Owasco Lake Watershed Management and Waterfront Revitalization Plan

Watershed and Waterbody Inventory Report

May 2015

This report was prepared with funds provided by the New York State Department of State under Title 11 of the Environmental Protection Fund.

PROJECT MANAGER

Cayuga County Department of Planning and Economic Development

Cayuga County Office Building
160 Genesee Street, 5th Floor
Auburn, New York 13021
(315) 253-1276
www.cayugacounty.us/Departments/Planning-and-Economic-Development

PROJECT CONSULTANT

EcoLogic, LLC

9 Albany Street, Suite 3J
Cazenovia, New York 13035
(315) 655-8305
http://www.ecologicllc.com

Funding provided by the New York State Department of State
under Title 11 of the Environmental Protection Fund.
Grant awarded to the Cayuga County Department of Planning and Economic Development

Contents

Acronyms, Abbreviations and Linked Documents v

Chapter 1: Introduction 1-1
1.1 Objective and Scope of This Document 1-1
1.2 Sources of Data and Information 1-2

Chapter 2: Environmental Setting 2-1
2.1 Owasco Lake and the New York Finger Lakes 2-1
2.2 Geology and Soils 2-1
2.3 Surface Water 2-2
2.4 Groundwater 2-4
2.5 Wetlands 2-4
2.6 Climate, Precipitation and Flood Hazard 2-4
2.7 Ecological Communities and Rare, Threatened and Endangered Species 2-5

Chapter 3: State of the Watershed 3-1
3.1 Population and Trends 3-1
3.2 Land Cover 3-1
3.3 Waterfront Access, Parks, and Open Space Amenities 3-3
3.4 Agriculture and Farmland 3-3
3.5 Groundwater quality 3-5
3.6 Stream Classification and Designated Use 3-6
3.7 Stream Water Quality and Habitat Conditions 3-8
3.7.1 Stream Segment Analysis (FLI Monitoring) 3-8
3.7.2 Nutrient and Sediment Loading Estimates, Dutch Hollow Brook (FLI Monitoring) 3-12
3.7.3 Biological and Habitat Assessments 3-12
3.7.4 Stream Bank Management Plans 3-15
3.8 Phosphorus Loading Estimates 3-16
3.9 Wastewater Treatment and Disposal 3-17
3.9.1 Village of Moravia WWTP 3-18
3.9.2 Village of Groton WWTP 3-19
3.9.3 Onsite Wastewater Disposal Systems 3-20
3.10 Roads and Bridges 3-21
3.11 CAFOs and Other Potential Sources of Pollution 3-22
3.12 Summary of Changes in the Owasco Lake Watershed Since 2000 3-22

Chapter 4: State of Owasco Lake 4-1
4.1 Classification and Designated Use 4-1
4.2 Public Water Supply 4-2
4.3 Trophic State Assessment 4-5
4.3.1 Total Phosphorus, Chlorophyll-a, and Secchi Disk Transparency 4-5
4.3.2 Dissolved Oxygen 4-8
4.4 Bacteriological Quality 4-8
4.5 Lake Biota 4-10

4.5.1 Fish Community....4-10
4.5.2 Macrophytes 4-11
4.5.3 Plankton Community....4-14
4.5.4 Asian Clam 4-15

4.6 Sediment Quality 4-15
4.7 Lake Level Management....4-16
4.8 Summary of Changes in Owasco Lake Since 2000....4-18

Chapter 5: Current Restoration and Protection Efforts....5-1
5.1 Introduction....5-1
5.2 Streambank Restoration and Protection Projects....5-1
5.3 Lakeshore and Lake Restoration and Protection Projects....5-2
5.4 Agricultural Best Management Practices 5-4
5.5 Farmland and Open-Space Conservation Initiatives 5-6
5.6 Lake and Watershed Monitoring....5-7
5.7 Waterfront and Parks 5-8

5.7.1 Emerson Park Updated Master Plan 5-8
5.7.2 Owasco Flats Nature Reserve....5-9
5.7.3 Owasco Flats Wildlife Management Area 5-9

Chapter 6: Emerging Issues....6-1
6.1 Introduction....6-1
6.2 Agronomic Practices....6-1
6.3 Invasive Species 6-3
6.4 Cyanobacterial Blooms....6-3
6.5 Climate Change....6-4

TABLES

Table 2-1. Soil Association Acres and Percentages for the Owasco Lake Watershed 2-2
Table 2-2. Tributary Subwatersheds and Drainage Areas 2-3
Table 2-3. Morphometric Characteristics of the New York Finger Lakes 2-3
Table 2-4. Unique and Protected Species and Habitats of the Owasco Lake Watershed 2-6

Table 3-1. Summary of Land Cover Classifications for the Owasco Lake Watershed....3-2
Table 3-2. Groundwater Quality of Two Bedrock Wells in the Owasco Lake Watershed Sampled by USGS in 2012 3-5
Table 3-3. NYSDEC Scale of the Severity of Use Impairment of Classified Waterbodies....3-7
Table 3-4. NYSDEC Basis for Classifying Various Stream Segments as Not Fully Supporting Designated Uses....3-8
Table 3-5. Summary of Finger Lakes Institute Stream Segment Monitoring Program, 2006–2014....3-9
Table 3-6. Loading Rates of Nutrients and Sediment, Dutch Hollow Brook at Rt. 38....3-12
Table 3-7. Results of NYSDEC Biological Assessment of Owasco Inlet, 2006 and 2011....3-13
Table 3-8. Summary of Recommendations for Stream Bank Stabilization within Three Tributaries 3-15
Table 3-9. Estimated Phosphorus Loads (kg/yr) Delivered to the Lake by Source 3-17
Table 3-10. Permit Requirements, Village of Moravia WWTP....3-18
Table 3-11. Permit Requirements, Village of Groton WWTP....3-19

Table 3-12. Cayuga County Requirements for Septic Systems within the Owasco Lake Watershed 3-20
Table 3-13. Cayuga County Actions Related to Individual Septic Systems, 2006–2013 (all Cayuga County) 3-21
Table 3-14. Decrease in Point Source Total P Load, 2001–2014 3-22

Table 4-1. Owasco Lake Priority Waterbodies List Status, Revised December 21, 2014..4-1
Table 4-2. History of Total Organic Carbon (TOC) Concentrations Measured at the City of Auburn Water Intake, 2001–2014 4-4
Table 4-3. Limits for Demarcation of Trophic State Condition, Compared with Owasco Lake Measurements, 2006–2014 4-5
Table 4-4. Summary of OWLA Bacteriological Monitoring of Owasco Lake and Streams, 2010–2014 4-9
Table 4-5. Scientific and Common Names of Fish Species Reported from the Owasco Lake Watershed, NY..........4-10
Table 4-6. Percent Distribution of Macrophyte Standing Crop Biomass Owasco Lake, 2007 4-12
Table 4-7. Summary of Results of NYSDEC Sediment Sampling Program, 1997–1998..4-16

Table 5-1. Farms in the Owasco Lake Watershed that Have Completed Agricultural Environmental Management Tiers 4-4
Table 5-2. Summary of Best Management Practices Installed in the Owasco Lake Watershed 5-5
Table 5-3. Summary of Lake and Watershed Monitoring Programs 5-8

Table 6-1. Projected Changes in Temperature and Precipitation Resulting from Climate Change in Region 1 6-4

FIGURES

Figure 2-1. Annual and Seasonal Precipitation in Auburn, NY...2-5

Figure 3-1. Population of the Owasco Lake Watershed, 1990–2010 3-1
Figure 3-2. Percent Land Cover by Subwatershed..3-3
Figure 3-3(a). Pooled Data from Stream Segment Monitoring Along Dutch Hollow Brook 3-10
Figure 3-3(b). Pooled Data from Stream Segment Monitoring Along Owasco Inlet 3-11
Figure 3-4. History of WWTP Effluent TP Loading to Owasco Inlet, 2001–2014 3-20
Figure 3-5. Total P Flux at Dutch Hollow Brook, 2011–2014 in Relation to Rainfall over Monitored Period...........3-22

Figure 4-1. Annual Average Total Organic Carbon Concentrations at City of Auburn Water Intake, 2001–2014......4-4
Figure 4-2. Total Phosphorus Concentration, Owasco Lake Upper Waters, 2006–2014 Compared to the Regulatory Threshold for Use Impairment for Recreation 4-6
Figure 4-3. Chlorophyll-a Concentration, Owasco Lake, 2005-2014 Compared to the (proposed) Threshold for Use Impairment for Public Water Supply 4-7
Figure 4-4. Secchi Disk Transparency, Owasco Lake 2005–2014 Compared to Swimming Safety Guidelines 4-7
Figure 4-5. Minimum Percent Saturation of Dissolved Oxygen in Owasco Lake's Deepest Waters, 2010–2014.......4-8
Figure 4-6. Relative Standing Crop of Macrophyte Species Plotted with Percent Occurrence of Those Species in 97 Sampled Points 4-13
Figure 4-7. Estimated Biomass of Aquatic Plants Removed from Owasco Lake by the Cayuga County SWCD Mechanical Harvesting Program, 2006–2013..4-14
Figure 4-8. Rule Curve Governing Owasco Lake Water Level Management 4-17

MAPS (Located at the end of each chapter)

2-1. Regional Setting
2-2. Owasco Lake Watershed
2-3. Terrain Relief
2-4. Percent Slope
2-5. Bedrock Geology
2-6. Surficial Geology
2-7. Soil Drainage Class
2-8. Prime Farmland Soils

2-9. Soil Erodibility
2-10. Subwatersheds
2-11. Major Aquifers
2-12. Wetlands
2-13. Flood Hazard Areas

3-1. Population Density
3-2. Recent Subdivisions
3-3. Land Cover
3-4. Percent Developed Imperviousness
3-5. Marinas and Boat Launches
3-6. Farms
3-7. Restaurants and Retailers
3-8. Groundwater Contamination Risk Areas
3-9. Streams and Creeks by Class and Standard Designation
3-10. Streams and Creeks by Waterbody Assessment Category
3-11. Tributary Habitat Assessment
3-12. Water and Wastewater Districts
3-13. Roads and Bridges
3-14. EPA Regulated Water Dischargers
3-15. Mined Land

5-1. Protected Lands
5-2. NYSDEC Proposed Owasco Flats Wildlife Management Area

Acronyms, Abbreviations and Linked Documents

AEM	Agricultural Environmental Management
AFO	Animal feeding operation
AMSL	Above mean sea level
AVGWLF	ArcView Generalized Watershed Loading Function
BMP	Best Management Practice
CAFO	Consolidated animal feeding operation
CALM	Consolidated Assessment and Listing Methodology
CSLAP	Citizens Statewide Lake Assessment Program
CNMP	Comprehensive nutrient management plan
CRRA	Community Risk and Resiliency Act
CSA	Community Supported Agriculture
CSP	Conservation Stewardship Program
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
EPOD	Environmental Protection Overlay District
EQIP	Environmental Quality Incentives Program
FLI	Finger Lakes Institute
FLLOWPA	Finger Lakes - Lake Ontario Watershed Protection Alliance
GIS	Geographic Information System
GPS	Global Positioning System
GWLF	Generalized Watershed Loading Function
HWS	Hobart and William Smith
MS4	Municipal Separate Storm Sewer System
NBI	Nutrient Biological Index
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NYCRR	New York Codes, Rules and Regulations
NYSDAM	New York State Department of Agriculture and Markets
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 Authority
NY-NLI	New York Nitrate Leaching Index
NY-PI	New York Phosphorus Index
OLWMC	Owasco Lake Watershed Management Council
OWLA	Owasco Watershed Lake Association
P	Phosphorus
PDR	Purchase of Development Rights
PRISM	Partnership for Regional Invasive Species Management
SBR	Sequencing Batch Reactor
SPDES	State Pollution Discharge Elimination System
SRP	Soluble reactive phosphate
SWCD	Soil and Water Conservation District
T-ALK	Total alkalinity
TMDL	Total Maximum Daily Load
TOC	Total organic carbon
TP	Total phosphorus
TSS	Total Suspended Solids
USACOE	U.S. Army Corps of Engineers
USDA	U. S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WQMA	Water Quality Management Agency
WWTP	Wastewater treatment plant
WMA	Wildlife Management Area

LINKED DOCUMENTS

Ambient Groundwater Monitoring Program —www.dec.ny.gov/lands/36117.html

Annual Reports for John Halfman's Research of Owasco Lake —www.cayugacounty.us/Departments/WaterQualityManagementAgency/InformationonCountyWaterbodies/OwascoLake.aspx

Blue-Green Harmful Algal Blooms (NYSDEC)— www.dec.ny.gov/chemical/77118.html

Clean Water Act Section 319 — www.epa.gov/nps/319

Climate Smart Communities Pledge (NYSDEC) —www.dec.ny.gov/energy/65494.html

Codes for the Global and NYS Conservation Ranks (NYSDEC) —www.dec.ny.gov/animals/29386.html

Emerson Park Master Plan (March 2015) — www.cayugacounty.us/Portals/0/planning/Documents/EmersonParkMasterPlan/Draft%20Emerson%20Park%20Master%20Plan%203-19-15.pdf

EnviroMapper — http://www.epa.gov/emefdata/em4ef.home

Fish Atlas Maps of New York — http://www.dec.ny.gov/animals/84622.html

Information on Wells Sampled in Central New York, 2012 (USGS) **—** http://pubs.usgs.gov/of/2014/1226/appendix/ofr2014-1226_appendix1.xlsx

New York Nature Explorer — http://www.dec.ny.gov/natureexplorer/app/

NRCS 590 Standard Update for New York — http://efotg.sc.egov.usda.gov/references/public/NY/nyps590.pdf

Owasco Flats: Conservation Planning and Stakeholder Survey Project — http://www.cnyrpdb.org/fingerlakes/docs/2007-07-05_OwascoFlatsReport.pdf

Owasco Lake Agriculture Conservation Blueprint. American Farmland Trust — http://newyork.farmland.org/wp-content/uploads/2012/02/Owasco-Lake-Agriculture-Conservation-Blueprint-12-22-11.pdf

USDA Census of Agriculture. New York, 2012 Census Volume 1, Chapter 2: County Level Data — http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/New_York/

Water Quality Study of the Finger Lakes (Callinan) — http://www.dec.ny.gov/lands/25576.html

Waterbody Inventory for Seneca River (Lower) Watershed — http://www.dec.ny.gov/docs/water_pdf/pwlorflsenl.pdf

Chapter 1: Introduction

1.1 Objective and Scope of This Document

Cayuga County is preparing a comprehensive plan to identify best practices for the use and management of Owasco Lake and the Owasco Lake watershed. The Owasco Lake Watershed Management Plan will also address recreational uses along the shoreline of Owasco Lake and the major tributaries flowing into the lake, particularly the Owasco Inlet and the Lake Outlet. The NYS Department of State (NYSDOS) awarded a matching grant to Cayuga County for development of the watershed management plan, with funds provided under Title 11 of the Environmental Protection Fund.

The Owasco Lake Watershed Management Plan, scheduled for completion in 2016, will include measures designed to ensure the sustainability of the lake and watershed, as well as measures to enhance and revitalize recreational uses. Preparation of the Owasco Lake Watershed Management Plan follows the approach jointly developed by the NYS Department of State and NYS Department of Environmental Conservation (NYSDEC) and described in the guidebook *Watershed Plans: Protecting and Restoring Water Quality*.

A watershed management plan addresses a series of questions:

1. **Where are we now?** That is, what is the current status of the natural, cultural, and political environment within the watershed? What are the assets, existing problems, and emerging threats and opportunities?
2. **Where are we going?** What processes and programs are in place that will affect the future of the watershed?
3. **Where do we want to be?** What is the community's vision for the future of the watershed? What desirable conditions or attributes of the watershed should be enhanced, and what undesirable conditions should be minimized or eliminated?
4. **How do we get there?** What strategic actions will enable the community to achieve the goals and vision? What specific practices and projects will help restore and protect the watershed and how can funds be leveraged?
5. **When will we get there?** When will the recommended projects be advanced, and how will the priority actions be decided?
6. **How do we measure progress?** What is the plan for tracking improvement and deciding what else needs to be done?

This **Waterbody and Watershed Inventory Report** provides the data and information needed to address questions 1 and 2: current conditions and trends. The inventory and analysis represent the technical basis for the Owasco Lake Watershed Management Plan to follow.

The U.S. Environmental Protection Agency (USEPA) has also promoted a framework for watershed management plans that are developed and implemented for threatened or impaired waters using funding from Clean Water Act Section 319. The NYSDEC is strongly encouraging watershed management plans to fully incorporate the USEPA framework, which is known as the Nine Minimum Elements watershed management plans for threatened or impaired waters. The nine minimum elements are as follows:

1. Identify the causes and sources of pollution
2. Estimate pollutant loading into the watershed and the expected load reductions to be realized with implementation of the recommendations
3. Describe management measures that will achieve load reductions and target critical areas
4. Estimate the amounts of technical and financial assistance and the relevant authorities needed to implement the plan
5. Develop an information/education component
6. Develop a project schedule
7. Describe the interim, measurable milestones
8. Identify indicators to measure progress
9. Develop a monitoring component

It is the intent of Cayuga County to integrate the USEPA nine minimum elements into the Owasco Lake Watershed Management Plan.

1.2 Sources of Data and Information

This initiative will build upon other collaborative, community-based efforts in watershed planning including the January 2000 *State of the Owasco Lake Watershed*; the 2001 *Owasco Lake Watershed Management Plan* developed by the Cayuga County Soil and Water Conservation District and the Cayuga County Department of Planning and Economic Development; the July 2007 *Final Report of the Owasco Flats Conservation Planning and Stakeholder Survey Project* conducted by Mark Whitmore and the Finger Lakes Land Trust; the *Owasco Flats Wildlife Management Area: A Conceptual Management Plan* published by NYSDEC in 2008; the 2011 *Owasco Lake Agricultural Conservation Blueprint*, published by the American Farmland Trust; and the *Cayuga County Agriculture and Farmland Protection Plan,* adopted in 2014.

