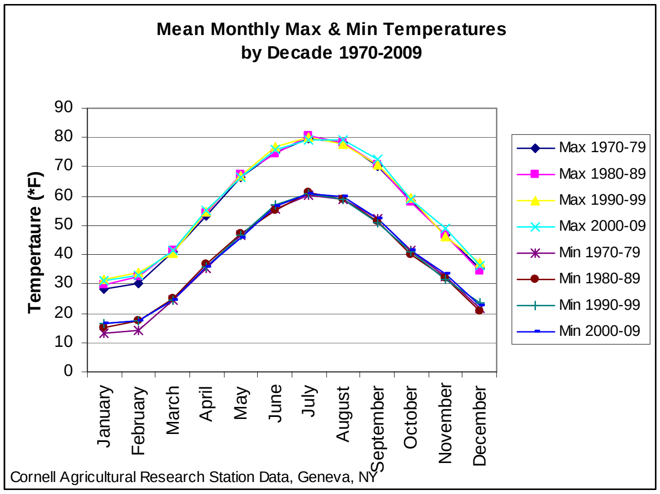


Fig. 7. Average annual precipitation in the Seneca Lake watershed.

Table 2. Mean monthly maximum and minimum tempertuares and mean monthly precipitation for Geneva, NY, 1970 through 2009. Data from Cornell's Agricultural Research Station, Geneva, NY.

Month	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean Max Temp (F)	30.2	32.3	41.0	54.4	66.7	75.5	79.9	78.4	70.9	58.6	47.1	35.8
Mean Min Temp (F)	15.4	16.6	24.6	24.6	46.6	56.1	56.1	59.2	51.8	41.0	32.4	22.1
Precipitation (in)	1.6	1.6	2.3	2.8	3.1	3.7	3.2	3.2	3.6	3.2	2.8	2.4



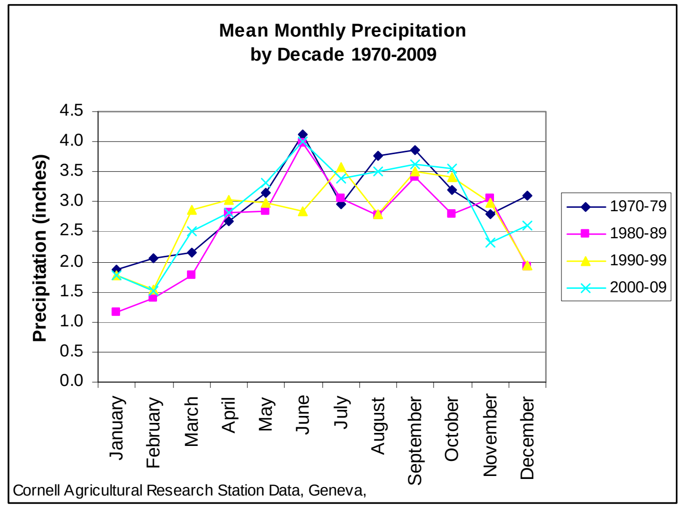


Fig.8. Maximum and minimum mean temperatures (left) by decade and mean monthly precipitation (right) by decade, 1970 through 2009 for Geneva, NY. Data from Cornell's Agricultural Research Station, Geneva, NY.

Geology

During the Paleozoic time period, 220-600 million years ago, the region now containing Seneca Lake was part of a vast inland sea (Fig. 9). Evaporation of water and precipitation of salts, along with deposition of muds and sands produced sediments that were compressed into sedimentary rocks with a depth of some 8,000 feet. The remnants of this rock, after repeated periods of uplifting and down cutting by erosion are present as today's sandstones and shales of the Hamilton, Genesee, Sonyea, Java, and West Falls formations characterizing the southern part of the basin and the Tully and Onondaga limestones further north.

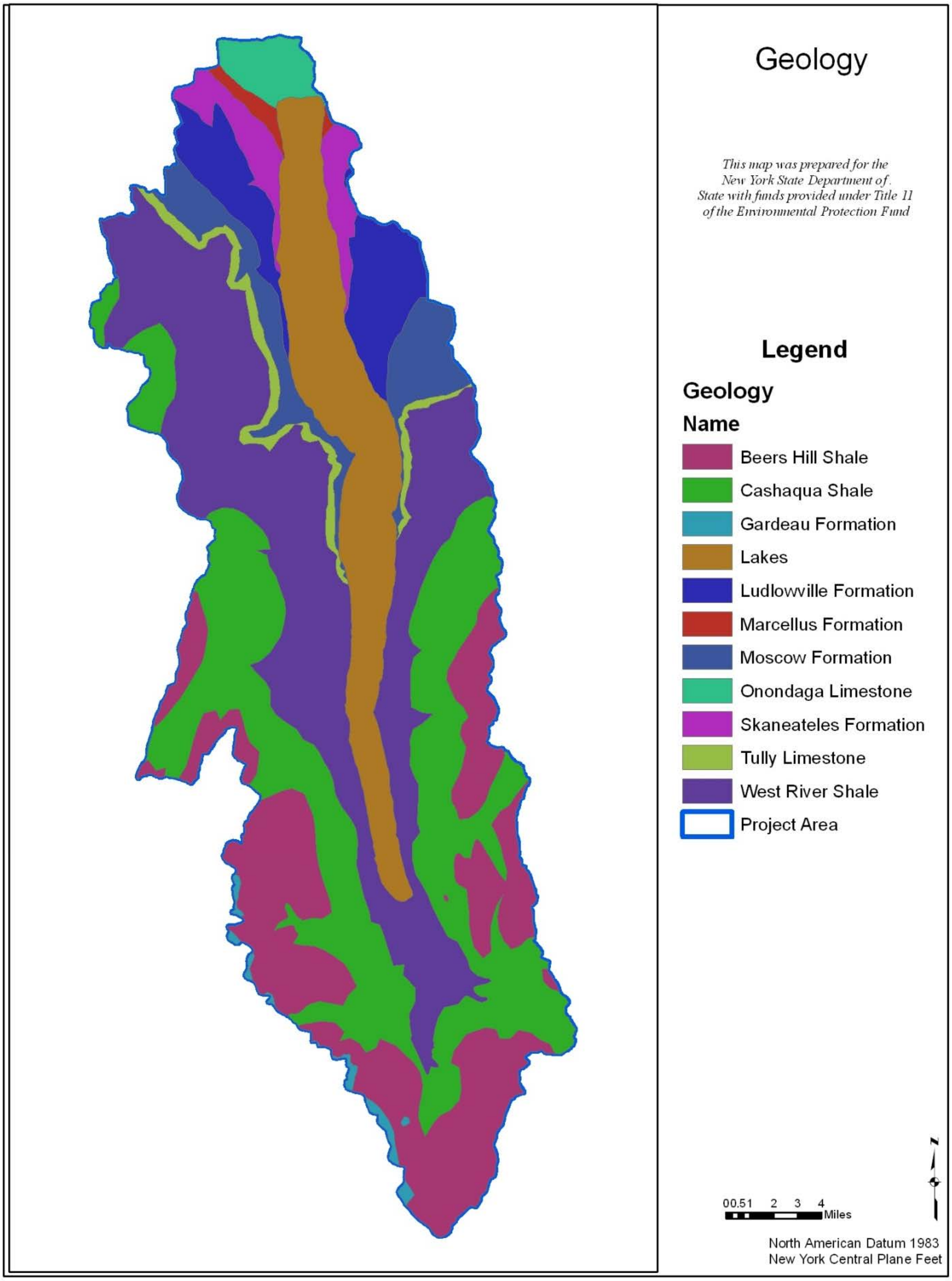


Fig. 9. Generalized geology in the Seneca Lake watershed.

The present day lake basins, gorges, and other geomorphological features resulted from repeated glacial activity in the region. The last major ice age began about 2 million years ago. Twenty massive glaciers invaded the Finger Lakes region. These advances occurred in 100,000 year cycles beginning with a slow glacial advance over 80,000 years, a rapid melt back over 10,000 years, followed by a 10,000 year warm interglacial period as warm or warmer than today's climate. A million tourists a year visit the famous gorges around the south end of Seneca Lake. Each gorge is a tangled skein of buried gorges, degraded relic falls, secondary side channels and partially excavated old gorges. The rich gorge diversity is due to multiple glacial advances covering the gorges, and then glacial retreats to excavate debris from old channels or cut new gorges.

Soils

As the most recent glacial ice sheet retreated some 9,000-10,000 years ago, glacial debris, mostly tills were left behind. Recessional moraines, ground moraines and other glacial deposits mantled the region (moraines are the sand and gravel left by the glacier). The largest sand and gravel deposits are located at the southern end of the watershed. Proglacial lakes, lakes dammed by the ice sheet to the north with drainage to the south, left glacial clay deposits next to and within 300 to 400 feet of the modern lake level. In the subsequent 10,000 years, soils developed on this glacial deposits and have, in many places, been overlaid by and mixed with other material deposited by wind and water, and by humus derived from forest that covered the area. One early (1778) traveler to this region describes the soil's upper layer as composed of 8 to 10 inches of black organic loam. This was undoubtedly a great boon to the earliest agriculturists but one soon lost due to erosion and oxidation.

The soils in the watershed are complex (Fig. 10a, 10b). The northern portion of Seneca Lake's basin contains moderately coarse-textured soil with calcareous substrata and is better suited for agriculture. These soils are typically classified as Howard, Langford, Valosia and Honeoye-Lima soils. Southward these give way to complex assemblages of more acidic, less drained soils, such as Volusia, and Mardin-Lordstown. The combination of steeper topography and soils less well suited to many types of agriculture in the south compared with better buffered, better drained soils on less steep topography northwards is strongly reflected in land use patterns and in the price of farmland.

Volusia Channery silty loam at a 0 to 3 percent slope and at 8 to 15 percent slope are the most commonly occurring soils within the watershed, occurring approximately 1,500 times each. These soils are considered to have a slight risk of erosion. Within the watershed, very few areas are underlain by highly erodible soils. Further, the highly erodible soils do not occur on the steeper slopes within the watershed.

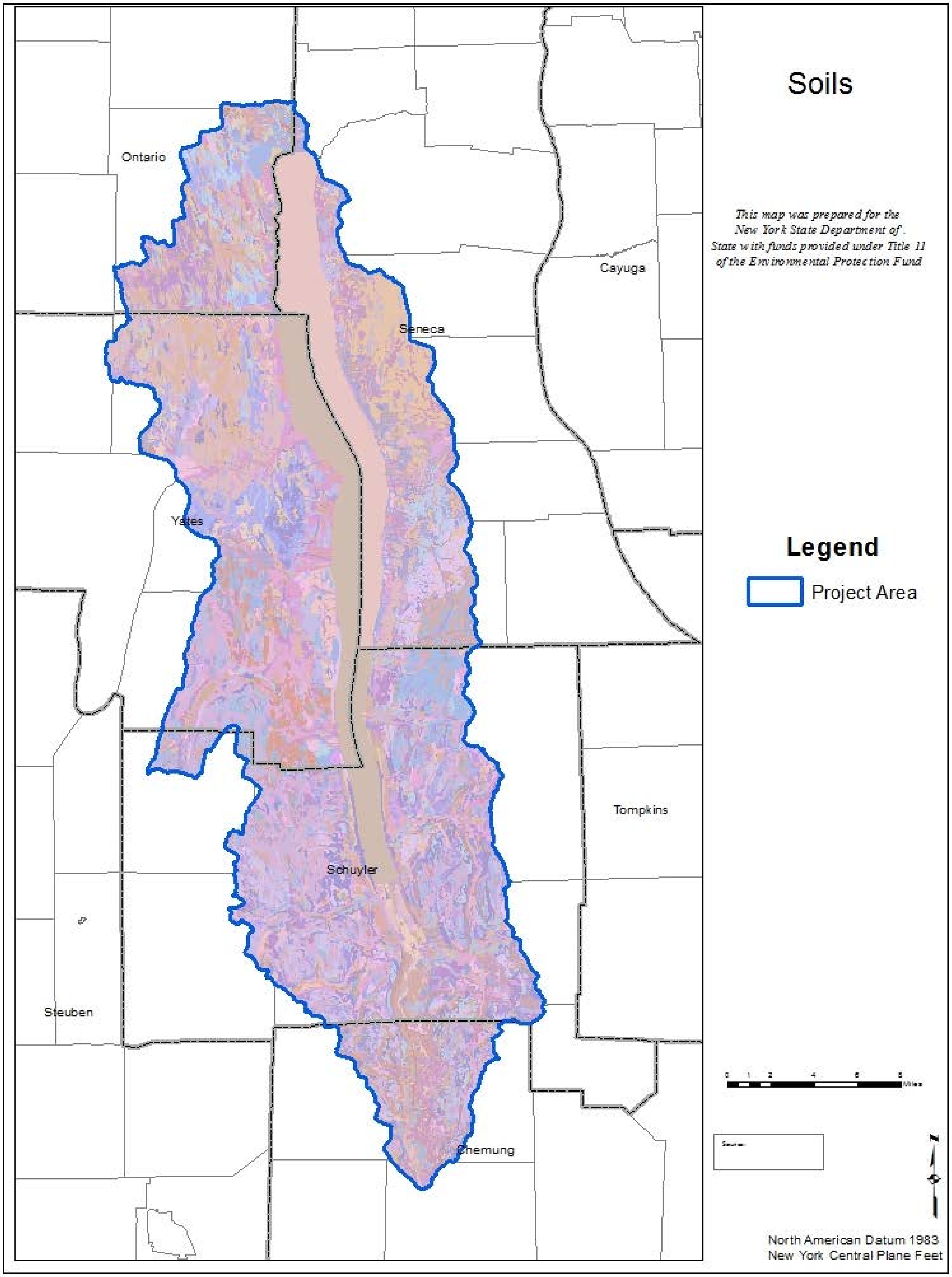


Fig. 10a. Soils in the Seneca Lake watershed. See Fig. 10b for map legend.

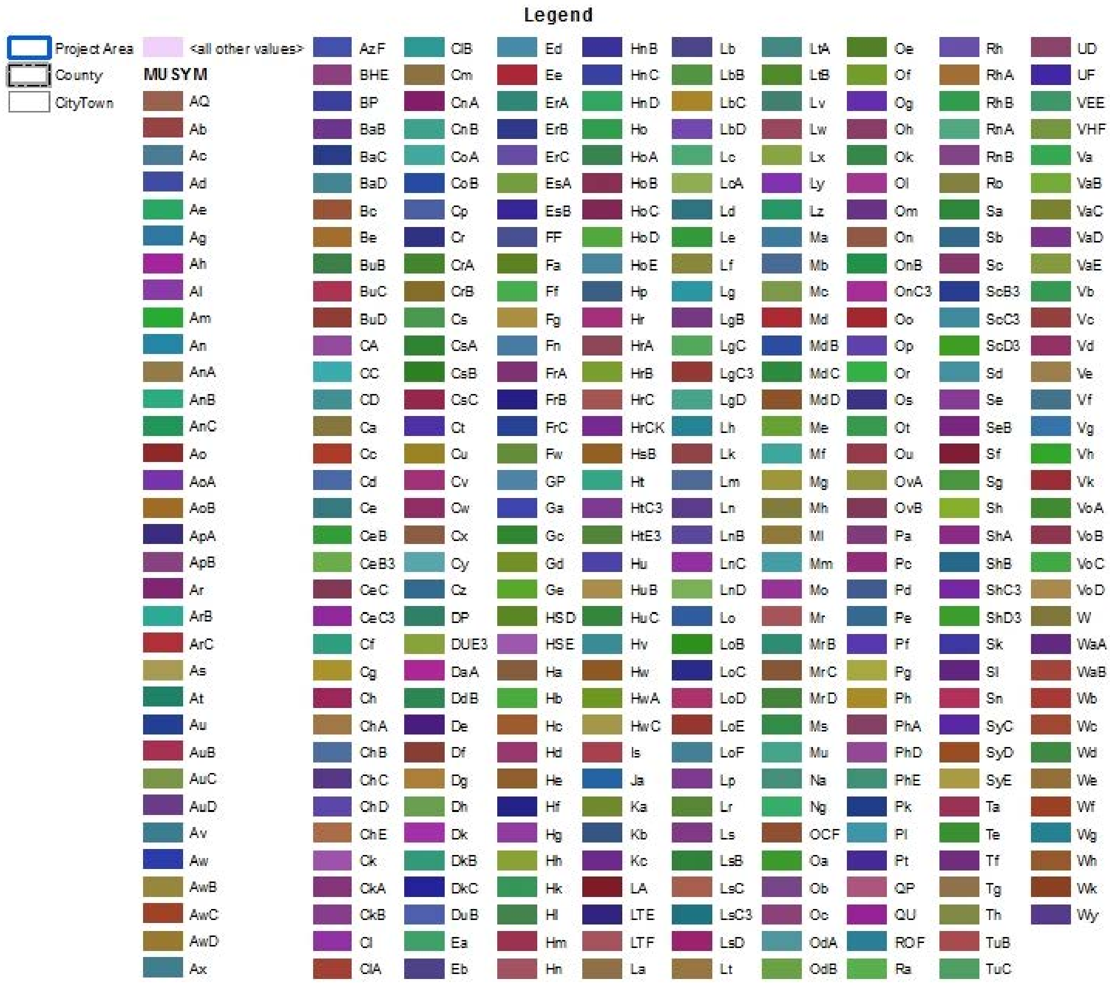


Fig. 10b. Map legend for soils in the Seneca Lake watershed.

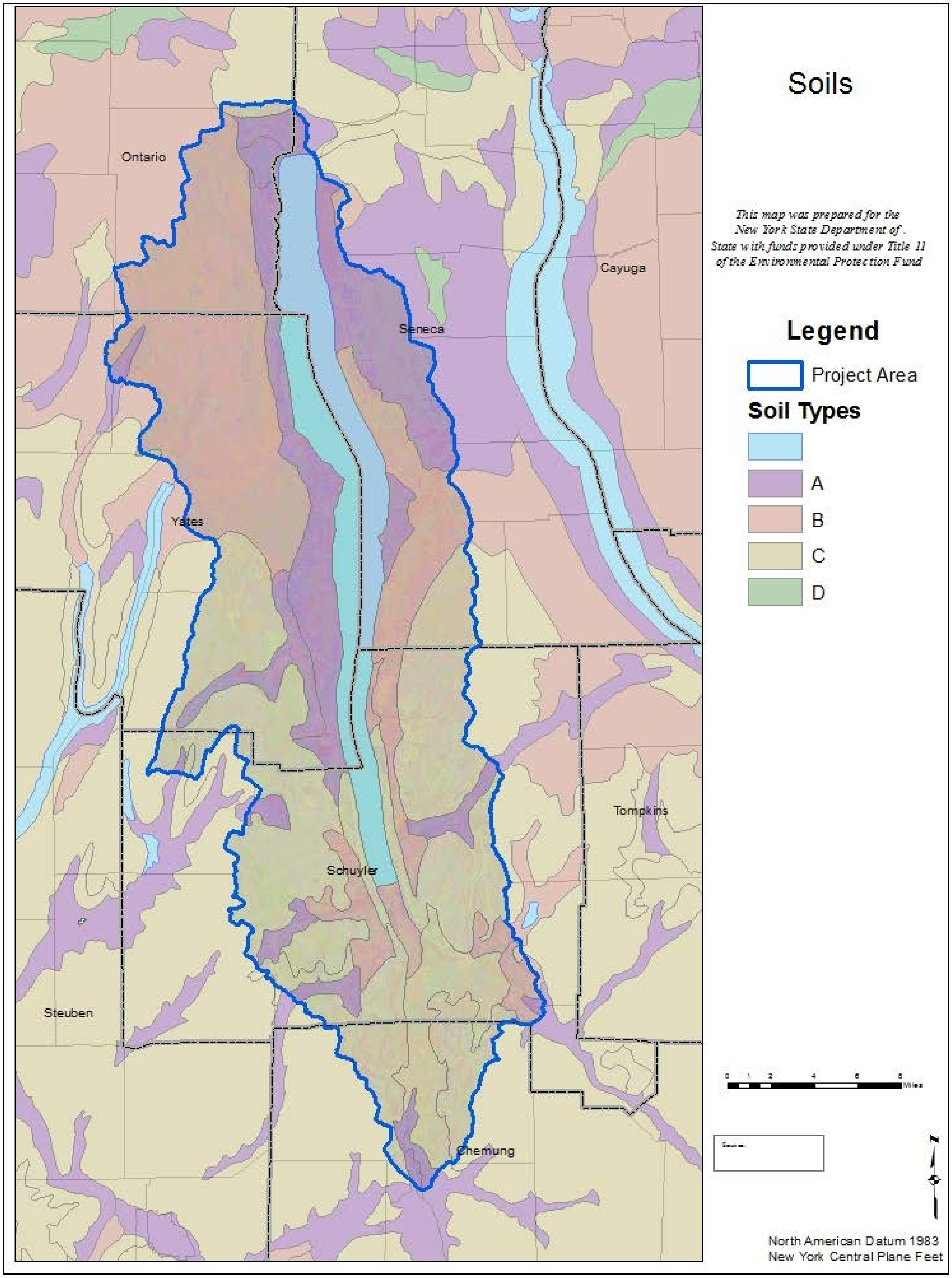


Fig. 11. A generalized soil map based on the soil's infiltration capacity (see text for clarification).

When evaluating the hydrologic soil groups (Fig. 11) four soil groups are revealed: A, B, C, and D. Jim Turenne's definition of each soil group is below.

> ***A***. *Soils with low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well drained to excessively well-drained sands or gravels.*
>
> ***B***. *Soils having moderate infiltration rates even when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well drained to well drained soils with moderately fine to moderately coarse textures.*
>
> ***C***. *Soils having slow infiltration rates even when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures.*
>
> ***D***. *Soils with high runoff potential. Soils having very slow infiltration rates even when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material.*

On the northern end of the lake, type A soils predominate directly adjacent to Seneca Lake and B soils within the northwestern portion of the watershed. "A" soils infiltration is high and B soils is moderate. The southern end of the lake has much slower infiltration with primarily B and C soils. This indicates that runoff issues may be more severe on the southern end of the lake due to such slow infiltration rates. D soils are located just outside the watershed in Seneca County.

Soil conservation is key to preventing contamination of lake water by soil, fertilizers and pesticide residues. Using soil conservation practices, we can maintain clean water in three ways, diversion of water around the farmland, filtering of water though the soil and groundcovers to provide a protective barrier to break the force of raindrops. While erosion continues to be a concern, efforts of soil conservation and controlling development on steeper slopes should prove to be fruitful practices.

Hydrography & Water Users

Surface water is the water that collects on the ground, in a stream, river lake or wetland. This water naturally increases with precipitation and is lost through evaporation, evapotranspiration, infiltration and runoff. Seneca Lake watershed is home to many different water body types. Seneca Lake itself is the largest of these water bodies and the largest and deepest of the glacial Finger Lakes in New York State. Seneca Lake is 38 miles long and has a volume of approximately 4.2 trillion gallons. The Lake's maximum depth is 618 feet. All of the surface water located in the Seneca Lake watershed naturally drains into Seneca Lake.

Seneca Lake watershed encompasses a total of 40 municipalities. Of these municipalities, 11 use surface water for their municipal public water systems. Keeping the surface water and groundwater clean is vital to the health and safety of Seneca Lake's watershed residents (Fig. 4).

Groundwater is the water located beneath the ground within the soil, or fractures of rock formations. Groundwater springs are also hypothesized to seep directly into the lake along the lake floor. This water eventually comes to surface via springs and can even form wetlands. Groundwater is stored in and moves through moderately to highly permeable rocks called aquifers. These aquifers can be sand

and/or gravel, glacial tills, or layers of sandstone or cavernous limestone bedrock. New York State has mapped and identified aquifers throughout the Seneca Lake Watershed. The largest aquifers are located at the southern and northern tip of Seneca Lake, with a few smaller aquifers located in the middle of Yates and Seneca County (Fig. 12). These sources of groundwater are important as one fourth of New Yorkers rely on groundwater for their drinking water. Within the Seneca Lake watershed, 11 municipalities rely on groundwater for their public water systems ("My Water's Fluoride", 2012). If public water is not available, watershed residents utilize private surface, shallow lakeshore wells or deeper groundwater sources (Table 3).

Table 3: Public water sources for water users in the Seneca Lake watershed.

County	Public Water Supply
Chemung County	
Town of Catlin	No Public Water
Town of Horseheads	No Public Water
Town of Veteran	No Public Water
Village of Horseheads	Ground
Village of Millport	No Public Water
Ontario County	
City of Geneva	Surface
Town of Geneva -9Districts	Surface, Ground
Town of Gorham	No Public Water
Town of Phelps	Ground
Town of Seneca	Ground
Schuyler County	
Town of Catharine	No Public Water
Town of Cayuta	No Public Water
Town of Dix	Surface
Town of Hector	Ground
Town of Montour	No Public Water
Town of Orange	No Public Water
Town of Reading	Surface
Town of Tyrone	No Public Water
Village of Burdett	Ground
Village of Montour Falls	No Public Water
Village of Odessa	Ground
Village of Watkins Glen	Surface
Seneca County	
Town of Fayette	No Public Water
Town of Lodi	No Public Water
Town of Romulus	No Public Water
Town of Varick	No Public Water
Town of Waterloo	Surface
Village of Lodi	No Public Water
Village of Ovid	Surface
Town of Ovid	No Public Water
Yates County	
Town of Barrington	No Public Water
Town of Benton- 3 Districts	Surface, Ground
Town of Jerusalem	No Public Water
Town of Milo	Surface
Town of Potter	No Public Water
Town of Torrey	No Public Water
Town of Starkey	No Public Water
Village of Dresden	Ground
Village of Dundee	Ground
Village of Penn Yan	Surface

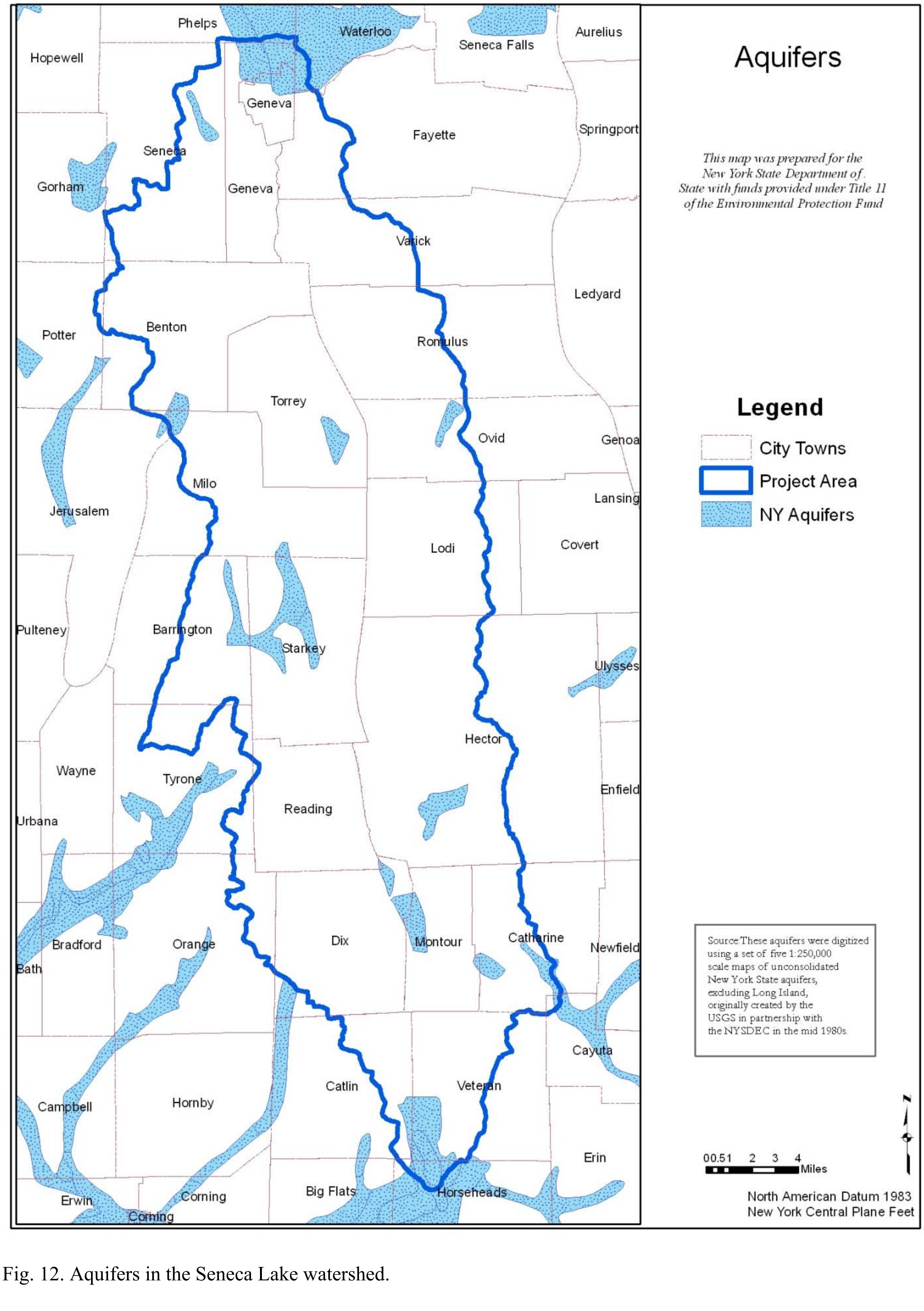


Fig. 12. Aquifers in the Seneca Lake watershed.

Seneca Lake is underlain by salt-rich and carbonate bedrock. This bedrock can increase the salinity and hardness of the groundwater. In Watkins Glen, located at the southern tip of Seneca Lake, the salt beds are mined and processed into salt.

Floodplains

The level of Seneca Lake is dependent on the amount of rainfall received over any given period of time. If soils are fully saturated and rainfall is falling directly into the lake, for every inch of rainfall the lake level increases by one foot within 1 to 2 days. Seneca Lake then can take a week or more to fully drain into the Barge Canal because the lake level can be lowered by only a tenth of a foot per day. This is one of the many challenges of lake level control for the Finger Lakes. Seneca Lake and basin suffer from rapid flowing inputs and very slow draining outflow. Often lake level issues are looked at as only local issues. Yet one municipality's "fix" to a flooding issue in a stream may cause much more harm in the way of sediment loading into the lake from the downstream erosion of stream banks, culverts and ditches.

Issues of flooding are even further exacerbated by the limitations of weather forecasting. Accuracy of forecasts diminishes significantly past two days, and two days is not enough time to prepare the Oswego River Basin for a heavy rain.

Water Use and Lake Level Control

Besides utilizing Seneca Lake is as a municipal and private drinking water source with permitted withdrawals of approximately 9 million gallons per day from four different sites (Callinan, 2001), industries utilize lake water as well. The primary user was the AES Greenidge coal-fired power plant in Dresden; however, it recently closed this past year (2011). Lake level is controlled by dams along the outlet. New York State Thruway Authority attempts to balance the control of lake levels within their winter and summer ranges with minimum flows along the outlet to operate the locks, move industrial and municipal effluents, and allow power generation at two hydroelectric power stations along the canal, and prevent flooding of the flat-lying Oswego River system farther downstream.

Topography and Steep Slopes

Seneca Lake has relatively flat topography at the north end of the watershed changing to rolling hills and then steep sided valleys, characteristically extending 900-1,000 feet below hill crests, to the south. The most conspicuous landform features are the Lake itself with an elevation of about 445 feet above sea level, and the carved rock channel gorges of east-west tributaries and their associated series of waterfalls. The lake has a smooth, regular shoreline. Irregularities that do occur are small and result from flat deltas built by tributary streams and wave action. From the surface edge of the lake to the bottom edge of the lake is a very steep slope, averaging nine percent (Fig. 13).

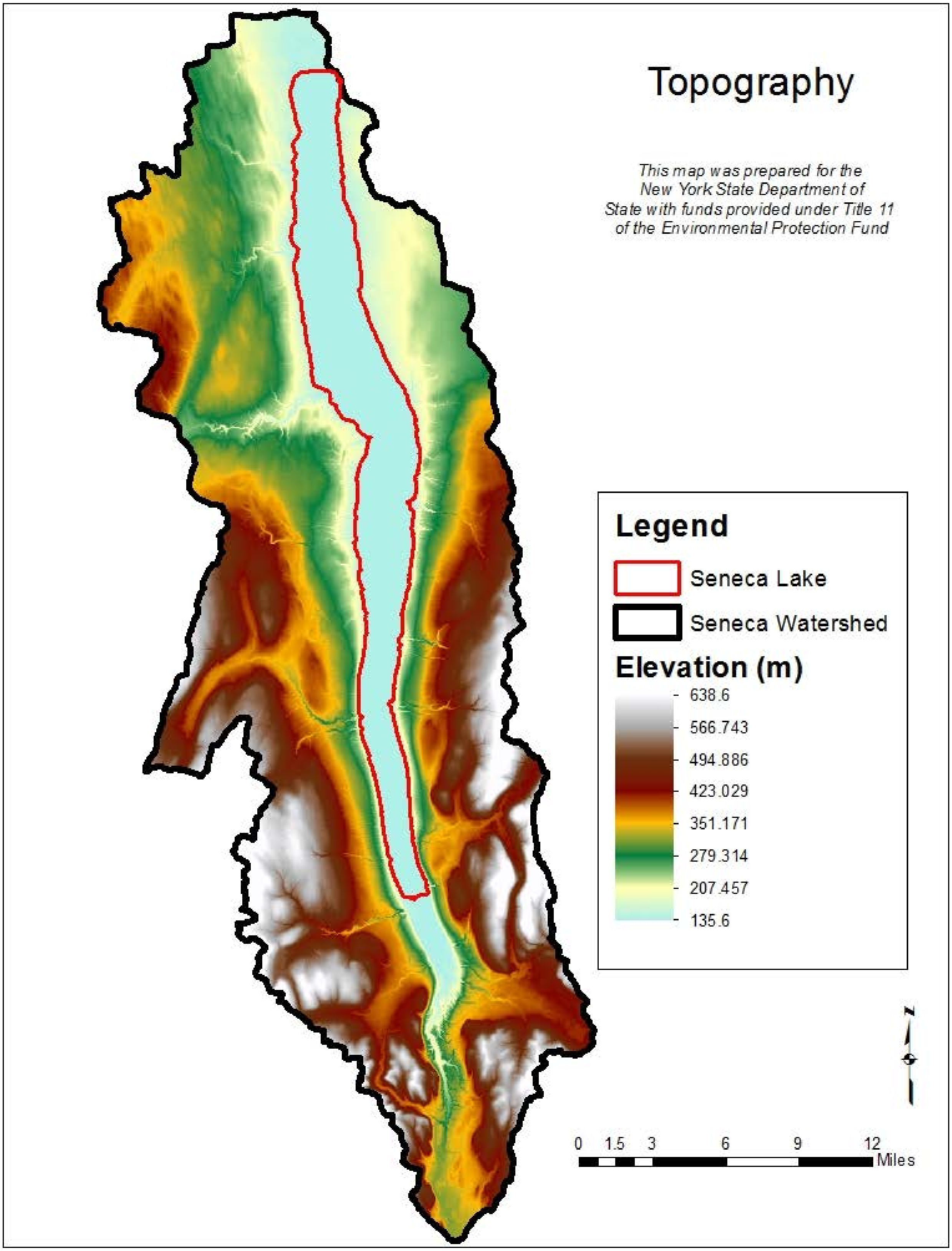


Fig. 13. Topography in the Seneca Lake watershed.

Most of the steep slopes within the Seneca Lake watershed are located in Yates County to the west of Seneca Lake, and along the southern half of the lakeshore. As Figure 14 indicates, slopes above 15%

are located within Yates County and Seneca County and farther south slopes are above 30% grade on the Lake's shoreline. Reducing development on slopes above 15% is vital to help control erosion. It is the stream bank erosion within the watershed that is the core sources of sediment loading into Seneca Lake. Protecting these stream banks is vital to controlling sediment loading and maintaining the rock structures and vegetation will help to prevent erosion.

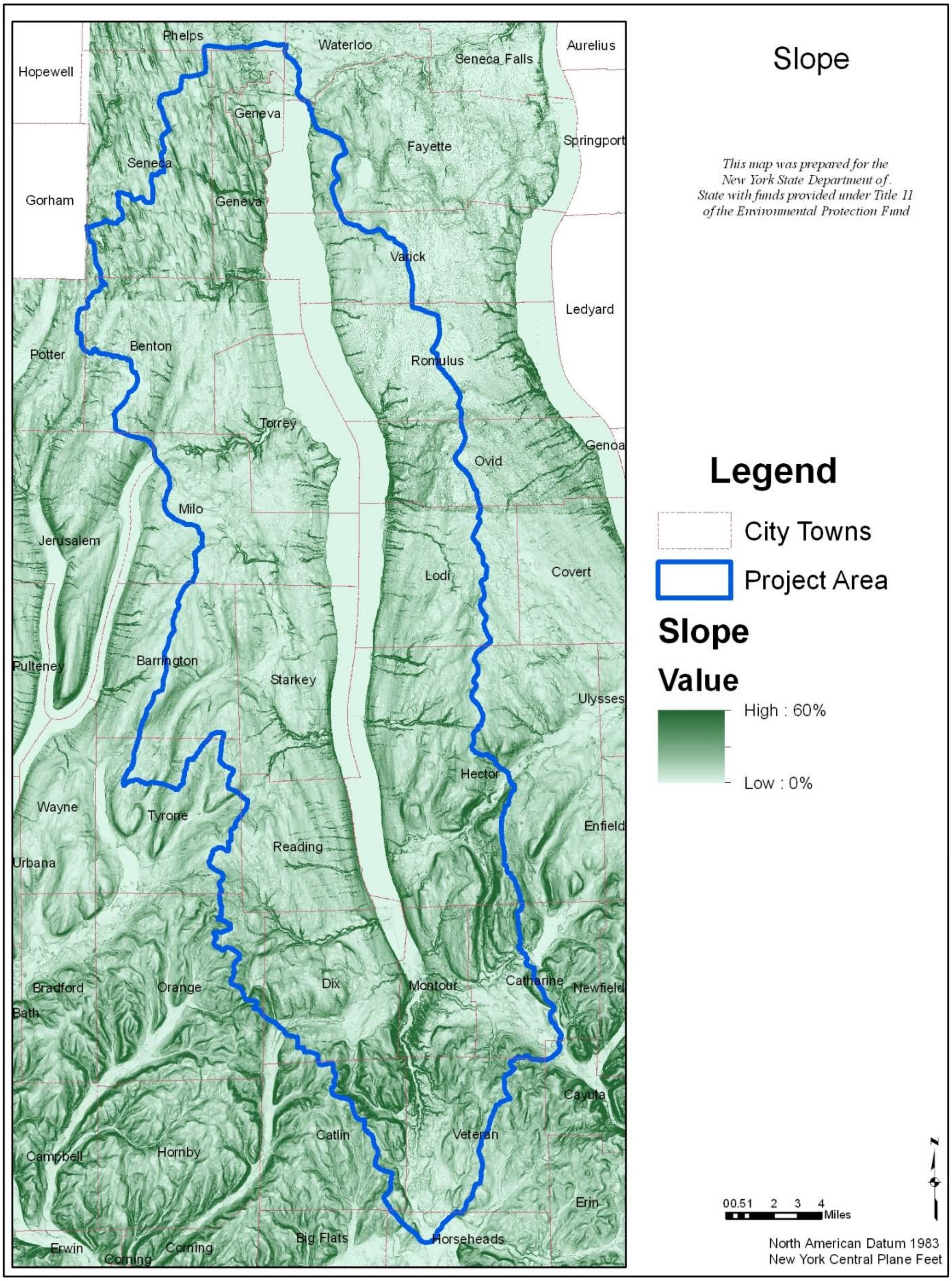


Fig.14. Slopes in the Seneca Lake watershed.

Areas of Erosion

One of the major sources of pollutants in Seneca Lake is sediment loading from eroding stream banks, road banks and the steep slopes surrounding the lake. As mentioned in the soils and steep slopes section, evaluating what soils exist and if they are at a high risk of erosion is important. After evaluating the most commonly occurring soils within the watershed, it was found that these soils are not at high risk of erosion. Yet, the steep slopes that exist throughout the watershed (Fig. 14) particularly on the banks of Seneca Lake are reason for concern. Controlling development and slowing down the water as it runs down these steep slopes is vital to preventing erosion. Controlling development may mean limiting development on slopes above 15%, which is already the local law in many municipalities surrounding the lake. Educating the watershed residents and municipalities on how to prevent erosion is also essential to controlling erosion. Slowing down runoff that flows through roadside ditches and culverts and maintaining those ditch and culverts will assist in preventing erosion and thus sediment loading into the lake. Lastly, stream bank stabilization to assist in slowing the velocity of the water flowing in the streams and thus how fast this water empties into the lake will be helpful in the fight to prevent erosion.

Demographics

Population

Population figures and trends are largely based on information provided through the decennial census of population conducted by the US Census Bureau. The following section provides a brief overview of our understanding of current population statistics and trends in the Seneca Lake watershed.

Census Block Analysis

The smallest geographic unit of observation (or land area) that the US Census Bureau reports population figures for is called the *census block*. Census blocks generally conform to municipal or neighborhood boundaries, not natural boundaries, such as a watershed. Therefore, it is not possible to identify a specific population figure for a watershed boundary utilizing decennial data from the US Census. Furthermore, the geographic units of observation often change between decennial census years, making 10-year trend analysis at the block level a difficult endeavor.

The Seneca Lake Watershed consists of multiple census blocks; by identifying those blocks that are completely within the watershed boundary and those that overlap the watershed boundary, we are provided with a reliable population range. An analysis of census block figures within the Seneca Lake watershed from Census 2000 showed a population range between 52,888 and 57,887 persons, a difference of over 4,999 persons (US Census Bureau, 2001). Figures for Census 2010 show a population range between 54,114 and 58,897 persons, a difference of over 4,783 persons (US Census Bureau, 2010). This assumption is based on close observation of population density maps in combination with the census block boundaries themselves (Table 4).

Table 4. Population estimated for 2000 and 2010 census in the Seneca Lake watershed by county.

County	Watershed Population (Census 2000)	Watershed Population (Census 2010)
Chemung	<14,929	<15,228
Ontario	<5,547	<7,313
Seneca	<13,274	<12,550
Schuyler	<18,693	<18,337
Yates	<5,444	<5,469

Population Density Map Census 2000 and Census 2010

Population density maps provide insight to the locations with the highest concentrations of population in the watershed (Fig. 15, 16). In both the Census 2000 and Census 2010 the greatest population density appears to be in the City of Geneva and the Village of Penn Yan, in the northern and western portion of the Seneca Lake watershed. Other locations with high population density include all of the villages and hamlets in the watershed, especially areas in the Towns of Geneva, Montour, Hector, Dix, Veteran, Milo, Benton Fayette and Starkey.

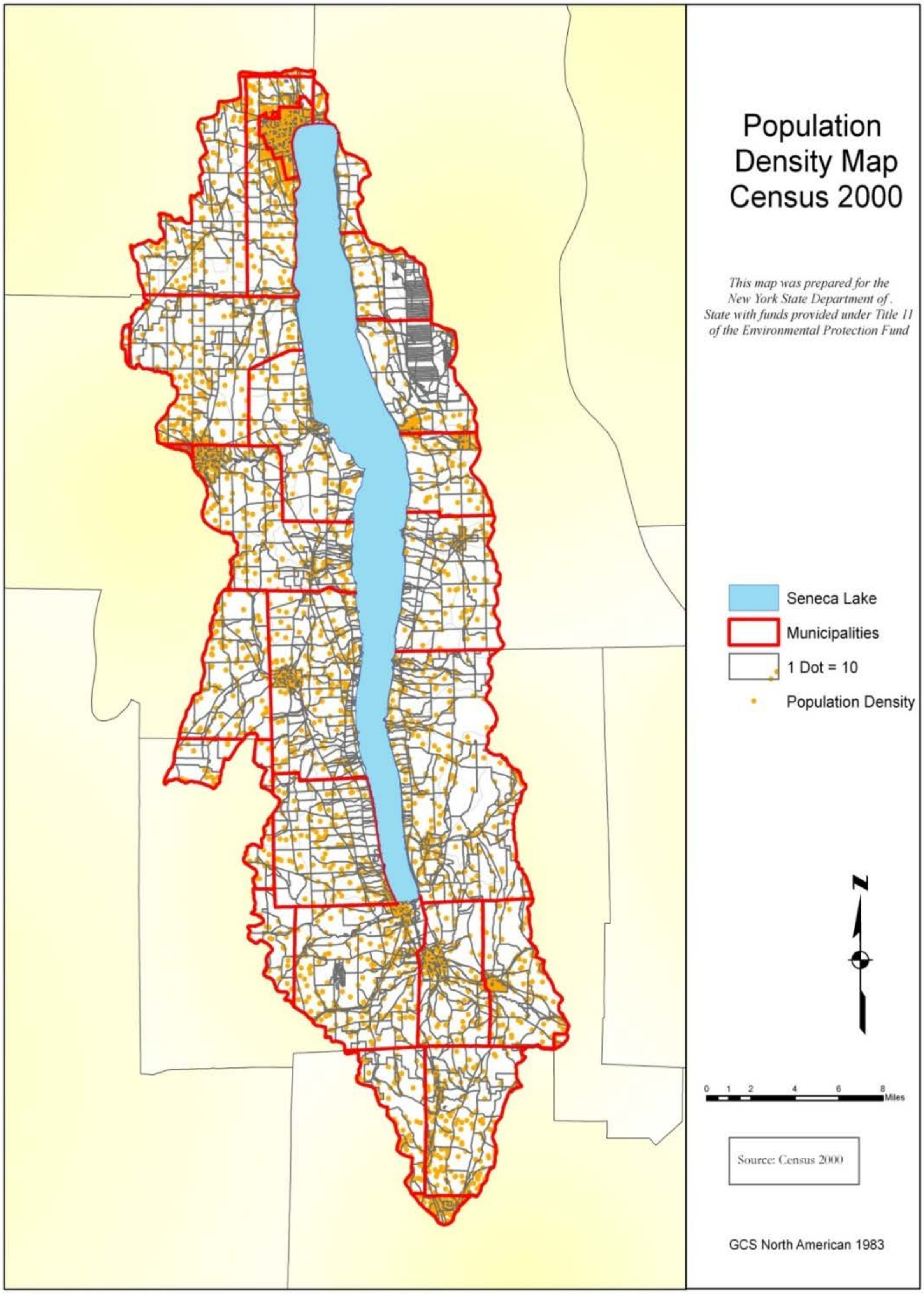


Fig. 15. Population density for 2000 in the Seneca Lake watershed.

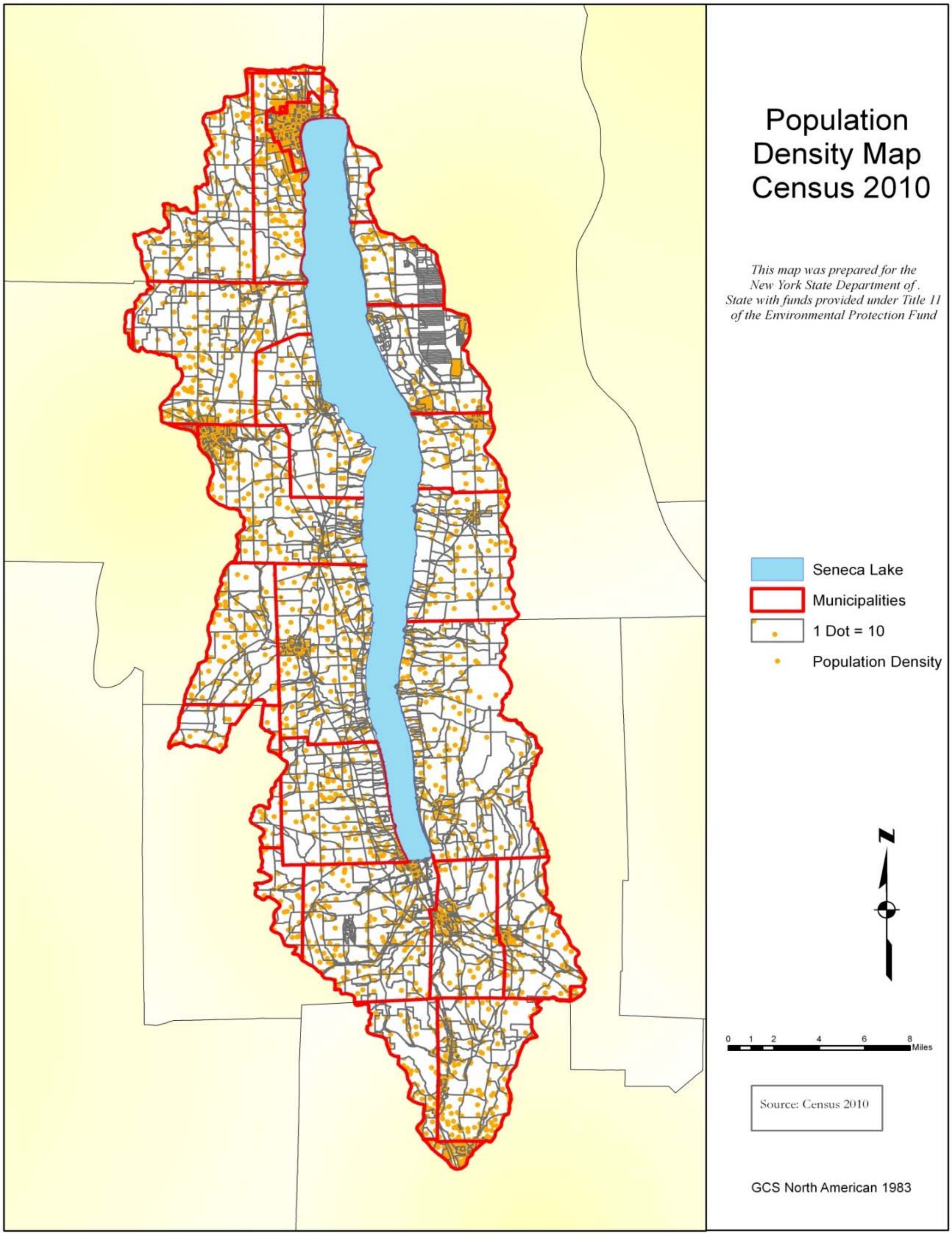


Fig. 16. Population density for 2010 in the Seneca Lake watershed.

Overall, population has been relatively stable in most municipalities in the Seneca Lake watershed since 1970; population trends are generally in line with those across Upstate New York and throughout the Great Lakes region of the United States during this period of time (Table 5). Of the 40 municipalities that have some portion of land area within the Seneca Lake watershed, seven have experienced continual increases in population since 1970– the towns of Milo, Hector, Fayette, Romulus Varick, Barrington, and Starkey and the village of Dundee. The most significant population increases are concentrated in the municipalities on the western and northeastern portions of the watershed, which happen to also be the most suburbanized towns in the watershed.

Population Projections

Population projections were calculated out to the year 2040 for all of the counties, cities, towns, and villages in the Seneca Lake Watershed. The methodology was developed primarily by the Capital District Regional Planning Commission. The Population Projection Model involves two distinct stages: a quantitative first stage using a log-linear projection model set up in a MS Excel Workbook, and a qualitative second stage using non-quantitative judgments of the likelihood and extent of future population change within particular jurisdictions. The projected data provided in Table 6 and 7 represent the quantitative population projections.

Table 5. Population totals 1970-2010 for municipalities in the Seneca Lake watershed.

Municipality	Population													Total Change	
	1970	**1980**	**(+/-) '70 to '80**	**(%) '70 to '80**	**1990**	**(+/-) '80 to '90**	**(%) '80 to '90**	**2000**	**(+/) '90 to '00**	**(%) '90 to '00**	**2010**	**(+/-) '00 to '10**	**(%) '00 to '10**	**(+/-) '70 to '10**	**(%) '70 to '10**
Chemung County (part)	6,484	6,370	-114	-1.8%	6,436	66	1.0%	6,220	-216	-3.4%	6,243	23	0.4%	-241	-3.7%
Town of Catlin	2,461	2,719	258	10.5%	2,626	-93	-3.4%	2,649	23	0.9%	2,618	-31	-1.2%	157	6.4%
Town of Veteran	3,543	3,211	-332	-9.4%	3,468	257	8.0%	3,274	-194	-5.6%	3,313	39	1.2%	-230	-6.5%
Village of Millport	480	440	-40	-8.3%	342	-98	-22.3%	297	-45	-13.2%	312	15	5.1%	-168	-35.0%
Ontario County (part)	22,382	20,959	-1,423	-6.4%	19,857	-1,102	-5.3%	19,637	-220	-1.1%	19,273	-364	-1.9%	-3,109	-13.9%
City of Geneva	16,793	15,133	-1,660	-9.9%	14,143	-990	-6.5%	13,617	-526	-3.7%	13,261	-356	-2.6%	-3,532	-21.0%
Town of Geneva	2,781	3,077	296	10.6%	2,967	-110	-3.6%	3,289	322	10.9%	3,291	2	0.1%	510	18.3%
Town of Seneca	2,808	2,749	-59	-2.1%	2,747	-2	-0.1%	2,731	-16	-0.6%	2,721	-10	-0.4%	-87	-3.1%
Schuyler County (part)	21,472	22,374	902	4.2%	23,473	1,099	4.9%	23,599	126	0.5%	22,288	-1,311	-5.6%	816	3.8%
Town of Catharine	1,886	1,932	46	2.4%	1,991	59	3.1%	1,930	-61	-3.1%	1,762	-168	-8.7%	-124	-6.6%
Village of Odessa	568	613	45	7.9%	986	373	60.8%	617	-369	-37.4%	591	-26	-4.2%	23	4.0%
Town of Dix	4,201	4,138	-63	-1.5%	4,130	-8	-0.2%	4,197	67	1.6%	3,864	-333	-7.9%	-337	-8.0%
Town of Hector	3,671	3,793	122	3.3%	4,423	630	16.6%	4,854	431	9.7%	4,940	86	1.8%	1,269	34.6%
Village of Burdett	454	410	-44	-9.7%	372	-38	-9.3%	357	-15	-4.0%	340	-17	-4.8%	-114	-25.1%
Town of Montour	2,324	2,607	283	12.2%	2,528	-79	-3.0%	2,446	-82	-3.2%	2,308	-138	-5.6%	-16	-0.7%
Village of Montour Falls	1,534	1,791	257	16.8%	1,845	54	3.0%	1,797	-48	-2.6%	1,711	-86	-4.8%	177	11.5%
Town of Orange	1,076	1,358	282	26.2%	1,561	203	14.9%	1,752	191	12.2%	1,609	-143	-8.2%	533	49.5%
Town of Reading	1,768	1,813	45	2.5%	1,810	-3	-0.2%	1,786	-24	-1.3%	1,707	-79	-4.4%	-61	-3.5%
Village of Watkins Glen	2,736	2,440	-296	-10.8%	2,207	-233	-9.5%	2,149	-58	-2.6%	1,859	-290	-13.5%	-877	-32.1%
Town of Tyrone	1,254	1,479	225	17.9%	1,620	141	9.5%	1,714	94	5.8%	1,597	-117	-6.8%	343	27.4%
Seneca County (part)	14,507	12,583	-1,924	-13.3%	13,091	508	4.0%	12,591	-500	-3.8%	14,856	2,265	18.0%	349	2.4%
Town of Fayette	2,997	3,561	564	18.8%	3,636	75	2.1%	3,643	7	0.2%	3,929	286	7.9%	932	31.1%
Town of Lodi	1,287	1,184	-103	-8.0%	1,429	245	20.7%	1,476	47	3.3%	1,550	74	5.0%	263	20.4%
Village of Lodi	353	334	-19	-5.4%	364	30	9.0%	338	-26	-7.1%	291	-47	-13.9%	-62	-17.6%
Town of Ovid	3,107	2,530	-577	-18.6%	2,309	-221	-8.7%	2,757	448	19.4%	2,311	-446	-16.2%	-796	-25.6%
Village of Ovid	779	666	-113	-14.5%	660	-6	-0.9%	612	-48	-7.3%	602	-10	-1.6%	-177	-22.7%
Town of Romulus	4,284	2,440	-1,844	-43.0%	2,532	92	3.8%	2,036	-496	-19.6%	4,316	2,280	112.0%	32	0.7%
Town of Varick	1,700	1,868	168	9.9%	2,161	293	15.7%	1,729	-432	-20.0%	1,857	128	7.4%	157	9.2%
Yates County (part)	21,068	21,211	143	0.7%	22,215	1,004	4.7%	23,044	829	3.7%	24,440	1,396	6.1%	3,372	16.0%
Town of Barrington	929	1,091	162	17.4%	1,195	104	9.5%	1,396	201	16.8%	1,651	255	18.3%	722	77.7%
Town of Benton	2,159	1,981	-178	-8.2%	2,380	399	20.1%	2,640	260	10.9%	2,836	196	7.4%	677	31.4%
Town of Milo	6,854	6,732	-122	-1.8%	7,023	291	4.3%	7,020	-3	0.0%	7,906	886	12.6%	1,052	15.3%
Village of Penn Yan	5,168	5,242	74	1.4%	5,248	6	0.1%	5,219	-29	-0.6%	5,159	-60	-1.1%	-9	-0.2%
Town of Starkey	2,783	2,868	85	3.1%	3,173	305	10.6%	3,465	292	9.2%	3,573	108	3.1%	790	28.4%
Village of Dundee	1,539	1,556	17	1.1%	1,588	32	2.1%	1,690	102	6.4%	1,725	35	2.1%	186	12.1%
Town of Torrey	1,186	1,363	177	14.9%	1,269	-94	-6.9%	1,307	38	3.0%	1,282	-25	-1.9%	96	8.1%
Village of Dresden	450	378	-72	-16.0%	339	-39	-10.3%	307	-32	-9.4%	308	1	0.3%	-142	-31.6%
TOTAL	**85,913**	**83,497**	**-2,416**	**-2.8%**	**85,072**	**1,575**	**1.9%**	**85,091**	**19**	**0.0%**	**87,100**	**2,009**	**2.4%**	**1,187**	**1.4%**

Source: US Census Bureau 1970-2010

Table 6. Population historic and projections.

Municipality	Historical									Projected					
	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Chemung County (part)	6,484	6,420	6,370	6,397	6,436	6,326	6,220	6,230	6,243	6,237	6,231	6,226	6,221	6,217	6,213
Town of Catlin	2,461	2,587	2,719	2,672	2,626	2,637	2,649	2,633	2,618	2,622	2,626	2,630	2,633	2,636	2,638
Town of Veteran	3,543	3,373	3,211	3,337	3,468	3,370	3,274	3,293	3,313	3,308	3,304	3,299	3,296	3,292	3,288
Village of Millport	480	460	440	388	342	319	297	304	312	307	302	298	294	290	287
Ontario County (part)	22,382	21,644	20,959	20,399	19,857	19,741	19,637	19,454	19,273	19,190	19,114	19,044	18,980	18,919	18,863
City of Geneva	16,793	15,941	15,133	14,630	14,143	13,878	13,617	13,438	13,261	13,167	13,082	13,003	12,930	12,862	12,798
Town of Geneva	2,781	2,925	3,077	3,021	2,967	3,124	3,289	3,290	3,291	3,304	3,315	3,326	3,336	3,345	3,354
Town of Seneca	2,808	2,778	2,749	2,748	2,747	2,739	2,731	2,726	2,721	2,719	2,717	2,715	2,714	2,712	2,711
Schuyler County (part)	21,472	21,895	22,374	22,880	23,473	23,504	23,599	22,927	22,288	22,332	22,373	22,413	22,447	22,481	22,510
Town of Catharine	1,886	1,909	1,932	1,961	1,991	1,960	1,930	1,844	1,762	1,761	1,760	1,760	1,759	1,759	1,758
Village of Odessa	568	590	613	777	986	780	617	604	591	594	597	600	602	605	607
Town of Dix	4,201	4,169	4,138	4,134	4,130	4,163	4,197	4,027	3,864	3,859	3,855	3,852	3,848	3,845	3,842
Town of Hector	3,671	3,732	3,793	4,096	4,423	4,633	4,854	4,897	4,940	4,976	5,008	5,038	5,066	5,092	5,116
Village of Burdett	454	431	410	391	372	364	357	348	340	337	334	332	329	327	325
Town of Montour	2,324	2,461	2,607	2,567	2,528	2,487	2,446	2,376	2,308	2,309	2,310	2,311	2,312	2,312	2,313
Village of Montour Falls	1,534	1,658	1,791	1,818	1,845	1,821	1,797	1,753	1,711	1,717	1,722	1,728	1,733	1,737	1,741
Town of Orange	1,076	1,209	1,358	1,456	1,561	1,654	1,752	1,679	1,609	1,626	1,642	1,656	1,669	1,682	1,693
Town of Reading	1,768	1,790	1,813	1,811	1,810	1,798	1,786	1,746	1,707	1,706	1,706	1,705	1,705	1,704	1,704
Village of Watkins Glen	2,736	2,584	2,440	2,321	2,207	2,178	2,149	1,999	1,859	1,839	1,820	1,803	1,787	1,772	1,758
Town of Tyrone	1,254	1,362	1,479	1,548	1,620	1,666	1,714	1,654	1,597	1,608	1,619	1,628	1,637	1,646	1,653
Seneca County (part)	14,507	13,383	12,583	12,823	13,091	12,804	12,591	13,497	14,856	14,838	14,820	14,803	14,789	14,774	14,762
Town of Fayette	2,997	3,267	3,561	3,598	3,636	3,639	3,643	3,783	3,929	3,950	3,969	3,987	4,004	4,019	4,034
Town of Lodi	1,287	1,234	1,184	1,301	1,429	1,452	1,476	1,513	1,550	1,557	1,564	1,570	1,576	1,581	1,586
Village of Lodi	353	343	334	349	364	351	338	314	291	291	290	289	289	288	287
Town of Ovid	3,107	2,804	2,530	2,417	2,309	2,523	2,757	2,524	2,311	2,295	2,280	2,266	2,253	2,241	2,230
Village of Ovid	779	720	666	663	660	636	612	607	602	598	594	590	586	583	580
Town of Romulus	4,284	3,233	2,440	2,486	2,532	2,270	2,036	2,964	4,316	4,286	4,258	4,233	4,209	4,187	4,167
Town of Varick	1,700	1,782	1,868	2,009	2,161	1,933	1,729	1,792	1,857	1,861	1,865	1,868	1,872	1,875	1,878
Yates County (part)	21,068	21,128	21,211	21,696	22,215	22,618	23,044	23,720	24,440	24,514	24,582	24,646	24,705	24,759	24,810
Town of Barrington	929	1,007	1,091	1,142	1,195	1,292	1,396	1,518	1,651	1,667	1,681	1,695	1,707	1,719	1,730
Town of Benton	2,159	2,068	1,981	2,171	2,380	2,507	2,640	2,736	2,836	2,853	2,869	2,884	2,897	2,910	2,921
Town of Milo	6,854	6,793	6,732	6,876	7,023	7,021	7,020	7,450	7,906	7,923	7,939	7,953	7,967	7,979	7,991
Village of Penn Yan	5,168	5,205	5,242	5,245	5,248	5,233	5,219	5,189	5,159	5,160	5,161	5,161	5,162	5,162	5,163
Town of Starkey	2,783	2,825	2,868	3,017	3,173	3,316	3,465	3,519	3,573	3,594	3,613	3,631	3,647	3,662	3,676
Village of Dundee	1,539	1,547	1,556	1,572	1,588	1,638	1,690	1,707	1,725	1,729	3,613	3,631	3,647	3,662	3,676
Town of Torrey	1,186	1,271	1,363	1,315	1,269	1,288	1,307	1,294	1,282	1,284	1,286	1,288	1,290	1,292	1,294
Village of Dresden	450	412	378	358	339	323	307	307	308	304	300	297	294	291	288

Table 7. Historic and projected decennial changes in the Seneca Lake watershed.

Municipality	Historical			Projected				Historical			Projected			
	1970-80	1980-90	1990-00	2000-10	2010-20	2020-30	2030-40	1970-80	1980-90	1990-00	2000-10	2010-20	2020-30	2030-40
	Net	Net	Net	Net	Net	Net	Net	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Chemung County (part)	-114	-23	66	-71	-216	-96	23	-1.8%	-0.4%	1.1%	-1.1%	-3.5%	-1.5%	0.4%
Town of Catlin	258	85	-93	-35	23	-4	-31	9.5%	3.2%	-3.5%	-1.3%	0.9%	-0.2%	-1.2%
Town of Veteran	-332	-36	257	33	-194	-77	39	-10.3%	-1.0%	7.8%	1.0%	-5.9%	-2.3%	1.2%
Village of Millport	-40	-72	-98	-69	-45	-15	15	-9.1%	-21.1%	-33.0%	-22.1%	-14.9%	-5.1%	5.2%
Ontario County (part)	-1,423	-1,245	-1,102	-658	-220	-287	-364	-6.8%	-6.3%	-5.6%	-3.4%	-1.2%	-1.5%	-1.9%
City of Geneva	-1,660	-1,311	-990	-752	-526	-440	-356	-11.0%	-9.3%	-7.3%	-5.7%	-4.0%	-3.4%	-2.8%
Town of Geneva	296	96	-110	103	322	166	2	9.6%	3.2%	-3.3%	3.1%	9.7%	5.0%	0.1%
Town of Seneca	-59	-30	-2	-9	-16	-13	-10	-2.1%	-1.1%	-0.1%	-0.3%	-0.6%	-0.5%	-0.4%
Schuyler County (part)	902	985	1,099	624	126	-577	-1,311	4.0%	4.2%	4.7%	2.8%	0.6%	-2.6%	-5.8%
Town of Catharine	46	52	59	-1	-61	-116	-168	2.4%	2.6%	3.1%	-0.1%	-3.5%	-6.6%	-9.6%
Village of Odessa	45	187	373	3	-369	-176	-26	7.3%	19.0%	60.5%	0.5%	-61.8%	-29.2%	-4.3%
Town of Dix	-63	-35	-8	29	67	-136	-333	-1.5%	-0.8%	-0.2%	0.8%	1.7%	-3.5%	-8.7%
Town of Hector	122	364	630	537	431	264	86	3.2%	8.2%	13.0%	10.9%	8.6%	5.2%	1.7%
Village of Burdett	-44	-40	-38	-27	-15	-16	-17	-10.7%	-10.8%	-10.6%	-7.9%	-4.5%	-4.9%	-5.2%
Town of Montour	283	106	-79	-80	-82	-111	-138	10.9%	4.2%	-3.2%	-3.5%	-3.5%	-4.8%	-6.0%
Village of Montour Falls	257	160	54	3	-48	-68	-86	14.3%	8.7%	3.0%	0.2%	-2.8%	-3.9%	-4.9%
Town of Orange	282	247	203	198	191	25	-143	20.8%	15.8%	11.6%	12.3%	11.6%	1.5%	-8.4%
Town of Reading	45	21	-3	-13	-24	-52	-79	2.5%	1.2%	-0.2%	-0.8%	-1.4%	-3.0%	-4.6%
Village of Watkins Glen	-296	-263	-233	-143	-58	-179	-290	-12.1%	-11.9%	-10.8%	-7.7%	-3.2%	-10.0%	-16.5%
Town of Tyrone	225	186	141	118	94	-12	-117	15.2%	11.5%	8.2%	7.4%	5.8%	-0.7%	-7.1%
Seneca County (part)	-1,924	-560	508	-19	-500	693	2,265	-15.3%	-4.3%	4.0%	-0.1%	-3.4%	4.7%	15.3%
Town of Fayette	564	331	75	41	7	144	286	15.8%	9.1%	2.1%	1.0%	0.2%	3.6%	7.1%
Town of Lodi	-103	67	245	151	47	61	74	-8.7%	4.7%	16.6%	9.7%	3.0%	3.9%	4.7%
Village of Lodi	-19	6	30	2	-26	-37	-47	-5.7%	1.6%	8.9%	0.7%	-9.0%	-12.8%	-16.4%
Town of Ovid	-577	-387	-221	106	448	1	-446	-22.8%	-16.8%	-8.0%	4.6%	19.6%	0.0%	-20.0%
Village of Ovid	-113	-57	-6	-27	-48	-29	-10	-17.0%	-8.6%	-1.0%	-4.5%	-8.1%	-4.9%	-1.7%
Town of Romulus	-1,844	-747	92	-216	-496	694	2,280	-75.6%	-29.5%	4.5%	-5.0%	-11.6%	16.5%	54.7%
Town of Varick	168	227	293	-76	-432	-141	128	9.0%	10.5%	16.9%	-4.1%	-23.2%	-7.5%	6.8%
Yates County (part)	143	568	1,004	922	829	1,102	1,396	0.7%	2.6%	4.4%	3.8%	3.4%	4.5%	5.6%
Town of Barrington	162	135	104	150	201	226	255	14.8%	11.3%	7.4%	9.1%	12.0%	13.2%	14.7%
Town of Benton	-178	103	399	336	260	229	196	-9.0%	4.3%	15.1%	11.8%	9.1%	7.9%	6.7%
Town of Milo	-122	83	291	145	-3	429	886	-1.8%	1.2%	4.1%	1.8%	-0.0%	5.4%	11.1%
Village of Penn Yan	74	40	6	-12	-29	-44	-60	1.4%	0.8%	0.1%	-0.2%	-0.6%	-0.9%	-1.2%
Town of Starkey	85	192	305	299	292	203	108	3.0%	6.1%	8.8%	8.4%	8.1%	5.6%	2.9%
Village of Dundee	17	25	32	66	102	69	35	1.1%	1.6%	1.9%	3.8%	2.8%	1.9%	1.0%
Town of Torrey	177	44	-94	-27	38	6	-25	13.0%	3.5%	-7.2%	-2.1%	3.0%	0.5%	-1.9%
Village of Dresden	-72	-54	-39	-35	-32	-16	1	-19.0%	-15.9%	-12.7%	-11.4%	-10.7%	-5.4%	0.3%

Land Use and Land Cover

Land activities and water quality are inherently linked to one another. The type of activities that take place on the land will directly influence the quality and characteristics of the water that runs off of it. Understanding the characteristics of the land within a watershed area is therefore a central aspect of watershed planning. When combined with a Geographic Information System analysis, land use and land cover information can be compared and contrasted in a variety of ways, providing users with multiple applications for the management and restoration of land and water. Subjects such as the present and future uses of the land, agricultural productivity, habitat, and environmental sensitivity can be readily assessed for an entire watershed or any given area within it.

Land Use History

In general on a watershed-wide basis, agricultural land has been on a steady decline, forests and developed areas have increased, and the category of idle land has been on the increase.

Early discussions of land uses in the Seneca Lake watershed are descriptive and informative (New York State Water Pollution Control Board, 1956). There was no documentation of acreages of land uses until the Land Use and Natural Resources (LUNR) inventory. This inventory which was conducted in 1969 across the state used the resource of satellite imagery to interpret land use. This database was created at a USGS quad scale (1:24,000) and was the basis for extensive land use planning in the early 1970s. The next statewide land use survey was conducted by the USGS in 1981; however, because the scale was much larger (1:250,000) and because it used different land use categories, it was not directly comparable to LUNR, but was useful in regional planning applications. As a result, aerial photos taken in 1994 and in 1995 were digitized by the Genesee/Finger Lakes Regional Planning Council (GFL) as part of the *Setting A Course for Seneca Lake, The State of the Seneca Lake Watershed* report. The scale, 1:7920, was more accurate and provided excellent data for not only an analysis of the current land use mix, but also for comparison with earlier LUNR inventory datasets.

Land uses documented in 1971, 1981 and 1995 were compared to assess the changes over time. Because of the differences in scale and in land use categories, detailed comparisons could not be made; but generalizations could be drawn once the land use types were combined into broader classifications. Table 8 provides the qualitative breakdown of the generalized land use types.

Table 8. Generalized classifications of land use within the Seneca Lake watershed: 1971, 1980, 1995.

Land Use	1971	1980	1995
(1) Agricultural	42.50%	53.20%	39.10%
(2) Forest	40.40%	38.50%	41.30%
(3) Idle	14.00%	2.10%	11.30%
(4) Development	3.10%	6.20%	8.30%

Land Use

Land use refers to the human purposes ascribed to the land, such as "industrial" or "residential" use. Land use can be analyzed utilizing Geographic Information System data derived from county Real Property System (RPS) tax parcel records. As explained on the New York State Department of Taxation and Finance Office of Real Property Tax Services website:

> The Assessment Improvement Law (Laws of 1970, Chapter 957) required local governments to prepare and maintain tax maps in accordance with standards established by the State Board of Equalization and Assessment (currently Office of Real Property Services). For the most part, this requirement is a county responsibility…Perhaps the most essential of all assessment tools is an adequate tax map reflecting the size, shape and geographical characteristics of each parcel of land in the assessing unit. The tax map is a graphic display of each assessing unit's land inventory and as such is the major source to the real property assessment roll. The working copy of the tax map used by the assessor can be utilized to record and analyze property transfers, to record other features pertinent to the valuation of land and in the development of a Geographic Information System (GIS). [The GIS] allows us to analyze and map the wealth of parcel level assessment information to solve problems related to: property valuation, local government reassessments, land use, environmental assessment, facility siting and economic development, public health, emergency services and disaster planning ("Tax Mapping in New York State", 2011).

Tax parcel information is available in GIS format from each county within the study area. Each GIS utilizes the same uniform classification system developed by the New York State Office of Real

Property Services that is used in assessment administration in New York State. The system of classification consists of numeric codes in nine categories.

The results listed in Table 9 were tabulated based on an analysis of those properties within the Seneca Lake watershed.

Table 9. Land use within the Seneca Lake watershed.