Taken together, these reports reflect the vast amount of local knowledge and public engagement in efforts to protect and improve Owasco Lake and its watershed. The objective of this document is to integrate the data and information gathered over the past 15 years by multiple agencies and researchers into an updated characterization of the land and water resources. The state of Owasco Lake and its watershed is evolving in response to human activities and other agents of environmental change. This **Waterbody and Watershed Inventory Report** provides an updated narrative and maps of important features of the landscape and waterways, including the following:

- Delineation of the Owasco Lake watershed and its subwatersheds
- Geological and geographical features (e.g., soils, slopes, floodplains, bedrock and surficial geology)
- Current infrastructure- including areas served by public water and sewers, stormwater conveyances, dams, etc.
- Aquifers, groundwater recharge areas, wellhead areas and public water supplies
- Current land use and land cover, including impervious surfaces
- Municipal zoning
- Regulatory classifications of surface waters, and areas/segments designated as impaired for their designated best use
- Demographics and population
- Regulated point sources (e.g., wastewater treatment plants)
- Fish and wildlife resources and habitats
- Estimated pollutant loadings for each subwatershed under current conditions, and anticipated changes resulting from changes in land uses.

In addition to the multitude of planning documents, the many agencies, elected officials, and interest groups engaged in managing the land and water resources in this region of the New York Finger Lakes have developed effective institutional mechanisms for sharing information and resources. There is a multi-agency framework in place to identify issues affecting the lake and watershed and make management decisions. Since completion of the original *Owasco Lake Watershed Management Plan* in 2001, stakeholders have come together to discuss priorities, share information, and collaborate on a monitoring program tracking the lake response. This document, the **Waterbody and Watershed Inventory Report,** catalogues recent information and updates the state of Owasco Lake and its watershed. The findings will provide the foundation for revising and updating the Watershed Management Plan.

Chapter 2: Environmental Setting

2.1 Owasco Lake and the New York Finger Lakes

Owasco Lake is one of the New York Finger Lakes, a group of eleven elongated lakes of glacial origin located in the west-central region of the state (Map 2-1). Owasco Lake is part of the Seneca-Oneida-Oswego River Basin. The lake's watershed (defined as the land area that drains into the lake) extends over approximately 205 square miles (Map 2-2) and encompasses all, or portions of, eleven towns and one village in Cayuga County (representing 81.5% of the watershed area), one town in Onondaga County (2.3%), and three towns and one village in Tompkins County (16.2%).

The water quality and aquatic habitat of Owasco Lake reflect its natural setting: environmental conditions of the watershed such as topography, soils, land cover, and climate; and physical features of the lake itself: depth, water residence time, and the extent of littoral zone habitat. These natural features are affected by the multitude of ways in which humans utilize the lake and its watershed, through settlement patterns, resource extraction, cultivation of agricultural crops, animal husbandry and waste management, water withdrawals, water level controls, wastewater disposal, recreational uses, introduction of invasive species, and other factors. Some features of Owasco Lake and its watershed have remained unchanged since the 2000 publication of the *State of the Owasco Lake Watershed,* while other features have changed. This chapter summarizes current conditions and presents updated maps prepared by the Cayuga County Department of Planning and Economic Development.

2.2 Geology and Soils

The geomorphology of the Finger Lakes was described by Von Engeln[1] and subsequently summarized in various publications, notably Schaffner and Oglesby.[2] This region of New York State was profoundly altered by glaciation during the Pleistocene Era. As the glaciers receded some 9,000 to 10,000 years ago, the pre-glacial river valleys that had been deepened and shaped by the advancing ice shield were filled with meltwater and streams from the surrounding hillsides. The watershed elevation map (Map 2-3) reflects the glacial history of the region, with the hilly deposits and carved depressions. The highest elevation within the watershed occurs at 1,350 feet in the towns of Scipio and Venice on the west side, and 1,800 feet in the town of Sempronius on the east side. The lowest elevation is the water surface at 710 feet above sea level (winter water level elevation). Another illustration of topography is provided in the map of percent slopes (Map 2-4).

The bedrock geology of the watershed (Map 2-5) is composed of limestone, sandstone, and shale beds approximately 8,000 feet thick.[3] The limestone-dominated formations are located in the northern portion of the watershed; sandstone and shale formations are found toward the south. The surficial geology (Map 2-6) of the watershed illustrates the legacy of glaciation on the landscape; glacial till dominates with pockets of outwash deposits and moraines.

There are a number of soil types mapped within the Owasco Lake watershed; a listing from the 2000 *State of the Owasco Lake Watershed* is included as Table 2-1. In general, watershed soils are deep and well-drained (Map 2-7), gently to moderately sloping, and of medium texture. The most dominant soils are calcareous (containing significant amounts of calcium) formed from weathered limestone, shale, and sandstone.

Table 2-1. Soil Association Acres and Percentages for the Owasco Lake Watershed

Soil Association	Code	Acres	Percent of Watershed
Mardin-Lordstown-Volusia	(NY 126)	52151.13	42.31
Honeoye-Ontario-Lima	(NY 128)	48075.80	30.00
Chenango-Howard-Palmyra	(NY 134)	8563.31	6.95
Valois-Bath-Howard	(NY 125)	6104.36	4.95
Manlius-Marilla-Fremont	(NY 058)	3680.68	2.99
Darien-Cazenovia-Nunda	(NY 131)	2327.99	1.89
Teel-Wayland-Hamlin	(NY 159)	1691.51	1.37
Urban Land-Howard-Niagara	(NY 143)	388.58	0.32
Minoa-Arkport-Lamson	(NY 140)	298.09	0.24

Source: Cayuga County Department of Planning & Economic Development, 2000

The deep, well-drained, and calcareous soils found throughout the watershed are very well suited for crop production. As displayed in Map 2-8, significant areas of USDA-designated prime farmland soils and farmland of statewide importance are found in the Owasco Lake watershed.

Soils are also classified with regard to their susceptibility to detachment and transport by rainfall and runoff. This characteristic (referred to as erodibility or k factor) varies primarily as a function of soil texture but is also affected by soil structure, permeability, and amount of organic matter. The values for k factor range from a low of 0.02 (sand) to a high of 0.69 (silt). As shown in Map 2-9, the k factors assigned to soils in the Owasco Lake watershed range in value from 0.1 to 0.49.

2.3 Surface Water

The major tributaries to the lake include the Owasco Inlet, Dutch Hollow Brook, Veness Brook, and Sucker Brook (Map 2-10). The Owasco Inlet has a number of tributary streams as well (Table 2-2). Additionally, there are over fifty small and intermittent streams that flow into the lake; most are less than one mile in length. Typical of the Finger Lakes, the majority of tributary flow enters the lake from the south. Owasco Inlet, which encompasses over 60% of the land area draining to the lake, flows through a large wetland complex known as the Owasco Flats before reaching the lake.

Table 2-2. Tributary Subwatersheds and Drainage Areas

Subwatershed	Drainage Area , mi^2	Drainage Area, km^2
Dutch Hollow Brook	29.37	76.07
Veness Brook	2.12	5.49
Direct Drainage to Owasco Lake	32.81	84.98
Sucker Brook	9.72	25.17
Owasco Inlet and Tributaries	115.76	299.82
Owasco Inlet (main stem)	(23.33)	(60.42)
Mill Creek	(30.40)	(78.74)
Headwaters to Owasco Inlet	(37.36)	(96.76)
Hemlock Creek	(18.16)	(47.03)
Tributaries to Owasco Inlet	(6.51)	(16.86)

As summarized in the 2000 *State of the Owasco Lake Watershed* report, the long-term average runoff into Owasco Lake is estimated at 0.47 meters/year, with substantial seasonal variation. During winter, 64.7% of precipitation becomes surface runoff and reaches the lake, while in the spring the percentage reaches 94.7%. Summer and fall conditions are conducive to higher infiltration rates; the average percentage of precipitation that becomes surface runoff during these seasons is 30% and 27.6%, respectively. Note that these estimates are for average hydrologic conditions. Rainfall intensity, soil wetness, and land cover greatly influence the fate of precipitation.

Owasco Lake itself has a surface area of 10.65 square miles, a length of 10.7 miles, an average width of 1.2 miles, and a maximum depth of 177 feet. The corresponding dimensions in metric units were reported by Schaffner and Oglesby[4] for all the Finger Lakes (Table 2-3).

Table 2-3. Morphometric Characteristics of the New York Finger Lakes

Lake	Surface Area (km^2)	Length (km)	Width (km)		Depth (m)		Volume ($10^6 m^3$)
			Max	Mean	Max	Mean	
Conesus	13.67	12.6	1.34	1.06	18.0	11.5	156.83
Hemlock	7.2	10.8	0.80	0.70	27.5	13.6	105.89
Canadice	2.6	5.1	0.62	0.51	25.4	16.4	42.6
Honeoye	7.05	6.6	1.42	1.06	9.2	4.9	34.81
Canandaigua	42.3	24.9	2.44	1.70	83.5	38.8	1640.1
Keuka	47.0	31.6	3.32	1.15	55.8	30.5	1433.7
Seneca	175.4	56.6	5.20	3.10	198.4	88.6	15539.5
Cayuga	172.1	61.4	5.60	2.80	132.6	54.5	9379.4
Owasco	26.7	17.9	2.10	1.49	54.0	29.3	780.7
Skaneateles	35.9	24.2	3.25	1.48	90.5	43.5	1562.8
Otisco	7.6	8.7	1.22	0.89	20.1	10.2	77.8

2.4 Groundwater

There are only few major aquifers within the Owasco Lake watershed, as shown in Map 2-11. The majority of the watershed is underlain by glacial till of variable thickness that produces only one to five gallons of water per minute to wells. Beneath the glacial till is a layer of shale bedrock that is capable of yielding water in larger quantities. South of the lake, along the Owasco Inlet, is a sand and gravel aquifer that may yield between five to over 500 gallons per minute of groundwater to wells. Another sand and gravel aquifer is located along Decker Brook and Dresserville Creek northeast of the Village of Moravia. This aquifer is close to the surface and capable of supplying between 10 and 100 gallons per minute. Other isolated sand and gravel aquifers may exist elsewhere in the watershed, but are too small to be mapped.[5]

2.5 Wetlands

Wetlands are found throughout the Owasco Lake watershed, with significant complexes mapped along the Owasco Inlet and in the watershed's northeastern region in the Town of Owasco (Map 2-12). There are 2,897 acres of NYSDEC-designated wetlands within the watershed. These state-mapped wetlands are over 12.4 acres in size and are ranked with respect to their ability to perform wetland functions and provide wetland benefits. Class I wetlands have the highest rank, and the ranking descends through Classes II, III and IV.

In the Owasco watershed, 482.6 acres (16%) of NYS-designated wetlands are Class I and 1671.4 acres (58%) are Class II. Class I and II wetlands provide important habitat to rare, threatened, or endangered species. In addition, these areas provide other functional benefits associated with moderating flood flows and improving water quality. Just over 720 acres of wetland are Class III and 23 acres are Class IV. An additional 5,652 acres of wetlands are delineated on federal National Wetland Inventory maps, but are below the minimum size required (12.4 acres) for NYSDEC regulation.

2.6 Climate, Precipitation and Flood Hazard

The Owasco Lake watershed exhibits annual temperature and precipitation patterns typical of central New York, with marked seasonal fluctuations and interannual variability. The average annual precipitation is 42.32 inches, based on data from 1981-2010. Data from 2011-2014 are compared to the 30-year average in Figure 2-1.

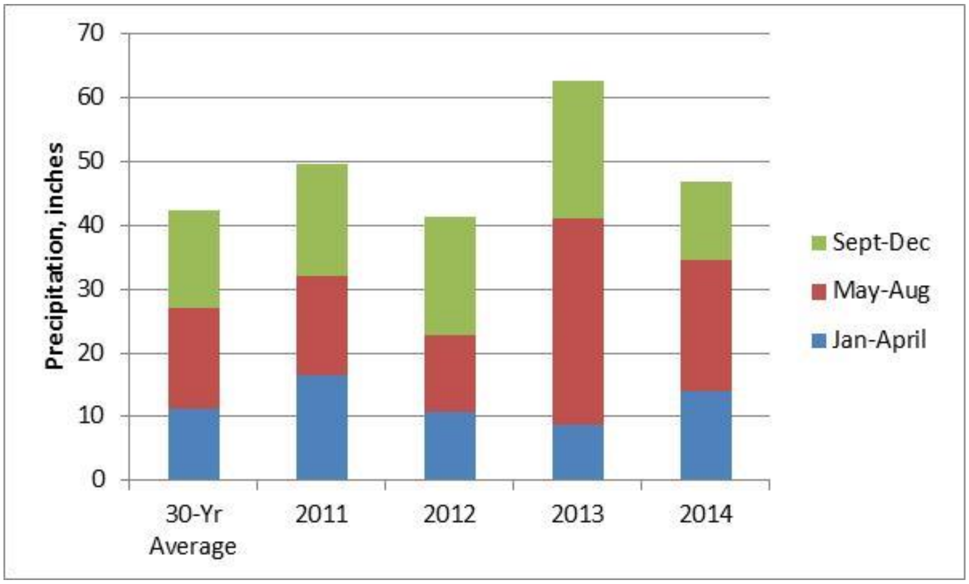


Figure 2-1. Annual and Seasonal Precipitation in Auburn NY

The long-term average air temperature for this region is reported as 47.35°F. According to the 2014 update to NYSERDA's report *Climate Change in New York State*,[6] the western NY/Great Lakes region, which includes Cayuga County, has exhibited a temperature rise of 0.32°F per decade between 1901 and 2012. Precipitation is trending upward as well; the increase is statistically significant at 0.33 inches per decade for this region. Moreover, the variability of rainfall is increasing from year-to-year. This represents a challenge for designing and maintaining practices to manage stormwater runoff.

Considering the regional topography, climate, and soil types the flood hazard areas within the Owasco Lake watershed are largely restricted to riparian areas along the tributary streams (Map 2-13). The Owasco Flats is a wet river bottom floodplain located in a narrow, glacially-steepened valley, consistent with its designation as a flood-prone area.

2.7 Ecological Communities and Rare, Threatened and Endangered Species

Information presented in this section was obtained from the New York Nature Explorer, a web-based tool providing access to information from databases maintained by NYSDEC regarding the status and distribution of the state's animals, plants, and significant natural communities. The Nature Explorer files encompass rare animals, rare plants, and significant natural communities; birds documented as breeding in the area; and reptiles and amphibians.

Several significant natural communities and rare, threatened or endangered species have been reported to occur within the Owasco Lake watershed (Table 2-4). In addition to these unique species and assemblages, the 2000 *State of the Owasco Lake Watershed* report described a diverse assemblage of wildlife; noted species encompassed highly abundant mammals such as the whitetail deer, cottontail rabbits, red and gray squirrels, skunks, voles, etc. Less visible inhabitants of the watershed include coyote, fox, raccoon, opossum, woodchuck, muskrat, mink, and beaver. The southern portion of the watershed has been listed as a possible site for introduction of river otter. Black bears have been observed in the more remote areas of the watershed.

Table 2-4. Unique and Protected Species and Habitats of the Owasco Lake Watershed, as compiled by the New York Nature Reporter

Common Name	Group	Distribution Status	State Protection Status	State Conservation Rank*	Global Conservation Rank*
Great Blue Heron	Birds	Recently Confirmed	Protected Bird	S5	G5
Waterfowl Winter Concentration Area	Animal Assemblages	Recently Confirmed		S3S4	GNR
Big Shellbark Hickory	Flowering Plants	Recently Confirmed	Threatened	S2	G5
Carey's Sedge	Flowering Plants	Historical (1939)	Endangered	S1S2	G4G5
Lake-cress	Flowering Plants	Historical (1910)	Threatened	S2	G4?
Swamp Buttercup	Flowering Plants	Historical (1947)	Endangered	S1	G5T5
Twin-leaf	Flowering Plants	Recently Confirmed	Threatened	S2	G5
Woodland Bluegrass	Flowering Plants	Historical (1918)	Endangered	S1	G5
Yellow Giant-hyssop	Flowering Plants	Historical (1918)	Threatened	S2S3	G5
Calcareous Shoreline Outcrop	Uplands	Recently Confirmed		S2	G3G4
Shale Cliff and Talus Community	Uplands	Recently Confirmed		S3	G4

**See Codes for the Global and NYS Conservation Ranks at NYSDEC website: www.dec.ny.gov/animals/29386.*

Of larger birds, wild turkey and ruffed grouse are found throughout the watershed. The numerous smaller wetland areas in the watershed serve as favorable waterfowl habitat. Confirmed breeding waterfowl include the mallard duck, Canada goose, and the wood duck. During the fall, winter, and spring, the numbers and individual species of waterfowl increase greatly as migrating birds visit. This includes rare species such as the common loon, tundra swan, and, in recent years, the sandhill crane. Many varieties of songbirds and raptors also breed within the watershed. Bald eagles are present in the watershed, and nesting sites have been confirmed along the Owasco Inlet.

Waterfowl vary in abundance with the largest diversity occurring in the Owasco Flats wetland area. In addition to waterfowl and numerous wetland obligate species, a great blue heron rookery, potential nesting habitat for osprey, and nesting habitat for eagles are present. The value and importance of the

Owasco Flats for migratory birds has been recognized by its inclusion in the Greater Summerhill Important Bird Area by the National Audubon Society.

The Owasco Flats region is unique for its diverse habitats in addition to the wetlands. As reported by Whitmore in 2007, eleven ecological communities have been identified in the Flats in accordance with the methodology of the New York Natural Heritage Program. The forest communities are especially diverse with 50 tree species present. Overall, more than 360 plant species were found in the Flats.[7]

The Owasco Inlet is home to a rich species assemblage of reptiles and amphibians (herps); several uncommon species including the wood turtle, blue spotted salamander, Jefferson salamander, and the mud puppy are among the 28 documented. According to the NYSDEC Herp Atlas, the Owasco Flats region contains the fourth highest number of reptile and amphibian species in New York State.

Notes

[1] von Engeln, O. D. 1961. *The Finger Lakes Region: Its Origin and Nature*. Cornell Univ. Press, Ithaca, NY.

[2] Schaffner, W. H., and R. T. Oglesby. 1978. “Limnology of Eight Finger Lakes.” In *Lakes of New York State, Volume I: Ecology of the Finger Lakes*, ed. J. Bloomfield. NYSDEC, Albany, NY.

[3] Oglesby, R. T., Cayuga County Planning Board. 1973. *Owasco Lake and Its Watershed : A Summary Report with Two Appendices and Maps*. Cornell Univ. Water Resources and Marine Sciences Center.

[4] Schaffner and Oglesby, *Limnology of Eight Finger Lakes.*

[5] Miller, G. L. 1987. *Unconsolidated Aquifers in Upstate New York*. Water Resources Investigations Report; and Kantrowitz, I. H. 1970. *Ground Water Resources in the Eastern Oswego River Basin, New York.* Eastern Oswego Regional Water Resources Planning Board.

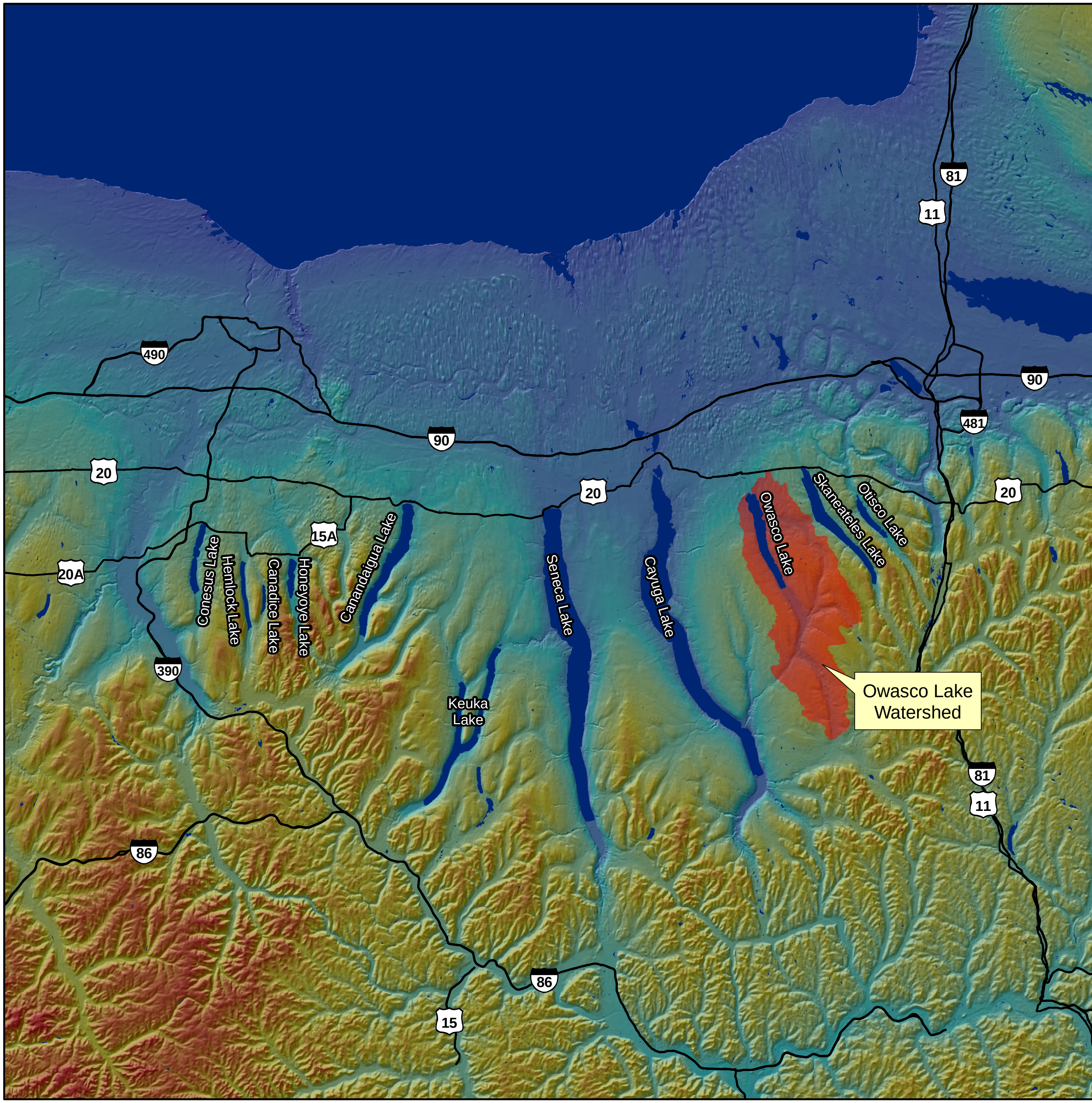
[6] Horton, R., D. Bader, C. Rosenzweig, A. DeGaetano, and W. Solecki. 2014. *Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information.* New York State Energy Research and Development Authority (NYSERDA), Albany, New York.

[7] Whitmore, Mark and the Finger Lakes Land Trust. 2007. *Owasco Flats: Conservation Planning and Stakeholder Survey Project*. Report prepared for Central NY Regional Planning and Development Board, Syracuse, NY. http://www.cnyrpdb.org/fingerlakes/docs/2007-07-05_OwascoFlatsReport.pdf.

Map 2-1

Regional Setting

Owasco Lake Watershed

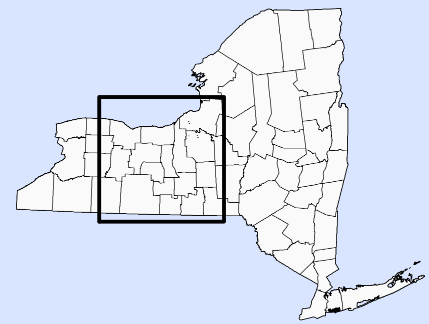


Sources:

U.S. Geological Survey. 2012. The National Elevation Dataset (NED).

U.S. Geological Survey. 2014. The National Hydrographic Dataset (NHD); The National Transportation Dataset (NTD).

Cayuga County Department of Planning and Economic Development. 2014. County Geographic Information System (GIS) database.



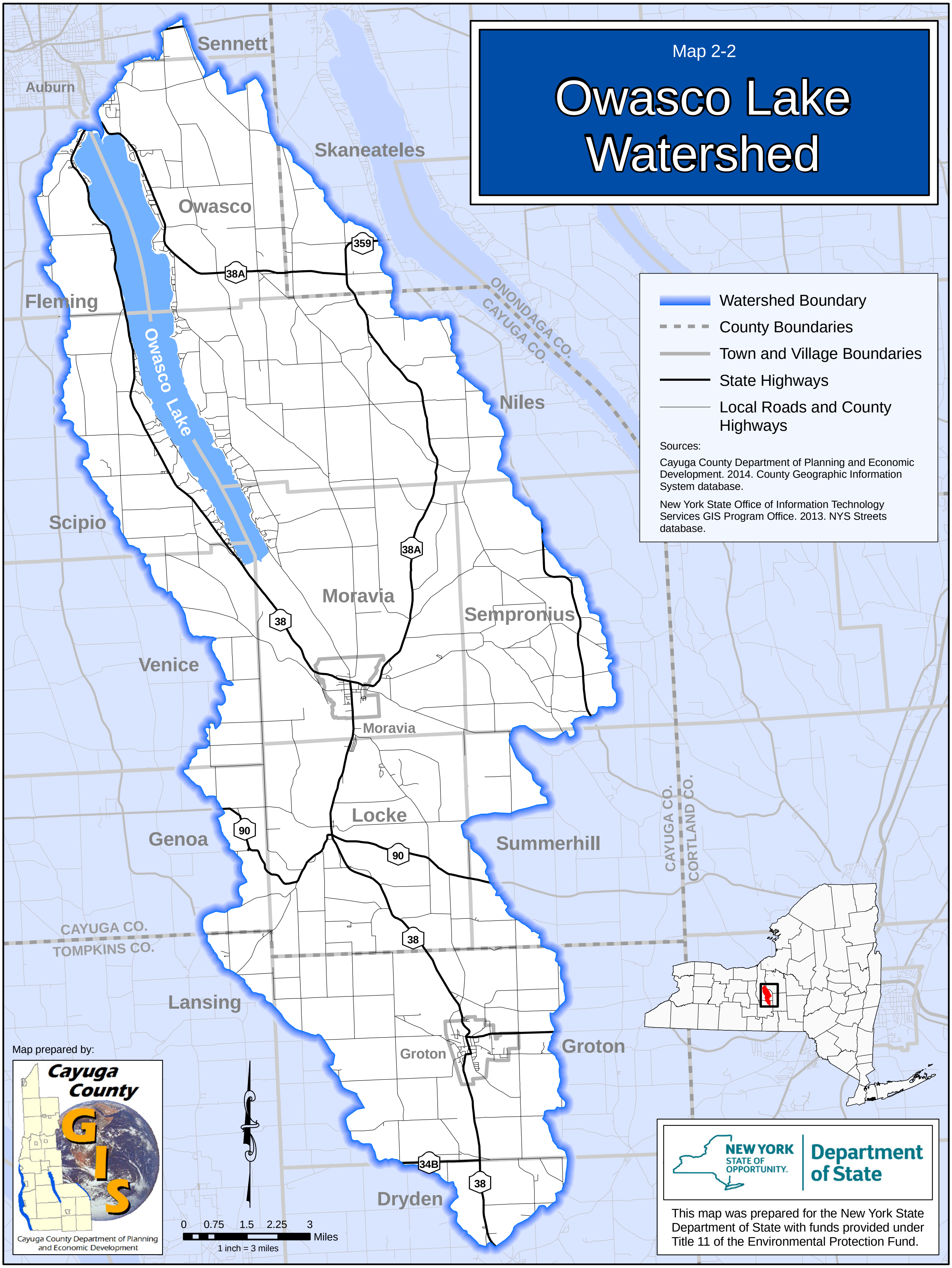
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

0 3 6 9 12 Mi.

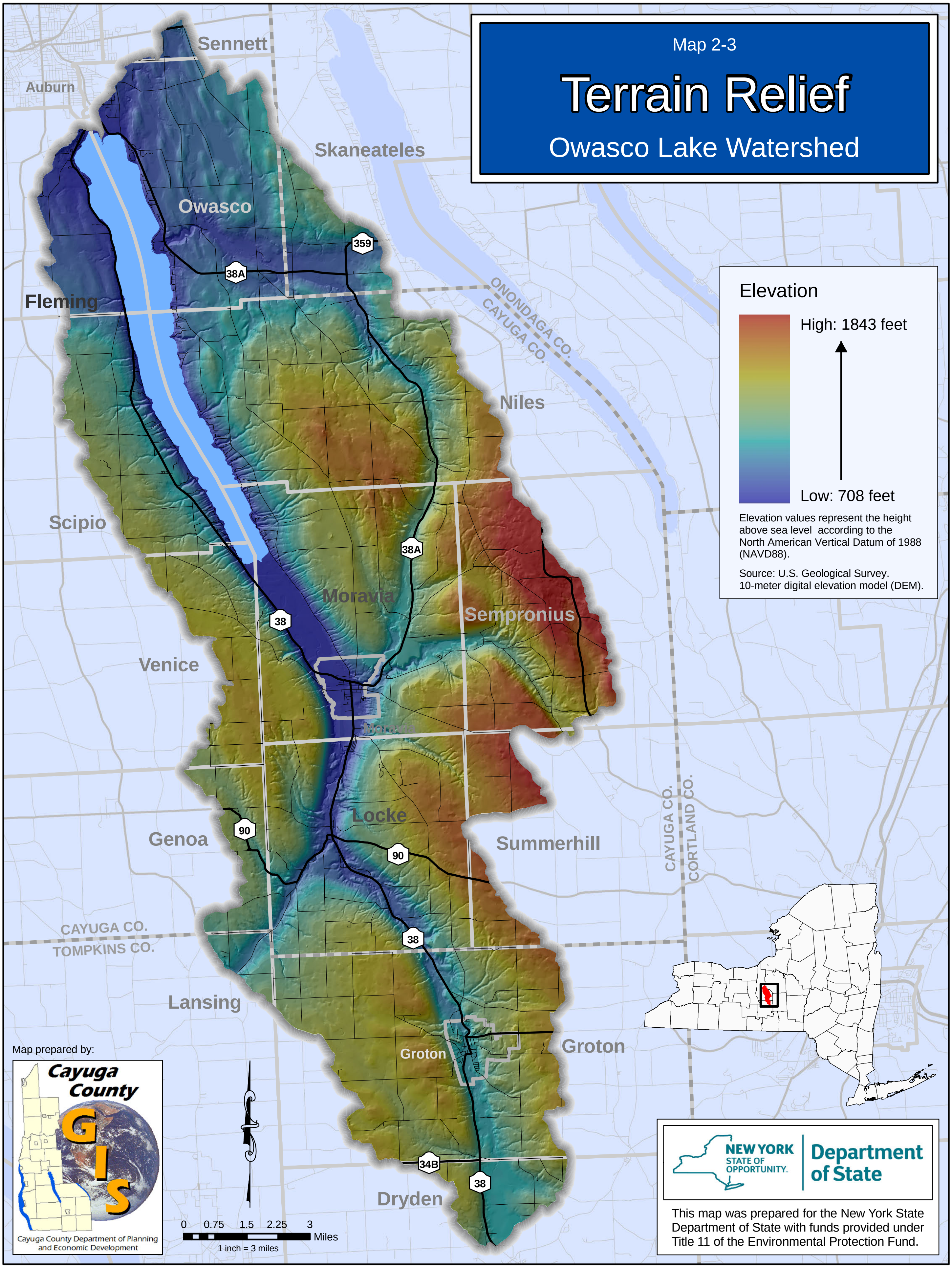
Map prepared by:

Cayuga County GIS

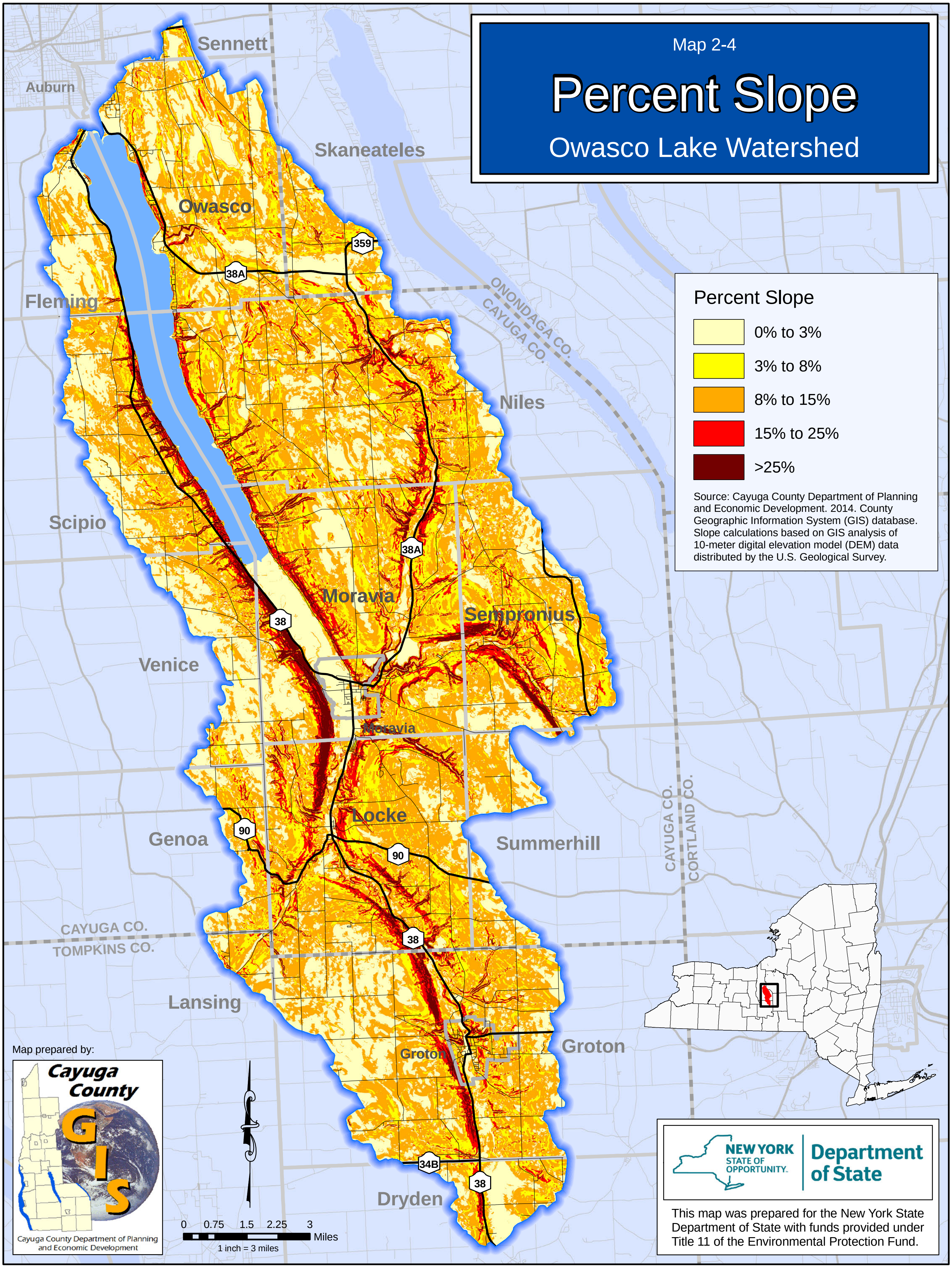
Cayuga County Department of Planning and Economic Development