Property Classification Category	Acres	% of Seneca Lake Watershed Area	# of Parcels	Average Size (Acres)
(1) Agricultural **Property used for the production of crops or livestock**	122,541.27	42.2%	1,837	72
(2) Residential **Property used for human habitation**	79,691.94	27.5%	18,105	5
(3) Vacant Land **Property that is not in use, is in temporary use, or lacks permanent improvement**	41,848.78	14.4%	4,817	9
(4) Commercial **Property used for the sale of goods and/or services**	3,549.75	1.2%	1,517	2
(5) Recreation and Entertainment **Property used by groups for recreation, amusement, or entertainment**	3,103.54	1.1%	109	29
(6) Community Services **Property used for the well-being of the community**	14,888.49	5.1%	552	29
(7) Industrial **Property used for the production and fabrication of durable and nondurable man-made goods**	1,482.05	0.5%	71	22
(8) Public Services **Property used to provide services to the general public**	2,316.90	0.8%	250	11
(9) Wild, Forested, Conservation Lands & Public Parks **Reforested lands, preserves, and private hunting and fishing clubs**	17,233.64	5.9%	259	86
Unclassified ***Property or land that has not been or is unable to be classified***	3,647.75	1.3%	380	11

Note: Waterbodies, road rights of way and other minor boundary irregularities account for a cumulative discrepancy between the actual total area of the watershed and the total property acreage that is ultimately classified through the real property system.

It is important to note that property classification and tax map maintenance is a responsibility of the county assessor's office (or local equivalent). While the classification system standards are intended to create uniform results, human error and subjectivity can sometimes lead to different interpretations of property types from place to place. Some level of inaccuracy with the results in Table 9 should therefore be assumed. Furthermore, properties are classified primarily for the purposes of taxation and public finance, not environmental analysis. While the information aids environmental assessment (lakefront vs. non-lakefront, wooded lot vs. pasture, etc.), the application of these results to watershed planning has its limitations. The information can nonetheless provide useful insight when combined and compared with land cover data and other land use analysis tools (Fig. 17).

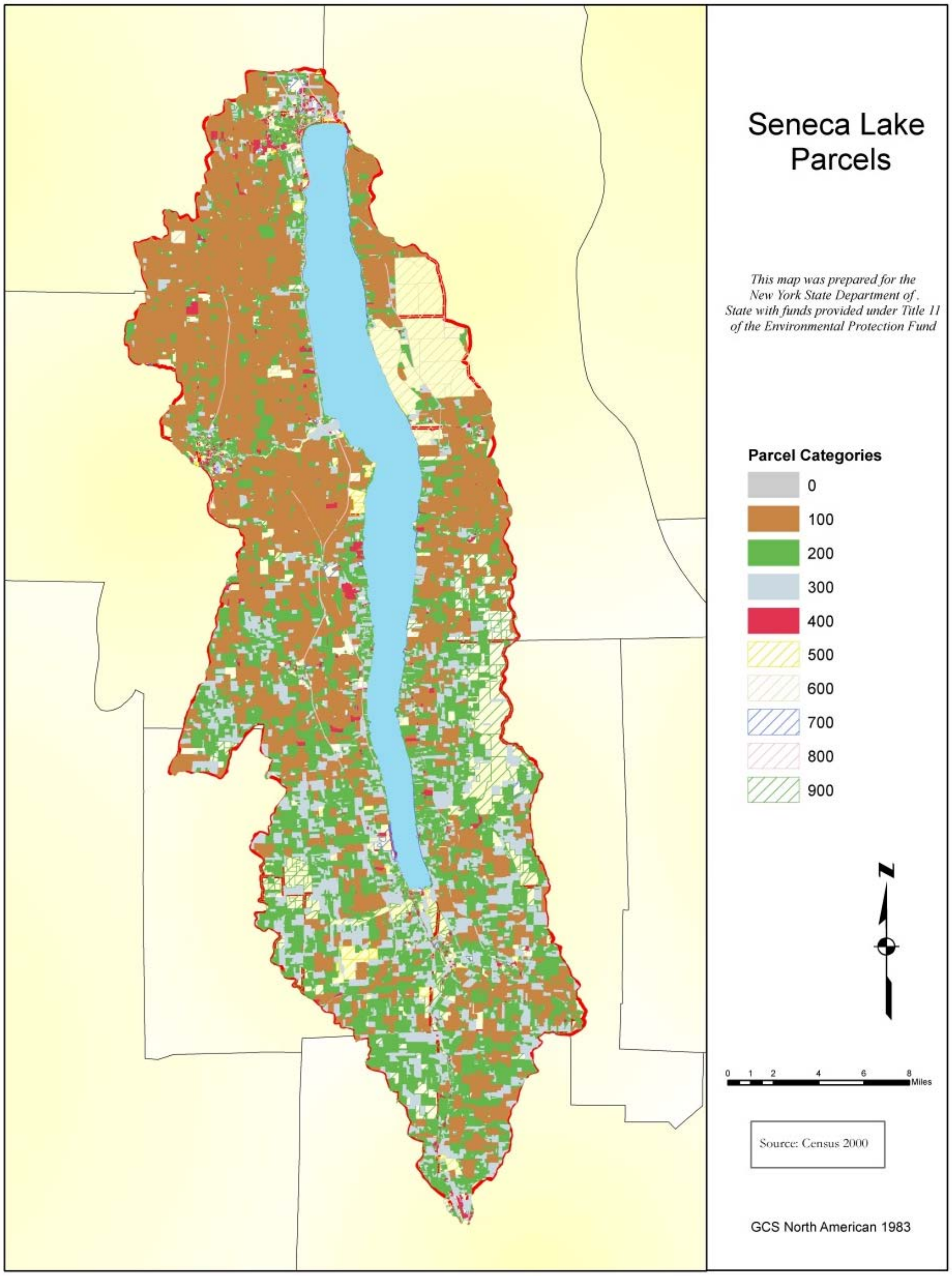


Fig. 17. Seneca Lake watershed land use parcels.

Parcel Categories (“How to Locate the Proper Property Type Classification Code”, 2012)
100 - Agricultural - Property used for the production of crops or livestock.
200 - Residential - Property used for human habitation. Living accommodations such as hotels, motels, and apartments are in the Commercial category - 400.
300 - Vacant Land - Property that is not in use, is in temporary use, or lacks permanent improvement.
400 - Commercial - Property used for the sale of goods and/or services.
500 - Recreation & Entertainment - Property used by groups for recreation, amusement, or entertainment.
600 - Community Services - Property used for the well-being of the community.
700 - Industrial - Property used for the production and fabrication of durable and nondurable man-made goods.
800 - Public Services - Property used to provide services to the general public.
900 - Wild, Forested, Conservation Lands & Public Parks - Reforested lands, preserves, and private hunting and fishing clubs

Land Cover

Land cover refers to the type of features present on the surface of the earth. For example, agricultural fields, water, pine forests, and parking lots are all land cover types. Land cover may refer to a biological categorization of the surface, such as grassland or forest, or to a physical or chemical categorization.

Land cover was assessed in the Seneca Lake watershed utilizing imagery associated with the National Land Cover Dataset (Table 10).

Table 10. 2006 NLCD Land Cover within the Seneca Lake watershed.

NLCD Category	Acres	% Cover
11 - Open Water	43,933	12.9
21 - Developed, Open Space	16,554	4.9
22 - Developed, Low Intensity	4,329	1.3
23 - Developed, Medium Intensity	1,316	.4
24 - Developed, High Intensity	382	.11
31 - Barren Land	191	.05
41 - Deciduous Forest	61,939	18.3
42 - Evergreen Forest	5,127	1.5
43 - Mixed Forest	23,123	6.7
52 - Shrub/Scrub	22,151	6.5
71 - Grassland/Herbaceous	2,190	.54
81 - Pasture Hay	83,620	24.5
82 - Cultivated Crops	61,281	18.0
90 - Woody Wetlands	13,228	3.8
95 - Emergent Herbaceous Wetlands	1,755	0.5
Total	341,119	100

This dataset was developed by the Multi-Resolution Land Characteristics (MRLC) Consortium, a group of federal agencies who first joined together in 1993 (Fry et. al., 2011) to purchase satellite imagery for the conterminous U.S. to develop the NLCD. The National Land Cover Dataset 2006 is a 15-class land cover classification scheme that has been applied consistently across the conterminous United States at a spatial resolution of 30 meters (Fry et. al., 2011).

An analysis of the 2006 NLCD land cover within the Seneca Lake Watershed estimates that there are 341,119 acres in the watershed. (Fig. 18) Nearly, 25% of land cover within the watershed fell under the category of 'Pasture Hay'. About 18% of the land cover was under the category of 'Deciduous Forest'. Approximately, 13% of the watershed was categorized as 'Open Water' with the majority of that land cover attributed to Seneca Lake.

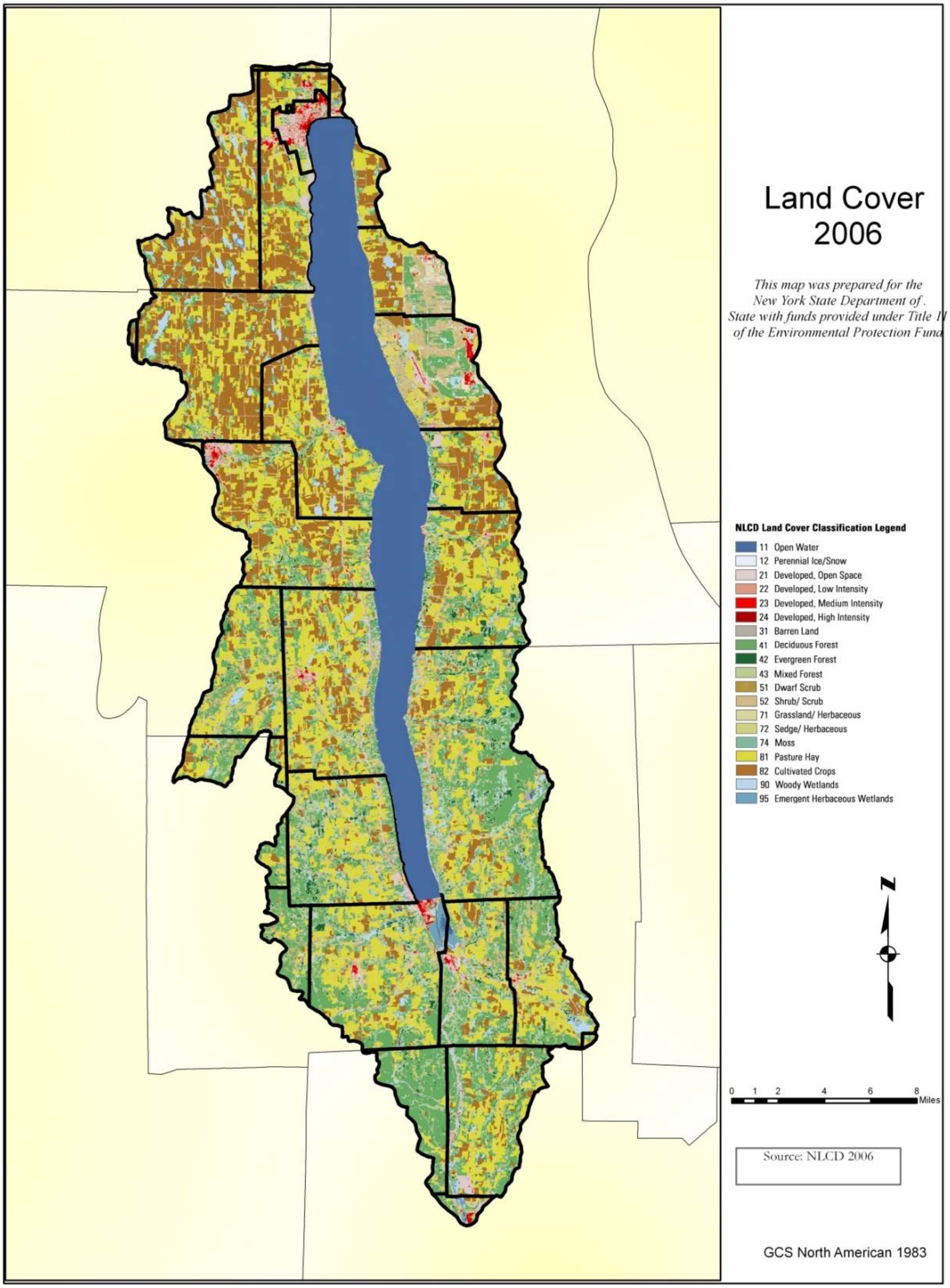


Fig. 18. Land cover in the Seneca Lake watershed.

A full explanation of 2006 NLCD categories (Fry et. al., 2011) and results by subwatershed is below:

11 – Open Water: All areas of open water, generally with less than 25% cover of vegetation or soil.

21 – Developed, Open Space: Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes

22 – Developed, Low Intensity: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.

23 – Developed, Medium Intensity: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.

24 – Developed, High Intensity: Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to100 percent of the total cover.

31 – Barren Land (Rock/Sand/Clay): Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.

41 – Deciduous Forest: Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.

42 – Evergreen Forest: Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.

43 – Mixed Forest: Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.

52 – Shrub/Scrub: Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early succession stage or trees stunted from environmental conditions.

71 – Grassland/Herbaceous: Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.

81 – Pasture/Hay: Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.

82 – Cultivated Crops: Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.

90 – Woody Wetlands: Areas where forest or shrub land vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

95 – Emergent Herbaceous Wetlands: Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water

Public Lands

Public lands can be classified into a number of different categories. The varieties of public lands that exist in the Seneca Lake watershed vary tremendously in terms of size, ownership, operation and maintenance, and designated and permitted uses. Public land uses include local municipal ball fields and cemeteries, multi-use county parks, and significant holdings of conservation lands by not-for-profit conservation organizations and land trusts, such as The Nature Conservancy, or other local and regional land trusts, such as The Finger Lakes Land Trust.

Federal Lands

Approximately 7,484 acres of the 16,212 acre Finger Lakes National Forest lies within the Seneca Lake watershed, located in Seneca and Schuyler Counties on the eastern side of Seneca Lake watershed. Lands continue to be acquired in the vicinity of the forest making an accurate measure of land area difficult to calculate. It is New York State's only National Forest and has over 30 miles of interconnecting trails that traverse gorges, ravines, pastures and woodlands.

NYSDEC Lands

The largest contiguous holding of NYSDEC land within the watershed is Sugar Hill State Forest ("Sugar Hill State Forest", 2012). Sugar Hill State Forest is located on the southwestern side of the watershed in Schuyler County and consists of over 9,000 acres of land, 2,440 of which is within the Seneca Lake Watershed. Texas Hollow State Forest consists of 931 acres, all of which lie on the southeastern side of the Seneca Lake watershed in the Towns of Hector and Catharine (Table 11).

Table 11. NYSDEC lands within the Seneca Lake watershed.

Land Unit Name	Land Unit Category	Location	Acreage within Seneca Lake Watershed	Total Acreage
Sugar Hill	State Forest	Schuyler County	2,440	9,099
Texas Hollow	State Forest	Schuyler County	931	931
Catharine Creek	Wildlife Management Area	Schuyler County	705	705
Coon Hollow	State Forest	Schuyler County	395	2,433
Willard	Wildlife Management Area	Seneca County	154	154
Seneca Lake	Boat Launch	Yates County	13	13
Catharine Creek	Fishing Access	Chemung County	3	3

The Catharine Creek State Wildlife Management Area lies at the southern end of Seneca Lake, between Watkins Glen and Montour Falls. Sedimentation and manipulation of the lake level has led to the formation of a 1,000 acre marsh complex. The area, named for the local Seneca Indian Queen, Catharine Montour, provides a haven for innumerable wildlife. Once navigable into what is now

Montour Falls, the waters of Catharine Creek still feed a remnant section of the Chemung Barge Canal, which runs through the center of the marsh. This canal, critical to local industrial development, connected this portion of southern New York to the entire east coast. The Pennsylvania Railroad, bordering the canal through the marsh, served the area after the canal was closed in 1878. The area is rich with history from the time of the Senecas through the years, when much of the marsh was used for truck crop farming, muskrat farming and eventually reed harvesting ("Catharine Creek State Wildlife Management Area", 2012). The complex also provides ample public fishing access.

In addition, the Willard Wildlife Management Area is located in the Town of Ovid in Seneca County and consists of 135 acres of cropland and 23 acres of woodland which borders on Seneca Lake. Because of its past agricultural history, the crop land is rented to local farmers and income from rentals has been used to develop roads, trails, and parking areas. Other improvements to make this area more productive for fish and wildlife resources are planned for the future ("Willard Wildlife State Wildlife Management Area", 2012).

Office of Parks, Recreation and Historic Preservation Lands

The New York State Office of Parks, Recreation and Historic Preservation has a number of land holdings that lie within the Seneca Lake watershed. These are listed in Table 12.

Table 12. NYS OPRHP lands within the Seneca Lake watershed.

Land Unit Name	Land Unit Category	County	Acreage within Seneca Lake Watershed	Total Acreage
Sampson	State Park	Seneca County	2,038	2,038
Watkins Glen	State Park	Schuyler County	804	804
Mark Twain	State Park	Chemung County	467	467
Bonavista	State Park	Seneca County	250	250
Seneca Lake	State Park	Ontario/Seneca Counties	103	145
Lodi Point	Marine Facility	Seneca County	12	12
Parrot Hall	State Historic Site	Ontario County	1	1

Other Local Public Lands

An analysis of locally and privately-owned public lands produced an interesting array of lands throughout the watershed (Fig. 19). Most notable among them include the Keuka Outlet Trail, which is owned and maintained by Friends of the Outlet, a local non-profit organization working with the community to preserve, protect and develop the properties along the Outlet. GIS analysis indicated that the Friends of the Outlet presently owns and maintains 277 acres of land in the Towns of Milo and Torrey and Village of Penn Yan.

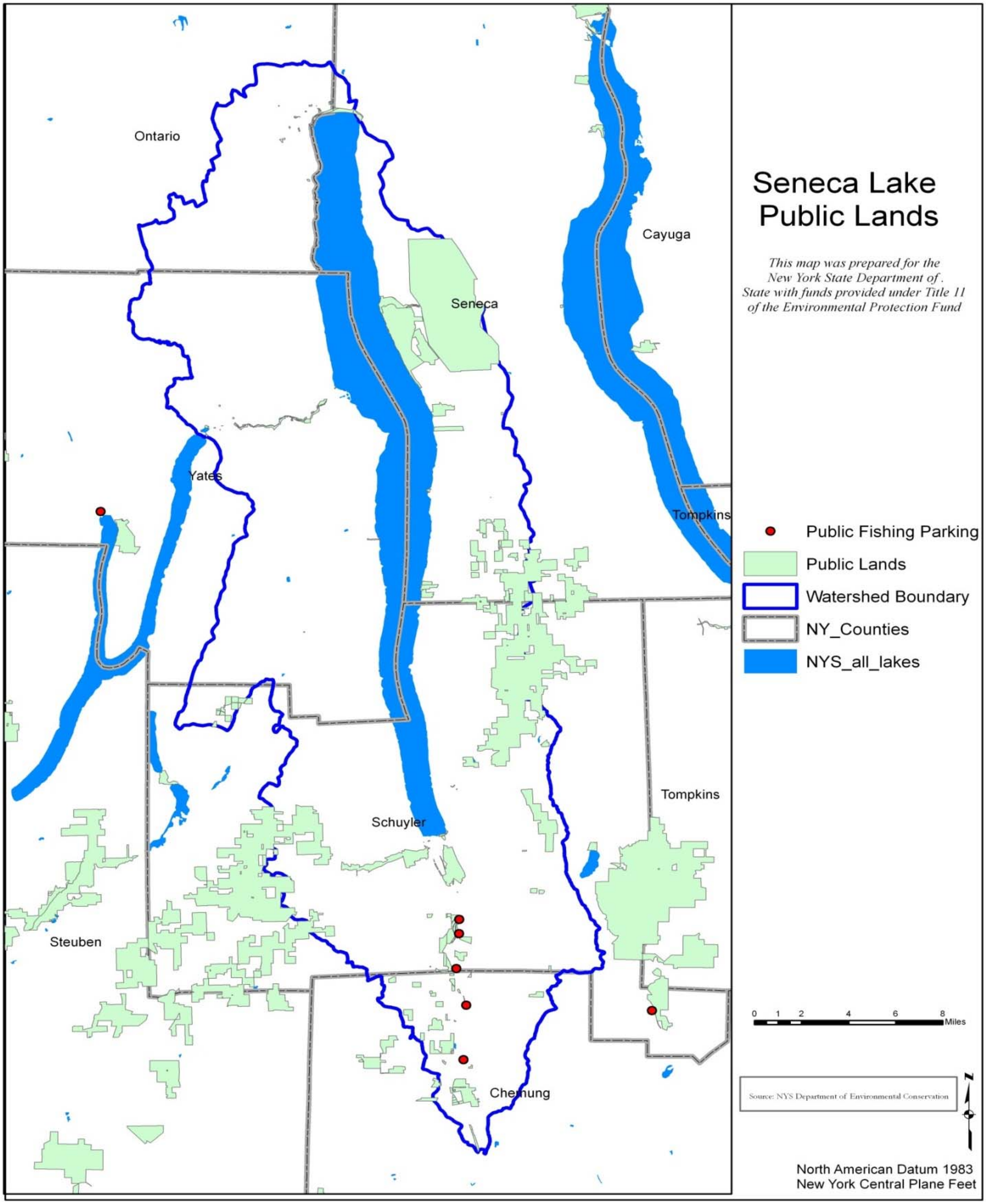


Fig. 19. Public lands [cemeteries excluded] in the Seneca Lake watershed.

The City of Geneva owns and maintains over 50 acres of parkland on the northern edge of Seneca Lake, which is contiguous with lands owned by the State of New York.

In addition to these lands, several small parcels of public land can be found scattered throughout the watershed which are located directly adjacent to Seneca Lake itself. While relatively small in size, these areas are extremely important public assets and can serve as important nodal linkages for public access across the lake.

New York State Open Space Conservation Plan

The *2009 New York State Open Space Conservation Plan* includes lists of regional priority conservation projects that have been identified by Regional Advisory Committees and through public comments received through the Plan's review process. Priority projects included on this list are eligible for funding from the State's Environmental Protection Fund, and other State, federal and local funding sources. The Plan states that, "For most of the project areas identified, a combination of State and local acquisition, land use regulation, smart development decisions, land owner incentives and other conservation tools used in various combinations, will be needed to succeed in conserving these open space resources for the long term" ("Open Space Conservation Plan", 2009). In addition to the Priority Projects listed in the body of the report, the Region 8 Advisory Committee also identified "Additional Priority Projects" warranting attention and focus for preservation and enhancement if resources allow.

Priority Projects

Finger Lakes Shorelines - While the Finger Lakes Region is identified in the 2002 Plan as a Major Resource Area and strategies such as acquisition of additional public access and consolidation of existing State projects are mentioned, the shorelines of these unique lakes are tied up in private ownership to a degree seldom seen in other states, so that most citizens have little direct experience of these beautiful lakes, even though their length provides hundreds of miles of shoreline. Public access for swimming, photography, shoreline fishing, and canoeing is minimal. Natural, forested shoreline is itself a scarce resource, incrementally lost over time to home site development.

Projects to preserve portions of the shoreline of these lakes for public access or wildlife could utilize acquisitions, easements, or additions to existing public segments. Parties including New York State, local governments, and non-profit organizations need to be prepared to capitalize on opportunities which will become increasingly critical as shoreline development and prices continue to climb. While it is not possible to predict future opportunities, several potential lakeshore protection projects can be listed now:

- Finger Lakes Water Trails – This is a network of strategically spaced open shoreline parcels to support low intensity and passive recreational uses, including: kayaking, boating, bird watching, angling, hunting, and simply seeking solitude by the water.
- Additional analysis is needed in order to identify other priority sites, especially on Seneca Lake where some of the greatest opportunities for currently undeveloped shoreline may exist.

Catharine Valley Complex - This unique Southern Tier complex extends from the southern end of Seneca Lake in Schuyler County, south to the Village of Horseheads in Chemung County. The complex is composed of three major environmental areas with varying habitats and recreational opportunities. Just south of Seneca Lake are towering shale cliffs bordered by Rock Cabin Road. This site harbors a rare plant community and an uncommon plant that is the exclusive food source for three butterflies considered rare in this region. The Wild Nodding onion, a rare species and listed on the NYS list of protected plants, grows in profusion on the cliffside. In addition more than 120 wildflower species have been identified on this site. Adjacent to Rock Cabin Road is the Queen Catharine wetland, identified as an Important Bird Area by the National Audubon Society. The second environmental area in this complex is the Horseheads Marsh, a Class 1 wetland and the largest freshwater wetland in Chemung County. The marsh is the headwaters for Catharine Creek, a world class trout stream and provides the stream with water quality and flood control functions. In addition, the marsh provides habitat for many species of birds (some on the endangered species list), wildlife and reptiles. The third focus in this complex is the abandoned Chemung Canal property, which passes through Horseheads Marsh. Purchase of this property will allow the Catharine Valley Trail connection to the Village of Horseheads by developing a trail along the historic Chemung Canal towpath. This complex offers opportunities to treasure and protect the biodiverisity present in the area and to expand recreational and educational opportunities in the valuable open space lands of the Southern Tier.

Seneca Army Deport Conservation Area - Located in the Towns of Varick and Romulus, Seneca County, this project is necessary to protect a unique population of white deer. The lands comprised part of a U.S. Army installation developed in the early 1940s and closed in the 1990s. The land is traversed by tributaries of four streams, and contains a 60-acre pond and nearly 500 acres of wetlands. The fenced perimeter allowed for the protection and management of the white deer herd, which is believed to be the largest, single herd of white deer in the world with approximately 200 individuals. The area also provides habitat for many species of birds and small game. As plans are devised for the development of the Depot, this project offers a unique open space opportunity (“Open Space Conservation Plan”, 2009).

Unabridged versions of the reports containing the regional priority project narratives and information on the identification process can be found in the Plan's Appendix A: Notes/Resources.

Wetlands

Wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin et. al., 1992). Wetlands serve a number of important functions within a watershed, including sediment trapping, chemical detoxification, nutrient removal, flood protection, shoreline stabilization, ground water recharge, stream flow maintenance, and wildlife and fisheries habitat. Numerous federal and state laws affect the use and protection of wetlands. Because no single one of these laws was specifically designed as a comprehensive policy for wetlands management, understanding how and when the various laws and levels of regulation apply can be somewhat confusing.

The principal federal laws that regulate activities in wetlands are Sections 404 and 401 of the Clean Water Act, and Section 10 of the Rivers and Harbors Act. Wetlands, as defined under the Federal Clean Water Act, are: “…those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (“Clean Water Act”, n.d.).

In 1986, the Emergency Wetlands Resources Act mandated that the US Fish and Wildlife Service complete the mapping and digitizing of the Nation’s wetlands. The result is the Wetlands Geospatial

Data Layer of the National Spatial Data Infrastructure. This digital data provides highly-detailed information on freshwater wetlands and ponds with numerous classifications and sub-classifications. Federal wetlands (referred to as the National Wetlands Inventory, NWI) in the Seneca Lake watershed are illustrated on Figure 20 below. An analysis of the NWI geospatial information by county is provided in Table 13.

Table 13. US Fish and Wildlife Service National Wetlands Inventory for the Seneca Lake watershed.

County	Total Acreage	*Freshwater Emergent Wetland*	*Freshwater Forested/Shrub Wetland*	*Freshwater Pond*	*Lake*	*Other*	*Riverine*
Chemung County	804.5	458.5	212.1	133.9			
Ontario County	2,042.9	298.0	1,690.5	48.6	5.7	0.2	
Schuyler County	10,234.6	1,174.2	1,900.4	317.7	6,746.2	4.1	92.0
Seneca County	22,504.2	102.8	1,127.8	60.3	21,213.4		
Yates County	18,227.2	435.0	2,078.3	178.4	15,504.3	0.6	30.8
Watershed	**53,813.5**	**2,468.5**	**7,009.0**	**738.9**	**43,469.5**	**4.8**	**122.8**

The principal New York State regulation affecting development activities in and near wetlands in the Seneca Lake watershed is the Freshwater Wetlands Act, Article 24 and Title 23 of Article 71 of the NYS Environmental Conservation Law. The NYSDEC has mapped the approximate boundaries of all freshwater wetlands of 12.4 acres or more in New York. In some cases, these maps include smaller wetlands of unusual local importance. An adjacent area of 100 feet is also protected to provide a buffer zone to the wetland (Fig. 20).

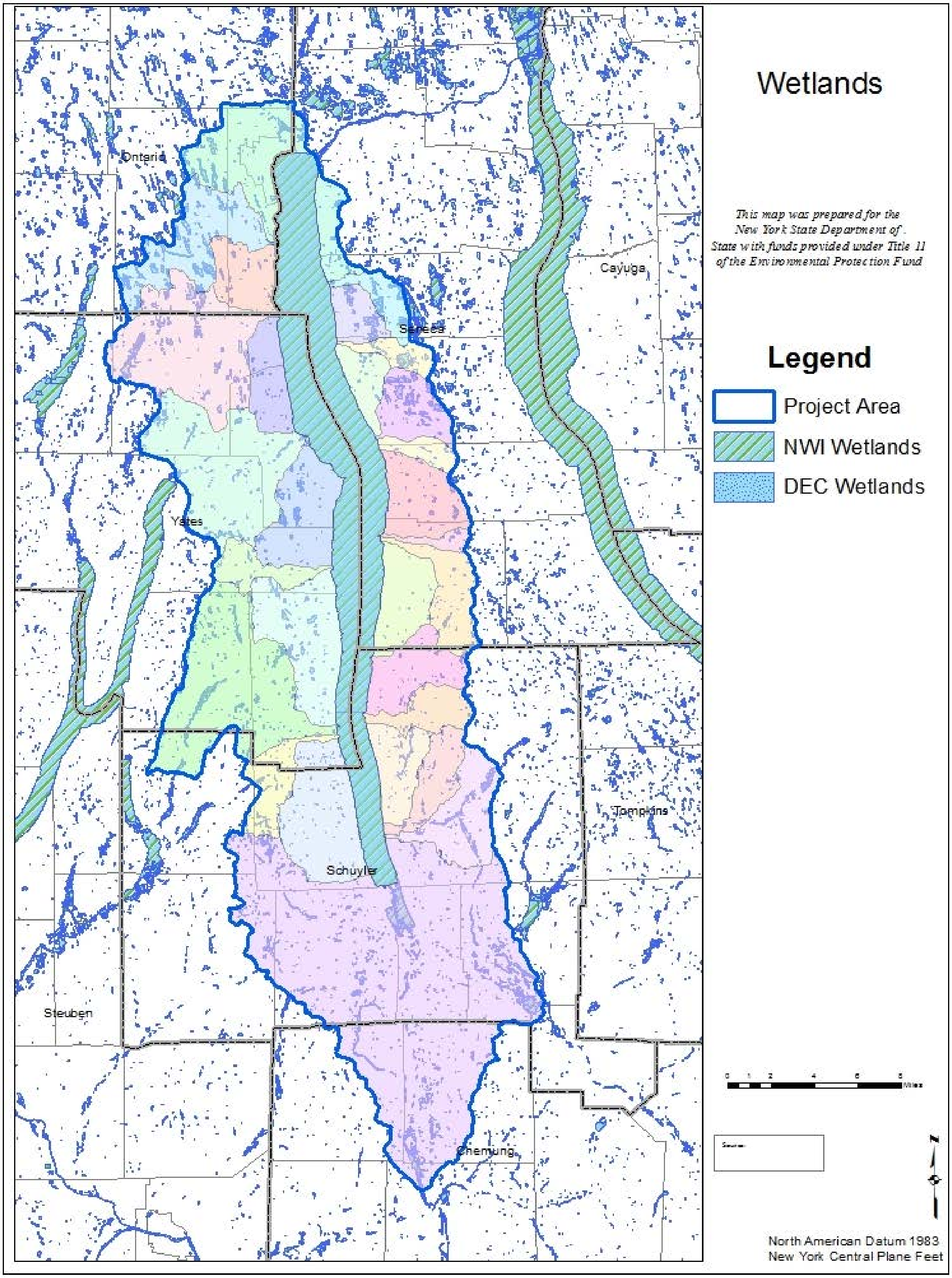


Fig. 20. Wetlands located within the Seneca Lake watershed.

Build-out Analysis

"Build-out" refers to a hypothetical point in time when a municipality (or, more specifically, a zoning district within a municipality) cannot accommodate any more development due to the lack of additional space as dictated by local land use regulations. Build-out scenarios are typically mathematical exercises that attempt to calculate the point in time when build-out is likely to occur given a projected rate of growth and development.

The intent of the build-out is not to generalize development as positive or negative but rather to illustrate when and where development may occur in order to consider the possible effects and plan ahead to manage these. Developments have the potential to affect water quality as well as the availability of open space and farmland among other things. The result of this analysis may indicate the need for local law review/revision to better guide development and protect local resources that are considered important.

Build-out scenarios are most accurate when they are focused on a very small area. Even when land use, zoning and development forecasts are readily available and accurate, build-out scenarios have limited application when generalized across a large land area or multiple zoning districts.

In light of these challenges, a concentrated approach was conducted in the Seneca Lake watershed in order to focus the analysis on areas that allow, and have potential for, single family residential development in the future (Fig. 21).

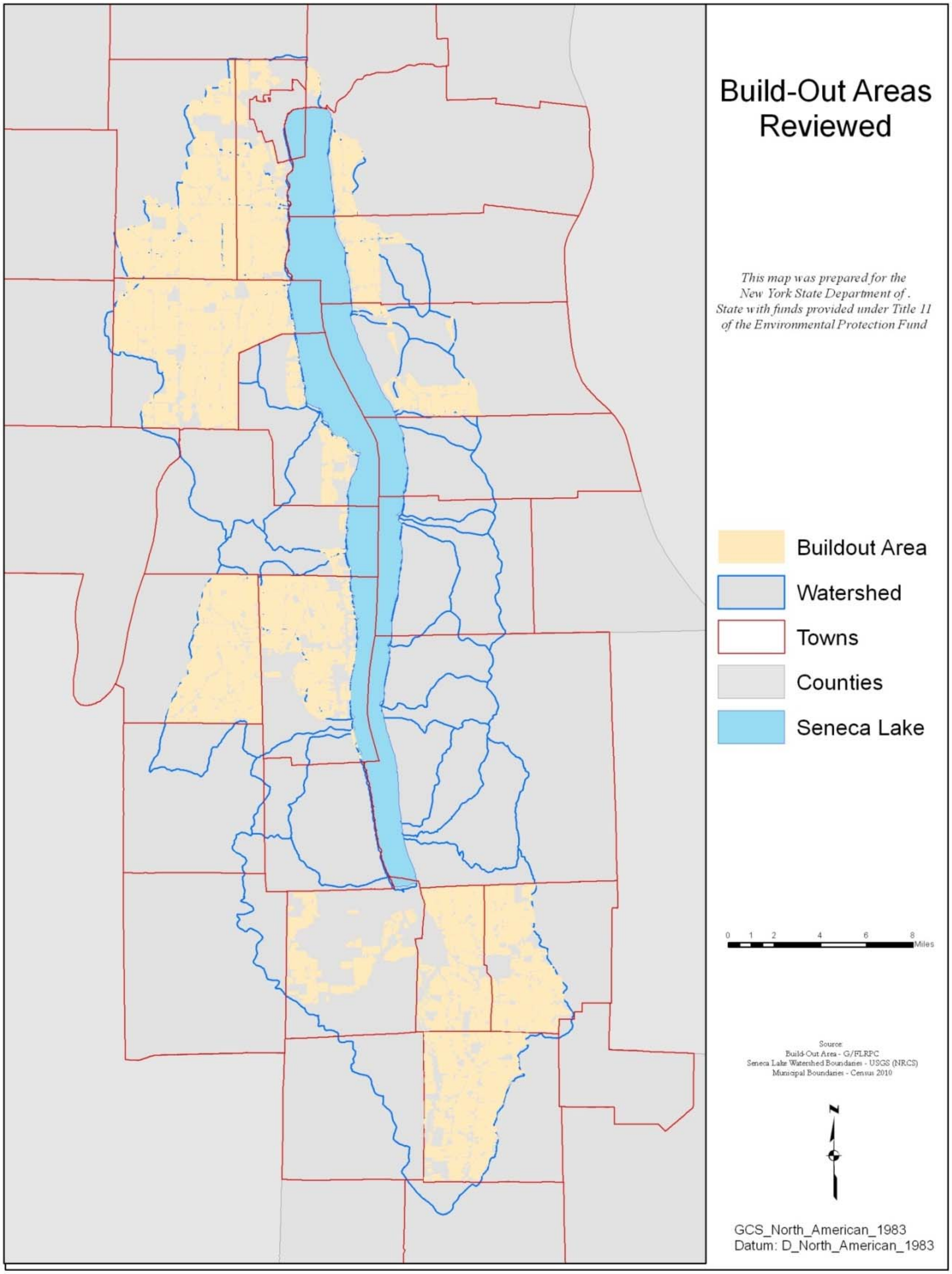


Fig. 21. Build-out areas in the Seneca Lake watershed.

In order to calculate build-out, a number of basic assumptions needed to be made. First, this model assumes that zoning laws regarding allowable uses and lot densities will remain the same over time. Next, the model requires a projected rate of growth to be assumed over time; this analysis used Census 2000-2010 municipal housing unit growth numbers as its basis for projected growth. Finally, the model should attempt to calculate or predict standardized constraints to development within a given area that would not be open to new home construction due to environmental restrictions or other physical constraints. This analysis included constraints such as areas of standing water, regulated/protected wetlands, and land that could be required for roads, parks, and other public services (see Appendix A-Notes/Resources).

Build-out Criteria

The areas considered for the build-out analysis were based on the following criteria:

- Villages were excluded - Most villages are often at or near buildable capacity, have limits to growth governed by their municipal boundaries or have significantly less developable land than towns.
- Only those zoning districts presently zoned 'residential' or 'agricultural' were analyzed.
    - While many agricultural areas in the watershed are deliberately zoned as such in order to protect and maintain agricultural uses, the model assumes that those protections may be waived by the land owner or municipality in lieu of residential development.
    - Mixed-use zoning districts were excluded as it would be nearly impossible to determine what the amount of land that would be developed in the future for each type of use.
- Towns without zoning were excluded – Towns with no zoning seldom have significant development pressure and this build-out method requires land-use regulations for its calculations.
- Only zoning districts that had access or potential access to public water or lake water were analyzed.
    - Water that is available either through public distribution or through extraction from Seneca Lake has the potential to induce faster residential growth and development.
- Only vacant residential, large lot residential or agricultural parcels equal to or larger than the minimum lot size for the zoning district were included in the analysis.

Limitations

Some limitations are apparent with this model based on the complexity of potential build-out, availability of data and the size of the watershed.

One limitation is that density of development is set based on minimum lot sizes which in turn shows the maximum number of single family homes that could fit within a zoning district. It is very difficult to predict if future development would occur at or near the minimum size. Often times lots are built much larger than minimum requirements.

One assumption regarding the availability of water can be considered a limitation. A zoning district that had a small amount of access to public water, including bulk lines, was considered to be developable throughout the entire zoning district. The assumption was made that future development could potentially tie into these lines but this may not be realistic as the decision to expand water infrastructure would have to be made along with available funding to do so. This may be most important to consider in some of the large agricultural zoning districts with little access to public water currently as it is unlikely that the whole zoning district would be connected to public water, but these areas were included in the study in order to illustrate the potential for this happening.

Build-Out Calculation

Results of the analysis are provided in Table 14. A full methodology of the build-out can be found in Appendix A- Notes/Resources.

Table 14. Estimated build-out for selected zones in the Seneca Lake watershed.

County	Municipality	Zone	Net Developable Land (acres)	Adjusted Developable Land (acres)*	Minimum Lot Size (sq. ft.)	Potential new units per zone	Potential new units per town (select zones)	Estimated unit growth per year**	Potential years until build-out occurs by zone	Potential years until build-out occurs by town (select zones)
Chemung	Veteran	RA	11,645.1	4,741.6	130,680	1,475	1,475	4.59	>100	>100
Ontario	Geneva (T)	A	6,906.3	4,017.6	45,000	3,852			>100	
Ontario	Geneva (T)	R1	1,451.1	917.0	15,000	2,658			>100	
Ontario	Geneva (T)	R2	48.7	28.5	15,000	82	6,592	9.2	9	>100
Ontario	Seneca	AG	13,926.8	***13,926.8	43,560	***444			>100	
Ontario	Seneca	R1	231.6	126.5	25,000	217			76	
Ontario	Seneca	R2	89.8	58.4	20,000	127	788	2.84	45	>100
Schuyler	Catharine	A1	8,768.6	2,723.1	87,120	1,296	1,296	-1.91	>100	>100
Schuyler	Dix	OSD	4,516.9	1,758.7	217,800	304			>100	
Schuyler	Dix	RR-C	290.0	161.6	45,000	151			>100	
Schuyler	Dix	RR-S	138.4	88.7	80,000	44	499	-1.68	>100	>100
Schuyler	Montour	RD	8,552.3	2,723.8	40,000	2,899	2,899	7.2	>100	>100
Seneca	Fayette	AR	2,108.3	1,352.3	40,000	1,467			>100	
Seneca	Fayette	L	26.2	8.8	40,000	9	1,467	3.4	3	>100
Seneca	Romulus	AG	3,250.1	1,970.4	43,560	1,950			>100	
Seneca	Romulus	HR	270.3	130.4	21,780	259			17	
Seneca	Romulus	LR	13.5	4.4	43,560	4	2,213	14.99	1	>100
Seneca	Varick	AGRR	3,232.7	2,027.3	30,492	2,889			>100	
Seneca	Varick	LR	123.0	78.5	30,492	112	3,001	1.9	59	>100
Seneca	Waterloo (T)	AG	393.6	228.7	30,000	331	331	0.52	>100	>100
Yates	Barrington	AR	11,575.4	6,083.7	43,560	5,981	5,981	10.37	>100	>100
Yates	Benton	AR1	18,368.0	11,114.0	40,000	12,048			>100	
Yates	Benton	ARB	1,433.1	852.5	40,000	917			85	
Yates	Benton	LR	31.7	19.7	40,000	21	12,986	10.77	2	>100
Yates	Milo	AMR	335.8	136.6	40,000	142			8	
Yates	Milo	RR	270.8	158.6	20,000	343	485	18.21	19	27
Yates	Starkey	A1	9,397.0	5,857.6	44,000	5,749			>100	
Yates	Starkey	R2	61.1	39.3	10,000	170			13	
Yates	Starkey	RR	814.4	187.7	44,000	166	6,085	13.5	12	>100
Yates	Torrey	AR	2,695.2	1,519.6	43,560	1,510	1,510	6.6	>100	>100

*Residential Land within watershed adjusted based on all constraints.

**Yearly average based on U.S. Census 10 year total unit growth by municipality. Estimate adjusted based on percentage of land within the watershed.

***Subdivision laws regulate in a way that would probably prevent any constraints from limiting developable land. Minimum lot sizes are 1 acre minimum but subdivision is limited to: 5-100acres - 2 lots, 100-150acres - 3 lots, 150-200acres - 4 lots, >200a

Results

As the table illustrates, most zoning districts could take over 100 years to be built-out based on current rates of growth and land use regulations, while a few could be built-out much sooner. All five zoning districts with a potential build-out of less than 10 years and two of the four zoning districts with a build-out between 10 and 20 years were adjacent to the shoreline of Seneca Lake. Most of the nine zoning districts that could be built-out in less than 20 years had small amounts of developable land in comparison to other zoning districts, also affecting the years until built-out.

Due to the very slow residential growth in the recent past and the vast amounts of undeveloped land available in targeted municipalities, a maximum build-out scenario is unlikely to occur in the next 100 years in all towns but Milo (projected to be built-out in 27 years).

While limitations may hinder this build-out's predictions, the model is still valuable and provides several useful insights.

The result of the calculation of net acres available for residential development (see Appendix A-Notes/Resources) is very useful. These are reliable figures that can provide local officials with a very rapid assessment of a zoning district's potential for further residential development.

Much of the land considered developable is productive farmland. Many build-out models operate under the assumption that residential uses are the highest market value and could eventually consume most farmland, but this is probably not the case here. The Seneca Lake watershed's specific location and quality soil types (which cannot simply be replicated elsewhere) have an influence on the value of the land being used for agriculture. This is especially true regarding the local wine and grape industry which has seen much success and is tied heavily to the soils and micro-climate surrounding Seneca Lake.

Although it is unlikely that all or most of the farmland in the watershed focus areas will be developed, the inclusion of farmland in the build-out should not be considered a limitation. There is still the potential for agricultural land to be converted to residential, and it is important to bring attention to the possibility. The demand for productive farmland vs. residential can quickly change at the local, regional, or statewide level. Unfortunately, while the demand and value can easily change, once agricultural land is developed, the possibility of ever changing it back to productive farmland is unlikely. If communities believe that preserving farmland is a priority than this build-out can be used as a gauge to determine whether land use regulations and practices are adequate or if they need to be expanded or revised.

Establishing better site planning and design standards and creating incentives for developers to conserve open space, farmland and natural areas could be a few ways to meet a community's demand for future growth without sacrificing environmental quality. These types of land often add value to the community and environment, but could be lost if a different use could be more profitable to the land owner. Decreasing minimum lot sizes and increasing density, mandating cluster subdivisions, conserving sensitive lands, and buffering water resources are among the tools and practices that can be incorporated directly into local law. By doing so, communities can make strides toward creating economically viable, yet environmentally sensitive development decisions. Such principles are already present in select municipalities and will be investigated in further depth in the Assessment of Local Laws, Programs and Practices Affecting Water Quality portion of the watershed management plan.

Municipalities should use the data within this analysis and seriously consider the type and amount of future growth and development that could occur and adjust land use policies and regulations to guide the future of their communities.

Related Infrastructure

Dams

The first dam on Seneca Lake was built at Waterloo in 1828. That dam, which included four sluice gates, was replaced with the present dam and navigation lock in 1916. Before the 1916 damn was built, the lake level in Seneca Lake fluctuated more and farmers were able to raise truck crops in the wetland area on the south end of the lake, now known as Queen Catharine Marsh. Flooding in the late 1800s lead to the creation of the NYS Water Storage Committee in 1902, whose purpose was to regulate river flow and to develop hydroelectric power sources. According to historical records, the farmers at the south end of the lake were opposed to this regulation since it would raise the lake so that farming would no longer be possible. They did not prevail. The Barge Canal, successor to the Erie Canal, was completed in 1917 and opened to boat traffic in 1918.

Outflow from Seneca Lake now passes though control structures at Waterloo and Seneca Falls (Fig. 22). There is a hydroelectric plant at Waterloo and a second one along the Cayuga-Seneca Canal. The level of the lake can be regulated by controls at the outlet or a control further downstream. During the winter the lake is drawn down to prevent ice and wind damage to docks and shore structures and to provide storage for spring runoff. In the summer the lake is stabilized to take into account priority uses of the lake such as boating (so convenient dock heights are considered.) Planned winter lake levels range between 445 plus or minus 0.3 feet. Summer levels are planned 446.0 plus or minus 0.3 feet. In the 1972 flood, lake levels rose to 450 feet. Flood stage is 448 feet.

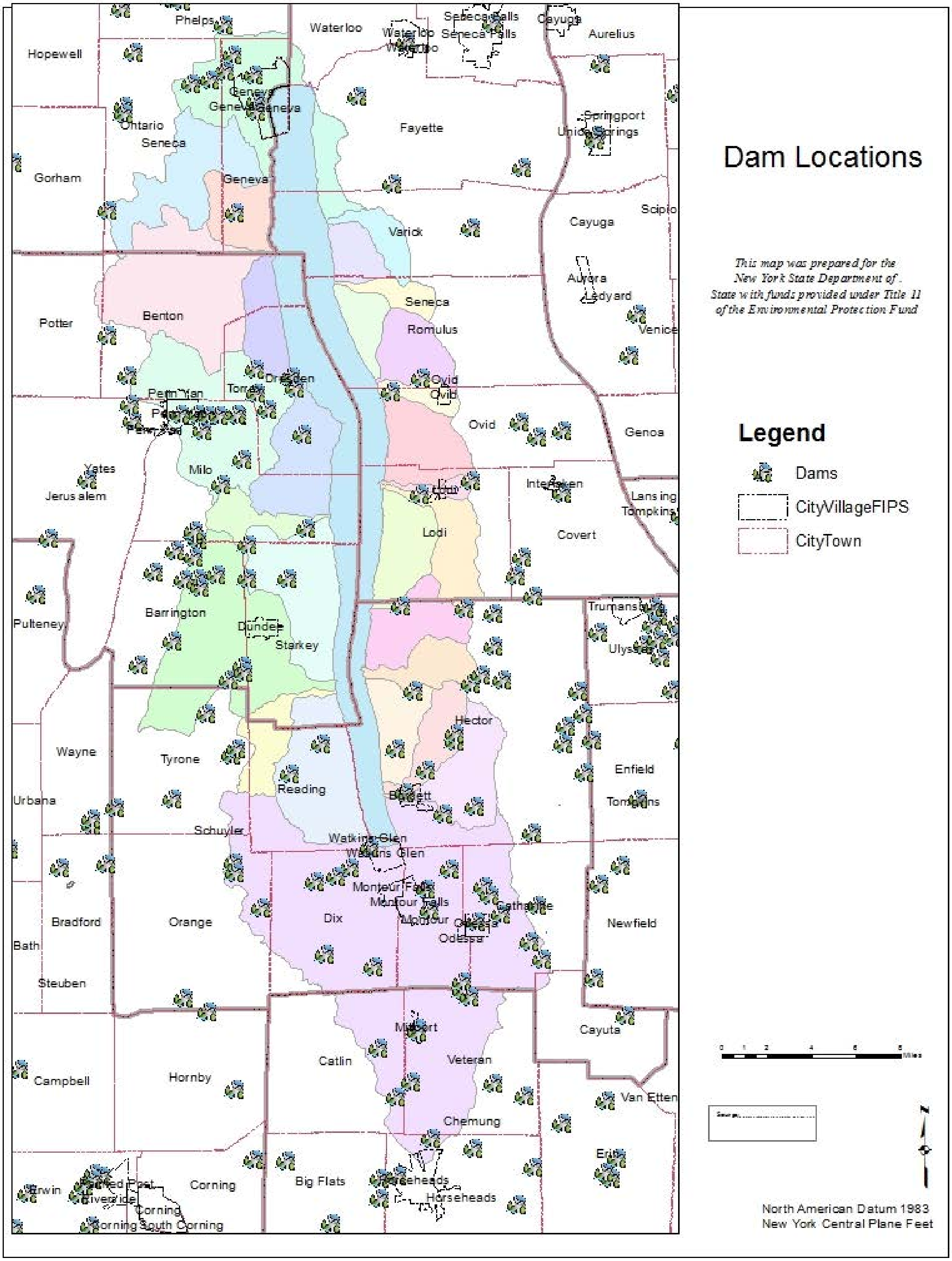


Fig. 22. Dam locations in the Seneca Lake watershed.

SPDES Permits

The State Pollutant Discharge Elimination System (SPDES) permit is a United States Environmental Protection Agency program for the control of wastewater and storm water discharge in accordance with the Clean Water Act. This program helps to control point source discharges to groundwater as well as surface water. A SPDES permit is needed for any construction activities that are using an outlet or discharge pipe that discharges wastewater into the surface or ground waters of the New York State, or for construction or operation of a disposal system such as a sewage treatment plant. According to NYSDEC, a total of 15 SPDES permits currently exist in the Seneca Lake watershed (Fig. 23).

- Ontario County 2 Permits
- Seneca County 3 Permits
- Yates County 5 Permits
- Schuyler County 4 Permits
- Chemung County 1 Permit

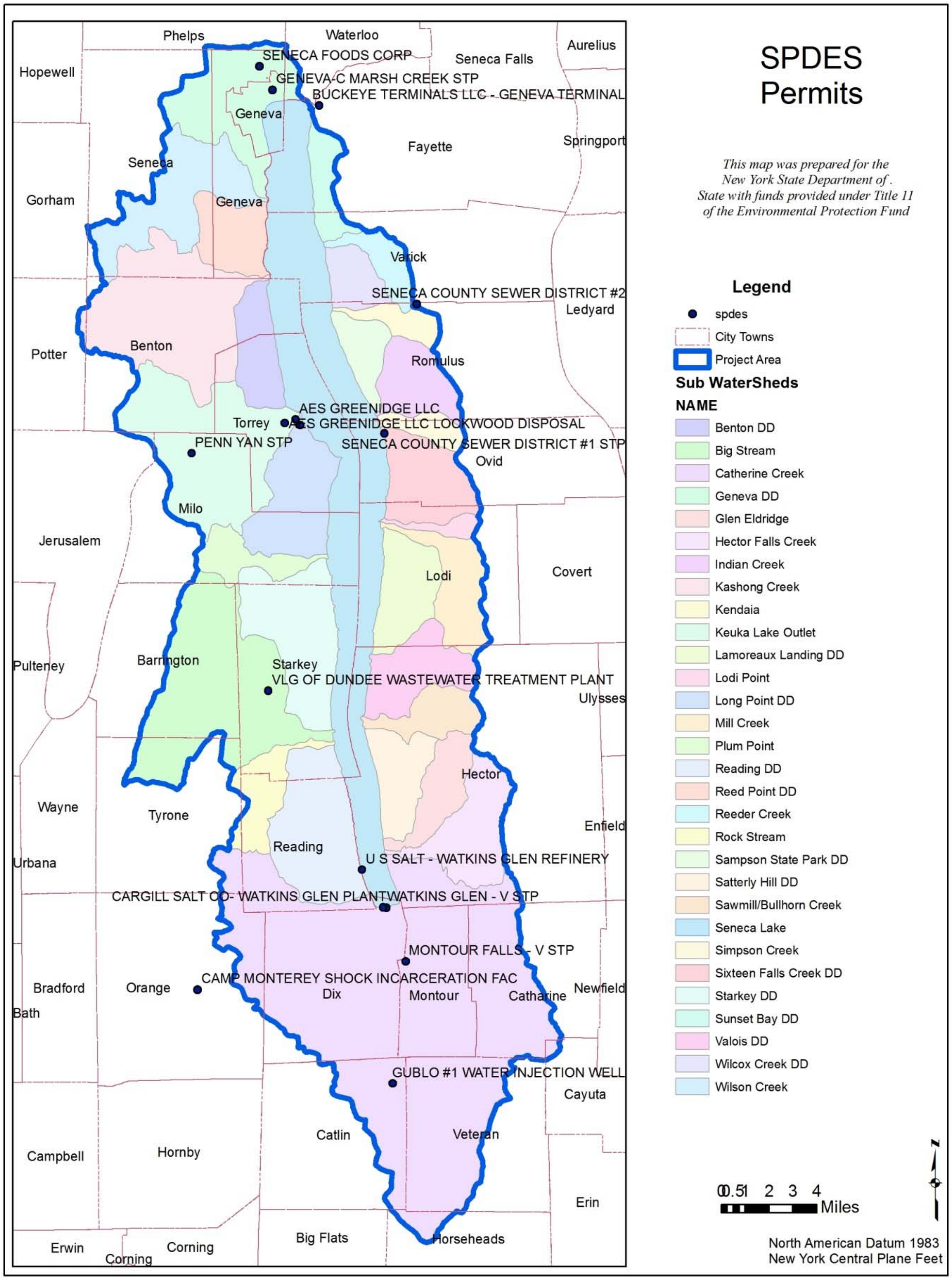


Fig. 23. SPDES permits in the Seneca Lake watershed.

Natural Gas and Marcellus Shale

Natural gas has been commercially drilled in New York State since 1821. It has been piped to towns for light, heat, and energy since the 1870s. The first storage facilities were developed in 1916. Hydraulic fracturing of vertical wells was first used in New York to develop low permeability reservoirs in the Medina Group around the 1970s-80s. Six new Trenton-Black River plays (underground reservoir rocks with fossil fuels) were discovered in 2005. There are dozens of plays across the country. Soon New York State may witness its first Marcellus Shale 'play'.

Recent advances in horizontal drilling and hydraulic fracturing have allowed extraction of natural gas from deep gas shale reserves, such as the Marcellus shale, to be economically feasible. The Utica Shale is a deeper and more expansive formation that may also have economic viability for the state. Both formations underlie the watershed. The Marcellus formation is exposed at the ground surface along the northern edge of the watershed (Fig. 9) and is found at progressive deeper depths southward towards Pennsylvania. The shale must be below approximately 3,000 ft. of overlying rock before it is a successfully play. The Marcellus is at or deeper than this depth near the southern edge of the watershed and into the Southern Tier.

The increased demand for cleaner energy and the proximity of these reserves to the Northeast's population hubs makes these particular 'plays' significant. There are certain financial benefits landowners may receive for leasing their land and certain economic gains a community could reap, but there will be challenges and costs that are associated with these benefits.

New York State Department of Environmental Conservation is developing the Generic Environmental Impact Statement to permit high volume hydraulic fracturing natural gas by horizontal well extraction. Many wells that are not considered high volume hydraulic fracturing wells have already been permitted. Figure 24 shows the current NYS Department of Environmental Conservation permitted natural gas wells. The developing horizontal well regulations are designed to ensure that all natural gas extraction is safe, does not significantly disrupt the natural flow of surface (or ground) water to make the hydrofracking fluids, and hydrofracking fluids will be disposed of safely as to not pollute our local water sources. This is vital in the Seneca Lake watershed as the surface and ground water is the source for Class AA drinking water for residents in the watershed. Furthermore, Seneca Lake is key to the tourism industry, and this primary economic driver would be damaged if the lake was polluted.

The associated storage and transmission of natural gas are also under development. Petroleum industries are seeking a permit to storage liquid petroleum in the Seneca Lake natural gas storage facility located in Schuyler County, New York, and have developed two related pipelines for approximately $65 million from New York State Electric & Gas Corporation ("Salt Cavern Storage", 2012). The Watkins Glen facility has abandoned salt caverns filled with salt brine that could be used to store liquid petroleum and natural gas. This proposed use provides some concerns as the liquid petroleum or salt brine could contaminate the lake and its watershed.

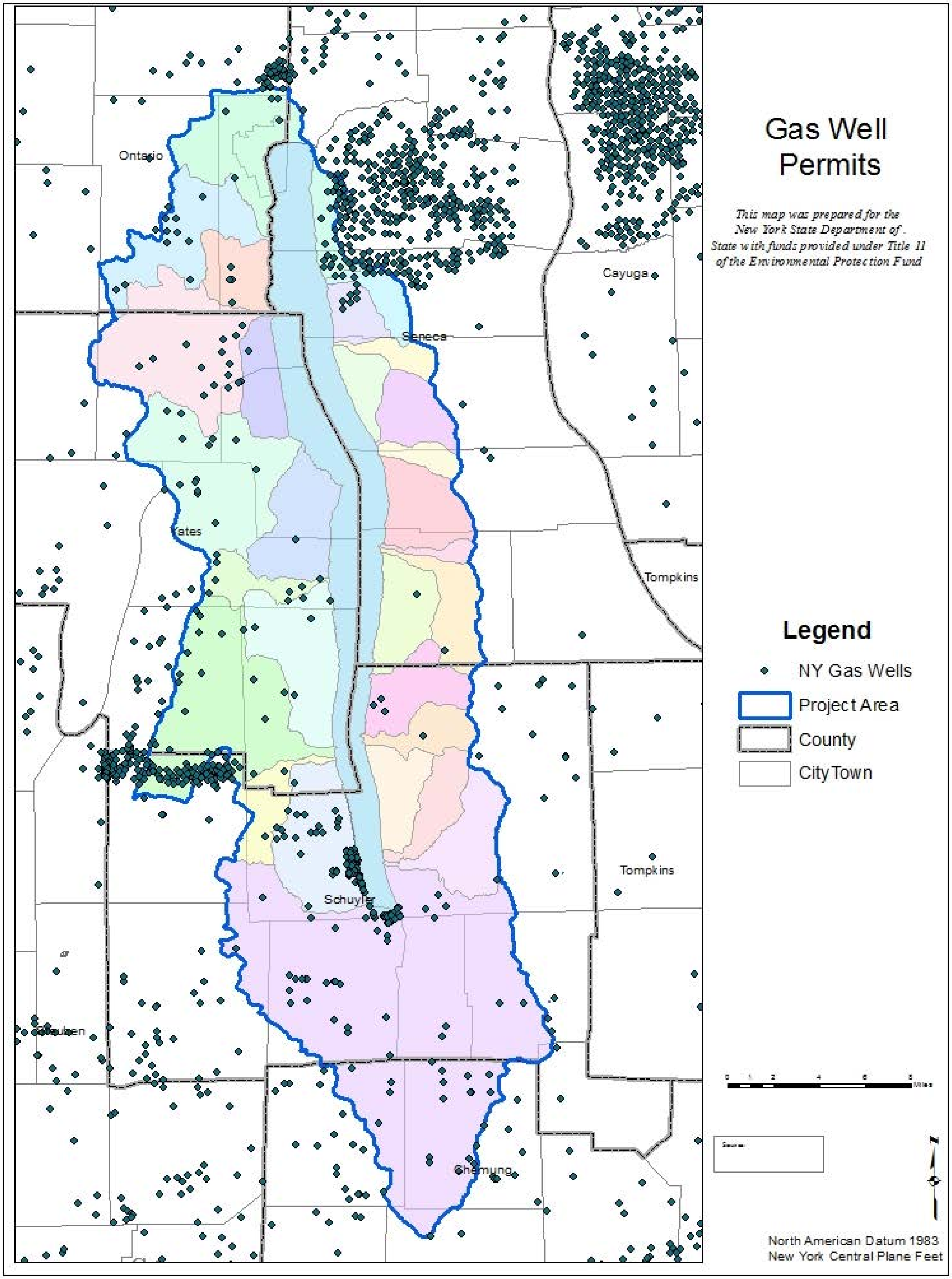


Fig. 24. Gas well permits in the Seneca Lake watershed.

Mining

The Seneca Lake watershed has 40 permitted, primarily open-pit, mine operations (Fig. 25). The most common mines are Sand and Gravel, Topsoil, Limestone and Shale primarily used in the construction industries. The southern end of Seneca Lake watershed has the most mines, with 25 mines in Schuyler County. There are a total of 40 mines permitted within the watershed boundaries. These mines are permitted though NYSDEC. NYSDEC currently permits approximately 2,100 active mines throughout New York State. Due to mining reclamation laws, most mines are bonded, which preserves funds to reclaim the mine after operations cease.

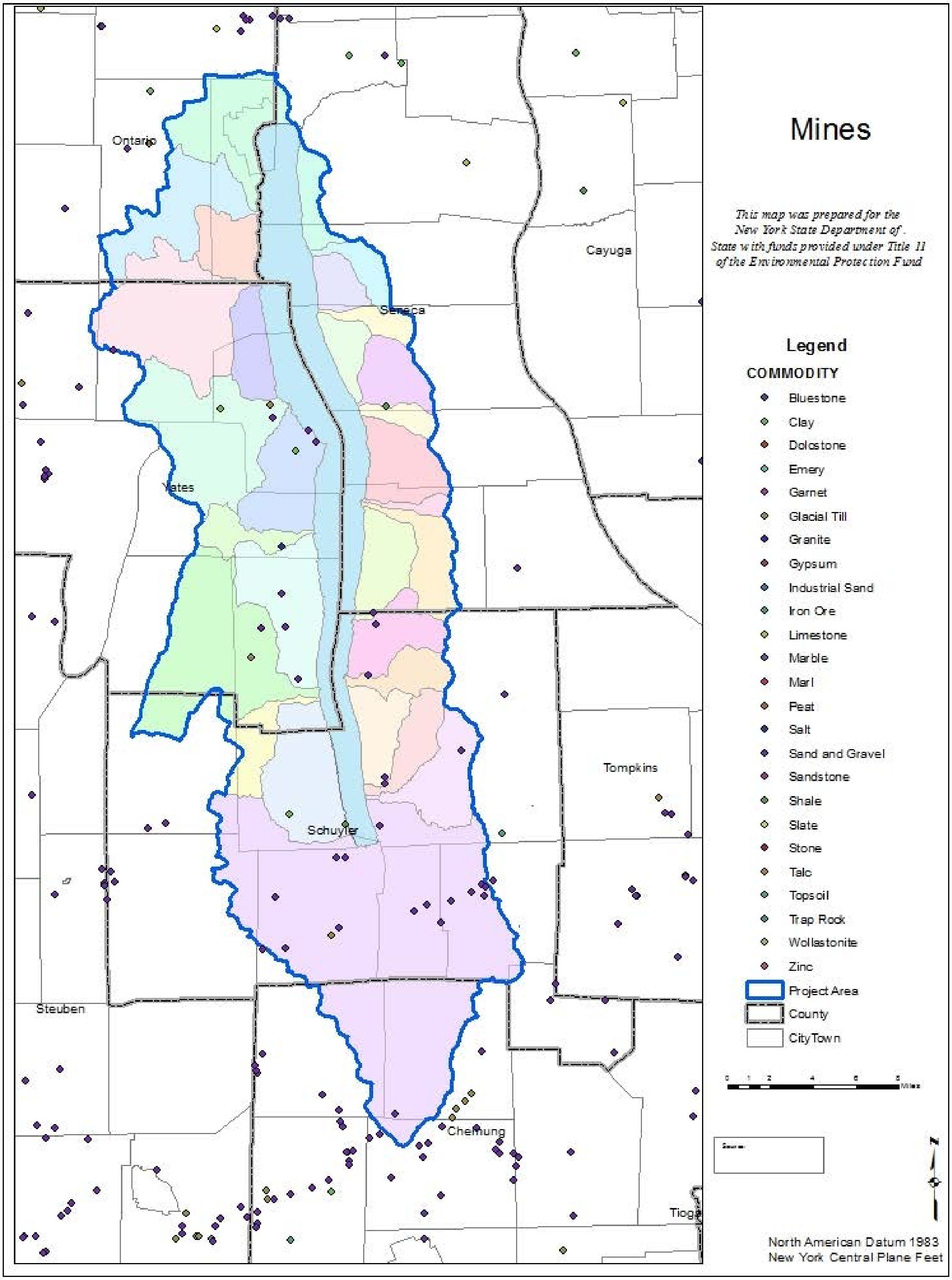


Fig. 25. Surface and subsurface mines in the Seneca Lake watershed.

Mined lands are of particular concern, as they can be a source of pollution within the Seneca Lake watershed. To mine lands, often large amounts of land are disturbed and this can increase the amount of erosion and sedimentation that can run off into nearby streams, rivers and the lake. New York State Environmental Conservation Law requires that runoff from the distributed lands be stored or detained to reduce potential for flooding, erosion, siltation and pollution. With the potential increase in natural gas extraction developments, more sand and gravel will be needed to run the natural gas pipes throughout the region. There is an expectation that sand and gravel mining will grow throughout the Seneca Lake watershed.

Surface mining provides the raw materials for consumer goods. It is the basis for many construction projects. The availability of "hydraulic" cement was as important in the success of the Erie Canal as it is to the maintenance of the New York State Thruway. Mines provided materials to improve the standard of living and the quality of life.

However, during the last five to ten years, there has been a steady decrease in the number of mines and mining applications in New York. This is because most mines produce materials used for construction aggregates, that is, crushed stone and sand and gravel. These are products that are high in volume but low in value. They must be produced close to market lest the value of transporting the material to the site of use exceeds the valued of the product itself. Depending on variables such as the cost of fuel and traffic congestion, the cost of hauling distances of thirty miles or less can be greater than the value of the material being delivered (Kelly, 2010).

NYSDEC's Waterbody Inventory and Priority Waterbodies List (WI PWL)

The Oswego River / Finger Lakes Waterbody Inventory and Priority Waterbodies List (PWL) published by the NYSDEC) in 2008 divides Seneca Lake (Ont 66-12-P369) into three sections, the extreme northern, middle and extreme southern, portions of the lake. The drinking water suppliers drawing directly from this waterbody include the City and Town of Geneva, the Village of Waterloo, and Village of Ovid, and all three draw from the Middle section ("Oswego River/Finger Lakes PWL", 2012). The NYSDEC rates segments of the watershed that reveal the degree of severity of the water quality problem or diminished use. Minimal changes were noted from those published in the 1999 State of the Seneca Lake Watershed report (Appendix C).

Water Quality Classifications

The main lake, northern section (0705-0026), reveals no known use impairment. This segment includes the portion of the lake north of an east-west line extending from Pastime Park on the east shore to a point 0.2 miles south of the City of Geneva on the west shore. This portion of the lake is Class B(T). These results are based on NYSDEC samples and Finger Lakes Water Quality Report (Callinan, 2001) from approximately a decade ago, thus a bit outdated. It characterizes this section of the lake as oligomesotrophic, between poorly to moderately productive. Hypolimnetic waters remain well oxygenated throughout the growing season. Recent sampling also reveals a significant decline in chloride and sodium levels (Callinan, 2001). The report further states that the lake supports a productive fishery of lake, brown and rainbow trout, landlocked salmon, perch, pike and smallmouth bass. Lake trout, brown trout and landlocked salmon have been stocked in the lake; the lake supports wild populations of the other species.

Impacts to the fishery from invasive species are a threat and a concern. The sea lamprey eel first appeared in the lake in the 1960s. Control of the lamprey by chemical treatment of spawning streams has been conducted over the past 25 years and has been largely successful. Zebra and quagga mussels have arrived in the lake more recently. These filter feeding species have significantly reduced algae in the lake, especially in the late 1990s. Similarly, the fishhook water flea is a carnivorous zooplankton whose feeding on herbaceous zooplankton reduces the supply of algae to the rest of the aquatic ecosystem.

The main lake, middle section (0705-0021), reveals possible threats to water quality as it related to its use as a water supply. This segment includes the portion of the lake south of an east-west line extending from Pastime Park on the east shore to a point 0.2 miles south of the City of Geneva. The southern boundary is defined by an east-west line from the mouth of an unnamed tributary (-58) on the eastern shore to the mouth of Quarter Mile Creek (-61) on the western shore (near Salt Point, Watkins Glen). This portion of the lake is primarily Class AA(TS); the portion of the lake within an one mile radius of the mouth of Keuka lake Outlet is Class B(T). The resolution potential is high, i.e., worthy of the expenditure of available resources (time and dollars) because the level of public interest is high, and unnamed management strategies are being implemented. The water supply use of this portion of the lake may experience minor threats due to various activities in the watershed.

A recent NYS Department of Health Source Water Assessment Program (SWAP), which estimates the potential for untreated drinking water sources to be impacted by contamination ad not the safety of quality of treated finished portable water, found an elevated susceptibility of contamination for this source of drinking water. Specifically, the amount of agricultural lands in the assessment area results in elevated potential for phosphorus, disinfectant bi-product precursors, and pesticides contamination. While there are some facilities and industries present, permitted discharges do not likely represent an important threat to source water quality based on their density in the region. However, it appears that the total amount of wastewater discharged to surface water in this area is high enough to raise the potential for contamination. Some susceptibility associated with other sources, such as landfills, was also noted (NYSDOH, Source Water Assessment Program, 2004). The inclusion of this waterbody on the NYSDEC Priority Waterbodies List as a threatened water is a reflection of the particular resource value reflected in this designation and the need to provide additional protection, rather than any specifically identifiable threats.

The main lake, south section (0705-0014), reveals no known use impairment. This segment includes the portion of the lake south of an east-west line extending the mouth of an unnamed tributary (-58) on the eastern shore to the mouth of Quarter Mile Creek (-61) on the western shore. This portion of the lake is Class B(T), as defined by the criteria below. No additional comments were reported for this section not already mentioned in the other two sections.

The following creeks and tributaries were designated as no known use impairment: Mill Creek, Saw Mill Creek, Hector Falls Creek, Catharine Creek, Rock Stream, Big Stream Keuka Lake Outlet, and Sugar Creek. The following creeks and tributaries have not been assessed by NYSDEC: Reeder Creek, Indian Creek, Mitchell Hollow Creek, Glen Creek, Old Barge Canal, Shequaga Creek, Upper reaches of Big Stream, Plum Point Creek, upper reaches of Sugar Creek, Wilson/Burrel Creek, and various minor creeks along Seneca and Keuka Lakes. Almost all of these assessed creeks and tributaries were classified as Class C. A few were classified as A, C(T), C(TS) or D. Class A was Johns Creek. C(T) was Cranberry Creek, and Keuka Lake Outlet. C(TS) was Sawmill Creek, Bullhorn Creek, Hector Falls Creek, Catharine Creek, Catlin Mill Creek, Glen Creek, and upper portion of Big Stream. Class D was found in the lower portion of Big Stream, and various tributaries to Keuka Lake.

The following criteria are used in order of high to low impairment:

- **Precluded (P)**: frequent and/or persistent impairment prevents all aspects of waterbody use including drinking, bathing/swimming, fish consumption, and fish propagation.
- **Impaired (I):** Occasional water quality or quantity, conditions and/or habitat characteristics periodically prevent the use of the waterbody, e.g., high coliform levels due to stormwater runoff, fish consumption advisories. Drinking water requires additional/advanced measures for treatment.
- **Stresses (S):** Waterbody uses are not significantly limited or restricted, but occasional water quality, or quantity conditions and/or associated habitat degradation periodically discourage the use of the waterbody.
- **Threatened (T):** Water quality currently supports waterbody uses and the ecosystem exhibits no obvious signs of stress, however existing or changing land use patterns may result in restricted use of ecosystem disruption (e.g., residential development). The classifications are defined below:
- **Class AA:** The best usages of Class AA waters are: a source of water supply for drinking, culinary or food processing purposes, primary and secondary contact recreations, and fishing. The waters shall be suitable for fish, shellfish, and wildlife propagation and survival. This classification of waters, if subjected to approved disinfection treatment, meet or will meet NYS Department of Health drinking water standards.
- **Class A:** The best usages of Class A waters are: a source of water supply for drinking, culinary or food processing purposes, primary and secondary contact recreations, and fishing. The waters shall be suitable for fish, shellfish, and wildlife propagation and survival. This classification of waters, if subjected to approved coagulate sedimentation, filtration and disinfection treatments, meet or will meet NYS Department of Health drinking water standards.
- **Class B:** The best use of Class B waters are primary and secondary contract recreation and fishing. The waters shall be suitable for fish, shellfish, and wildlife propagation and survival.
- **Class C:** The best use of Class C waters is fishing. The waters shall be suitable for fish, shellfish, and wildlife propagation and survival. The water quality is suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
- **Class D:** The best use of class D waters is fishing. Due to natural conditions as intermittent flow, water conditions not conductive to propagation of game fishery, or stream bed conditions, the waters do not support fish propagation. The waters shall be suitable for fish, shellfish, and wildlife survival. The water quality is suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.
- **Class SA SB or SC:** Waters too saline for drinking, but suitable for A, shell fishing, B, primary and secondary recreation and fishing, and C, fishing.