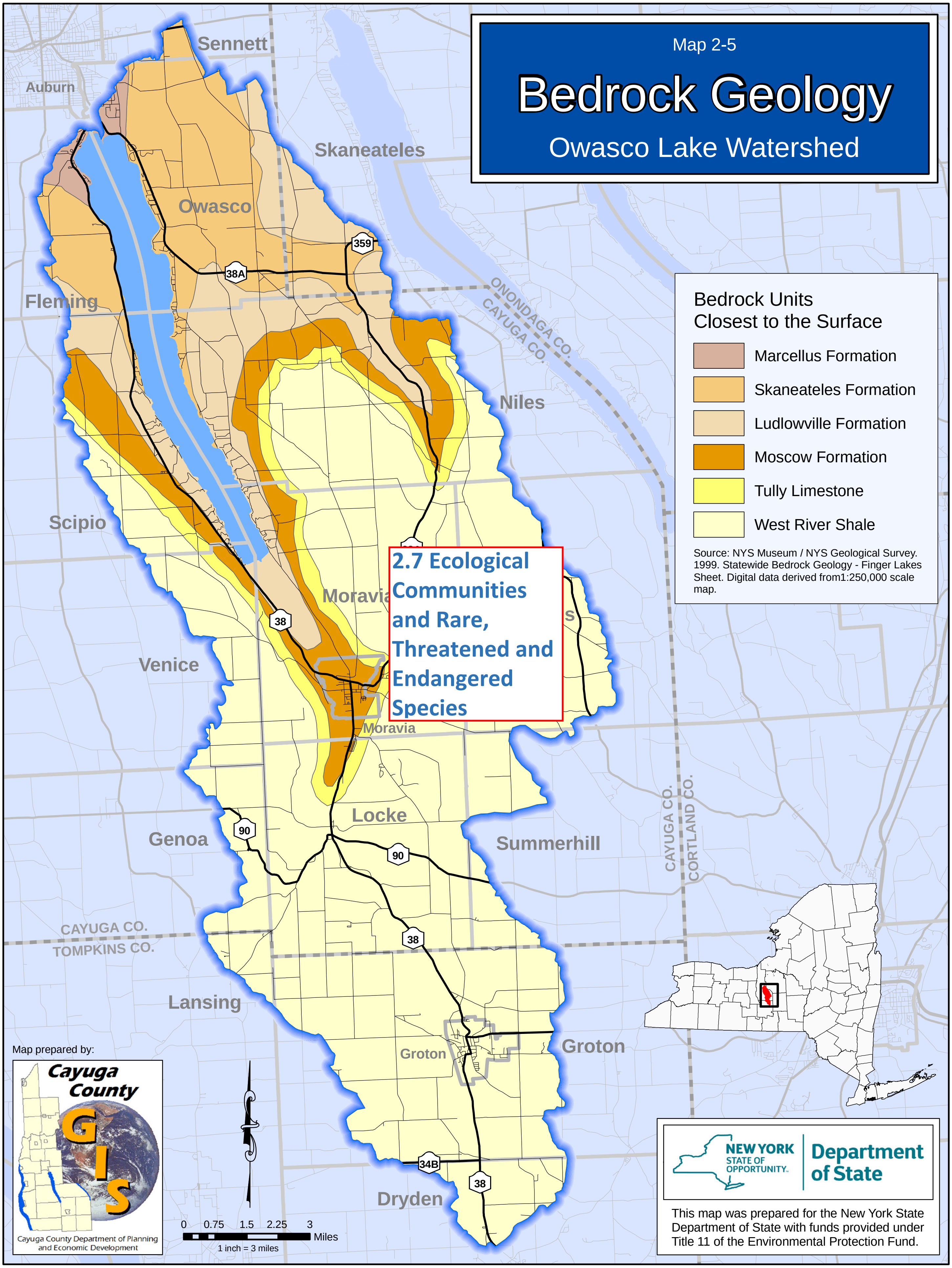


Map 2-2
Owasco Lake Watershed
Watershed Boundary
County Boundaries
Town and Village Boundaries
State Highways
Local Roads and County Highways
Sources:
Cayuga County Department of Planning and Economic Development. 2014. County Geographic Information System database.
New York State Office of Information Technology Services GIS Program Office. 2013. NYS Streets database.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Owasco Lake
ONONDAGA CO.
CAYUGA CO.
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3 Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY. Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

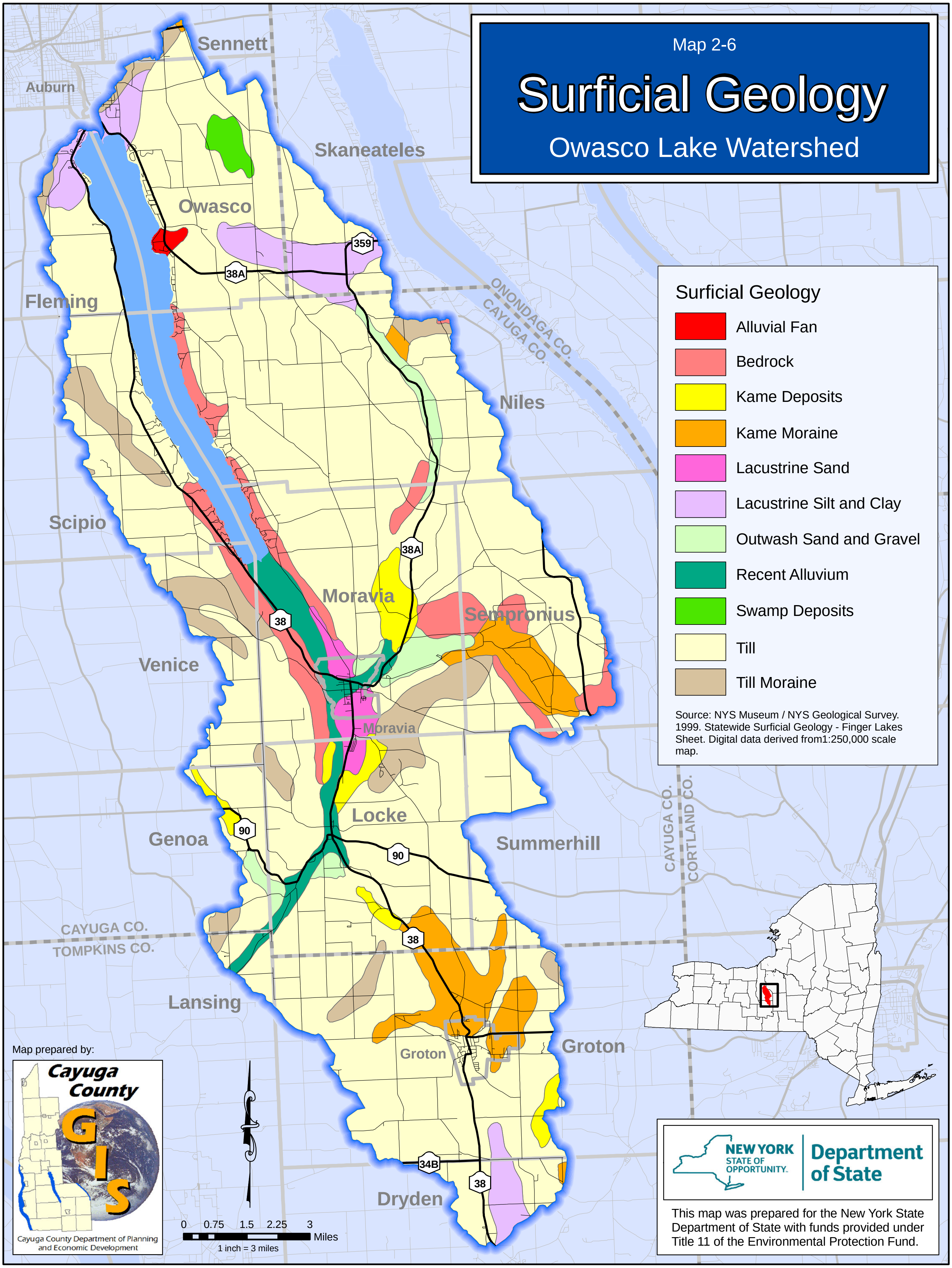


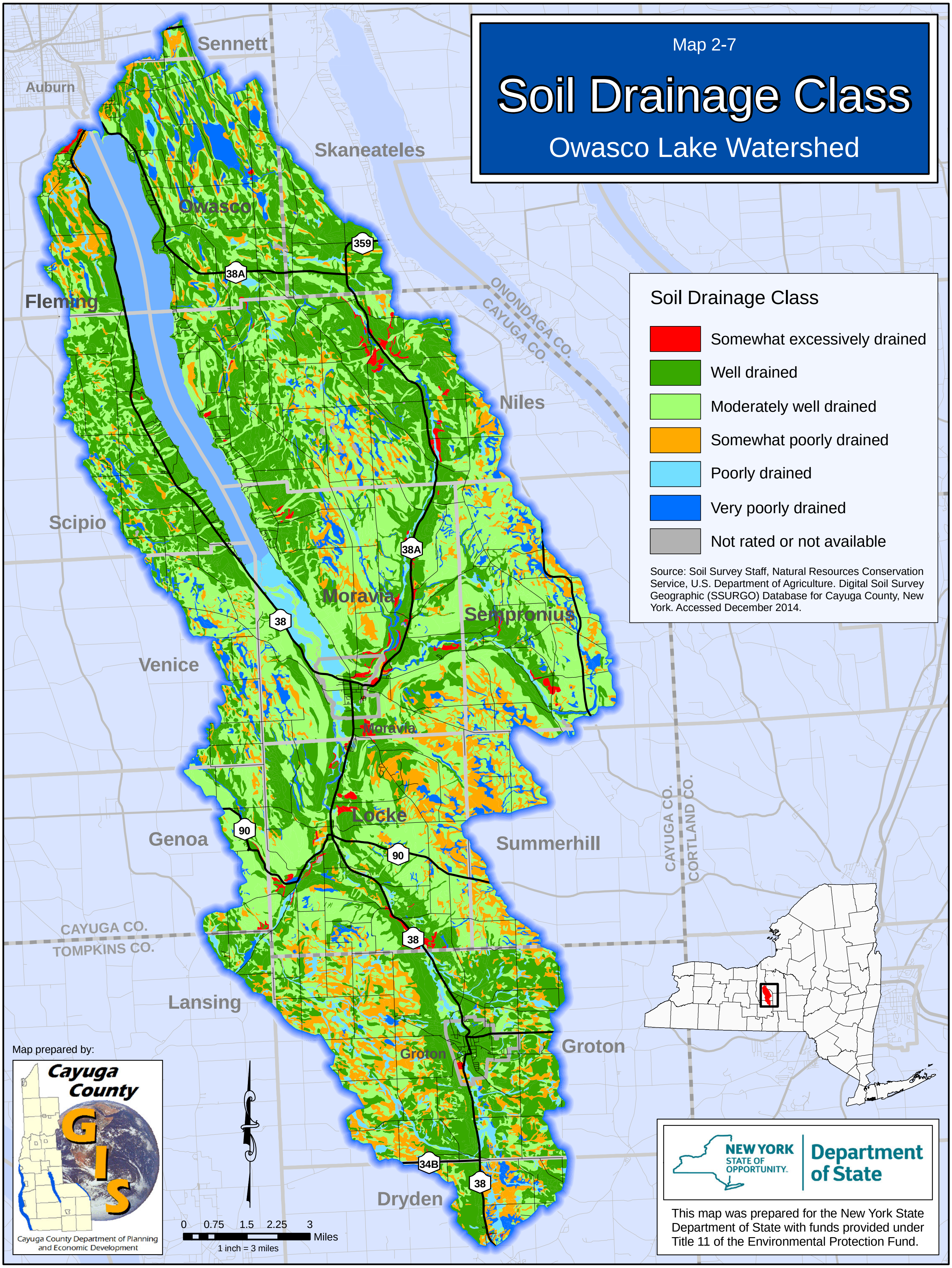
Map 2-3
Terrain Relief
Owasco Lake Watershed
Elevation
High: 1843 feet
Low: 708 feet
Elevation values represent the height above sea level according to the North American Vertical Datum of 1988 (NAVD88).
Source: U.S. Geological Survey. 10-meter digital elevation model (DEM).
Sennett
Auburn
Skaneateles
Owasco
Fleming
ONONDAGA CO.
CAYUGA CO.
Niles
Scipio
Moravia
Sempronius
Venice
Locke
Genoa
Summerhill
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

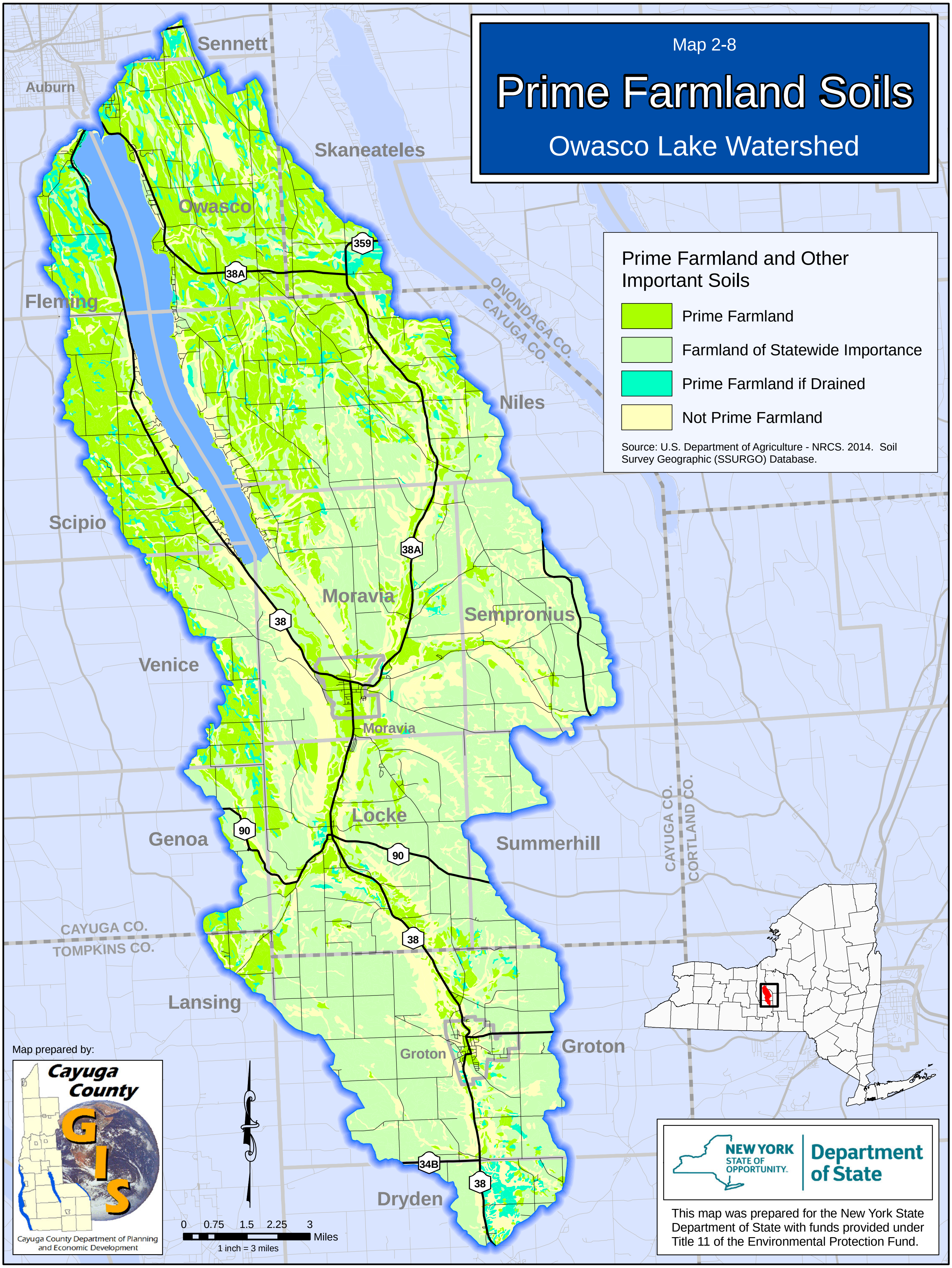

Map 2-4
Percent Slope
Owasco Lake Watershed
Percent Slope
0% to 3%
3% to 8%
8% to 15%
15% to 25%
>25%
Source: Cayuga County Department of Planning and Economic Development. 2014. County Geographic Information System (GIS) database. Slope calculations based on GIS analysis of 10-meter digital elevation model (DEM) data distributed by the U.S. Geological Survey.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Genoa
Locke
Summerhill
Lansing
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CORTLAND CO.
TOMPKINS CO.
359
38A
38
90
34B
Map prepared by:
Cayuga County
GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

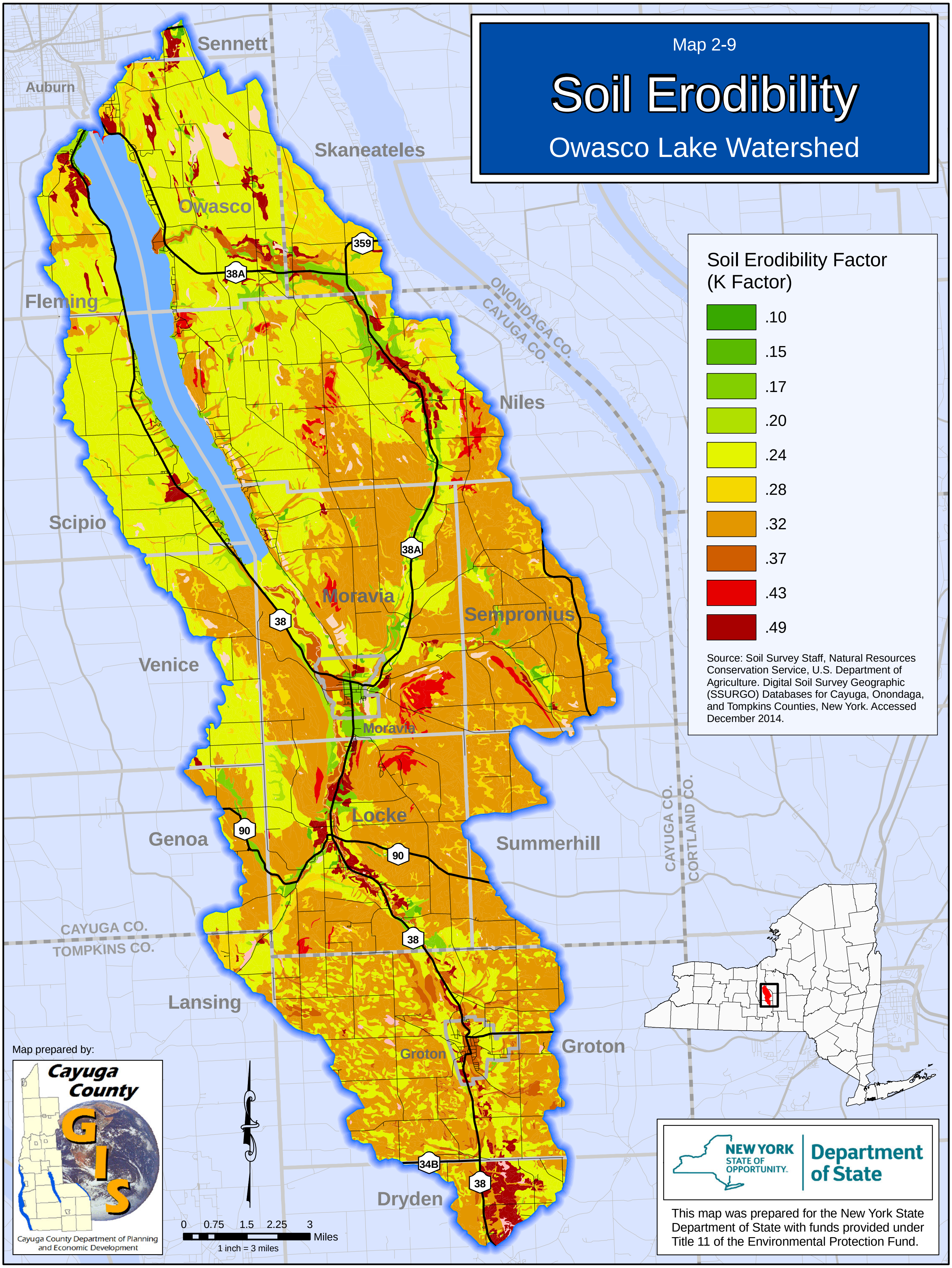


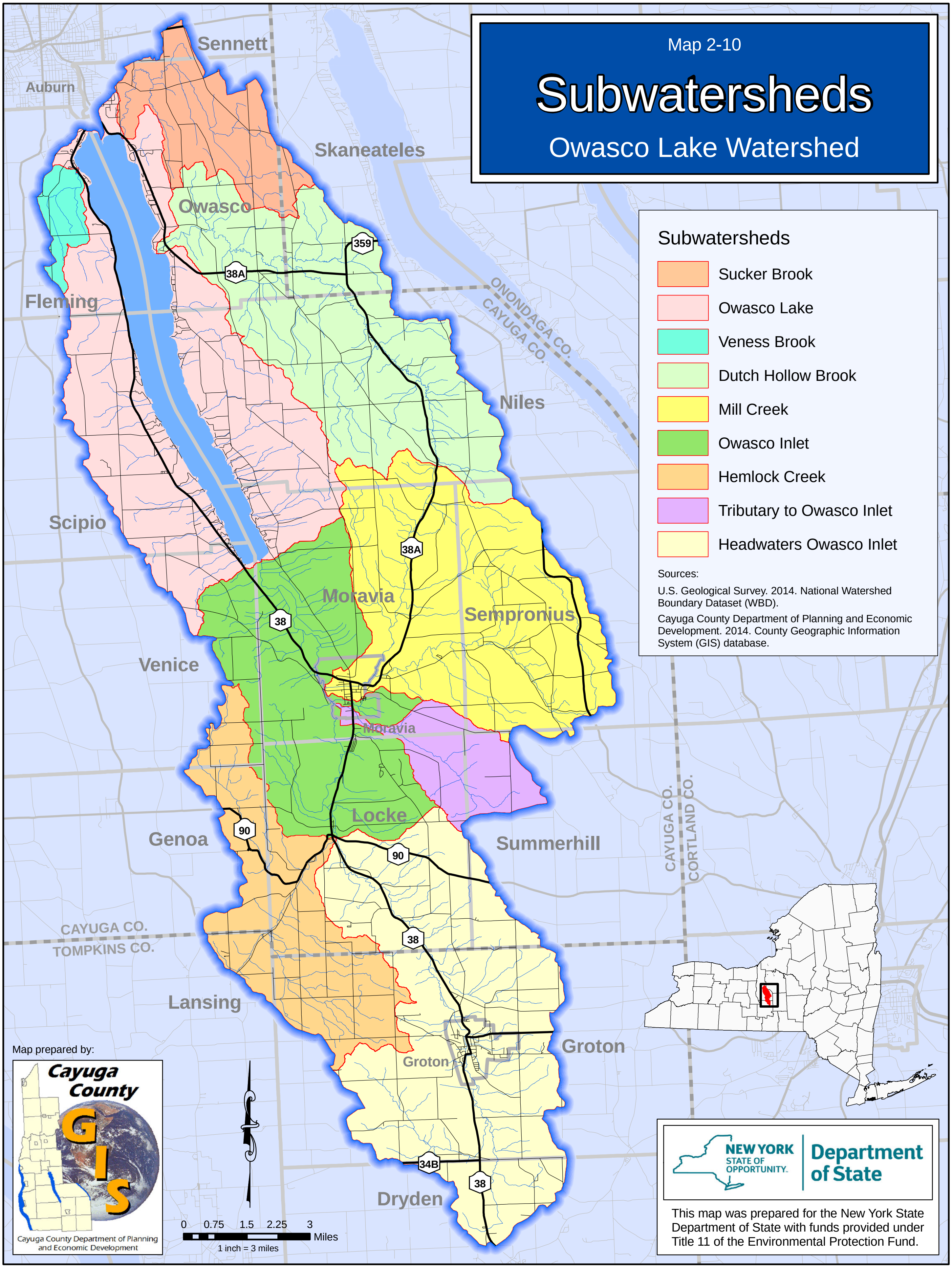
Map 2-5
Bedrock Geology
Owasco Lake Watershed
Bedrock Units
Closest to the Surface
Marcellus Formation
Skaneateles Formation
Ludlowville Formation
Moscow Formation
Tully Limestone
West River Shale
Source: NYS Museum / NYS Geological Survey. 1999. Statewide Bedrock Geology - Finger Lakes Sheet. Digital data derived from1:250,000 scale map.
2.7 Ecological Communities and Rare, Threatened and Endangered Species
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Venice
Locke
Genoa
Summerhill
Lansing
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CORTLAND CO.
TOMPKINS CO.
359
38A
38
90
34B
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

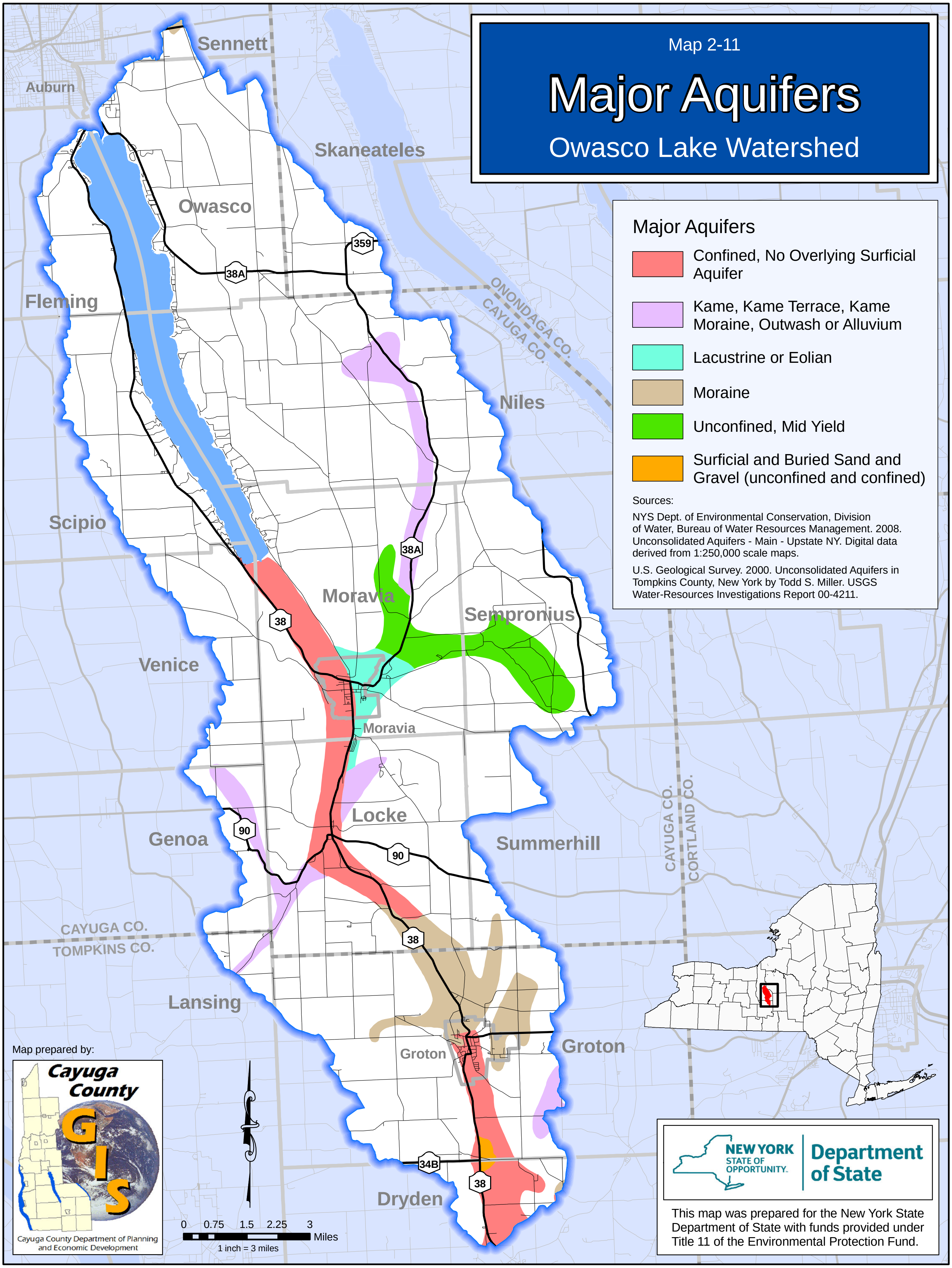

Map 2-6
Surficial Geology
Owasco Lake Watershed
Surficial Geology
Alluvial Fan
Bedrock
Kame Deposits
Kame Moraine
Lacustrine Sand
Lacustrine Silt and Clay
Outwash Sand and Gravel
Recent Alluvium
Swamp Deposits
Till
Till Moraine
Source: NYS Museum / NYS Geological Survey. 1999. Statewide Surficial Geology - Finger Lakes Sheet. Digital data derived from1:250,000 scale map.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
Lansing
Groton
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.


Map 2-7
Soil Drainage Class
Owasco Lake Watershed
Soil Drainage Class
Somewhat excessively drained
Well drained
Moderately well drained
Somewhat poorly drained
Poorly drained
Very poorly drained
Not rated or not available
Source: Soil Survey Staff, Natural Resources Conservation Service, U.S. Department of Agriculture. Digital Soil Survey Geographic (SSURGO) Database for Cayuga County, New York. Accessed December 2014.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
Lansing
Groton
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County
GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

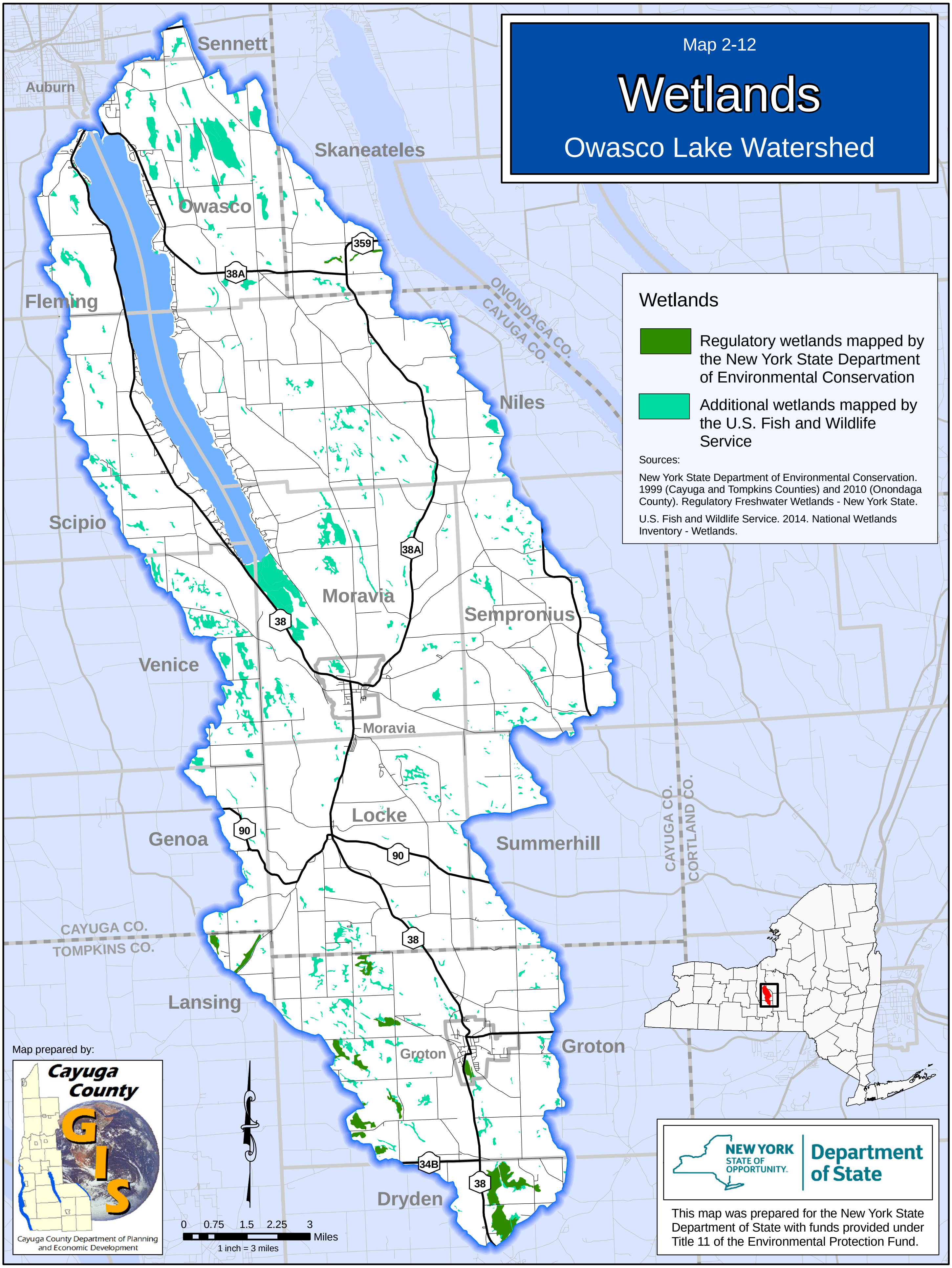

Map 2-8
Prime Farmland Soils
Owasco Lake Watershed
Prime Farmland and Other Important Soils
Prime Farmland
Farmland of Statewide Importance
Prime Farmland if Drained
Not Prime Farmland
Source: U.S. Department of Agriculture - NRCS. 2014. Soil Survey Geographic (SSURGO) Database.
Sennett
Auburn
Skaneateles
Owasco
Fleming
ONONDAGA CO.
CAYUGA CO.
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Genoa
Locke
Summerhill
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.


Map 2-9
Soil Erodibility
Owasco Lake Watershed
Soil Erodibility Factor (K Factor)
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
Source: Soil Survey Staff, Natural Resources Conservation Service, U.S. Department of Agriculture. Digital Soil Survey Geographic (SSURGO) Databases for Cayuga, Onondaga, and Tompkins Counties, New York. Accessed December 2014.
Sennett
Auburn
Skaneateles
Owasco
Fleming
ONONDAGA CO.
CAYUGA CO.
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3 Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

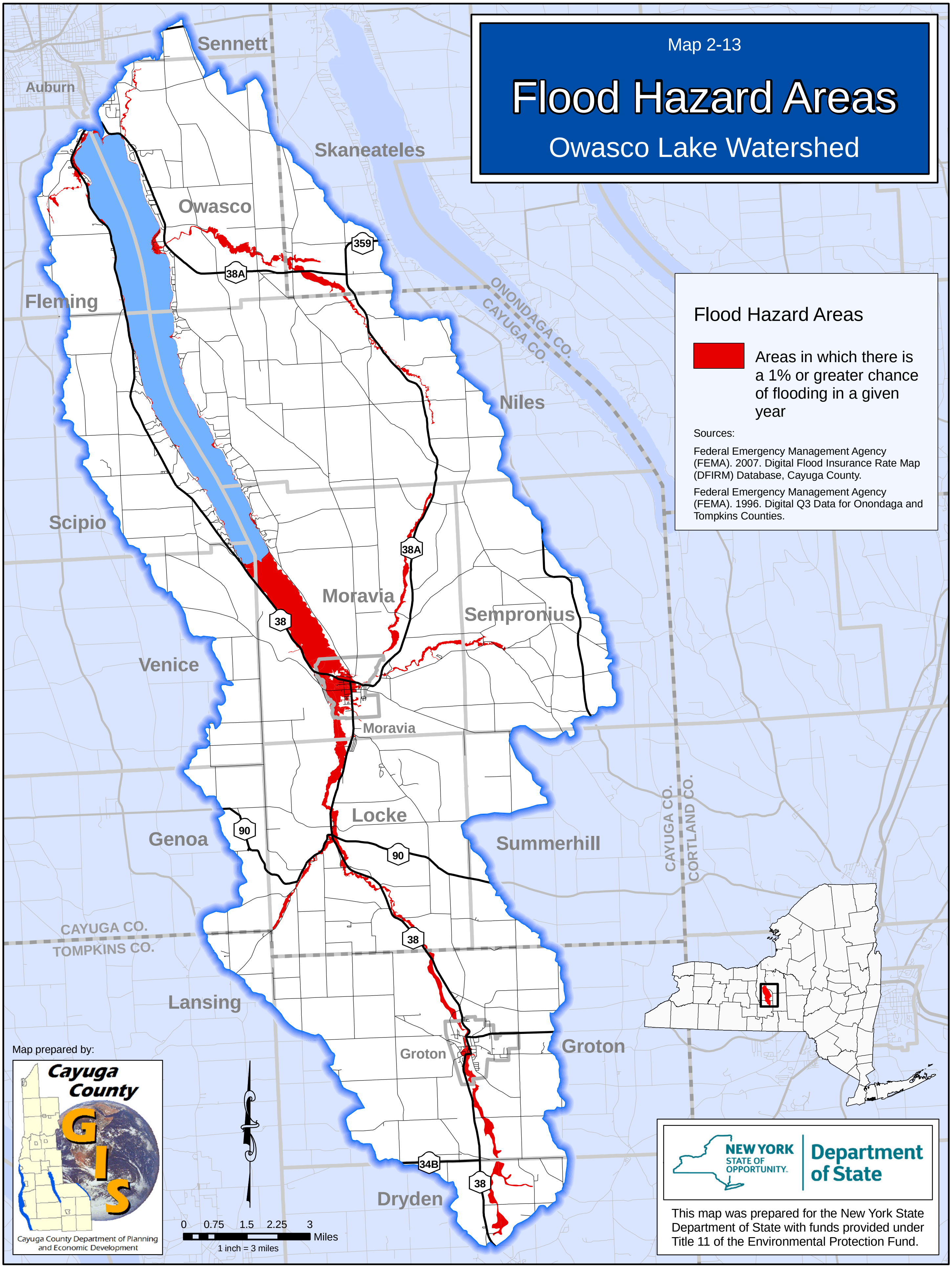

Map 2-10
Subwatersheds
Owasco Lake Watershed
Subwatersheds
Sucker Brook
Owasco Lake
Veness Brook
Dutch Hollow Brook
Mill Creek
Owasco Inlet
Hemlock Creek
Tributary to Owasco Inlet
Headwaters Owasco Inlet
Sources:
U.S. Geological Survey. 2014. National Watershed Boundary Dataset (WBD).
Cayuga County Department of Planning and Economic Development. 2014. County Geographic Information System (GIS) database.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
ONONDAGA CO.
CAYUGA CO.
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.