The symbol (**T**) in the standards column in the classification means that the classified waters are trout waters. Any water quality standard, guidance value, or thermal criterion that specifically refers to trout or trout waters applies. The symbol (**TS**) distinguishes the waterbody as a trout spawning waters. Any water quality standard, guidance value, or thermal criterion that specifically refers to trout spawning or trout spawning waters applies.

Chapter 3: Watershed and Subwatershed Habitats

Habitat of Fisheries

Seneca Lake supports an important fishery for primarily lake trout *Salvelinus namaycush*, although brown trout *Salmo trutta*, Atlantic salmon *Salmo salar* and rainbow trout *Oncorhynchus mykiss*) provide added diversity to the salmonine catch. Connelly and Brown (2009) estimated that a total of 340,000 angler days occurred on Seneca Lake in 2007, making it the 8th most heavily fished waterbody in New York and the most heavily fished Finger Lake. Anglers spent an estimated $8.5 million dollars related to fishing in Seneca Lake (Connelly and Brown, 2009). Salmonine fishing accounted for about 33% of targeted effort. Seneca Lake is also known for its high quality yellow perch *Perca flavescens* fishery fishing. Smallmouth bass *Micropterus dolomieui* and northern pike *Esox lucius* fishing has historically been excellent although based on angler reports, populations appear to have recently declined.

Historically, alewives and smelt, although not native to these lakes, have provided excellent forage for predators in Seneca Lake. Recently, the smelt population has significantly declined. Potential reasons for this decline include the invasion of zebra mussels *Dreissena polymorpha* in the mid 1990s and more recently quagga mussels *D. burgensis*, and resultant impacts on the base of the food chain (Hammers et al. 2007). Additionally an increase in lake trout abundance may also have negatively impacted these forage populations (Hammers and Kosowski, 2011). Chiotti (1980) provides pre-*Dreissenid* descriptions of the ecology and biology as well as a fisheries management plan for Seneca Lake.

The native lake trout are the dominant salmonine in Seneca Lake, and the City of Geneva, located at the north end of Seneca Lake is dubbed the "Lake Trout Capital of the World". Although native to Seneca Lake, records indicate that lake trout were stocked in 1894 (Chiotti, 1980), and more consistent stocking began in the 1930s (NYSDEC stocking records, Avon). Seneca strain lake trout have been the primary source of stocked lake trout throughout the New York state as well as numerous other states. They have been highly valued throughout New York and the Great Lakes as they have been thought to be more tolerant of sea lamprey *Petromyzon marinus* attacks than other strains of lake trout. Therefore measures to ensure their continued success are warranted.

Natural recruitment of lake trout has fluctuated throughout the years. Naturally spawned lake trout were estimated to be as high as 70% of the population in the 1950s (Webster 1959) to only 5% in 1980 (Kosowski, 1980). Factors including increased predation by sea lampreys (Chiotti, 1980), degradation of spawning habitat (Sly and Widmer, 1984), possible predation by smelt (Sly and Widmer, 1984), and Early Mortality Syndrome (EMS), a result of thiamin deficiency from alewife consumption were suggested to account for this reduction. More recently, natural recruitment of lake trout has been estimated to be at least 60% of the lake population (Hammers and Kosowski, 2011), and has resulted in recent reductions in lake trout stocking. Potential reasons for this increase relate to reduced predation as the smelt population disappeared, increased spawning habitat and interstitial spaces created by *Dreissenid* populations, and a reduction in EMS as alewife populations decreased (Hammers and Kosowski 2011). However, more research is needed, especially to see if *Dreissenid* beds have created additional spawning habitat or have further degraded it.

Currently, rainbow trout populations in Seneca Lake are self-sustaining, relying primarily on quality tributaries such as Catharine Creek and its tributaries for both spawning and nursery habitat. However, there is growing concern from NYSDEC staff and anglers about a decrease in the rainbow trout abundance primarily during the spring spawning run in Catharine Creek (Hammers, 2011; Hammers and Kosowski, 2011). Although numerous tributaries along the lake provide spawning habitat for rainbow trout, production is limited in these tributaries because of the relatively short stream reaches due to impassible falls related to steep topography surrounding the lake. Catharine Creek and its tributaries have no such barriers and result in the production of the majority of rainbow trout in Seneca Lake. Rainbow trout were introduced in 1910 (Chiotti, 1980). Recent population declines have been linked to abundant lake predators, primarily lake trout, reduced lake forage, which provide a buffer between young rainbow trout and lake predators, and to changes in stream habitat.

Historically, Catharine Creek has been subjected to extensive manipulation by flooding, extreme fluctuations in water levels, and man induced activities, both detrimental (i.e. bulldozer activities-stream channelization, flood control improvements) and beneficial (i.e. pool diggers, log cribbing, bank stabilization) (Heacox, 1943; Hartman, 1958). Stream conditions were generally favorable for trout spawning, but warming water and lack of pools and other cover resulted in poor nursery habitat. Thus, rainbow trout migrated to Seneca Lake in summer months during their first year (Hartman, 1958). Extensive habitat improvement in 1950s and 60s along with increased protection of water quality and habitat through regulatory processes improved Catharine Creek as a trout nursery stream (Kosowski, 1988) as evidenced by results from the 1970s production surveys showing decent numbers of age 1+ and older trout in the late summer.

In 1996, extensive flooding followed by extreme flood control measures utilizing heavy equipment by NYSDEC emergency personnel resulted in significant damage to both spawning and nursery habitat, both manmade and natural, in Catharine Creek. This likely resulted in stream conditions similar to those described by Hartman (1958) resulting in earlier rainbow trout migrations to the lake, potentially accounting for the lower abundance of young of year (YOY) and age 1+ and older trout found in recent production studies. As part of the 1996 Clean Water, Clean Air Bond Act grant program, extensive stream and bank restoration and improvements occurred in the early 2000s (Sanderson, 2000). This work included extensive bank stabilization using rip-rap, numerous pool diggers both on Catharine Creek and Sleepers Creek, and willow plantings to provide shading. These stream improvements should provide additional cover and habitat for both YOY and age 1+ and older trout hopefully delaying their return to the Seneca Lake until at least age 1+.

Negative impacts of sea lamprey on salmonine populations have been well documented in Seneca Lake (Jolliff et al., 1980, Engstrom-Heg and Kosowski, 1991). Sea lamprey control measures have been used successfully in Seneca Lake since 1982. Treatment guidelines were established by Kosowski and Hulbert (1993) based on the evaluation of a five-year experimental program using lampricides to treat Seneca Lake (Engstrom-Heg and Kosowski, 1991). Since 1982, Catharine Creek and Keuka Lake Outlet, have been treated with the lampricide TFM (3-trifluoromethyl-4'-nitrophenol) a total of nine and six times, respectively, with the most recent treatment of Catharine Creek occurring in 2011. To maintain adequate control of sea lamprey populations, stream treatments are recommended every three years (Kosowski and Hulbert 1993). The delta areas off Catharine Creek in Watkins Glen and Keuka Lake Outlet in Dresden were treated with Bayer 73 (niclosamide) in 1982 and 1986. In 2008, a 41 acre portion of the Dresden Delta in the immediate vicinity of the mouth of Keuka Outlet was treated with Bayluscide (niclosamide). Additionally, a 10 acre portion of the Catharine Creek Canal, a slow moving section immediately downstream of Catharine Creek was treated with Bayluscide in 2008. NYSDEC fishery personnel visually inspected 49 tributaries to Seneca Lake in 2006 to determine likelihood of sea lamprey spawning or nursery habitat. Only three streams had suitable habitat, however sampling yielded no ammocoetes (NYSDEC, unpublished data).

Experience gained from sea lamprey control efforts since 1982 and new methods employed in the Great Lakes and Lake Champlain sea lamprey programs provide guidance for developing specific control strategies for streams and delta areas in Seneca Lake. Increased knowledge of sea lamprey distributions and abundance, recolonization of treated areas, efficacy and longevity of control processes, assessment techniques and applicability of control techniques have contributed to the development and refinement of sea lamprey control methodologies. Sea lamprey control techniques currently under development (sterile male releases, pheromone attractants) are recognized and will be scrutinized for application to Seneca Lake if and when they become feasible for use as part of the Finger Lakes sea lamprey control program. Flexibility will be an important component of an effective sea lamprey control program because sea lamprey distribution and production are not static.

Other Habitats

Besides habitats for lake trout and other fisheries, other habitats are important for the overall ecology of the Seneca Lake watershed, and include the profundal lake floor, nearshore macrophyte beds, streams and stream corridors, wetlands and buffering lands, as well as forested shorelines in the watershed. These habitats and the native species are stressed by exotics, including the zebra and quagga mussels, Eurasian watermilfoil, *Cercopagis pengoi* and other plankton. Native populations are also on the decline. For example, benthic *Diporeia* populations are declining, and the decline is a concern because they form an important link in the food chain for lake trout and other fish species. The nearshore macrophytes form an important habitat for the growth and development of many plankton and fish species, yet can be a nuisance for lakeshore property owners. *C. pengoi*, a carnivorous zooplankton, presents a “top-down” ecologic stressor. These details are described more fully in *Chapter 4: Seneca Lake Limnology and Stream Hydrochemistry*. Unfortunately, much less is known about streams, stream corridors and upland habitats, and wetlands and buffering lands in the watershed and should be the focus of additional research.

Chapter 4: Seneca Lake Limnology and Stream Hydrochemistry

Introduction

Since the pioneering limnological investigations by Birge and Juday (1914), and summaries by Schaffner and Olgesby (1978), only a few groups have monitored Seneca Lake and/or its watershed until 1990. The NYSDEC included Seneca Lake in its regional survey of lakes and streams (Callinan, 2001), and has not issued a report since. Other federal, state, regional, county or local groups have investigated one or more water quality aspects but never in a systematic and extended way. For example, Dr. Dawn Dittman, USGS Cortland, systematically collected and analyzes sediment samples to assess the benthic invertebrate community. Dr. Bin Zhu, U Hartford, CT collected zebra and quagga mussels and macrophyte surveys at various locations and depths around the lake. Dr. Hank Mullins, Syracuse U., collected and analyzed sediment cores for records of environmental change preserved in the sediments. Debra Smith, Finger Lakes National Forest, has preliminary data on the benthic ecology of streams in the southeastern part of the watershed. Locally, the various municipal water providers monitor the water dispersed to their customers. Their information was included in this report when possible, but much of it is unpublished.

The most extensive collection of Seneca Lake watershed data over the past decade and since the 1999 publication of *Setting a Course for Seneca Lake – State of the Seneca Lake Watershed Report* in 1999 (Halfman, et al., 1999a, 1999b) was by researchers at Hobart and William Smith Colleges. Dr. John Halfman routinely monitors the basic limnology and hydrogeochemistry of the lake and selected tributaries. Dr. Meghan Brown investigated the biological limnology with a focus on zooplankton dynamics. Dr. Susan Cushman has preliminary information on stream macroinvertebrate and fish populations. Dr. Lisa Cleckner has preliminary heavy metal analyses on stream and lakes samples. Finally, Dr. Tara Curtin has a few sediment cores with historical organic carbon and mercury flux data. Much of the following report summarizes information compiled in a Seneca Lake volume (Halfman, 2012; Brown, 2012; Abbott and Curtin, 2012; and Cushman, 2012), and the primary source for this report. The objective of this report is to summarize new limnological and stream hydrogeochemical findings since the 1999 publication.

Seneca Lake Limnology

Physical Limnology

Hobart and William Smith Colleges has been investigating the physical limnology of the lake for the past few decades. The primary data set for these interpretations are water column profiles by conductivity, temperature, depth (CTD) and a buoyed platform. Current meter and current Doppler profiles were also collected. The thermal structure, its seasonal changes and associated lake dynamics are critical to understand in the lake because they influence the internal dynamics, which impacts, for example, distributions of algal and other organisms, concentrations of nutrients and dissolved oxygen, and other aspects of the lake.

CTD profiles have been collected from four northern sites and occasionally from nine sites distributed along the entire lake since the early 1990s and more frequently since 1996 (Fig. 26).

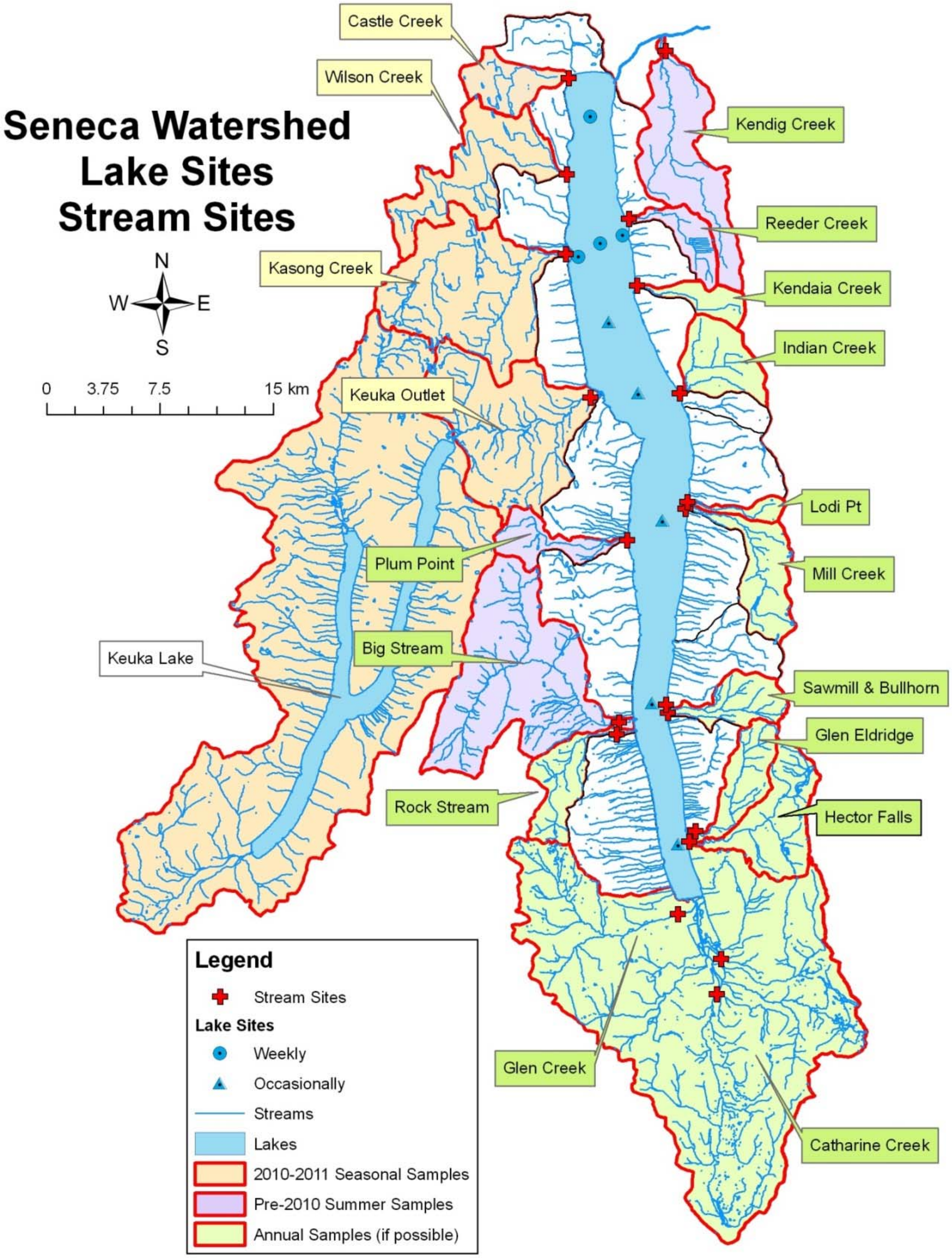


Fig. 26. Lake and stream sites for the limnological and hydrogeochemical investigations (Halfman, 2012).

Profiles were typically collected weekly during the ice free, April to November, field season but the actual frequency depended on classroom and research use. Before 2007, a SeaBird SBE-19 CTD electronically collected water column profiles of temperature, conductivity (reported as specific conductance), dissolved oxygen, pH, and light transmission (water clarity, inversely proportional to turbidity) every 0.5 m through the entire water column. In 2007, the CTD was upgraded to a SeaBird SBE-25 with additional sensors for photosynthetically active radiation (PAR), turbidity by light scattering and chlorophyll-a by fluorescence. In addition, a water quality (WQ) monitoring buoy, a YSI 6952 platform with a YSI 6600-D logger, collected two water quality profiles each day of temperature, conductivity, turbidity and fluorescence (chlorophyll) data. The WQ buoy also collected hourly averaged meteorological data including air temperature, barometric pressure, light intensity, relative humidity, wind speed and direction.

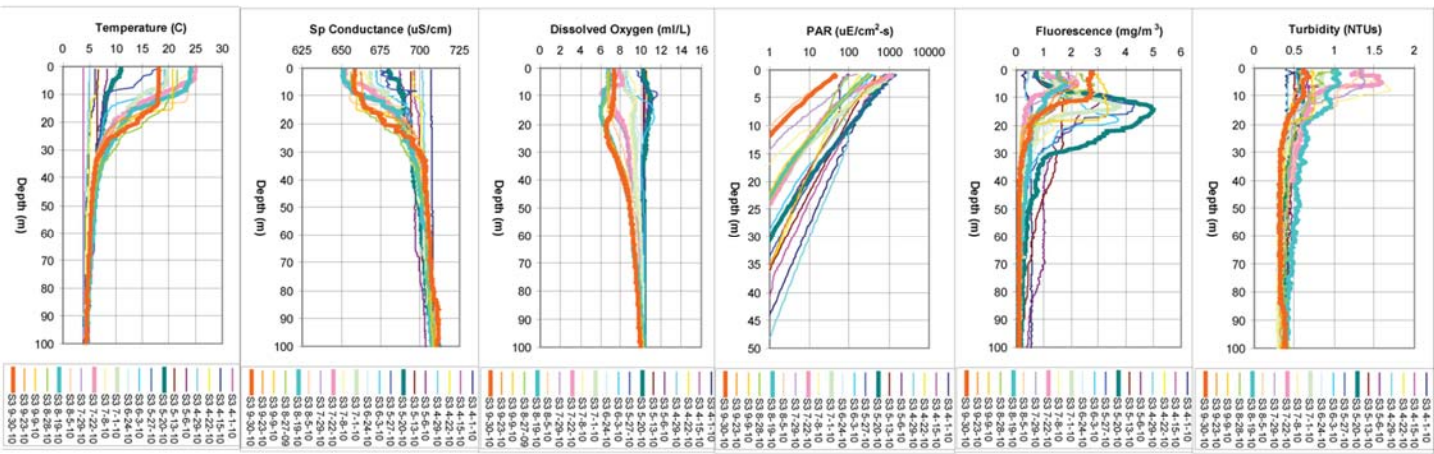
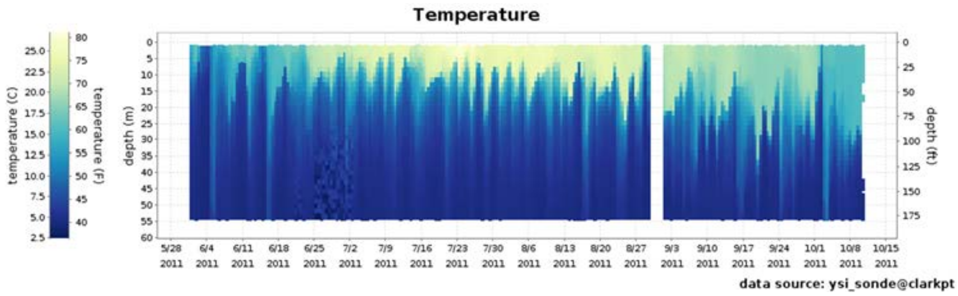


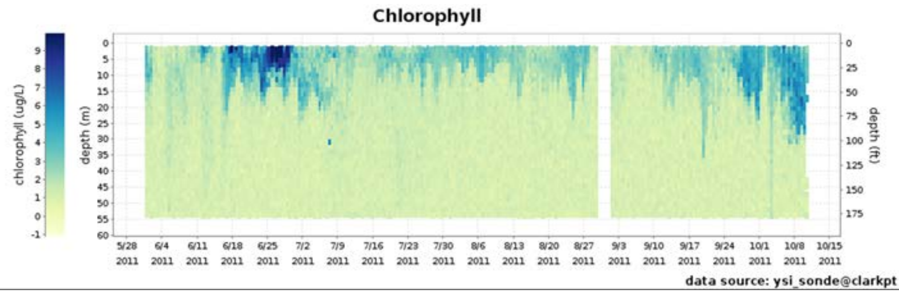
Fig. 27. Seneca Lake 2010, Site 3. Temperature, photosynthetic active radiation (PAR, light), specific conductance (salinity), dissolved oxygen, fluorescence (chlorophyll-a) and turbidity CTD profiles from 2010. This year was representative for earlier data.

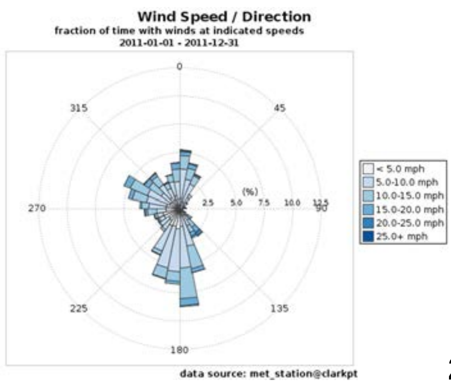
CTD temperature profiles were typical for a relatively deep lake in central New York (Fig. 27). A thermocline typically developed in early May as the epilimnion (surface waters) warmed above 4ºC in the early spring to 25ºC (or more) by mid to late summer. The thermal stratification persisted throughout the remainder of each field season as the surface waters never cooled to isothermal conditions (4ºC) by the last cruise of the year. Data was unavailable to determine if the lake is dimictic (spring and fall overturn each year) or warm monomictic (one overturn throughout the winter), however the lake has never completely frozen since 1912 and strongly suggests a monomictic lake. Surveys of the entire lake revealed consistent temperature profiles from one site to the next on any given cruise, and similar seasonal progressions through the year, except for the occasional change in the depth of the thermocline due to seiche activity.

When present, the thermocline was typically at a depth of 20 m. However, its depth oscillated vertically in response to internal seiche activity, epilimnetic mixing by storm waves, and season warming and cooling of the epilimnion. Its seasonal presence and depth are fundamental to biological, chemical and geological processes because it forms the boundary between the warmer (4 to 25°C), less-dense and sunlit epilimnion and the colder (4°C), more-dense and dark hypolimnion. The more frequent WQ buoy profiles revealed that the thermocline depth moved vertically by 10 to 15 meters on a weekly time frame (Fig. 28).

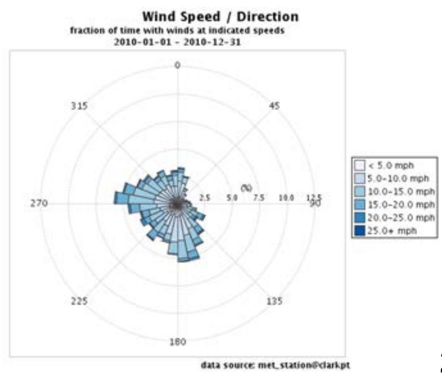


2011 Data





2011 Data



2010 Data

Fig. 28. Seneca Lake WQ buoy contoured temperature and specific conductance data for 2011, and wind rose diagrams from 2010 and 2011. The other years revealed similar patterns (Halfman, 2012).

It suggests that wind stress sets up the thermocline for subsequent internal seiche activity. Mean thermocline depths typically result from epilimnetic mixing by wind and waves. The largest theoretical wind-generated wave height and length based on the maximum length (maximum fetch) is 2.5 m high and up to 40 m long with a mixing depth of approximately 20 meters. This depth was slightly larger than the observed deepest depth of the summertime thermocline.

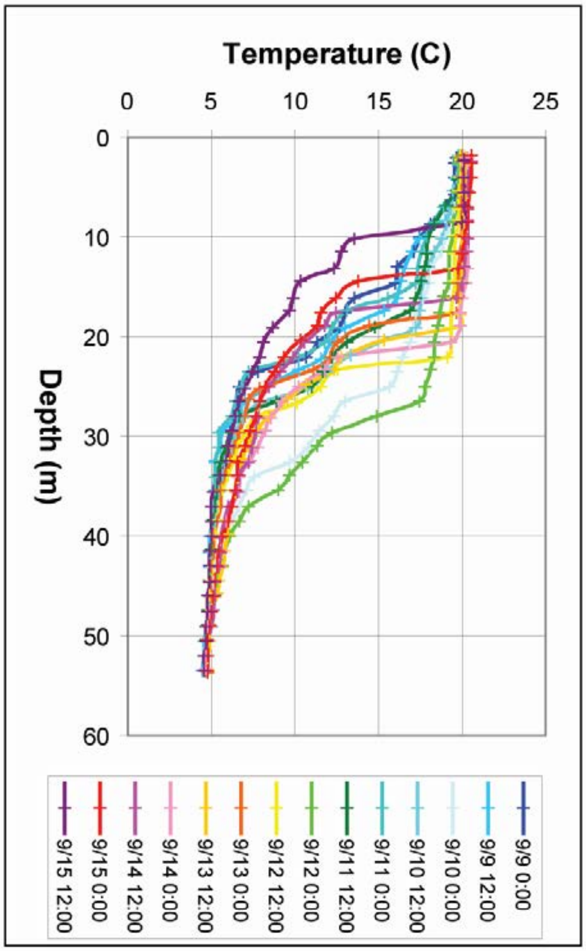


Fig. 29. WQ buoy temperature profiles form 9/9/2011 to 9/15/2011 exhibiting a ~2-day 20-m vertical oscillation of the thermocline due to internal seiche activity.

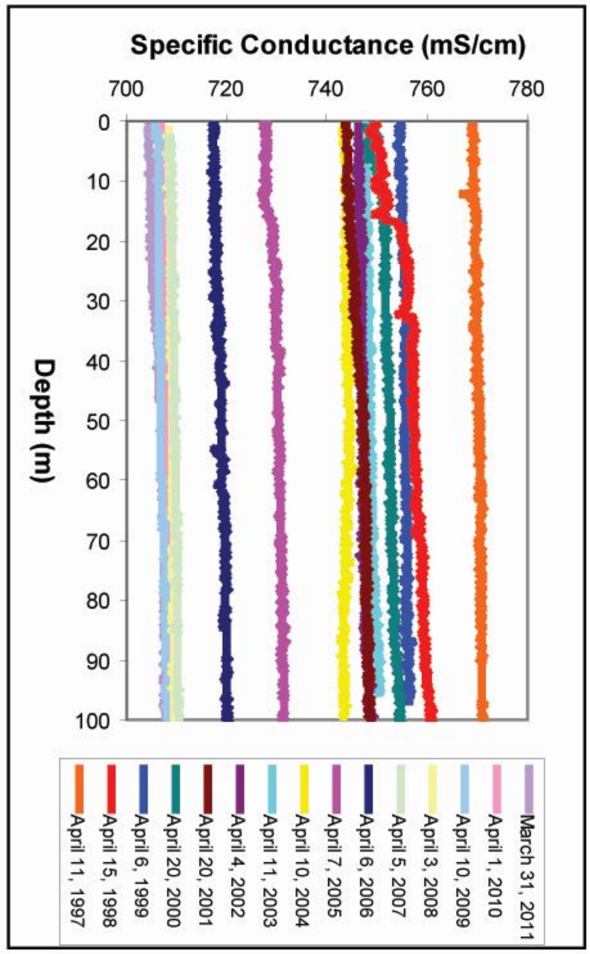


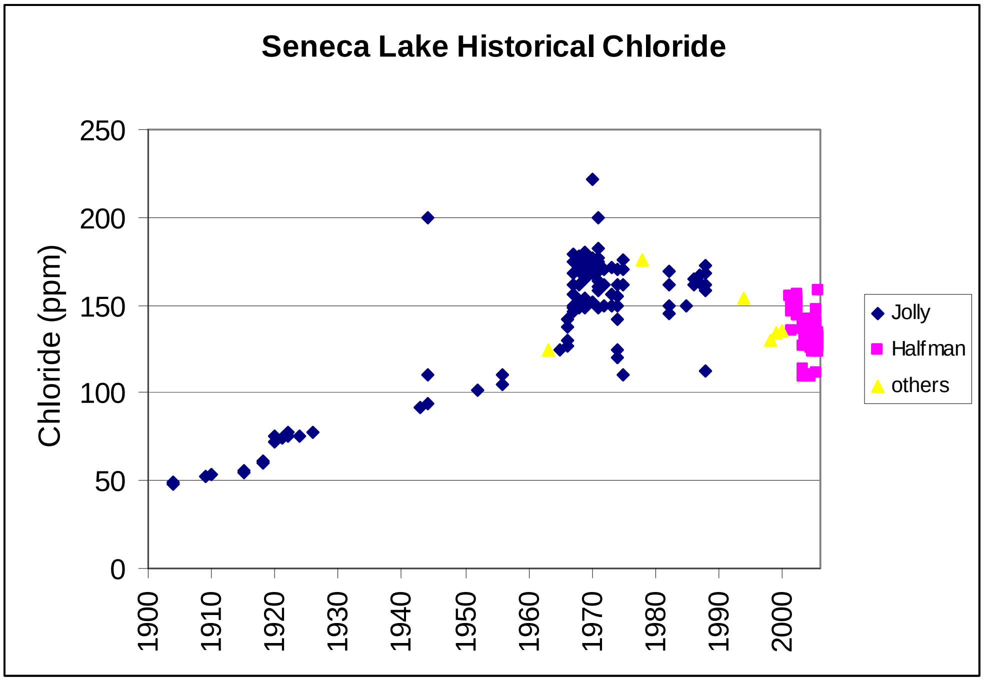
Fig. 30. 1997 to 2011 early spring, isothermal, specific conductance profiles.

The theoretical period of the surface and internal seiche activity are 1 hour and 1.7 days, respectively, based on mean depth, maximum length and estimated thermocline depth of 20 meters, and summer temperatures for the epilimnion and hypolimnion (25 and 4°C). Lake water-level data recorded by Dr. Ahrnsbrak in the 1970s indicated a surface seiche amplitude of ~2-3 cm and period of 50-55 minutes, similar to the theoretical period. A 9/9/2011 to 9/15/2011 snapshot of the WQ buoy data revealed a thermocline that vertically oscillated with a periodicity of ~2 days (Fig. 29). Differences between theory and real-life were due to non-ideal basin geometry, friction and other factors. Currents exceeding 40 cm/s have been detected at 1 m above the lake floor in association with internal seiche activity (Ahrnsbrak, 1974; Ahrnsbrak *et al*., 1996; Laird, unpublished data). The weather instruments on the Seneca Lake buoy revealed variability from one year to the next (Fig. 28). For example, annual wind rose diagrams revealed more intense southerly winds in 2011 than 2010, thus a larger wind stress along the long axis of the lake in 2011 may precipitate more internal seiche activity. More work is required to better understand the linkages between the meteorology, heat fluxes of the dynamics in the lake.

Light is fundamental to physical and biological processes, as its availability drives the seasonal thermal structure of the lake and phytoplankton growth. CTD photosynthetic active radiation (PAR) intensities in the CTD data decreased exponentially from a few 100 to a few 1,000 $\mu E/cm^2$-s at the surface to ~1% surface intensities at 10 to 30m depth, near the base of the epilimnion. The surface variability reflected the season and cloud cover. The 1% surface light depth typically represents the minimum amount of solar energy for algal survival, i.e., a net production of zero. The observed exponential decrease reflected the expected absorption and conversion of longer wavelengths of light (infrared, red, orange, yellow) to heat, and scattering of shorter wavelengths of light (ultraviolet, violet, blue) back to the atmosphere. Seasonal changes were observed, and light penetration was deeper in the early spring, and shallower in the summer months. The change was inversely proportional to the density of algae in the water column.

Chemical Limnology

CTD specific conductance (salinity) profiles revealed an isopycnal lake in early spring, just over 700 μS/cm (or ~0.33 ppt) in 2011 (Fig. 30; Halfman, 2012). This concentration was approximately a thousand times smaller than the maximum concentrations for safe drinking water. Specific conductance decreased in the epilimnion throughout the stratified season by ~50 μS/cm presumably until overturn in the fall of each year. The decrease was most likely influenced by the input of more dilute precipitation and associated runoff. The hypolimnion salinity remained relatively constant when stratified but decreased from one year to the next. The lake wide specific conductance decreased by ~10 μS/cm each year over the past decade (Fig. 31). The QW buoy and full-lake CTD surveys revealed similar trends (Fig. 28).



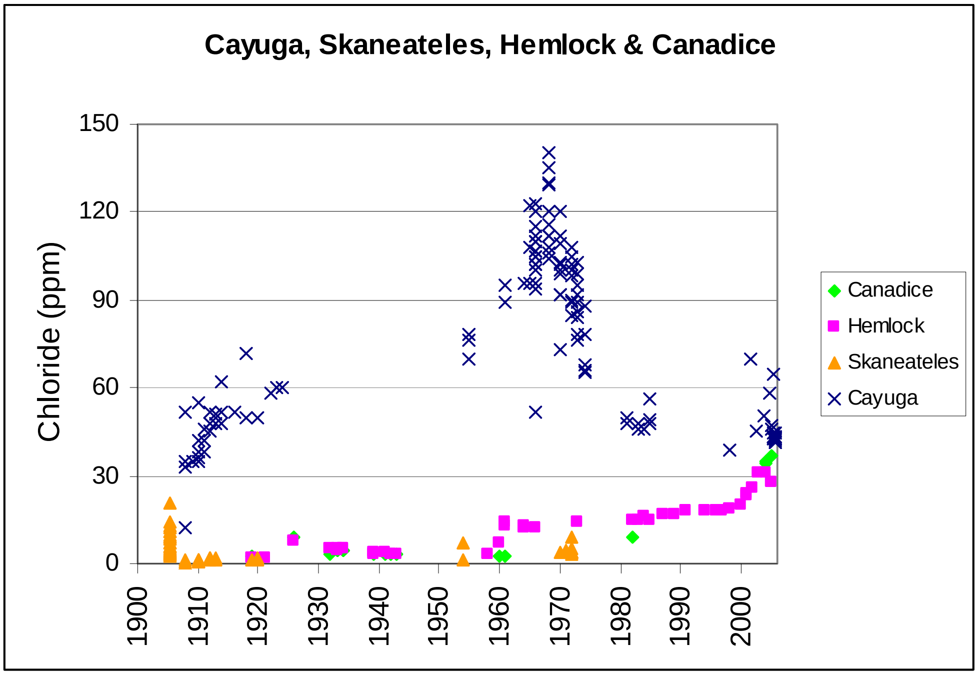


Fig. 31. Historical chloride data in Seneca and Cayuga Lakes (Jolly, 2005, 2006), and in Canadice, Hemlock and Skaneateles Lakes (Sukeforth and Halfman, 2006).

The salinity of Seneca Lake was dominated by chloride (140 mg/L, Cl^-), bicarbonate (105 mg/L HCO_3^-, measured as total alkalinity), sodium (80 mg/L Na^+) and calcium (42 mg/L Ca^{2+}) with lesser amounts of sulfate (38 mg/L SO_4^{2-}), magnesium (11 mg/L Mg^{2+}) and potassium (3 mg/L K^+) (Halfman et al., 2006). The composition reflected the weathering of carbonate-rich bedrock, tills and soils. The lake was more saline than the other Finger Lake due to elevated chloride and sodium concentrations. For example, chloride and sodium concentrations are ~140 and ~80 mg/L in Seneca Lake and only ~40 and ~20 mg/L in the other Finger Lakes, respectively.

The fluvial flux of chloride and sodium to the lake was insufficient to provide the concentrations measured in Seneca, and to a lesser extent Cayuga, but was sufficient to support the chloride and sodium concentrations in neighboring Finger Lakes. Thus, a groundwater source for chloride and sodium was hypothesized to compliment fluvial sources (Wing et al., 1995, Halfman et al., 2006). The bedrock floor of Seneca, and to a lesser extent Cayuga, is deep enough to intersect the Silurian beds of commercial-grade rock salt located ~450-600 m below the surface (Mullins et al., 1996). Historical chloride data revealed two distinct century-scale patterns in the Finger Lakes (Jolly, 2005; Jolly, 2006; Sukeforth and Halfman, 2006) (Fig. 31). In Seneca, chloride concentrations were low ~40 mg/L in 1900, rose to ~170 mg/L by the 1960s, and subsequently decreased since 1980 to the present day concentration of ~120 mg/L with parallel changes in Cayuga Lake (Jolly, 2005; 2006). The decrease over the past two decades was substantiated by major ion analyses and CTD profiles (Fig. 30; Halfman, 2012). Historical chloride concentrations from Canadice, Hemlock and Skaneateles were much smaller than Seneca, and increased from below 10 mg/L to above 30 mg/L from 1920 to the present day. They were interpreted to reflect increased use of road salt on our major roadways (Sukeforth and Halfman, 2006). A groundwater source for chloride and sodium was still necessary in Seneca and Cayuga, however the flux of salt from the ground must have varied during the past century. Perhaps the historical change was dictated by an increase and subsequent decrease in solution salt mining activity at the southern end of the watershed, and would provide an interesting avenue of future research.

Mass-balance arguments indicated that sulfate also has an additional groundwater source to complement fluvial inputs, perhaps originating from the underlying gypsum-rich ($CaSO_4 \cdot H_20$), Bertie Formation. The calcium and magnesium data indicated moderately hard water in Seneca Lake. Calcium, magnesium and alkalinity concentrations were smaller in the lake than predicted by stream inputs, and were removed from the water column by the precipitation of fine-grained, calcium carbonate ($CaCO_3$) during algal bloom induced whiting events and formation of carbonate shells for *Dreissena spps.* (zebra & quagga mussels), clams, snails and other shelled animals.

The pH of Seneca Lake was consistently between 8 to 9 (Halfman, 2012). Thus, acid rain has had a minimal impact on the acidity of the lake due to the buffering capacity (i.e., the ability to neutralize acid rain acids) in this watershed. Limestone is abundant in the glacial tills and bedrock under the northern portion of the watershed, and the lake is alkaline, i.e., the water is rich in bicarbonate and other acid buffering compounds.

The epilimnetic dissolved oxygen (DO) concentrations revealed by CTD profiles decreased from the spring to summer and increased again in the fall. The seasonal progression reflected the seasonal warming and cooling of the epilimnion as DO concentrations remained saturated or nearly saturated throughout the field season. Sources of oxygen to the epilimnion include diffusion from the atmosphere and photosynthesis. Both kept the epilimnion saturated. In the hypolimnion, DO concentrations steadily decreased to from 12 to 13 mg/L (100% saturation) just after spring overturn to 6 mg/L (~40% of saturation) just below the thermocline by the end of the stratified season. Decreases in DO were only down to 10 or 11 mg/L in deeper water. Similar profiles were observed in the deeper portions of the lake on the full-lake cruises. Sinks for DO in the hypolimnion were primarily bacterial respiration, and it lacked sources like diffusion from the atmosphere and/or inputs from photosynthesis. The hypolimnetic temperature was a constant 4°C, thus had no influence on the summer season decline in DO. Seneca Lake was apparently large enough and respiratory needs small enough to restrict the bulk of the oxygen depletion to the upper hypolimnion. Over the past two decade, the maximum DO deficit in the upper hypolimnion has fluctuated between 5 and 7 mg/L (Halfman, 2012).

Biological Limnology

A basic limnological primer for temperate, deep lakes is required to understand the implications of this section, and starts with the thermal control on basic biological processes. Isothermal conditions during spring overturn mix essential nutrients, phosphates and nitrates, uniformly throughout the water column. Add sunlight, and phytoplankton (algae) bloom, i.e., initiate sustained growth just as the lake becomes stratified, as it helps keep algae in the sunlit epilimnion. Summer stratification however isolates photosynthesis to the epilimnion and nutrients become scarce due to algal uptake. Nutrients are instead replenished in the hypolimnion (dark, colder, more dense, bottom waters) by bacterial decomposition (respiration) over time. The nutrient scarcity in the epilimnion reduces algal populations. Predation by herbaceous zooplankton also keeps algal populations in check. Algal populations typically remain small through the summer until another bloom during the thermal decay of the epilimnion during the fall and mixing of hypolimnetic nutrients into the sunlight. Nutrient loading by tributaries, internal seiche activity, waves and currents, upwelling and other events can also introduce nutrients to the epilimnion and stimulate algal blooms. Reduced light limits algal growth in the winter.

Manipulating nutrients and light is not the only means to induce algal blooms. Zooplanktivorous fish like alewife and/or carnivorous zooplankton like *Cercopagis pengoi* the fishhook water flea can induce algal blooms as well (Brown, 2012). Their predation on herbaceous zooplankton reduces zooplankton predation on algae. Thus, both "bottom up" nutrient loading and "top down" predation on herbaceous zooplankton can stimulate algal blooms and decrease water quality.

The following is a compilation of open water limnological data, including CTD fluorometer profiles, secchi disk depths, and surface and bottom water concentrations of chlorophyll-a, nutrients, including total phosphate (TP), dissolved phosphate (SRP) and nitrate, and total suspended solids (TSS). Water samples were analyzed by standard limnological techniques (Wetzel and Likens, 2000). Additional information on the plant and animal communities in the lake comes from plankton tows (e.g., Brown, 2012), nearshore benthic sampling for macrophytes (Zhu, 2009) and deep water dredging for benthic invertebrates (Shelley et al., 2003; Zhu, unpublished data; Dittman, unpublished data).

Open-Water Limnology: Phytoplankton biomass, as detected by the CTD fluorescence profiles, were found throughout the epilimnion and occasionally extended into the metalimnion of the lake. Algal peak concentrations were up to 7 or 8 μg/L during algal blooms, and peaks were typically located 5 to 20 m below the water's surface. The peak depth typically rose and fell with light availability (i.e., algal density), and depth or absence of the thermocline. The hypolimnion rarely had any algae (< 0.5 μg/L), as expected because it was too dark for photosynthesis.

The fluorometer data collected by the WQ buoy revealed spring and fall phytoplankton blooms and associated with the onset and decay of the summer stratification season (Fig. 27). Additional blooms were detected mid-summer during the stratified season. Some of these mid-summer blooms may be related to the "bottom up" inputs of nutrients, especially growth limiting phosphates, by major runoff events, and/or mixing of hypolimnetic waters into the epilimnion by the internal seiche activity (e.g., Baldwin, 2002). The blooms may also be related to the reduction of herbaceous zooplankton by "top down" ecological stressors like *C. pengoi*, and/or zooplanktivorous fish.

The open-lake limnological data are not life threatening as nitrate concentrations were below the 10 mg/L MCL and phosphate concentrations below NYSDEC's 20 μg/L threshold for impaired water bodies (Table 15, Fig. 32). An epilimnion to hypolimnion increase in nutrient concentrations and decrease in chlorophyll-a concentrations over the stratified season reflected a normal seasonal progression of the algal uptake and removal of nutrients in the epilimnion, and algal decomposition and nutrient release by bacteria in the hypolimnion. P:N ratios in the water column averaged 1:160

over the past decade. The P:N ratio required by phytoplankton is 1:7 (Redfield Ratio), so the significantly larger Seneca Lake ratio dictated that phosphate, not nitrate, was the limiting nutrient in a lake, like most of the other Finger Lakes. It also implies that additional inputs of phosphate from the watershed or atmosphere should stimulate algal growth and move the lake to a more productivity system with declining water quality.

Table 15. Annual Mean Chlorophyll and Nutrient Data (2000-2011 Average).

	Secchi Depth	**Chlorophyll**	**Total Phosphate**	**Phosphate, SRP**	**Nitrate**	**TSS**
	(m)	(μg/L)	(μg/L, P)	(μg/L, P)	(mg/L, N)	(mg/L)
Surface	6.3	2.3	9.7	1.4	0.4	1.1
Bottom	N/A	0.7	9.7	2.6	0.4	0.7

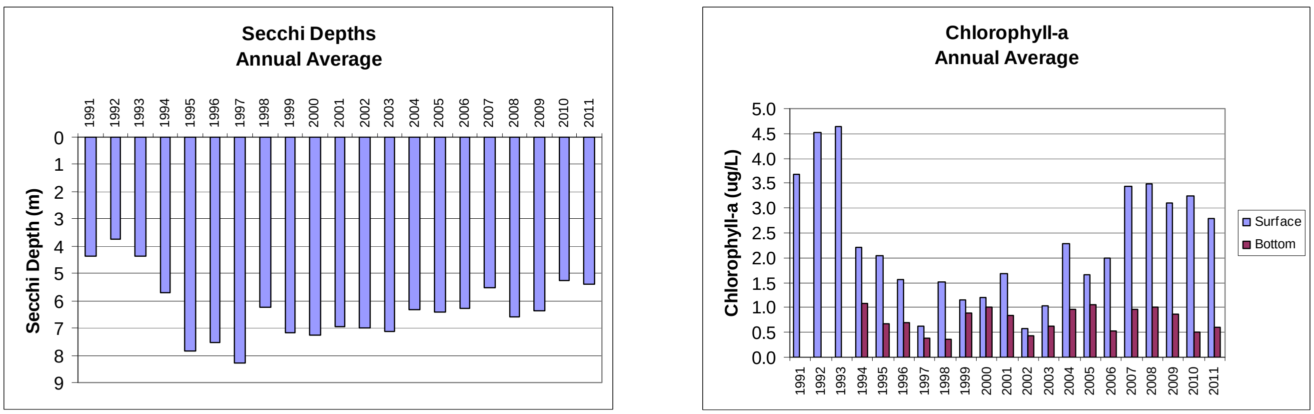


Fig. 32. Annual mean secchi disk depths and surface and bottom water chlorophyll-a data (Halfman, 2012).

Significant decade-scale changes were observed in secchi disk depths and chlorophyll concentrations of Seneca Lake (Halfman and Franklin, 2007; Halfman, 2012, Fig. 32). The data divided into two primary, decade-scale trends: from 1992 to 1997, and 1998 to 2011. Annual average secchi disc depths became progressively deeper from 3 to 4 m in the early 1990s to 7 to 8 m by the end of 1997, and since then decreased to nearly 5 m by 2011. Chlorophyll-a concentrations decreased from an annual average of ~4.5 μg/L in the early 1990s to 0.6 μg/L by 1997, and then steadily increased to 2.5 to 3.5 μg/L by 2010 and 2011 with a deviation to larger concentrations, up to 3 to 4 μg/L, in 2007.

The 1992 through 1997 trends were consistent with increased grazing by the growing population of filter-feeding zebra mussels in the early 1990s (Halfman et al., 2001; Halfman and Franklin, 2007) and consistent with findings elsewhere (e.g., Strayer, 2010). Zebra mussels were first detected in 1992, and successfully colonized Seneca Lake within a few years. The introduction and establishment had implications on the limnology of the lake by decreasing algal concentrations and sequestering nutrients in their live biomass. Fewer nutrients reinforced declining algal biomass. Unfortunately, zebra mussel densities were not consistently measured over this time frame to confirm this hypothesis.

The trend reversed after the initial major die off of zebra mussels in 1998. The die off and associated bacterial decomposition of the mussel biomass released the previously sequestered nutrients back into the water column during 1998 and 1999, as reflected in increasing TP, N, SRP and algal concentrations and decreasing secchi disk depths. The lake became progressively more impaired since, as shown by shallower secchi dish depths and larger chlorophyll concentrations (Hoering and Halfman, 2010; Halfman and Franklin, 2008; Halfman et al., 2010).

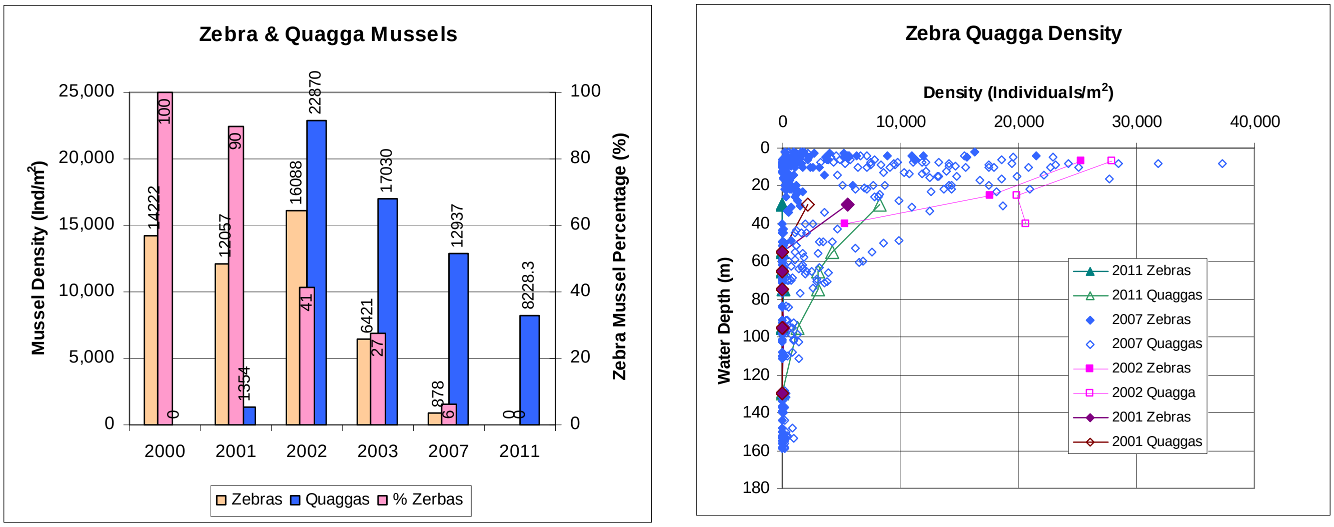


Fig. 33. Zebra and quagga mussel populations from 10 to 40 meters (left) and depth distributions (right) over the past decade (B Zhu '07, B Shelley '02, D Dittman '01 & '11, Geo-330 class data '00, '01, '03, unpublished data, Shelley et al., 2003). The 2001 to 2011 data exhibited a significant increase in quagga mussel densities at depths below 40 m (D Dittman, unpublished data).

Various factors contributed to the decline in water quality over the past decade. First, the available data suggest that both zebra and quagga mussel populations declined since 2002 (B Zhu, unpublished data; D. Dittman, unpublished data; Shelley et al., 2003, Fig. 33). Zebra mussels posted the largest decline, from 100% to 0% of the total mussel population between 10 and 40 meters of water from 2000 to 2011. Thus, the mussel impact on and reduction of the algal populations probably decreased as well. Unfortunately, these conclusions are speculative at this time because the data were collected from a variety of water depths and site locations, and mussel densities are depth and site sensitive (Fig. 33). Second, nutrient loading could have stimulated algal growth and decreased secchi disk depths. The stream hydrogeochemistry and the phosphorus budget sections below highlight the nutrient loading issue (Halfman, 2012). Finally, "top down" predation pressures on herbaceous zooplankton would promote summertime blooms and a decline in water quality. For more details on "top down" pressures, see the zooplankton section below and more details in Brown (2012).

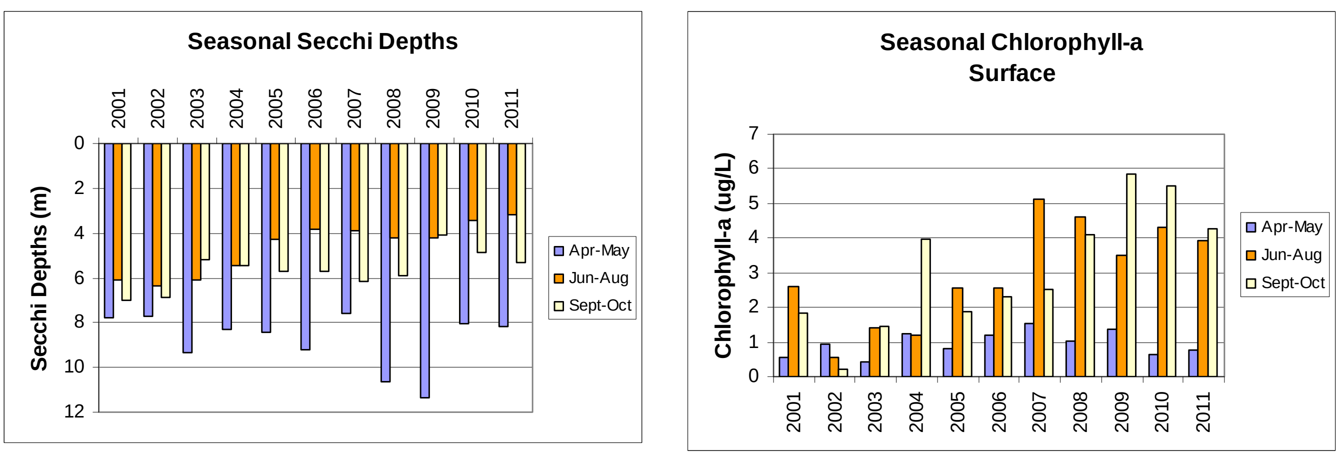


Fig. 34. Seasonal variability in secchi disk and chlorophyll data from 2001 through 2011 (from Halfman, 2012).

Seasonal patterns in the limnology of the lake were also observed (Fig. 34). Secchi disk depths became progressively deeper from 2001 to 2011 in the early spring but were progressively shallower in the summer and fall. Parallel trends were also detected in the chlorophyll, TSS and SRP data, e.g., smaller algal concentrations in the spring but progressive larger algal concentrations in the summer and the fall. The exact reasons for the increased water clarity in the spring were unclear but were perhaps related to mussels grazing and light limitations as both limit algal growth and their impact on nutrient concentrations in the near isothermal spring. Finally, shallow secchi depths and larger chlorophyll concentrations in the summer and fall were critical to the overall change in the annual concentrations over the past decade.

Trophic Status: Nutrient concentrations, algal concentrations, secchi disk depths and dissolved oxygen concentrations document the trophic status of a lake, i.e., the degree of productivity. Lakes are divided into oligotrophic (poorly productive), mesotrophic (intermediate) to eutrophic (highly productive) systems which parallels water quality using secchi disk depths, and concentrations of chlorophyll-a, total nitrogen, total phosphate, and hypolimnetic dissolved oxygen (Table 16).

Table 16. Oligotrophic, Mesotrophic and Eutrophic Indicator Concentrations (EPA).

Trophic Status	Secchi Depth (m)	Total Nitrogen (N, mg/L, ppm)	Total Phosphate (P, µg/L, ppb)	Chlorophyll a (µg/L, ppb)	Oxygen (% saturation)
Oligotrophic	> 4	< 2	< 10	< 4	> 80
Mesotrophic	2 to 4	2 to 5	10 to 20	4 to 10	10 to 80
Eutrophic	< 2	> 5	> 20 (> 30)	> 10	< 10

In Seneca Lake, 2011 annual mean total phosphate concentrations and hypolimnetic oxygen saturation data were within the mesotrophic range however, secchi disk depths, chlorophyll and nitrate concentrations were oligotrophic (Table 15) even after adding estimated nitrogen from the particulate organic matter to the nitrate concentrations. In 2007 and earlier, all of the parameters were in the oligotrophic range, although some were near the oligotrophic-mesotrophic cutoff. Thus, Seneca Lake has migrated from an oligotrophic to borderline oligotrophic-mesotrophic lake, and water quality has declined over the past decade.

Finger Lake Water Quality Comparison: Since 2005, the Finger Lakes Institute, under the direction of Dr. Halfman, has maintained a water quality monitoring program for the eight eastern Finger Lakes: Honeoye, Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, and Otisco (added in 2008). The survey collected and compared CTD profiles, secchi disk depths, plankton tows, and the analysis of surface water samples from at least two open water sites in each lake. The water samples were analyzed for chlorophyll-a, total phosphate, soluble reactive phosphate, nitrate and total suspended solids following standard limnological techniques. Annual ranks were calculated from the annual average water quality data. For each parameter and subsequently for the overall annual rank, the worst lake is set at 8, the best at 1, and the remaining six proportionally in between these end members. Seneca Lake water quality was still one of the worst, and only slightly better than the ranks calculated for Honeoye, Cayuga, Owasco and Otisco (Fig. 35). The other three lakes, Canandaigua, Keuka and Skaneateles, consistently exhibited the best water quality of the group. Lake to lake and year to year differences in water quality were due to the degree of water quality protection, the percentage of agricultural land, the amount of precipitation and other factors in each watershed (e.g., Bush, 2006; Halfman and Bush, 2006; Halfman et al., 2011). Other stressors like human population density, watershed size and watershed size to volume ratio, exhibited minimal correlations (Halfman and O'Neill, 2009).

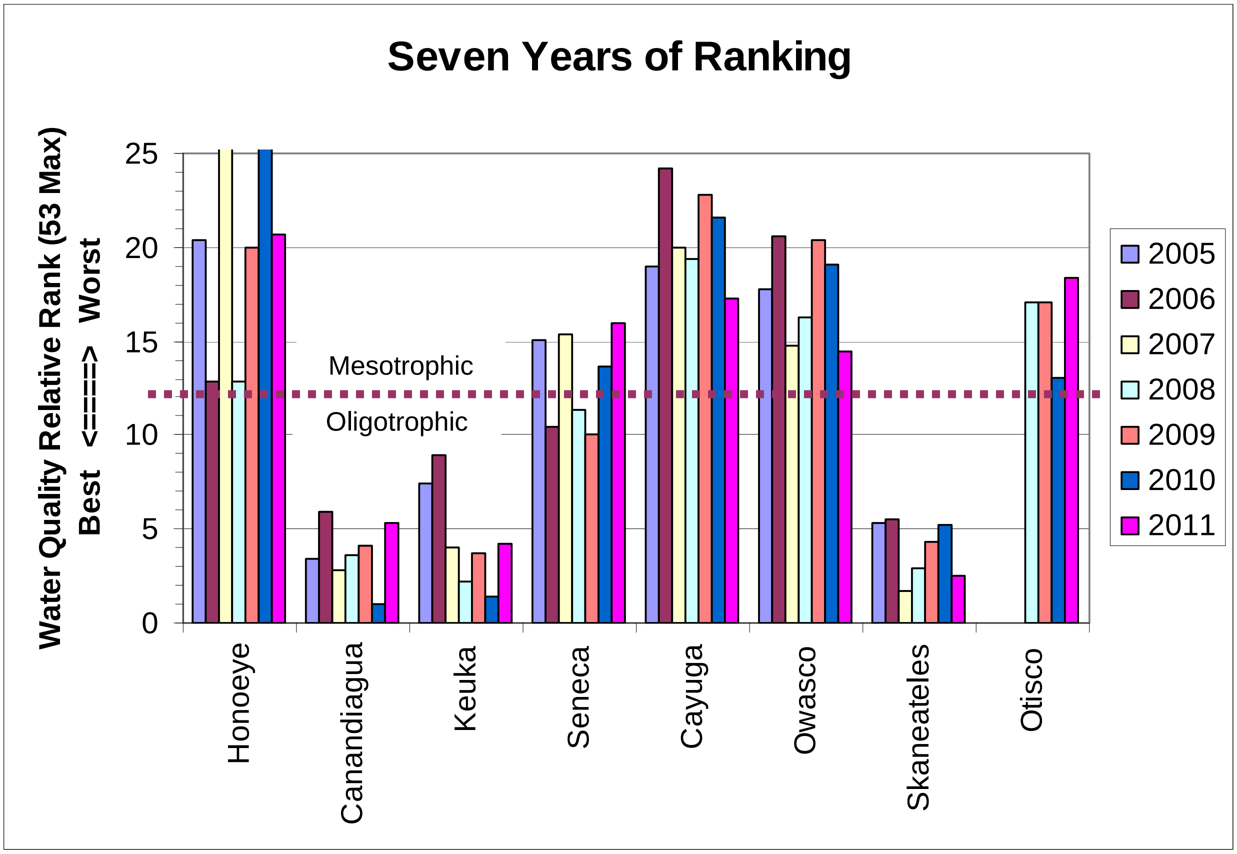


Fig. 35. Annual water quality ranks for the eight easternmost Finger Lakes. The dashed purple line is the boundary between oligotrophic and mesotrophic lakes converted to the Finger Lake "ranking" systems (Halfman et al., 2012).

Phytoplankton: Phytoplankton are the base of the aquatic food web, and the driver for water clarity, transparency, and quality issues. They were collected at each site through an 85 μm mesh, 0.2 m diameter opening net, horizontally along the surface and vertically integrating the upper 20 m, preserved in a formalin/Ethanol mixture, and the first 100 to 200 identified to genus, or species level when possible. Over the past decade, annual average abundances were dominated by the diatoms *Asterionella* (25%), *Tabellaria* (5%), *Diatoma* (13%), and *Flagillaria* (13%), and during the early part of the decade by dinoflagellates *Dinobryon* (2%) and *Ceratium* (2%). The seasonal succession typically moved from *Asterionella* (>50%) to *Tabellaria* & *Diatoma* (>50%) to *Flagillaria*, *Diatoma*, *Dinobryon* & *Ceratium* (>50%) to *Flagillaria* (>50%). Over the past decade, fewer dinoflagellates were detected in the tows (annual averages decreased from 10% to less than 1%). *Tabellaria* was less prevalent than *Diatoma* starting in 2006 through 2010 but returned in 2011. Quagga mussel larvae were first detected in 2004 (Table 17).

Table 17. Mean annual plankton abundance from near surface tows in Seneca Lake.

Diatoms	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
Fragilaria	13.7	14.5	12.5	15.1	13.9	10.8	5.3	19.0	13.2	9.7	11.0	12.6
Tabellaria	1.9	5.1	20.2	7.5	11.7	0.0	0.1	0.3	0.2	0.2	6.5	4.9
Diatoma	0.0	0.0	0.0	0.0	0.0	29.4	34.5	11.3	21.7	26.2	21.5	13.1
Asterionella	43.8	15.4	35.2	25.8	29.0	29.1	21.8	15.1	26.0	21.0	17.9	25.5
Synedra	2.4	8.3	2.7	1.9	0.8	2.7	2.7	14.7	0.7	1.1	2.6	3.7
Cymbella	2.0	0.4	0.3	0.1	0.0	0.0	0.1	0.1	0.1	0.3	0.2	0.3
Stephanodiscus	0.3	0.4	0.2	0.7	0.2	0.1	0.9	0.3	0.0	0.3	0.4	0.4
Cocconeis	0.0	0.0	0.5	1.1	0.5	0.7	0.6	1.5	0.2	0.7	0.7	0.6
Melosira	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.3	0.0	0.1	0.8	0.2
Rhoicosphenia	0.0	0.0	0.0	0.0	0.0	1.7	0.4	2.4	5.8	0.8	0.5	1.1
Other Diatom	2.0	3.2	0.1	0.6	4.7	0.5	1.3	0.9	0.0	0.4	0.3	1.3
Dinoflagellates												
Chrysosphaerella	0.0	0.3	0.1	5.7	0.1	0.0	0.0	0.8	0.0	0.1	0.0	0.6
Dinobryon	1.7	8.9	4.0	2.6	2.0	1.7	0.9	1.2	0.8	1.0	0.0	2.3
Ceratium	11.2	5.2	1.7	0.1	0.5	0.2	0.2	0.6	0.1	0.1	0.1	1.8
Colacium	0.3	1.8	0.0	2.8	2.3	0.7	5.4	0.2	1.9	5.3	0.5	1.9
Copepods												
Copepods	0.9	1.3	1.2	3.6	7.5	0.6	0.5	4.0	2.4	1.2	4.7	2.5
Naupilus	1.2	3.4	1.3	3.1	3.7	0.9	0.4	3.9	1.4	1.1	1.6	2.0
Rotifers												
Keratella	5.0	0.6	5.5	3.1	2.9	5.7	2.3	0.8	4.9	5.2	5.3	3.7
Kellicottia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Polyarthra	0.8	1.0	0.8	1.2	2.5	1.5	1.2	5.1	0.6	0.7	1.2	1.5
Monostyla	0.9	6.8	2.1	1.4	1.7	2.7	2.2	0.3	5.1	2.5	1.5	2.5
Asplanchna	0.0	0.0	0.0	0.0	0.0	0.3	1.1	0.4	0.0	0.9	0.5	0.3
Cladocerans												
Cladocerans	1.1	3.8	1.9	0.0	1.4	1.7	6.3	1.6	1.9	4.1	4.1	2.5
Cercopagis	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.4	0.4	0.7	0.5	0.2
Other Things												
Staurastrum	0.2	0.2	0.0	0.7	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1
Pediastrum	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.1	0.1	0.3	0.1
Anabaena	0.7	0.7	0.1	0.1	0.0	0.3	0.6	0.1	1.2	0.7	0.3	0.4
Stichosiphon	0.3	1.8	0.1	0.0	0.4	0.1	0.5	2.0	0.4	0.1	0.7	0.6
Trichodesmium	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1
Microcystis	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.3	0.3	0.9	0.2	0.2
Chroococcus	2.9	0.4	0.2	1.7	0.2	0.3	0.3	0.0	0.1	0.2	0.9	0.7
Wolffiella	0.0	0.9	1.1	0.5	0.2	0.0	0.4	0.7	0.8	0.6	0.8	0.6
Zebra Larvae	0.2	1.0	0.2	0.2	0.2	0.4	0.1	0.3	0.2	0.2	0.1	0.3
Quagga Larvae	0.0	0.0	0.0	0.3	0.3	0.6	0.4	0.4	0.2	0.3	0.3	0.3

Zooplankton: Invertebrate animals are important members of the Seneca Lake food web. In Seneca Lake herbivorous zooplankton included members of the Cladocera (e.g., *Daphnia*, *Bosmina*), Copepoda, and Rotifera. Some invertebrates, such as the common cladoceran *Daphnia*, are considered keystone taxa because their grazing can control phytoplankton growth and nutrient cycling, and their own biomass provides an immense food source for fish (e.g., Carpenter, 1987; Kitchell, 1992).

There is a subset of invertebrate animals that are predacious and primarily prey on herbivorous zooplankton (Thorp and Covich, 2001). In Seneca Lake, predatory species of cladocerans occupy the water column and their populations can grow exponentially when lake temperatures warm in the spring and summer due to rapid asexual reproduction. These cladocerans are typically absent for the water column during the winter and are maintained in a sediment egg bank (Pennak, 1989). In contrast, the native mysid in Seneca Lake, *Mysis diluviana,* is a cold-water stenotherm that is confined to the cold-water regions of the lake and reproduces sexually (Pennak, 1989). The following examines the dominant predatory crustacean zooplankton and mysids present in offshore areas of Seneca Lake with the objectives to 1) generally characterize the species assemblage in Seneca Lake, 2) measure seasonal changing in density of dominant species from May until November and 3) measure daily changes in vertical position. Details are in Brown (2012).

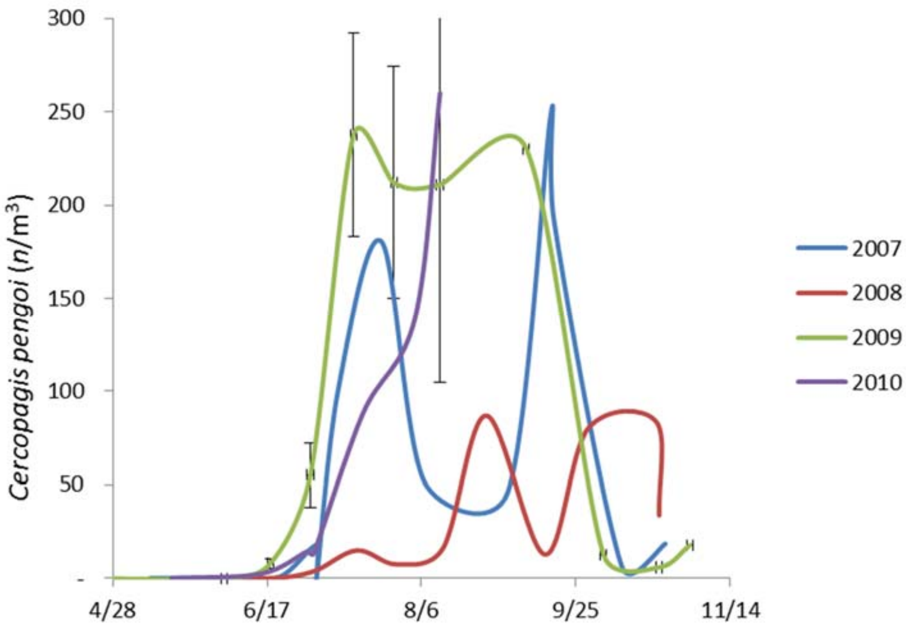


Fig. 36: Abundance of Cercopagis pengoi at the reference station (see methods) from 2007-2010 during the ice-free season. Error bars (+ 1SD) are shown only for 2009 for clarification. In 2010, samples after August were not collected.

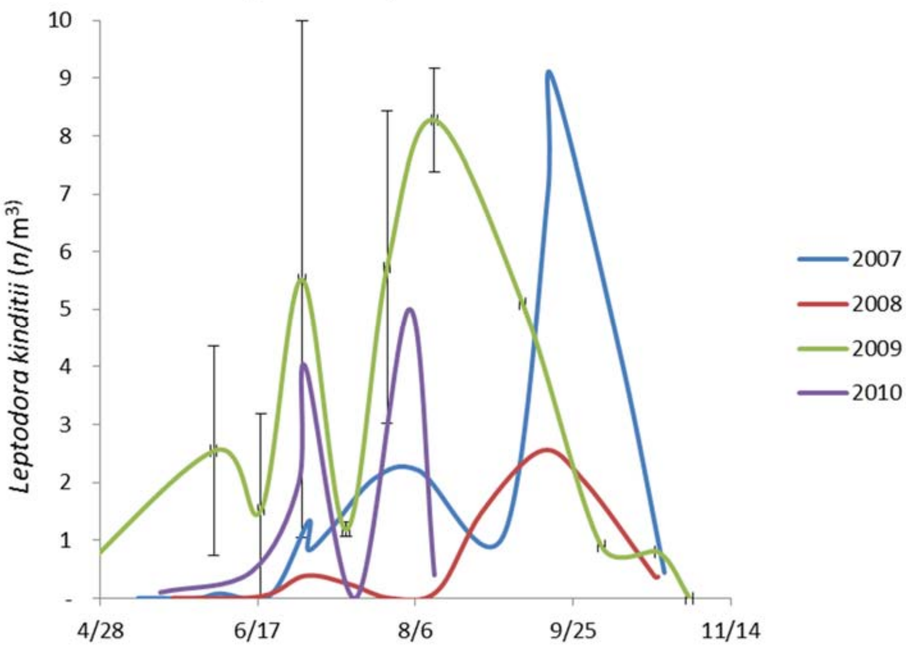


Fig. 37: As per Figure 36, but for *Leptodora kindtii*.

Table 18. Recorded Maximum Density of *M. diluviana* at Site 3 from 2007-2010.

Year	2007	2008	2009	2010
Max Density (n/m3)	1.5	2	1.1	1.7

In the open-lake from 2007 to 2010, the abundance of *Cercopagis pengoi* was higher, at times more than 100 fold, than that of *L. kindtii* and *M. diluviana* at the reference sampling station (Figs. 36 & 37, Table 18). Maximum densities of *C. pengoi* often exceeded 100 n/m^3 at the 100m-deep reference station (Fig. 36) and were much higher at other sampled stations (data not shown). The seasonal phenology (i.e., life cycle patterns) and abundance for *C. pengoi* and *L. kindtii* displayed a consistent pattern among years for the first appearance and autumn decline of each species (Figs. 36 & 37). *C. pengoi* typically exhibited two peaks in summer density (Fig. 36), whereas *L. kindtii* densities were less patterned and overall numerically much lower (Fig. 37).

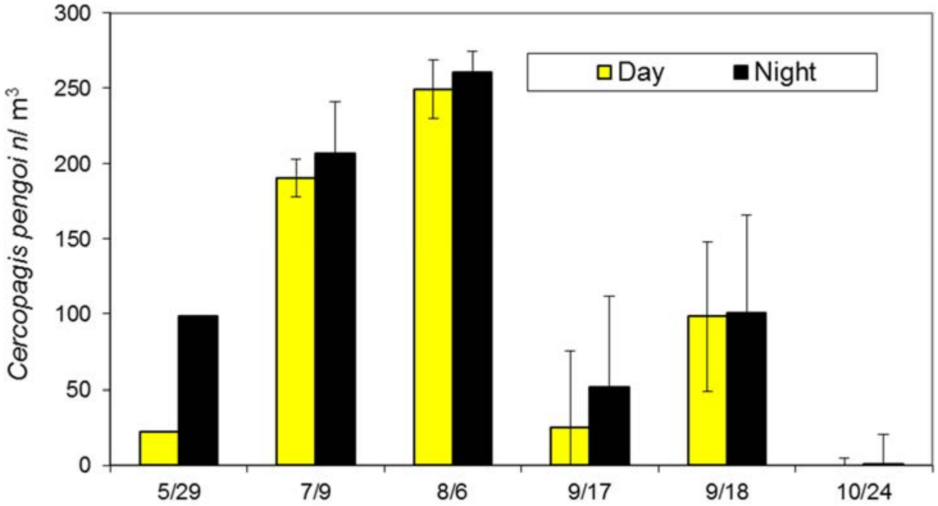


Fig. 38: Day and Night mean abundances (± 1SD) of *Cercopagis pengoi* at the reference station in 2008. Note that no error bars are displayed for May 29th because replicates were not enumerated separately. Mean abundance for October 24th was less than 10 n/m^3.