Map 2-11
Major Aquifers
Owasco Lake Watershed
Major Aquifers
Confined, No Overlying Surficial Aquifer
Kame, Kame Terrace, Kame Moraine, Outwash or Alluvium
Lacustrine or Eolian
Moraine
Unconfined, Mid Yield
Surficial and Buried Sand and Gravel (unconfined and confined)
Sources:
NYS Dept. of Environmental Conservation, Division of Water, Bureau of Water Resources Management. 2008. Unconsolidated Aquifers - Main - Upstate NY. Digital data derived from 1:250,000 scale maps.
U.S. Geological Survey. 2000. Unconsolidated Aquifers in Tompkins County, New York by Todd S. Miller. USGS Water-Resources Investigations Report 00-4211.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
CAYUGA CO.
TOMPKINS CO.
ONONDAGA CO.
CAYUGA CO.
CAYUGA CO.
CORTLAND CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.



Map 2-12
Wetlands
Owasco Lake Watershed
Wetlands
Regulatory wetlands mapped by the New York State Department of Environmental Conservation
Additional wetlands mapped by the U.S. Fish and Wildlife Service
Sources:
New York State Department of Environmental Conservation. 1999 (Cayuga and Tompkins Counties) and 2010 (Onondaga County). Regulatory Freshwater Wetlands - New York State.
U.S. Fish and Wildlife Service. 2014. National Wetlands Inventory - Wetlands.
Sennett
Auburn
Skaneateles
Owasco
Fleming
ONONDAGA CO.
CAYUGA CO.
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.


Map 2-13
Flood Hazard Areas
Owasco Lake Watershed
Flood Hazard Areas
Areas in which there is a 1% or greater chance of flooding in a given year
Sources:
Federal Emergency Management Agency (FEMA). 2007. Digital Flood Insurance Rate Map (DFIRM) Database, Cayuga County.
Federal Emergency Management Agency (FEMA). 1996. Digital Q3 Data for Onondaga and Tompkins Counties.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Scipio
Niles
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
Lansing
Groton
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0
0.75
1.5
2.25
3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

Chapter 3: State of the Watershed

3.1 Population and Trends

The population of the Owasco Lake watershed, calculated by the Cayuga County Department of Planning & Economic Development using the decennial census data, has been quite stable over the past 20 years. The numbers (Figure 3-1) correspond to a population density of about 80 persons per square mile. The variation in population density is illustrated in Map 3-1.

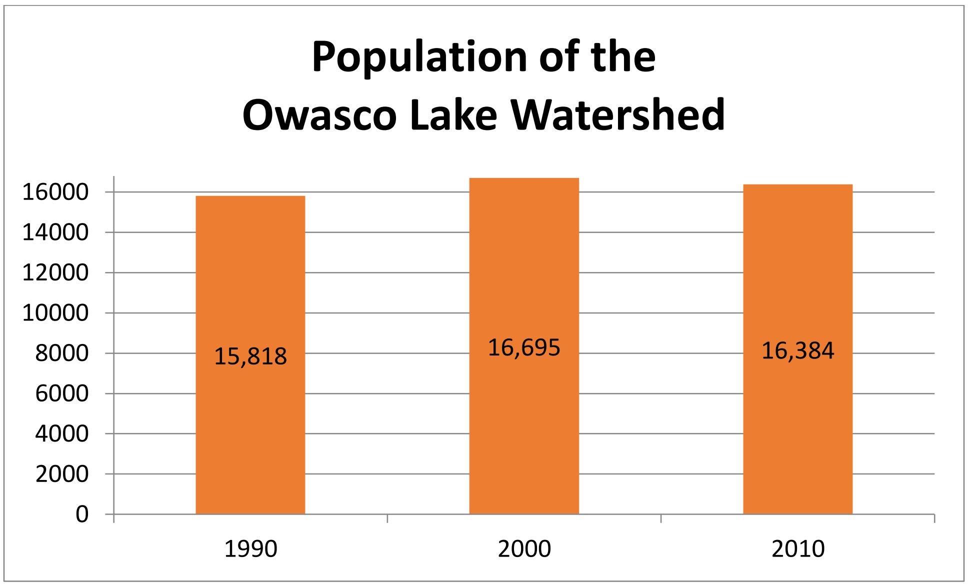


Figure 3-1. Population of the Owasco Lake Watershed, 1990-2010

One indirect indicator of population growth is subdivision of lands. As shown in Map 3-2, recent subdivisions in the Owasco Lake watershed tend to be located away from the lake shoreline and outside of village boundaries. Northern Tompkins County (Town of Groton) experienced the highest amount of subdivision activity within the watershed between 2004 and 2014.

3.2 Land Cover

Land cover and land use are two measures of the extent to which human activities have shaped the landscape of a particular area. Land cover is a classification designating the location and extent of forests, wetlands and open waters, grasslands, croplands, and developed areas within the watershed. Land use provides additional information related to how people use the landscape, whether for residential development, parks and recreational, industrial uses, commercial uses, etc. Two parcels may have similar land cover, but different land use. For example, an industrial assembly plant may look, from the outside, very much like an office building. The first is an example of industrial use, the latter an example of commercial use. Similarly, two parcels with similar land use may have different land cover. A golf course and an office building are both classified as commercial land uses. The former would have a land cover of grass, while the latter would be classified as developed. In the context of a watershed management plan, both land use and land cover can affect the movement of water and materials from the landscape to the waterways.

The land cover for the Owasco Lake watershed is displayed in Map 3-3. Note the relative importance and distribution of natural land cover (forests, wetlands), the working landscape (hay/pasture, cultivated crops), and developed areas. Owasco Lake watershed has large areas of contiguous open fields, which contributes to its aesthetic quality and rural character. The watershed-wide breakdown of land cover is summarized in Table 3-1.

Table 3-1. Summary of Land Cover Classifications for the Owasco Lake Watershed

Land Cover Classification	Watershed Area (mi^2)	Watershed Area (ha)*	Percent of Total
Open Water	0.24	62.7	0.1%
Developed, Open Space	7.41	1919.3	3.6%
Developed, Low Intensity	1.23	317.9	0.6%
Developed, Medium Intensity	0.25	65.1	0.1%
Developed, High Intensity	0.08	20.3	0.0%
Barren Land	0.01	2.2	0.0%
Deciduous Forest	48.11	12457.6	23.7%
Evergreen Forest	5.29	1369.3	2.6%
Mixed Forest	4.60	1189.9	2.3%
Shrub/Scrub	12.61	3265.8	6.2%
Herbaceous	0.80	207.9	0.4%
Hay/Pasture	53.76	13920.5	26.4%
Cultivated Crops	43.84	11352.3	21.6%
Woody Wetlands	10.44	2701.9	5.1%
Emergent Herbaceous Wetlands	1.26	326.8	0.6%

Source: National Land Cover Database, 2011 *A hectare (ha) is 2.47 acres*

From a water quality assessment and management perspective, the distribution of land cover within the major subwatersheds provides additional insight regarding the allocation of resources for restoration and protection efforts. The land cover statistics summarized in Table 3-1 are displayed by subwatershed in Figure 3-2; some of the categories have been combined. The detailed breakdown of land cover by subwatershed is included in Table 3-2. The Owasco Inlet and its eastern tributaries (Mill Creek, Fillmore/Dry Creek) have the highest percentage of forested land cover.

Another feature of land cover that affects water resources is the percent imperviousness. As impervious surfaces in the watershed increase, hydrology is affected; a higher percent of precipitation and snowmelt runs off the land surface rather than infiltrating into the soil profile and recharging the groundwater. As shown in Map 3-4, there are very limited areas of the Owasco Lake watershed with substantial percentages of impervious surfaces. Therefore, the watershed's land cover enhances infiltration and has a reduced risk of overland flow. This characteristic is beneficial for water resources protection.

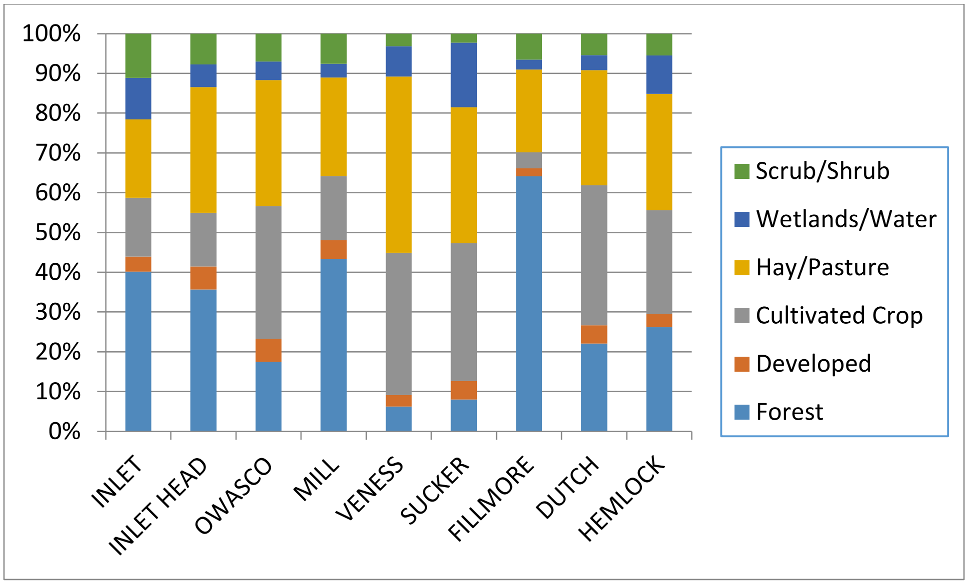


Figure 3-2. Percent Land Cover by Subwatershed

3.3 Waterfront Access, Parks, and Open Space Amenities

There are eight marinas and boat launches on Owasco Lake and along the lake outlet (Map 3-5). Cayuga County operates a public beach as well as a boat launch at Emerson Park; this popular park also offers picnic facilities, a walkway (pier) along the Owasco Lake outlet, and fishing areas. Because recreational boating is a vector for introducing invasive species to a lake, lake managers have begun to focus their efforts on watercraft stewardship- educating the public and inspecting boats as they enter the lake.

Several other parks and recreational trails are located within the watershed. The lands owned by County and the Owasco Flats Nature Reserve in Owasco Flats at the south end of Owasco Lake offer open space and recreational amenities including a canoe launch, trails, and boardwalks. Fillmore Glen State Park in Moravia has public trails and a swimming area. Frozen Ocean State Reforestation Area, with private recreation trails, is located along the eastern watershed boundary in Niles. In addition, a portion of the Summerhill State Reforestation Area, with public snowmobile trails, lies within the watershed. There are two Important Bird Areas recognized by the National Audubon Society, Greater Summerhill and the southern Skaneateles Lake forest, which includes the headwaters of Dresserville Creek and a portion of Bear Swamp State Forest. Just outside of the watershed boundaries, a multi-use trail extends from Auburn to Fleming along the lake's western side. In the future, the Owasco Flats Wildlife Management Area may provide additional open space.

3.4 Agriculture and Farmland

Agriculture is a dominant land use within the Owasco Lake watershed, representing approximately 48% of the land cover including pasture, hay fields, and cultivated croplands. According to the Owasco Lake

Agriculture Conservation Blueprint published in 2011 by the American Farmland Trust,[1] there are about 200 farms in the watershed ranging in size of less than 20 acres to over 2,000 acres. A majority of the farmland is utilized to produce feed and forage for dairy and beef cows with major field crops grown in the watershed including corn, wheat, soybeans, hay, and sweet corn. Roadside stands, Community Supported Agriculture (CSA) farms and orchards are also producing food crops such as tomatoes, pumpkins, gourds, strawberries, blueberries, garlic, beans, and fruit in the watershed.

The number and location of major farms in the Owasco Lake watershed, based on information from the 2014 Cayuga County Agriculture and Farmland Protection Plan, are displayed in Map 3-6. The Agriculture and Farmland Protection Plan was prepared by the Department of Planning & Economic Development and has been formally adopted by the Cayuga County Legislature. The maps display the locations of farming and related activities in the Cayuga County portion of the Owasco Lake watershed. Dairy farms and field crops, livestock farms (primarily beef, but also including hogs, poultry and eggs, sheep, goats, horses, alpaca, etc.) and some specialty crops, including vegetables, fruits, trees and tree products, honey, etc., are included. Finally, restaurants and retailers of local agricultural produce are shown in Map 3-7.

The U.S. Department of Agriculture (USDA) releases a census of agriculture every five years. The most recent census was published in early 2014, summarizing conditions as of 2012.[2] Since the results are reported by county, these data may not correspond directly to conditions and trends in farming within the Owasco Lake watershed. The reported changes from 2007 to 2012 for Cayuga County include the following:

- The number of farms decreased about 5% (936 farms in 2007; 891 farms in 2012)
- The market value of products sold increased by 37% (66% livestock; 34% crop sales)
- The average size of farms remained stable
- The number of cattle and calves per farm increased

The USDA census also ranks each county relative to the 62 counties in New York and nationally. Cayuga County is ranked first in New York counties for acres planted in soybeans, and sales of beans and grains. The County is ranked second in New York for the total value of agricultural products sold, the value of livestock, poultry and their products, the number of cattle and calves, the market value of those animals, as well as the sales of milk, cattle and calves. In addition, Cayuga County has the second highest land area planted in corn (silage) of New York counties. The County is ranked second in the number of sheep and goats.

It is important to recognize that agriculture is a fundamental component of the local economy. The USDA reported that the market value of products sold in Cayuga County increased 37% from 2007 to 2012, from $214,403,000 to $293,474,000.

3.5 Groundwater quality

Just as the New York State Department of Environmental Conservation (NYSDEC) is committed to periodically evaluating surface water quality conditions throughout the state, the agency collaborates with the federal U.S. Geological Survey on a program to evaluate groundwater quality in New York's major river basins on a five-year rotating basis. The Ambient Groundwater Monitoring Program parallels the Rotating Intensive Basin Study program and helps NYSDEC comply with the federal requirement to report on the chemical quality of groundwater. The state's groundwater quality assessment program began in 2002. Groundwater quality within the Central New York region, encompassing the Seneca, Oneida, Oswego, and central Lake Ontario river basins, has been monitored in 2007 and 2012.

Results of the 2012 sampling program were published by the U.S. Geological Survey (USGS) in December 2014. [3] Two of the 29 wells sampled in 2012 were located within the Owasco Lake watershed. Well CY1201 is sited near the lake's western shoreline, approximately mid-lake. Well CY1325 is within the Owasco Inlet subwatershed, located to the southeast of the lake. Both wells are domestic supply wells drawing water from bedrock aquifers composed of shale, siltstone, and sandstone. The two wells extend 113 and 272 ft. below the land surface; the well casing is screened at 19 and 24 ft. Neither well was included in the 2007 sampling program.

Drinking-water standards for nitrate, nitrite, antimony, barium, beryllium, cadmium, chromium, copper, lead, mercury, selenium, silver, thallium, zinc, gross alpha radioactivity, uranium, fecal coliform, and *Escherichia coli* were not exceeded in any of the samples collected. None of the pesticides or volatile organic compounds analyzed exceeded drinking-water standards. Results from one of the two wells in the Owasco Lake watershed revealed color and pH at levels in excess of drinking water standards; methane levels in this same well were reported at 12.3 mg/L. All other monitored constituents were within state and federal standards. As cited in the 2000 *State of the Owasco Lake Watershed* report, groundwater in this region has relatively high concentrations of dissolved solids, carbonates, and hardness. Selected data from the 2014 USGS report are included in Table 3-2. The complete set of water quality results is available at http://pubs.usgs.gov/of/2014/1226/appendix/ofr2014-1226_appendix1.xlsx

Table 3-2. Groundwater Quality of Two Bedrock Wells in the Owasco Lake Watershed Sampled by SGS in 2012

Parameter	Units	Well CY1201	Well CY1325
pH	Standard units	7.9	9.2
Color	Platinum units	<1	300
Hardness	mg/L as CaCO3	156	28.1
Total dissolved solids	mg/L	314	265
Methane	mg/L	<0.001	12.3
Sodium	mg/L	53.8	93.2
Calcium	mg/L	41.8	7.87
Magnesium	mg/L	12.5	2.05
Potassium	mg/L	1.25	0.62
Alkalinity	mg/L as CaCO3	236	205
Chloride	mg/L	2.29	7.85
Sulfate	mg/L	32	11.6

Another recent investigation of groundwater quality in Cayuga and Orange Counties tested groundwater wells sited in agricultural areas in each county (40 wells per county) for the presence of a suite of 93 pesticides.[4] Sampling locations were selected based on local knowledge of groundwater conditions, risk modeling, interpretation of aerial photos, and a database of pesticide purchases. Most of the wells were shallow, and considered vulnerable to transport of agricultural chemicals to the groundwater aquifer. The study design explicitly focused on sites at the highest risk of contamination. Results indicated that all samples from the 80 wells resulted in non-detections of the pesticides using sensitive analytical measurements. No wells from either county exceeded any of 15 state groundwater standards or guidance values. These results support a finding that the current regulatory framework for pesticide application provides adequate protection from groundwater contamination in the two agricultural counties investigated.