Since *C. pengoi* are a non-native species to the Finger Lakes and their day-to-night behavior was unknown, this study investigated diel behavior. *C. pengoi* were observed at substantial densities during both the day and night (Fig. 38), indicating the water-column position of this zooplankter does not change with changing light intensity. This was also true of *L. kindtii* (data not shown). The patterns in 2008 (Fig. 38) were similar to observations in other years of the study. A non-native mysid, *Hemimysis anomala* (bloody red shrimp) recently established in the nearshore of Seneca Lake and its abundance and season demography are reported in Brown et al. 2011. Both *C. pengoi* and *H. anomala* are native to Eurasia and were most likely introduced to the North American Great Lakes through ballast water discharged by transatlantic ships. A secondary invasion of the Finger Lakes is likely a result of human and/or natural vectors moving propagules from regional invaded lakes (e.g., Brown et al., 2011).

In Seneca Lake, *C. pengoi* abundance was higher throughout the summer than either of the native species, which indicated that *C. pengoi* avoided fish predation pressure and has the propensity to consume a greater share of zooplankton prey resources. The presence and numerical dominance of *C. pengoi* may pose an ecological shift for Seneca Lake, as this species consumes zooplankton prey at a rate of up to 16 individuals per day. *C. pengoi* feeds by ripping open its prey and then consuming the contents (Laxson et al., 2003). *C. pengoi* commonly exhibits this predacious behavior on *Daphnia retrocurva* and *Bosmina longirostris*, and field studies have illustrated a steady decrease in both of these native, zooplankton species when *C. pengoi* population increases in abundance, which may result in competition with native fish for zooplankton prey (Laxson et al., 2003; Brown and Balk, 2008).

Ecological shifts after an invasion of *C. pengoi* were also supported by investigating the sediment record. Microfossils and eggs of *C. pengoi* and their prey accumulate at the bottom of Seneca Lake and cores were extracted to study the historical record. In fact, the abundance of herbivorous zooplankton prey declined dramatically and their size increased coincident with the introduction of *C. pengoi* to Seneca Lake (Brown et al., in revision). Although *C. pengoi* may compete with native invertebrate predators for prey, the seasonal abundances of native species, *L. kindtii* and *M. diluviana*, showed the three species co-exist. Future laboratory studies should investigate the interaction of these three predatory invertebrates, and although challenging, would provide an interesting avenue of research.

How these three invertebrate predators interact with fish predators in the lake is another area for future research. In Seneca lake, *C. pengoi* and *L. kindtii* abundance was similar from day to night, unlike *M. diluviana*, which was observed solely during night sampling due to its extensive vertical migration to avoid fish predation. The long caudal appendage of *C. pengoi* may reduce its vulnerability to fish predators (Laxson et al., 2003) and allow the species to maintain a position high in the water column to consume prey. The similar phenology in stage 1 and 2 during 2008 could reflect a vulnerability of these smaller stages to predation, but is also likely tied to recruitment and reproduction of *C. pengoi* and should be further investigated (Fig. 39).

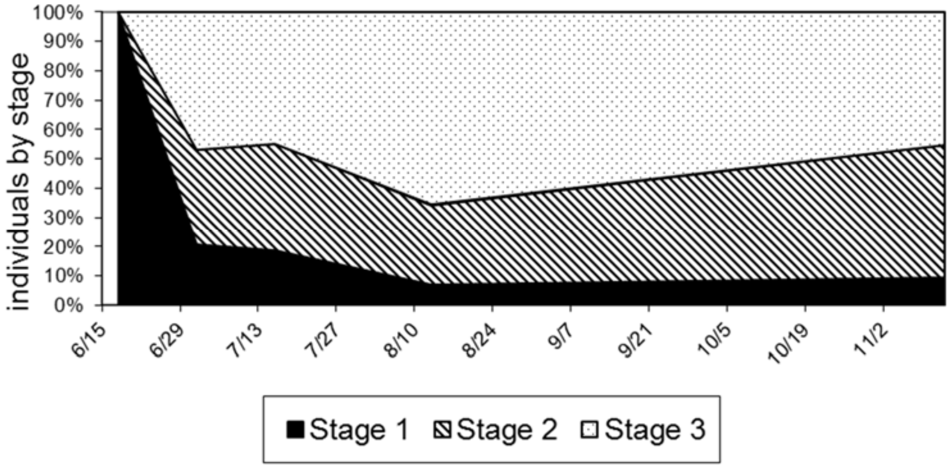


Fig. 39: Stage class distribution of *Cercopagis pengoi* at the reference station (see methods) in 2008. *C. pengoi* are born into stage 1 and possess a single pair of lateral barbs. They molt into stage 2 individuals that have two pairs of lateral barbs, and then molt a second time to stage 3, and possess three pairs of lateral barbs.

Benthic Ecology: The pelagic (deep water) benthic ecology was populated by *Dreissena polymorpha* and *D. rotriformis* (zebra and quagga mussels). Zebra mussels were first detected in Seneca Lake by 1992 and soon afterwards became firmly established in the lake. Quagga mussels were first detected in 2001. Three studies investigated the density of zebra and quagga mussels. Lake wide investigations in 2002, in 2007, and a third duplicated a N-S, mid-lake transect in 2001 and 2011 (Shelley et al., 2003; Zhu, unpublished data; Dittman, unpublished data). In each study, lake-floor densities (individuals/m^2) were determined for live zebra and quagga mussels. These data were augmented with less robust data collected in 2000, 2001 and 2003 from the Fall Geolimnology Class at HWS. The data revealed that zebra mussel populations preferred shallow water, as live zebra mussels were rarely found deeper than 40 meters, whereas quaggas lived in deeper water and some live quagga mussels were recovered from 160 m (Fig. 33). Both mussel populations declined in water depths shallower than 5 m. Annual mean zebra mussel densities between 10 and 40 meters fluctuated from 2000 to 2002 but then declined since 2002 (Fig. 33). None were recovered in 2011. Similar multi-decade records of initial invasion, dominance, and subsequent decline, change in zebra to quagga dominance, and their impact of these changes on the rest of the ecosystem were detected elsewhere, e.g., the Hudson River, NY and the Great Lakes (Nalepa, et al., 2007; Nalepa et al., 2009; Strayer et al., 2011). The number of quagga mussels increased from 2001 to 2002 and then declined afterwards in the 10 to 40 meter interval. However their total population increased from 2001 to 2011, from 1,300 to 3,300 ind/m^2, respectively, if deeper depths were included in the tally (D Dittman, unpublished data). Speculating, the 10 to 40 m decline may be due to mussel reproductive problems, competition, predation of the planktonic veligers and/or the migration of the zebra to quagga depth distributions, and should be further investigated.

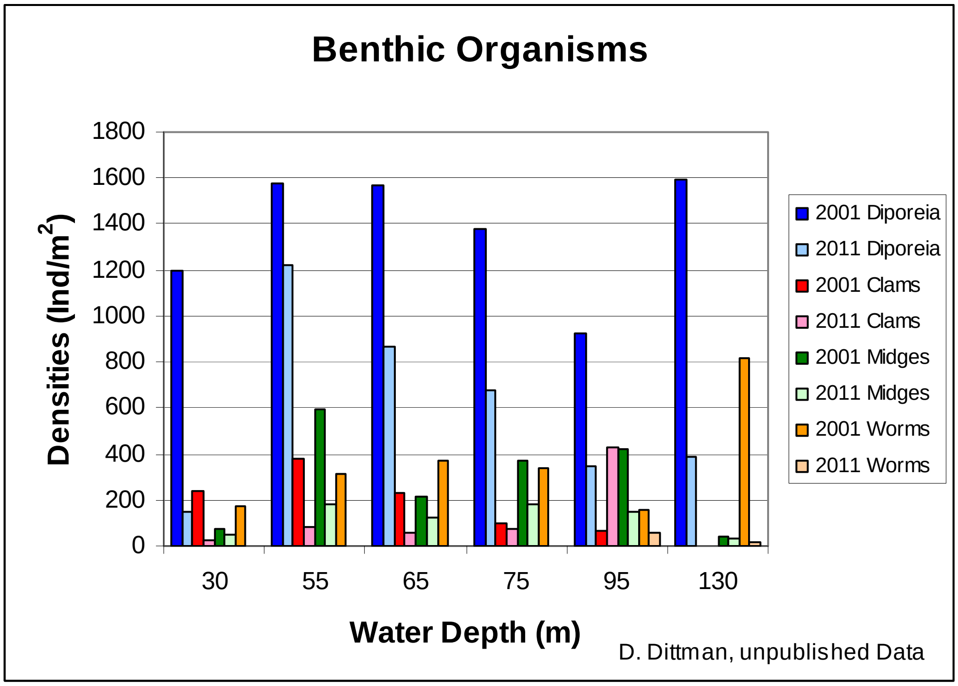


Fig. 40. Other benthic organisms in Seneca Lake (D Dittman, unpublished data).

Other benthic organisms were detected by D Dittman, USGS (unpublished data). *Diporeia spps*, a deep water amphipod and critical to the Lake Trout food chain, has decreased from 2001 to 2011 from ~1,400 to 600 individuals/m^2, but have not disappeared completely from Seneca Lake like they have in neighboring Great Lakes (Fig. 40, Dittman, unpublished data). Small clams, worms and various midges comprise the remainder of the benthic community at densities of ~10 to 300 individuals/m^2. Their populations have declined from 2001 to 2011 as well, but reasons for the decline are unclear at this time. Perhaps the deepwater benthic organisms were influenced by the multi-decade impact of zebra mussels and their supposed pelagic to littoral zone transfer of aquatic ecosystem resources. These declines should be further investigated.

Macrophyte Ecology: Scientific knowledge is scarce on the macrophyte communities in Seneca Lake despite a public outcry on their nuisance qualities and their importance for littoral zone (shallow water) food webs and nursery habitats for zooplankton, invertebrates and fish (especially juveniles) (Zhu, 2009). Macrophytes, the macroscopic plants in aquatic systems, include both large algae such as *Chara spps* and flowering plants such as the invasive Eurasian water milfoil. They are what comprise the "weed beds" in shallow-water environments, many of them rooted into the substrate. A preliminary study at 26 sites split between the northern and southern ends of the lake indentified eleven different taxa (Zhu, 2009). Eurasian water milfoil (*Myriophyllum spicatum*) and Sago pondweed (*Potamogeton pectinatus*) comprised an average of 130 and 25, respectively of the total macrophyte dried biomass of 170 g/m^2, and collectively over 90% of the macrophytes in the lake. Other taxa included: contail, (*Ceratophyllum demersum)*, stonewart, (*Chara spps)*, Elodea, (*Elodea canadensis)*, slender naiad, (*Najas flexilis)*, large-leaf pondweed, (*Potamogeton amplifolius)*, curly-leaf pondweed, (*Potamogeton crispus)*, leafy pondweed, (*Potamogeton foliosus)*, Richardson's pondweed, (*Potamogeton pectinatus)*, eelgrass, (*Vallisneria americana)*. Similar species were detected along the Seneca County shoreline (B. Johnson, personal communication).

Milfoil's dominance was not surprising because it dominates most lakes throughout the northeastern US. Macrophyte species richness was larger in neighboring Owasco (18) and Honeoye (20) but the difference may be due to the less detailed sampling in Seneca (26 vs. ~100 sites). Seneca species richness was also lower than its sediment total phosphate concentrations would predict (Zhu, 2009). Laboratory studies confirmed that Eurasian water milfoil was light limited in most aquatic ecosystems, more so than phosphate limited (Zhu et al., 2008). Thus, the lakeshore property owners outcry was not surprising when perceived macrophyte densities increased as zebra mussels increased water transparency in the late 1990s. Luckily, no sightings of the European frogbit (*Hydricharis morsis-vanae L.*), hydrilla (*Hydrilla verticillata*), or water chestnut (*Trapa natans L.*) have been reported in the lake but they are expected to arrive in the near future (Zhu et al., 2008). All three can completely dominate the littoral zone community, completely choke waterways, and have been detected in nearby waterways and lakes. These limited findings and scary future provide numerous avenues for future research.

Historical Water Quality Changes

Limnological data for Seneca Lake are sparse before 1990 (Brown et al., in revision). Secchi disk and chlorophyll-a data reveal some changes over the past 100 years (Fig. 41a; Birge and Juday, 1914, Muenscher, 1928; Mills, 1975). The available data suggest that Seneca Lake was more oligotrophic during the early 1900s. The data gaps however preclude comment on additional pre-1990 water quality trends. To overcome these data gaps, researchers investigated records of environmental change, namely organic matter, carbonate content and/or total mercury content, that were preserved in short, ~50-cm long, sediment box cores (Lajewski et al. 2003; Abbott and Curtin, 2010; Brown et al., in revision). These short cores span the past 100 to 200 years, thus provide a record of the historical water quality changes for Seneca Lake.

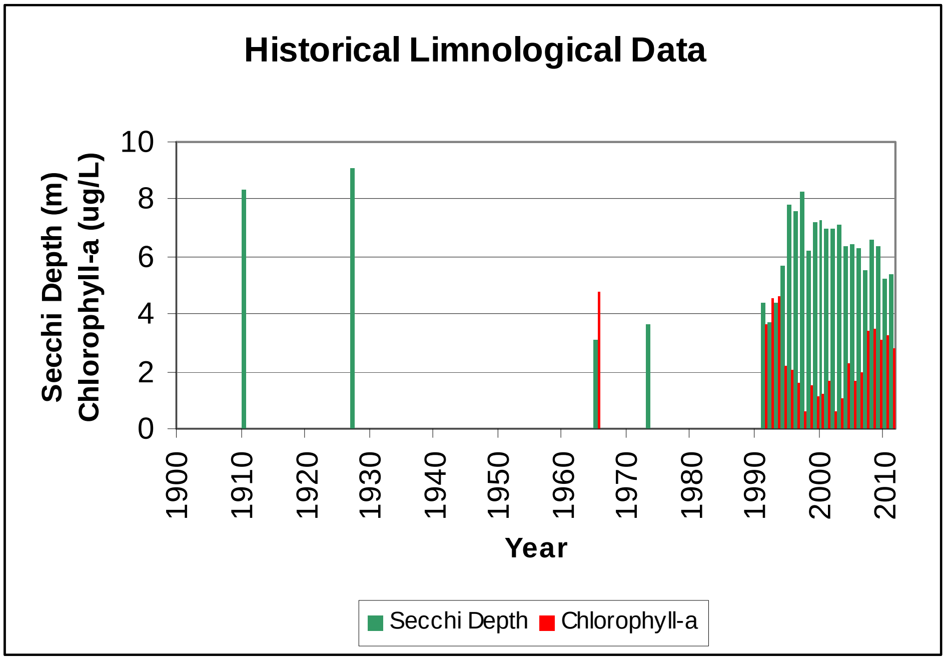


Fig. 41. Historical records of secchi disk depths and chlrorophyll-a concentrations (Birge and Judy, 1914, Muenscher, 1928, Mills, 1975).

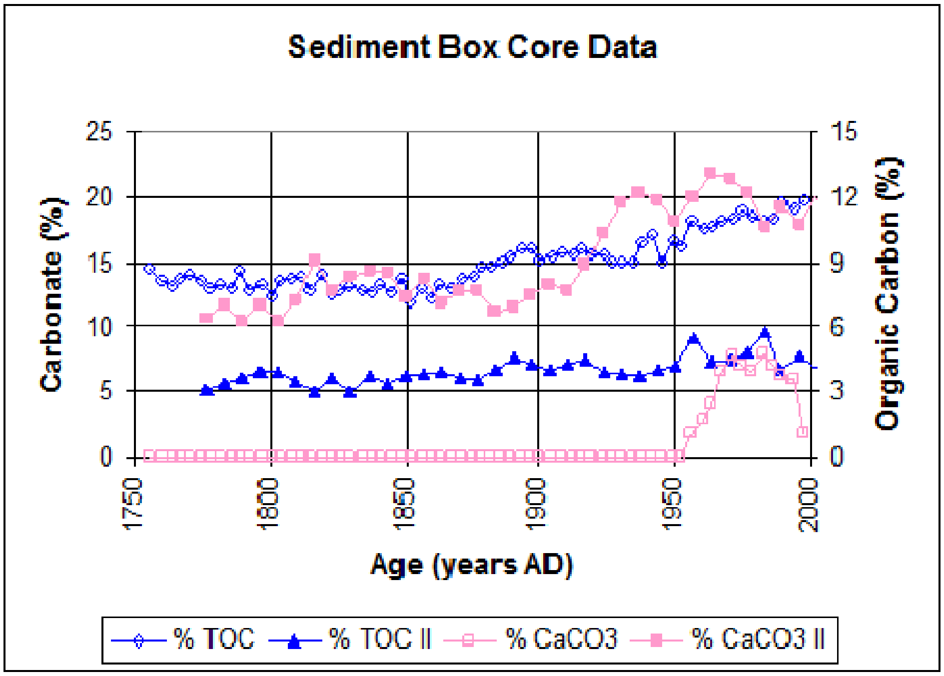


Fig. 42. Box core records of total organic carbon and carbonate content (Lajewski et al., 2003, Brown et al., in revision).

Historical Productivity: Box cores revealed increasing organic matter and carbonate contents from ca. 1770 to today (Fig. 42). Total organic matter concentrations in sediments (TOC) reflect the amount of algal production in the lake, and increasing TOC trends are typically sometimes interpreted as increasing productivity in the lake (Dean, 1974; Brown et al., in revision). The change was interpreted to reflect increased nutrient loading from the increase in human population densities and agricultural activities in the watershed. Carbonate precipitation is controlled by temperature, algal productivity and the watershed supply of calcium and bicarbonate/carbonate (alkalinity) to the lake. Warmer temperatures can induce calcite precipitation due to a reduction of carbon dioxide saturation concentrations (and acidity) in the water. Algal photosynthesis also removes carbon dioxide from the water. On a warm summer day, blooms can induce whiting events, the precipitation of calcium carbonate, and turn the surface waters into a milky (calcite) green (algae) color. Increasing up-core carbonate concentrations, suggest that algal productivity increased from ca. 1770 to today as well. Alternatively, increasing the supply of calcium and alkalinity to the lake increases the likelihood for the precipitation of calcite. The supply of calcium and bicarbonate/carbonate has increased due to the increase in acid rain since the late 1850s. Thus, these records could also reflect the onset of acid rain, and its impact on chemical weathering rates in the watershed. Lajewski et al. (2003) favored the latter interpretation because many neighboring Finger Lakes do not reveal a parallel change in total organic matter, and only carbonate increased up-core. Interestingly, the limited historical data are more consistent with the increasing productivity interpretation (Brown et al., in revision).

Mercury Levels: Lake sediment records across the Northern Hemisphere preserve evidence for increases in atmospheric deposition of mercury (Hg) over the last ~150 years (Bookman et al., 2008). Mercury contamination is pervasive in aquatic ecosystems across North America. Its bioaccumulation can lead to severe health concerns for both wildlife and humans, and in 2001, sixty three lakes in New York were added to the Department of Health's fish consumption advisory list due to elevated levels of Hg (Fitzgerald and Clarkson, 1991; US EPA, 1997; Callinan, 2001). There are many potential natural (e.g., forest fire, volcanic eruptions) and anthropogenic (e.g., fossil fuel combustion, medical and municipal waste incineration, metal smelting) sources of Hg in the environment (Bookman et al, 2008;

Pirrone et al, 1998; Lorey & Driscoll, 1999; Perry et al., 2004). Previous studies in the Seneca Lake watershed show that the highest surficial sediment Hg concentrations in the lake occurred near the mouth of the Keuka Outlet (Blackburn et al., 1979, Abbott and Halfman, 2009). Abbott and Curtin (2010) analyzed a ~50-cm long sediment box core to assess the timing and magnitude of change in Hg deposition in Seneca Lake and potential sources of contamination (Fig. 43).

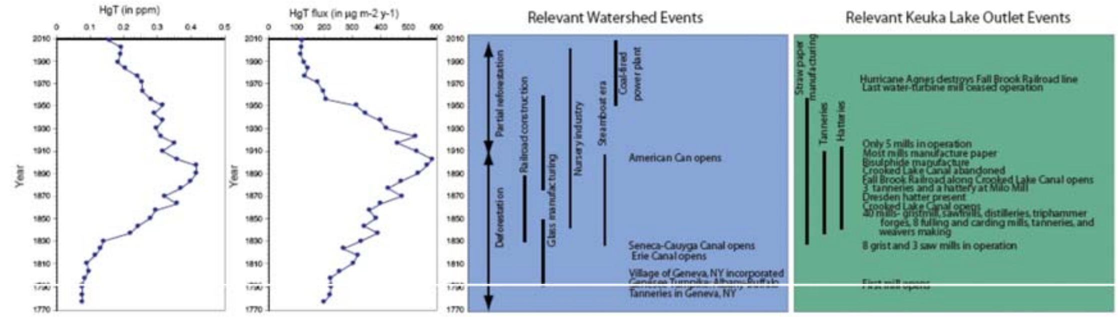


Fig. 43. HgT concentrations and HgT fluxes with age in the core. The timing of changes in Hg are compared with events in the Seneca Lake watershed and Keuka Lake Outlet (Abbott and Curtin, 2012).

Analysis of a ^{137}Cs and ^{210}Pb-dated sediment box core indicates total Hg (HgT) concentrations ranged from 0.075 ppm in 1790 to a maximum of 0.414 ppm between 1890 and 1897 with an average of 0.24 ppm (Appleby and Oldfield, 1978). No correlations appeared to exist between the HgT to wt% organic matter, carbonate, or terrigenous grain size. The onset of Hg contamination in Seneca Lake was at ~1810, whereas in nearby lakes the onset was clearly much later, between 1910 and 1930. In Seneca Lake, HgT fluxes were low (197 µgm-2y-1) in 1770 and peaked between 1890 and 1910 (583 $\mu g/m^2/yr$) and gradually returned to regional background levels (127 $\mu g/m^2/yr$) by 1977. This peak in HgT flux predates those observed in other local and regional lakes (Fig. 44), the maximum flux is greater than in most local lakes except Lakes Ontario and Erie. Other lakes in the northeastern United States reached their maximum HgT flux post World-War II. Because of the mismatch in timing of peak Hg accumulation in these lakes, a more localized point source rather than widespread atmospheric deposition appears to be the reason for increased HgT flux to the sediment in Seneca.

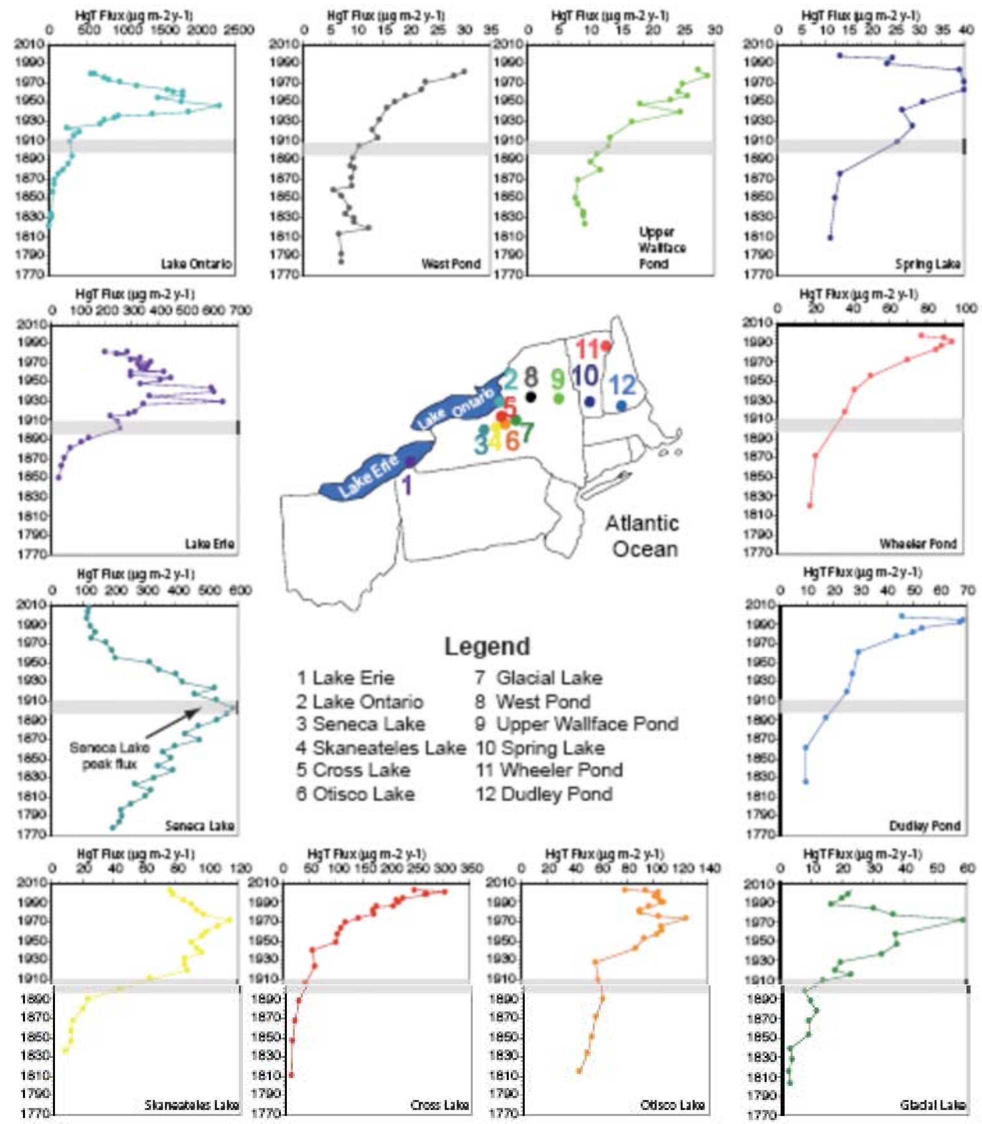


Fig. 44. Regional comparison of HgT fluxes (Abbott and Curtin, 2012, Bookman et al., 2008, Pirrone et al., 1998).

Natural sources such as active volcanoes do not exist locally, and evidence for local forest fires was not detected in the sediment. The timing of the HgT peak in Seneca Lake is also incongruent with the 19th century peak of the gold and silver mining in North America (locally in Ontario, Canada). Any of these regional sources, forest fires or mining activities would also have shown up in the neighboring lake records. The records of Hg contaminant in neighboring lakes instead typically match the atmospheric deposition from burning fossil fuels, smelters, and waste incineration, or local sources.

Agriculture has played a significant role in the western NY economy for centuries (Cunningham and Wessels, 1939). Since the 1800s, orchards and nurseries were abundant at the northern end of Seneca Lake, and among the largest in the country. Mercury was used as an effective pesticide for agriculture, typically in the form of mercuric chloride. However, typical application rates fall far below the amounts accumulating in the sediment record. Mercury was also used for a common cure-all solution. It was commonly used as rat poison, and a cure for constipation and other forms of gastrointestinal agony (Willich and Mease, 1803). These uses also cannot account for the high concentrations found in the lake. Other industries existed in the region. For example, the Ontario Glass Manufacturing Company and Geneva Glass Works, now defunct, operated small plants at Glass Factory Bay along the northwestern shore of the lake in the 1800s to mid-1990s (Miscellaneous Register, 1823; Foley, 1963).

The Keuka Outlet was a magnet for mills, and chemical processing plants, because the many waterfalls and an elevation drop of 82 m make the course an ideal location for hydropower. Early industry, including tanneries, battery factories, paper mills, and a flourishing nursery market, as well as a growing population during the late 19th century are possible sources for the high Hg concentrations found at Seneca Lake (Clayton, 1926; Collier, 1893; Dumas, 1989; Watras and Hucklebee, 1992; Merwin et al., 1994; Grebinger and Grebinger, 1993). Numerous gristmills, sawmills, tanneries, paper mills, battery and other chemical factories were built along the outlet. The largest Hg producers could be the tanneries, paper mills, and battery and other chemical factories. The timing of the greatest number of mills coincides with the HgT flux peak in the sediment record.

Another possible reason for the rapid increase in HgT flux is the result of land use change. Deforestation in the watershed initiated during the early 1800s as land was cleared for agriculture (Galpin, 1941; DeLaubenfels, 1966; Siles, 1978). Deforestation destabilizes soils and results in a major increase in the contribution of terrestrial material to the lake. The increased HgT flux to Seneca Lake is coincident with an increase in the land are used for agriculture. Although paper production and other mill activity ceased in the watershed by 1910, and deforestation slowed and reforestation began, Hg still entered the lake as erosion continued to mobilize remnant Hg in the soils.

Mercury in Fish: The New York State Department of Environmental Conservation has published mercury data for lake trout, an organism found at the top of the aquatic foodweb for Seneca Lake (Skinner et al. 2010.) The reported concentrations of mercury in four to six year old lake trout are about 300 ng/g mercury wet weight. For older fish (> six years old), the Mercury concentrations are higher, on average, with levels around 400 ng/g mercury with a maximum concentration of 578 ng/g (Skinner et al., 2010.). This analysis was done on approximately 76 lake trout collected in 2008 from Seneca Lake in Seneca, Yates, and Schuyler counties (NYSDEC Bureau of Habitat, 2010).

The action level for mercury in fish issued by the US Food and Drug Administration (FDA) is 1,000 ng/g of methyl mercury. The action level "represents limits at or above which FDA will take legal action to remove products from the market ("Guidance for Industry", 2000). Since virtually all of the mercury present in fish at the top of the foodweb is methyl mercury, total mercury measurements are often used as a surrogate for methyl mercury (Bloom, 1992). The US EPA has issued a screening value of 300 ng/g for methyl mercury in fish. This concentration "in fish tissue should not be exceeded to protect the health of consumers of noncommercial freshwater/estuarine fish" ("Human Health Criteria", 2001).

An earlier investigation of mercury concentrations in fish across NY was conducted between 2003 and 2005 (NYSDEC, 2008). Yellow perch and smallmouth bass were collected from Seneca Lake in Seneca County and analyzed for total mercury concentrations. Results of this analysis are summarized in Table 16. These mercury concentrations overlap those from the lake trout collected in 2008. Since different species of fish were sampled during different years, it is not known whether mercury levels in fish are decreasing in Seneca Lake or if the data reflect interspecies differences between lake trout, smallmouth bass, and yellow perch. In general, of the fish analyzed for mercury, one would expect yellow perch to have the lowest concentrations of mercury since they are at the lowest trophic level. However, the data were inconclusive and revealed too much variability within individuals of the same species from the 2003 to 2005 sampling since the coefficient of variation for the yellow perch samples is 60% and 36% for the smallmouth bass. (Table 17)

Table 19. Fish mercury data from Seneca Lake from NYSDEC's "*Strategic Monitoring of Mercury in New York State Fish*," (NYSDEC, 2008).

Fish	n	Mean Length (mm) (Range)	Mean Weight (g) (Range)	Mean Fish Mercury (ng/g) (Range)
Smallmouth bass	6	291 ± 52 (226 – 365)	456 ± 265 (158 – 890)	421 ± 151 (222 – 668)
Yellow perch	10	262 ± 28 (225 – 322)	294 ± 111 (201 – 574)	295 ± 177 (129 – 678)

In order to understand more about the fish total mercury levels in Seneca Lake tributaries, analysis of small fish collected by Dr. Cushman in summer 2011 was performed at the Finger Lakes Institute. Determining fish mercury levels is important since tributaries and watersheds are known locations of methyl mercury production and mercury bioaccumulation (Hurley et al. 1995; Cleckner et al. 2003). Streams are also ecologically important for macroinvertebrates and fish, and are popular locations for sport anglers. Figure 45 show mercury concentrations for a small number (n=2 to 5 composited fish per site) of blacknose dace in selected Seneca Lake tributaries. Blacknose dace are a small ubiquitous omnivorous fish, found throughout the Finger Lakes and NY (Kraft et al., 2006).

Large differences in blacknose dace mercury concentrations were observed among the sampled Seneca Lake watershed tributaries. In general, higher fish total mercury concentrations were found in tributaries at the northern and southern ends of the watershed (Figure 44). However, the levels of mercury in the tributary blacknose dace are on average below those reported for the yellow perch, smallmouth bass, and lake trout sampled in Seneca Lake. This is expected since the blacknose dace are at the bottom of the foodweb. From this preliminary analysis, it appears that blacknose dace is an excellent indicator species to investigate spatial and temporal variability in mercury, since they are found at every site, show differences in mercury concentrations among sites, typically live about three years, have a range of about 26 m (Cushman, 2006), and are eaten by larger fish such as trout (Kraft et al., 2006). Further analyses should determine methyl mercury levels in these small fish to determine the percentage of total mercury present as methyl.

Based on the mercury data in fish for Seneca Lake, the consumption advice for eating Seneca Lake fish is the same as for the State of New York – "Eat no more than one meal per week" (NYSDEC, 2008.)

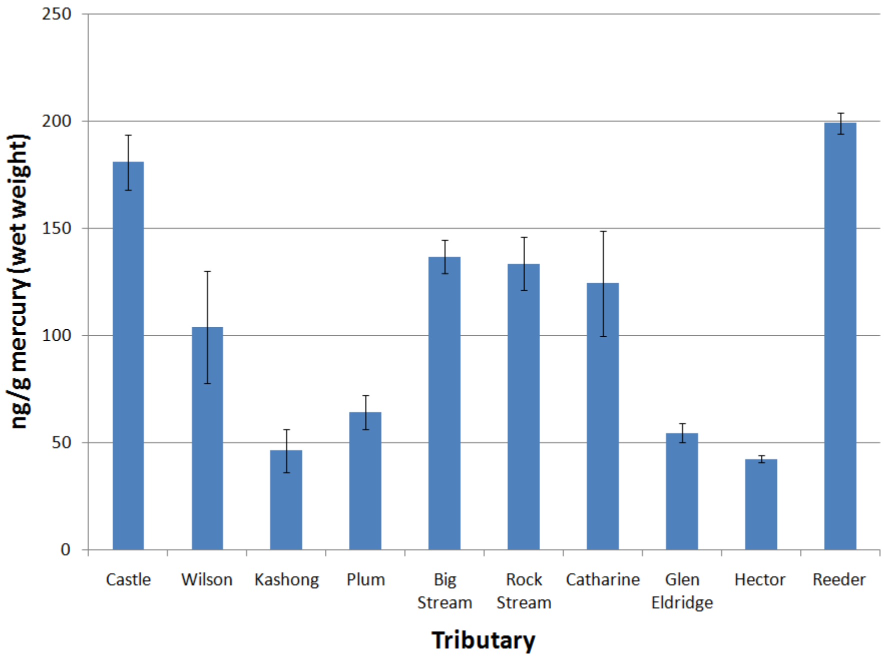


Fig. 45. Blacknose dace mercury levels (ng mercury per g of wet weight fish tissue) in tested Seneca Lake Watershed tributaries. Error bars represent two standard deviations for fish tissue sub-samples from each site. The average coefficient of variation for all analyses is 8.6%.

Seneca Lake Subwatersheds and Stream Hydrogeochemistry

Stream Hydrology & Hydrogeochemistry

HWS has been monitoring selected streams in the Seneca watershed since 1998. The data were typically collected near the terminus of Wilson, Kashong, Keuka Outlet, Plum Pt, Big Stream, Reeder and Kendig Creek during the late spring and early summer, and less frequently from the other major tributaries in the watershed. Since 2010, year round, weekly to bi-monthly, sampling focused on Castle, Wilson, Kashong, and Keuka Outlet to assess seasonal differences in stream hydrogeochemistry, nutrient loading and other issues. Catharine Creek was also sampled in 2011, but the other tributaries were sampled less frequently, if at all, in 2010 and 2011. On each visit, stream discharge, temperature, pH, conductivity, dissolved oxygen and alkalinity were measured onsite, and additional water was collected and analyzed back in the laboratory for total phosphate (TP), dissolved phosphate (SRP), nitrate, total suspended sediment (TSS), and major ion concentrations following identical procedures to the lake samples. Details can be found in (Halfman, 2012).

Stream Discharge: The 1999-2011 average stream discharge for each primary site ranged from less than 0.1 to 7.9 m^3/s in the watershed (Table 20, Fig. 46). The smallest discharge was detected in the smallest watersheds, e.g., Plum Point and Castle Creek, and largest was detected in the largest watersheds, e.g., Keuka Outlet and Catharine Creek. Basin size was the primary determinant for stream discharge (r^2 = 0.99). All of the tributaries exhibited a flashy, precipitation-event influenced, hydrology. Almost every tributary, except for the largest tributaries, was dry for a portion of the summer.

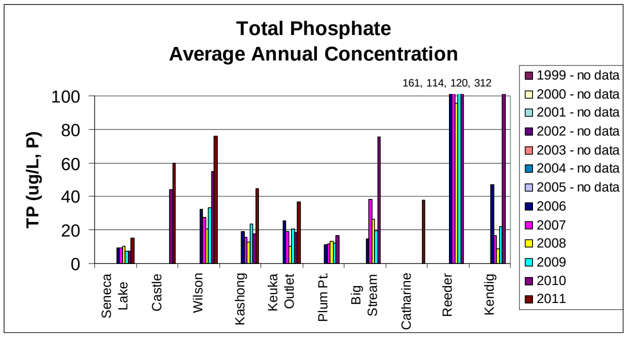
Two United States Geological Survey (USGS) gauge sites are located in the Seneca Lake watershed. One monitors flow down the Keuka Outlet, the largest tributary to the lake (USGS Site: 04232482).

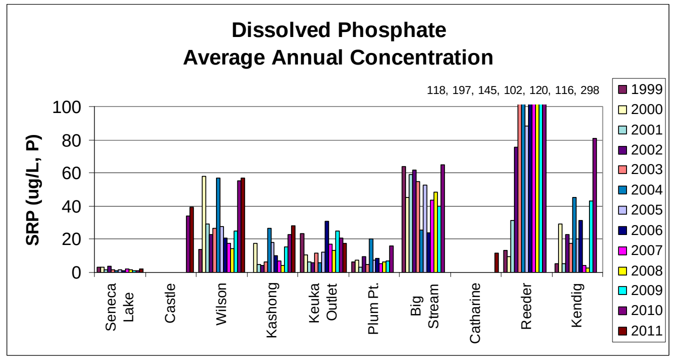
The Keuka Outlet is the outflow for Keuka Lake to the west. The other monitors flow out the outlet, the Seneca River, near Seneca Falls, NY (USGS Site: 04232734).

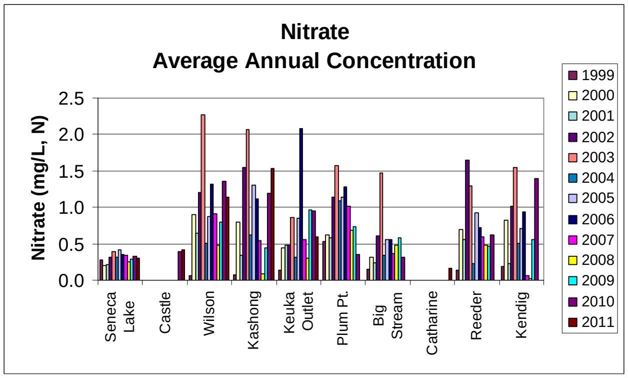
Table 20. Average stream concentration and flux data 1999-2011 (Halfman, 2012).

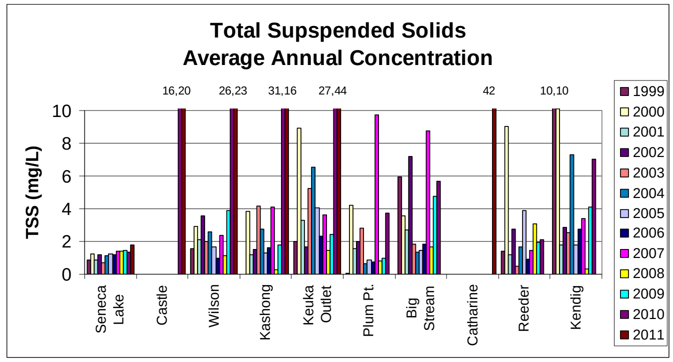
Concentrations	Conductivity μS/cm	Discharge m^3/s	Nitrate mg/L, N	Total Phosphate μg/L, P	Phosphate (SRP) μg/L, P	Suspended Sediment mg/L, N
Seneca Lake	696	--	0.3	9.8	1.9	1.2
Castle	844	0.3	0.4	51.9	36.9	18.7
Wilson	629	0.4	1.0	40.8	32.7	5.7
Kashong	561	0.7	0.9	22.3	13.8	5.8
Keuka Outlet	359	3.2	0.7	21.7	15.4	8.7
Plum Pt.	580	0.1	0.9	13.0	8.5	2.3
Big Stream	400	0.6	0.5	34.9	48.6	3.9
Catharine	416	2.6	0.2	37.9	11.4	42.5
Reeder	589	0.2	0.7	160.4	109.5	2.5
Kendig	527	0.2	0.7	40.1	25.6	4.5

Fluxes	Nitrate kg/day	Total Phosphate kg/day	Phosphate (SRP) kg/day	Suspended Sediment kg/day
Castle	10.9	1.4	1.0	1.2
Wilson	34.2	1.8	1.4	18.7
Kashong	59.7	1.7	1.0	5.7
Keuka Outlet	177.0	7.6	3.9	5.8
Plum Pt.	7.6	0.0	0.1	8.7
Big Stream	23.6	0.8	2.3	2.3
Catharine	37.4	8.7	2.6	3.9
Reeder	11.2	0.8	1.2	42.5
Kendig	16.4	0.4	0.6	2.5









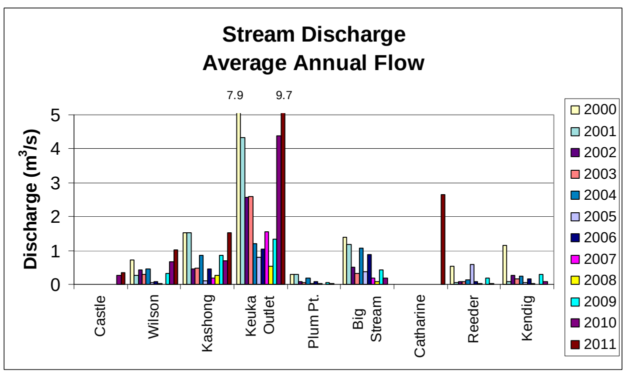


Fig. 46. Annual, site-averaged, stream discharge and water quality data. Castle Creek was added to the survey in 2010 which also focused on Wilson, Kashong and Keuka Outlet. Catharine Creek was only sampled in 2011. Annual Seneca Lake concentrations are shown for comparison.

The annual average, mean daily inflow at Keuka Outlet from 2001 to 2010 was 5.5 m^3/s, and individual annual-average, mean-daily flows ranged from 3.4 (2001) to 9.1 m^3/s (2004) (Fig. 46). Annual hydrographs exhibited larger discharges in the winter and/or spring (13.5 and 15.7 m^3/s) than the summer and fall (5.0 and 10.7 m^3/s). The fall flows were larger than expected due to the release of upstream Keuka Lake water through its outlet dam to maintain lower winter levels in the lake. The annual inflow of water averaged 173 million m^3/yr and ranged between 107 (2001) and 287 (2004) million m^3/yr during the past decade. This basin encompasses ~30% of the watershed.

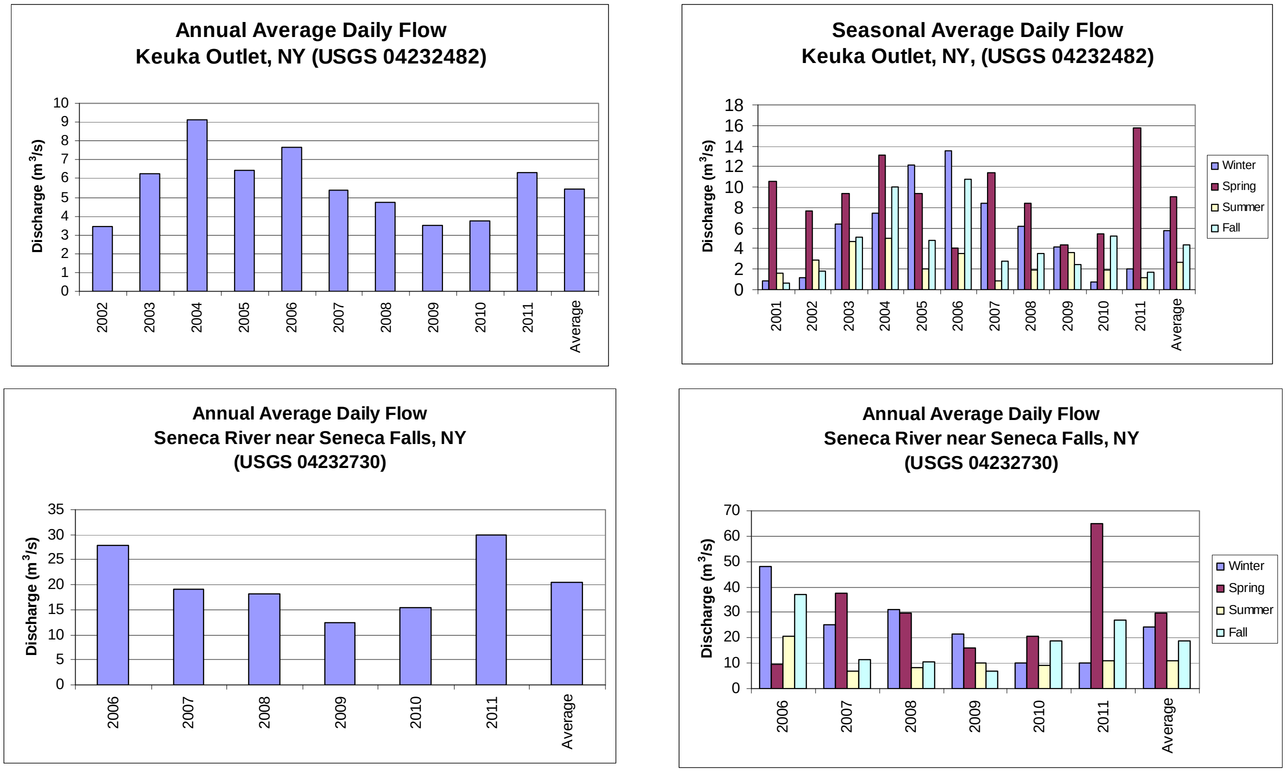


Fig. 47. Annual average, daily discharges at the USGS gauge stations on Keuka Outlet (top-left) at Dresden, and on the Seneca River (bottom-left), near Seneca Falls, NY, for the past six and ten years respectively. Seasonal average, daily discharges, are also shown for both sites (top & bottom right). (http://waterdata.usgs.gov/nwis)

The annual average, mean daily flow out the Seneca River near Seneca Falls, NY from 2006 to 2010 was 20.5 m^3/s, and individual annual-average, mean-daily flows ranged from 12.6 (2009) to 29.9 m^3/s (2011) (Fig. 46). Larger discharges were typically detected in the winter and/or spring (34.4 and 39.7 m^3/s) than the summer and fall (11.0 and 18.7 m^3/s). The flow was regulated by a dam. The NYS Thruway Authority attempts to balance disparate needs including Seneca Lake levels "rule curve", Erie Canal levels, minimum flows for boat traffic and downstream flooding, flow though a hydroelectric facility, and minimum flows for industrial discharges like the Waterloo wastewater treatment facility (Kappel and Landre, 2000). The Seneca Lake level "rule curve" is targeted at 446 ± 0.3 ft relative to the Barge Canal Datum in the summer (March 15 to November 1), and 445 ± 0.3 ft in the winter (December 15 to March 1) (http://www.canals.ny.gov/faq/oswego/netdata/seneca-levels.pdf). Flood stage is at 448 ft, and major flood stage at 449 ft (National Weather Service, http://water.weather.gov/ahps/). The annual discharge out the outlet averaged 645 million m^3/yr and ranged between 390 and 942 million m^3/yr over the past six years. The available hydrologic data paint an incomplete picture of the watershed hydrology and should be investigated further.

Seneca Lake's water residence time estimated using tritium, stable isotope and USGS Runoff data were estimated at: 12, 18, 19 and 23 years and average ~18 years (Michel and Kraemer, 1995).

Nutrient Concentrations in Streams: Nutrient loading impacted the watershed (Halfman & Franklin, 2007; Halfman, 2012). All of the nutrient and TSS concentrations were larger in the streams than the lake (Table 19, Fig. 46). For example, fluvial total phosphate concentrations averaged 47 μg/L but were below 10 μg/L in the lake, fluvial nitrate concentrations averaged 0.7 mg/L but averaged 0.3 mg/L in the lake over the past decade. Thus, Seneca has a nutrient loading problem, as do most agriculturally-rich watersheds in the Finger Lakes.

Annual mean nutrient concentrations varied from stream to stream. Wilson Creek, Kendig Creek, Castle Creek, Big Stream, and especially Reeder Creek revealed larger phosphate concentrations than the other tributaries. Unfortunately, no one reason accounts for these differences (Spitzer, 1999; Halfman and Franklin, 2007; Halfman, 2012). Wilson and Kendig Creeks have large nutrient concentrations because they drain larger portions of agricultural land (e.g., Makarewicz, 2009). The loading characteristically increased during an intense runoff event at Wilson Creek (Kostick and Halfman, 2003). In contrast, Big Stream drained much less agricultural land but had larger phosphate concentrations than Wilson and Kendig. Stream segment analysis in 2001 indicated that the Dundee wastewater treatment (WWT) facility was an important point source of nutrients to the stream but stream concentrations never increased above MCLs (Bowser, 2002). A similar segment analysis along the Keuka Outlet indicated that the Penn Yan WWT facility was not a significant point source of nutrients to Keuka Outlet (Hintz, 2004).

Catharine Creek revealed larger total suspended solid concentrations, but smaller phosphates (both TP and SRP), nitrates and specific conductance data than the other streams. It drains more forested land than the other surveyed watersheds (~60% compared to 15 to 18% forested land), and forested watersheds typically yield fewer nutrients and suspended sediments than agricultural watersheds, especially during runoff events. The larger suspended solid concentrations in Catharine were inconsistent with forested watersheds, and perhaps reflected upstream logging, construction and/or gravel pit practices in the watershed. Forested watersheds in neighboring lakes revealed minimal nutrient and TSS loads compared to their neighboring agricultural-rich streams (Halfman et al., 2011).

The largest concentrations of SRP and TP were consistently detected in Reeder Creek. This "honor" started in 2002 when SRP concentrations rose from typical tributary values of ~20 μg/L to 100 μg/L or more. Concentrated Animal Feeding Operations (CAFOs), in this case pig farms, entered the region, and the former Seneca Army Depot was systematically disposing of and exploding old, unstable, phosphate-bearing, munitions at this time. Both could contribute to the initial increase in 2002 but only pig farms persisted through 2011.

Finally, annual mean discharges, TP and TSS concentrations were larger in 2010 and 2011 than previous years in Castle, Wilson, Kashong, and Keuka Outlet, and larger than most of the other tributaries. These four streams were sampled year round since 2010, whereas every stream was only sampled in the late spring and early summer during pre-2010 fieldwork. The seasonal analysis (see below) revealed larger discharges, concentrations and fluxes during the winter and/or spring compared to the summer months, which dictated this difference.

Nutrient Fluxes:

The largest fluxes were from streams with the largest basin areas (Table 19, Fig. 48). For example, Keuka Outlet and Catharine Creek, the largest streams sampled, revealed annual average fluxes of 7.6 and 8.7 kg/day for total phosphates compared to loads below 2 kg/day in the other streams, and 4,800 and 9,700 kg/day for total suspended solids vs. 500 kg/day in the other streams. The smallest fluxes were from the smallest watersheds, like Plum Pt. and Reeder Creek, adding only 0.04 and 0.8 kg/day for TP, and 20 and 65 kg/day for TSS over the past decade. These trends were interesting because Keuka Outlet revealed one of the smaller concentrations and Redder Creek one of the largest concentrations for TP but Keuka Outlet had the largest fluxes and Reeder the smallest. Castle Creek, another small watershed, discharged as much TP (1.4 kg/day), SRP (1.0 kg/day), and TSS (500 kg/day) as its larger and more agricultural neighbors, Wilson and Kashong Creeks. Perhaps Castle Creek's elevated flux reflected drainage of an urban area, and/or annual averages from year round samples; whereas the other stream averages included years with summer only data. Mean TP, SRP, TSS and nitrate fluxes correlated to basin size (r^2 from 0.63 and 0.85, Halfman, 2012).

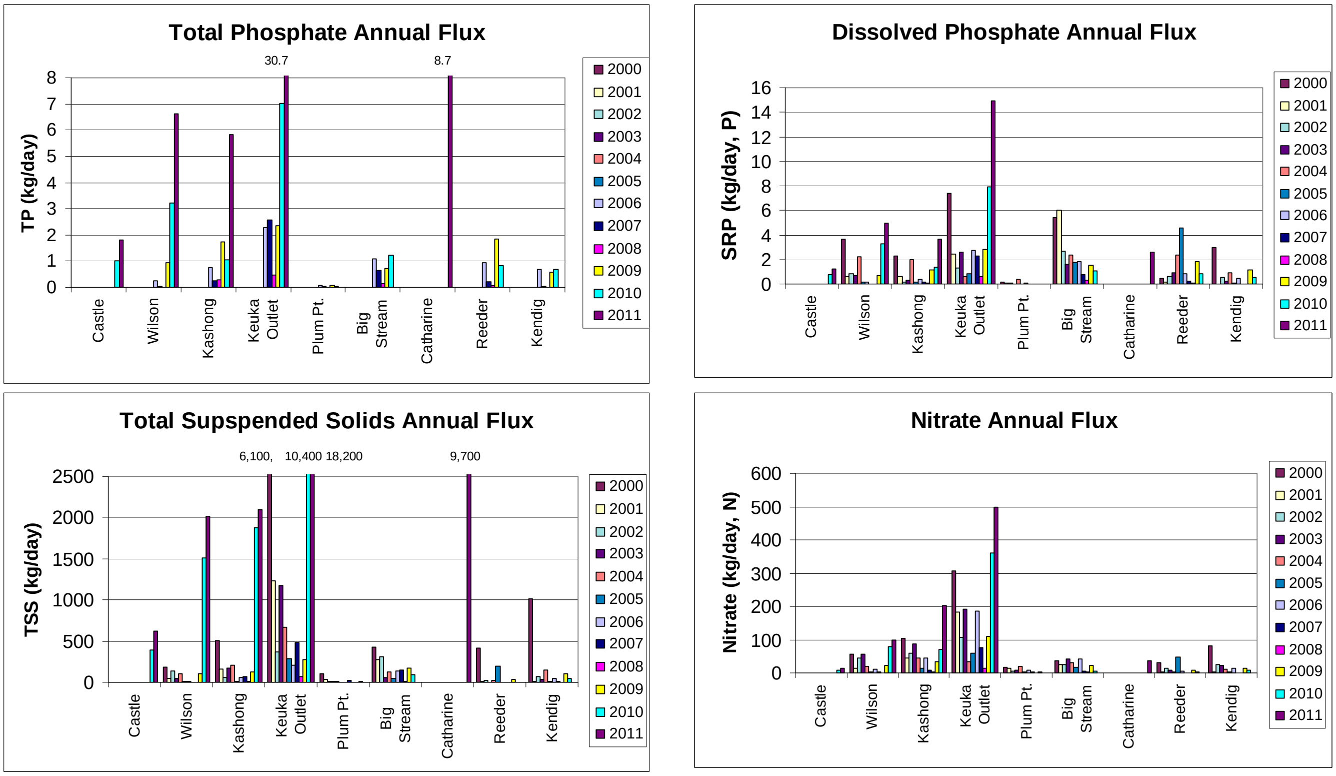


Fig. 48. Annual average flux of nutrients and suspended sediments to Seneca Lake (Halfman, 2012).

Seasonal Changes in Stream Data: Stream discharge, concentrations and fluxes of nutrients and suspended sediments changed seasonally (Fig. 35). These changes were critical for long term comparisons because the pre-2010 samples were typically restricted to the late spring and early summer, whereas the post-2010 samples were collected year round. Stream discharge was largest in the winter and/or spring and smallest in the summer and fall. Whether the season was winter or spring was dependent on the timing of snow melt and "spring" rains. Spring rains sometime happened in late winter. The anomalous large fall discharge at Keuka Outlet reflects the dam on Keuka Lake and fall releases to lower Keuka Lake to winter levels. TSS concentrations were larger in the winter or spring and related to the timing of the early spring rains and snow melt. Seasonality for the other parameters was most apparent in their fluxes, with more material entering the lake in the late winter or early spring.

Phosphate Budget for Seneca Lake

Phosphorus is critical to the health and water quality of Seneca Lake because it limits algal growth. The stream concentrations and fluxes suggest that a nutrient loading problem exists. However, stream inputs are only one part of the equation. A phosphorus budget must also include additional inputs like atmospheric loading, lakeshore lawn care fertilizers, lakeshore septic systems and municipal wastewater treatment facilities, and outputs like the outflow of phosphorus-bearing, dissolved and particulate materials through the Seneca River and organic matter burial into the sediments (Fig. 49).

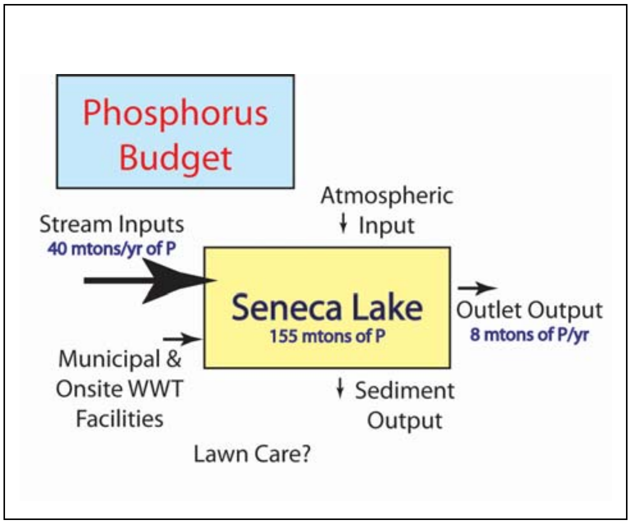


Fig. 49. Estimated phosphorus fluxes into and out of Seneca Lake. The arrow size is proportional its flux.

Inputs: The total fluvial flux of phosphorus to the lake is, on average, 40 metric tons/year, assuming a mean stream total phosphate concentration of 47 μg/L, and an estimated annual stream discharge of 863 x 10^6 m^3 (Wing et al., 1995). This stream influx is almost three times larger than the 17 metric tons/year estimated earlier using the same annual discharge (Halfman and Franklin, 2007). The difference reflected the inclusion of year round samples in the more recent calculation.

Other notable inputs include lakeshore septic systems, lakeshore lawn care, atmospheric deposition and municipal wastewater treatment facilities that do not discharge into a sampled stream (Halfman, 2012). Extrapolating a septic input per km of shoreline estimated for Owasco Lake (Halfman et al., 2011), the lakeshore septic influx is approximately 5 metric tons/yr. The atmospheric loading of 0.8 metric tons/year directly onto the lake's surface was estimated from National Atmospheric Deposition Program data collected at Ithaca, NY (Site NY67, e.g., Koelliker et al., 2004). Finally, the Geneva (Marsh Creek) wastewater treatment facility discharged approximately 2.4 metric tons of phosphorus per year (http://www.epa-echo.gov/echo/). Unfortunately, phosphate data was not publically available for the Waterloo and other facilities, and estimating a lawn care/fertilizer flux is too tenuous at this time.

Combining all the known inputs, the influx of phosphorus to the lake was approximately 55 metric tons/year. This estimate was probably low due to the lack of some, albeit minor, contributions and simplifying assumptions.

Losses: Phosphorus was lost from Seneca Lake through the outlet and into the sediments. The efflux through the outlet was estimated at ~8 metric tons per year, assuming a mean lake TP concentration of 10 μg/L, and an outflow discharge of 760 x 10^6 m^3/year (Wing et al., 1995). Unfortunately, very few sediment cores have both total phosphate and sedimentation rate data. Extrapolation from the limited number of cores estimated a flux of 1.5 metric tons/year to the sediments. The sediment burial estimate is tentative at this time.

Combining all the outputs, the efflux of phosphorus from the lake was approximately 10 metric tons/year. This total efflux is less certain than the inputs.

Budget: The total inputs estimated at 55 mtons/yr were much larger than the total outputs estimated at 10 mtons/yr, thus Seneca Lake experienced a significant nutrient loading problem over the past two decades. The total amount of phosphorus in the lake was 155 metric tons estimated from the 2011 mean lake total phosphate concentration of 10 mg/L and a lake volume of 15.5 km^3. Thus the annual net gain was approximately 1/3rd of the phosphorus in the lake. Assuming a net positive flux of 45 metric tons/year, the lake is destined to become eutrophic. Predicting when eutrophication will happen is difficult to estimate. For example, larger algal productivity from nutrient loading induces larger effluxes out the outlet and to the sediments. Changes in rainfall, thus runoff and discharge, proportionally influence the fluvial flux. However, the budget highlights the tenuous nature of the lake, and the need to proactively decrease nutrient loading, and especially loading from streams. The budget should be more thoroughly investigated in the future.

In conclusion, the Seneca Lake watershed has a number point and nonpoint sources of nutrients. They included municipal wastewater treatment facilities and onsite wastewater treatment (septic systems), atmospheric loading, runoff from agricultural land both crop farming and animal husbandry, and runoff of nutrients and other products from well-manicured lawns. The preliminary analysis indicated that runoff from streams dominated all inputs to the lake. Clearly, the phosphorus budget indicates that inputs overshadow outputs. This net flux was consistent with the observed degradation in water quality degradation over the past decade. Resolving these "bottom up" stressors with various "top down" forces makes Seneca Lake an excellent, but complicated, natural laboratory and numerous projects over the next decade (Fig. 50).

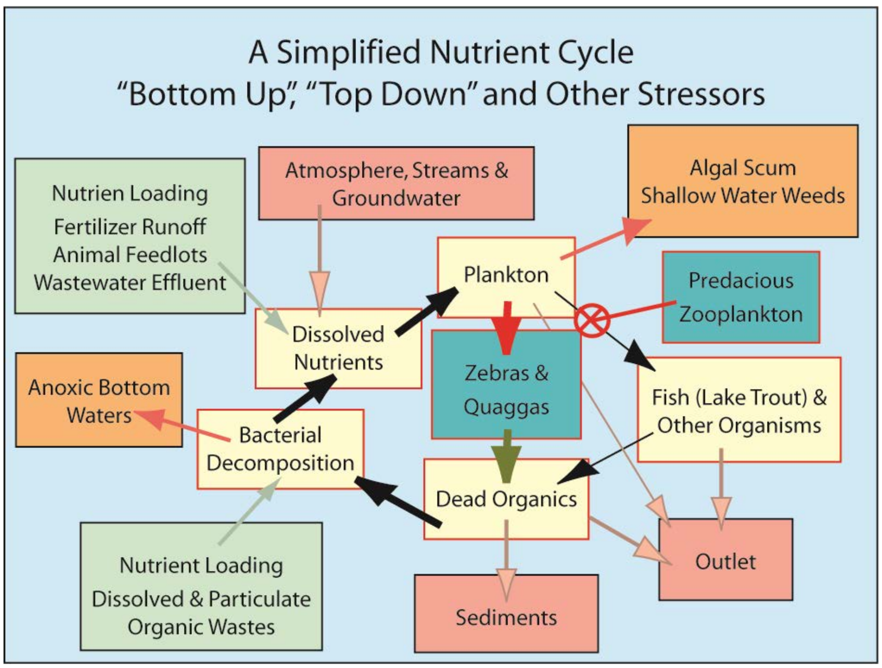


Fig. 50. A simplified nutrient cycle with "bottom up", i.e., nutrient loading, "top down", i.e., carnivorous zooplankton, and other stressors like zebra and quagga mussels.

Other Hydrogeochemical Water Quality Indicators

Herbicides: The source of atrazine, a common herbicide to control board-left weeds in corn in the Seneca Lake watershed was investigated in 1999 and 2000 (McSweeney, 1999; Baldwin and Halfman, 2000; Baldwin et al., 2001; Baldwin, 2002; Halfman and Franklin, 2007). Atrazine concentrations were typically below 1.0 μg/L throughout 1999. In 2000, concentrations were similar to 1999 values up to the end of May. After May, stream concentrations rose to or very close to 3 μg/L, the EPA's MCL, with the largest detected concentration of 8 μg/L at Kendig Creek (August, 2000). The study concluded with following spatial and temporal changes. First, streams draining more agricultural land had larger atrazine concentrations. Second, atrazine concentrations peaked during June, July and August, a timing that corresponds with the application of atrazine in the fields. Third, the amount of rainfall co-varied with the concentration of atrazine in the runoff. The largest concentrations were detected during a large rainfall event. The smaller concentrations in 1999 compared to 2000 corresponded to lower rainfall in 1999. Finally, none of the lake concentrations exceeded 1 μg/L, consistently below the EPA's MCL.

Coliform & E. coli Bacteria: Total coliform and *E. coli* bacteria concentrations in 2003, 2004 and 2005 were typically below the EPA's MCL (Bush and Halfman, 2006; Bush, 2006). These bacteria are used to monitor for the presence of human organic wastes and associated disease causing organisms in natural waters. However, these bacteria themselves pose minimal health threats, except for a few toxic strains of *E. coli*. Coliform sources also include geese, dogs, deer and other warm blooded, wild and domesticated, animals. Lake samples were typically ten times less concentrated than stream water, and lacked any temporal or spatial trends. Bacteria concentrations were largest in the streams during runoff events, and a runoff event influenced the large mean counts in 2005. Wilson and Hector Falls regularly had larger bacteria concentrations than the other streams, especially during runoff events. It suggests that agricultural and rural landscapes with aging septic systems input more bacterial than the other drainage systems, and pose potential but currently not detrimental threats to the Seneca Lake watershed.

Trihalomethanes: Trihalomethanes (THMs) concentrations were not above analytical detection limits for all the analyzed stream and lake water samples during the 2010 spring field season. Trihalomethanes (e.g., chloroform, bromoform, bromodichloromethane) are disinfection byproducts predominantly formed when chlorine is used to disinfect water.

Stream Macroinvertebrates & Fish

Biological indicators are an important analytical tool to determine water quality in flowing waters (Simon, 2002). Stream benthic macroinvertebrates (bottom-dwelling aquatic organisms without a backbone and not visible without magnification) are found in and around the stream channel and primarily include insects, gastropods, mollusks, and worms. Most insects spend their larval stage underwater and hatch into terrestrial adults, while other invertebrates spend their entire life in the stream. Macroinvertebrates are an important part of the stream food web, differ in their sensitivities to pollution, represent stream conditions over long time periods, are relatively easy to collect, and therefore serve as an important biological indicator of stream health (IWLA, 2000). Stream fish are dependent on insects and other invertebrates for food sources, but are generally more mobile on short time scales, and occupy and use different habitats than macroinvertebrates. Fish assemblage composition is also indicative of water quality and/or if stream habitat conditions are favorable or degraded (Karr, 1981).

Castle, Wilson, Kashong, Keuka Plum Pt., Big Stream, Rock Stream, Catharine (at two locations), Hector Falls, Glen Eldridge and Reeder Creek were sampled for macroinvertebrates and fish between May and June of 2011 (see Cushman, 2012 for details). The macroinvertebrates were collected by 500 μm benthic D-Net, sieved over a no. 60 sieve, preserved in 95% Ethanol, and 100 macroinvertebrates sorted and identified to family level in each sample following standard NYSDEC protocols (Bode et al., 2002).

The Percent Model Affinity (PMA) and Biotic Indices were utilized to assess the degree of impairment. PMA is a biological indicator developed for NY streams that provides a "model" community to which sample communities are compared (Novak and Bode, 1992). The model community is comprised of 40% ephemeroptera, 5% plecoptera, 10% trichoptera, 20% chironomidae, 10% coleopteran, 5% oligochaeta, and 10% other organisms. Those sample PMA scores that are greater than 65% are not impacted, while 50-64% are slightly impacted, 35-49% are moderately impacted, and lower than 35% are severely impacted (Novak and Bode, 1992). The Biotic Index (BI) indicator has higher specificity of taxonomic groupings and therefore impact level. Twenty-three groupings (by order and family groups) assigned biotic index scores are used to estimate the magnitude of water quality impact. Scores less than 4.5 represent non-impacted communities, but 4.51-5.50 are slightly impacted, 5.51-7.00 are moderately impacted, and 7.01-10.00 are severely impacted.

Fish were sampled by installing two 10 m block seine nets, at upstream and downstream boundaries, to isolate a 75 m sampling reach at each site. Starting at the downstream net, fish were stunned using a backpack electrofisher (Smith-Root LR 20B) and long-handled nets were used to retrieve fish. This was done twice. Fish were identified to species and two common species, *Rhinichthys atratulus* (blacknose dace) and *Semotilus atromaculatus* (creek chub), were measured for total length. The nets were then removed and all fish were returned to the stream channel. Dissolved oxygen, pH, temperature, and conductivity were measured using an YSI 556 multiprobe handheld meter to determine environmental conditions and proper settings for the electrofisher.

Results: The average PMA score for the entire Seneca Lake watershed was 61%, which represents slight water quality impact. Castle Creek, Keuka Outlet, Plum Creek, Rock Stream, the upper tributary of Catharine Creek and Glen Eldridge Creek all had PMA scores over 65% (no impact), while Reeder Creek, Wilson Creek, and Kashong Creek had scores ≤ 50%, representing moderate water quality impact (Fig. 51). None of the streams in the watershed were severely impacted. The best water quality among all subwatersheds was found in Plum Creek (PMA = 88%). The biotic index (BI), another biological indicator of water quality which incorporates a finer level taxonomic analysis, demonstrated similar findings.

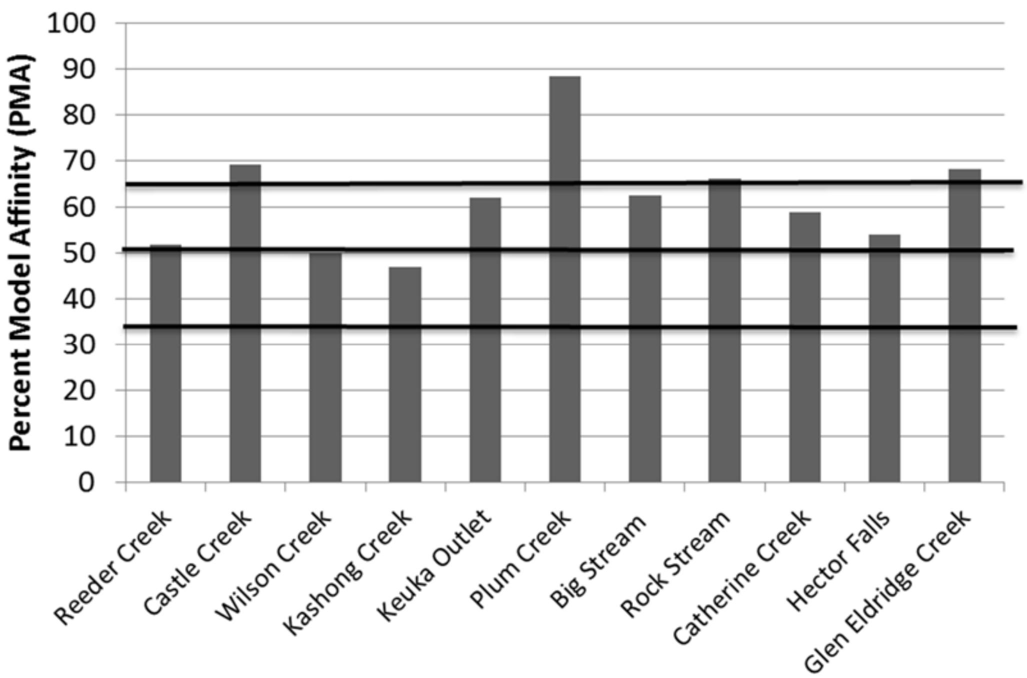


Fig. 51. Water quality in Seneca Lake subwatersheds indicated by the Percent Model Affinity (PMA) analysis. Scores represent the departure from a "model" benthic macroinvertebrate community using major group analysis in excellent stream water quality. Values greater than 65% indicated no water quality impact on the community (top bar), while those between 50 and 64% represent slight impact, 35-49% represent moderate impact and those below 35% are considered severely impacted (bottom bar).

On average, there are 4.5 species of fish in streams flowing into Seneca Lake. The typical fish assemblage, by order of average abundance, included *Rhinichthys atratulus* (blacknose dace), *Semotilus atromaculatus* (creek chub), *Campostoma anomalum* (central stoneroller), and *Catostomus commersoni* (white sucker). The first three are species in the minnow family, and the last is in the sucker family of fish. The only game fish and non-native salmonid species, *Salmo trutta* brown trout, was collected in Hector Falls Creek. In addition, one other non-native species, the swallowtail shiner *Notropis procne* was collected in Wilson Creek, Glen Eldridge Creek and Hector Falls Creek.

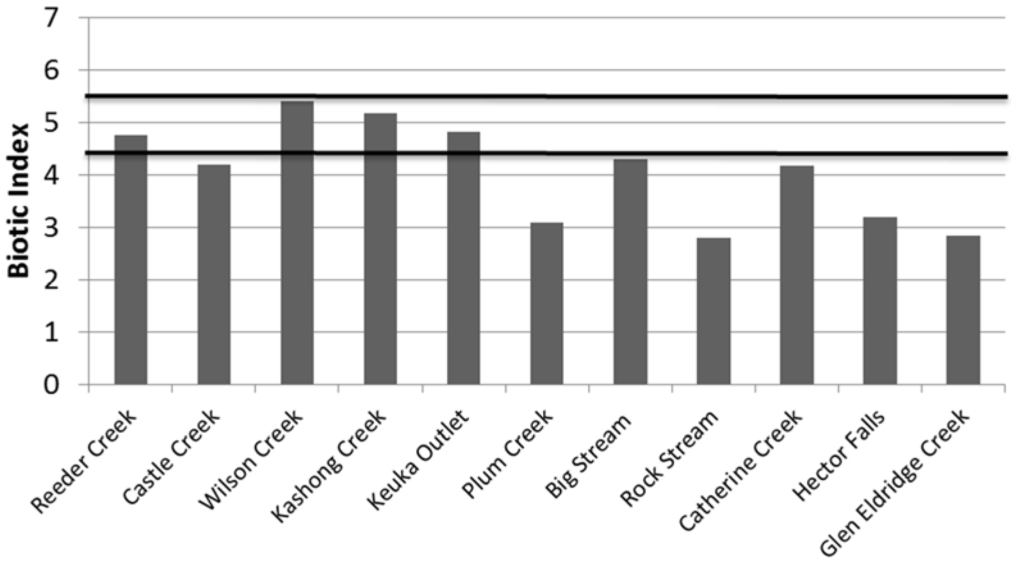


Fig. 52. Water quality in Seneca Lake subwatersheds indicated by the biotic index (BI). Scores represent a measure of diversity and sensitivity to water quality at both the family and order level of benthic macroinvertebrate identification. Values less than 4.50 indicated no water quality impact on the community (bottom bar), while those between 4.51 and 5.50 represent slight impact (top bar), 5.51-7.00 represent moderate impact and those above 7.01 are considered severely impacted.