Regions of the Owasco Lake watershed vary with respect to vulnerability to groundwater contamination by surface-applied materials such as manure, fertilizers, and pesticides from agriculture and residential uses. As displayed in Map 3-8, areas where carbonite bedrock formations are close to the surface are at higher risk, as groundwater infiltration may be rapid.

3.6 Stream Classification and Designated Use

Under authority of the Clean Water Act, the USEPA requires states and tribes to classify waters for a designated use (e.g., water supply, recreation, aquatic life), to promulgate ambient water quality standards—defined as enforceable limits on pollutants related to these designated uses—and to periodically evaluate whether the designated uses are, in fact, being met. To support the states in meeting these responsibilities, USEPA scientists develop criteria—defined as the best professional judgment of limits on specific parameters that will support the designated use (e.g., ammonia concentrations that would not harm the aquatic biota). The federal criteria are not legally enforceable limits. States have the option of promulgating the federal criteria as their standards, or developing their own standards that are at least as stringent as the federal criteria.

NYSDEC classifications for surface waters range from Class AA to Class D depending on the expected best use of the water and whether additional treatment (e.g., filtration) is currently required to meet that use.

> **AA, A:** Source of water supply for drinking, culinary or food processing purposes; primary and secondary contact recreation; and fishing. The waters shall be suitable for fish, shellfish, and wildlife propagation and survival.
>
> **B:** Primary and secondary contact recreation and fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival.

C: Fishing. These waters shall be suitable for fish, shellfish, and wildlife propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

D: Fishing. Due to such natural conditions as intermittency of flow, water conditions not conducive to propagation of game fishery, or stream bed conditions, the waters will not support fish propagation. These waters shall be suitable for fish, shellfish, and wildlife survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

Certain Class AA and Class A surface waters may be further designated as "Special"; this designation requires additional controls on any discharges. Class B or C waters may be designated "T", meaning that the water quality conditions must be adequate to support survival of trout, or "TS" meaning that water quality and habitat conditions must be adequate to support trout spawning.

The current classification of stream segments in the Owasco Lake watershed is displayed in Map 3-9. Note that the majority of stream segments are Class C, with some designated as trout waters. Recent monitoring and assessment data were used to determine the extent to which these stream segments exhibit water quality and habitat conditions that support the designated uses. NYSDEC uses a scale to indicate whether and to what extent the designated uses are supported; the scale progresses from threatened (least evidence of adverse impacts), stressed, impaired, and precluded (greatest evidence of adverse impacts) (Table 3-3).

Table 3-3. NYSDEC Scale of the Severity of Use Impairment of Classified Waterbodies

Severity	Criteria
Precluded	• *Frequent/persistent* water quality, or quantity, conditions and/or associated habitat degradation *prevents all aspects* of the waterbody use.
Impaired	• Occasional water quality, or quantity, conditions and/or habitat characteristics *periodically prevent* the use of the waterbody, or; • Waterbody uses are not precluded, but some aspects of the use are *limited* or *restricted*, or; • Waterbody uses are not precluded, but *frequent/persistent* water quality, or quantity, conditions and/or associated habitat degradation *discourage* the use of the waterbody, • Support of the waterbody use *requires additional/advanced* measures or treatment.
Stressed	• 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	• 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 or ecosystem disruption, or; • Monitoring *data reveal increasing contamination* or the presence of toxics below the level of concern, or; • Waterbody uses are not restricted and no water quality problems exist, but the waterbody is a *highly valued resource* deemed worthy of special protection and consideration.

Source: New York State Consolidated Assessment and Listing Methodology - Section 305(b) Assessment Methodology. May 2009

The current assessment of the extent to which the watershed's creeks and streams meet their designated use is displayed in Map 3-10. In December 2014, NYSDEC issued an updated assessment of the status of waterbodies within the Owasco Lake watershed (see Waterbody Inventory for Seneca River Lower Watershed) . The data from the 2014 update are summarized in Table 3-4.

Table 3-4. NYSDEC Basis for Classifying Various Stream Segments as Not Fully Supporting Designated Uses

Water segment (size)	Use(s) Impacted	Type of pollutant (CAPS indicate major)	Source of pollutant (CAPS indicate major)
Tributaries to Owasco Lake: includes lower reaches of Sucker, Veness, & unnamed (89.4 miles)	Aquatic life (stressed) Recreation (stressed) Habitat/Hydrology (stressed)	NUTRIENTS Silt/sediment	STREAMBANK EROSION agriculture, stormwater, road banks
Dutch Hollow Brook and tributaries (68.5 miles)	Habitat/Hydrology (stressed)	SILT/SEDIMENT Thermal changes	HABITAT MODIFICATION, STREAMBANK EROSION Hydrologic modification, agriculture
Owasco Inlet and tributaries (59.1 miles)	AQUATIC LIFE (impaired) Recreation (stressed)	NUTRIENTS (PHOSPHORUS) Silt/sediment	AGRICULTURE, MUNICIPAL, streambank erosion

Every two years, NYSDEC is required to report to USEPA a list of waters where designated uses are not met, and a Total Maximum Daily Load (TMDL) approach or other restoration strategy is required. This list is referred to as the 303(d) list. The final 2014 list includes the Owasco Inlet (upper and tribs), a Class C(T) river segment that is listed as impaired by excessive nutrients from municipal and agricultural sources. This river segment has appeared in Part 1 of the 303(d) list since 2008. The 2014 listing of Owasco Inlet is marked with an asterisk (*) which denotes a High Priority Water, scheduled for TMDL/restoration strategy development and submission for approval to USEPA within the next two years.

Several stream segments within the Owasco Lake watershed are reported as fully supporting their designated use. These include Mill/Dresserville Creek and its tributaries (33.2 miles), and Decker Creek and its tributaries (30.5 miles). This assessment indicates that there are extensive segments of tributaries to Owasco Lake where water quality and/or habitat conditions are not fully supportive of the designated uses.

3.7 Stream Water Quality and Habitat Conditions

3.7.1 Stream Segment Analysis (FLI Monitoring)

There have been numerous investigations of the tributaries to Owasco Lake since the *State of the Owasco Lake Watershed* report was completed in 2000. Most notably, Professor John Halfman of Hobart William Smith Colleges and the Finger Lakes Institute (FLI) has implemented a monitoring program focused on the water quality condition of streams and the loading of materials—primarily nutrients and sediment—to the lake. Professor Halfman's program encompasses automated sampling at the mouths of tributaries to provide data for calculating load, as well as stream segment analysis to identify spatial variability in water quality and habitat conditions. The FLI program also includes lake sampling, which is discussed in Chapter 4.

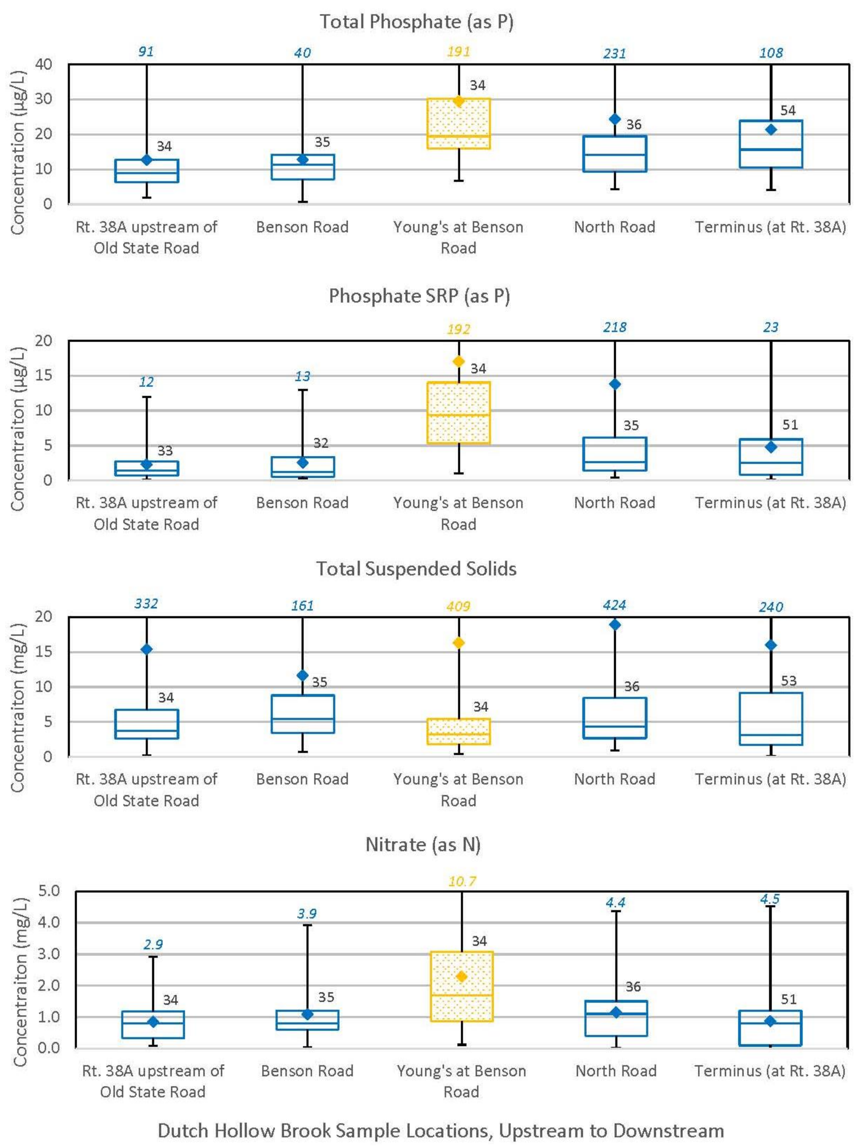
The FLI stream segment initiative has produced water quality data for multiple locations in the watershed; the vast majority of sampling has been conducted along the two major tributaries, Owasco Inlet and Dutch Hollow Brook, and their subwatersheds. A summary of the stream segment sampling conducted from 2006-2014 is presented in Table 3-5. This multi-year and multi-station data set represents a rich characterization of the chemical quality of the tributaries to Owasco Lake. Each year, Professor Halfman reports on the findings of the FLI monitoring program, both as a written report and as presentations to the Cayuga County water resources management professionals and the public. The annual reports for John Halfman's Research of Owasco Lake are available on the Cayuga County website for the Water Quality Management Agency. Funding for the monitoring effort comes from Cayuga County, the Owasco Watershed Lake Association, member item grants from New York State, the Town of Fleming, The Emerson Foundation, and the Finger Lakes Institute.

Table 3-5. Summary of Finger Lakes Institute Stream Segment Monitoring Program, 2006–2014

Year	Stream	Number of Segments	Number of Events (Timing)	Parameter List *
2006	Dutch Hollow	1	5 (May–Sept.)	Discharge, DO, pH, temperature, sp. cond,NO_3-N, SRP, TP, T-ALK, Silica, TSS
	Owasco Inlet & tribs	6		
2007	Dutch Hollow	1	9 (May–Sept.)	Discharge, DO, pH, temperature, sp. cond,NO_3-N, SRP, TP, T-ALK, Silica, TSS
	Owasco Inlet & tribs	7		
	Sucker	1		
	Veness	1		
2009	Dutch Hollow	5	2 (Sept.–Dec.)	Discharge, pH, temperature, sp. cond,NO_3-N, SRP, TP, TSS
	Owasco Inlet & tribs	2		
	Veness	1		
2010	Dutch Hollow	5	3 (April–June)	Discharge, pH, temperature, sp. cond,NO_3-N, SRP, TP, TSS
	Owasco Inlet & tribs	2		
	Veness	1		
2011	Dutch Hollow	8	15 (April–Oct.)	Discharge, temperature, sp. cond,NO_3-N, SRP, TP, TSS
	Owasco Inlet & tribs	10		
2012	Dutch Hollow	7	8 (March–Oct.)	Discharge, temperature, sp. cond,NO_3-N, SRP, TP, TSS
	Owasco Inlet & tribs	9		
	Fire Lane 20	1		
2013	Dutch Hollow	7	7 (April–Sept.)	Discharge, temperature, sp. cond,NO_3-N, SRP, TP, TSS
	Owasco Inlet & tribs	10		
	Fire Lane 20	1		
2014	Dutch Hollow	12	2 (July, Aug.)	Discharge, temperature, sp. cond,NO_3-N, SRP, TP, TSS
	Owasco Inlet & tribs	16		
	Fire Lane 20	1		

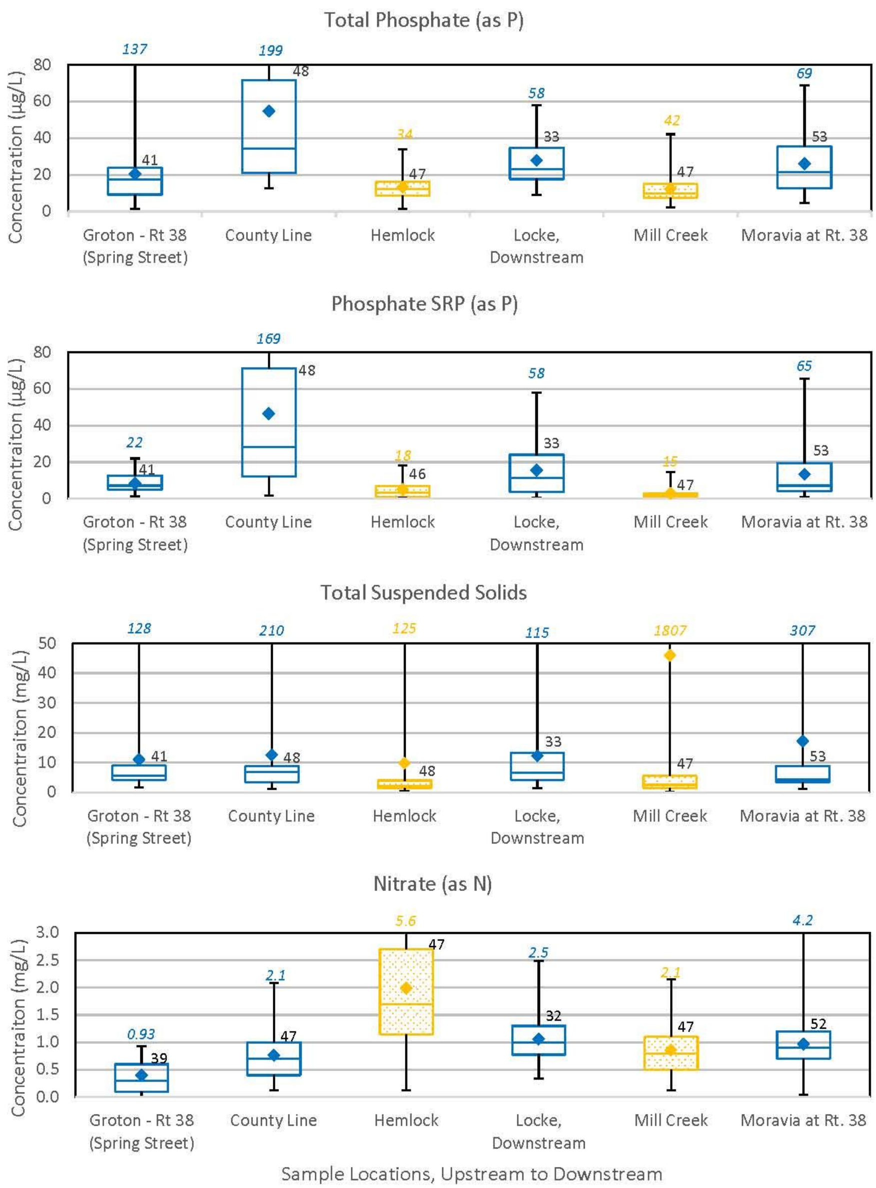
*DO = dissolved oxygen; sp. cond = specific conductance (conductivity); NO_3-N = nitrate-nitrogen; SRP = soluble reactive phosphorus; TP = total phosphorus; T-ALK = total alkalinity

The monitoring program documents the spatial and temporal variability in stream water quality conditions. Because the concentration and loading of nutrients and sediment of the tributary streams vary with land cover, land use, management practices, rainfall, and runoff, these spatial and temporal variations are to be expected. The program can help managers identify stream reaches where nutrient and sediment concentrations increase and pinpoint regions where improving land management practices can accrue substantial benefits. Data from the stream segment monitoring program are displayed in Figure 3-3(a) (Dutch Hollow Brook) and Figure 3-3(b) (Owasco Inlet). Note that the data presented for Owasco Inlet encompass data prior to completion of the enhanced phosphorus removal facilities at the Village of Groton Wastewater Treatment Plant.



Box and Whisker Plots of data collected 2006 through 2014 from Dutch Hollow Brook (blue) and Young's Brook tributary (orange). Upper and lower borders of the box represents first and third quartiles, respectively; the horizontal line inside represents the median. The diamond shape represents the average, and the error bars show the maximum and minimum. The italicized value above the error bar is the maximum, while the value above the box to the right of the error bar is the number of samples in the dataset.

Figure 3-3(a). Pooled Data from Stream Segment Monitoring Along Dutch Hollow Brook



Box and Whisker Plots of data collected 2006 through 2014 from Owasco Inlet (blue) and two tributaries (Hemlock and Mill Creek, in orange). Upper and lower borders of the box represents first and third quartiles, respectively; the horizontal line inside represents the median The diamond shape represents the average, and the error bars show the maximum and minimum. The italicized value above the error bar is the maximum, while the value above the box to the right of the error bar is the number of samples in the dataset.