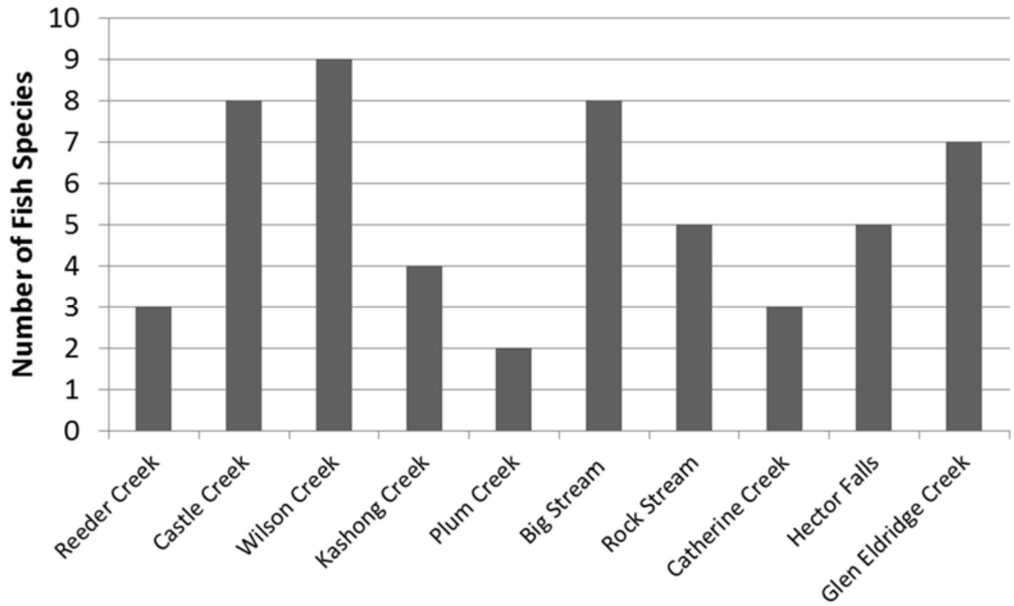


Fig. 53. Fish species richness in streams flowing into Seneca Lake. Fish were collected in a 75 m reach in each stream by double pass electrofishing.

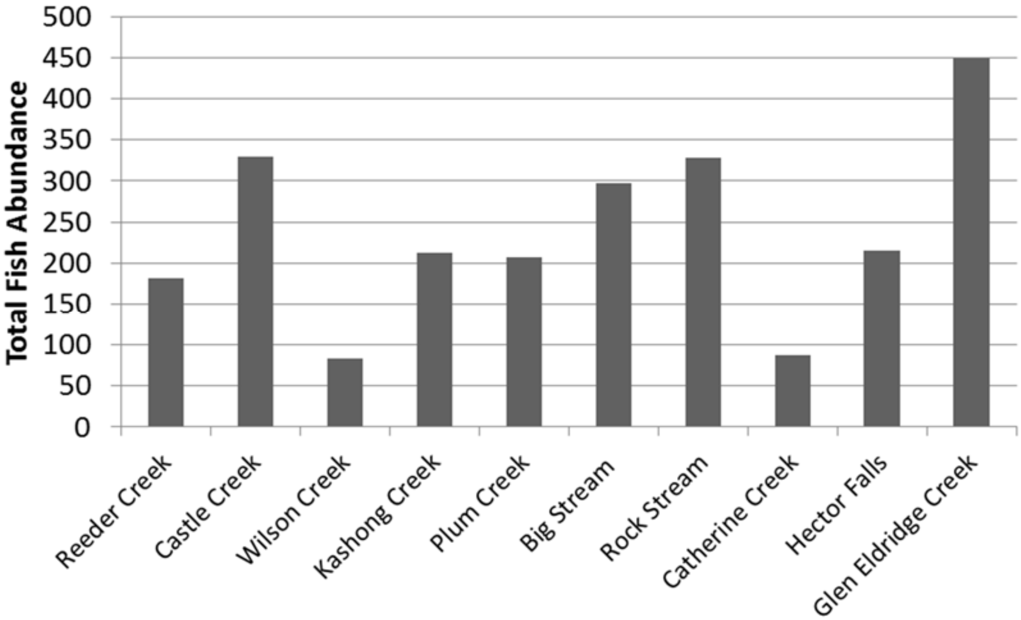


Fig. 54. Representative fish abundance (#fish/75 m) in streams flowing into Seneca Lake. Values represent all fish collected in a 75 m stream reach by double pass electrofishing.

Fish species richness varied across streams in the Seneca Lake watershed with the highest richness found in Wilson Creek (9 species) and the lowest in Plum Creek (2 species; Fig. 52). The smaller streams generally exhibited fewer species (Fig. 53). Fish abundance followed different trends, however. The highest total fish abundance (# fish per 75 m) was found in Glen Eldridge Creek (449 individuals), while the lowest fish abundance was in Wilson Creek (84 individuals; Fig. 54). Castle Creek, Big Stream, and Glen Eldridge Creek all both showed relatively high species richness and total fish abundance. Alternatively, Wilson Creek showed high species richness, but low total abundance, only 84 individuals. In 9 of the 10 streams where fish sampling was conducted, over 80% of the fish community was blacknose dace and creek chub.

Discussion: The macroinvertebrate analysis revealed that Reeder Creek, Wilson Creek and Kashong Creek have the worst water quality (slightly impacted). Wilson and Kashong Creeks have the most agriculture within each watershed impacting the macroinvertebrate assemblages. However, they both had excellent fish habitats including deep pools, excellent fish refuge/cover, i.e., instream woody debris, rootwads, and undercut banks (Cushman, data not shown). Reeder Creek exhibited poor macroinvertebrate habitat and low fish species richness and abundance due to scouring to bedrock layers, high silt covering bottom substrate, high conductivity, little woody debris and warm water (Cushman, data not shown). Castle Creek showed both good insect and fish habitat due to high frequency of woody debris, undercut banks, deep pools and overhead canopy cover by riparian buffer (Cushman, data not shown).

Big Stream exhibited good insect habitat with deep riffles, low conductivity and siltation, which are also good characteristics for fish habitat, except fish had little habitat to seek refuge. The fish community had a high prevalence of blackspot disease caused by a trematode parasite (*Neascus*). It also supported a small *Umbra limi* (central mudminnow) population that is a fish known for its tolerance to low dissolved oxygen. Rock Stream presented both poor insect and fish habitat, primarily due to bedrock as the primary bottom substrate resulting in a lack of riffles (insects) and deep pools (Cushman, data not shown). The stream bottom showed evidence of heavy erosion upstream and resulting downstream siltation, as well as warmer stream water. The *Pimephales promelas* (fathead minnow) was also abundant in this community.

Plum Creek stood out as the best habitat for both insects and fish, with cool stream water, low siltation, thick overhead riparian canopy and equal distribution of riffle and pools. Plum Creek was comprised of 99% blacknose dace and 1% creek chub, two of the most common small stream fish species in the northeast and mid-Atlantic region of the US, but lacked deep pools for a greater fish diversity. Catharine Creek, Hector Falls, and Glen Eldridge all showed good insect and fish habitat i.e., excellent pool-riffle distribution, consistent with the water quality bioindicators. As a result, the tributary to Catharine Creek supported a unique fish species, *Etheostoma flabellare* (fantail darter), which are very intolerant of poor water quality including sedimentation. Hector Falls Creek also had excellent fish habitat, including good woody debris, debris jams, and cool temperatures (Cushman, unpublished data), which supported not only the common fish assemblage (above), but also *Salmo trutta* (brown trout). However, the eroded clay banks were consistent with silted riffles which lowered the quality of macroinvertebrate habitat. Finally, Glen Eldridge Creek represented good insect and great fish habitat, primarily due to good water quality, deep pools, some woody debris and rootwads, however upstream erosion was evident. The *Notropis procne* (swallowtail shiner), a non-native to this area was present (3) in this stream, along with the high fish abundance (449) of all sites sampled. Blacknose dace and creek chub were a high percentage of this community.

This preliminary survey adds to the limited knowledge about stream community composition in small streams in the Finger Lakes region. Considering the Finger Lakes are an important resource as both sources of water for surrounding communities as well as natural environment areas, it is important to study how the land across which water drains impacts the water quality. More importantly, since Seneca Lake is the deepest and holds the most water volume, knowing which subwatersheds influence water quality the most can play a large role in watershed planning and remediation (“Seneca Lake Watershed Management Plan”, 2010).

Chapter 5: Potential Sources of Pollution due to Human Activities

A number of potential sources of pollution due to human activities exist in the Seneca Lake watershed. They range from agricultural activities, forestry, urban landscapes, chemical and petroleum storage, spills, landfills and solid waste disposal, mining activities, road salt, road-bank erosion, boating activities, onsite and municipal liquid waste disposal, storm water runoff, construction activities, energy development, and air quality. Excellent details on these issues are found in the *Setting the Course for Seneca Lake, The State of the Seneca Lake Watershed* ("Seneca Lake Watershed Management Plan", 2010), and the information in this report is summarized below. These details were not updated for this report, and should be investigated and updated in the near future (see information gaps section, chapter 6).

A: Agriculture: The report attempted to quantify the non-point source impacts by agricultural activities using a comprehensive farm survey in conjunction with a nonpoint source computer model, generalized watershed loading functions model developed by Dr Haith, Cornell University. The survey identified the need for implementing agricultural best management practices in the Seneca Lake watershed. It also ranked each subwatershed in terms of its potential concern. Catharine Creek, Keuka Lake Outlet and Kashong Creek were ranked high, Reading drainage, Rock Stream, Big Stream, Starkey Drainage and Long Point Drainage as medium, and the remaining watersheds and drainages as low.

B: Chemical Bulk Storage: The report identified sixteen chemical bulk storage facility permits in the watershed. These facilities, and the sale, storage and handling of hazardous substances, fall under jurisdiction of Article 40 of the Environmental Conservation Law, the Hazardous Substance Bulk Storage Act of 1986, enforceable by NYSDEC. No facilities were in the Chemung County portion of the watershed, and only one facility ion the Seneca County portion. Schuyler had five, Ontario six, and Yates County four facilities. The chemicals included: aluminum sulfate, sodium hypochlorite, ferric chloride, sodium hydroxide, methanol, cupric chloride, phosphoric acid, nitric acid, ammonia, sulfuric acid, and 2- propanone.

C: Forestry & Forestry Practices: Forests are the best types of lands for protecting water quality. However timber harvesting is occurring throughout the watershed exposing highly erodible land. Best Management Practices are available for timber harvesting and apply to publicly owned lands, e.g., USDA Forest Lands and NYSDEC properties. The private landowner, who controls the bulk of forested lands in the watershed, however may or may not employ these BMPs to stop erosion and sedimentation from reaching Seneca Lake.

D: Landfills, Dumps and Inactive Hazardous Waste Sites: Landfills are regulated by NYSDEC. Based on information from NYSDEC and conversations with local residents, twenty landfills and/or dumps were located in the watershed. At that time only two landfills were active, both located in Yates County. Twelve inactive hazardous waste sites were all considered closed with complete or some sort of remediation taking place. Five landfills were ranked with a high potential to threaten surface and/or groundwater (and located in Lodi, Montour, Hector, Torrey). Six others had a medium potential and eight with a low potential to threaten water quality. Nine of the twelve were identified as having a high potential to impact water quality (located in Romulus, Dix, Horseheads, Waterloo, Torrey, and Milo).

E: Mined Lands: Erosion from mined lands, especially surface mines, has the potential to impact sedimentation and water quality of nearby streams and the lake. NYSDEC law regulates onsite storage and/or runoff detention at each mine site. Thirty-six NYSDEC mined land and reclamation permits were listed in the watershed. Schuyler County had the most with 21, then Yates with 13 and Seneca with 2 mined land permits. These mines mostly extracted sand and gravel with some clay, glacial till, and shale. Mines worked prior to 1975 that are abandoned are not subject to reclamation laws, and may be potential water quality risks.

F: Petroleum Bulk Storage Faculties: NYS passed the Petroleum Bulk Storage Law in 1985. It requires NYSDEC to develop and enforce state code for the storage and handling of petroleum products to protect public health, welfare and the lands and waters of the state. These fuels include petroleum-based oils refined for use as a fuel to produce heat or energy or suitable as a lubricant (gasoline, heating oil, kerosene, lubricant oils, etc.). A facility with a capacity of 1,100 to 400,000 gallons must be registered with NYSDEC. The watershed had 166 active, regulated and smaller unregulated petroleum bulk storage permits listed with NYSDEC. Geneva (38), Catharine (38) and Keuka Lake Outlet (24) subwatersheds had the greatest number of sites. Other subwatershed had eleven or less. Forty-three sites were not active.

G: Roadbank Erosion: A survey of all public roadways delineated roadbank conditions in the watershed, and categorized erosion in road ditches as moderate, severe or very severe. The very serve category implied cut, bare, and collapsing banks, exposed roots, and blow-out holes in ditch bottoms and gully erosion with estimated soil erosion rates of 100 to 200 tons per bankside mile. The very severe sections typically correlated to topographic slopes of 8% or more. Subwatersheds with the highest potential for roadbank erosion included Big Stream, Catharine Creek, Hector Falls Creek, Kashong Creek, and Mill Creek, Benton, Reading, Starkey and Sunset Bay subwatersheds. Those subwatersheds with the lowest rank included Kendaia, Lodi Point, Reeder, Wilson, Lamoreaux Landing, Reed Point, Sampson State Park and Valois subwatersheds.

H: Salt Storage & Deicing Materials: A survey of the county, municipal, and NYS Department of Transportation, Seneca Army Depot, and other private organizations that use salt revealed nineteen storage piles in the watershed. Two of them are exposed. In the 1997-1998 winter season, almost 7,000 tons of salt were applied to 1,270 road miles in the watershed, or 5.5 tons per mile. The largest amounts of salt were applied to the roads in the Big Stream, Catharine Creek, Geneva, Kashong Creek, Indian Creek, Reading, and Reed Point sunwatersheds. Benton, Glen Eldridge, Hector Fall Creek, Lamoreaux Landing, Long Point, Mill Creek, Plum Point Creek, Reeder Creek, Sampson State Park, Satterly Hill, Sawmill/Bullhorn Creek, Sixteen Falls Creek, and Valois subwatersheds were low contributors of deicing materials.

Shore Residences Environmental Health Risks: A survey of over 1000 lakeshore residents assessed the impact of lakeshore residents. The process also distributed Home*A*Syst books to each resident. The results indicated that 57% of the responses were from seasonal properties. Most people were not concerned about water quality as 65% did not treat the water, and 54% never had their water tested. However, 37% used bottle water for drinking. The average age of the septic system was 17 years. Almost one quarter used septic system additives. 95% of the residences were located within 500 ft of the lakeshore, and 42% within 50 feet of the shoreline. Over 80% of the residences had low erosion impact lawns (no bare spots), and 69% were not fertilized. Compost happened at 30% of the residences. Most participants recycled household wastes (90%) rather than burn it. A ranking system designated Catharine, Sixteen Falls, and Indian Creek subwatersheds to have the most risk from all these factors. Geneva drainage had the lowest risk and may reflect the use of public water and sewer systems.

J. State Pollution Discharge Elimination System (SPDES) Permits: A SPDES permit is a contract between NYSDEC and any facility discharging wastewater directly into surface or groundwater. The data gathered from NYSDEC revealed eighty significant SPDES permits in the watershed, i.e., those facilities with large amounts of wastewater discharge or wastewater with toxic substances, with fifty-one discharged to surface waters. Twenty-one discharged directly into Seneca Lake. Catharine Creek, Geneva, Keuka Lake Outlet, and Big Stream subwatersheds had the largest number of permitted facilities. Rock Stream, Reeder Creek, Kendaia Creek, Mill Creek, Lamoreauz Landing, Valois, Sawmill/Bullhorn Creek, and Glen Eldridge subwatersheds had none.

K: Spills: NYSDEC Spill Prevention and Response Data section maintains a record of all known reported spills and follow-up investigations. From 1974 to 1998 there were 990 hazardous material spills within the Seneca Lake watershed. The Geneva subwatershed had the most spills with 24% of the total number. Catharine Creek (20%), Keuka Lake Outlet (15%) and the Seneca Army Depot (10%) subwatersheds had the next largest number. Approximately 237% of the spills were petroleum products, primarily gasoline and #2 fuel oil.

L. Streambank Erosion: The erosion and sediment inventory conducted in 1974 by the USDA Soil Conservation Service (now the Natural Resources Conservation Service) estimated a sediment yield of 143 tons of sediment/bank mile/year or a total load of 43,657 tons per year. This study listed Kashong Creek, Big Stream and Catharine Creek subwatersheds as major contributors. The State of the Lake report also estimated that streambank erosion based on an Erosion Potential Index Number was largest in Catharine Creek, Big Stream, Keuka Lake Outlet, Reading, Starkey, Long Point, and Satterly Hill subwatersheds. It was lowest in Plum Point Creek, Wilson Creek, Reeder Creek, Kendaia Creek, Indian Creek, Simson Creek, Lodi Point, Mill Creek, Benton, Reed Point, Geneva, Sunset Bay, Wilcox, Sampson State Park, and Sixteen Falls Creek subwatersheds.

Chapter 6: Watershed and Subwatershed Information Gaps

The data and related information reported in this characterization is not exhaustive. A number of gaps exist in our knowledge of Seneca Lake and its watershed. These include issues alluded to in the previous chapters, and information not yet investigated. For example, the 1999 characterization, *Setting the Course for Seneca lake, the State of the Seneca Lake Watershed*, investigate a number of potential sources of pollution, including agricultural activities, forestry, urban landscapes, chemical and petroleum storage, spills, landfills and solid waste disposal, mining activities, road salt, road-bank erosion, boating activities, onsite and municipal liquid waste disposal, storm water runoff, construction activities, energy development, and air quality. The state of these issues and problems should be re-evaluated to see if water quality and/or conditions improved, declined or remained the same over the past decade. New industries and activities should be investigated to assess their impact on the watershed. For example, the proposed storage of energy products (propane and natural gas) in the abandoned salt caverns near Watkins Glen and drilling for shale gas loom close on the horizon. The Shale drilling has impacts on both water use and water quality. Pre- and post-drilling and storage monitoring should occur in nearby waterways to accurately assess potential future impacts. Finally, the terrestrial and wetland ecosystems in the watershed can be better understood.

Surface and groundwater sources are not very well understood. As mentioned in an earlier chapter, surface water resources are dependent on limited information and critical for numerous users in the watershed, and impact those downstream of the lake. For example, only the Keuka Outlet out of the numerous inflows is routinely monitored for flow. The volume of the lake is based on old “lead-line” depth data from the turn of the 20th century. The available residence time estimates vary considerably.

The availability and water quality of groundwater resources are even less understood. Aquifers are not abundant in the watershed, however many people still depend on groundwater for drinking water and other uses. Groundwater resources and quality are also subjected to a variety of pollutant sources, see a partial list above. Preliminary studies indicate elevated levels of TCE and PAHs, arsenic, copper, lead and other metals, radioactivity, and beryllium in the water of both Kendaia and Reeder Creeks or in the sediments just offshore of these two creeks (Gonzales and Campbell, 2000). The source is probably from groundwater contamination and runoff over the former Seneca Army Depot site. Any investigation should initiate flow directions, recharge areas, and perhaps designate aquifer recharge protection zones in the watershed to protect its quality. For example, the well fields and groundwater systems for any of the groundwater dependent municipalities should be mapped and water quality assessments investigated.

Another large unknown in the Seneca Lake watershed is the new chemical and biological threats just becoming a concern across the nation in the past decade. These include items like human and veterinary drugs (including antibiotics), natural and synthetic hormones, detergent metabolites, plasticizers, herbicides, insecticides, caffeine, fire retardants, organic wastewater contaminants and other compounds (Koplin, et al., 2002, Barnes et al., 2012). All are at concentrations near, or above MCLs, when MCLs are known, in a variety of surface and groundwater systems across the nation. A number of these compounds are too new to have MCLs.

Various contributors to this characterization presented preliminary data that requires additional study for more complete understanding. The list, besides issues raised in the previous paragraphs, should include the following to arrive at a better understanding of the water supply and waste disposal coverage and associated infrastructure within the watershed, a better delineation and characterization of wetlands and stream corridors, monitoring the physical, biological, chemical and other aspects of the lake’s limnology and the biology and hydrogeochemistry of its major tributaries. Each chapter typically mentioned where additional information is required. More work is required to better understand:

- The linkages between the meteorology, heat fluxes of the dynamics (physical limnology) in the lake.
- The linkages between salt mining activities and the salinity of the lake.
- The detection, distribution, impact and potential control of exotic species with the lake and its watershed.
- The observed decline of the benthic communities in the lake and its impact on the lake's ecology.
- Follow up on the initial fish and macroinvertebrate distributions, heavy metal concentrations, and other associations in the watershed's tributaries.
- The linkages between stream corridors, sediment transport, and habitat availability and quality.
- Maintain the active water quality monitoring program in the lake to document future changes in the lake's trophic status, and maintain efforts to determine its relationship to nutrient and sediment loading from the watershed and internal pressures by various exotic species.
- The historical record of heavy metals, organic and other potentially toxic compounds for the watershed.

Appendix A: Notes/Resources

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Active Seneca Lake Watershed Organizations

Abbreviation	Organization
ACE	Army Corps of Engineers
AEM	Agricultural Environmental Management
AFT	American Farmland Trust
CCE	Citizens Campaign for the Environment
CCE	Cornell Cooperative Extension
CEC	Citizens Environmental Coalition
CEDC	Community Environmental Defense Council, Inc.
CEI	Center for Environmental Information
CNYRPDB	Central New York Regional Planning and Development Board
CPFL	Committee to Preserve The Finger Lakes
CPNY	Coalition to Protect New York
CSLAP	Citizens Statewide Lake Assessment Program
DOI	Department of Interior
DOT	Department of Transportation
EFC	Environmental Facilities Corporation
EMC	Environmental Management Council
EPA	Environmental Protection Agency
ESF	SUNY Environmental Science & Forestry
FDA	Food and Drug Administration
FEMA	Federal Emergency Management Agency
FF	Freshwater Future
FLA	Finger Lakes Association
FLCC	Finger Lakes Community College
FLCWI	Finger Lakes CleanWaters Initiative
FLEN	Finger Lakes Environmental Network, Inc.
FLI	Finger Lakes Institute
FLLOWPA	Finger Lakes-Lake Ontario Watershed Protection Alliance
FLLT	Finger Lakes Land Trust
FL-PRISM	Finger Lakes Partnership for Regional Invasive Species Management
FLRU	Finger Lakes ReUse
FLRWA	Finger Lakes Regional Watershed Alliance
FLVC	Finger Lakes Visitors Connection
FLZWC	Finger Lakes Zero Waste Coalition
FOLA	Federation of Lake Associations
FSA	Farm Service Agency
G/FLRPC	Genesee/Finger Lakes Regional Planning Council
GFS	Gas Free Seneca
GGC	Geneva Green Committee
GLBAC	Great Lakes Basin Advisory Council
GLRC	Great Lakes Research Consortium
GNRC	Geneva Neighborhood Resource Center
HWS	Hobart and William Smith Colleges
IAGT	Institute for the Application of Geospatial Technology, Inc.
ILEC	International Lake Environment Committee
IPCNYS	Invasive Plant Council of New York State
ISTF	New York State Invasive Species Task Force
KLA	Keuka Lake Association
KWIC	Keuka Watershed Improvement Cooperative
NALMS	North American Lake Management Society
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWF	National Wildlife Foundation
NWR	National Wildlife Refuge

NYFB	New York Farm Bureau
NYPIRG	New York Public Interest Research Group
NYSDAM	New York State Department of Agriculture and Markets
NYSDOH	New York State Department of Health
NYSDOS	New York State Department of State
NYSDOT	New York State Department of Transportation
NYSOPRHP	New York State Office of Parks, Recreation, and Historical Preservation
NYSORPS	New York State Office of Real Property Services
NYSAES	New York State Agricultural Experiment Station
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOS	New York State Department of State
NYSDOT	New York State Department of Transportation
NYSERDA	New York State Energy Research and Development Agency
NYSFOLA	New York State Federation of Lake Associations
NYSG	New York Sea Grant
NYSTA	New York State Thruway Authority
OPRHP	Office of Parks, Recreation & Historic Preservation
ORPS	Office of Real Property Services (see also NYSORPS)
R-CAUSE	Rochesterians Concerned About Unsafe Shale-gas Extraction
SC-FL	Sierra Club Finger Lakes Group
SCOPED	Schuyler County Partnership for Economic Development
SCS	Soil Conservation Service
SHPO	State Historic Preservation Office
SLAP-5	Seneca Lake Area Partners in 5 Counties
SLPWA	Seneca Lake Pure Waters Association
STCRPDB	Southern Tier Central Regional Planning and Development Board
SUNY ESF	State University of New York Environmental Science and Forestry (ESF)
SWCD	Soil and Water Conservation District
TNC	The Nature Conservancy
TPA	Tourism Promotion Agency
TU	Trout Unlimited
USACE	United States Army Corp. of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WAC	Watershed Advisory Council
WEC	Water Education Collaborative
WQCC	Water Quality Coordinating Committee
WQIP	Water Quality Improvement Program
WQMA	Water Quality Management Agency
WRC	Water Resource Council

Glossary of Acronyms

AEM	Agricultural Environmental Management
BMP	Best Management Practice
CAFO	Concentrated Animal Feeding Operation
CEO	Code Enforcement Officer
CPESC	Certified Professional in Erosion and Sediment Control
CREP	Conservation Reserve Enrollment Program
CRP	Conservation Reserve Program
CRS	Community Rating System (see NFIP)
CSLAP	Citizens Statewide Lake Assessment Program
CSO	Combined Sewage Overflow
CWA	Clean Water Act
CWS	Community Water System
CWSRF	Clean Water Act State Revolving Fund
DWSRF	Drinking Water State Revolving Fund
EIS	Environmental Impact Statement
EMC	Environmental Management Council
EPF	Environmental Protection Fund
EQIP	Environmental Quality Improvement Program
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FL-PRISM	Finger Lakes Partnership for Regional Invasive Species Management
FOIL	Freedom of Information Law
FSA	Farm Service Agency
GIS	Geographic Information System
GLRI	Great Lakes Restoration Initiative
GPS	Global Positioning System
HAZMAT	Hazardous Materials
IA	Intermunicipal Agreement
IDA	Industrial Development Agency
IJC	International Joint Commission
ILEC	International Lake Environment Committee
IO	Intermunicipal Organization
LEED	Leadership in Energy and Environmental Design
LOCI	Lake Ontario Coastal Initiative
LWRP	Local Waterfront Revitalization Plan
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer Systems
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHS	National Historic Site
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NWF	National Wildlife Foundation
NWR	National Wildlife Refuge
OWWT	On-site wastewater treatment
PB	Planning Board
PUD	Planned Unit Development
PWL	Priority Waterbodies List
PWS	Public Water System
QA/QC	Quality assurance/quality control
RCRA	Resource Conservation and Recovery Act

RIBS	Rotating Intensive Basin Study
ROW	Right of way
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SEMO	State Emergency Management Office
SEQRA	State Environmental Quality Review Act
SHPO	State Historic Preservation Office
SPDES	State Pollution Discharge Elimination System
STP	Sewage Treatment Plant
SWCD	Soil and Water Conservation District
SWP	Source Water Protection
SWPPP	Stormwater Pollution Prevention Plan
SWTR	Surface Water Treatment Rule
TMDL	Total Maximum Daily Load
TPA	Tourism Promotion Agency
TRI	Toxic Release Inventory
TU	Trout Unlimited
USACE	United States Army Corp. of Engineers
VOC	Volatile Organic Compound
WAC	Watershed Advisory Council
WEC	Water Education Collaborative
WHPA	Wellhead Protection Area
WQCC	Water Quality Coordinating Committee
WQIP	Water Quality Improvement Program
WQMA	Water Quality Management Agency
WRC	Water Resource Council
WRI	Water Resource Institute
ZBA	Zoning Board of Appeals
ZEO	Zoning Enforcement Officer

Seneca Lake Facts

Carved out of bedrock over 10,000 years ago by glaciers, Seneca Lake is the deepest freshwater lake east of the Mississippi River outside the Great Lakes. Due to its depth, the lake does not freeze in the winter.

Location: New York, USA 42.39 N, 76.89 W; 135.6 m above sea level Lake
Type: Ground Moraine
Primary Inflows: Catharine Creek, Keuka Lake Outlet, underwater sources
Primary Outflows: Cayuga-Seneca Canal
Mean Length: 56.6 km (35.2 mi)
Max Length: 61 km (38 mi)
Mean Width: 3.10 km (1.9 miles)
Mean Depth: 88.6 m (290.7 ft)
Max Depth: 198.4 m (650.9 ft)
Surface Elevation: ~440 ft (130 m)
Surface Area: 42,800 acres, 66.9 sq mi, (173 km^2)
Volume: 15.539 km3 (3.8 cu mi)
Retention time: ~18.1 yr; the longest of the Finger Lakes

1" of lake level on Seneca Lake = 1.2 billion gallons of water

Seneca Falls Power Corp normal operation = 1,500 cubic feet per second
Maximum operation = 3,200 CFS
Average usage: 1,500 cu ft sec = 11,221 gal/ sec = 40.4 million gal/hr = 323 million gal/8 hours

Canal locks 45' x 328', varying depths; 25' (worst case) = 2.8 million gallons per operation
Summer hours: 7 AM to 10 PM; Winter hours: 7 AM to 5 PM
Average cycle time = 45 minutes
8 hours of operation = ~ 11 cycles = 31 million gal/8 hours

Water Level Data
Condition 6 of the Federal Energy Regulatory Commission requires that the daily fluctuation of Seneca Lake should not exceed 0.1 foot and the daily fluctuation of Van Cleef Lake should not exceed 0.25 feet from the daily target elevation for each lake, respectively, set by the New York State Thruway Authority (NYSTA). Seasonal fluctuations should be in accord with the rule curve developed by the New York State Department of Transportation and NYSEG in the late 1970s in response to concerns of the Seneca Lake Waterways Association.
*Fact sheet produced and published by Seneca Lake Pure Waters Association, www.senecalake.org

Data Sources and Notes

Public Lands and Recreation Trails

Public lands data compiled from multiple sources under the Genesee/Finger Lakes Regional Planning Council Finger Lakes Open Lands Conservation Project (2010). Project overview available online from http://gflrpc.org/Publications/FLOLCP/index.htm.

Sources include:

NYS Department of Environmental Conservation:

- NYSDEC Lands (2010)
- Public Fishing Rights (2010)
- Public Fishing Stream Parking Areas

NYS Office of Parks, Recreation & Historic Preservation:

- New York State Historic Sites and Park Boundary
- State-funded Snowmobile Trails

Genesee Transportation Council:

- Regional Trails Inventory

NYS Regulated Freshwater Wetlands

Freshwater Wetlands (NYSDEC; NAD83) Coverages (wetlands boundary datasets) are published by county, and are updated as amendments occur, or as errors in the data are discovered and corrected. For the most recent updates to coverages by county, visit the Cornell University Geospatial Information Repository at http://cugir.mannlib.cornell.edu/ .

US Fish and Wildlife Service National Wetlands Inventory

The U.S. Fish and Wildlife Service is the principal Federal agency that provides information to the public on the extent and status of the Nation's wetlands. The agency has developed a series of topical maps to show wetlands and deepwater habitats. This geospatial information is used by Federal, State, and local agencies, academic institutions, and private industry for management, research, policy development, education and planning activities. Digital GIS data can be viewed and downloaded at http://www.fws.gov/wetlands/

Build-out Analysis Methodology

1. This analysis reviewed the potential for future residential growth only in locations that were pre-determined to have this potential.

2. Determined areas with higher potential growth for analysis by reviewing the following data sources:

A) Zoning districts with the availability of public or lake water were considered to have higher potential for growth. Zoning districts that had any public water in them (even bulk lines) or were adjacent to the Lake were included.

B) Villages were excluded from this analysis. Across the board, towns were considered as having both more potential and space for development, and were also the areas that this study was focused on as developments could potentially have more effects on the non-developed areas in towns.

C) Towns with no zoning were excluded from this analysis as they usually have very little development pressure, and the build-out method is heavily based on land use regulations.

3. Within selected towns, determined the zoning districts for further analysis

A) Identified Residential, Agricultural, and Agricultural/Residential zoning districts in selected municipalities that are at least partially within the watershed and have access to public/lake water. Zoning districts that have water lines intersecting them at any point or are adjacent to Seneca Lake are considered to have access to public/lake water.

B) Excluded Mobile Home Park zoning districts.

C) Excluded Mixed Use/PUD zoning districts; it is extremely difficult to determine how these zoning districts will ultimately be developed.

4. Determined bulk regulations for identified zoning districts

A) Bulk regulations refer to the minimum and maximum standards for lot sizes and address geometric and structural issues such as building setbacks and building height.

B) The bulk regulations were reviewed in an effort to establish the minimum single family residential lot size in each selected zoning district.

   a. This study excluded the potential for multi-family buildings/lots given the vast multitude of potential scenarios that these options would create for each zoning district.

5. Determined total land area open to potential development

A) Only the portions of zoning districts that were within the watershed were considered for analysis.

   a. This study only analyzed the area of zoning districts that fell within the boundary of the Seneca Lake watershed.

B) Among zoning districts remaining for future consideration, the study considered bulk regulations and Office of Real Property Services parcel data to determine if those zoning districts had adequate vacant property to accommodate new development. “Developable” parcels are those that meet the following criteria:

   a. Parcels identified as “vacant” residential property in RPS records and large enough for residential development.

   b. Large residential lots 10 acres in size or larger were reviewed because it is assumed that these would be large enough to be subdivided without affecting existing structures or residences.

c. All agricultural properties large enough for residential development were considered.
    i. While agricultural use is in many cases protected or specifically zoned "agricultural" in order to preserve such use, the property could feasibly be sold or re-zoned in the future for the purposes of residential development and are therefore considered for further analysis. This is for the purpose of portraying land that could be developed, not suggesting that these areas are always appropriate for development.

C) Determined the total "developable" land area for each identified zoning district.
    a. Properties determined to qualify for future development as stated above were summed to arrive at a raw figure of total area in square feet for each zoning district.

6. Determined potential constraints to development within each zoning district

A) Constraints to development were examined only on parcels considered developable, and subtracted from the amount of total developable land. This analysis did not conduct a parcel by parcel analysis of how constraints affected each property's buildable area but rather focused on the sum within each zoning district.

B) Environmental constraints included:
    a. NYS Regulated Freshwater Wetlands (+100ft buffer)
    b. Surface water (lakes, ponds, streams, creeks, rivers, + a standard 50ft buffer area)
    c. Land area that had a slope of 15% or greater based on 30 meter Digital Elevation Model data

C) The remaining land area open for development was reduced by 35%
    a. A 25% reduction was based on the space that could be needed to accommodate anticipated infrastructure (such as roads, sidewalks, power lines, stormwater facilities, etc.), natural features (including poor soils), and irregularly-shaped parcels (this is in accordance with the Monroe County Department of Transportation study "Ballantyne Corridor Study") (Erdman, 2005).
    b. A 10% reduction was based on space reserved for parkland and open space. Some municipalities require or "may" require residential developments to set aside a certain percentage of land or a space per unit for open space or parkland. Others do not require this in code. The 10% was applied across the board to all zoning districts. Even developments in municipalities without this requirement would often have some open space even if it were simply due to lots built larger than the minimum size regulation.

D) Land area within the identified 100-year flood zone was not considered to be a constraint. In most towns, 100-year flood zones were open to new development with proper precautions and approval. In some instances, towns have identified locations of high flood risk and zoned accordingly; these zoning districts were therefore removed from analysis early on in the build-out study.

7. Final calculation of potential land available for development.

A) Each zoning district had a customized series of calculations performed in order to determine the estimated land area open to potential residential development. This is generally determined by conducting the following steps:
    a. Environmental constraints (see 6.B above) are subtracted from the total gross land open to development
    b. 35% standard reduction is applied to this figure (see 6.C above)

c. The result was a figure estimating the land area available for development within each zoning district.

8. Assuming a specific rate of growth and development, determine when the developable land with each zoning district will become "built-out"

A) The minimum lot size for each zoning district is established under bulk regulations; this figure was divided into the land area available for development to determine a total lot number which was then adjusted based on units already present (any occupied units on residential lots over 10 acres that were included as developable) in order to determine the total number of new residential lots that the zoning district could accommodate.

B) The average unit increase between the years 2000 and 2010 was determined by municipality using U.S. Census data and was adjusted based on the percentage of the municipal area within the watershed in order to estimate a yearly rate of development. The growth rate is specific to ten year total unit increase in the entire municipalities, rather than being specific to the zoning district or single family units.

C) The estimated potential number of years until build-out could occur by zoning district was determined by dividing the estimated number of lots that the zoning district could accommodate by the average yearly unit increase. This was determined for each zoning district assuming development were to be concentrated in each, as well as for the total of all selected zoning districts in each municipality.

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Appendix C: NYSDEC Water Quality Classifications

Copied from http://www.dec.ny.gov/regs/4536.html; New York State Department of Environmental Conservation web site: Part 898: Finger Lakes Drainage Basin.
This table pertains to Seneca Lake and its watershed (including Keuka Lake watershed). Item numbers include 397 through 474.

Water Index Number	Name	Description	Map Ref. No.	Class	Standards
Ont. 66-12-P 369 portion as described	Seneca Lake	That portion of Seneca Lake from most northerly point on north shore line of lake south 2.4 miles to an imaginary eastwest line across lake passing through Pastime Park with west end 0.2 miles south of south City of Geneva line.	J-12sw	B	B(T)
Ont. 66-12-P 369 portion as described	Seneca Lake	That portion of Seneca Lake within a 1-mile radius of mouth of Keuka Lake Outlet coming into Seneca Lake from west in Village of Dresden, 0.7 mile northwest of Perry Point.	K-12nw	B	B(T)
Ont. 66-12-P 369 portion as described	Seneca Lake	That portion of Seneca Lake beginning at imaginary east-west line passing through Pastime Park and extending southerly for approximately 32 miles to an imaginary line passing through mouth of Quarter Mile Creek (trib. 61) on west side of lake 0.2 mile south of north line of Village of Watkins Glen and through mouth of trib. 58 on east side of lake 0.2 mile north of north line of Village of Watkins Glen. The portion within a 1-mile radius of Keuka Lake Outlet is excluded.	J-12sw K-12nw K-12ne K-12se K-12sw L-12nw L-12ne	AA	AA(T)
Ont. 66-12-P 369 portion as described	Seneca Lake	That portion of Seneca Lake southerly of imaginary line across lake passing through mouth of Quarter Mile Creek and mouth of trib. 58 to south shore of lake.	L-12ne L-12nw	B	B(T)
Ont. 66-12-P 369-a, 2, 2a, 2b and tribs., 3, 4, 5 and trib.	Tribs. of Seneca Lake	Enter Seneca Lake along east shore from a point 0.1 mile south of where Seneca River enters lake and N.Y. Route 96A crosses Seneca River to a point 0.3 mile north of Yale Farm Road and 0.7 mile south of Sunset Bay.	J-12sw	C	C
Ont. 66-12-P 369-6 portion as described	Reeder Creek	Enters Seneca Lake from east at a point 0.3 mile southeast of intersection of East Lake Road and Yale Farm Road and extending 2.0 miles upstream to a point which is located 0.4 mile east of intersection of Route 96A and Yale Farm Road.	J-12sw	C	C(T)
Ont. 66-12-P 369-6 portion as described including all tribs.	Reeder Creek	From a point 2.0 miles upstream from mouth to source.	J-12sw J-12se K-12ne	C	C
Ont. 66-12-P 369-6a, 7, 7a, 8, 9 and trib., 10, 11, 12, 14 portion and tribs., 15 portion including P 371 and tribs., 16, 18, 19, 20 portion, 21 portion, 22 and trib., 23 portion and tribs., 25, 26, 26a, 27, 28 portion and tribs., 28a, 29 and trib., 30, 30a, 31, 32, 32a, 33, 34, 35 and trib., 36, 36a, 36b, 37, 37a, 37b, 37c, 37d, 38 portion and tribs.,	Tribs. of Seneca Lake	Enter Seneca Lake along east shore from a point 0.9 mile south of Yale Farm Road, 3.2 miles southwest of MacDougall, to a point 2.4 miles south of Seneca- Schuyler county line, 0.4 mile north of Peach Orchard Point. Trib. 9 portion upstream from	J-12sw K-12nw K-12ne K-12se K-12sw	C	C

		source. Trib. 15 upstream from above 1st road crossing within N.Y.S. Willard Psychiatric Center property, including tribs. and P 371, to source. Trib. 20 from above falls upstream to source. Trib. 21 from above falls upstream to source, also known as "16 Falls Creek". Trib. 23 upstream from above falls to source. Trib. 28 upstream from above falls, including tribs., to source. Trib. 38 upstream from above falls, including tribs., to source. Trib. 40 upstream from above falls to source.			
Ont. 66-12-P 369-44 portion as described	Sawmill Creek	Enters Seneca Lake from east at Peach Orchard Point 0.6 mile south of trib. 43. Mouth to falls 0.3 mile upstream.	L-12nw	C	C(TS)
Ont. 66-12-P 369-44 portion as described	Sawmill Creek	From falls 0.3 miles upstream from mouth to source.	L-12nw L-12ne K-12se	C	C
Ont. 66-12-P 369-44-a and trib., 1 and tribs., 2, 3, 4	Tribs. of Sawmill Creek	Enter Sawmill Creek from a point 1.7 miles upstream from mouth and 0.1 mile north of Hector Road to a point 3.9 miles upstream from mouth and 0.8 mile northeast of Logan.	L-12ne K-12se	C	C
Ont. 66-12-P 369-45 and trib., 46, 47, 48, 49, 51, 51a, 51b, 51c, 51d, 51e, 52 and tribs., 53 and trib., 54, 54a, 54b, 54c, 54d, 54e, 54f, 54g, 54h, 54j, and 54k	Tribs. of Seneca Lake	Enter Seneca Lake along east shore from McGrath Point 0.4 mile south of Peach Orchard Point southerly to 0.4 mile north of Glen Eldridge Point 1.1 miles northwest of Village of Burdett. Trib. 45 portion from above falls to source.	L-12nw L-12ne	C	C
Ont. 66-12-P 369-45 portion	Bull Horn Creek	From mouth upstream 650 ft. to falls.	L-12ne	C	C(TS)
Ont. 66-12-P 369-55 portion as described	Trib. of Seneca Lake	Enters Seneca Lake from east at Glen Eldridge Point 0.9 mile northwest of northwest corner of Village of Burdett. From mouth to first impassable falls located 0.1 mile upstream of mouth.	L-12ne	C	C(TS)
Ont. 66-12-P 369-55 portion as described	Trib. of Seneca Lake	From first impassable falls to N.Y. Route 414 bridge located 0.2 mile upstream of mouth.	L-12ne	C	C
Ont. 66-12-P 369-55 portion as described including P 371a and all tribs.	Tribs. of Seneca Lake	From N.Y. Route 414 bridge to source.	L-12ne	C	C
Ont. 66-12-P 369-56 portion as described	Hector Falls Creek	Enters Seneca Lake from east at Hector Falls Point 0.5 mile south of Glenn Eldridge Point and 0.7 mile west of Village of Burdett. From mouth to first falls impassable by fish, approx. 300 feet upstream of mouth.	L-12ne	C	C
Ont. 66-12-P 369-56 portion as described	Hector Falls Creek	From first falls impassable by fish to N.Y. Route 227 bridge in center of Village of Burdett.	L-12ne	C	C(TS)
Ont. 66-12-P 369-56-P 371b	Trib. of Hector Falls Creek	Unnamed pond.	L-12ne	C	C
Ont. 66-12-P 369-56 portion as described	Hector Falls Creek	From N.Y. Route 227 bridge in Village of Burdett to trib. 6a.	L-12ne	C	C(TS)

Ont. 66-12-P 369-56 portion	Hector Falls Creek	From above trib. 6a upstream to source.	L-12ne	C	C(T)
Ont. 66-12-P 360-56-2 and trib., 3a	Tribs. of Hector Falls Creek	Enter Hector Falls Creek from a point 1.8 miles upstream from Route 227 bridge at Village of Burdett and 0.4 mile northwest of Bennettsburg to trib. 3a,1.0 mile upstream and 0.6 mile northwest of Bennettsburg.	L-12ne	C	C
Ont. 66-12-P 369-56-4	Trib. of Hector Falls Creek	Enters Hector Falls Creek from south 0.1 mile upstream from trib. 3a, 0.6 mile northeast of Bennetsburg. From mouth to source.	L-12ne	C	C(TS)
Ont. 66-12-P 369-56-4-1, 2, 4, 5, P 372a and P 372b	Tribs. of trib. 4 of Hector Falls Creek	Enter stream from a point 1.2 miles upstream from mouth and 1.0 mile southeast of Bennettsburg to a point 1.1 miles upstream and 0.7 mile west of Newtown Road.	L-12ne	C	C
Ont. 66-12-P 369-56-5, 6, 6a	Tribs. of Hector Falls Creek	Enter Hector Falls Creek from a point 1.1 miles west of Newtown Road and 0.3 mile north of N.Y. Route 227 to a point 0.8 mile west of Newtown Road and just north of N.Y. Route 227.	L-12ne	C	C
Ont. 66-12-P 369-56-8	Trib. of Hector Falls Creek	Enters Hector Falls Creek from west 0.5 mile south of Reynoldsville and 0.2 mile east of N.Y. Route 227.	L-12ne	C	C(T)
Ont. 66-12-P 369-56-8-1	Trib. of trib. 8 of Hector Falls Creek	Enters trib. 8 of Hector Falls Creek from south 0.3 mile upstream from mouth, 0.1 mile west of N.Y. Route 227.	L-12ne	C	C
Ont. 66-12-P 369-56-9 and trib., 10	Tribs. of Hector Falls Creek	Enter Hector Falls Creek from north and west 0.3 mile south and 0.5 mile southwest of Reynoldsville and 0.2 mile east and 0.1 mile west of N.Y. Route 227, respectively.	L-12ne	C	C
Ont. 66-12-P 369-57, 58 and trib., 58a	Tribs. of Seneca Lake	Enter Seneca Lake from east at a point 0.7 mile southeast of Hector Falls Point and 0.1 mile west of N.Y. Route 414 to a point just south at north line and just west of east line of Village of Watkins Glen.	L-12ne	C	C
Ont. 66-12-P 369-59 portion as described	Seneca Lake Inlet (name changes to Catharine Creek at trib. 6)	Enters Seneca Lake from south 0.2 mile south of north line and 0.1 mile west of east line of Village of Watkins Glen. From mouth to confluence with Barge Canal.	L-12ne L-12se	C	C(T)
Ont. 66-12-P 369-59 portion	Seneca Lake Inlet	From confluence with Barge Canal to trib. 6, 1.9 miles upstream.	L-12se	C	C(TS)
Ont. 66-12-P 369-59 portion as described	Catharine Creek (upstream end of	From trib. 6 to a point 1.0 mile upstream from trib. 28, 0.6 mile south of Veteran-Horseheads town line and 0.8 mile east of N.Y.	L-12se M-12ne	C	C(TS)

	Seneca Lake Inlet)	Route 14.			
Ont. 66-12-P 369-59 portion as described	Catharine Creek	From a point 1.0 mile upstream from trib. 28 to source.	M-12ne L-12se	C	C
Ont. 66-12-P 369-59-1	Trib. of Seneca Lake Inlet	Enters Seneca Lake Inlet from east at a point 1.1 miles upstream from mouth, 0.3 mile west of east line of Village of Watkins Glen.	L-12ne L-12se	C	C
Ont. 66-12-P 369-59-2	Diversion channel	From above trib. 3b to Barge Canal (previously unclassified).	L-12se	C	C(T)
Ont. 66-12-P 369-59-3a portion as described	Johns Creek	Enters Seneca Lake Inlet from east 1.3 miles upstream from trib. 1, 0.6 mile east of N.Y. Route 14 in Village of Montour Falls. From mouth 1.2 miles upstream to outlet of P 373a which is Village of Montour Falls water supply reservoir 1.7 miles south of Hector-Montour town line and 0.5 mile east of Skyline Drive.	L-13se	C	C
Ont. 66-12-P 369-59-3a portion as described including P 373a	Johns Creek	From and including P 373a to source.	L-12se L-12ne	A	A
Ont. 66-12-P 369-59-3a-1a	Trib. of Johns Creek	Enters Johns Creek from east 0.8 mile upstream from mouth and 0.5 mile north of N.Y. Route 224.	L-12se	C	C
Ont. 66-12-P 369-59-3a-6, 6a, 7, 9, 9a	Tribs. of Johns Creek	Enter Johns Creek from east and north from a point 0.5 mile south and 1.1 miles west of north and east Montour Town lines to a point 0.1 mile south and 0.9 mile west of said town lines.	L-12ne	A	A
Ont. 66-12-P 369-59-3b, 3c and trib.	Tribs. of Seneca Lake Inlet	Enter Seneca Lake Inlet from east in Village of Montour Falls, 0.1 mile north and just south of N.Y. Route 224 and 0.2 mile west of Skyline Drive. Trib. 3c portion from above falls to source.	L-12se	C	C
Ont. 66-12-P 369-59-3c	Trib. of Seneca Lake Inlet	From mouth upstream to falls.	L-12se	C	C(TS)
Ont. 66-12-P 369-59-5a	Catlin Mill Creek	Enters Seneca Lake Inlet from east in Village of Montour Falls 0.3 mile south of N.Y. Route 224 and 0.3 mile east of N.Y. Route 14. From mouth to source.	L-12se L-12ne	C	C(TS)
Ont. 66-12-P 369-59-5a-2	Cranberry Creek	Enters Catlin Mill Creek from north in Village of Odessa, 0.2 mile south and 0.2 mile west of north and east village lines, respectively. From mouth upstream to below trib. c.	L-12se L-12ne	C	C(T)
Ont. 66-12-P 369-59-5a-2 portion	Cranberry Creek	From trib. c upstream to source.	L-12se L-12ne	C	C(TS)
Ont. 66-12-P 369-59-5a-2-a, b, c	Tribs. of Cranberry Creek	Enter Cranberry Creek from a point 0.7 mile upstream from its mouth and 0.7 mile east of Upper Foots Hill Road to a point 1.9 miles upstream from its mouth and 0.6 mile east of Upper Foots Hill Road.	L-12se	C	C

Ont. 66-12-P 369-59-5a-2a, 3, 3a, 3b	Tribs. of Catlin Mill Creek	Enter Catlin Mill Creek from a point 0.2 mile south and 0.1 mile west of north and east lines of Village of Odessa to a point 0.6 mile south of Victor-Catherine town line and 0.2 mile west of Steam Mill Road.	L-12se L-12ne	C	C
Ont. 66-12-P 369-59-5a-7	Trib. of Catlin Mill Creek	Entire trib. 7.	L-12ne	C	C(TS)
Ont. 66-12-P 369-59-5b	Trib. of Seneca Lake Inlet	Enters Seneca Lake Inlet from east 0.5 mile north of south line and 0.4 mile west of east line of Village of Montour Falls.	L-12se	C	C
Ont. 66-12-P 369-59-6 portion as described	Trib. of Seneca Lake Inlet	Enters Seneca Lake Inlet from east 0.1 mile north of south and 0.5 mile west of east lines of Village of Montour Falls. From mouth 1.0 mile upstream to a point 0.5 mile southeast of southeast corner of Village of Montour Falls.	L-12se	C	C(T)
Ont. 66-12-P 369-59-6 portion as described including all tribs.	Tribs. of Seneca Lake Inlet	From a point 1.0 mile upstream from mouth to source.	L-12se	C	C
Ont. 66-12-P 369-59-7 portion and tribs.	Trib. of Catharine Creek (name changed from Seneca Lake Inlet)	Enters Catharine Creek from east on south line of Village of Montour Falls 0.5 mile east of southeast corner of village. From above trib. 1 upstream to source.	L-12se	C	C
Ont. 66-12-P 369-59-7 portion	Tribs. of Catharine Creek	From mouth upstream to trib. 1.	L-12se	C	C(TS)
Ont. 66-12-P 369-59-9 portion as described	Trib. of Catharine Creek	Enters Catharine Creek from east at a point 0.3 mile south of south line of Village of Montour Falls and 0.1 mile west of N.Y. Route 14. Mouth to a point 0.8 mile upstream at Wigwam Road bridge.	L-12se	C	C(TS)
Ont. 66-12-P 369-59-9 portion as described	Trib. of Catharine Creek	From Wigwam Road bridge to source.	L-12se	C	C
Ont 66-12-P 369-59-1 and trib., 2, 3 and tribs.	Tribs. of trib. 9 of Catharine Creek	Enter trib. 9 from a point 0.1 mile upstream from mouth and 0.4 mile south of south line of Village of Montour Falls to a point 1.8 miles north of Schuyler- Chemung county line and 1.2 miles west of Montour-Catherine town line.	L-12se	C	C
Ont. 66-12-P 369-59-9a, 18, 18b, 19 portion and trib., 20a and tribs., 25 including P 377, 27 and trib., 27a, 28 and trib. including P 377a, 29, 33, 34	Tribs. of Catharine Creek	Enter Catharine Creek from a point 1.0 mile south of the south line of Montour Falls Village and 0.4 mile west of the Dix-Montour town line to a point 0.6 mile south of Merka Road and 0.4 mile west of Veteran Hill Road.	L-12se L-12sw M-12ne	C	C
Ont. 66-12-P 369-59-10a portion, 12 portion, 15 portion, 15-1 portion, 18a portion, 24 portion, 26 portion	Tribs. of Catharine Creek	Trib. 10a, from mouth to 1.0 mile upstream; Trib. 12, from mouth to first falls impassable by fish (0.1 mile); trib. 15, mouth	L-12se L-12sw M-12ne	C	C(TS)

		to first falls impassable by fish (1.0 mile); trib. 15-1, mouth to first falls impassable by fish (0.2 mile); trib. 18a, mouth to first falls impassable by fish (0.1 mile); trib. 24, from mouth upstream 0.5 mile; trib. 26, from mouth to 0.4 mile upstream of trib. 2.			
Ont. 66-12-P 369-59-10a portion and tribs., 12 portion and tribs., 15 portion and tribs. including trib. 1 portion, 18a portion and trib., 24 portion and trib., 26 portion and tribs.	Tribs of Catharine Creek	Trib. 10a, from 1.0 mile upstream of mouth to source; trib. 12, from first falls impassable by fish to source; trib. 15, from first falls impassable by fish to source; trib. 15-1, from first falls impassable by fish to source; trib. 18a, from first falls impassable by fish to source; trib. 24, from 0.5 mile upstream of mouth to source; trib. 26, from 0.4 mile upstream of trib. 2 to source.	L-12se L-12sw M-12ne	C	C
Ont. 66-12-P 369-59-22 and tribs.	Johnson Hollow Creek and tribs.	Enters Catharine Creek immediately and south of Burch Hill Road.	L-12se L-12sw	B	B
Ont. 66-12-P 369-59-19 portion	Trib. of Catharine Creek	From mouth upstream to below trib. 1.	L-12se	C	C(TS)
Ont. 66-12-P 369-60 portion as described	Glen Creek (trib. of Seneca Lake)	Enters Seneca Lake from south at a point 0.3 mile south of north line and 0.5 mile west of east line of Village of Watkins Glen. From mouth to trib. 1.	L-12ne	C	C
Ont. 66-12-P 369-60 portion as described	Glen Creek	From trib. to 1 N.Y. Route 14 bridge in Village of Watkins Glen.	L-12ne	C	C(TS)
Ont. 66-12-P 369-60 portion as described	Glen Creek	From N.Y. Route 14 bridge at Village of Watkins Glen to first falls impassable by fish (0.15 mile).	L-12ne L-12se	B	B(TS)
Ont. 66-12-P 369-60 portion as described including P 378a, P 378b and trib. 3	Glen Creek and VanZandt Hollow	From first falls impassable by fish to source, including P 378a, P 378b and trib. 3.	L-12se L-12nw L-12sw L-11ne	B	B
Ont. 66-12-P 369-60-1	Old Barge Canal Channel	Enters Glen Creek from south 0.3 mile upstream from mouth and 0.4 mile west of east line of Village of Watkins Glen to confluence of Seneca Lake Inlet and Catharine Creek 0.1 mile north of south line and 0.5 mile west of east line at Village of Montour Falls.	L-12ne L-12se	C	C(T)
Ont. 66-12-P 369-60-1-1 portion as described	Trib. of Old Barge Canal Channel	Enters Old Barge Canal Channel from west in Village of Montour Falls, 2.0miles upstream from mouth and 0.2 mile east of N.Y. Route 14. From mouth to first falls impassable by fish (0.15 mile).	L-12se	C	C(TS)
Ont. 66-12-P 369-60-1-1 portion as described and trib.	Trib. of Old Barge Canal Channel	From first falls impassable by fish to source.	L-12se L-12sw	C	C
Ont. 66-12-P 369-60-1-2 portion as described	Shequaga Creek	Enters Old Barge Canal Channel from south in Village of	L-12se	C	C(T)

		Montour Falls 2.2 miles upstream from mouth just south of N.Y. Route 14 crossing. Mouth to 0.7 mile upstream at Village of Montour Falls west line.			
Ont. 66-12-P 369-60-1-2 portion as described	Shequaga Creek	From Village of Montour Falls west line to trib. 5.	L-12se L-12sw	C	C(TS)
Ont. 66-12-P 369-60-1-2 portion as described	Shequaga Creek	From trib. 5 to source (unnamed). Trib. 5 also named Shequaga Creek.	L-12sw	C	C
Ont. 66-12-P 369-60-1-2-a, 2, 3a, 4 and trib., 6, 8, 9	Tribs. of Shequaga Creek	Enter Shequaga Creek from a point 0.5 mile upstream from mouth in Village of Montour Falls and 0.2 mile east of Dix-Montour town line to a point 0.7 mile north of Schuyler-Chemung county line and 0.5 mile southwest of Moreland.	L-12se L-12sw	C	C
Ont. 66-12-P 369-60-1-2-5 portion as described	Trib. of Shequaga Creek	From mouth to 4.2 miles upstream of mouth.	L-12sw	C	C(TS)
Ont. 66-12-P 369-60-1-2-5 portion as described and tribs.	Trib. of Shequaga Creek	From 4.2 miles upstream of mouth to source.	L-12sw	C	C
Ont. 66-12-P 369-60-1-3 and trib.	Trib. of Old Barge Canal Channel	Enters Old Barge Canal Channel in Village of Montour Falls 0.6 mile north of its south line and 0.2 mile west of N.Y. Route 14.	L-12se	C	C
Ont. 66-12-P 369-60-6 and trib., 7 and tribs., 8 and trib., 11 and tribs., 13, 14, 15 and tribs., 16 and tribs., 19 and trib., 20, 21, 22 and trib., 23	Trib. of Glen Creek and VanZandt Hollow	Enter Glen Creek and VanZandt Hollow from a point on Glen Creek in Watkins Glen State Park 2.3 miles upstream from west line of Village of Watkins Glen and 0.1 mile north of N.Y. Route 329 to a point on VanZandt Hollow 0.9 mile west of Reading-Tyrone town line and 0.6 mile north of Mud Lake Road.	L-12sw L-12nw L-11ne	C	C
Ont. 66-12-P 369-61 and trib., 62, 63, 65, 66, 67, 68, 69, 70 and tribs., 70a, 71 and trib., 71a, 72 and trib., 73, 74, 74a, 75 and P 378c, 75a, 75b, 76, 78 and trib., 79 and trib., 81, 85, 85a, 86, 88, 88a, 89, 89a, 89b, 90 and trib., 93a, 94, 94a, 95, 95a, 96 and trib., 97 and trib., 98, 99, 101, 102 and tribs., 102a, 104a and trib., 104b and trib., 105, 105a, 105b, 106 and tribs., 106a, 106b, 106c, 106d, 107, 107a, 107b, 108, 108a, 109 and trib., 110, 112, 113 and tribs.	Tribs. of Seneca Lake	Enter Seneca Lake from west from a point in Village of Watkins Glen 0.2 mile south of north village line to Perry Point 0.3 mile south of Romulus-Ovid town line. Pond P 378c is unnamed.	L-12nw K-12sw K-12nw K-11se L-11ne	C	C
Ont. 66-12-P 369-93 portions as described, 104 and trib. 1a portions as described, 91 portion, 103 portion	Tribs. of Seneca Lake	Trib. 93, from mouth to first falls impassable by fish (0.15 mile). Trib. 104, from mouth to first falls impassable by fish (1.0 mile), trib. 104-1a from mouth to first falls impassable by fish (200 feet). Trib. 91 from mouth upstream to falls. Trib. 103 from mouth upstream to falls.	L-12nw K-12sw K-11se L-11ne	C	C(TS)
Ont. 66-12-P 369-104 and trib. 1a portions as described, and tribs., 91 portion and tribs. and P 378d, 103 portion and tribs.	Tribs. of Seneca Lake	Trib. 104 and trib. 1a, from first falls impassable by fish to source. Trib. 91 from above falls upstream to source, including all tribs. Trib. 103 from above falls upstream to source, including all tribs. Pond P 378d is unnamed, and stocked with brown,	L-12nw K-12sw K-11se L-11ne	C	C

		brook trout.			
Ont. 66-12-P 369-93 portion	Big Stream	Trib. 93 from falls (0.15 mile) to Rt. 14A.	L-12nw K-12sw	D	D
Ont. 66-12-P 369-93 portion	Big Stream	From Route 14A at Dundee upstream for about 1.0 mile to Pre-emption Road.	K-12sw	B	B
Ont. 66-12-P 369-93 portion	Big Stream	From Pre-emption Road to 1.0 mile above trib. 11.	K-12sw K-11se	C	C
Ont. 66-12-P 369-93 portion	Big Stream	From 1.0 mile above trib. 11 to trib. 16.	K-11se L-11ne	C	C(TS)
Ont. 66-12-P 369-93 portion and tribs.	Big Stream	From above trib. 16 to source. Includes all tribs.	L-11ne K-11se K-12sw L-12nw	C	C
Ont. 66-12-P 369-115 portion as described	Keuka Lake Outlet	Enters Seneca Lake from west in Village of Dresden on Seneca-Yates county line 0.8 mile northwest of Perry Point. From mouth 0.6 mile upstream to N.Y.C. Railroad bridge within Village of Dresden.	K-12nw	C	C(T)
Ont. 66-12-P 369-115 portion as described	Keuka Lake Outlet	From a point 0.6 mile upstream from mouth in Village of Dresden to trib. 10.	K-12nw K-11ne	C	C(T)
Ont. 66-12- P 369-115 portion as described	Keuka Lake Outlet	From trib. 10 to source at Keuka Lake south of Village of Penn Yan 0.2 mile west of East Lake Road and 0.5 mile south of West Lake Road.	K-11ne	C	C
Ont. 66-12-P 369-115-a, 1 and trib., 2, 2a, 2b, 3 and tribs., 3a, 3b, 3c, 4 and trib., 5, 6 and tribs., 7a, 8 and trib., 9, 10, 11, and tribs., 11a, 12 and tribs., 13, 14 and tribs.	Tribs. of Keuka Lake Outlet	Enter Keuka Lake Outlet from a point 0.1 mile upstream from mouth in Village of Dresden to a point 0.3 mile downstream from Keuka Lake just east of the westline of Village of Penn Yan.	K-12nw K-11ne K-12sw K-11se	D	D
Ont. 66-12-P 369-115-P 388	Keuka Lake	Begins at source of Keuka Lake Outlet south of Village of Penn Yan and extends southerly 18 miles to Village of Hammondsport.	K-11ne K-11se L-11ne L-11nw K-11sw	AA	AA(TS)
Ont. 66-12-P 369-115-P 388-a, 2, 3, 4 and tribs., 6, 7, 8 and trib., 8a, 8b, 9, 10, 11, 12 and trib., 12a, 13, 14 and trib., 15, 16 and tribs., 17, 18, 18a, 19, 19a, 20, 20a, 20b, 20c, 21 and tribs., 23 and trib., 24, 25, 25a and trib., 25b, 25c	Tribs of Keuka Lake	Enter Keuka Lake from east beginning at a point 0.6 mile south of Keuka Lake Outlet 0.1 mile west of East Lake Road to a point 11 miles south on Keuka Lake 1.0 mile northwest of junction of Yates, Schuyler and Steuben county lines and 0.5 mile west of Steuben-Yates county line where trib. 25c enters Lake.	K-11ne K-11se L-11ne	D	D
Ont. 66-12-P 369-115-P 388-26 portion as described and trib.	Power Flume	Enters Keuka Lake from east 0.1 mile southwest of trib. 25c,0.9 mile northwest of junction of Yates, Schuyler and Steuben county lines. This flume carries water diverted from Waneta and Lomoco Lake to Hydro-electric Station at Keuka on Keuka Lake. Mouth upstream to a point 0.3 mile downstream from	L-11ne	D	D

		Waneta Lake at Wayne.			
Ont. 66-12-P 369-115-P 388-26a, 27, 27a, 27b, 27c, 27d, 27e, 28 and trib., 30, 32, 32a, 33, 33a, 34, 35	Tribs. of Keuka Lake	Enter Keuka Lake from east from a point 0.1 mile southwest of trib. 26 (Power Flume) southwesterly 6.0 miles to Willow Point 1.0 mile east of Village of Hammondsport.	L-11ne L-11nw	C	C
Ont. 66-12-P 369-115-P 388-36	Keuka Inlet and Cold Brook	Enters Keuka Lake from south immediately south of southeast corner of Village of Hammondsport, 0.4 mile north of N.Y. Route 54. Mouth to a point 3.9 miles upstream to trib. 7 and Cold Brook from trib. 7 to source.	L-11nw L-10ne L-10se	C	C(TS)
Ont. 66-12-P 369-115-P 388-36-1 and tribs.	Tribs. of Keuka Inlet	Enter Keuka Inlet from south at a point 0.5 mile upstream from mouth and 0.2 mile north of N.Y. Route 54.	L-11nw	C	C
Ont. 66-12-P 369-115-P 388-36-2 portion as described	Trib. of Keuka Inlet	Enters Keuka Inlet from south at a point 0.1 mile upstream from trib. 1 and 0.2 mile north of N.Y. Route 54. Mouth to a point 1.2 miles upstream to N.Y. Route 54 bridge which is located 1.0 mile southwest of Village of Hammondsport.	L-11nw	C	C(T)
Ont. 66-12-P 369-115-P 388-36-2 portion as described, including trib.	Tribs. of Keuka Inlet	From N.Y. Route 54 bridge to source.	L-11nw L-10ne L-10se	C	C
Ont. 66-12-P 369-115-P 388-36-2a, 3 and tribs., 5 and trib., 6 and tribs., 6a and tribs., 7 and trib., 7a, 8, 9	Tribs. of Keuka Inlet and Cold Brook	Enter Keuka Inlet and Cold Brook from a point 0.3 mile north of N.Y. Route 54 and 0.3 mile west of N.Y. Route 54A to a point on Cold Brook in Town of Bath 0.3 mile south and 0.4 mile west of southwest Bath-Urbana town line.	L-11nw L-10ne L-10se	C	C
Ont. 66-12-P 369-115-P 388-37 and tribs., 37a, 37b, 37c, 38 and tribs., 40, 40a, 40b, 40c, 41, 42, 42a, 43, 44, 45, 46, 47 and tribs., 48 and tribs., 49, 50, 51, 51a, 52, 53, 54 and trib., 54a, 55, 56 and trib., 57 and tribs., 58, 58a,59, 60, 61 and tribs.	Tribs. of Keuka Lake	Enter Keuka Lake along entire west shore of lake beginning at a point in Village of Hammondsport 0.1 mile west of its east line and 0.1 mile south of N.Y. Route 54A to a point 0.8 mile north of Yates-Steuben County line and 0.2 mile east of N.Y. Route 54A.	L-11nw L-10ne K-11sw	C	C
Ont. 66-12-P 369-115-P 388-48-P 388a	Subtrib. of Keuka Lake	Unnamed pond.	K-11sw	C	C
Ont. 66-12-P 369-115-P 388-62	Sugar Creek	Enters Keuka Lake from north at Branchport hamlet 0.3 mile east and 0.2 mile south of N.Y. Route 54A. From mouth to trib. 4, and from trib. 20 to source.	K-11sw K-11nw K-11ne	C	C(T)
Ont. 66-12-P 369-115-P 388-62 portion	Sugar Creek	From trib. 4 upstream to trib. 20.	K-11sw K-11nw	C	C(TS)
Ont. 66-12-P 369-115-P 388-62-a, b, c, d and trib., 1, 1a, 3 and trib., 4 and trib. 4a, 5 and tribs., 5a, 5b and trib., 6, 8, 9, and tribs., 9a, 9b, 10, 12, 13, 13a, 13b, 13c, 14 and trib., 16, 17, 18, 18a,19 and trib., 19a, 20 and tribs., 21, 22 and trib., 22a, 23 and trib., 23a, 24 and tribs., 25 and tribs.	Tribs. of Sugar Creek	Enter Sugar Creek from east and west beginning at a point 0.1 mile upstream from mouth in Branchport hamlet to a point just west of Potter-Benton town line and 0.4 mile north of Tears Road. Trib. 9 from above falls to source, including all tribs.	K-11sw K-11nw K-11ne	D	D
Ont. 66-12-P 369-115-P 388-62-7, portion as described	Trib. of Sugar Creek	From mouth upstream 0.8 mile.	K-11sw K-11nw	C	C(TS)

Ont. 66-12-P 369-115-P 388-62-7 portion as described and tribs.	Trib. of Sugar Creek	From 0.8 mile upstream of mouth to source.	K-11nw K-11sw	C	C
Ont. 66-12-P 369-115-P 388-62-9 portion	Unnamed trib. of Sugar Creek	From mouth to falls, 4,000 ft. upstream.	K-11nw	C	C(TS)
Ont. 66-12-P 369-115-P 388-62a, 63 and trib., 63a, 63b, 63c and trib., 63d, 63e, 63f, 63g, 63h, 63I, 63j, 63k, 63l, 63m, 63n, 63o, 63p, 63q, 63r, 63s, 63t, 63u, 63v, 63w, 63x, 63y, 63z, 63aa, 63bb, 63cc, 63dd, 63ee, 63ff, 63gg, 64 and tribs.,64a, 65, 65a, 66 and trib., 66a, 67, 68, 69	Tribs. of Keuka Lake	Enter Keuka Lake from north, east and west from a point0.5 mile east of Branchport hamlet and continuing around periphery of lake to a point 0.6 mile west of Keuka Lake Outlet at Penn Yan, 1.2 miles south of Benton-Jerusalem town line.	K-11sw K-11se K-11ne	C	C
Ont. 66-12-P 369-115-P 388-67-P 388b, 68-P 388c	Subtribs. of Keuka Lake	Unnamed ponds.	K-11ne	C	C
Ont. 66-12-P 369-115a, 116,117, 118a, 121, 124, 127, 127a, 128 and tribs., 129, 130, 131, 132, 132a, 132b, 133 and tribs.	Tribs. of Seneca Lake	Enter Seneca Lake from west from a point on Seneca-Yates county line 0.1 mile north of Village of Dresden north line to a point 8.5 miles northerly to Clark Point which is located 0.2 mile northeast of intersection of N.Y Route 14 and Billsboro Road.	K-12nw J-12sw J-11se K-11ne	C	C
Ont. 66-12-P 369-134	White Springs Brook	Enters Seneca Lake from west at a point on Seneca-Ontario County line 0.3 mile southeast of intersection of N.Y. Route 14 and Turk Road.	J-12sw J-11se	C	C
Ont. 66-12-P 369-134-P 392, P 393, P 394	Ponds trib. to White Springs Brook	Three isolated ponds located 0.3, 0.2 and 0.2 mile east of Pre-Emption Road and 0.45, 0.5 and 0.3 mile south of N.Y. Route 5, respectively.	J-11se	C	C
Ont. 66-12-P 369-134-P 395	Pond trib. to White Springs Brook	Located 0.25 mile east of Pre-Emption Road and 0.28 mile south of N.Y. Route 5.	J-11se	B	B
Ont. 66-12-P 369-134-P 395a	Pond trib. to White Springs Brook	Located 0.2 mile east of Pre-Emption Road and 0.2 mile south of N.Y. Route 5.	J-11se	C	C
Ont. 66-12-P 369-136, 137, 138 and tribs., 138a, 139 and tribs.	Tribs. of Seneca Lake	Enter Seneca Lake from west and north from a point on Seneca-Ontario County line 0.6 mile south of south line of City of Geneva to a point just south of N.Y. Route 5 and 0.4 mile east of N.Y. Route 14.	J-12sw J-11se J-11ne J-12nw	C	C
None	Barge Canal	Beginning at confluence of State Bridge Canal and Canandaigua Outlet in Village of Lyons, westerly to drainage basin limits at Wayne Port 3.0 miles west of Village of Macedon.	H-12sw H-11se H-11sw H-10se	C	C

ASSESSMENT OF LOCAL LAWS, PROGRAMS, AND PRACTICES AFFECTING WATER QUALITY

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1.0 Introduction

1.1 Introduction

The *Seneca Lake Assessment of Local Laws, Programs, and Practices Affecting Water Quality* is a component of the comprehensive Seneca Lake Watershed Management Plan. It includes:

- Description and analysis of federal and state laws, programs, and practices that impact water quality in the watershed;
- Description and analysis of local laws, plans, programs, and practices affecting the watershed:
    - Including zoning, site plan review, subdivision regulations, stormwater management, and wetlands, watercourse, and flooding regulations;
- Analysis of strengths and weaknesses of local laws, plans, programs, and practices as they relate to management of point and nonpoint source pollution and protection of aquatic habitat
- Recommendations for priority additions or amendments to local laws, plans, programs, and practices, based on planning and water quality best management practices (BMPs)

The Seneca Lake Watershed Management Plan serves as a long-term strategy for the protection and restoration of water quality and ensures compatible land use and development. In addition to this *Assessment of Local Laws, Programs, and Practices Affecting Water Quality*, additional project components together comprise an overall strategy to protect and restore water quality within the Seneca Lake Watershed. These include:

- A characterization of the watershed and its constituent sub-watersheds, land use and land cover, demographics, natural resources, and infrastructure, completed in 2012;[1]
- An evaluation of existing water quality data, run-off characteristics, and pollutant loadings, completed in 2012;[2]
- A community education and outreach program on water quality and quantity and watershed protection issues, completed in 2011;[3]
- Identification of management strategies and prioritization of projects and other actions for watershed protection and restoration;
- An implementation strategy, including the identification of watershed-wide and site-specific projects and other actions necessary to protect and restore water quality.

Portions of this report are based on and excerpted from existing reports and studies such as *Protecting Water Resources through Local Controls and Practices*.[4]

Section 1.0 Endnotes

[1] *Seneca Lake Watershed Management Plan Characterization and Subwatershed Evaluation,* 2012. http://stcplanning.org/usr/Program_Areas/Water_Resources/Seneca_Lake_Plan/SenecaCharacterizationSubwatershedEval.pdf

[2] *Ibid*.

[3] *Seneca Lake Watershed Management Plan: Community Outreach and Education Plan*. 2011. http://www.stcplanning.org/usr/Program_Areas/Water_Resources/Seneca_Lake_Plan/Community%20Outreach%20%20Education%20Plan_Final.pdf

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[4] Genesee/Finger Lakes Regional Planning Council. *Protecting Water Resources through Local Controls and Practices: An Assessment Manual for New York Municipalities*, 2006. http://www.gflrpc.org/Publications/LocalLaws/Manual/Protecting_Water_Resources.pdf

2.0 Roles and Responsibilities of Governmental and Non-Governmental Agencies

This section provides an overview of various groups – both governmental and non-governmental at the local, county, regional, state, and federal level – that have an effect on water quality in the Seneca Lake watershed. It includes descriptions of organizational roles and responsibilities as well as information on some of their major programs.

Information was gathered from a variety of sources including agency websites and the *Protecting Water Resources through Local Controls and Practices*[5] report. Additional information was obtained from a draft of the *Healthy Niagara: Niagara River Watershed Plan, Watershed Organizations and Agencies involved in Watershed Planning & Protection.*[6]

2.1 Federal Government Agencies

2.1.1 US Army Corps of Engineers (USACE)[7]

The US Army Corps of Engineers plays a significant role in planning and building water resource improvements. The USACE stated vision is to "Provide vital public engineering services in peace and war to strengthen our Nation's security, energize the economy, and reduce risks from disasters." USACE regulates construction and other work in navigable waterways under Section 10 of the Rivers and Harbors Act of 1899, and has authority over the discharge of dredged or fill material into the "waters of the United States" (a term which includes wetlands and all other aquatic areas) under Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92500, the "Clean Water Act"). Under these laws, those who seek to carry out such work must first receive a permit from the Corps. Other significant areas regarding the Corps' role in planning and building water resource improvements include recreation, emergency response and recovery, flood control and floodplain management, navigation, erosion and shore protection, hydrologic modeling, hydropower and water supply management.

2.1.2 US Geologic Survey (USGS)[8]

A division of the US Department of the Interior, the USGS focuses on research in the natural sciences with emphasis on climate and land use change, core science systems, ecosystems, energy, minerals and environmental health, natural hazards, science quality and integrity, and water.

2.1.3 Federal Emergency Management Agency (FEMA)[9]

A division of the US Department of Homeland Security, FEMA's mission is to support citizens and first responders to build, sustain, and improve capability to prepare for, protect against, respond to, recover from, and mitigate all hazards. Responsibilities include floodplain management, flood hazard mapping, and administration of the National Flood Insurance Program.

2.1.4 Environmental Protection Agency (EPA)

The EPA's primary mission is to protect human health and the environment. EPA's FY 2011-2015 Strategic Plan identifies five strategic goals to guide the Agency's work:

- Taking Action on Climate Change and Improving Air Quality;
- Protecting America's Waters;

- Cleaning Up Communities and Advancing Sustainable Development;
- Ensuring the Safety of Chemicals and Preventing Pollution; and
- Enforcing Environmental Laws.

The EPA enforces the Clean Water Act, the Safe Drinking Water Act, and a number of other important environmental regulations.[10] The Clean Water Act requires states to classify waters according to their best uses and to adopt water quality standards that support those uses. Section 404 of the Clean Water Act requires that anyone depositing dredged or fill material into waters of the United States, including wetlands, must receive authorization for such activities. The US Army Corps of Engineers (USACE) has been assigned responsibility for administering the Section 404 permitting process.

The Safe Drinking Water Act protects public health by regulating the nation's public drinking water supply. The law requires many actions that help protect public health and drinking water, including rivers, lakes, reservoirs, springs, groundwater wells, and other sources.

While the EPA is the primary federal body enforcing regulations such as the Endangered Species Act, the Clean Air Act, and the Clean Water Act, enforcement of these regulations is generally delegated to the New York State Department of Environmental Conservation. The EPA provides significant sources of funding to be used by the responsible state agencies for enforcement and implementation of federal laws and regulations.[11]

2.1.4.1 National Pollutant Discharge Elimination Systems Permit (NPDES)

Under the Clean Water Act, the National Pollutant Discharge Elimination System permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. In New York State, this program is administered by the NYSDEC and is referred to as the State Pollutant Discharge Elimination System (SPDES). The EPA, in conjunction with state and local authorities, monitors pollution levels in the nation's water and provide status and trend information on compliance and other issues.

2.1.4.2 EPA Regulated Facilities

To improve public health and the environment, the EPA collects information about facilities or sites subject to environmental regulation. The public is able to conduct research on facilities within their neighborhoods or areas of interest through the EPA Envirofacts database, an online database and retrieval system for regulated facilities in the United States. To view a detailed list of facilities in the watershed, search the Envirofacts database[12] (http://www.epa.gov/enviro/index.html) using the keywords 'Seneca Lake.'

2.1.5 USDA Natural Resources Conservation Service (NRCS)[13]

A division of the US Department of Agriculture, the NRCS works with landowners through conservation planning and assistance designed to benefit the soil, water, air, plants, and animals that result in productive lands and healthy ecosystems. Services include technical assistance to farmers regarding water quality and erosion control issues, preparation of Comprehensive Nutrient Management Plans, Agricultural Conservation Plans, the Conservation Reserve Program, and the Wetlands Reserve Program.

The Resource Conservation and Development (RC&D) program is one that helps communities improve their economies through the wise use of natural resources. The purpose of the RC&D program is to improve the capability of state, tribal and local units of government and local nonprofit organizations in rural areas to plan, develop and carry out programs for resource conservation and development. The NRCS provides administrative support for the RC&D program including office space and staff.[14]

2.1.6 US Fish and Wildlife Service[15]

The US Fish and Wildlife Service is a bureau within the Department of the Interior. Its mission is working with others to conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people. Among its key functions, the Service enforces federal wildlife laws, protects endangered species, manages migratory birds, restores nationally significant fisheries, and conserves and restores wildlife habitat such as wetlands.

2.1.7 Great Lakes Commission[16]

The Great Lakes Commission is a public agency established by the Great Lakes Basin Compact in 1955 to help its Member states and provinces speak with a unified voice and collectively fulfill their vision for a healthy, vibrant Great Lakes - St. Lawrence River region. The Commission houses a wide variety of action-oriented programs intended to address specific concerns related to regional coordination and management of natural resources.

2.2 New York State Agencies

2.2.1 NYS Department of State, Office of Planning & Development[17]

NYSDOS Office of Planning & Development helps protect and enhance coastal and inland water resources and encourage appropriate land use. The Office also works in partnership with local governments in preparation of Local Waterfront Revitalization Programs (LWRP), which serve as comprehensive land and water use plans, as well as intermunicipal watershed management plans which identify problems, threats and opportunities for achieving long lasting improvements in water quality as well as establishing priorities for action. Financial assistance for the preparation and implementation of such programs and plans is available through the Environmental Protection Fund (EPF).[18]

This Seneca Lake Watershed Management Plan is being developed for the New York State Department of State Office of Planning & Development with funds provided under Title 11 of the Environmental Protection Act Local Waterfront Revitalization Program.

Additional DOS functions include implementing the State's Waterfront Revitalization of Coastal Areas and Inland Waterways Act, planning and technical assistance for redevelopment of brownfields, abandoned buildings and deteriorated urban waterfronts, protecting water quality through intermunicipal watershed planning, as well as investing in improvements to waterfront areas through state and federal grant programs.

2.2.2 NYS Department of Environmental Conservation (NYSDEC)[19]

NYSDEC exists to "conserve, improve, and protect New York State's natural resources and environment, and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well-being."[20] The NYSDEC plays a major role in a diverse array of watershed planning and management issues, including regulatory, chemical and pollution control, dam safety, management of public lands and waters, wetlands protection, mining and reclamation, and the protection and management of animals, plants, aquatic life and associated habitats. NYSDEC has numerous departments and programs, some of which are described below.

2.2.2.1 NYSDEC Division of Environmental Permits

The Division of Environmental Permits manages UPA (Uniform Procedures Act) permits, intended to protect air, water, mineral and biological resources. The Division also oversees implementation of the State Environmental Quality Review Act (SEQR), and assists other agencies with SEQR requirements.[21] Agencies proposing projects that require SEQR must identify and mitigate any significant environmental impacts of the project or activity proposed.[22]

2.2.2.2 NYSDEC Division of Water[23]

DEC's Division of Water protects and conserves the water resources of New York State through a wide range of programs and activities. Water quality standards contain the classification system for New York State surface and ground waters. The standards and guidance values for surface water and groundwater quality and groundwater effluent limitations are included in these regulations, including the State Pollution Discharge Elimination System (SPDES).

Citizens Statewide Lake Assessment Program (CSLAP)[24]

DEC's Division of Water, along with the New York State Federation of Lake Associations, began the Citizens Statewide Lake Assessment Program (CSLAP) as an outreach and education program in 1985. CSLAP volunteers educate the public about lake conservation and are trained in collecting water samples in lakes throughout New York. CSLAP data collection helps identify lake problems and changes in water quality and is used in support of individual lake and statewide management decisions, water quality listings, and the development of management plans for CSLAP lakes.

Seneca Lake was added to CSLAP in 1992, with regular monitoring coordinated through the 1990's. Seneca Lake Pure Waters Association (SLPWA) and the Community Science Institute have begun synoptic sampling annually as of 2013.

2.2.2.3 NYSDEC Protection of Waters Program

The protection of waters program was developed by NYSDEC to create and enforce regulations to protect lakes rivers streams and ponds from undesirable activities, and is an implementation strategy of the Article 15 of the NYS Environmental Conservation Law.

The Protection of Waters Regulatory Program regulates five different categories of activities:

- Disturbance of bed or banks of a protected stream or other watercourse.
- Construction, reconstruction or repair of dams and other impoundment structures.
- Construction, reconstruction or expansion of docking and mooring facilities.
- Excavation or placement of fill in navigable waters and their adjacent and contiguous wetlands.
- Water quality certification for placing fill or undertaking activities resulting in a discharge of waters of the United States.

A class is given to each waterway or segment based on its best use. The level of protection often relates to this classification. Classifications include:

- AA or A – Source of drinking water
- B – swimming/recreation but not drinking water
- C – fisheries and non-contact activities
- D – lowest classification

2.2.2.4 NYSDEC Freshwater Wetlands

The DEC has classified regulated freshwater wetlands according to their respective function, values and benefits. Wetlands may be Class I, II, III or IV. Class I wetlands are the most valuable and are subject to the most stringent standards. A wetland must be 12.4 acres or larger for protection under the Freshwater Wetlands Act. Smaller wetlands may be protected when the NYSDEC Commissioner determines they have unusual local importance in providing one or more wetland functions. The wetland buffer zone, an adjacent area that extends 100 feet from the wetland boundary, may also be regulated.

2.2.2.5 NYSDEC Priority Waterbodies List (PWL)

The Priority Waterbodies List is required by Section 303(d) of the federal Clean Water Act and is a section of the 305(b) Water Quality Report written by NYSDEC and provided to the United States Environmental Protection Agency (USEPA). The PWL identifies waters that have one or more uses that are not fully supported or are threatened by conditions or practices that could lead to declining water quality. The PWL is used as a basis for water program management.

The existing NYSDEC Routine Statewide Monitoring and Assessment Program includes Rotating Integrated Basin Studies (RIBS) of rivers and streams, Lake Classification and Inventory (LCI), and groundwater sampling program. The most recent Oswego/Finger Lakes Basin Waterbody Inventory/Priority Waterbodies List Report[25] was issued in February 2012.

2.2.2.6 NYSDEC Division of Fish, Wildlife and Marine Resources[26]

DEC's Division of Fish, Wildlife and Marine Resources is made up of the Bureau of Fisheries, Bureau of Habitat, Bureau of Marine Resources, Bureau of Wildlife, and Bureau of Fish & Wildlife Services. Some of their responsibilities include providing information to the public about hunting and fishing, and issuing licenses.

2.2.2.7 NYSDEC Division of Lands and Forests

This DEC Division manages more than four million acres of state owned land and conservation easements including all State Forests as well as the Adirondack and Catskill Forest Preserves. The Division also administers the Saratoga Tree Nursery and programs for forest health, urban and community forestry, forest products use, and provides assistance to private forest land owners.[27]

2.2.2.8 NYSDEC Spill Incidents Database[28]

The NYSDEC maintains a database of chemical and petroleum spills that have been reported to the Department since 1978.

2.2.2.9 NYSDEC Hazardous Waste Sites

The NYSDEC Division of Environmental Remediation maintains a database of sites being addressed under one of the Division's remedial programs – State Superfund, Brownfield Cleanup, Environmental Restoration and Voluntary Cleanup. This database also includes the Registry of Inactive Hazardous Waste Disposal Sites and information on Institutional and Engineering Controls in New York State.

2.2.2.10 State Pollution Discharge Elimination System (SPDES)[29]

SPDES is New York State's version of the National Pollutant Discharge Elimination System (NPDES) permit program. The goal is to limit pollution of lakes, streams and rivers by runoff from construction sites and developed areas using a SPDES permit (State Pollutant Discharge Elimination System). SPDES has been approved by the US EPA for the control of wastewater and stormwater discharges in accordance with the Clean Water Act. SPDES is goes further than what's required by the Clean Water Act as it controls point source discharges to groundwater as well as surface waters. A list of permitted SPDES discharge points that are present in the watershed are provided in Figure 23 of the *Seneca Lake Watershed Management Plan Characterization and Subwatershed Evaluation*.[30]

SPDES General Construction Permit

The state has issued two non-industrial Stormwater Management General Permits under SPDES: one for construction site operators and one for regulated localities. The NYS General Permit for Construction Activities is required for any construction activity that will disturb land one acre or more in size.[31] Before commencing construction activity, the owner or operator of a construction project that will involve soil disturbance of one or more acres must obtain coverage under the Permit for Stormwater Discharges from Construction Activity. The permit is intended to reduce impacts to area waterbodies from sediment runoff. This is achieved in part through the development of a Stormwater Pollution Prevention Plan (SWPPP) as well as strict compliance and enforcement standards.

Concentrated Animal Feeding Operations (CAFOs)

The general trend occurring in United States agriculture over the past half century has been a reduction in small, family-operated farms and consolidation into larger, more centralized operations. The Concentrated Animal Feeding Operation (CAFO) is a direct reflection of that trend and represents an economy of scale in agricultural commodity production. CAFOs are defined as lots or facilities where animals are stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period; they are categorized as either "large" or "medium" sized operations based on the numbers of animals confined.[32] CAFOs that discharge to waters of New York State are regulated by the NYSDEC under the authority of the Clean Water Act through the New York State Pollution Discharge Elimination System (SPDES).[33]

2.2.3 NYS Department of Health (NYSDOH)[34]

NYSDOH tracks environmental health data and trends; oversees the delivery of drinking water in coordination with the EPA, addresses pathogens and other sources of contamination in public sources of drinking water; coordinates emergency preparedness and response for water systems; and provides financing mechanisms to help protect and expand public water systems.

2.2.4 NYS Department of Agriculture & Markets – Agricultural Environmental Management (AEM)[35]

Agricultural Environmental Management (AEM) is an incentive-based, voluntary program, that helps farmers make cost-effective and science-based decisions to meet business objectives, and protect and conserve natural resources. The program partners Farmers and local AEM resource professionals to work together to develop AEM plans.[36] AEM techniques include educating farmers on different agricultural best management practices, their effect on the environment and implementation strategies. Assistance is also given to farmers to help understand regulations (such as CAFO regulations) and stay in compliance.[37] The SWCDs coordinate the AEM program in the watershed, based on county AEM strategic plans which are updated every five years.

2.2.5 NYS Office of Emergency Management (NYSOEM)[38]

NYSOEM is responsible for coordinating State agencies to protect communities, the economy, and the environment from disasters and emergencies. OEM provides technical assistance to communities to prepare for hazard events and prevent/reduce the impacts of disasters through its programs such as: hazard identification, loss prevention, planning, training, operational response to emergencies, technical support, and disaster recovery assistance. OEM also partners with the Federal Emergency Management Agency (FEMA) to administer a number of hazard planning, mitigation, and recovery grants.

2.2.6 NYS Department of Transportation (NYSDOT)[39]

NYSDOT is responsible for transportation policy and implementation in New York State, coordinating and assisting in the development and operation of transportation facilities and services for highways, railroads, mass transit systems, ports, waterways, and airports through efforts at 11 regional offices covering the state.

2.2.7 NYS Energy Research and Development Authority (NYSERDA)[40]

NYSERDA is a public benefit corporation responsible for reducing statewide energy consumption, promoting the use of renewable energy sources, and protecting the environment. NYSERDA's programs and services provide a vehicle for the State to work collaboratively with businesses, academic institutions, industry, the federal government, environmental community, public interest groups, energy buyers, and utilities. Through these collaborations, NYSERDA seeks to develop a diversified energy supply portfolio, improve market mechanisms, and facilitate the introduction and adoption of advanced energy technologies, particularly renewables, to plan for and respond to uncertainties in the energy markets.

2.3 Regional Agencies

2.3.1 Seneca Lake Area Partners in Five Counties (SLAP-5)[41]

The Seneca Lake Area Partners in Five Counties is an organization whose mission is to "develop a watershed management plan for Seneca Lake that will protect and improve water quality and is supported by the citizens and communities in the watershed. To provide representation of all important sectors in the Seneca Lake Watershed and to keep in contact with people in their areas of expertise to ensure the watershed program reflects and responds to the people represented."[42] Formation of Seneca Lake Area Partners in 5 Counties (SLAP-5) to conduct education and outreach was an outcome of the *Seneca Lake Watershed Study: Developing and Understanding of An Important Natural Resource* (1996); the two-volume report of findings, *Setting a Course for Seneca Lake: The State of the Seneca Lake Watershed*, followed in 1999. The group remains an active participant in planning efforts for the watershed. SLAP-5 members pursue funding for a range of planning and implementation projects to protect and improve water quality in Seneca Lake.

2.3.2 Seneca Lake Pure Waters Association (SLPWA)[43]

The Seneca Lake Pure Waters Association is dedicated to enhancing and preserving the quality of Seneca Lake. The organization promotes understanding and preservation of the lake through funding scientific research, collecting and dissemination information on the watershed, and promoting patterns of development that further that mission. SLPWA received a 20 l 3 Environmental Quality Award, the highest public award given by US EPA for demonstrated outstanding commitment to protecting and enhancing environmental quality and public health.

Seneca Lake was added to CSLAP in 1992, with regular monitoring coordinated through the 1990's. SLPWA and the Community Science Institute have begun synoptic sampling annually as of 2013.

2.3.3 Finger Lakes/Lake Ontario Watershed Protection Alliance (FL-LOWPA)

FL-LOWPA is comprised of county representatives from multiple disciplines and agencies, including Soil and Water Conservation Districts, Planning and Health Departments, and Water Quality Management Agencies. Governed by a Water Resources Board made up of appointees from its member counties, FL-LOWPA's purpose is to protect and enhance water resources by promoting the sharing of information, data, ideas, and resources pertaining to the management of watersheds in New York's Lake Ontario Basin; fostering dynamic and collaborative watershed management programs and partnerships; and emphasizing a holistic, ecosystem-based approach to water quality improvement and protection.[44]

A major tenet of FL-LOWPA is grassroots programming. Water quality problems are defined and solutions are developed and implemented at the local level. Through participation in the Alliance, member counties develop a more regional perspective that informs local programming and encourages cooperation.

2.3.4 Genesee/Finger Lakes Regional Planning Council (G/FLRPC)

Regional Planning Councils are established pursuant to New York State General Municipal Law to address regional issues and assist with local planning efforts. The Genesee/Finger Lakes Regional Planning Council supports watershed planning in the Seneca Lake watershed directly through the acquisition of funding sources for specific projects as well as indirectly through its ongoing land use and water resources planning projects that are active across its nine-county region. These programs encompass a variety of services which advance the overall goal of protecting and improving water quality and quantity. As a regional agency, G/FLRPC is able to effectively examine and coordinate water resource issues at a watershed scale.

2.3.5 Genesee Transportation Council (GTC)

Genesee Transportation Council is the designated Metropolitan Planning Organization (MPO) responsible for transportation policy, planning, and investment decision making in the Genesee-Finger Lakes Region. The U.S. Department of Transportation (USDOT) requires every metropolitan area with a population of over 50,000 to have a designated MPO to qualify for the receipt of federal highway and transit funds. These highway funds can be a significant share of funding for transportation improvement projects in the watershed, such as road and bridge maintenance or construction. All GTC activities are responsive to mandates and guidelines including, but not limited to, the Americans with Disabilities Act, Clean Air Act Amendments of 1990, Title VI of the Civil Rights Act of 1964, and environmental justice considerations.

2.3.6 The Nature Conservancy (TNC)[45]

The TNC's mission is to preserve the plants, animals and natural communities that represent the diversity of life by protecting the lands and waters they need to survive. Their Central & Western New York Chapter works in eight priority conservation landscapes. They have protected nearly 100,000 acres of landscapes throughout Central and Western New York.[46]

2.3.7 Western New York Land Conservancy (WNYLC)[47]

The Western New York Land Conservancy is a non-profit land trust devoted to long term conservation of important natural lands including farms, scenic areas and habitats. WNYLC has protected over 4,300 acres of land in their eight county target area.

2.3.8 Center for Environmental Information (CEI)[48]

The Center for Environmental Initiatives is a non-profit organization that works for environmental protection and enhanced quality of life. CEI educates and builds partnerships with stakeholders, and works to identify environmental issues, and develop potential solutions through projects and initiatives.

2.3.9 Academic Institutions

Regional academic institutions have played an important role in watershed planning and management in the watershed. Independent research conducted by environmental science, geology, biology and other similar departments at regional colleges and universities has significantly advanced the knowledge base within the watershed. The Finger Lakes Institute at Hobart and William Smith Colleges and Cornell University have each focused research effort and expertise specifically on the Seneca Lake watershed. Academic institutions will continue to be important watershed stakeholders playing a vital role in information gathering and analysis.

2.3.9.1 Finger Lakes Institute, Hobart and William Smith Colleges

The Finger Lakes Institute promotes environmental research and education about the Finger Lakes and surrounding environments. In collaboration with regional environmental partners and state and local government offices, the Institute helps further environmentally-aware development practices throughout the region, and disseminates that information to the general public. Hobart and William Smith Colleges, particularly the Department of Geoscience & Environmental Studies Program, are very active in the watershed, conducting various water quality and quantity monitoring studies in support of a variety of short- and long-term projects and programs. Among them are John Halfman's semi-annual *Water Quality of Seneca Lake* reports,[49] the aforementioned *Seneca Lake Watershed Management Plan Characterization and Subwatershed Evaluation,*[50] and many other studies on the limnology, hydrogeochemistry, and ecology of the Finger Lakes system.

2.3.9.2 Cornell Cooperative Extension[51]

Cornell Cooperative Extension (CCE) extends Cornell's land-grant programs to every county in the state. They seek to conserve and ensure the quality of water supplies, promote environmental stewardship and community, agricultural and residential environmental enhancement, and enhance science education. CCE can be an important collaborator with water quality research, education and outreach.

2.3.9.3 NYS Water Resources Institute at Cornell University[52]

The New York State legislature established the New York State Water Resources Institute at Cornell University in 1987 to address critical problems of water resource quality and management. The WRI's mission is to connect the water research and water management communities. They undertake specific projects in support of state agencies, particularly the development of assessment methodologies and criteria for guidance or standards for use in management and regulatory programs, including technical and scientific consultation with and briefings for state agencies concerned with water resources management and regulatory affairs. The WRI Water Infrastructure Annotated Reference List is attached as Appendix B.

2.4 County Governments

County governments have a large stake in the management of watershed resources. Protecting the public's health and safety through flood and hazard management and the maintenance or monitoring of regional water quality are important responsibilities that a number of county departments and divisions share. Flood monitoring and control also has direct implications for the protection of public infrastructure, such as roads, bridges and other forms of public property which may cross or lie within a floodway.

2.4.1 County Health Departments

County Health Departments manage and regulate county sanitary codes and are responsible for on-site wastewater treatment systems. Sanitary codes vary by county, thus some have more strict regulation, inspection and enforcement than others.

2.4.2 County Water Quality Coordinating Committees (WQCC)

WQCCs identify water quality problems, identify funding opportunities, and create and implement programs to reduce nonpoint source water pollution and improve water quality and water resources. The committees are made up of county and municipal representatives as well as agencies and organizations related to water quality.

2.4.3 Rural Stormwater Coalition of Chemung, Schuyler and Steuben Counties[53]

The Rural Stormwater Coalition of Chemung, Schuyler and Steuben Counties was formed in December 2007 with the goal for a regional approach to stormwater management. The Water Quality Coordinating Committees, the Soil & Water Conservation Districts of Chemung, Schuyler and Steuben Counties, as well as the Southern Tier Central Regional Planning & Development Board assist local agencies and municipal representatives focusing on stormwater management issues. They work across Chemung, Schuyler, Seneca, Steuben and Yates Counties with Stormwater Pollution Prevention Plan (SWPPP) review, construction site inspections, training, and formal complaint investigation.

2.4.4 Schuyler County Watershed Protection Agency

The Watershed Protection Agency (WPA) is an agency within the Public Health and Community Services Agency of Schuyler County. Created in 1973 by the Schuyler County Legislature as an offshoot of the County Watershed Protection Law, the agency works cooperatively with the NYS Department of Health Hornell District Office, local code enforcement officers, NYS Department of Environmental Conservation, and other local organizations. They run the Water Supply Protection Program, provide water quality monitoring services, conduct property transfer inspections, further public watershed knowledge, and are a valuable local resource for environmental health issues.

2.4.5 County Soil and Water Conservation Districts (SWCDs)

Soil and Water Conservation Districts (SWCDs) within each county play a critical role in the management of natural resources and agricultural activities in the watershed. SWCD activities are guided through the leadership of the New York State Soil and Water Conservation Committee which works closely with the New York State Department of Agriculture & Markets. The mission of the New York State Soil and Water Conservation Committee is to develop and oversee implementation of an effective soil and water conservation and agricultural nonpoint source water quality program for the State of New York that is implemented primarily through county Soil and Water Conservation Districts.[54]

The County SWCDs implement a number of local conservation and agricultural nonpoint source pollution control programs. One of these is the Agricultural Environmental Management (AEM) program, which consists of planning and implementation of agricultural Best Management Practices (BMPs) on local farms. SWCDs in the watershed also played an important role in applying for funding and implementing projects related to erosion and sediment reduction, streambank remediation, and nonpoint source pollution control.

2.4.6 County Planning Departments and County Planning Boards

Counties can affect land use on a more limited basis through County Planning Board review of certain municipal zoning and development actions that may have countywide impacts. These reviews, conducted pursuant to Section 239 of New York State General Municipal Law, are often referred to as "239 reviews." [55] County Planning departments usually act as staff to the County Planning Boards, and also offer technical assistance and information regarding land use and related planning issues to municipalities.

2.5 Local Government

In New York State, municipalities have significant land use powers that can be used to effectively address a wide variety of environmental issues. The comprehensive plan, zoning, and a host of tools such as site plan review, subdivision regulation, erosion and sediment control ordinances, and special use permits can be used separately or in combination to produce the desired environmental outcomes in a community.[56] We address these tools in the Section 4: Recommended Regulatory Tools and Best Management Practices.

SECTION 2.0 ENDNOTES

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3.0 Overview of Local Laws, Plans, Programs, and Practices

3.1 Method

This section provides an inventory of laws, plans, programs, and practices in effect in counties and municipalities in the Seneca Lake watershed. The assessment is intended to determine gaps between present laws/practices and model best management practices (BMPs).

3.1.1 Setting

Seneca Lake is the largest of the eleven Finger Lakes, a complex system of lakes and rivers in central New York State known as the Oswego River Basin. The Oswego River Basin has an area of 5,100 square miles and drains the hills and valleys of the Finger Lakes into the Oswego River, which flows north into Lake Ontario.[57] Seneca Lake holds half of the water contained in all eleven of the Finger Lakes.

3.1.2 Municipalities

The Seneca Lake watershed overlaps portions of 40 municipalities, located within five counties. Chemung, Ontario, Schuyler, Seneca and Yates Counties surround Seneca Lake (Fig. 6):

Chemung County

- Towns of: Catlin, Horseheads, Veteran
- Villages of: Horseheads, Millport

Ontario County

- City of: Geneva
- Towns of: Geneva, Gorham, Phelps, Seneca

Schuyler County

- Towns of: Catharine, Cayuta, Dix, Hector, Montour, Orange, Reading, Tyrone
- Villages of: Burdett, Montour Falls, Odessa, Watkins Glen

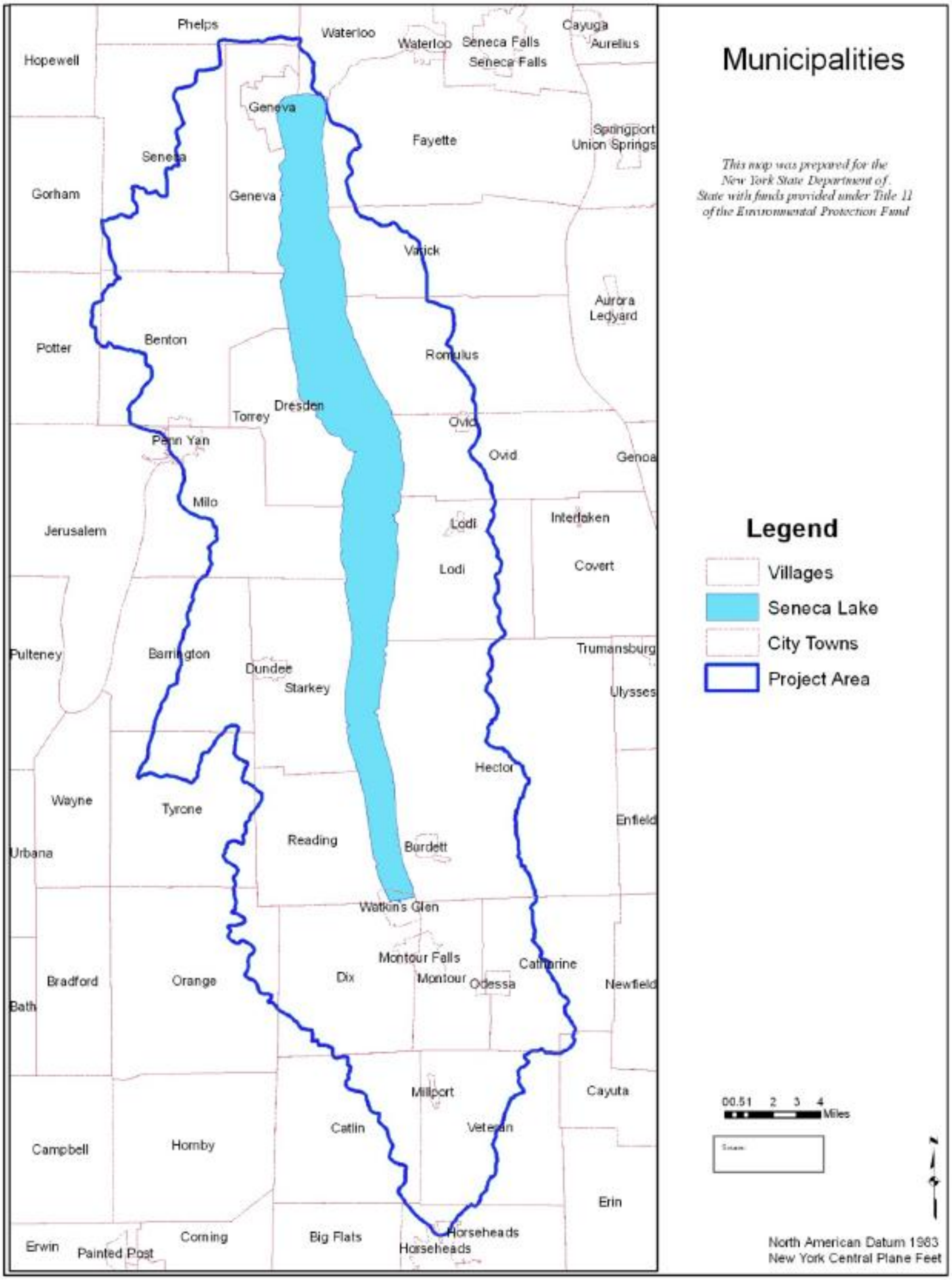
Seneca County

- Towns of: Fayette, Lodi, Ovid, Romulus, Varick, Waterloo
- Villages of: Lodi, Ovid

Yates County

- Towns of: Barrington, Benton, Milo, Potter, Torrey, Starkey, Jerusalem
- Villages of: Dresden, Dundee, Penn Yan

Figure 3.1: Municipalities of the Seneca Lake Watershed



3.2 Inventory of Local Laws, Plans, Programs and Practices

Information for this section was gathered from a variety of sources including municipal laws, county planning databases, organizational websites, interviews and correspondence with representatives from municipalities, counties, and organizations involved in water quality.

Below is a list of the types of laws and plans that were included in the assessment:

- Zoning laws
- Site plan review
- Subdivision regulations
- Planned unit developments (PUDs)
- Excavation and fill regulations
- Drainage and watercourse regulations
- Stormwater management regulations/plans
- Construction regulations for stormwater management
- Post construction regulations for stormwater management
- Illicit discharge laws
- Animal waste storage facility laws
- Erosion and sediment control laws
- Flood damage prevention laws
- Floodplain overlay regulations
- Wetlands regulations
- Sanitary codes
- Utility (water and sewer) regulations
- Comprehensive/Master plans
- Open space plans
- Smart growth plans
- Agriculture/farmland protection plans

BMPs related to practices and programs were updated through online research, interviews and information provided from:

- Cornell Cooperative Extension
- County Planners
- County Highway Departments
- County SWCDs
- County Health Departments
- County Water Quality Coordinating Committees (WQCC)
- Finger Lakes Institute
- Finger Lakes Lake Ontario Watershed Protection Alliance (FLLOWPA)
- Municipal Highway Departments
- Regional Planners
- Rural Stormwater Coalition of Chemung, Schuyler and Steuben Counties
- Seneca Lake Area Partners in 5 Counties (SLAP-5)
- Seneca Lake Pure Waters Association
- Seneca Lake Watershed Plan Advisory Committee
- Water Education Collaborative

As summarized in Table 3.3 below, Chemung, Ontario, and Schuyler Counties each has its own farmland and agricultural protection plan in place, with Seneca and Yates Counties currently in process. Farmland and agricultural protection plans are created pursuant to 1 NYCRR Part 372 of the New York State Agriculture and Markets Law. Such plans are required to include a statement of the county's goals with respect to agricultural and farmland protection, identify any lands or areas that are proposed to be protected, and describe the strategies intended to be used by the county to promote the maintenance of lands in active agricultural use.

Table 3.3 also provides a brief overview of the role of county health departments in monitoring of on-site wastewater treatment systems (septic systems). Sections 347 and 308 of NYS Public Health Law give county boards of health the authority to enact regulations for protection of public health. Each county within the study area has a Department of Health which performs or requires new on-site wastewater treatment system inspections at the time of new construction; Genesee, Orleans, and Wyoming Counties require inspections at the time of property transfer as well. It is important to note, however, that the specific requirements associated with individual inspection of on-site septic systems vary significantly from county to county.

Table 3.1: Summary of Selected County Plans and Regulations

	Farmland and Agricultural Protection Plan	Dept. of Health On-site Wastewater Treatment System Inspection		Hazard Mitigation Plan
		Inspection for new construction	*Inspection at time of refinance or property transfer**	
Chemung County	2011	Yes	No	Yes
Ontario County	2000, update in progress	Yes	Yes	In progress
Schuyler County	2008	Yes	Yes	Yes
Seneca County	In progress	Yes	Yes	Yes
Yates County	In progress	Yes	Yes	Yes

** For refinancing, inspections are typically performed upon request from the lending institution*

Each county has developed or is in the process of developing a multi-jurisdictional "all-hazard" mitigation plan which operates under a five-year mandatory review cycle.[58] These plans typically include a detailed characterization of natural and man-made hazards in the county (such as flooding risk or hazard materials risk); a risk assessment that describes potential losses associated with the hazards; a set of goals, objectives, strategies and actions that will guide the county's hazard mitigation activities; and a detailed plan for implementing and monitoring the plan.

A full review and comparison of county inspection procedures is included in Section 5 of this report.

3.2.1 Municipal Plans and Regulations

As illustrated in Table 3.1 below, an inventory of the local regulatory environment indicated that each municipality within the watershed has zoning and some form of comprehensive plan in place. The majority of municipalities have a host of additional supplemental regulations in place that are intended to lessen the impacts of land development on the natural environment or to decrease risks to the health and safety of residents.

As with county plans and regulations, a more in-depth review and analysis of the local regulatory environment will take place under subsequent tasks associated with this watershed planning project in an effort to identify and elucidate the effectiveness of these local laws with respect to water quality and natural resource protection.

Table 3.2: Summary of Local Land Use Regulations Among Municipalities in the Seneca Lake Watershed[59]

	Comprehensive Plan	Zoning	Site Plan Review	Subdivision Law	Planned Unit or Cluster Development	Erosion/ Sediment Control Law	Flood Damage Prevention
Town of Barrington	2009	2003	Yes	2013	Yes	No	No
Town of Benton	2001	2008	Yes	2008	Yes	Yes	1989
Village of Burdett	No	No	No	No	No	No	No
Town of Catharine	No	2012	No	1997	No	No	1989
Town of Catlin	No	1999	1999	1999	1999	1999	1987
Town of Cayuta	No	No	No	No	No	No	No
Town of Dix	2001	2006	Yes	Yes	Yes	No	No
Village of Dresden	2004	2008	Yes	Yes	Yes	No	Yes
Village of Dundee	1969	1975	Yes	1975	No	No	No
Town of Fayette	2006	2008	Yes	2008	Yes	No	Yes
City of Geneva	1997	1968	Yes	1968	Yes	No	1987
Town of Geneva	2006	1972	Yes	1990	Yes	1997	1997
Town of Gorham	2009	2013	Yes	2006	Yes	1991	1996
Town of Hector	2001	No	No	No	No	No	No
Town of Horseheads	1971	1982	Yes	1995	Yes	2005	1996
Village of Horseheads	2010	2007	Yes	No	No	2008	1996
Town of Jerusalem	2006	2012	Yes	2009	No	No	No
Town of Lodi	No	No	No	No	No	No	Yes
Village of Lodi	No	No	No	No	No	No	Yes
Village of Millport	No	2005	No	No	No	2007	1999
Town of Milo	2009	2012	Yes	2007	No	No	1997
Town of Montour	2007	2008	Yes	No	Yes	No	No
Village of Montour Falls	2007	2010	Yes	2010	No	No	1993
Village of Odessa	No	2005	Yes	No	Yes	Yes	No
Town of Orange	2012	No	Yes	No	No	No	No

	Comprehensive Plan	Zoning	Site Plan Review	Subdivision Law	Planned Unit or Cluster Development	Erosion/ Sediment Control Law	Flood Damage Prevention
Town of Ovid	In progress	No	No	No	No	No	No
Village of Ovid	No	No	No	No	No	No	No
Village of Penn Yan	2000	2004	Yes	1990	Yes	No	No
Town of Phelps	2007	2012	Yes	Yes	Yes	No	No
Town of Potter	1979	2012	Yes	2011	No	No	No
Town of Reading	1993	No	Yes	No	No	No	No
Town of Romulus	2001	2006	Yes	2012	Yes	Yes	No
Town of Seneca	2013	2008	Yes	2010	No	No	Yes
Town of Starkey	1969	2009	Yes	1997	No	No	2003
Town of Torrey	2008	2011	Yes	2013	2008	No	Yes
Town of Tyrone	2004	No	No	2008	Yes	No	No
Town of Varick	2006	2010	Yes	2007	No	No	No
Town of Veteran	2004	1983	Yes	2002	No	2008	2008
Town of Waterloo	2000	2011	2011	No	No	No	Yes
Village of Watkins Glen	1993	2007	Yes	No	No	Yes	No

Section 3.0 Endnotes

[57] *Seneca Lake Watershed Study: Setting a Course for Seneca Lake.* 1999. Ch. 3. http://www.gflrpc.org/Publications/SenecaLakeWMP/chap3.pdf

[58] Federal authorization to prepare a countywide all-hazard mitigation plan comes from the Disaster Mitigation Act of 2000 and 44 CFR (Code of Federal Regulations, Title 44). These regulations provide a mandate directing local governments to assess the potential dangers posed by natural hazards to their communities and propose cost effective means of reducing/eliminating the threats posed by those hazards. Hazard mitigation planning programs are strongly encouraged and supported by the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1974, known as the Stafford Act (PL 93-288, as amended) and New York State Executive Law Article 2B: State and Local Natural and Man-Made Disaster Preparedness.

[59] Year indicates the year that the law was originally adopted; amendments have often been made since this date. "Ecodes" are those made available online through the General Code website. General Code is an independent, for-profit service; it is assumed that the municipality provides the company with appropriate updates to their code on a regular basis. An entry of 'unk' indicates that the municipality's code was not available in its entirety at the time of review; it is therefore unknown whether the component exists. Municipalities listed as a "Regulated MS4" are required to have an erosion and sediment control law in place as per state and federal law.

4.0 Recommended Regulatory Tools and Best Management Practices

4.1 Methodology

Recommended regulations and practices discussed in this section are based upon a number of sources of best management practices (BMPs) and models, along with the information collected in the Assessment. The Assessment was used both to determine gaps in certain municipal laws and programs and to find good examples in others.

Priority focus areas included:

- Development-related land use tools – zoning, site plan review, subdivision regulations (amount of vegetation, impervious surfaces, etc.)
- Stormwater regulations, including MS4 regulations and suggestions for non-MS4s
- Stream corridor protections
- Riparian buffers – vegetated areas, additional setbacks
- Floodplain protections and increased restrictions on use and site changes
- Wetlands
- Agricultural issues – setbacks, manure storage, etc.
- Erosion and sediment

Recommendations are given for all municipalities that were reviewed as a set of next steps that can be taken. These are based on priority issues and do not include every possible way to improve water quality. Many BMPs and recommendations are applicable to more than one county or municipality; as such, these are included throughout this section. Detailed recommendations specific to counties and municipalities, respectively, are based on their unique assessments and needs and located in Section 5: Recommendations for Local Laws, Plans, Programs, and Practices.

4.2 Land Use Tools

The Constitution of the State of New York specifies that the primary authority for guiding community planning and development is vested in cities, towns and villages. This authority is commonly referred to as "home rule" and is implemented locally through the creation of comprehensive plans, zoning, site plan review, and subdivision standards. Counties are also vested with certain powers and capacities to guide development and act as a steward of resources within its borders.

These building blocks of land use control and planning also help establish water quality controls, either directly or indirectly.

4.2.1 Comprehensive Plans

Comprehensive plans are strategic documents that set out the broad goals and vision of a community. The plan should reflect current conditions and issues of the municipality, where the community would like to be, and how to reach those goals. The plan should be developed with widespread citizen input and put in writing by the land use decision makers in a community (planning board, zoning board of appeals, conservation board, code enforcement officer, planner, municipal board, and elected officials). While the planning board or planning department staff may prepare the plan, by law the comprehensive plan must be adopted by the local legislative body after public hearing.

A comprehensive plan should identify the type and intensity of development to be accommodated. A comprehensive plan which is too generalized may not serve to effectively guide future development. Municipalities should ensure that their comprehensive plans – at minimum – list watershed management and related topics such as water quality, stormwater management, and erosion and sediment control as municipal priorities. Prioritizing these issues is a good starting point, and justifies the need to expand related local laws and practices.

Some communities in New York may not have comprehensive land use planning processes; for those that do, there is often no link between the land use plan and water quality protection and planning. Water is currently regulated through a patchwork of federal and state laws, yet the future of water resource management will likely require a more holistic approach to how we deal with drinking water, wastewater and stormwater runoff. Communities should seek initial funding to update their comprehensive plan in order to be eligible for a host of water-related programs – which consider smart growth, green infrastructure, and sustainability in funding decisions – regardless of MS4 status. For assistance in developing a comprehensive plan, see *Protecting Water Resources through Local Controls and Practices* Appendix E1.[60]

4.2.2 Zoning

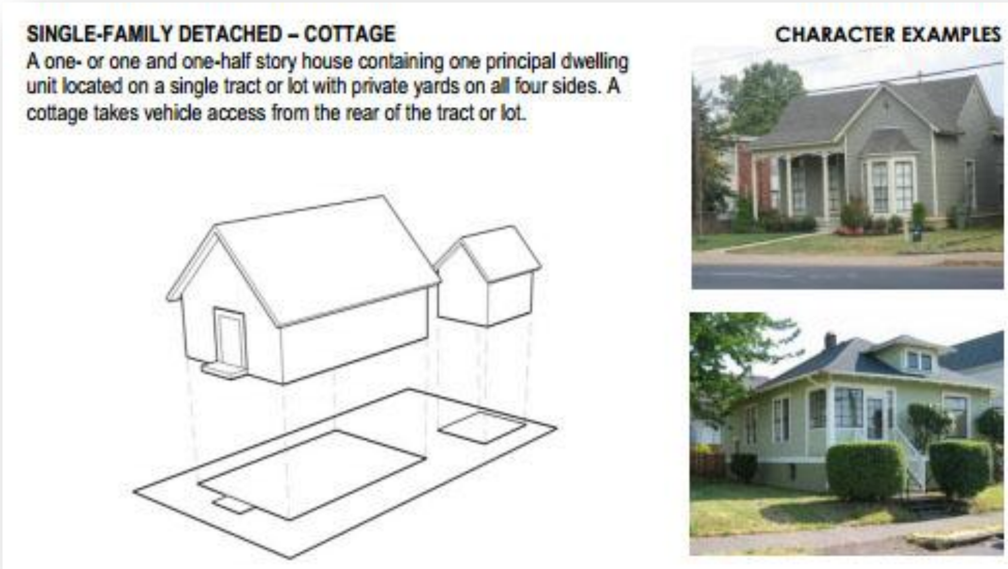
To help make the leap from planning to zoning to implementation and enforcement, zoning laws should concisely implement the purpose and intent laid out in the comprehensive plan. Zoning can regulate the use, form, siting, and character of development on individual land parcels. Zoning is most effective in preventing future issues with development or harmful uses. While an existing use or form is generally grandfathered, after the use or building is abandoned for a certain amount of time new regulations are enforceable; non-conforming use is lost through abandonment, typically defined by local zoning law. These regulations also have power to prevent a property owner from expanding a use or building when they are non-conforming in the new zone.

Encouraging development within or adjacent to already developed areas limits the amount of required infrastructure expansion and often results in the preservation of open space in outer lying areas. Zoning for adaptive reuse development encourages the redevelopment of vacant or underutilized structures. Consider increasing the allowable uses in a zone or zoning by form rather than use. One way to accomplish this is to allow for Mixed-Use zoning, especially in village downtowns and infill areas.

Consider the costs of not implementing these practices; smart growth saves an average of 38 percent on upfront costs for new construction of roads, sewers, water lines and other infrastructure.[61] These measures save municipalities an average of 10 percent on police, ambulance, and fire service costs and generates 10 times more tax revenue per acre than conventional suburban development. The geographical configuration of a community and the way streets are connected significantly affect public service delivery. Smart growth patterns can reduce costs simply by reducing the miles service vehicles must drive. The savings on services in rural areas are much higher, as much as 75 to 80 percent.[62]

A form-based zoning code can be limited to verifiable building form characteristics such as setbacks, yard types, building height and massing, frontage size and lot coverage. For example, a municipality can mandate that all buildings be of a similar height to fit in with the character of a neighborhood without exhaustive architectural design standards such as the size of windows or facade details.[63]

Including graphics, such as the following example of expected development form and character, help make zoning easier for everyone to use and understand:



4.2.2.1 Overlay Districts

An overlay district is a zoning technique that selects natural or cultural areas of the municipality based on criteria such as main street retail areas, historic districts, scenic views, steep slopes, wetlands, woodlots, or riparian areas. As the name suggests, these districts overlay the underlying zoning designation (such as commercial, residential, etc.). The underlying zoning, and all of its regulations, remain in place. The overlay district simply adds another set of regulation processes to help protect sensitive areas.

An Environmental Protection Overlay District (EPOD) could be utilized to restrict uses with large impacts on the water. This could also include development setbacks, vegetative buffers, etc. Current allowable uses should be grandfathered in to the law as still allowable. As non-conforming uses are abandoned, properties will be required to comply with the buffer regulations. These non-conforming grandfathered uses will come into compliance over time.

Active River Areas

River health depends on a wide array of processes that require dynamic interaction between the water and land through which it flows. The areas of dynamic connection and interaction provide a frame of reference from which to conserve, restore and manage river systems. The active river area framework offers a more holistic vision of a river than solely considering the river channel as it exists in one place at one particular point in time. Rather, the river becomes those lands within which the river interacts both frequently and occasionally. The active river area (ARA), therefore, is a critical zone in which watershed restoration and protection efforts should be focused.

The Nature Conservancy developed this approach to address river health in areas directly adjacent to streams. The ARA framework can be used as a tool to inform conservation, restoration and management of riparian areas and entire watersheds.[64] Municipalities should utilize the Active River Area method to determine the area of land most important to target to protect water quality through practices and programs. Many of the regulatory tools and best management practices outlined here could be targeted toward the active river area. The Active River Area can be prioritized in laws and practices, such as a zoning overlay district based on the five components of the ARA: material contribution areas; the meander belt; floodplains; terraces; and riparian wetlands.

4.2.3 Site Plan Review

Site plan review addresses the layout and design of development on a single parcel of land. It is commonly considered supplemental to other land development guidance controls and is usually included within a community's zoning law. Yet it is a critical planning tool for identifying and addressing drainage, erosion control, amount of impervious cover, vegetation, and other stormwater mitigation measures. This is often the easiest place to add watershed protections because the law and review system are usually already in place, and just need to be expanded slightly. The site plan review process allows for greater municipal scrutiny and application of intent for certain land uses and/or structures. Some examples of intent may include:

- Promoting environmental sustainability in new development and redevelopment
- Preserving and enhancing neighborhood character
- Achieving compatibility with adjacent development and uses
- Improving the design, function, aesthetics, and safety of development projects and the overall visual and aesthetic quality of the city/town/village
- Mitigating potentially negative impacts on drainage and the landscape
- Removing or reducing minimum parking requirements, reducing the size of parking spaces, and developing parking lot design standards that include grass areas, filter strips, bioswales, and other types of biofilers for capturing runoff
- Encouraging creative shared parking options between uses with non-competing peak use periods[65]
- Limited site plan reviews for small projects can be conducted at an administrative level by a staff planner or zoning code administrator
- Site plan approvals conditional on other permits and approvals, such as Stormwater Pollution Prevention Plans (SWPPP) and building permits

A site plan should show the existing and proposed conditions, including topography, vegetation, drainage, floodplains, marshes, wetlands, and waterways; open spaces, walkways, means of ingress and egress, utility services, landscaping, structures and signs, lighting and screening devices; submitted along with building plans, elevations and building materials; and any other information that may be reasonably required to allow an informed decision to be made by a planning board.

One approach that begins to address the integration of sustainable policies with proposed development is the concept of Better Site Design (BSD). Better site design incorporates non-structural and natural approaches to future development projects to minimize effects on watersheds by conserving natural areas, reducing impervious cover and improve application of stormwater treatment. The DEC's Handbook on Better Site Design[66] includes easy-to-follow tables and checklist for applying these practices. Green Infrastructure, also known as Low Impact Development, such as Bioswales (roadside ditches) and bioretention areas (sunken gardens), French drains (retention trenches) and brick and cobblestone streets (pervious pavers) are old technologies given new life. Some of the best practices in Green Infrastructure were developed by the USDA's Soil Conservation Service in the wake of the Great American Dust Bowl.[67]

New residential development guidelines for the design, planting, and maintenance of trees may include certification by a Registered Landscape Architect and the use of structural soils, such as CU-Soil™, which helps trees get established and grow to fuller crowns while also assisting in stormwater management. A number of relevant publications are available from the Urban Horticulture Institute at Cornell University.[68]

Site plan review should include:

- Preservation of open space, natural features, vegetation and trees
- Landscape elements, including grass areas, filter strips, and bioswales
- Live plant materials and maintenance schedule, including protection of existing mature vegetation, especially trees over eight inches DBH (diameter-breast-height)
- Percentage of open space based on the size of the development parcel(s)
- Minimization of impervious surfaces and the use of permeable materials such as porous asphalt and structural soil
- Plan compliance with New York Standards and Specifications for Erosion and Sediment Control especially Appendix G – Sample Checklist for reviewing Erosion & Sediment Control Plans[69]
- Construction plan, including haul route, staging area, and runoff management strategy

Development should be limited in key areas such as riparian buffers, wetlands, floodplains, Active River Areas, etc. The Board should seek advice from County SWCD, especially on proposals disturbing over one acre, as well as those located near sensitive areas such as steep slopes, high erosion areas, wetlands, floodplains, etc. Input from County Environmental Management Councils (EMCs) and municipal Conservation Advisory Councils (CACs) and Conservation Boards can assist with taking inventory of natural features of the landscape to identify those locations that are important to preserve and protect. A thorough urban/suburban site plan review model can be found in the City of Ithaca[70]; a rural model can be found in the Town of Ithaca.[71]

4.2.4 Subdivision of Land

Subdivision regulations control the manner by which land is divided into smaller parcels of land. While zoning and subdivision control are entirely separate and distinct parts of the planning implementation process; used together they result in well-ordered, environmentally-aware development. Subdivision regulations ensure that when development occurs, streets, lots, open space and infrastructure are adequately designed and the municipality's land use objectives are met. Aspects of subdivision regulation that many municipalities find useful include: distinction between major and minor subdivision; timeline for subdivision of land; a three-stage process (conceptual plan, preliminary plan, final plan) for review; and the ability for the municipality to charge the applicant for expenses incurred as a result of retaining outside consultants.

These and other features should be integrated into a concise, easy-to-understand subdivision law. Used correctly, the subdivision law is a key tool used to implement the objectives of the comprehensive plan. Subdivision regulations can be used to limit the negative impacts development can have on waterbodies before during and after the construction period. Approval can be contingent on additional requirements such as:

- Preservation of natural features, trees, and vegetation
- Conservation of imperiled species, ecological communities, and unique natural areas
- Agricultural land conservation
- Floodplain avoidance
- Minimization of the creation of impervious areas / encourage permeable surfaces
- Limit parking footprint to no more than 20% of the total development footprint area for all new off-street surface parking facilities, with no individual surface parking lot larger than 2 acres[72]
- Pre-construction, construction, and post-construction
- Site protections to minimize erosion and runoff (retaining vegetation, sediment fencing, etc.)
- Clustered subdivision

Under Section 278 of New York State Town Law, towns have the authority to mandate clustered subdivisions. A subdivision is considered a cluster subdivision when lots and dwelling units are clustered closer together than in a conventional subdivision; open space is created on the remainder of the property without increasing density for the tract as a whole. This can be an effective way to preserve open space, while not reducing the total number of development units. Clustered subdivisions allow developers to reduce minimum lot sizes and increase density if they preserve an appropriate portion of the proposed development as open space, identified by important agricultural soils, water bodies, and conservation of open space. They allow for a range of lot sizes, building densities, and housing choices to accommodate a variety of age and income groups. Clustered development also has fiscal benefits; clustering requires less road and sewer infrastructure and lowers ongoing public safety operations and maintenance costs. For subdivisions from a few acres up to 320 acres (1/2 square mile) in size, municipalities may consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to holistically tie together development siting, street design, development of pedestrian linkages, stormwater management, green infrastructure and building design, and other performance standards. These standards can be applied to infill development as well. The 2013 *Technical Guidance Manual for Sustainable Neighborhoods* is available from the US Green Building Council.[73]

4.3 Stormwater and Erosion Management

Once water runs off of private property, it tends to become the problem of the municipality. Roads, buildings, parking, sidewalks, and driveways all increase runoff from rain events and snow melt. Stormwater runoff contains pollutants such as nutrients, pathogens, sediment, toxic contaminants, and oil and grease. Water quality problems generated by these pollutants have resulted with waterbodies such as lakes and streams having impaired or stressed uses. Impervious surfaces such as roofs, driveways, and parking lots may be regulated by municipalities through zoning and subdivision regulations and the site plan review process. In addition, poorly designed or maintained public drainage infrastructure (such as ditches) can cause erosion, which leads to sedimentation of waterways. Not only a significant cause of nonpoint source pollution, sedimentation can increase costs to municipalities in terms of ditch and storm drain cleaning.

To address these local concerns, federal stormwater regulations commonly known as "Stormwater Phase II" require "urbanized area" municipalities to develop a Small Municipal Separate Storm Sewer System (MS4) management program. To prevent harmful pollutants from being washed or dumped into an MS4, operators must obtain a NPDES (National Pollutant Discharge Elimination System) permit and develop a stormwater management program. Pursuant to Section 402 of the Clean Water Act, stormwater discharges from certain construction activities are unlawful unless they are authorized by a NPDES permit or by a state permit program. New York's SPDES (State Pollutant Discharge Elimination System) is a NPDES-approved program with permits issued in accordance with New York's Environmental Conservation Law. Municipalities can use the EPA's MS4 maps to determine whether their jurisdiction is located in the 2010 urbanized area where the MS4 program would apply.[74]

MS4 municipalities should continue strict implementation and enforcement of Stormwater Phase II requirements as a top priority. Any municipalities not currently in compliance should make this their top priority. Listed below are the six minimum control measures (MCMs) that operators of regulated small MS4s must incorporate into stormwater management programs:

- MCM 1: Public Education and Outreach
- MCM 2: Public Involvement and Participation
- MCM 3: Illicit Discharge Detection and Elimination
- MCM 4: Construction Site Runoff Control
- MCM 5: Post-Construction Runoff Control
- MCM 6: Pollution Prevention and Good Housekeeping

Municipalities are encouraged to participate in the Stormwater Coalition of Monroe County to foster the sharing of ideas. Ensure coordination between the Municipality and the County Soil and Water Conservation District for advice and recommendations on certain project proposals. Identify which group will be responsible for implementation of each minimum measure (Municipality, SWCD, etc.)

The New York State Smart Growth Public Infrastructure Policy Act (the Act) of 2010 requires the New York State Environmental Facilities Corporation (EFC) to determine that infrastructure projects meet relevant smart growth criteria in order to provide Clean Water State Revolving Fund financial assistance. Public infrastructure projects cannot use the CWSRF for land, including right-of-ways, unless that land is integral to the wastewater treatment process. Percolation of stormwater through the soil matrix is essential to the operation of green infrastructure practices, many of which can be conveniently located in public right-of-ways. This utilization of soil and plants in a right-of-way to clean and infiltrate stormwater allows the land in that right-of-way becomes integral to the treatment process and thus could be eligible for CWSRF funding.[75]

A Note for Non-MS4 Communities

Non-urbanized areas that are not required to follow MS4 Stormwater Phase II requirements should consider working toward voluntary compliance with some or all of the minimum measures to better manage stormwater and its potential effects. In many areas this work is already occurring through SWCDs and other groups though public outreach, education, and participation. Other strides could be made through adoption (or strengthening) local laws related to illicit discharge and runoff (MCMs 3, 4, and 5). A Sample Local Law for Stormwater Management and Erosion & Sediment Control prepared by NYSDEC is available in Appendix C.

More information sharing and collaboration between counties, municipalities, water quality groups and interested citizens could be beneficial. The Rural Stormwater Coalition (made up of Southern Tier Central Regional Planning, DEC, Chemung, Schuyler, and Steuben County agencies and non-MS4 municipalities) leverages funding through grants to create and distribute educational materials and conduct a variety of training programs for code enforcement officers, planning boards, zoning boards, highway departments, contractors, and the general public.

4.3.1 Public Education and Outreach

It is important to target the right groups for education opportunities to make efficient use of often scarce resources. It can be effective to aim and customize education and outreach strategies for different groups. Some groups can receive advanced training depending on their background, while others may benefit from brief introductory information. Three types of groups that might be considered for different outreach strategies could be government employees and decision makers, stakeholder groups, and the general public.

One of the biggest aims of the program is outreach: improving awareness of stormwater pollution sources and educating the public on how pollution gets into local waters. A 2005 report by the National Environmental Education & Training Foundation, *Environmental Literacy in America*[76], found that a large percentage of the public does not understand that runoff from agricultural land, roads, and lawns, is now the most common source of water pollution; nearly half of Americans believe industry still accounts for most water pollution. Many people don't recognize the fact that storm drains are connected directly to waterways or just don't think about it during their normal routine.

4.3.1.1 Government Employees and Decision Makers

This group includes planning and zoning boards, town/village boards, as well as code enforcement officers, zoning officers, highway department, public works employees and planners. Appointed and elected officials and employees should be trained both on the importance of improving water quality and the ways that they can have a positive effect through the use of their zoning code, approval of site plans and subdivisions, etc. Training is available on these and other topics at Genesee/Finger Lakes Regional Planning Council's Local Government Workshops. Held in the fall and spring each year, these events helps fulfill state law requiring training for local planning officials. Training is also available on a regular basis from the Department of State, as well as through counties, associations, and private entities.

In municipalities throughout New York, Conservation Advisory Councils (CACs) and Boards (CABs) serve as important advisory bodies to town boards, planning boards, and zoning boards of appeals. By providing a scientific perspective on site plan review, comprehensive plans, environmental ordinances, open space protection, and biodiversity conservation, CACs contribute to the preservation and improvement of the natural environment and quality of life for residents. Article 12-F, Section 239-x and 239-y of the State of New York General Municipal Law details how a city, town, or village can create a Conservation Advisory Council or Conservation Board to advise on the development, management, and protection of its natural resources and act as an environmental liaison to the public.

Employees such as highway department workers or code enforcement officials should receive education specific to their positions and should help further their knowledge of local laws and practices and why they are important to protecting the environment and water quality. Local Code Enforcement should coordinate and partner with SWCDs regarding inspecting requirements and enforcement; even if it's not the code enforcement officer's duty, they should be aware of regulations to report issues that they notice

County Soil and Water Conservation District employees often have a much greater depth of understanding of watershed issues, but additional advanced training related to best management practices and water quality implementation strategies can be very beneficial, especially since these groups are often involved in educating the other groups. Monroe County SWCD offers 4-hour E&SC courses for certain contractors (Trained Contractor) and certain Qualified Inspectors in addition to the Western New York Stormwater Management Training Series (offered in 2012 and 2013).

4.3.1.2 Stakeholder Groups

Groups that have a specific interest or mission related to water quality should be targeted for education. Expanding citizen stewardship becomes easier when tapping into the network of groups that work toward improved local management of water resources. Watershed committees, Water Quality Coordinating Committees (WQCCs), county Environmental Management Councils (EMCs), municipal Conservation Advisory Councils (CACs) and Conservation Boards, lake associations and other environmental groups usually already have a general understanding of issues and can be excellent at disseminating information to the general public. These groups are often filled with volunteers who are willing to strategize ways to educate others such as organizing outreach materials, attending and speaking at events and just generally sharing information with others. These organizations can facilitate education and public involvement activities that foster a citizen-based watershed ethic:

- SWCDs
- WQCCs
- Volunteer citizen educators
- Watershed Groups
- Region, County, and Municipal Planners
- Cornell Cooperative Extension

4.3.1.3 Public Educational Materials and Strategies

It is important to educate the public on issues that are affecting water quality and alert them of simple things they can do to positively affect certain water quality issues. Many people may be willing to make small changes if they knew their actions could have a positive impact on the environment and water quality. The public may also support municipal and county expenditures on programs and practices if they understood the importance of protecting water quality.

Targeting the public geographically is one option. The population of residents within a close geographic area of waterbodies can be a very important group to reach out to. The actions of these residents have the biggest direct impact on water quality due to their close proximity to the water body. This group may be more receptive toward water quality improvement concepts because they may appreciate the water body's recreational or aesthetic value and may benefit directly from it, and could, depending on the issue, relate water quality issues to their property value. This group should be targeted for education on simple household BMPs like those included in the H2O Hero campaign such as the use of or disposal of fertilizers, paints, pet waste, as well as septic system maintenance.[77] For example, information could be provided to restaurants on the effects of grease clogging storm drains and to auto garages on the effects of dumping used oil into storm drains.

Effective outreach materials are also interesting and accessible to children and included in places traditionally used for education. The Water Education Collaborative's H2O Hero campaign accomplishes this through information sharing with educational institutions and in school education programs. The H20 Hero could be marketed more extensively in existing target markets and be expanded into new markets.

Targeting key places that are important to protect for distribution of education materials can also be an effective strategy; storm drain labeling is a good example of this method. The storm drain markers inform residents that "anything that goes down a storm drain goes directly into a water body without being treated."[78] Placing recreational guides and outreach materials at parks and in kiosks along waterbodies can help connect recreational groups using the water and adjacent land such as boaters, marina owners, paddlers, and fishing and hiking groups. Setting up a booth at a water or park cleanup event can be effective in targeting people who are both interested in the health of the environment and are also willing to volunteer their time to make a difference. Storm drain stenciling and labeling was done in Schuyler County by the Soil and Water Conservation District with both the WQCC and Rural Stormwater Coalition in the Village of Watkins Glen, the Village of Odessa, and the Village of Montour Falls.

4.3.2 Public Participation and Involvement

Make sure a system is in place for the public to report any issues they see; this will help to point inspections and enforcement in the right direction. Evaluate potential expansion of monitoring efforts, such as monitoring and assessments for bacteria and emerging contaminants of concern.

4.3.2.1 Adopt a Storm Drain

"Adopt a Storm Drain" programs encourage individuals or groups to keep storm drains free of debris and to monitor what is entering local waterways through storm drains. A natural progression of this could be the recruitment of volunteer web developers and municipal information technology professionals to develop a real-time, mobile civic engagement platform to send reports on storm drains. Developed using open source software,[79] mobile reporting empowers residents to identify civic issues and report them right from their smartphone to the appropriate authority (SWCDs, town/city hall, etc.) for quick resolution. This allows government to use technology to save time and money plus improve accountability to those they govern; this acts as a positive, collaborative platform for real action. A number of municipalities have implemented this for public infrastructure; for instance, Boston's Adopt a Hydrant program[80] allows users to adopt a fire hydrant to shovel out after it snows.

4.3.3 Illicit Discharge Detection and Elimination

Illicit discharges enter the system through either direct connections (e.g., wastewater piping either mistakenly or deliberately connected to the storm drains) or indirect connections (e.g., infiltration into the MS4 leaching from septic systems, spills collected by drain outlets, or paint or used oil dumped directly into a drain). These untreated discharges contribute high levels of pollutants, including heavy metals, toxins, oil and grease, solvents, nutrients, viruses, and bacteria to waterbodies. Pollutant levels from these illicit discharges are high enough to significantly degrade receiving water quality and threaten aquatic, wildlife, and human health.

For MS4 communities, the first step in designing a program to publicize and facilitate public reporting of illicit discharges is to implement an ordinance or other regulatory mechanism that prohibits non-stormwater discharges into the MS4. It should also outline appropriate enforcement procedures and actions, including a plan to detect and address non-stormwater discharges, including illegal dumping, into the MS4 and education of public employees, businesses, and the general public about the hazards associated with illegal discharges and improper disposal of waste.

4.3.3.1 On-Site Wastewater Treatment Systems (OWTS)

The number one source of nonpoint source pollution in New York State is on-site wastewater treatment systems, and the average age of a septic system in Seneca Lake Watershed is 17 years.[81] Fortunately, septic system repairs are a lower-cost measure that can make a significant impact on water quality and health in this watershed. Over the last twenty years, technological advances have increased the level of treatment but also the complexity of design and operation. New York State Department of Health's (NYSDOH) Administrative Rules and Regulations for the design of residential onsite wastewater treatment systems (OWTS) apply to systems discharging residential wastewater flows of 1,000 gallons per day or less from year-round and seasonal dwellings.[82] New York State Department of Environmental Conservation (NYSDEC) standards under 6 NYCRR Part 750 applies to private, commercial, institutional, and residential wastewater system flows of over 1,000 gallons per day.[83] Each agency's standards have similar OWTS design options for residential OWTSs; however, for residential systems discharging over 1,000 gallons per day, NYSDEC's design standards and applicable permits apply.

Countywide and Watershed Methods

All of the Counties that make up the watershed have some regulations regarding on-site wastewater treatment systems, but many could be strengthened and improved. Details specific to each county can be found in within Section 5.0 of this report. Best practices, such as regular inspections, should be stated directly in law. Sewage disposal system failures can manifest in a number of ways over time and those failures can be very difficult to detect because the system is buried. Standard inspections, which are typically non-invasive, are not necessarily thorough enough to ensure that the system is functioning properly.

A model On-site Wastewater Treatment Law[84] was prepared by the Ontario County Planning Department. It includes requirements for inspection and permitting before construction or repair of OWTS. The Department of Health inspects and investigates when there are questions of public health and/or nuisances, and can require remediation. When public sewers are available and accessible, the commissioner may require properties with existing OWTS to abandon use and connect to public sewers. Setbacks of 200 feet from public drinking water sources are required for OWTS as well as storage of other unsanitary and or offensive materials.

Municipal Method

Counties may not have the capacity to take on the additional responsibility that comes with strengthening the onsite wastewater treatment regulations in their Sanitary Codes. Municipalities can take on this role by creating a local On-site Wastewater Treatment Law. The most important portions to include would be setting an inspection schedule and the requirement to repair, update, and replace systems that are failing. Permits should not be transferrable to different parties; rather, inspection and permitting should be done at property transfer. Additional updates could include the requirement to connect to public sewers when possible. These could vary depending on which county the municipality is located in, and what regulations/practices are already in place.

While most regulation of OWTS traditionally occurs at the state and county level, municipalities can also enact regulations to help mitigate some of the associated risks through their building permit and certificate of occupancy regulations.[85] The Town of Huron, New York, Septic Law, Local Law 1-2013,[86] written by environmental engineer and land use attorney Alan Knauf, can be easily calibrated for another New York State municipality. Huron, a community on Sodus Bay, requires specific controls for the design of private wastewater systems installed in the town's designated coastal zone and sets an inspection timetable for residential and commercial septic inspections; this ordinance can be found attached in Appendix D.

Important regulations to have in a septic law:

- Mandatory inspections at set time intervals or at certain specified points in time such as change of ownership, change in use or intensity of use
- Required compliance and or upgrades for failed inspection
- Requirement to connect to public sewers if available within a given distance
- Implement an onsite wastewater management system inspection program
- Require a minimum design flow of 150 gpd/bedroom for shoreline properties and 130 gpd/bedroom for all other properties
- Require a minimum depth of the absorption system following ATV or microbial inoculator generator of 2 feet depth of usable soil
- Require an inspection every 5 years for on-site systems within 200 feet of the lake and require all inspections to use the standardized On-site Training Network (OTN) inspection provided.

The Canandaigua Lake Watershed Inspection Program

The Canandaigua Lake Watershed Commission is an organization of the five municipalities – the City of Canandaigua, the Town of Gorham, the Village of Rushville, Village of Palmyra, and the Village of Newark – that withdraw and sell water from Canandaigua Lake. The Canandaigua Lake Watershed has over 4,200 OWTS that emit an estimated 1 million gallons of effluent into the soils of the watershed daily.[87] Together they've instituted a Lake Watershed Inspection Program that employs an inspector to conduct deep hole and percolation tests for OWTS placement, consultations for new construction and repairs of systems, reviews of building plans for suitability of OWTS, and inspections at the time of property deed transfer, and investigations of violations. They transmit the results of their Onsite Wastewater System Inspection Report[88] to the State Department of Health.[89]

Keuka Watershed Improvement Cooperative (KWIC)[90]

The collaborative method and inspection system used by KWIC joins the efforts of municipal officials from eight Keuka Lake towns and villages – Hammondsport, Penn Yan, Barrington, Jerusalem, Milo, Pulteney, Urbana, and Wayne – to ensure uniform regulations and enforcement of wastewater systems to protect the purity of the lake. KWIC was formed through an inter-municipal agreement in 1993 after more than a decade of discussion and debate and is widely considered to be a model of cooperation and pro-active wastewater management.

Two other collaborative models are Schuyler County's Lamoka-Waneta Lakes Wastewater Treatment Inspection Program, and the Otsego Lake Onsite Wastewater Management Program.[91] The New York Onsite Wastewater Treatment Training Network (OTN)[92] offers training on system design and maintenance, technological advances in OWTS and continuing education credits for engineers, architects, code enforcement officers, and wastewater operators.

4.3.4 Construction Site Runoff Control

Sediment runoff from construction sites is typically 10 to 20 times greater than those of agricultural lands, and 1,000 to 2,000 times greater than those of forest lands.[93] During a short period of time, construction sites can contribute more sediment to streams than can be deposited naturally during several decades.

To assist municipalities in implementing methods for protecting water quality, New York State Department of Environmental Conservation released updated *Specifications for Erosion and Sediment Control* in 2005.[94] This manual, known as 'The Blue Book,' should be used by site developers in preparing their erosion and sediment control plans and by local municipalities in preparing and implementing their soil erosion and sediment control programs. It includes a number of excellent models, including an Erosion and Sediment Control Plan for Small Homesite Construction,[95] Example Erosion and Sediment Control Plan,[96] and a Sample Checklist for reviewing Erosion & Sediment Control Plans.[97] Requiring developers to think about stormwater protections results in better site planning and lessens the likelihood of problems that need to be mitigated by the municipality or other property owners.

Pollutants commonly discharged from construction sites include:

- Sediment
- Solid and sanitary wastes
- Phosphorus and Nitrogen
- Pesticides
- Oil and grease
- Concrete truck washout
- Construction chemicals and debris

The SPDES general permit for Construction Activity[98] was updated in 2010 (valid through 2015) and is required for projects disturbing over one acre of land. Ensure that requirements are being followed for projects disturbing over one acre of land. Include requirements in site plan review and subdivision approval process.

Many municipalities count on SWCD to inspect upon their request, but code enforcement officials need to be educated in stormwater practices, and familiar with construction permits and plans in order to know when to request assistance from the SWCD. In addition, code enforcement officials spend a great deal of time in the field, thus understanding stormwater regulations would help them notice any violations or issues that could be reported to SWCD or DEC. Code Enforcement Officers should ensure that construction sites:

- Have dumpsters or other containers for debris and solid waste
- Store hazardous materials or waste fluids away from receiving waters and catch basins
- With areas for refueling of vehicles or equipment on-site are bermed or away from receiving waters and storm drains
- Properly install concrete truck washouts away from receiving waters and storm drains
- Identify and stabilize critical areas of protection and all exposed soil areas

The Stormwater Toolbox[99], developed by the Rural Stormwater Coalition and distributed to each Southern Tier county in 2008, can be a great resource for non-MS4 communities. It includes packets of information for distribution to developers of small construction sites for which a state stormwater permit is required and explains the how sections of the New York Building Code and Property Maintenance

Codes, respectively, apply to stormwater drainage. A local Construction Stormwater Pollution Prevention and Erosion and Sediment Control Ordinance developed by the Town of Parma is available at the end of this report in Appendix E.

4.3.5 Erosion and Sediment Control Regulations

Soil erosion is the removal of soil by water, wind, ice, or gravity and it is largely influenced by season and topography but also to what degree it's covered by vegetation. Erosion is a problem during runoff events, particularly intense rainfall. Counties and municipalities may adopt laws pertaining to erosion and sediment control in accordance with MCMs 5 & 6. An Erosion and Sediment Control Model Ordinance geared towards counties in New York State is found in *Protecting Water Resources through Local Controls and Practices* Appendix E6.[100]

Site Plan Review is a good point in the development process to review a project's Erosion and Sediment Control plan, which should incorporate practices such as phasing, seeding, grading, mulching, filter socks, stabilized site entrances, preservation of existing vegetation, and other best management practices to control erosion and sedimentation during construction. The Erosion and Sediment Control plan must show how the project team intends to:

- Preserve vegetation and mark clearing limits
- Protect vegetation during construction
- Establish and delineate construction access
- Control flow rates
- Install sediment controls
- Stabilize soils, including providing erosion control protection to a temporary critical area for an interim period
- Protect slopes
- Stabilize channels and outlets
- Control pollutants
- Control dewatering

4.3.5.1 Riparian Buffers

Stream bank erosion is a primary source of sediment loading into Seneca Lake.[101] Protecting riparian areas – those adjacent to waterbodies, wetlands, and flood plains – is critical to water quality. The land area directly adjacent to streams is considered to be among the most dynamic and sensitive components of a watershed. A riparian buffer is a special type of vegetated area along a stream, wetland, or shoreline where development is restricted or prohibited. Its primary function is to protect and physically separate a stream, lake, coastal shoreline or wetland from polluted stormwater discharges from future disturbance or encroachment. If properly designed, a buffer can provide stormwater management functions, can act as a right-of-way during floods, and

can sustain the integrity of water resource ecosystems and habitats.

A stream with a riparian buffer, surrounded by tree cover and vegetation, benefits from both the cooling effects from the tree canopy overhead and the bank stabilization from tree roots and other types of plant cover. Detritus from surrounding plants also contribute to the stream as a source of nutrition and habitat for a variety of animals and organisms. Conversely, streams surrounded by impervious, hard, non-vegetative cover or agricultural cover will likely experience greater soil loss and more impacts from nonpoint source pollution. Stream buffers have financial benefits as well: they minimize property damage, reduce municipal investment, increase property values, and reduce maintenance costs.[102]

According to the EPA's Aquatic Buffer Model Ordinance[103]:

Buffers adjacent to stream systems and coastal areas provide numerous environmental protection and resource management benefits that can include the following:

1. Restoring and maintaining the chemical, physical, and biological integrity of the water resources
2. Removing pollutants delivered from urban stormwater
3. Reducing erosion and sediment entering the stream
4. Stabilizing stream banks
5. Providing infiltration of stormwater runoff
6. Maintaining base flow of streams
7. Contributing the organic matter that is a source of food and energy for the aquatic ecosystem
8. Providing tree canopy to shade streams and promote desirable aquatic organisms
9. Providing riparian wildlife habitat
10. Furnishing scenic value and recreational opportunity

Substantial research has been conducted on the effective size of buffers, particularly related to water quality considerations, to assist planners in developing scientifically sound minimum buffer widths.[104] Recommendations for appropriate buffers widths vary based on the management goal; there is no ideal buffer that is applicable in all circumstances. Buffer sizes should be significantly larger if the intent is to protect ecological functions, such as providing wildlife habitat and supporting species diversity in addition to water quality functions.

Larger, more restrictive buffers are most beneficial to water quality, but there are other factors that prevent a direct correlation between buffer size and percentage of pollutant reduction entering streams. Soil characteristics, hydrology, and types of vegetation also affect how effective a buffer will be in filtering pollutants. In general the most effective buffers are those that are applied to all streams, are at least 100 feet wide and consist of natural forest vegetation.[105] Municipalities should determine what size and types of buffers work in their community and enact these. At minimum, small buffers (approximately 30 feet), can still have a major effect on water quality. More information pertaining to buffer effectiveness related to width, soil type, buffer type, etc.-especially related to nitrogen removal- can be found in the EPA Study *Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations.*[106]

Figure 4.1: Recommended Buffer Widths by Stream Order

Stream Order	Stream Classification		
	(Sensitive Streams)	(Restorable Streams)	(Impacted Streams)
1	75 feet	60 feet	50 feet
2	125 feet	100 feet	75 feet
3+	150 feet	125 feet	100 feet

Notes:

1. Stream order refers to a classification system for stream networks, where low order (e.g., 1st and 2nd order) are smaller streams and high order are progressively larger streams. When two 1st order streams meet, they become a 2nd order stream, and so on.
2. Stream classification refers to the condition or quality of the stream. Stream classification may already exist in a community or can be initially determined using certain indicators such as watershed impervious cover.
3. Buffer widths are total widths measured from top of active channel bank.
4. Widths may be expanded to include site-specific considerations, such as steep slopes (e.g., >15%), flood zones, critical habitat, etc.

Adapted from City of Lenexa, KS: Successful Implementation of Riparian Buffer Programs. Stormwater Magazine. Nov/Dec 2006 issue.

Though it is recommended that preference be given to variable-width buffers, based on stream classification and topographic index, uniform widths are easier to enforce and require less time and expertise to administer. The latter approach to creating riparian buffers is to have a three-tiered buffer system, with the most restrictive buffer adjacent to the water body, and a second less restrictive buffer beyond that.

The inner buffer, adjacent to the water body, should be vegetated. This consists of an area of land within a set distance, such as 75 feet, from each bank of the waterway and would be intended to remain in a natural state (natural vegetation, mix of forested vegetation and natural grasses (un-mowed)). Some planting may be beneficial in areas that need to be restored to their natural state. Strict regulations should be placed on the allowable uses on this land, and development would be prohibited. An outer buffer could also be created with few vegetation requirements and would restrict most structures from being built but allow some uses while still restricting others. Another option for this second buffer would be to allow more uses with stricter regulations regarding stormwater, runoff, erosion, etc. Allowable uses could include flood control or recreation.[107]

Another method recommended by NYSDEC's 2010 Stormwater Management Design Manual,[108] is a three buffer system. Essentially the vegetated buffer above would be split into two buffers, a more restrictive one adjacent to the stream (minimum of 25ft) with very few allowable uses such as flood control or footpaths, and another vegetated buffer (minimum of 25ft) with a few more allowable uses such as recreation and less restrictive vegetation requirements. The outer buffer similarly restricts structures, but allows more uses.

Methods

Like other land use regulations, there are a number of different places to incorporate Riparian Buffers into local law:

- Environmental Protection Overlay Districts – Buffer zones may be created as EPODs and designated on the municipal zoning map. Like other zoning districts, allowable uses and restrictions may also be included.
- Setbacks – Regulations on development could be included as part of the bulk zoning regulations of the appropriate zones. Example: Structures must be at least 150 feet from the top of a stream bank, maintained with native vegetation.
- Site Plan Review – This can include native vegetation, clearing or grading, and tree conservation requirements for site plan approval. If municipalities do not wish to create restrictive Riparian Buffers, the Site Plan Review process is one place where they can try to encourage retention of vegetation. Many municipalities encourage retaining trees and natural vegetation as much as possible during development. This could be strengthened by specifying this practice within 50 to 100 of feet of stream banks, depending on stream order and whether the site is a greenfield or infill.
- Subdivision Law – Buffer regulations can be mandatory in order to get a subdivision approval. If municipalities do not wish to create restrictive riparian buffers, at minimum they should use their Subdivision Law to give their planning boards the ability to encourage retention of natural vegetation especially adjacent to waterbodies. Example: Town of Batavia-Subdivision of Land: IV Sec 2.E.2: "To the fullest extent possible, all existing trees and shrubbery shall be conserved." Simply adding "especially on properties adjacent to or within 50 feet of streams" could be an effective way to prioritize these areas related to this review requirement.

Perceptions include concerns about private property rights, complaints about pests and nuisances, and additional costs to local governments due to implementation, regulation, and enforcement of a buffer program. A riparian buffer that includes the 100-year floodplain may also eliminate the need for expensive flood controls.

4.3.5.2 Floodplains

Floodplains act as a check valve for streams; they allow water to be slowed down, to dissipate energy after a rainstorm or snow melt. They spread out the stream's energy and allow water to soak into aquifers. Flood Insurance Rate Maps (FIRM) are produced by the Federal Emergency Management Agency and provide the official record of special flood hazard areas. While paper FIRMs are generally available online for every community in the Seneca Lake watershed, corresponding digital GIS data pertaining to the flood boundary is not yet available for every community through state or federal agencies.

Basic Flood Regulations

Flood regulations play an important role in protecting water quality, through limiting and regulating certain types of development and uses within the floodplain. Improper regulation of the flood zone could in turn increasing flooding, flood damage, and erosion, and has a negative effect on water quality through pollutants and sedimentation.

All of the municipalities within the Seneca Lake watershed are included in FEMA's National Flood Insurance Program (NFIP) and have at least the minimum flood regulations and maps in place. These include restrictions on land use and what types of structures can be built in the flood zone as well as first floor elevation requirements and other flood proofing requirements for structures. The National

Flood Insurance Program (NFIP) is a federal program that enables property owners to purchase affordable flood insurance. The NFIP uses the 100-year flood as the standard on which to base its regulations. This is a national standard used by virtually every federal and most state agencies (including New York State) in the administration of their programs as they relate to floodplains. The technical and engineering methods involved in determining the magnitude of these floods are well established. A 100-year flood is an event estimated to have a one percent chance of occurring each year. Yet a flood of this magnitude could occur more or less frequently than once every 100 years. FEMA boundaries are important, not just because they indicate areas where insurance is federally mandated, but also because these boundaries communicate risk to a homeowner or community.

Designation of a floodplain manager is not only a requirement but also an effective way to ensure that at least one person is responsible for ensuring flood regulations are being followed and that developers and municipal boards understand them. Enforcement is often the biggest issue with flood plain regulations and the possibility that they are not being used in land use decision making and development approval. Most of these regulations in the watershed date back to the early 1980’s and it may be easy for them to be overlooked by representatives in municipalities that are not used to having much development in the floodplain.

Improved Flood Regulations

Most municipalities could benefit from strengthening their floodplain regulations as many are simply based on minimum standards. Strengthening regulations can help municipalities to qualify for the Community Rating System (CRS) of the National Flood Insurance Program.[109] Residents in CRS communities receive a discount on their flood insurance. NYSDEC’s Model Local Law for Flood Damage Prevention includes Optional Additional Language[110] to strengthen some of the basic flood requirements; see attached Appendix F. Legal addendums such as Compensatory Storage, Repetitive Damage, Cumulative Substantial Improvement, Critical Facilities, and Areas Behind Levees or below High Hazard Dams, bolster basic flood regulations.

Local communities are encouraged to provide an extra margin of safety by requiring structures to be elevated above the base flood elevation. Flood insurance for a house built two or more feet above the base flood elevation will cost about half as much as for a house built to the base flood elevation. Flood insurance for a house built just a foot below the base flood elevation will cost about four times more than for a house built to the base flood elevation. All municipalities should update their flood regulations to comply with NYS Building Code requirements (the lowest elevated floor in an A zone (special flood hazard area) is elevated to or above the base flood elevation (BFE), plus two feet above base flood elevation). This is known as freeboard: the height of watertight surface between a building above a given level of stream, lake, or river.

Another way to improve floodplain laws is to limit the allowable land uses within a floodplain. Preventing some agricultural operations in the floodplain is also possible. The Town of Geneva provides guidance on the location of manure pits and barnyards. Another option to improve flood regulations is to limit fill in flood zones. For example, the Town of Byron restricts fill in flood areas as fill brought into a flood zone has the potential to change the boundaries of the flood zone.

Methods

Some floodplain regulations were created as a standalone law. This option is acceptable, but it may be more beneficial to incorporate them directly into the municipality’s zoning law, increasing the visibility of floodplain regulations in the community bringing them to the direct attention of planning/zoning board members. Flood ordinances are most effective when also integrated with site plan review, environmental quality review (SEQRA), and subdivision review. Similarly, flood zones should be incorporated into zoning maps. Bringing flood regulations out into the forefront exposes them to more people and will also help to influence their update when zoning laws are reviewed and updated.

A flood EPOD may prohibit the following without a variance or special permit:

- construction or operation of onsite-wastewater
- new structures, including parking lots
- mining, filling, grading, paving, excavation or drilling operations

If historical settlement patterns offer no feasible alternative for development, a licensed professional engineer or architect should develop or review structural design, specifications, and plans for construction and must certify that the design and methods of construction are in accordance with accepted standards of practice to floodproof the structure.

4.3.5.3 Wetlands

There are significant wetlands in the Seneca Lake Creek watershed; there are over 53,000 total acres of wetlands across the five counties. Wetlands are places where saturation with water is the dominant factor determining both the nature of soil development and the types of plant and animal communities living in the soil and on its surface.[111] Freshwater wetlands commonly include shrub or forested swamps, marshes, bogs, and fens, and many lie along rivers and streams in the floodplain riparian zone. Wetlands serve a number of important functions within a watershed, including filtering sediment, chemical detoxification, nutrient removal, flood protection, shoreline stabilization, ground water recharge, stream flow maintenance, and wildlife and fisheries habitat. Wetlands are arguably among the most productive and economically valuable ecosystems in the world.

The US Army Corps of Engineers evaluates permit applications for essentially all construction activities that occur in the nation's waters, including federal wetlands. Under the NYS Freshwater Wetlands Act, NYSDEC regulates wetlands 12.4 acres (5 hectares) or larger. Most New York State Freshwater Wetlands have been surveyed by the DEC – for most counties, the original wetland maps were completed and filed between 1984 and 1986 – and many are in the process of being re-surveyed. What can and should be done with a wetland can be subject to a broad range of interpretation and enforcement. A good deal depends upon the ability of federal, state, and local agencies to understand the context of wetlands within a watershed or subwatershed.

Municipalities should place extra emphasis on protecting wetlands. Wetland regulations in place at the state and federal level should be reviewed and understood by and local decision makers such as planning boards to ensure that property owners have submitted information and are allowed to proceed with projects based on state and federal approval when needed. Municipalities should also strictly adhere to any local review and/or regulations in place regarding wetlands. Municipal officials such as planning board members, and code enforcement officers should be familiar with local regulations and prioritize the protection of wetlands in their project review approval and enforcement duties. County Environmental Management Councils and municipal Conservation Boards or Advisory Councils can be a great resource for information on unique natural areas such as wetlands.

Beyond the protection of wetlands areas themselves, municipalities should enact wetland buffers and regulations at the local level. Protection of the areas surrounding wetlands improves the functions of the wetland. This table from the *Planner's Guide to Wetland Buffers for Local Governments*[112] gives a general estimate of the distances where vegetated non-disturbance type buffers begin to be effective and the point where they are no longer needed to be effective by function. The actual effectiveness of these types of restrictive buffers varies case by case depending on the location, surrounding land uses, topography, soil type, buffer characteristics, watershed characteristics, etc.

Figure 4.2: Recommended Buffer Widths by Wetland Function

Wetland Function	Special Features	Recommended Minimum Width (feet)
Sediment Reduction	Slopes (5-15%) and/or functionally valuable wetland	100
	Shallow slopes (<5%) or low quality wetland	50
	Slopes over 15%	Consider buffer width additions with each 1% increase of slope (e.g., 10 feet for each 1% of slope greater than 15%)
Phosphorus Reduction	Steep slope	100
	Shallow slope	50
Nitrogen (Nitrate) Reduction	Focus on shallow groundwater flow	100
Biological Contaminant and Pesticide Reduction	N/A	50
Wildlife Habitat and Corridor Protection	Unthreatened species	100
	Rare, threatened, and endangered species	200-300
	Maintenance of species diversity	50 in rural area 100 in urban area
Flood Control	N/A	Variable, depending on elevation of flood waters and potential damages

Adapted from: Center of Watershed Protection and United States Environmental Protection Agency. Wetlands and Watersheds: Adapting Watershed Tools to Protect Wetlands. United States Environmental Protection Agency, 2005.

Buffers often take the form of either areas where either additional review and approval are needed for disturbance or areas with specific restrictions regarding disturbances, land use, development, land cover, etc.; or a combination of both. Examples of buffer regulations/review concepts could include:

Vegetation requirements

- Restrictions on use – permitted uses, non-permitted uses, uses permitted with approval, etc.
- Restrictions on fill

- Setback requirements from wetlands or wetland buffers for structures, development, certain land uses, etc.
- Classification of buffers to determine which are high priority to protect
- Requirement of a permit for disturbance/use including a review and approval process
- Multiple buffers – vegetated buffer, use/disturbance restriction buffer, buffer area requiring review/permit approval, structural setback (buffer), etc.
- A determination of which wetlands will have buffers[113]
- All wetlands and waters
- Specific types of wetlands (federal, state, non-federal/state regulated, those of a specific size)
- Those within stream and river corridors, floodways, riparian buffers, or adjacent areas
- Specific identified and mapped wetlands
- A varying degree of regulation based on site – size, location, surrounding land uses, slope, soil type, etc.

To some extent, larger, more vegetated, and more restrictive wetland buffers are more effective,[114] but municipalities must determine what balance to strike between the buffer size and restrictions and other competing needs and interests.

4.4 Agriculture

Land use within the Seneca Lake watershed is largely devoted to agricultural uses, encompassing 46% of the total land use; property designated as residential accounts for 27% of the watershed.[115] Farming can have a negative effect on water quality through erosion of crop land, sedimentation, and runoff contaminated with fertilizers or animal wastes. These effects can be mitigated through best management practices, and regulations in some cases. BMPs and regulations can be expensive to farm owners; focusing on areas closest to waterways is the most effective strategy for improving water quality and limiting hardship to farmers.

Of the 343 farm surveys analyzed for the *Seneca Lake Watershed Management Plan Characterization and Subwatershed Evaluation,* [116] 71% indicate having at least one conservation practice installed on the farm. The four most common practices installed on farms were crop rotation, subsurface drainage, diversion ditch and cover crop. The least common practice was filter strips, with only 9% of the farms using this practice. The subwatersheds adding the largest amount of sediment from agriculture are Kashong Creek, Reeder Creek, the Keuka Lake Outlet, and Catharine Creek; a higher concentration of animals, associated manure management issues, and more intensive cropping operations predominate in these subwatersheds.[117] Nutrient loading, if left unchecked, will further degrade water quality in the lake if not addressed in a meaningful and sustainable manner.

Many municipalities within the Seneca Lake watershed have strong representation by the farming community on local planning, zoning, and conservation boards. These bodies seek to balance quality of life issues of the entire community while considering the functions that are necessary to run a profitable agricultural business, all while meeting the obligations of federal, state and applicable local laws. The advancement of sound agricultural practices within the local farming community have been incrementally applied on local farms by a variety of agencies – in particular, local branches of the Natural Resources Conservation Service (NRCS, a service of the United States Department of Agriculture), county Cornell Cooperative Extension offices, and county Soil and Water Conservation District offices. This voluntary, gradual approach to implementing environmental BMPs has been successful, as evidenced by the growing number of farming operations participating in programs like Agricultural Environmental Management and other USDA-sponsored conservation programs.

4.4.1 Land Use Tools for Agriculture

Counties and towns can proactively support local agriculture, particularly through right-to-farm laws, property tax reduction, purchase and transfer of development rights programs, and agricultural and farmland protection plans. Yet the land use tools described in Section 4.2 – comprehensive plans, zoning, subdivision ordinances – are equally important, as towns have primary land use and decision-making authority and these may be applied to farm operations in agricultural districts. For example, a town that wishes to prevent animal waste from entering water bodies may regulate the siting of barnyards (heavy use area) adjacent to a stream and require animals to be fenced out of the stream with all runoff addressed with an appropriate collection and treatment system according to Natural Resource Conservation Service standards.

Yet the Commissioner of the Department of Agriculture and Markets can intervene when local governments enact laws that *unreasonably* restrict farm operations in agricultural districts. Town boards and county legislators should understand whether a local ordinance is unreasonable by the standard of state Agricultural Districts Law.[1] At the least, an ordinance should be clear, free of vague language that could be interpreted to impinge on the rights of farmers, and should be thoroughly vetted so that no particular farmer is unduly restricted by the proposed change. The best approach is an ordinance consistent with DEC standards that balances the need to uphold public health and safety alongside the needs of farmers to bring food to New York's table.

Generally, construction of on-farm buildings and the use of land for agricultural purposes should not be subject to site plan review, special use permits, or non-conforming use requirements when conducted in a state-certified agricultural district. The Department of Agriculture and Markets has developed a model streamlined site plan review process, available within *Guidelines for Review of Local Zoning and Planning Laws;*[118] the guide is a useful tool for understanding the limits of zoning and planning laws in agricultural districts. Questions concerning review of local laws should be directed to the Commissioner's office, preferably during the potential legislation's drafting stage.[119]

Two additional resources aimed at local planners and officials – *Planning for Agriculture in New York: A Toolkit for Towns and Counties,*[120] published by the American Farmland Trust in 2011, and the Department of State's James A. Coon Local Government Technical Series' *Local Laws and Agricultural Districts: How Do They Relate?,*[121] updated in May 2013 – also contain extensive information for local decision makers.

4.4.2 Agricultural Environmental Management (AEM)

Agricultural Environmental Management (AEM) is a voluntary program adopted by New York State to help farmers make common-sense, cost-effective and evidence-based decisions to help meet business objectives while protecting and conserving natural resources. A five-tiered process, from inventory to plan implementation, customizes best management practices to a particular farm; virtually identical farm operations in different locations may have entirely different environmental concerns. The result is a coordinated approach to implementing agricultural conservation practices that make a meaningful improvement to the health and stability of the natural environment. AEM is

[1] New York State Agriculture and Markets Law (AML) §305-a.

coordinated by county Soil and Water Conservation Districts in each of the five Seneca Lake watershed counties. AEM priorities are detailed in county AEM strategic plans which are updated on a five-year cycle. The plans prioritize actions by specific watersheds within the county based on local water quality concerns and input from a local advisory committee.

4.4.2.1 Participation and Outreach

While there are few farmers who have not had received at least some information on AEM, local stakeholders and municipal officials may be unaware of the AEM program.

- Update mailing lists and collect all AEM data from previous years for focus watershed year
- Contact all landowner/farmers in via letters and follow-up phone calls to generate interest in a free, confidential AEM Risk Assessment
- Follow up with past participants of AEM in focus watershed to update information and encourage farms to move forward in tiered process
- Schedule outreach and education presentations and look for new opportunities to collaborate and form new partnerships.
- Conduct meetings with farmers as requested to complete tiered worksheets, including Tier 3 conservation plans.
- Prepare any Tier 3's for farmers interested in pursuing funding through agricultural nonpoint source grant program.
- Apply for agricultural nonpoint source grants and seek additional funding through other programs such as EQIP to implement high priority practices on farms in priority watersheds.
- Staff should attend AEM and any relevant trainings or updates as scheduled.
- Encourage ABMP field trials and demonstrations of new agricultural environmental technologies
- Incorporating AEM practices into local law where possible (ex: location of barnyards, additional drainage/runoff considerations in Site Plan Review)

4.4.2.2 Vegetated Buffers

Vegetative buffers on agricultural land are a cost-effective way to reduce phosphorus. Ag buffer strips could be located between crops, at the edge of crop fields or bordering waterbodies.

All existing agricultural uses should be grandfathered and allowed to continue their use if in place at the time of adoption, but beyond that, municipalities have the option of allowing new agricultural land uses to be exempt from buffer regulations in the future, or requiring compliance. Neither the Tompkins

County Model or Ithaca Model exempt agricultural uses; this in order to prevent the negative effects of runoff from future agricultural land, which could include fertilizers, animal wastes, and soil from erosion. The EPA Model suggests making farms with an approved Natural Resource Conservation Service Conservation Plan exempt from this type of law. Voluntary Agricultural Environmental Management techniques are often used to help farmers limit their effects on water quality in place of regulation. Conservation Tillage, Stripcropping, Ag-to-Forest Land Conversion, Ag-to-Wetland Conversion, Nutrient Management, Grazing Land Management, Terraces/Diversions, Streambank Protection, Barnyard Management, and Cropland Management are all strategies for supporting a healthy Seneca Lake.

The Natural Resource Conservation Service (NRCS) Ithaca Field Office has an ongoing sign up for the Conservation Reserve Enhancement Program (CREP) specifically for implementing and cost-sharing exclusion for fences, crossings, alternative watering facilities, and riparian buffers.

4.4.3 Concentrated Animal Feeding Operations (CAFOs)

Small, family-operated farms have been consolidated into larger, more centralized operations known as Concentrated Animal Feeding Operations (CAFO), reflecting a trend towards economy of scale in agricultural commodity production. CAFOs are defined as lots or facilities where animals are stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period; they are categorized as either “large” or “medium” based on the numbers of animals confined.[122] CAFOs that discharge to waters of New York State are regulated by the DEC under the authority of the Clean Water Act through the New York State Pollution Discharge Elimination System (SPDES) (refer to Section 2.2.2.10 for more information on the SPDES program).[123] Intermittent, sporadic, even occasional flows to waters may be the norm for many CAFOs, but they are nonetheless discharges prohibited under the Clean Water Act.

4.4.4 Alternative Energy Strategies

In aquatic ecosystems, phosphorous is usually the limiting nutrient for plant growth. This means that excessive amounts of phosphorous in a system can lead to an abundant supply of vegetation and low dissolved oxygen for fish. Manure from dairy cows contains approximately 2 lbs of phosphorus (and 13 lbs of nitrogen) per wet ton; 1,200 cows in a milking herd (a large CAFO) generate around 69 tons of manure every day.[124] Farms across the country have begun converting this manure into electricity via anaerobic methane digestion.

Soil and Water Conservation Districts lead the charge in enabling the development of anaerobic digesters with funding through NYSERDA, the USDA Rural Development program, EPA’s AgSTAR program, USDA NRCS grants, and the NYS Department of Agriculture & Markets. Small-scale projects typically do not yet benefit from economies of scale; digester cost per head of cattle tends to be prohibitively high since dairy manure is not a particularly energy dense feedstock. Yet co-digestion alongside food waste increases separation efficiency and digestate balance. Several states, including Vermont, Massachusetts, California, and Connecticut have banned food waste from going to landfills and this trend is likely to continue. Digested effluent can be sold as a crop fertilizer and as animal bedding. Excess power may be sold to NYSEG under a power purchase agreement; that option is being explored for the greater Rochester market.[125]

NYSERDA’s Agriculture Energy Efficiency Program (AEEP)[126] also offers assistance in identifying and implementing electric and natural gas energy efficiency measures to eligible farms and on-farm producers, including orchards, dairies, greenhouses, vegetables, vineyards, grain dryers, and poultry farms.

4.5 Highway Department Practices

Paved development has the highest coefficient of runoff, and thus highway departments have a very important role in preserving roadway longevity and watershed quality. Many highway problems are drainage related. Roads and highways have the potential to generate and contribute substantial amounts of eroded material and other pollutants into local waterbodies. Specific contaminants associated with road runoff include sediment, oils and grease, heavy metals, garbage/debris, and road salts, as well as fertilizers, pesticides and herbicides applied to roadside facilities or spilled on or near roads. Hydrologically-connected roads – roads that are designed to contribute surface flow directly to a drainage channel – have the greatest potential to deliver road-derived contaminants to streams. New roads can also be a vector to human encroachment on the natural landscape and, in combination with other public services, can induce new development outside of traditional population centers.

A 2010 Paul Smith's College report on the effects and costs of road de-icing in the Adirondacks[127] details a series of best management practices for winter maintenance, including a salt management plan, development of an anti-icing strategy, and precision application techniques. To produce a high level of service at a modest cost, at pavement temperatures above 25ºF, Road Salt (NaCl) is probably the most cost effective choice, but at lower temperatures other chloride based deicers may be more cost effective.

4.5.1 Roads and Highways

Highway departments should follow NYS DOT design and guidance documents and manuals such as the NYS DOT Highway Design Manual,[128] the NYS DOT Environmental Manual,[129] and the Southern Tier Central Regional Planning *Highway Superintendents Roads and Water Quality Handbook*.[130]

4.5.2 Bridges and Culverts

Bridges present a number of additional risks to hydrologic function. In some cases, the bridge itself creates a direct connection between the roadway and stream if the bridge drain is not diverted to an on-land treatment facility (generally ground infiltration or retention). Bridges and culverts, if built too small, can restrict and concentrate stream flow, thereby creating or accelerating stream bank erosion and stream incision. When not properly maintained or designed, bridges and culverts will cause debris accumulation and contribute to upstream flooding and possible property damage. Bridges and culverts also have the potential to restrict wildlife passage and fish movement if not properly designed and maintained. Conversely, bridge crossings also offer excellent opportunities for recreational access to rivers and streams, a possibility that should be considered during any necessary construction or repair of such facilities.

Section 4.0 Endnotes

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5.0 Review of Local Laws, Plans, Programs, and Practices

5.1 Review

Many of the gaps in local laws and practices across the watershed are similar. This section attempts to tailor recommendations to each specific municipality based on the Assessment, but also refers back to recommendations in Section 4 that are applicable to multiple municipalities. These recommendations may be used as a starting point to help municipalities and counties hone in on top priorities, determine what additional information is needed, and what steps may to be taken toward implementation.

The inclusion of some standardized recommendations will hopefully facilitate the sharing of information between counties and municipalities; one of the strongest recommendations is to increase collaboration between groups. Water quality management is a regional issue and thus collaboration and standardization of strategies can be beneficial to all. Sharing of knowledge and expertise can also be financially beneficial; for example, two groups can share the cost of a joint training session, or neighboring municipalities can adopt the same model regulation. Collaboration and standardization can make initial efforts more efficient and allow groups to focus on implementation work. Shared practice allows for better design, better maintenance, and economic incentives that can deliver higher performance and lower cost.

5.1.1 Chemung County

Recommendations for Future Action by Local Officials:

- **Continue to prioritize and expand AEM Program** – The Schuyler County Soil and Water Conservation District implements a robust New York State AEM program in both Schuyler and Chemung Counties. Continue to apply for funding to bring farms and farmers into the tier 1 (inventory) and tier 2 (assessment) through AEM Base Funding as well as funding for tier 3 (planning) and tier 4 (BMP implementation) through the Agricultural Nonpoint Source Abatement and Control Program.[131] Refer to Section 4.4.1 for more details.
- **Update Onsite Wastewater Treatment System regulations and handbook –** Chemung County Sanitary Code Article V[132] allows construction of new and/or the alteration or repair of existing residential on-site systems with a permit and also includes soil percolation standards. We recommend updating the law to require inspection/permit renewal and subsequent repair when necessary at property transfer; to set a minimum inspection schedule timeframe including a tiered inspection schedule prioritizes the inspection of systems in closer proximity to the creek, systems located in more porous soils, and older systems; and to create setbacks from waterbodies and drinking water sources. Encouraging municipalities and/or counties to conduct on-site wastewater system inspections and to develop management strategies is a primary recommendation of Southern Tier Central's 2012 Susquehanna-Chemung Action Plan.[133] See Section 4.3.3.1 for further details.
- **Continue stormwater best management practices** – SWCD conducts construction site and construction permit inspections at the request of municipalities. They also respond to requests for technical assistance including MS4 & Construction SPDES Permit assistance, SWPPP Review, construction site complaints, stormwater pond assistance, and MS4 audit assistance

upon municipal request. The Chemung County All-Hazard Mitigation Plan, 2012 update,[134] provides a lot of great guidance for municipalities.

- **Continue stream monitoring and protection best practices –** SWCD has assisted municipalities in stream bank protection though resloping and installation of vegetation, willow stakes, vegetated rip rap, and toe deflector stones to redirect water to the center of the creek channel, and have also cleared debris from waterways. They also encourage municipalities and residents to vegetate streambanks, discourage mowing to the edge of the stream banks, and have held workshops on erosion and sediment control. They've helped create a number of decentralized wetland areas and plan to continue to add one to two each year.
- **Continue education and outreach efforts** – The Chemung County SWCD conducts water quality and resource conservation related public outreach and programs, such as participation in Envirothon, North America's largest high school environmental education competition. The Rural Stormwater Coalition of Chemung, Schuyler and Steuben Counties assists municipalities with SWPPP Review, Construction Site Inspections, training, and formal complaint investigations.

5.1.1.1 Town of Catlin

Land use documents reviewed:

- ***Zoning Law***, Town of Catlin L.L. 3-1999 [135]
- ***Site Plan Review***, Town of Catlin L.L. 3-1999, Article 9
- ***Subdivision Law***, Town of Catlin L.L. 1-1999
- ***Flood Damage Prevention***, Town of Catlin L.L. 1-1987

Recommendations for Future Action by Local Officials:

- **Draft a comprehensive plan** – Draft a comprehensive plan emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality. See Section 4.2.1 for more information.
- **Continue stormwater best management practices** – The Town of Catlin best practices include a ditch and drainage maintenance program, though dirt roads require constant repairs and are highly susceptible to flooding and erosion problems. See Section 4.5 for more information.
- **Strengthen onsite wastewater treatment regulations** – We recommended that Chemung County strengthen its Sanitary Code to improve on-site wastewater treatment regulations regarding required inspections and setbacks from waterways, wetlands, and floodplains. The Town of Catlin may also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** The existing buffer and barrier requirements ("Zoning Law," 10.23) do not include distances from water bodies. Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. While the current zoning law specifically prevents building structures within 50 feet from a stream bank, an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for recommendations and models.

- **Strengthen floodplain regulations** – Catlin appears to have no restrictions on agriculture in the floodway. The town may regulate future farm practices such as the location of manure pits and barnyards, while grandfathering current agricultural uses; see Section 4.4.1. Also review the list of optional flood regulation additions created by DEC in Appendix F; also see Section 4.3.5.2 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after soil disturbance. See Section 4.2.3 for more information.
- **Amend clustered development (and subdivision) regulations –** Catlin's zoning provides for cluster development. The RCD Plan conditions call for focused development away from environmentally sensitive areas but the minimum density requirements (low-density, segregated housing and commercial uses located in automobile-dependent outlying areas) may actually interfere with the goal of promoting a more efficient and economical provision of utility services ("Zoning Law," Article 6). Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4.

5.1.1.2 Town of Horseheads

The Town (and Village) of Horseheads both have comprehensive stormwater management programs and have MS4 permit coverage within the Elmira urbanized area. The Town of Horseheads' local laws are strong in addressing Phase II stormwater compliance; three laws address many water quality issues (Illicit Discharge Detection and Elimination, Stormwater Management and Erosion and Sediment Control, and Flood Damage Prevention laws, respectively). The Town's Site Plan Review Procedure[136] also has robust water quality oversight. The Town has also earned Class 9 status on the NFIP Community Rating System, entitling the community to a 5% discount on flood insurance premiums.

Land use documents reviewed:

- ***Comprehensive Plan***, January 1971.
- ***Town of Horseheads Zoning Ordinance,*** adopted 1982.[137]
- ***Town of Horseheads Subdivision Ordinance,*** Town of Horseheads L.L. 5-1995[138]
- ***Flood Damage Prevention,*** Town of Horseheads L.L. 4-1996[139]
- ***Stormwater Management and Erosion Control,*** Town of Horseheads L.L. 1-2005.[140]
- ***Illicit Discharge Detection and Elimination,*** Town of Horseheads L.L. 2-2007[141]

Recommendations for Future Action by Local Officials:

- **Revise comprehensive plan** – Update 1971 comprehensive plan, including an emphasis on the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality. While the existing plan holds value as a historic document, a comprehensive plan should reflect current conditions and issues of the municipality, where the community would like to be, and how to reach those goals. See Section 4.2.1 for more information.

- **Continue strengthening floodplain regulations** – Update zoning ordinance (Chapter 204) to include enumeration of the newest inundation maps and overlay districts and to reflect the 2012 updates to the town's zoning map. The Town of Horseheads appears to have no restrictions on agriculture in the floodway. The town might want to look into regulating future farm practices such as the location of manure pits and barnyards, while grandfathering current agricultural uses; see Section 4.4.1. Review the list of optional flood regulation additions created by DEC in Appendix F; see Section 4.3.5.2 for more details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The current zoning law has no restrictions on excavation adjacent to a waterbody; consider creating a buffer area with vegetation requirements and use restrictions. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Onsite wastewater treatment regulations** – We recommended that Chemung County strengthen its Sanitary Code to improve on-site wastewater treatment regulations regarding required inspections and setbacks from waterways, wetlands, and floodplains. The Town of Horseheads may also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Update Site Plan Procedure –**Consider updating the Site Plan Review Procedure to reflect green infrastructure standards articulated in Schedule A; see Section 4.2.3 for more information.
- **Amend subdivision regulations –** Horseheads' zoning law provides for planned unit development and requires some environmentally-sensitive design standards within the subdivision regulations (Article IV). Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street network design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed; see Section 4.2.4. Smart growth strategies applied to subdivisions can make a dramatic difference in service delivery costs; see Section 4.2.2 for details.

5.1.1.3 Village of Horseheads

The Village has a comprehensive stormwater management program and has MS4 permit coverage within the Elmira urbanized area. The Village of Horseheads' local laws are generally strong in addressing Phase II stormwater compliance including Stormwater Management and Erosion and Sediment Control and Flood Damage Prevention laws, respectively. The Town has also earned Class 9 status on the NFIP Community Rating System, entitling the community to a 5% discount on flood insurance premiums.

Land Use Documents Reviewed:

- ***Village of Horseheads Comprehensive Plan,*** April 2010
- ***Stormwater Management and Erosion Control,*** Village of Horseheads L.L. 2-2008[142]
- ***Flood Damage Prevention,*** Village of Horseheads L.L. 2-1996[143]
- ***Zoning,*** Code of the Village of Horseheads v 23, updated December 15, 2007[144]

Recommendations for Future Action by Local Officials:

- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The current zoning law has no restrictions on excavation adjacent to a waterbody; consider creating a buffer area with vegetation requirements and use restrictions. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Develop green infrastructure standards –** Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after soil disturbance. Consider adopting Site Plan Review, as recommended in the 2010 comprehensive plan (Recommendations 3.1 and 3.3) to include green infrastructure standards; see Section 4.2.3 for more information.
- **Continue strengthening floodplain regulations** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some potential options; also see Section 4.3.5.2 for more details.
- **Adopt subdivision regulations –** The Village's zoning law provides for planned unit development and requires some environmentally-sensitive design standards within the subdivision regulations (Article IV). Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street network design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as recommended in the Village's 2010 comprehensive plan (Goal 9: "As part of site design, encourage the use of LEED-based or similar standards for building construction"; see Section 4.2.4. Smart growth strategies applied to subdivisions can make a dramatic difference in service delivery costs; see Section 4.2.2 for details.

5.1.1.4 Village of Millport

The village has a comprehensive stormwater management program and has MS4 permit coverage within the Elmira urbanized area. The Village of Millport's local laws are generally strong in addressing Phase II stormwater compliance including Illicit Discharge Detection and Elimination, Stormwater Management and Erosion and Sediment Control, respectively.

Land Use Documents Reviewed:

- ***Illicit Discharge Detection and Elimination,*** Village of Millport L.L. 1-2007
- ***Stormwater Management and Erosion Control,*** Village of Millport L.L. 2-2007
- ***Town of Millport Zoning Ordinance,*** adopted May 2005
- ***Flood Mitigation Action Plan: Town of Veteran & Village of Millport,*** September 1999

Recommendations for Future Action by Local Officials:

- **Draft a comprehensive plan** – Draft a comprehensive plan emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality. See Section 4.2.1 for more information.

- **Amend floodplain regulations** – Millport has not received updated Flood Insurance Rate Maps since 1988, a recommendation made by Southern Tier Central Planning in 1999. Add question about 100-year floodplain to building permit application if not already included. Also review the list of optional flood regulation additions created by DEC in Appendix F; also see Section 4.3.5.2 for details.
- **Adopt onsite wastewater treatment regulations** – We recommended that Chemung County strengthen its Sanitary Code to improve on-site wastewater treatment regulations regarding required inspections and setbacks from waterways, wetlands, and floodplains. As Millport had several septic system failures during flooding events,[145] the Village may also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Continue stormwater best management practices** – The Village of Millport best practices include a ditch and drainage maintenance program, though dirt roads require constant repairs and are highly susceptible to flooding and erosion problems. See Section 4.5 for more information.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after soil disturbance. See Section 4.2.3 for more information.

5.1.1.5 Town of Veteran

The town has a comprehensive stormwater management program and has MS4 permit coverage within the Elmira urbanized area. The Town of Veteran's local laws are generally strong in addressing Phase II stormwater compliance; two laws address many water quality issues: Illicit Discharge Detection and Elimination and Stormwater Management and Erosion and Sediment Control, respectively. Along with Chemung County Soil and Water, the Town of Veteran has begun to create one to two wetlands per year and is designing them for wildlife habitat and stormwater management. The Town's highway department forestalled damage from the 2011 storm season with ditch maintenance.

Land Use Documents Reviewed:

- ***Comprehensive Plan***, September 2004
- ***Town of Veteran Zoning Ordinance**,* adopted February 24, 1983
- ***Subdivision Local Law Town of Veteran,*** adopted July 10, 2002
- ***Stormwater Management and Erosion Control,*** Town of Veteran L.L. 2-2008
- ***Illicit Discharge Detection and Elimination,*** Town of Veteran L.L. 3-2008

Recommendations for Future Action by Local Officials:

- **Continue public participation and involvement –** The Comprehensive Plan encourages land preservation efforts in order to protect the creek and its watershed.
- **Continue stormwater best management practices** – The Town of Veteran best practices include a ditch and drainage maintenance program, though dirt roads require constant repairs and are highly susceptible to flooding and erosion problems. See Section 4.5 for more information.

- **Adopt onsite wastewater treatment regulations** – We recommended that Chemung County strengthen its Sanitary Code to improve on-site wastewater treatment regulations regarding required inspections and setbacks from waterways, wetlands, and floodplains. The Town may also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Amend subdivision regulations –** Neither the Town's zoning or subdivision law provides for cluster or planned unit development and neither requires environmentally-sensitive design standards within the subdivision regulations. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street network design, development of pedestrian linkages, green infrastructure and building design, and other performance standards in concert with the Town's 2004 comprehensive plan; see Section 4.2.4. Smart growth strategies applied to subdivisions can make a dramatic difference in service delivery costs; see Section 4.2.2 for details.

5.2.1 Ontario County

Recommendations for Future Action by Local Officials:

- **Update the 2000 Ontario County Agricultural Plan and continue to prioritize and expand AEM Program –** Continue the Lake-Friendly Farmer Program and apply for funding to bring farms and farmers into the tier 1 (inventory) and tier 2 (assessment) through AEM Base Funding as well as funding for tier 3 (planning) and tier 4 (BMP implementation) through the Agricultural Nonpoint Source Abatement and Control Program.[146] Refer to Section 4.4.1 for more details
- **Encourage public participation and involvement –** Establish an Environmental Management Council, a volunteer advisory board to the county legislature enabled under Article 47 of the New York State Environmental Conservation Law. EMCs advise the county legislature on matters affecting the preservation, development, and use of the natural features of the county that have a bearing on environmental quality; they also serve as a link between the government and the public.
- **Continue education and outreach efforts** – Stormwater Coalition of Ontario County conducts water quality and resource conservation related public outreach, programs, distribution of materials, including a robust guide to Soil Erosion Control for Single Family Dwelling Construction.[147] SWCD encourages participation in Envirothon, North America's largest high school environmental education competition.

5.2.1.1 City of Geneva

Land Use Documents Reviewed: N/A

- ***City of Geneva Master Plan and Local Waterfront Revitalization Program,*** 1997
- ***Flood Damage Prevention,*** adopted October 7, 1987[148]
- ***Zoning,*** adopted July 3, 1968[149]
- ***Subdivision Regulations***, adopted July 3, 1968[150]

Recommendations for Future Action by Local Officials:

- **Revise comprehensive plan** – Revise comprehensive plan to emphasize the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watersheds and other neighboring watersheds within the municipality.
- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning, site plan and subdivision regulations; it should account for topography and soil type and require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion. Such a law would require developers to prepare a Stormwater Pollution Prevention Plan and submit it to the Planning Board as part of Site Plan Review. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Strengthen floodplain regulations** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some potential options; also see Section 4.3.5.2 for more details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The current zoning law does not prohibit excavation next to a stream, but an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Update subdivision regulations –** Neither the City's zoning or subdivision law requires environmentally-sensitive design standards within the subdivision regulations. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street network design, development of pedestrian linkages, green infrastructure and building design, and other performance standards in concert with the City's 1997 master and waterfront plan; see Section 4.2.4. Smart growth strategies applied to subdivisions can make a dramatic difference in service delivery costs; see Section 4.2.2 for details.

5.2.1.2 Town of Geneva

Land Use Documents Reviewed:

- ***Town of Geneva Comprehensive Plan,*** updated 2006.
- ***Flood Damage Prevention***, Town of Geneva L.L. 5-1997[151]
- ***Soil Erosion and Sedimentation Control***, Town of Geneva L.L. 3-1997[152]
- ***Subdivision of Land,*** Town of Geneva L.L. No. 2-1990[153]
- ***Zoning,*** adopted 1972 [154]

Recommendations for Future Action by Local Officials:

- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.

- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. One of the stated purposes in the Town's Erosion Control law is to "Maintain the integrity of stream geometry so as to sustain the hydrologic functions of streams." Stream corridors should be delineated as a buffer area with vegetation requirements and limitations on use. Refer to Section 4.3.5.1 for recommendations and models.
- **Strengthen floodplain regulations –** Geneva appears to have no restrictions on agriculture in the floodway, though does provide some general guidance on the location of manure pits and barnyards (§165-28.5); see Section 4.4.1. Also review the list of optional flood regulation additions created by DEC in Appendix F; also see Section 4.3.5.2 for details.
- **Amend Cluster Development and Subdivision regulations –** Geneva's zoning provides for cluster development and calls for open space preservation within that but does not include environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.2.1.3 Town of Gorham

Land Use Documents Reviewed:

- ***Town of Gorham Comprehensive Plan,*** November 2009[155]
- ***Town of Gorham Farmland, Open Space & Resource Conservation Plan***, June 2005[156]
- ***Zoning Local Law,*** adopted January 28, 2013[157]
- ***Subdivision Regulations,*** adopted May 1969, amended by Town of Gorham L.L. 11-2006[158]
- ***Soil Erosion and Sedimentation Control,*** Town of Gorham L.L. 2-91[159]
- ***Flood Damage Prevention,*** Town of Gorham L.L. 3-96[160]
- ***On-site Individual Wastewater Treatment Systems Law***, Adopted October 23, 2000.[161]

Recommendations for Future Action by Local Officials:

- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Create/Improve riparian buffers –** While stream encroachment is only permitted with an engineer's technical evaluation and a conditional FIRM revision, an actual buffer area with vegetation requirements and use/development restrictions should be created. Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Update subdivision regulations –** Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of

pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4.

- **Strengthen floodplain regulations** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some potential options; also see Section 4.3.5.2 for more details.

5.2.1.4 Town of Phelps

Land Use Documents Reviewed:

- ***Town and Village of Phelps Comprehensive Plan,*** 2007
- ***Zoning,*** adopted 2012

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning, site plan, and/or subdivision ordinances. Such a law would require developers to prepare a Stormwater Pollution Prevention Plan and submit it to the relevant local board as part of the process for new development. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The current zoning law specifically prevents excavation closer than 50 feet from a stream, but an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Strengthen floodplain regulations** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some potential options; also see Section 4.3.5.2 for more details.
- **Amend subdivision regulations –** The town's subdivision law does not quantify most of its environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street network design, development of pedestrian linkages, green infrastructure and building design, and other performance standards in concert with the Town's 2007 comprehensive plan; see Section 4.2.4. Smart growth strategies applied to subdivisions can make a dramatic difference in service delivery costs; see Section 4.2.2 for details.

5.2.1.5 Town of Seneca

Land Use Documents Reviewed:

- ***Town of Seneca Comprehensive Plan,*** June 2013[162]
- ***Town of Seneca Zoning Law,*** July 2008
- ***Floodplain Regulations.***
- ***Chapter 21: Subdivision of Land,*** May 2010

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The current zoning law specifically prevents excavation closer than 50 feet from a stream, but an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Strengthen floodplain regulations** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some potential options; also see Section 4.3.5.2 for more details.
- **Amend subdivision regulations –** The town's subdivision law does not quantify most of its environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street network design, development of pedestrian linkages, green infrastructure and building design, and other performance standards in concert with the Town's 2013 comprehensive plan; see Section 4.2.4. Smart growth strategies applied to subdivisions can make a dramatic difference in service delivery costs; see Section 4.2.2 for details.

5.3.1 Schuyler County

- **Continue to prioritize and expand AEM Program** – The Schuyler County Soil and Water Conservation District has a robust AEM program, having received over $5.1M in funding for 172 farms. The Schuyler County Soil and Water Conservation District implements the New York State AEM program not only in Schuyler but also in Chemung County; there are over 250 participants already a part of this program in just Schuyler County. The Schuyler County Soil and Water Conservation District has two Certified Nutrient Management Planners on staff. Continue to apply for funding to bring farms and farmers into the tier 1 (inventory) and tier 2 (assessment) through AEM Base Funding as well as funding for tier 3 (planning) and tier 4 (BMP implementation) through the Agricultural Nonpoint Source Abatement and Control Program.[163] Refer to Section 4.4.1 for more details.
- **Stormwater Management** – Schuyler County Soil and Water Conservation District has a substantial Stormwater program that focuses on the SPDES Phase II permits with its partnership

with the Chemung County Stormwater Team. They provide and exchange of services with the Soil and Water District for Schuyler County and all its municipalities. This is also the main focus of the Rural Stormwater Coalition that exists between Schuyler, Chemung and Steuben Counties.

- **Update Onsite Wastewater Treatment System regulations –** On an annual basis, between 10% and 15% of the individual water supply samples collected by the WPA in Schuyler County do not meet EPA potability standards.[164] As approximately 75% of the County's population disposes of their wastewater through an OWTS, it's important to have robust septic regulations. The County has a good foundation for OWTS, updated in 2011 (Article II – Sewage Treatment – Individual Systems), through inspection and permitting required before construction or repair of OWTS inspection and investigations when there are questions of public health and/or nuisances; requirement to connect when public sewers are available and accessible. There is no mention of inspection or re-permitting and subsequent repair/remediation required during a property transfer or minimum setbacks from waterbodies. We recommend updating the law to reflect the latest technological advancements in systems design, engineering, and testing; to require inspection/permit renewal and subsequent repair when necessary at property transfer; to set a minimum inspection schedule timeframe including a tiered inspection schedule prioritizes the inspection of systems in closer proximity to the priority waterbodies, systems located in more porous soils, and older systems; and to create setbacks from waterbodies, not just drinking water sources. See Section 4.3.3.1 for further details.
- **Continue education and outreach efforts** – The Schuyler County SWCD conducts water quality and resource conservation related public outreach and programs, such as participation in Envirothon, North America's largest high school environmental education competition. The Rural Stormwater Coalition of Chemung, Schuyler and Steuben Counties assists municipalities with SWPPP Review, Construction Site Inspections, training, and formal complaint investigations.
- **Continue roads and highways best practices –** The Schuyler County Soil and Water Conservation District worked with its municipalities to stress the need for Road Use Agreement Laws, Drive way laws, and the overall engineering needed to support both of those to be used to protect the municipalities' infrastructure during large, heavy use construction projects. The County and State have an inspection process and program for bridges (which also covers a majority of the bridges in all municipalities) in place. The Schuyler SWCD performs many projects on a shared services basis with its municipalities from road ditch stabilization, to box culvert or culvert installations, to drainage issues for roadways. The SWCD has also done an extensive culvert inspection project with all municipalities, including the geolocation of all culverts for all towns as well as the creation of a GIS database that includes the picture, year installed, length, size, and material of these structures.

5.3.1.1 Village of Burdett

Land Use Documents Reviewed: N/A

Recommendations for Future Action by Local Officials:

- **Draft a comprehensive plan** – Draft a comprehensive plan emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality.
- **Develop stormwater management ordinance** – Develop a local law that accounts for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for

seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. See Section 4.3 for details.

- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.

5.3.1.2 Town of Catharine

Land Use Documents Reviewed:

- ***Subdivision Control Regulations,*** effective October 5, 1978; amended March 18, 1997[165]
- ***Flood Damage Prevention,*** Town of Catharine L.L. 2-1989[166]
- ***Zoning Ordinance,*** 2012[167]

Recommendations for Future Action by Local Officials:

- **Adopt draft comprehensive plan** – Adopt the draft joint Town of Catharine & Village of Odessa comprehensive plan, including an emphasis on the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality.
- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning, site plan and subdivision regulations; it should account for topography and soil type and require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion. Such a law would require developers to prepare a Stormwater Pollution Prevention Plan and submit it to the Planning Board as part of Site Plan Review. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Strengthen floodplain regulations** – Catharine appears to have no restrictions on agriculture in the floodway. The town may regulate future farm practices such as the location of manure pits and barnyards, while grandfathering current agricultural uses; see Section 4.4.1. Also review the list of optional flood regulation additions created by DEC in Appendix F; also see Section 4.3.5.2 for details.
- **Develop onsite wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Catharine could also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.

- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The current zoning and flood laws do not contain stream setback language; an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Update subdivision regulations –** Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street network design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as recommended in the Town's draft comprehensive plan Vision Statement; see Section 4.2.4. Smart growth strategies applied to subdivisions can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.3.1.3 Town of Cayuta

Land Use Documents Reviewed: N/A

Recommendations for Future Action by Local Officials:

- **Draft a comprehensive plan** – Draft a comprehensive plan emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality.
- **Develop stormwater management ordinance** – Develop a local law that accounts for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Develop onsite wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Cayuta could also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The current zoning and flood laws do not contain stream setback language; an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Create floodplain regulations** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.

5.3.1.4 Town of Dix

Land Use Documents Reviewed:

- ***Town of Dix Comprehensive Plan: The Pioneer Plan,*** 2001[168]
- ***Town of Dix Zoning Code,*** Adopted December 21, 2006[169]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards –** Dix has added a number of erosion control mechanisms to Zoning and Site Plan Review. Also consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information
- **Update Subdivision regulations –** The Town of Dix Zoning code Article XIII – Subdivision of Land provides for cluster development and calls for open space preservation within that but does not include environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.
- **Develop onsite wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Dix could also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create floodplain regulations** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.

5.3.1.5 Town of Hector

Land Use Documents Reviewed:

- ***A Comprehensive Plan for the Town of Hector, New York,*** 2001[170]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that accounts for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. See Section 4.3 for details.

- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Create floodplain regulations** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Develop onsite wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Hector could also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The current zoning and flood laws do not contain stream setback language; an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.

5.3.1.6 Town of Montour

Land Use Documents Reviewed:

- ***A Comprehensive Plan for the Town of Montour & Village of Montour Falls,*** August 2007[171]
- ***Town of Montour Zoning Law,*** December 2008[172]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review requirements. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Update floodplain development standards** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.

- **Develop onsite wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Montour should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The current zoning law contains stream setback language only in relation to waterfront yards (100 feet); an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Update conservation subdivision regulations –** The Town of Montour zoning code provides for cluster development and calls for open space preservation within that but does not include quantitative or environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.3.1.7 Village of Montour Falls

Land Use Documents Reviewed:

- ***A Comprehensive Plan for the Town of Montour & Village of Montour Falls,*** August 2007[173]
- ***Zoning and Subdivision of Land,*** L.L. 2-2010[174]
- ***Flood Damage Prevention,*** L.L. 1-1993[175]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that accounts for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Update floodplain development standards** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Amend on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Village of Montour Falls should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.

- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. Neither the current zoning or flood damage prevention law contains stream setback language; an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Update conservation subdivision regulations –** The zoning code provides for cluster development and calls for open space preservation within that but does not include quantitative or environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.3.1.8 Village of Odessa

Land Use Documents Reviewed:

- ***Zoning Ordinance,*** Adopted June 2002, amended December 2005

Recommendations for Future Action by Local Officials:

- **Adopt draft comprehensive plan** – Adopt the draft joint Town of Catharine & Village of Odessa comprehensive plan, including an emphasis on the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality.
- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning, site plan and cluster regulations; it should account for topography and soil type and require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion. Such a law would require developers to prepare a Stormwater Pollution Prevention Plan and submit it to the Planning Board as part of Site Plan Review. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Adopt flood damage prevention law and amend floodplain development standards –** Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Village of Odessa should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The current zoning law does not contain stream setback language; an actual buffer

area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.

- **Update cluster development regulations –** The zoning code provides for cluster development and calls for open space preservation within that but does not include quantitative or environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.3.1.9 Town of Orange

Land Use Documents Reviewed:

- ***Town of Orange Comprehensive Plan,*** May 2012[176]
- ***General Code.***

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that accounts for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Adopt flood damage prevention law and amend floodplain development standards** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Amend on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Orange should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.

5.3.1.10 Town of Reading

Land Use Documents Reviewed:

- ***Town of Reading Comprehensive Plan,*** Adopted 1993[177]
- ***Town of Reading Land Use Law***[178]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing land use ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Adopt flood damage prevention law and amend floodplain development standards –** Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Amend on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Reading should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The land use law prevents excavation within 50 feet of a first order stream, but an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Update cluster development regulations –** The land use law's rural siting principles calls for open space preservation but does not include quantitative or environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.3.1.11 Town of Tyrone

Land Use Documents Reviewed:

- ***Western Schuyler County Inter-Municipal Comprehensive Plan, adopted for the Town of Tyrone,*** adopted October 12, 2004[179]
- ***Subdivision Regulations, Town of Tyrone,*** adopted 2008[180]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that accounts for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. See Section 4.3 for details

- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Adopt flood damage prevention law and amend floodplain development standards** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Amend on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Tyrone should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The subdivision regulations require visual landscape buffers, but an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Update cluster development regulations –** The subdivision law calls for open space preservation but does not include quantitative or environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.3.1.12 Village of Watkins Glen

Land Use Documents Reviewed:

- ***Village of Watkins Glen Comprehensive Plan,*** adopted 1993[181]
- ***Village of Watkins Glen Zoning Law,*** L.L. 1-2007[182]
- ***Local Waterfront Revitalization Plan,*** adopted April 30, 2009[183]

Recommendations for Future Action by Local Officials:

- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.

- **Amend floodplain development standards** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. The subdivision regulations require visual landscape buffers, but an actual buffer area with vegetation requirements and use restrictions should be created. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Update cluster development regulations –** The zoning law calls for open space preservation but does not include quantitative or environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.4.1 Seneca County

- **Continue to prioritize and expand AEM Program** – Continue to apply for funding to bring farms and farmers into the tier 1 (inventory) and tier 2 (assessment) through AEM Base Funding as well as funding for tier 3 (planning) and tier 4 (BMP implementation) through the Agricultural Nonpoint Source Abatement and Control Program.[184] Refer to Section 4.4.1 for more details.
- **Update onsite wastewater treatment systems regulations** – Regulations regarding on-site wastewater treatment systems in Seneca County could be strengthened. Currently, the Seneca County Sanitary Code requires only the minimum state standards. We recommend updating the law to reflect the latest technological advancements in systems design, engineering, and testing; to set a minimum inspection schedule timeframe, including a tiered inspection schedule prioritizes the inspection of systems in closer proximity to the creek, systems located in more porous soils, and older systems; and to create setbacks from waterbodies and drinking water sources. See Section 4.3.3.1 for further details.
- **Public Participation and Involvement –** Consider establishing an Environmental Management Council, a volunteer advisory board to the county legislature enabled under Article 47 of the New York State Environmental Conservation Law. EMCs advise the county legislature on matters affecting the preservation, development, and use of the natural features of the county that have a bearing on environmental quality; they also serve as a link between the government and the public. See section 4.3.1.1 for further details.

5.4.1.1 Town of Fayette

Land Use Documents Reviewed:

- ***Towns of Fayette and Varick Comprehensive Plan***, adopted 2005/2006[185]
- ***Town of Fayette Land Use Regulations***, adopted September 11, 2008[186]
- ***Town of Fayette Subdivision of Land Regulations***, adopted September 11, 2008[187]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing land use ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would require developers to prepare a Stormwater Pollution Prevention Plan and submit it to the relevant local board as part of the process for new development. See Section 4.3 for details.

- **Develop green infrastructure standards –** Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Develop onsite wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Fayette should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Adopt flood damage prevention law and amend floodplain development standards** – While the EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection, the town should also bolster its flood protection mechanisms. Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Update subdivision regulations –** The subdivision law calls for open space preservation and clustered housing objectives but does not include robust quantitative or environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.4.1.2 Town and Village of Lodi

Land Use Documents Reviewed:

- ***Flood Damage Prevention,*** L.L. 1-1987

Recommendations for Future Action by Local Officials:

- **Draft a comprehensive plan** – Draft a comprehensive plan emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality.
- **Develop stormwater management ordinance** – Develop a local law that accounts for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding,

erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. See Section 4.3 for details.

- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Amend floodplain development standards** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Lodi should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. An actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Create cluster development regulations –** Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.4.1.3 Town and Village of Ovid

Land Use Documents Reviewed:

- ***Comprehensive Plan for the Town of Ovid,*** [188]

Recommendations for Future Action by Local Officials:

- **Adopt the draft comprehensive plan** – Adopt the draft comprehensive plan, emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality.
- **Develop stormwater management ordinance** – Develop a local law that accounts for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management

practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.

- **Adopt flood damage prevention law** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Ovid should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. An actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.

5.4.1.4 Town of Romulus

Land Use Documents Reviewed:

- ***Comprehensive Plan for the Town of Romulus,*** draft
- ***Town of Romulus Subdivision Regulations,*** adopted 2012[189]
- ***Town of Romulus Zoning Regulations,*** adopted 2006
- ***Town of Romulus Agricultural and Farmland Protection Plan***, draft, October 2011

Recommendations for Future Action by Local Officials:

- **Adopt the draft comprehensive plan** – Adopt the draft comprehensive plan, emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality.
- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards –** Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Adopt flood damage prevention law** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations –** We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from

waterways, wetlands and floodplains). The Town of Romulus should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.

- **Update subdivision regulations –** The subdivision regulations provide for cluster development and calls for open space preservation within that but does not include quantitative or environmentally-sensitive design standards. As recommended by a recent Seneca County Planning audit,[190] modify the Town's subdivision regulations to authorize the Planning Board to require clustered subdivisions where such a design would effectively protect agricultural land or significant natural features. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.4.1.5 Town of Varick

Land Use Documents Reviewed:

- ***Towns of Fayette and Varick Comprehensive Plan***, adopted 2005/2006[191]
- ***Town of Varick Subdivision Regulations,*** adopted December 1977, amended December 2007
- ***Town of Varick Zoning Regulations,*** adopted 2010

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Adopt flood damage prevention law** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Varick should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. Though the current subdivision guidelines require a 20 foot easement adjacent to a waterbody, an actual buffer area with vegetation requirements and use restrictions should be

created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.

- **Update subdivision regulations –** The subdivision regulations do not provide for cluster development or environmentally-sensitive design standards. Modify the Town's subdivision regulations to authorize the Planning Board to require clustered subdivisions where such a design would effectively protect agricultural land or significant natural features. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.4.1.6 Town of Waterloo

Land Use Documents Reviewed:

- ***Town of Waterloo Comprehensive Plan***, adopted August 2000
- ***Town of Waterloo Site Plan Review and Approval,*** L.L. 6-2011[192]
- ***Town of Waterloo Zoning,*** L.L. 9-2011[193]
- ***Town of Waterloo Flood Damage Prevention***

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Amend flood damage prevention law** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations –** We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Waterloo should also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. Though the current subdivision guidelines require a 20 foot easement adjacent to a waterbody, an actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.

5.5.1 Yates County

- **Continue to prioritize and expand AEM Program** – Continue to apply for funding to bring farms and farmers into the tier 1 (inventory) and tier 2 (assessment) through AEM Base Funding as well as funding for tier 3 (planning) and tier 4 (BMP implementation) through the Agricultural Nonpoint Source Abatement and Control Program.[194] Refer to Section 4.4.1 for more details.
- **Update onsite wastewater treatment systems regulations** – Regulations regarding on-site wastewater treatment systems in Yates County could be strengthened. Currently, the Yates County Sanitary Code requires only the minimum state standards. We recommend updating the law to reflect the latest technological advancements in systems design, engineering, and testing; to set a minimum inspection schedule timeframe, including a tiered inspection schedule prioritizes the inspection of systems in closer proximity to the creek, systems located in more porous soils, and older systems; and to create setbacks from waterbodies and drinking water sources. While the Yates County Soil and Water Conservation and FL-LOWPA inspect 150 existing septic systems within 200 feet of Keuka and Seneca Lakes, plenty of standards are available for bolstering the efficacy of new systems. See Section 4.3.3.1 for further details.
- **Public Participation and Involvement –** Consider establishing an Environmental Management Council, a volunteer advisory board to the county legislature enabled under Article 47 of the New York State Environmental Conservation Law. EMCs advise the county legislature on matters affecting the preservation, development, and use of the natural features of the county that have a bearing on environmental quality; they also serve as a link between the government and the public. See section 4.3.1.1 for further details.

5.5.1.1 Town of Barrington

Land Use Documents Reviewed:

- ***Town of Barrington Comprehensive Plan***, adopted January 28, 2009[195]
- ***Town of Barrington Zoning***, adopted April 15, 2003
- ***Town of Barrington Subdivision Regulations,*** adopted June 26, 2013[196]
- ***Town of Barrington Flood Insurance Resolution***, L.L. 2-1987
- ***Wastewater Treatment Law***, L.L. 4-2011[197]
- ***Regulations for Construction on Steep Slopes,*** L.L. 5-2011[198]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and

seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.

- **Adopt flood damage prevention law and amend floodplain development standards** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. Though the current zoning guidelines prohibit junkyards within 150 feet from a waterbody, an actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Amend cluster subdivision regulations –** The recent subdivision law calls for open space preservation and clustered housing objectives and includes some quantitative and environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.5.1.2 Town of Benton

Land Use Documents Reviewed:

- ***Town of Benton Comprehensive Plan***, adopted May 15, 1991, revised August 21, 2001
- ***Town of Benton Zoning***, adopted June 2008
- ***Town of Benton Flood Law***, L.L. 2-1989

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Amend flood damage prevention law –** Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from

waterways, wetlands and floodplains). The Town of Benton may also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.

- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. An actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Amend residential cluster subdivision regulations –** The zoning law allows for residential cluster development but does not include robust quantitative and environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.5.1.3 Village of Dresden

Land Use Documents Reviewed:

- ***Village of Dresden Comprehensive Plan***, July 2004
- ***Zoning Law of the Village of Dresden***, adopted June 2008

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Amend flood damage prevention law** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Village of Dresden may also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. Though the current zoning guidelines prohibit development within 50 to 100 feet

from a stream edge or wetland, depending on the zone, an actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.

- **Amend residential cluster subdivision regulations –** The zoning law allows for residential cluster development but does not include robust quantitative and environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.5.1.4 Village of Dundee

Land Use Documents Reviewed:

- ***Comprehensive Plan for the Village of Dundee and the Town of Starkey***, September 1969
- ***Zoning***, L.L. 1-1975
- ***Subdivision of Land***, L.L. 1-1975
- ***Site Plan Review,*** L.L. 7-2006

Recommendations for Future Action by Local Officials:

- **Revise comprehensive plan** – Update 1969 comprehensive plan, including an emphasis on the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality. While the existing plan holds value as a historic document, a comprehensive plan should reflect current conditions and issues of the municipality, where the community would like to be, and how to reach those goals. See Section 4.2.1 for more information.
- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Amend flood damage prevention law** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from

waterways, wetlands and floodplains). The Village of Dundee may also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.

- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. An actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Amend subdivision regulations –** Neither the zoning or subdivision law allows for residential cluster development nor includes robust quantitative and environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.5.1.5 Town of Jerusalem

Land Use Documents Reviewed:

- ***Town of Jerusalem Comprehensive Plan***, August 2006[199]
- ***Town of Jerusalem Zoning Ordinance***, adopted October 14, 1975, amended by L.L. 1-2012[200]
- ***Subdivision of Land,*** L.L. 7-2009[201]
- ***Flood Damage Prevention,*** L.L. 1-1997.[202]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Amend flood damage prevention law –** Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. An actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.

- **Update subdivision regulations –** The town's subdivision law allow for cluster development but does not include robust quantitative and environmentally-sensitive design standards. As recommended in the 2006 comprehensive plan, good subdivision regulations can have a significant impact on the community. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.5.1.6 Town of Milo

Land Use Documents Reviewed:

- ***The Town of Milo Comprehensive Plan***, September 21, 2009[203]
- ***Zoning***, adopted October 14, 1975, amended by L.L. 1-2012
- ***Flood Damage Prevention,*** L.L. 2-1997.
- ***Subdivision Chapter of the Code of the Town of Milo,*** L.L. 2-2007[204]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Amend flood damage prevention law** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. An actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Create subdivision regulations –** The town's subdivision resolution does not allow for residential cluster development nor includes robust quantitative and environmentally-sensitive design standards. As recommended in the 2009 comprehensive plan, good subdivision regulations can have a significant impact on the community. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other

performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.5.1.7 Village of Penn Yan

Land Use Documents Reviewed:

- ***The Village of Penn Yan Comprehensive Master Plan***, January 2000[205]
- ***Zoning***, adopted October 25, 2004
- ***Site Plan Review***, October 1, 1996
- ***Subdivision of Land,*** L.L. 14-1990

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Create flood damage prevention law** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. An actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Create subdivision regulations –** The town's subdivision resolution allows for residential cluster development but it does not include robust quantitative and environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in service delivery costs; see Section 4.2.2 for details.

5.5.1.8 Town of Potter

Land Use Documents Reviewed:

- ***Town of Potter Comprehensive Master Plan***, 1979
- ***Zoning Law***, adopted 1979, amended by L.L. 2-2010
- ***Subdivision Regulations,*** adopted 1979, amended 2011

Recommendations for Future Action by Local Officials:

- **Revise comprehensive plan** – Update 1979 comprehensive plan, including an emphasis on the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality. While the existing plan holds value as a historic document, a comprehensive plan should reflect current conditions and issues of the municipality, where the community would like to be, and how to reach those goals. See Section 4.2.1 for more information.
- **Develop stormwater management ordinance** – Develop a local law that accounts for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. See Section 4.3 for details.
- **Adopt on-site wastewater treatment regulations** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Potter may also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Create flood damage prevention law** – Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. An actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Amend subdivision regulations –** The subdivision regulations do not allow for residential cluster development nor does it include robust quantitative and environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.5.1.9 Town of Starkey

Land Use Documents Reviewed:

- ***Comprehensive Plan for the Village of Dundee and the Town of Starkey***, September 1969
- ***The Town of Starkey Zoning Ordinance,*** adopted January 1970, revised July 2009[206]
- ***Subdivision Regulations***, May 1997

- ***Flood Damage Prevention,*** L.L. 1-2003
- ***Town of Starkey Watershed Ordinance,*** adopted September 5, 2002

Recommendations for Future Action by Local Officials:

- **Revise comprehensive plan** – Update 1969 comprehensive plan, including an emphasis on the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality. While the existing plan holds value as a historic document, a comprehensive plan should reflect current conditions and issues of the municipality, where the community would like to be, and how to reach those goals. See Section 4.2.1 for more information.
- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Amend flood damage prevention law** – Since Starkey already has strong flood damage prevention regulations, the town is likely an eligible community for the Community Rating System (CRS) program from NFIP. Review the list of optional flood regulation additions created by DEC in Appendix F to see some options; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations or strengthen watershed ordinance** – We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Starkey may also consider these regulations to be included in local law. See Section 4.3.3.1 for further details.
- **Create riparian buffers –** Riparian buffers and similar protections can be very effective tools in protecting water quality, preventing erosion and sedimentation, reducing nonpoint source pollution, etc. An actual buffer area with vegetation requirements and use restrictions should be created. The Town of Fayette's EPOD (1) Stream and Canal Corridor is an excellent example of riparian buffer protection. Refer to Section 4.3.5.1 for buffer recommendations and models.
- **Amend subdivision regulations –** Neither the zoning or subdivision law allows for residential cluster development nor includes robust quantitative and environmentally-sensitive design standards. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

5.5.1.10 Town of Torrey

Land Use Documents Reviewed:

- ***Town of Torrey Comprehensive Plan***, August 12, 2008[207]
- ***Town of Torrey Zoning Law***, adopted 1977, revised March 8, 2011[208]
- ***Town of Torrey Land Subdivision Law,*** L.L. 1-2013[209]
- ***Flood Damage Prevention,*** L.L. 1-2010[210]
- ***Planned Unit Development,*** L.L. 4-2008[211]

Recommendations for Future Action by Local Officials:

- **Develop stormwater management ordinance** – Develop a local law that works in conjunction with existing zoning ordinances; it should: account for topography and soil type; require retaining and protection of trees and other natural vegetation on and near disturbed sites to minimize erosion; stabilize disturbed soils; redistribute topsoil for seeding and planting; use temporary vegetation, silt barriers, and mulching; and maintain runoff rates, or control increased runoff caused by changed surface conditions to minimize flooding, erosion, sedimentation and pollutants entering waterbodies prior to, during and after construction. Such a law would work in concert with the existing Site Plan Review standards. See Section 4.3 for details.
- **Develop green infrastructure standards** – Consider opportunities to retrofit existing properties with new facilities, such as stormwater detention/retention ponds; also attempt natural conveyance restoration wherever possible. Continue ditch maintenance using best management practices, maintaining vegetative buffers near waterbodies, lining sensitive areas with rip rap and seeding disturbed areas immediately after are recommended practices. See Section 4.2.3 for more information.
- **Strengthen flood damage prevention law** – Since Torrey already has strong flood damage prevention regulations, the town is likely an eligible community for the Community Rating System (CRS) program from NFIP. Review the list of optional flood regulation additions created by DEC in Appendix F to see some options for qualifying for CRS; also see Section 4.3.5.2 for more details.
- **Adopt on-site wastewater treatment regulations** – Effluent discharges from septic systems are bad for the lake. We recommended that the County strengthen its Sanitary Code to improve on-site wastewater treatment regulations especially regarding required inspections, connection to public water/sewer and setbacks (potentially from waterways, wetlands and floodplains). The Town of Torrey may consider adopting the draft Wastewater Law prepared in 2011 by GFLRPC. See Section 4.3.3.1 for further details.
- **Amend subdivision regulations –** The subdivision regulations allow for residential cluster development and it includes some environmentally-sensitive design standards, though it is missing some quantitative basis. Consider adopting the LEED for Neighborhood Development (LEED-ND) Standard to assist with selection of suitable lands, street design, development of pedestrian linkages, green infrastructure and building design, and other performance standards as needed. See Section 4.2.4. Smart growth strategies can make a dramatic difference in rural service delivery costs; see Section 4.2.2 for details.

SECTION 5.0 ENDNOTES

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6.0 Conclusion

Counties and municipalities should review both the general and specific recommendations and determine which recommendations are possible to enact based on public support, and which there is capacity to enforce. If some recommendations are not feasible, less restrictive actions may still have a positive impact on water quality. While taking steps towards protecting the watershed can potentially be expensive, county and municipal decision makers should consider the short-term as well as long-term costs associated with taking no action. Mitigating problems that could have been prevented can have huge costs. Other potential money could be lost if water/environmental quality deteriorates and reduces the desire for people to live in and visit an area; this in turn could have an effect on property values and tax revenues. In some cases, local laws can be relatively inexpensive to create or amend and have little to no increased enforcement effort. Sometimes the cost burden can be shifted to the person or group potentially affecting water quality, such as a property developer.

Many recommendations can fit within different parts of municipal code; determine what method works best for your municipality (i.e., site plan review vs. a chapter in zoning). Many laws can be cost-effective if they are incorporated into existing processes such as site plan review or if they take the form of restrictions present at or before the point of approval rather than after. Use this document as a guide to start making changes. Though many subjects will need additional research and review, it is not necessary for a municipality to spend a lot of money to have someone write them a law from scratch. Municipalities should review model laws, and laws from other municipalities, and can use different portions that they like. Municipalities can use the Assessment tables to look for other municipal laws that address the topic of concern.

The recommendations in Sections 4 and 5 are ideal options for protecting water quality in the watershed, but can be difficult to enact or enforce. Enacting some of these regulations may be unpopular if residents or businesses think they infringe too much on their property rights, or cost them money. It's not sufficient to just have regulations pertaining to water quality in local law; regulations need to be enforced and fully understood by parties intended to use them in decision making such as planning boards, and code enforcement officers. Before creating or expanding regulations, municipalities should consider if there is sufficient enforcement capacity. When considering recommendations that require increased enforcement, counties and municipalities should consider enforcement costs, and determine where funding may come from. Enforcement recommendations may also be difficult due to lack of funding. In these instances it is recommended to focus on which recommendations are both high priority and possible to implement. Small changes still have the potential to have an impact

The final section of the Seneca Lake Watershed Plan will take these recommendations and recommendations from other sections and attempt to identify which groups could take the lead in implementation and potential funding sources.

APPENDIX A: TABLE

APPENDIX B: ANNOTATED REFERENCE LIST, NEW YORK WATER RESOURCES INSTITUTE (2013); http://wri.eas.cornell.edu/Infrastructure_References.pdf

APPENDIX C: SAMPLE LOCAL LAW FOR STORMWATER MANAGEMENT AND EROSION & SEDIMENT CONTROL (REVISED 3/06); http://www.dec.ny.gov/docs/water_pdf/localaw06.pdf

APPENDIX D: TOWN OF HURON SEPTIC LAW (3/11/13);
http://townofhuron.org/content/Generic/View/23:field=documents;/content/Documents/File/176.pdf

APPENDIX E: CONSTRUCTION STORMWATER POLLUTION PREVENTION AND EROSION AND SEDIMENT CONTROL ORDINANCE; http://www.parmany.org/pdf/building/stormwater/Final-Construction-Ordinance.pdf

APPENDIX F: NYSDEC OPTIONAL ADDITIONAL LANGUAGE: MODEL LOCAL LAW FOR FLOOD DAMAGE PREVENTION; http://www.schohariecounty-ny.gov/CountyWebSite/EmergencyManagement/NYSDEC-OptionalLanguage.pdf

Identification and Description of Management Practices, Approaches and Strategies for Watershed Protection and Restoration & Implementation Strategy and Schedule

This planning matrix, known more formally as the *Identification and Description of Management Practices, Approaches and Strategies for Watershed Protection and Restoration & Implementation Strategy and Schedule,* represents the culmination of nearly four years of deep research into the current conditions of Seneca Lake, both in the lake itself and across its surrounding watershed. The matrix shows specific steps and strategies needed to complete an action, the groups responsible for completing the actions, and the timeline by which the tasks must be completed.

The matrix includes priority assignments, actions, objectives, steps, strategies, anticipated reductions and water quality improvements, benefits, related issues, lead organizations, potential funding sources, long- and short-term measures, approximate cost, and regulatory approvals in the following areas of concern for Seneca Lake:

- Coordination, collaboration, and partnership recommendations
- Agriculture
- Stormwater management and erosion control
- Forestry and silviculture management
- Wastewater Treatment Systems and Management
- Hazardous Waste Management
- Roads and Highways
- Wetlands
- Regulatory management
- Invasive species management

The *Identification and Description of Management Practices, Approaches and Strategies for Watershed Protection and Restoration & Implementation Strategy and Schedule* was reviewed by NYSDOS and the PAC at the May 5, 2014 Project Advisory Committee meeting. It was subsequently revised based on their input and submitted to the Seneca Lake Watershed Educator for stakeholder distribution on June 16, 2014 in anticipation of the stakeholder input and prioritization meetings in Montour Falls and Geneva on July 7, 2014. Based on the stakeholder input and prioritization meetings the draft Seneca Lake Watershed management Plan was distributed for review on July 28, 2014 in anticipation of the draft Watershed Management Plan public meeting on August 26, 2014. Based on the public meetings and input from the Project Advisory Committee and NYSDOS the Seneca Lake Watershed Management Plan was revised and approved on September 8, 2014.

Recommendations have been developed in order to address a number of areas of concern. These recommendations are presented in the *Assessment of Local Laws, Programs, and Practices Affecting Water Quality*, and in a matrix, known more formally as the *Identification and Description of Management Practices, Approaches and Strategies for Watershed Protection and Restoration & Implementation Strategy and Schedule.* The matrix represents the culmination of nearly four years of deep research into the current conditions of Seneca Lake, both in the lake itself and across its surrounding watershed. The matrix includes recommendations that are presented in the *Assessment of Local Laws, Programs, and Practices Affecting Water Quality*, and shows specific steps and strategies needed to complete an action, the groups responsible for completing the actions, and the timeline by which the tasks must be completed.

The matrix includes priority assignments, actions, objectives, steps, strategies, anticipated reductions and water quality improvements, benefits, related issues, lead organizations, potential funding sources, long- and short-term measures, approximate cost, and regulatory approvals in the following areas of concern for Seneca Lake:

Coordination, Collaboration & Partnership Recommendations – This set of recommendations addresses the need for improved collaboration amongst watershed municipalities, citizens and stakeholders; addresses the need for continuous water resource related monitoring activities; and identifies specific educational opportunities that exist. One of the strongest recommendations is to increase collaboration between groups; collaboration and standardization can make initial efforts more efficient and allow groups to focus on implementation work. Shared practice allows for better design, better maintenance, and economic incentives that can deliver higher performance and lower cost. Specific recommendations pertaining to Coordination, Collaboration & Partnership opportunities can be found in the matrix.

Agriculture – Farming can have a negative effect on water quality through erosion of crop land, sedimentation, and runoff contaminated with fertilizers or animal wastes. This section includes some of the highest prioritized actions of all the recommendations in the watershed, including the creation of riparian buffer zones around streams adjacent to agricultural land and the development of Comprehensive Nutrient Management Plans (CNMPs) tailored to all farms in the watershed. Also highly recommended is additional research into collaborative anaerobic digesters – systems that convert manure into electricity – and the development of educational materials customized for the Seneca Lake watershed on nutrient management, manure handling, and erosion control. Further specific recommendations pertaining to agriculture can be found in the matrix.

Stormwater Management & Erosion Control – Stormwater runoff contains pollutants such as nutrients, pathogens, sediment, toxic contaminants, and oil and grease, resulting in water quality problems. This section's highest recommendation is to provide training to local officials on erosion controls and stormwater management in order to strengthen local capacity for successful management and protection of the Seneca Lake watershed by empowering decisionmakers. Streambank erosion within the watershed is the core source of sediment loading into Seneca Lake. Protecting these stream banks is vital to controlling sediment loading and maintaining the rock structures and vegetation that helps prevent erosion. Thus the other highest priority in this category is the revision of land use laws to limit development on slopes greater than 10%. Further specific recommendations pertaining to stormwater management and erosion control can be found in the matrix.

Forestry and silviculture management – Sustainable forestry balances preserving the integrity of our forests with economic development and maintaining our diverse wildlife population while minimizing damage to the agriculture and rural communities. An array of tools is available from the New York State Cooperative Forest Management Program; further details are available in the matrix.

Wastewater Treatment Systems and Management – The number one source of nonpoint source pollution in New York State is on-site wastewater treatment systems. One of the highest overall recommendations for the Seneca Lake watershed is to adopt a uniform sanitary law throughout the Seneca Lake watershed, based on the Ontario County model or the model Local Law for On-Site Individual Wastewater Treatment. Residences within 500 feet of the lake and 150 feet of tributaries should be considered in a "critical environmental zone" and subject to more frequent inspection. Another highly-ranked recommendation is to advance the education of the general public on the role, process, accomplishments, needs, and future strategy of sewer districts and wastewater treatment facilities. Further specific recommendations pertaining to wastewater treatment systems and management can be found in the matrix.

Hazardous Waste Management – Highly-ranked priorities in the Seneca Lake watershed are determining the location of inactive or unpermitted landfills; assessing the concentrations of contaminants in fish; providing outreach and education on pollution prevention practices; and implementing a watershed-wide hazardous waste pick-up or drop-off. Educating the public and providing an opportunity to safely dispose of hazardous products keeps dangerous wastes out of landfills, lowering the environmental risks associated with improper disposal. Further specific recommendations pertaining to hazardous waste management can be found in the matrix.

Roads and Highways – The highest-ranked priority in this section is educating municipal and county highway departments on ditch and culvert design and stream bank stabilization methods. Paved development has the highest coefficient of runoff, and thus highway departments have a very important role in preserving watershed quality. Further specific recommendations pertaining to highway department practices can be found in the matrix.

Wetlands – There are significant wetlands in the Seneca Lake Creek watershed; there are over 53,000 total acres of wetlands across the five counties. Thus one of the top recommendations for the watershed is the restoration of degraded wetlands in order to absorb the forces of flood and tidal erosion to prevent loss of upland soil. Preservation of wetlands as natural habitat for many species of plants and animals and for critical flood and stormwater control functions; wetlands are arguably among the most productive and economically valuable ecosystems in the world. Further specific recommendations pertaining to wetlands can be found in the matrix.

Regulatory management – Two of the highest regulatory recommendations pertain to the building blocks of local land use: zoning and comprehensive plans. The highest recommendation is to adopt stream buffer setbacks to reduce the amount of harmful runoff and sedimentation into the lake caused by land use activities, achieved through an environmental protection overlay district (EPOD) or setbacks from waterbodies within the zoning code. Another highly prioritized action is the drafting (or revision) of comprehensive plans in municipalities without one, emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality. A number of municipalities within the watershed either do not have comprehensive plans or are utilizing obsolete or incomplete comprehensive plans. Further specific recommendations pertaining to regulatory management can be found in the matrix.

Invasive species management – The highest ranked priorities are education and outreach initiatives on invasive species as well as support for further research and monitoring to improve early detection and management of invasive species. The Finger Lakes PRISM (Partnership for Regional Invasive Species Management) is a cooperative partnership in central New York focused on reducing the introduction, spread, and impact of invasive species through coordinated education, detection, prevention and control measures. A number of other related recommendations pertaining to invasive species can be found in the matrix.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
2	**Coordination, Collaboration & Partnership Recommendations**													
3	**High**	Educate municipalities, residents and other interested parties on soil conservation, steep slope development, erosion control, flooplain development and water quality.	To create a more educated public and policy makers so eventually better decisions and stronger land use policies are put in place to protect the water quality.	Regional plans and outreach	reduced runoff	N/A	Improved water quality	engage citizens with the life of the lake	Site planning, design standards, open space, floodplain mitigation	Regional Planning Boards, County planning offices, municipal planning boards	LWRP, Cleaner Greener Phase II	Long Term, On-going	Varies…education should be ongoing. For the entire watershed, $5,000 a year	N/A
4	**High**	Practice soil conservation.	Reduce pollutant runoff into the lake.	Education using soil and water conservation districts	Education of landowners	see reductions	Improved water quality	Improved water quality	Site planning, design standards, agricultural planning	Soil and Water Conservation districts, Agricultural Protection Boards, NYS Ag and Markets, American Farmland Trust	Agricultural Protection Grants, LWRP	Medium Term	Varies	N/A
5	**High**	Continued and additional water quality monitoring in the entire lake and sub-watersheds	Creating and updating baseline of water quality and comparisons to ensure there are no degradations to water quality	Work with soil and water conservation districts, county watershed inspectors, and FLI to secure continued funding for water quality testing.	Maintain consistent and regular testing for comparison and monitoring	Evaluate reductions	Based on getting necessary data	data to evaluate the health of the lake	Lake level testing	FLI, Soil and Water Conservation Districts, County Watershed Inspectors	EPA	Short Term	$25,000 per year	N/A
6	**High**	Development of an Intermunicipal Organization (IO)	final MOU, municipal presentations, municipal approval	Memorandum of Understanding (see Appendix)	local / muncipal board ownership essential for implementation of watershed management plan	project-dependent	project-dependent	facilitate partnership across political boundaries to promote the ecological vitality of the Seneca Lake Watershed	water quality, education	Chemung, Ontario, Schuyler, Seneca and Yates Counties and municipal governments that geographically fall within the Seneca Lake Watershed	Local Government Efficiency Program	all muncipalities signed on to MOU	$2,500	all muncipalities signed on to MOU
7	**Medium**	Create a Seneca Lake Book, a guide for residents in protecting the lake	strengthen local capacity for successful management and protection of watersheds by empowering volunteers	gather information on the history and ecology of the lake, water quality, advances in septic technology, and green infrastructure	prepare and publish book and associated website	N/A	Improved water quality	engage citizens with the life of the lake	water quality, education	Seneca PAC, Keuka Lake Association, Cayuga Watershed Network, SLAP-5, SLPWA, FLI, STCRPDB, G/FLRPC	Great Lakes Commission, FLLOWPA, Ontario County Water Resources Council	Review similar books year 2, seek funding year 3, complete book year 4	$35,000	N/A
8	**Medium**	MOU to be signed by each watershed municipality.	Meet with each of the five watershed counties and the 40 municipalities.	Continue to work with municipalities to understand the importance and value of the MOU. Work with individual municipalities to buy into the watershed process and begin attending regular meetings.	Stormwater runoff, sediment, nutrients and overall more coordinated planning	N/A	water quality restoration and more coorindated more efficient planning across municipal boundaries	facilitate partnership across political boundaries to promote the ecological vitality of the Seneca Lake Watershed	local laws, site planning, water quality	Regional Planning Boards, Chemung, Ontario, Schuyler, Seneca and Yates Counties, Soil and Water Conservation Districts	LWRP, Cleaner Greener Phase II	Short Term	$3,000 in staff cost	Each county and each municipality to have their councils/boards to sign MOU.
9	**Medium**	Increase participation in volunteer monitoring program, the NYS Master Watershed Steward	strengthen local capacity for successful management and protection of watersheds by empowering volunteers	coordination with FLI and SLPWA	strengthen local capacity for successful management and protection of watersheds by empowering volunteers.	based on sampling and monitoring	based on sampling and monitoring	increased sampling and monitoring capacity	water quality	NYS Master Watershed Steward Program - CCE, PAC, SLAP-5, SLPWA, WQCC	NYSDEC, CFA	Increase number of volunteers by 10% within 1 year	$55/per participant	N/A
10	**Medium**	Develop a framework for working with the Cayuga Lake Watershed Network and the Keuka Lake Association/Watershed Management Plan	coordination, collaboration, partnership	coordination with FLI and SLPWA, PAC, SLAP-5	Get on the agenda to discuss at PAC and SLAP-5 meetings	project-dependent	project-dependent	project-dependent	water quality	Seneca PAC, Keuka Lake Association, Cayuga Watershed Network, SLAP-5, SLPWA, FLI, STCRPDB, G/FLRPC	N/A	Meet with and develop a framework within 6 months	$500	N/A
11	**Low**	Increase participation in volunteer monitoring programs such as SLPWA/CSI pilot stream monitoring program	Recruit participants with chemical, physical, and biological sciences background	coordination with FLI and SLPWA, PAC, SLAP-5	Appoint a coordinator to ensure participation and use of data	based on sampling and monitoring	based on sampling and monitoring	strengthen local capacity for successful management and protection of watersheds by empowering volunteers.	water quality, education	PAC, SLAP-5, SLPWA, FLI, NYSDEC, WQCC	N/A	4 volunteers per sampling site trained and active by Summer 2015	$3,000	N/A
12	**Low**	Continued and additional lake level monitoring to better predict low water levels in order to prevent health and safety issues as well as protect the wildlife.	Regularly funded monitoring program.	Work with soil and water conservation districts to secure funding for monitoring.	Maintain consistent and adequate water levels	Less variation in water levels	Less variation in water levels	Less variation in water levels	flooding	Soil and Water Conservation districts.	EPA	Short Term	TBD. Varies dependent on equipment needs by county and changing cost of staff.	N/A

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
13	**Low**	Short presentation to municipal boards on watershed and restoration protection plan (including preparation, one staff person and one person from PAC)	coordination, collaboration, partnership	prepare presentation highlighting achievements thus far, future opportunities and areas for improvement	Get on the agenda to discuss in all Seneca Lake municipalities	N/A	potentially high	educating a broad range of people to help carry out best practices	water quality, education	G/FLRPC, STC, PAC, SLAP-5, SLPWA, FLI, all municipal signers of the MOU	EPF	100% within one year	$9,500	N/A
14	**Low**	Initiate a process to further engage the County WQCCs, including brief presentations to the PAC about a) county water quality strategies and current projects of the committees; b) identification of common goals and efforts; and c) application for joint funding to conduct work across the watershed.	coordination, collaboration, partnership	SLAP-5 and PAC coordination	Get on the agenda to discuss at PAC, SLAP-5, and WQCC meetings	advance county water quality strategies	advance county water quality strategies	advance county water quality strategies	water quality, education	WQCC, PAC, SLAP-5, SLPWA, FLI	N/A	100% within one year	$3,500	N/A
15	**Low**	Identify stakeholders with respect to specific priority issues, such as local roads management, and facilitate funding applications to support joint projects	coordination, collaboration, partnership	SLAP-5 and PAC coordination	Develop benchmarks and other criteria for measuring progress	project-dependent	project-dependent	project-dependent	water quality	PAC, SLAP-5, SLPWA, FLI	N/A	Identify 3 significant joint projects and seek funding within one year	$1,500	N/A
16	**Low**	Provide opportunities for citizens to volunteer for specific projects and on PAC committees	coordination, collaboration, partnership	SLAP-5 and PAC coordination	Get on the agenda to discuss at PAC and SLAP-5 meetings	project-dependent	project-dependent	project-dependent	water quality	PAC, SLAP-5, SLPWA, FLI	N/A	Increase number of volunteers by 10% within 1 year	$2,500	N/A
17	**Agriculture**													
18	**Highest (*Top 5 overall)**	Create and maintain riparian buffer zones for all streams adjacent to agricultural land starting with the critical areas	Assist the Town of Catlin, Town/Village of Horseheads, City/Town of Geneva, Town of Gorham, Town of Phelps, Town of Seneca, Town of Catharine, Town of Cayuta, Town of Hector, Town of Montour, Village of Montour Falls, Village of Watkins Glen, Village of Odessa, Town of Orange, Town of Reading, Town of Fayette, Town of Tyrone, Town/Village of Lodi, Town/Village of Ovid, Town of Varick, Town of Waterloo, Town of Benton, Town/Village of Dresden, Town of Barrington, Village of Dundee, Town of Jerusalem, Town of Milo, Village of Penn Yan, Town of Potter, Town of Starkey, Town of Torrey	exclusion fencing from water bodies in pastured riparian areas	implement agricultural best management practices	potentially high	potentially high	water erosion control, wind erosion control, improved soil tilth, improved water quality and stream health	agriculture, stormwater, drinking water, water quality, sediment	USDA, NRCS, SWCD, CCE, landowners	cost-sharing for this program may be available through the Conservation Reserve Program	x% of defined critical areas within 10 years	$1,000,000	municipalities
19	**Highest (*Top 5 overall)**	Encourage all farms in the Seneca Lake watershed to develop a Comprehensive Nutrient Management Plan (CNMP) that meets the provisions of NY NRCS Standard 590. The Comprehensive Nutrient Management Plan should include specific recommendations tailored to individual producers and the conditions of soil type, drainage, cropping practices, and livestock density.	A Comprehensive Nutrient Management Plan includes specific recommendations tailored to individual producers and the conditions of soil type, drainage, cropping practices, and livestock density.	Encourage farms that need the plan to do it - look for funding to do this	Practices are selected based on site-specific conditions of soil type, topography, drainage, cropping practices, and livestock density.	potentially high	potentially high	balance nutrients entering and leaving farms	agriculture, stormwater, drinking water, water quality, nutrient loading, pathogens, education, sustainability	SWCD, CCE, USDA, NRCS, landowners, certified planners, private consultants, Cornell Nutrient Management Spear Program	NYS Agricultural Nonpoint Source Abatement & Control Grant Program	Percent of farms in AEM Tier 2 livestock operations by 2020	$20/acre without soil testing	N/A

	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
20	**High**	Promote the preservation of high quality and unique agricultural areas by guiding non-agricultural development into other areas of the watershed	Assist Town of Catlin, Town/Village of Horseheads, Village of Millport, Town of Veteran, City/Town of Geneva, Town of Gorham, Town of Phelps, Town of Seneca, Village of Burdett, Town of Catharine, Town of Cayuta, Town of Dix, Town of Hector, Town of Montour, Village of Montour Falls, Village of Odessa, Town of Orange, Town of Reading, Town of Fayette, Town of Tyrone, Town/Village of Lodi, Town/Village of Ovid, Village of Watkins Glen, Town of Romulus, Town of Varick, Town of Waterloo, Town of Benton, Town/Village of Dresden, Town of Barrington, Village of Dundee, Town of Jerusalem, Town of Milo, Village of Penn Yan, Town of Potter, Town of Starkey, Town of Torrey	actively identify and protect prime soils, encourage cluster development and transfer/purchase of development rights (TDR/PDR), update subdivision standards	Create land use policies and zoning regulations that support the economic viability of agriculture	potentially high	potentially high	NYSDAM PDR program will not only protect water quality but also protect farmland	agriculture, development, sustainability	counties, municipalities, G/FLRPC, STCRPDB, County Farmland Protection Boards	NYSDAM, NRCS, SWCD	acres of farmland and vineyards recovered	N/A	municipalities, NYSDAM
21	**High**	Consider the feasibility of technologies that reduce the mass of animal waste material to be handled, particularly collaborative anaerobic digesters	On-farm digestion would be preferred so the nutrients should stay in the same watershed that they are generated in	feasibility studies	Utilize NYSERDA PON 2828 $2 million in New York State Renewable Portfolio Standard (RPS) funding available through 2015 to support the installation and operation of Anaerobic Digester Gas (ADG)-to-Electricity Systems	project-dependent	project-dependent	potentially high	agriculture, stormwater, drinking water, tourism, water quality, nutrient loading, pathogens, sustainability	NYSERDA, SWCD, CCE, Cornell Manure Management, landowners	NYSERDA PON 2828 $2 million in New York State Renewable Portfolio Standard (RPS) funding is available through 2015 to support the installation and operation of Anaerobic Digester Gas (ADG)- to-Electricity Systems	number of farms using waste for power by 2020	engineering and project development $300,000	N/A
22	**High**	Document and disseminate successful strategies for nutrient management, manure handling, and erosion control. Consider publishing reports in trade journals for the dairy industry.	develop educational materials for agricultural producers and the community at large	research available materials and customize to suit Seneca Lake	Consider publishing reports in trade journals for the dairy industry.	N/A	potentially high	educating a broad range of people to help carry out best practices	agriculture, stormwater, drinking water, water quality, nutrient loading, pathogens, sediment, education, sustainability	SWCD, CCE, USDA, NRCS, landowners, academic institutions, Nutrient Management Spear Program	NYSDAM, NRCS, SWCD	Distribute information to farms participating in AEM type programs within 2 years	$1,500	N/A
23	**Medium**	Promote nutritional management as a tool to optimize feed efficiency and ultimately reduce nutrient content of animal waste.	implement agricultural best management practices	elimination of the use of P containing fertilizers on fields that test high or very high in soil test P and reduction of P in dairy rations to levels recommended by the National Research Council	proactive agricultural and environmental management	The 2002 statewide P balance decreased from +7.2 to +4.3 lb/acre when improvements in dairy nutrition were taken into account	potentially high	balance nutrients entering and leaving farms	agriculture, stormwater, drinking water, water quality, nutrient loading, pathogens, education, sustainability	SWCD, CCE, USDA, NRCS, landowners	Nutrient management (590) cost sharing may be available through USDA NRCS Environmental Quality Incentives Program (EQIP) or Ag Nonpoint Source programs	100% of livestock operations by 2016	$35,000	N/A
24	**Low**	Identify or develop and distribute public information materials that discuss agricultural issues of concern to the entire watershed community	Develop educational materials for agricultural producers and the community at large	research available materials and customize to suit Seneca Lake	illustrate the factors affecting farm size, regulatory and voluntary measures to control agricultural pollution, and the relationships between agriculture and other amenities such as open space	N/A	potentially high	educating a broad range of people to help carry out best practices	agriculture, tourism, comprehensive planning, education	PAC, agricultural boards, SWCD, counties, American Farmland Trust, Couinty Farmland Protection Boards	NYSDAM, NRCS, SWCD	3 articles submitted to various media per year	$6,500	N/A

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
25	**Low**	Plant cover crops in regions with high leaching potential where nutrients need to be controlled.	implement agricultural best management practices	select cover crop types and varieties adapted to the region	Cover crops recycle nutrients that might otherwise be lost to leaching during the winter and spring.	Past research has shown that fields with winter cover plowed under in the spring have 55 percent less water runoff and 50 percent less soil loss annually than do fields with no winter cover	potentially high	water erosion control, wind erosion control, improved soil tilth, improved crop yield	agriculture, stormwater, drinking water, water quality, nutrient loading, pathogens, education, sustainability	SWCD, CCE, USDA, NRCS, landowners	Nutrient management (590) cost sharing may be available through USDA NRCS Environmental Quality Incentives Program (EQIP) or Ag Nonpoint Source programs	Identify 3 significant joint projects and seek funding within one year	$40-$70-per-acre range	N/A
26	**Low**	Implement vegetated filter strips (edge of field solutions) where appropriate	define and protect critical areas	help farms enter AEM program to take advantage of this technology	slow runoff from fields, trapping and filtering sediment, nutrients, pesticides and other potential pollutants before they reach surface waters	project-dependent	project-dependent	lower nutrient loadings	agriculture, stormwater, drinking water, water quality, sediment	USDA, NRCS, SWCD, CCE, landowners	cost-sharing for this program may be available through the Conservation Reserve Program	x% of defined critical areas within 10 years	$100,000	N/A
27	**Low**	Expand agricultural and soil health initiatives that provide technical assistance and incentives to implement practices such as cover cropping, nutrient management, conservation tillage, conservation cropping systems	improve profitability and competitiveness of farms while protecting the environment	research existing institutional offerings and body of research	utilize research done by Cornell nutrient management, soil science, etc.	potentially high	potentially high	Improve soil health to increase infiltration/water retention capcity; reduce stormwater runoff	agriculture, stormwater, drinking water, tourism, water quality, nutrient loading, pathogens, sustainability	NRCS, SWCDs, NYSDAM, CCE, Cornell Nutrient Management Spear Program	cost-sharing for this program may be available through the Conservation Reserve Program	one priority project per year	$50,000	N/A
28	**Low**	Install fences to keep livestock from critical areas, including streams and other water bodies	implement agricultural best management practices	identify critical areas	2 strand HT only meets the standard for adult dairy cows, and they must both be electrified. 3-5 strand HT is the minimum allowed by NRCS standards for critical area fencing for all other livestock	project-dependent	potentially high	maintain integrity of stream channel and banks to mitigate nutrient and soil runoff into surface waters	agriculture, stormwater, drinking water, water quality, sediment	NRCS, SWCD, landowners	cost-sharing for this program may be available through the Conservation Reserve Program	100% of critical areas protected by 2016	$1.80-$2.50 per foot depending on post spacing	N/A
29	**Low**	Development, distribution and analysis of a follow-up comprehensive farm survey (original survey conducted in 1997 and 1998)	quantify impact of agricultural best practices implementation over the last 15 years	design new survey	quantify the non-point source impacts by agricultural activities using a comprehensive farm survey in conjunction with a nonpoint source computer model	N/A	N/A	new computer models (such as MapShed and BATHTUB) and orthoimagery upgrades significant since last survey	agriculture, water quality	PAC, SLAP-5, SWCD, SLPWA, FLI, STCRPDB, G/FLRPC, academic institutions	EPF	2-3 years	$100,000-$300,000	N/A
30	**Stormwater Management & Erosion Control**													
31	**Highest (*Top 5 overall)**	Provide education and training of local officials on erosion controls and stormwater management	strengthen local capacity for successful management and protection of watersheds by empowering decisionmakers	SLAP-5 and PAC coordination	begin with towns with most severely degraded streambank segments	reduced erosion, sedimentation	potentially high	reduced erosion, sedimentation	stormwater, drinking water, water quality, education	NYSDOS, NYSDEC, counties, municipalities, G/FLRPC, STC, SWCD, PAC, SLAP-5, SLPWA, FLI, academic institutions, CCE	LWRP, Cleaner Greener Communities	number of trainings held annually	$1,500/year	N/A
32	**High**	Revise land use laws to limit development on slopes greater than 10%	To reduce sedimentation and runoff into the lake.	Provide municipalities with draft language for zoning laws.	reduced runoff	reduced erosion, sedimentation	potentially high	reduced erosion, sedimentation	development, site planning, design standards	Regional Planning Boards, County planning offices, municipal planning boards	LWRP, Cleaner Greener Phase III	On-going - Long Term	Varies...should be combined with other tasks that revise local codes for efficiency. In combination	Each municipality to adopt amendments to zoning law.
33	**Medium**	Continue and expand the program of streambank inventories throughout the watershed to identify priority segments in need of restoration	prioritize streambank segments for restoration	develop inventory and assessment protocol, prioritize remediation efforts, train volunteer assessors	Use existing streambank inventory (Seneca Lake, 1999) to target implementation	reduced erosion, sedimentation	high	reduced erosion, sedimentation	Stormwater, drinking water, water quality, sediment, education, sustainability	G/FLRPC, STC, PAC, SLAP-5, SLPWA, FLI, academic institutions	LWRP, Cleaner Greener Phase III	Full inventory of six streams per year	$15,000/year	N/A

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1	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
34	**Medium**	Require new developments to maintain the volume of runoff at predevelopment levels by using structural controls and pollution prevention strategies	Assist the Town of Horseheads, City of Geneva, Town of Phelps, Town of Seneca, Village of Burdett, Town of Catharine, Town of Cayuta, Town of Dix, Town of Hector, Town of Montour, Village of Montour Falls, Village of Odessa, Town of Orange, Town of Reading, Town of Fayette, Town of Tyrone, Town/Village of Lodi, Town/Village of Ovid, Town of Romulus, Town of Varick, Town of Waterloo, Town of Benton, Town/Village of Dresden, Town of Barrington, Village of Dundee, Town of Jerusalem, Town of Milo, Village of Penn Yan, Town of Potter, Town of Starkey, Town of Torrey	Integrate into all zoning, subdivision, and/or site plan review controls; no new stormwater discharge pipes into lake	adoption of a Stormwater Management & Erosion Control Local Law and the enforcement of performance standards	reduction of the total water quality volume by application of green infrastructure techniques and stormwater best management practices	reduction of sedimentation and runoff	Minimizing erosion to protect habitat and reduce stress on natural water systems by preserving steep slopes in a natural, vegetated state	development, stormwater, drinking water, water quality, comprehensive planning	municipalities	stormwater management fees calculated using a formula based on the square footage of impervious surface per lot	20% in 5 years of ones that presently do not have controls	$15,000	municipalities
35	**Low**	Create green infrastructure standards	Town of Catlin, Town/Village of Horseheads, Village of Millport, Town of Veteran, City/Town of Geneva, Town of Gorham, Town of Phelps, Town of Seneca, Village of Burdett, Town of Catharine, Town of Cayuta, Town of Dix, Town of Hector, Town of Montour, Village of Montour Falls, Village of Odessa, Town of Orange, Town of Reading, Town of Fayette, Town of Tyrone, Town/Village of Lodi, Town/Village of Ovid, Village of Watkins Glen, Town of Romulus, Town of Varick, Town of Waterloo, Town of Benton, Town/Village of Dresden, Town of Barrington, Village of Dundee, Town of Jerusalem, Town of Milo, Village of Penn Yan, Town of Potter, Town of Starkey, Town of Torrey	adoption of a Stormwater Management & Erosion Control Local Law and the enforcement of performance standards	Low Impact Development, such as Bioswales (roadside ditches) and bioretention areas (sunken gardens), French drains (retention trenches) and brick and cobblestone streets (pervious pavers)	reduce impervious cover	potentially high	reduced erosion, sedimentation	development, comprehensive planning, site planning, design standards	Regional Planning Boards, County planning offices, municipal planning boards	USEPA, NYSDEC, stormwater management fees calculated using a formula based on the square footage of impervious surface per lot	% pervious surfaces	combine with other tasks that revise local codes for efficiency. In combination with other local codes. $15,000	municipal
36	**Low**	Restore very severe streambank segments using Watershed Stream Restoration Method based on State of the Lake Erosion Potential Index Number (1999).	slow down sediment yield of 143 tons of sediment/bank mile/year (total load of 43,657 tons per year)	develop inventory and assessment protocol, prioritize remediation efforts, train volunteer assessors	Erosion Potential Index Number was largest in Catharine Creek, Big Stream, Keuka Lake Outlet, Reading, Starkey, Long Point, and Satterly Hill subwatersheds	slow down sediment yield of 143 tons of sediment/bank mile/year (total load of 43,657 tons per year)	high	reduced erosion, sedimentation	agriculture, stormwater, drinking water, water quality, sediment	SWCD, CCE, landowners	LWRP, Cleaner Greener Phase III	3 miles/year for 10 years	$50-$100/foot	N/A
37	**Forestry & Silviculture Management**													
38	**Low**	Encourage private landowners to apply sound forest management practices to woodlands: NYS Forestry Best Management Practices for Water Quality	preserving the integrity of our forests balanced with economic development and maintaining our diverse wildlife population while minimizing damage to the agriculture and rural communities	apply forestry best management practices	sustainable forestry management, plan for conservation easements, protecting water quality and the forest and soil resources	project-dependent	project-dependent	Protecting water quality, forest and soil resources are among the most important aspects of a successful and environmentally sustainable timber harvest.	stormwater, drinking water, water quality, sediment, education, sustainability	NYSDEC, CCE, Cornell Agroforestry Research Center, GFLRPC, municipalities, landowners	federal Stewardship Incentives, Forestry Incentives, Tree Assistance and Conservation Reserve Programs	Ongoing as appropriate for the program	N/A	N/A
39	**Low**	Coordinate with the New York State Cooperative Forest Management Program administered by the NYSDEC to encourage the private forest landowners in New York to apply sound forest management practices to their woodlands	preserving the integrity of our forests balanced with economic development and maintaining our diverse wildlife population while minimizing damage to the agriculture and rural communities	plantation establishment and care, the marking of timber, marketing assistance and silvicultural treatment of immature stands	sustainable forestry management, plan for conservation easements	project-dependent	project-dependent	increasing contact between landowners and professional foresters promotes wise stewardship of forest land	stormwater, drinking water, water quality, sediment, education, sustainability	NYSDEC, CCE, Cornell Agroforestry Research Center	federal Stewardship Incentives, Forestry Incentives, Tree Assistance and Conservation Reserve Programs	Ongoing as appropriate for the program	$3,000	N/A
40	**Wastewater Treatment Systems and Management**													

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
41	**Highest (*Top 5 overall)**	Adopt uniform sanitary law throughout the Seneca Lake watershed based on the Ontario County model or the model Local Law for On-Site Individual Wastewater Treatment	Assist Town of Catlin, Town of Horseheads, Village of Millport, Town of Veteran, Town of Catharine, Town of Cayuta, Town of Dix, Town of Hector, Town of Montour, Village of Montor Falls, Village of Odessa, Town of Orange, Town of Reading, Town of Fayette, Town of Tyrone, Town of Lodi, Town of Ovid, Town of Romulus, Town of Varick, Town of Waterloo, Town of Benton, Town of Dresden, Village of Dundee, Town of Potter, Town of Starkey, Town of Torrey	Residences within 500 feet of the Lake and 150 feet of tributaries should be considered in a critical environmental zone and subject to more frequent inspection. ubstandard systems in this zone should be required to install holding tanks until systems can be brought into compliance.	Examine pros and cons of existing uniform sanitary laws in the region and in other collaborative septic program to reduce effluent disposal into Seneca Lake	Reduce nutrient and pathogen runoff into groundwater and surface waters	Reduce nutrient and pathogen runoff into groundwater and surface waters	Reduce nutrient and pathogen runoff into groundwater and surface waters	OWTS, water quality, drinking water, education, pathogens	NYSDOH, SWCD, WQCC, county health department, county planning department	LWRP, Cleaner Greener Phase II	all towns signed onto uniform agreement by 2020	$15,000 in staff cost	municipalities
42	**High**	Educate the general public on the role, process, accomplishments, needs, and future strategy of sewer districts and wastewater treatment facilities.	educating a broad range of people to help carry out best practices	identify experts in WWTPs, such as Ithaca WWTP operator Dan Ramer	stakeholder discussions to consider the potential for the effects of increased population growth and associated increased point source loading	N/A	N/A	educating a broad range of people to help carry out best practices	OWTS, water quality, drinking water, nutrient loading, pathogens, education, sustainability, infrastructure	NYSDEC, PAC, CCE, educational institutions, wastewater treatment facilities, PAC, county health departments, county planning departments, municipalities	LWRP	Target high priority communities beginning in year 1. Offer assistance and materials as appropriate.	$10,000	N/A
43	**Medium**	Implement and promote programs to encourage homeowners to adopt best practices for septic system maintenance	prevent discharge of nutrients and pathogens from OWTS to surface and ground waters	Collate existing best practices into a single document that is accessible to the whole watershed	Target audience includes home owners, local code enforcement officers, design professionals, and representatives of State and County Health Departments	Reduce nutrient and pathogen runoff into groundwater and surface waters	Reduce nutrient and pathogen runoff into groundwater and surface waters	Reduce nutrient and pathogen runoff into groundwater and surface waters	OWTS, water quality, drinking water, nutrient loading, pathogens, education	CCE, Planning, SWCDs	unknown	50 homeowners and 30 professionals trained within 4 years	$5,000	N/A
44	**Low**	Revise land use laws to require infiltration rates (Perc. Test) be tested for development. Limiting development in soils with high runoff potential	limit loading in soils with high runoff potential	Provide municipalities with draft language for zoning laws.	reduced runoff	Reduce nutrient and pathogen runoff into groundwater and surface waters	Water quality restoration	Water quality restoration	Site planning, design standards, open space	Regional Planning Boards, Five watershed counties, Soil and Water Conservation Districts	LWRP, Cleaner Greener Phase II	Medium Term	$15,000 in staff cost	Each municipality to adopt amendments to zoning law.
45	**Low**	Host technology transfer workshops for those responsible for evaluating alternative and innovative OWTS technologies	elevate quality of future OWTS	coordination with PAC and SWCD	Target audience is local code enforcement officers, design professionals, and representatives of State and County Health Departments	Reduce nutrient and pathogen runoff into groundwater and surface waters	potentially very high	Onsite systems are effective when properly designed, installed and maintained.	OWTS, water quality, drinking water, education, pathogens	NYSDOH, SWCD, county health department, county planning department	unknown	Workshop offered watershed-wide annually through 2016	$12,000	N/A
46	**Low**	Hold educational/ training sessions targeted towards OWTS installers, owners, and municipal officials	elevate quality of future OWTS	identify experts in OWTS and organize sessions	Contractors and others associated with septic system design and construction, municpal officials (elected, planning, zoning), homeowners	potentially high	Water quality restoration	Carefully directing development in soils with high runoff potential	OWTS, water quality, drinking water, nutrient loading, pathogens, education	G/FLRPC, STCRPDB, CCE, SWCD, counties, municipalities, county health department, county planning department	EPF	50 homeowners and 30 professionals trained within 4 years	$7,500	N/A
47	**Hazardous Waste Management**													
48	**High**	Conduct a follow-up study to determine the location of inactive or unpermitted landfills, dumps and hazardous material storage, as well as mined lands and petroleum bulk storage facilities	Determine dates of operation, the type of materials disposed at each and the vulnerability of water resources	develop inventory and assessment protocol, prioritize remediation efforts, identify potential solutions	Expand on list of hazardous sites in Characterization Chapter 5	unknown	project-dependent	project-dependent	drinking water, water quality, pathogens, fertilizers, pesticides, organic compounds	USEPA, USGS, NYSDEC, PAC	NYSDEC	100% of counties and muncipalities surveyed	$40,000	N/A
49	**High**	Assess concentrations and significance of contaminants such as pesticides, trace metals, and persistent organic pollutants in fish, wildlife, and vulnerable fish-consuming populations	Monitoring/Planning	develop proposals and identify funding sources to conduct work	Identify high priority chemicals based on toxicity, persistence, potential health impacts, high exposure levels	better understanding of legacy and emerging contaminant exposure levels, and the sub-watershed and temporal trends of contaminants	project-dependent	learning more about potential risk associated with chemicals in the watershed	drinking water, water quality, pathogens, fertilizers, pesticides, organic compounds	NYSDEC, NYSDOH, NYSERDA, research institutions	NYSDEC, NYSERDA, US EPA, USGS	additional monitoring and research studies completed targeting chemicals	Varies based on studies, target chemicals	N/A

	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
50	**High**	Provide outreach and education to community, schools, and other institutions on geen chemistry, green engineering, and other pollution prevention practices	Education/Outreach	identify curricular resources and contacts to provide expertise	Promote new permanent drop-off locations in Ontario County	pollution prevention practices are implemented by target groups	reduced discharge of chemicals into surface waters through point and non-point sources	Prevent chemicals from being used without thought for product development, use, disposal	drinking water, stormwater	NYSDEC, NYSPPI	NYSPPI, Empire State Development Corporation, US EPA	development and delivery of outreach programs for pollution prevention	$25,000	N/A
51	**High**	Implement watershed-wide pickup of hazardous wastes and obsolete/canceled use pesticides using the "Clean Sweep" model	reduce hazardous wastes in watershed	schedule pickups and publicize	coordination with PAC and SWCD; promote new permanent drop-off locations in Ontario County	potentially high	potentially high	By providing the public with an opportunity to safely dispose of such hazardous products, we keep these products out of landfills and lower the environmental risks associated with such improper disposal.	agriculture, stormwater, drinking water, water quality, fertilizers, pesticides, organic compounds	NYSDEC, SWCD, CCE, landowners	NYSDEC administers state assistance programs for household hazardous waste (HHW) programs. Funding is provided on a 50% reimbursement rate for eligible costs.	regular program for hazardous waste disposal	$120,000	N/A
52	**Medium**	All wells to be tested with any transfer of property regardless of mortgage/sale requirements	Reduce number of contaminated wells	provide draft language (schuyler county model) and have counties provide support/funding for this testing	reduction in contaminants seeping into latek	see reductions	Improved water quality	Reduce potential for groundwater contamination	drinking water, water quality, organic compounds, education	County watershed inspectors, Soil and Water Conservation Districts	County funded	Medium Term	TBD.	County Legislation.
53	**Low**	Distribute hazardous spills information throughout the watershed to various community groups, fire departments, chamber of commerce, citizens, municipalities with names and numbers of the agencies and staff in charge and who has appropriate jurisdiction in emergency situations	strengthen local capacity for successful management and protection of watersheds by empowering decisionmakers	identify experts in hazardous waste management and organize sessions	organize sessions	N/A	N/A	strengthen local capacity for successful management and protection of watersheds by empowering decisionmakers	drinking water, water quality, organic compounds, education	NYSDEC, county planning department, PAC, county health department	unknown	number of trainings held annually	$2,500	N/A
54	**Low**	Significantly reduce toxic chemical use from industrial and commercial sources by providing tax incentives, loans and grants to organizations, as well as direct technical assistance through NYS programs	Action - Project	identify programs from NYS that may be used as incentives	Reduce use of toxic chemicals	Less chemicals released to air, water, soil of watershed	lower toxic chemical burden in organisms in watershed	less potential harmful impacts from chemicals	drinking water, fish, wildlife, human health	NYSPPI, NYS MEPs, All	unknown	reduced chemical discharges into air, water, soil	unknown	N/A
55	**Low**	Prevent discharge of pharmaceuticals through community collection programs and by promoting best management practices and process changes at health care institutions, livestock and food industries, and other manufacturers	Education/Outreach	work with community partners to identify pharmaceutical drop off programs and locations	Promote new permanent drop-off locations in Ontario County	discharges of pharmaceutical chemicals and by-products are reduced	lower toxic chemical burden in organisms in watershed	less potential harmful impacts from chemicals	drinking water, fish, wildlife, human health	NYSDEC, NYSDOH, communities, SLPWA	unknown	reduced chemical discharges into air, water, soil	unknown	N/A
56	**Low**	Identify or develop public educational materials to describe landfill issues, such as the difference between old and new types of landfills, threats to public health and water quality, and the need to ensure that sites are closed properly	educating a broad range of people to help carry out best practices	research available materials and customize to suit Seneca Lake	utilize and distribute research, organize training sessions	N/A	N/A	strengthen local capacity for successful management and protection of watersheds by empowering decisionmakers	drinking water, water quality, pathogens, fertilizers, pesticides, organic compounds, education	USEPA, USGS, NYSDEC, PAC, counties	unknown	Identify resources and share locations on web site and with collaborating agencies (6 months).	$3,000	N/A
57	**Roads and Highways**													
58	**High**	Educate municipal and county highway departments on ditch and culvert design and stream bank stabilization methods.	Education of DOT's, Highway superintendents, and Soil and Water conservation	Provide education to those working on ditch, cuverts and streams	reduced runoff, sedimentation	project-dependent	project-dependent	project-dependent	Design Standards	Soil and Water Conservation Districts, State DOT, County DOT, Highwya Superintendents	604(b), WQIP	Medium Term	Varies...education should be on going. For the entire watershed, maybe $5,000 a year	N/A
59	**Medium**	Increase training for highway officials in erosion control, hydroseeding, and road deicing	Education of DOT's, Highway superintendents, and Soil and Water conservation	Provide education to those working on ditch, cuverts and streams	reduced runoff, sedimentation	project-dependent	project-dependent	project-dependent	education	G/FLRPC, STCRPDB, NYSDOT, counties, municipalities	604(b), WQIP	Medium Term	$5,000/year	N/A

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1	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
60	**Medium**	Require special vegetative measures such as hydroseeding and mulching of roadside swales based on purchasing and sharing of hydroseeder and training and education of municipal, county, and state highway departments	repair cut, bare, and collapsing banks, exposed roots, and blow-out holes in ditch bottoms and gully erosion	assessment of most severe sites	Initial hydroseeding should occur on the very severe sites, based on the Seneca Lake Characterization roadbank inventory	estimated soil erosion rates of 100 to 200 tons per bankside mile	potentially high	reduced runoff, sedimentation	development, stormwater, drinking water, water quality, sediment, comprehensive planning	NYSDOT, counties, municipalities	604(b), WQIP	20% of very severe ditches/year	$150,000	N/A
61	**Medium**	Use sensible de-icing material application procedure (e.g. intersections, posting of signs, driver education)	Develop guidelines and implement sensible deicing procedures	educate on best management practices for winter maintenance, including a salt management plan, development of an anti-icing strategy, and precision application techniques	Focus on hydrologically-connected roads – roads that are designed to contribute surface flow directly to a drainage channel – which have the greatest potential to deliver road-derived contaminants to streams	potentially high	potentially high	balanced with cost with temperature	stormwater, drinking water, water quality, education	NYSDOT, counties, municipalities, Cornell Local Roads	604(b), WQIP	long-term reduction of salt-only road de-icing, shift to more holistic approach	depends on materials used	N/A
62	**Low**	Conduct a follow-up salt survey study to determine the location of salt storage and application practices in the Seneca Lake Watershed	G-FL region collaborative effort to reduce the threat to the chemical and physical characteristics of the lake, and reduce pollution of groundwater	develop (or assess previous) survey, identify municipal and private salt storage facilities, gather responses	reduce impact of salt application, mixing, or storing on Seneca Lake	potentially high	potentially high	reduction of threat to the chemical and physical characteristics of the lake, and reduce pollution of groundwater	water quality	G/FLRPC, STCRPDB, NYSDOT, counties, municipalities	EFP, NYSDEC	long-term reduction of salt-only road de-icing, shift to more holistic approach	$15,000	N/A
63	**Wetlands**													
64	**Highest (*Top 5 overall)**	Restore degraded wetlands (based on watershed-wide analysis of potential benefit to water quality, habitat, and hydrology)	Inventory all wetlands in watershed to establish priorities	prioritize wetlands for restoration	develop inventory and assessment protocol, prioritize remediation efforts, train volunteer assessors	absorb the forces of flood and tidal erosion to prevent loss of upland soil	potentially high	Protection of the areas surrounding wetlands improves the functions of the wetland	agriculture, development, stormwater, drinking water, water quality, organic compounds, fertilizers, pesticides, heavy metals, nutrient loading, pathogens, sediment, comprehensive planning	NYSDEC, USEPA, SWCD, NRCS	EPF	20 acres/year at $5,000/acre	$50,000	N/A
65	**Medium**	All municipalities that do not presently deal sufficiently with flood plain development within local law should adopt ordinances prohibiting development in 100-year floodplain, restrict location of barnyards and manure pits, and require elevation certificate required for all new development in Zone X	Assist Town of Catlin, Town/Village of Horseheads, Village of Millport, City/Town of Geneva, Town of Gorham, Town of Phelps, Town of Seneca, Town of Catharine, Town of Cayuta, Town of Dix, Town of Hector, Town of Montour, Village of Montour Falls, Village of Odessa, Town of Orange, Town of Reading, Town of Fayette, Town of Tyrone, Town/Village of Lodi, Town/Village of Ovid, Village of Watkins Glen, Town of Romulus, Town of Varick, Town of Waterloo, Town of Benton, Town/Village of Dresden, Town of Barrington, Village of Dundee, Town of Jerusalem, Town of Milo, Village of Penn Yan, Town of Potter, Town of Starkey, Town of Torrey	draft language, request review by NYSDAM if there is concern about conflict with existing Right to Farm law	reduce loss caused by floods and prevent animal waste from entering water bodies	potentially high	Improved water quality and diminished losses	reduce loss caused by floods and prevent animal waste from entering water bodies	agriculture, development, stormwater, drinking water, water quality, organic compounds, fertilizers, pesticides, heavy metals, nutrient loading, pathogens, sediment, comprehensive planning	Regional Planning Boards, municipalities, landowners	EPA, 604(b), WQIP	20% within 5 years	combine with other tasks that revise local codes for efficiency. In combination with other local codes. $15,000	Adoption and enforcement of strategy by each municipality and/or each county.
66	**Medium**	All municipalities that have land use control ordinances should require review of disturbances within 100 ft of all natural wetlands and all municipalities should prohibit discharge of stormwater to wetlands without prior treatment	preservation of wetlands as natural habitat for many species of plants and animals and for critical flood and stormwater control functions	preservation of wetlands as natural habitat for many species of plants and animals and for critical flood and stormwater control functions	evaluate through GIS and EAF Mapper by parcel, integrate into all zoning, subdivision, and/or site plan review controls	absorb the forces of flood and tidal erosion to prevent loss of upland soil	potentially high	Protection of the areas surrounding wetlands improves the functions of the wetland	agriculture, development, stormwater, drinking water, water quality, organic compounds, fertilizers, pesticides	municipalities, landowners	N/A	all municipalities with wetlands adjacent to riparian corridors	N/A	Adoption and enforcement of strategy by each municipality and/or each county.

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1	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
67	**Low**	Enforce floodplain development regulations	Reduce loss caused by floods.	Flood/Hazard mitigation strategy and code enforcement	Reduction of loss due to flood as well as erosion and sedimentation due to flooding	see reductions	Improved water quality and diminished losses	Improved water quality and diminished losses	agriculture, development, stormwater, drinking water, water quality, organic compounds, fertilizers, pesticides, heavy metals, nutrient loading, pathogens, sediment, comprehensive planning	Regional Planning Boards, County Emergency Management Councils, County Planning	EPA, 604(b), WQIP	Medium Term	TBD	Adoption and enforcement of strategy by each municipality and/or each county.
68	**Regulatory Management**													
69	**High**	Adopt stream buffer setback regulations.	Reduce the amount of harmful runoff and sedimentation into the lake caused by land use activities.	Provide municipalities with draft language for zoning laws.	Reduce contaminated runoff due to development/ agriculture	project-dependent	project-dependent	reduced erosion, sedimentation	Site Planning, design standards and Ag planning	Regional Planning Boards, County planning offices, municipal planning boards, Agricultural Protection Boards	LWRP, 604(b), WQIP	Medium Term	Varies…should be combined with other tasks that revise local codes for efficiency. In combination with other local codes. $15,000	Each municipality to adopt amendments to zoning law.
70	**High**	Draft (or revise) a comprehensive plan emphasizing the protection of local water resources and recognizing the importance of watershed planning efforts within the Seneca Lake watershed and other neighboring watersheds within the municipality	adoption of a comprehensive plan	charrettes, gather widespread public input, draft initial comprehensive plan as strategic document that sets out the broad goals and vision of the community	Town of Catlin, Town of Horseheads, Village of Millport, City of Geneva, Village of Burdett, Town of Catharine, Town of Cayuta, Village of Odessa, Town/Village of Lodi, Town/Village of Ovid, Town of Romulus, Village of Dundee, Town of Potter, Town of Starkey	N/A	potentially high	public engagement with plan development process and solidification of watershed management and related topics such as water quality, stormwater management, and erosion and sediment control as municipal priorities	water quality, comprehensive planning	G/FLRPC, STCRPDB, counties, municipalities	NYSERDA Cleaner Greener Communities program	updated comprehensive plans and zoning	$5,000-$100,000	municipality
71	**Medium**	The Intermunicipal Organization working with municipalities and through County Health Departments should consider adopting Watershed Rules and Regulations, which could lead to the development of a Watershed Inspector position	strengthen local capacity for successful management and protection of watersheds	review existing regional programs, collaboratives, and case studies for guidance	Chemung County, Seneca County, Yates County	potentially high	potentially high	strengthen local capacity for successful management and protection of watersheds by empowering decisionmakers	drinking water, water quality,	PAC (IO), county, municipalities	unknown	Written within 1 year, approval of NYSDOH within 2 years	$50,000	all muncipalities signed on to MOU
72	**Medium**	Protection of white deer population	Seneca Army Depot Conservation Area	Conservation Plan	Wildlife analysis	N/A	N/A	wildlife conservation	development, open space	NYSDEC	NYSDEC	Plan development	unknown	N/A
73	**Medium**	Counties and municipalities should consider agricultural protection and preservation while addressing associated land conservation and water quality concerns though various county, state and federal programs.	IO should help to develop methods to assist in implementation of plans	review existing regional programs, collaboratives, and case studies for guidance	conservation easements, viewshed analysis, scenic preservation, rural design guidelines, tax districts	potentially high	potentially high	strengthen local capacity for successful management and protection of watersheds by empowering decisionmakers	agriculture, development, tourism, comprehensive planning, sustainability, economic development	counties, muncipalities	NYSDAM	Updated farmland and agricultural protection plans	$25,000	N/A
74	**Low**	The IO along with each municipality and county agency should educate themselves about specifics of federal and state regulations and programs, and funding as they relate to nonpoint source pollution and water quality.	strengthen local capacity for successful management and protection of watersheds by empowering decisionmakers	IO coordination with FLI and SLPWA, PAC, SLAP-5	Representative of each municipality attend 2-3 workshops per year	potentially high depending on funding acquired	project-dependent	strengthen local capacity for successful management and protection of watersheds by empowering decisionmakers	agriculture, development, stormwater, drinking water, water quality, OWTS, wastewater treatment, water quality standards, education	PAC (IO), county, municipalities	unknown	Representative of each municipality attend 2-3 workshops per year	$300 per municipality per year	N/A

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1	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
75	**Low**	Municipalities should encourage alternative agricultural uses of land within comprehensive planning and zoning structure	Update comprehensive plans and zoning to reflect this	review existing regional programs, collaboratives, and case studies for guidance	cluster subdivisions, LEED-ND	N/A	potentially high	public engagement with plan development process and solidification of watershed management and related topics such as water quality, stormwater management, and erosion and sediment control as municipal priorities	agriculture, development, tourism, comprehensive planning, sustainability, economic development	counties, municipalities	NYSERDA Cleaner Greener Communities program	updated comprehensive plans and zoning	$5,000-$100,000	municipalities, counties, NYSDAM
76	**Low**	All municipal elected officials, enforcement officers, highway superintendents, boards, and related professional staff should attend training on Stormwater Phase II state and federal regulations	strengthen local capacity for successful management and protection of watersheds by empowering decisionmakers	IO coordination with FLI and SLPWA, PAC, SLAP-5	Representative of each municipality attend 4 workshops per year	N/A	project-dependent	strengthen local capacity for successful management and protection of watersheds by empowering decisionmakers	agriculture, development, stormwater, runoff, drinking water, water quality, sediment, erosion	county, municipalities	unknown	Four workshops a year	$6,000	N/A
77	**Low**	Municipalities consider adoption of aquifer protection laws.	Protect the drinking water from harmful contaminants.	Provide municipalities with draft language for land use law.	Protected water	Fewer water quality issues	Improved water quality	Improved water quality	water quality, comprehensive planning	Regional Planning Boards, County planning offices, municipal planning boards	LWRP, Cleaner Greener Phase II	Medium Term	Combine with other recommended land use law updates.	Each municipality to adopt an aquifer protection law.
78	**Low**	Purchase of shoreline parcels	Finger Lakes Water Trails	Water Trails/Access analysis	Identfication of strategic locations	potentially high	potentially high	Access	development, open space	County planning, regional planning, NYSDEC, SLPWA, SLAP-5, municipalities	LWRP	Number of parcels purchased, increased access	$100,000	yes, for built access
79	**Low**	Extension of eastern terminus of Outlet Trail to Seneca Lake Shoreline	Finger Lakes Water Trails	Water Trails/Access analysis	Analysis of extension and rights of way	N/A	project-dependent	Access	development, open space	County planning, regional planning, NYSDEC, SLPWA, SLAP-5, municipalities, MPO, NYSDOT	UPWP, TEP	Trail development	$100,000	yes, for trail
80	**Low**	Open space conservation	Site planning, design standards	Site plan standards, decrease minimum lot sizes, increase density, cluster subdivisions, buffing water courses	Develop site plan standards including minimum lot size, increased density, cluster subdivision, and water course setback standards and options	Stormwater runoff, sediment, nutriets	potentially high	conservation of open space and farmland, water quality restoration	development, open space, local laws, design standards	County planning, regional planning, municipalities	LWRP	Developed land, farmland, residential density, infrastructure, water quality	$200,000	local law updates
81	**Invasive Species Management**													
82	**High**	Support invasive species outreach and education initiatives	Prevention and education are most important for invasive species prevention	share information and best practices for education programs and campaigns	Leverage resources of PRISM	prevent new introductions of invasive species	limited disruption of ecosystem function	More public engagement	water quality, sport fishing, recreation	PRISMs, Cornell Cooperative Extension	PRISM, NYS DEC, USFWS, USEPA, Ag and Markets	number of individuals reached for invasive species messaging	$15,000	N/A
83	**High**	Conduct research and monitoring to improve early detection and management of IS	Early detection of species may prevent full invasion	determine locations for most likely invasions; prioritize highly invasive species	Target highly probable areas	identify new invasive species at low point of invasion curve	limited disruption of ecosystem function	Improved detection and management capabilities	water quality, sport fishing, recreation	ISRI, PRISMs	PRISM, NYS DEC, USFWS, USEPA, Ag and Markets	locations sampled and negative findings	$50,000	N/A
84	**Medium**	Increase state, regional and local capacity to respond to new or additional invasive species discoveries	Engage as many partners as possible	share information and best practices for invasive species detection and management	Participate in Finger Lakes PRISM	additional resources available for rapid response	limited disruption of ecosystem function	Enhanced state and local response coordination and capacity	water quality, sport fishing, recreation	PRISMs, Municipalities	PRISM, NYS DEC, USFWS, USEPA	number of individuals in field looking for invasive species	unknown	N/A
85	**Medium**	Support watercraft steward programs at boat launches	Prevention and education are most important for invasive species prevention	identify funding and volunteers for steward duties	Work with watershed groups on coordinated messaging and programs	prevent new introductions of invasive species	limited disruption of ecosystem function	Reduced spread as boat launches are highly probable areas for spread	water quality, sport fishing, recreation	PRISMs, Cornell Cooperative Extension, SLPWA, FLI	PRISM, NYS DEC, USFWS, USEPA	number of stewards working at launches in watershed	$15,000	N/A
86	**Medium**	Install boat cleaing stations and informational kiosks at public boat launches	Provide location where species can be removed from watercraft entering and exiting waters	identify high use locations and best design based on existing infrastructure	Target high use launches	prevent new introductions of invasive species	limited disruption of ecosystem function	Reduced spread	water quality, sport fishing, recreation	Municipalities, watershed groups	PRISM, NYS DEC, USFWS, USEPA	boat washing station installed at launches	$35,000	N/A
87	**Low**	Secure a sustainable funding stream for PRISMs	Keep invasive species funding in state budget	promote value of invasive species education and management	Communicate with local and state leaders about importance of PRISM program	prevent new introductions of invasive species	limited disruption of ecosystem function	Reduced spread	water quality, sport fishing, recreation	Municipalities	PRISM, NYS DEC, USFWS, USEPA	continuation of PRISM program in Finger Lakes region	N/A	N/A
88	**Low**	Implement integrated control strategies to addres high-priority aquatic and terrestrial invasive species	Ensure that terrestrial and aquatic invasive species programs are complementary of each other	when control measures are undertaken, look at other existing control programs	Coordinate with other water quality and land use groups and issues	leveraging resources for invasive species management	limited disruption of ecosystem function	Reduced impacts	water quality, sport fishing, recreation	NYSDEC, others	PRISM, NYS DEC, USFWS, USEPA	identification of existing plans, approaches	N/A	N/A

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Priority	Action	Objective	Steps (e.g., feasibility, design, permitting, construction)	Strategy	Anticipated Reductions	WQ Improvements	Benefits	Related Issue(s)	Lead and Potential Responsible Organization(s) (including sponsor, partners)	Potential Funding Sources	Measures/Targets (e.g., short-, medium-, or long-term)	Approximate Cost	Regulatory Approvals
89	**Low**	Develop rapid response plans to address high priority invasive species (e.g., Hydrilla, etc.)	Planning to be able to deal with new invasive species in a coordinated and timely fashion	share existing plans, list of possible invasive species	Have plan that can be used and updated to address new species introduced to Seneca Lake watershed	timely and coordinated response if new invasive species found and need to be managed	Prevent ecosystem function disruption - e.g., disruption of native species	Reduced risk of introducation and spread of invasives	water quality, sport fishing, recreation	ISRI, PRISMs	unknown	identification of existing plans, approaches	N/A	N/A
90	**Low**	Increase enforcement of existing related laws and regulations e.g., live bait, moving firewood	Use laws that are on the books already	connect with enforcement agencies to develop appropriate education and outreach programs	Work with enforcement agencies	fewer invasive species introductions	Prevent ecosystem function disruption - e.g., disruption of	Enhanced state and local response coordination and capacity	water quality, sport fishing, recreation	Planning, municipalities	unknown	identification of existing plans, approaches	N/A	N/A
91	**Low**	Enact appropriate regulations to minimize the introduction and spread of invasive species via boats/motor vehicles, other vectors	Promulgate as needed	outreach and education to elected officials about need for consistent laws	Work on consistent laws across jurisdictions	less confusion about existing laws	Prevent ecosystem function disruption - e.g., disruption of	Reduced introduction and spread	water quality, sport fishing, recreation	NY State, Municipalities, watershed groups	unknown	promulgation of consistent invasive species tranport laws across NYS	N/A	N/A

Appendix A

SENECA LAKE WATERSHED MANAGEMENT PLAN MEMORANDUM OF UNDERSTANDING FOR SENECA LAKE MUNICIPALITIES

This Memorandum of Understanding is among the five counties (Chemung, Ontario, Schuyler, Seneca and Yates) and municipal governments that geographically fall within the Seneca Lake Watershed in the Finger Lakes region of New York.

I. INTRODUCTION & BACKGROUND:

The Seneca Lake Watershed Management Plan was funded by a Local Waterfront Revitalization Grant (LWRP) through New York State Department of State. This plan was written by three partner organizations; Finger Lakes Institute at Hobart and William Smith Colleges, Genesee/Finger Lakes Regional Planning Council and Southern Tier Central Regional Planning and Development Board. The plan is an update of the 1999 report, "Setting a Course for Seneca Lake" in which an intermunicipal organization named Seneca Lake Area Partners of Five Counties (SLAP-5) was formed. The work of the Seneca Lake Watershed Management Plan was overseen by a Project Advisory Committee and coordinated with SLAP-5.

With the culmination of the Seneca Lake Watershed Management Plan, it is in the best interest of the water quality of Seneca Lake to form an intermunicipal organization of the five counties and municipal governments (see appendix) within the Seneca Lake watershed to implement the recommendations of the Seneca Lake Watershed Management Plan. The intermunicipal group will cooperate with SLAP-5 and work within the confines of this MOU. We respectfully issue a call for support of Seneca Lake's Watershed Management Plan.

II. RECITALS:

1.Each of the parties of this MOU is a local government or County entity functioning within the watershed of Seneca Lake.

2. The parties desire to recognize that an intermunicipal organization can best facilitate partnership across political boundaries to promote the ecological vitality of the Seneca Lake Watershed.

3. It is to the parties' mutual advantage and benefit to develop and implement cooperative restoration and protection efforts throughout the watershed, and to promote a regional alliance to supplement local government and county programs.

4. The parties hereto plan to continue exploring joint local, state, federal and other funding opportunities and to obtain public support for programs that implement the mission and goals of the Seneca Lake Watershed Management Plan.

5. The parties hereto recognize the value of using common resources effectively.

6. The parties hereto desire to be proactive in addressing watershed-based issues which affect areas beyond traditional political boundaries.

7. The parties hereto desire to educate the communities in the Seneca Lake Watershed about the importance of watershed stewardship.

8. The parties hereto wish to communicate and coordinate on local, state and federal policies and programs that affect water quality in Seneca Lake.

9. The parties hereto find that promoting stewardship of the Seneca Lake Watershed resources is in the public interest and for the common benefit of all within the Seneca Lake Watershed.

10.The parties agree to share information and coordinate efforts to comply with regulatory requirements.

11. The geographic boundaries of the Intermunicipal Organization shall be the entire Seneca Lake Watershed, including five counties (Chemung, Ontario, Schuyler, Seneca and Yates) and municipalities within the watershed.

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III. GENERAL PROVISIONS:

1. Definitions. As used in this MOU, the following words and phrases shall have the meanings set forth below unless the context clearly indicates otherwise.

   a. "MOU" shall mean this memorandum of understanding reconfirming SLAP-5.

   b. "Member" or "members" shall mean the representatives from the local governments and five counties encompassed in the Seneca Lake watershed.

   c. "Watershed" shall mean the entire Seneca Lake Watershed. A map depicting the boundaries of the watershed is appended.

2. Purpose. This MOU is to affirm each member's commitment to the mission, goals and objectives of the Seneca Lake Watershed Management Plan.

3. Establishment of the Intermunicipal Organization. There is hereby established the Seneca Lake Intermunicipal Organization. The geographic boundaries of the organization will be the entire Seneca Lake Watershed.

4. Vision. Watershed stakeholders, municipalities and government agencies will work together through implementation of the Seneca Lake Watershed Management Plan to maintain the common goal of clean water and sustainable watershed management for the future of the Seneca Lake Watershed. Sustainable watershed management must include local involvement in the planning and management of natural resources and be the shared responsibility of all stakeholders and watershed residents.

5. Organization Membership. Each of the five counties and municipal governments shall appoint one representative to participate in regular meetings and report actions to their local government. Further, one representative from each of the regional planning boards (Genesee / Finger Lakes Regional Planning Council and Southern Tier Central Regional Planning and Development Board), one representative from each county Soil and Water Conservation District one representative from area water quality interest groups such as Finger Lakes Institute and Seneca Lake Pure Waters Association (SLPWA) may be members of the organization.

6. Voting Requirements. Each organization that signs this MOU shall have one representative and one vote.

7. Quorum. A majority of the members of the organization shall constitute a quorum for the purposes of transacting business. Fewer than a quorum may vote to adjourn a meeting.

8. Officers and Terms. The organization shall have four officers elected by the organization every year at the January meeting.

   a. Chair: The Chair shall organize and attend each regular meeting. The chair will be responsible for writing an agenda and setting the direction and tone of the organization

   b. Vice Chair: Will provide support to the Chair and serve as the Chair in the absence of the Chair.

   c. Treasurer: Will keep track of and provide regular reports of any funding transactions to the organization.

   d. Secretary: Will take minutes of each regular meeting and make them available to all members and other interested parties.

9. Staff. The organization may employ staff as needed and as funding is available. One administration staff, member, or SLAP-5 member may be retained to write a regular newsletter, set-up and provide regular trainings and to provide regular outreach to member communities.

10. An annual plan of work shall be approved by a quorum vote of organization members.

IV. AGREEMENT:

Intermunicipal Organization members agree to:

a. Work together to protect the water quality of Seneca Lake, which in turn protects the quality of life for residents and the economic viability of the region.

b. Participate in regular Intermunicipal Organization meetings.

c. Work to implement recommendations of the Seneca Lake Watershed Management Plan's goals and objectives.

d. Participate in and provide watershed stakeholders with meaningful training opportunities.

e. Seek funding opportunities that meet the goals and objectives of the Seneca Lake Watershed Management Plan.

f. Strive to update the Seneca Lake Watershed Management Plan at least every 10 years.

V. EFFECTIVE DATE:

This MOU shall become effective on the date of signature below. This MOU is ongoing unless it is terminated by a member upon written notice to the remaining membership of this Intermunicipal Organization. This MOU may be amended at any time by mutual accord.

Signed:________________________________ Dates_______________

Witness: ________________________________