Figure 3-3(b). Pooled Data from Stream Segment Monitoring Along Owasco Inlet

3.7.2 Nutrient and Sediment Loading Estimates, Dutch Hollow Brook (FLI Monitoring)

In addition to conducting the stream segment monitoring program, Professor Halfman and his colleagues deploy an automated sampling device at Dutch Hollow Brook where it crosses Route 38A; this location is close to where the tributary enters Owasco Lake. Samples are collected three times each day over the entire period of deployment, which has ranged from five to eight months in duration. A subset of the collected samples is analyzed in the laboratory; all storm event samples are analyzed, while only one base flow (non-storm event) sample per day is analyzed. The calculated loading of total suspended sediment, nitrate-N, total P and soluble reactive P from 2011-2014 are summarized in Table 3-6, which is reproduced from Halfman et al. 2014.[5]

Table 3-6. Loading Rates of Nutrients and Sediment, Dutch Hollow Brook at Rt. 38

2011 (6/9- 11/4)	TSS (kg/day)	NO_3-N kg/day	Total P (kg/day)	SRP (kg/day)
Mean Loading Rate over monitoring period	8,700	75	2.7	1.7
Calculated Loading Rate during Events	24,500	180	6.9	4.5
Calculated Loading Rate during Base Flow	115	19	0.4	0.1
Percent of Total Load attributed to Events	99%	84%	90%	96%
2012 (3/20- 11/2)	**TSS (kg/day)**	**NO_3-N kg/day**	**Total P (kg/day)**	**SRP (kg/day)**
Mean Loading Rate over monitoring period	2,400	69	1.9	0.4
Calculated Loading Rate during Events	6,850	150	4.0	0.6
Calculated Loading Rate during Base Flow	190	28	0.9	0.2
Percent of Total Load attributed to Events	95%	73%	70%	60%
2013 (4/10- 10/29)	**TSS (kg/day)**	**NO_3-N kg/day**	**Total P (kg/day)**	**SRP (kg/day)**
Mean Loading Rate over monitoring period	7,550	270	4.4	1.3
Calculated Loading Rate during Events	12,000	370	6.4	1.8
Calculated Loading Rate during Base Flow	290	100	1.3	0.3
Percent of Total Load attributed to Events	99%	85%	89%	91%
2014 (4/19- 10/28)	TSS (kg/day)	NO_3-N kg/day	Total P (kg/day)	SRP (kg/day)
Mean Loading Rate over monitoring period	14,600	115	3.5	1.6
Calculated Loading Rate during Events	36,000	185	6.5	3.2
Calculated Loading Rate during Base Flow	300	67	1.5	0.5
Percent of Total Load attributed to Events	99%	65%	74%	81%

3.7.3 Biological and Habitat Assessments

The chemical monitoring program represents a snapshot of stream conditions. A complementary approach is to evaluate the benthic macroinvertebrate community to infer water quality and habitat conditions over time. Freshwater benthic macroinvertebrate taxa include aquatic insects (Insecta), worms (Oligochaeta), snails (Gastropoda), clams (Bivalvia), leeches (Hirudinea), and crustaceans (Crustacea). These organisms provide the link in the food web between microscopic organisms and fish, and also facilitate the transfer of energy and materials between the terrestrial and aquatic ecosystems.

There are important differences among groups of macroinvertebrates that influence the structure and function of a particular community. The organisms' different level of tolerance to adverse environmental conditions is the basis for their use as biological indicators of stream water quality. Macroinvertebrates are grouped into three broad categories based on their tolerance to organic materials: intolerant, moderately tolerant, and tolerant. The intolerant group includes species of mayflies, stoneflies, caddisflies, riffle beetles, and hellgrammites; the tolerant group includes worms, some midges, leeches, and some snails. The moderately tolerant group includes most snails, sowbugs, scuds, blackflies, craneflies, fingernail clams, dragonflies, and some midges.[6] Many water resource management agencies, including NYSDEC, have developed various metrics based on the presence/absence of certain organisms for a biological stream assessment. The indices based on organic enrichment have recently been expanded in New York State to include a metric that relates specifically to nutrient enrichment; this Nutrient Biological Index (NBI) complements the various metrics developed to indicate the presence of organic enrichment.

The NYSDEC Stream Biomonitoring Unit evaluated the benthic macroinvertebrate community of a segment of the Owasco Inlet in 2001, 2006, 2007 and most recently in 2011. Prior to the 2011 survey, the macroinvertebrate assessment results indicated that water quality of the Inlet was degraded and the Village of Groton Wastewater Treatment Plant (WWTP) discharge was cited as a major contributing source.[7] The 2011 survey, which included the NBI among the suite of metrics used to develop the Biological Assessment Profile, documented improved conditions in the stream downstream of the Village of Groton WWTP and attributed them to the reduction in nutrient and organic loading from the facility that was achieved by the recent improvements. As summarized in Table 3-7, the macroinvertebrate communities were similar to previous years, with the exception of station 2, located just downstream of the WWTP outfall. A biological assessment of slightly impacted indicates that aquatic life uses are fully supported. The Owasco Inlet is affected by nutrient enrichment.

Table 3-7. Results of NYSDEC Biological Assessment of Owasco Inlet, 2006 and 2011

Station	Location and Bridge Crossing	2006 Assessment	2011 Assessment
1	Above Groton (Peru Rd.)	Slightly Impacted	Slightly Impacted
2	Below Groton (Walpole Rd.)	Moderately Impacted	Slightly Impacted
3	Below Groton (Rt. 38)	Slightly Impacted	Slightly Impacted
4	Above Locke (Rt. 38)	Slightly Impacted	Slightly Impacted
5	Below Locke (Rt. 38)	Slightly Impacted	Slightly Impacted
6	Above Moravia (Rounds Lane)	Slightly Impacted	Slightly Impacted
7	Below Moravia (Rt. 38)	Slightly Impacted	Slightly Impacted

Field biologists from EcoLogic completed a monitoring program in summer 2014 to characterize conditions in major and minor tributaries of the lake, major land uses within the watershed, and factors that potentially affect water quality within the tributaries and the lake proper. Ten sites on Owasco Inlet, Dutch Hollow Brook, and Veness Brook were surveyed; habitat and biological conditions within these streams were documented. The monitoring sites were characterized with regard to habitat type (riffle, run, and pool), substrate characteristics, in-stream cover, bank stability, riparian zone quality, channel form and alteration, and surrounding land use. The team also completed the rapid assessment of habitat condition following NYSDEC protocols, measured dissolved oxygen and specific conductance, and examined the aquatic macroinvertebrate at eight of the 10 sites.

As part of the field effort, the EcoLogic field biologists evaluated each site for a suite of 10 metrics associated with aquatic habitat conditions and compared the results to a modeled ideal (undisturbed) stream site. The score is a summed value of how close each of the metrics is to the ideal condition. This "model affinity" score is used by NYSDEC and others to infer the suitability of the habitat for the aquatic community. The individual metrics provide insight into the factors affecting deviation from ideal conditions, e.g., conditions of the streambed and banks, riparian vegetation, etc. Note the variation in the model affinity score among the sites included in the evaluation (Map 3-11).

The EcoLogic field team returned to the Owasco Lake watershed in September 2014 to characterize tributaries draining relatively small areas of the watershed directly to the lake. This effort encompassed 14 streams or rivulets; general habitat conditions, water chemistry (dissolved oxygen, pH, and specific conductance), and existing or potential factors that could affect water quality were documented. General land use characteristics within the subwatershed were observed and photographed.

The 14 streams varied considerably in size, form, physical characteristics, and potential to contribute to water quality impairment within the Owasco Lake watershed. Features of these streams that likely contribute to degraded habitat and water quality included insufficient riparian buffer zones between the stream and adjacent agricultural or residential land use and altered drainage patterns, including road ditching practices, resulting in excessive stormwater runoff and consequent erosion and sedimentation. Not all of the streams visited exhibited these features or exhibited them to the same degree, but nearly every stream showed some evidence of degradation, at least in the vicinity of the road crossings. There was evidence of bank erosion in areas upstream of road crossings as well. Some of the eroded banks likely are the result of scouring during high flow events. The relatively high gradient of the many streams draining the steep lake valley makes these streams susceptible to flash flooding, which can result in the type of erosion observed. This problem is exacerbated by insufficient vegetated riparian buffer zones characteristic of many of the streams in the watershed.

Example of an insufficiently vegetated riparian area (2014)

Insufficient vegetated riparian buffers not only allow stormwater to quickly enter a stream and attain levels of volume and velocity capable of scouring stream beds and banks, but also fail to capture pollutants and nutrients before they enter the stream and potentially the lake. The Owasco Lake watershed has many regions where agricultural fields or residential lawns extend within several feet of streams, or are separated from streams by very narrow vegetated riparian zones. Portions of these narrow riparian buffers were often comprised of herbaceous plants (including invasive species) with

Photograph from the Dutch Hollow Brook Stream Corridor Assessment, 2003

shallow or poorly-developed root systems that do not offer the protection from erosion like the more extensive root systems of woody vegetation.

3.7.4 Stream Bank Management Plans

With funding from the Great Lakes Basin Program for Soil Erosion and Sediment Control, Cayuga County completed detailed tributary assessments and management plans for Dutch Hollow Brook, Sucker Brook and Veness Brook between 2000 and 2003. The project team included the Cayuga County Department of Planning & Economic Development, the Cayuga County Soil & Water Conservation District, and the Cayuga County Department of Information Technology. Members of AmeriCorps provided additional field support. Management plans for the three tributaries were finalized in 2003.

The tributary assessments employed a uniform methodology for the three study subwatersheds. Members of the project team walked each stream corridor, after receiving access permission from landowners, and identified areas of streambank erosion, downed trees, and other problem areas. Each problem area was catalogued, located using GPS technology, and photographed. The field observations and measurements included: adjacent land use; the length, height and slope of erodible area; whether the banks were undercut; soil texture of the streambed and banks; channel width; direction of flow; blockages; and turbidity. The resulting field data were mapped. Information from the field program was reviewed by professional engineers, water resources scientists, and senior SWCD staff. These analyses resulted in recommended remedial measures and cost estimates for each site.

The remedial measures include bioengineering approaches, such as plantings, along with some recommendations for stabilizing with stone and rip-rap. Undercut and eroding banks are targeted for re-grading. Riparian buffers are recommended; in some areas, conservation easements along the stream corridor are seen as the most effective means to establish effective buffers and stabilize the eroding sections. As funding becomes available, the sites identified in the 2000 – 2003 streambank survey are being stabilized and/or restored. A summary of the recommended actions and their current status is provided in Table 3-8.

Table 3-8. Summary of Recommendations for Stream Bank Stabilization within Three Tributaries

Tributary	Number of Problem Sites	Estimated Cost for Remedial Measures, per site	Status of Recommendations (as of 2014)
Owasco Inlet	--	---	Grant of $750,000 awarded to SWCD (2004)
Dutch Hollow Brook	44	$1,500 - $14,000	Demonstration project completed in 2005; $37,000 grant funding
Sucker Brook	13	$475 - $5,000	Four sites: S1 (including bridge removal), S9, S10, and S11 received $4,700 grant funding
Veness Brook	7	$1,000 - $5,000	Sites V1, V2, V3 and V6 Two grants: $5,500 (NYS, 2004)) $1,255 (FLLOWPA)

There are several general recommendations relevant to all the stream corridors. For example, at a minimum, vegetative and/or wooded buffer zones should be maintained or established throughout the length of the stream. The buffers should extend at least 30 feet from each bank, thus providing at least a 60 feet buffer. The planners further recommend educational programs for landowners on riparian, stream, yard waste and household waste management.

3.8 Phosphorus Loading Estimates

In 2008, Professor Barry Evans of Penn State University's Institutes of Energy and the Environment released results of a watershed loading model for Owasco Lake.[8] Dr. Evans applied the GIS-based model ArcView Generalized Watershed Loading Function (AVGWLF) to quantify nutrient and sediment loading to the lake. In addition, he used the simple lake water quality model BATHTUB to simulate how Owasco Lake's water quality conditions (as indexed by total phosphorus, chlorophyll-a, and Secchi disk transparency) would respond to the modeled estimates of external phosphorus loads.

AVGWLF is based on the Generalized Watershed Loading Function (GWLF) model that was developed by Cornell University Professors Doug Haith and Christine Shoemaker; this mathematical model is used to estimate the amount of runoff, sediment, and nutrients (N and P) from a watershed based on a suite of input parameters including land use/land cover, soils, and topography. The model can also account for wastewater inputs, both from onsite (septic) systems and wastewater treatment plants. While hydrology is tracked on a daily time-step, the model output is an estimated monthly load of nutrients and sediment. The model was set up for Owasco Lake to include three major subwatershed areas: Dutch Hollow Brook, Owasco Inlet, and the remainder of the lake watershed. Dr. Evans used Owasco Inlet monitoring data collected over the period 1988-1991 to calibrate the model; the Inlet data included daily stream flow measurements and frequent water chemistry analyses over this time period.

Once calibrated, the model was applied to simulate annual nitrogen and phosphorus loading for 1990, 2000, and 2007—three years with different rainfall conditions, intensity of agricultural land use, number of septic systems, and performance of the wastewater treatment plants. In-lake phosphorus data were available for each of the three target years; thus, Dr. Evans was able to compare the BATHTUB model's prediction of in-lake phosphorus from the estimated loading (using AVGWLF) to the measured in-lake phosphorus concentrations. The report focused primarily on phosphorus, since this is the limiting nutrient for algal growth in Owasco Lake.

The major findings are as follows:

- There was an excellent correlation between the predicted in-lake phosphorus concentrations (generated using the AVGWLF model to estimate load and the BATHTUB model to calculate lake response to the load) and the observed in-lake phosphorus concentrations.
- Based on the AVGWLF model, agricultural land uses contributes most of the total annual phosphorus input to Owasco Lake; this source affects both surface water and groundwater (Table 3-9). Dr. Evans estimates the contribution to be in the range of 70%.

- External phosphorus loading from the landscape is higher in wet years.
- Owasco Lake currently exhibits an oligo-mesotrophic trophic state condition. Trophic state of the lake (discussed in Chapter 4) has remained relatively stable, with some interannual variation attributable to weather.

Table 3-9. Estimated Phosphorus Loads (kg/yr) Delivered to the Lake by Source

Contributing Source of Total Phosphorus	2007 Estimate Summed Annual TP Load by Source (kg/yr)	Percent of Total Estimated TP Load to Lake (2007 Conditions)
Forest/wetlands	143	1%
Agricultural land*	7,615	56%
Developed land	474	3%
Farm animals	646	5%
Point sources	1,691	12%
Golf courses	93	1%
Groundwater*	2,374	18%
Streambanks	522	4%
TOTAL	13,556	100%

Source: Evans, B. M. 2008 *A significant part of the "groundwater" load is from agricultural sources.

Note that the point source loading (discussed in section 3.9) has decreased from the value calculated in by Dr. Evans for 2007 conditions. Improvements to the phosphorus removal capacity of the wastewater treatment plants serving Groton and Moravia have reduced the annual average point source TP load to 340 kg/yr (2008-2013 average of the summed load from the two facilities).

3.9 Wastewater Treatment and Disposal

The properties (parcel boundaries) within the Owasco Lake watershed that are served by water and/or wastewater are displayed in Map 3-12. Note that the vast majority of lands within the watershed rely on private wells and onsite wastewater disposal.

There are two publicly-owned wastewater treatment plants within the Owasco Lake watershed. The Village of Moravia WWTP provides advanced treatment including phosphorus removal and year-round disinfection to wastewater collected from residential and commercial properties within the Village and the New York State correctional facility. Treated effluent is discharged to the Owasco Inlet, approximately 3.5 miles upstream of its confluence with Owasco Lake. The second wastewater treatment plant serves the Village of Groton. Similar to the Moravia plant, the Groton facility provides advanced treatment including phosphorus removal and year-round disinfection. This facility also discharges to the Owasco Inlet, at a point about 11.9 miles upstream of the lake.

3.9.1 Village of Moravia WWTP

The Village of Moravia WWTP is regulated under the State Pollution Discharge Elimination System (SPDES) permit number NY 002 2756, which was last modified effective March 1, 2010. The SPDES permit for this facility is seasonal; one set of limits governs performance during the summer period (June 1 – October 31) and a second set of limits is in place for the winter (November 1 – May 31). The WWTP has a treatment train that includes grit removal, chemical addition for phosphorus removal, primary settling, activated sludge (extended aeration), final settling, sand filtration, and disinfection (using ultra-violet radiation). The facility is permitted to discharge 0.6 million gallons per day (mgd) of treated wastewater.

In addition to the flow limit, the facility's permit limits the mass and/or concentration of oxygen-demanding materials, solids, nitrogen, phosphorus, and fecal coliform bacteria. The limits on ammonia nitrogen are more stringent in the summer, to protect the aquatic community of Owasco Inlet from toxicity when the stream's pH and temperature are high. Solids limits are more stringent during the summer months as well, to protect recreational and aesthetic uses of the stream.

The current SPDES permit for the Moravia WWTP is summarized in Table 3-10. The facility is in full compliance with its limits. The volume of treated wastewater discharged to Owasco Inlet from this facility is well below its permitted discharge of 0.6 mgd; the average annual discharge (2008 – 2014) was slightly less than 0.4 mgd.

Table 3-10. Permit Requirements, Village of Moravia WWTP

Parameter	Type of Limit (Compliance Assessment)	Limit & Units (concentration)	Limit & Units (mass load)
Year Round Limits			
Flow	Monthly Average	0.6 mgd	--
Ultimate Oxygen Demand	Monthly Average	30 mg/L	150 ppd
Settleable Solids	Daily Maximum	O.3 ml/L	--
pH	Range	6.0 – 9.0 SU	--
Phosphorus	Monthly Average	0.5 mg/L	2.5 ppd
Fecal coliform bacteria	30-day geometric mean	200 cells/100 ml	--
Fecal coliform bacteria	7-day geometric mean	400 cells/100 ml	--
Summer Limits (June 1- Oct 31)			
Suspended Solids	Monthly average	12 mg/L	60 ppd
	7-day average	18 mg/L	90 ppd
Ammonia -N	Monthly average	2.4 mg/L	12.0 ppd
Winter limits (Nov. 1 – May 31)			
Suspended Solids	Monthly average	30 mg/L	150 ppd
	7-day average	45 mg/L	225 ppd
Ammonia -N	Monthly average	7.4 mg/L	37.0 ppd

Abbreviations: mgd = million gallons per day; mg/L = milligrams per liter; ppd = pounds per day; SU = standard units

3.9.2 Village of Groton WWTP

The Village of Groton WWTP, which is regulated under SPDES permit number NY 02 5585, provides advanced treatment to wastewater collected from residential and commercial properties within its service area. The SPDES permit in place for the Village of Groton WWTP was renewed March 1, 2014 for a five-year period. The facility has been upgraded to allow advanced treatment plus phosphorus removal. Two new Sequencing Batch Reactor (SBR) units have come on line. Effluent disinfection is accomplished using chorine and subsequent dechlorination. The facility is permitted to discharge 0.5 mgd of treated wastewater to the Owasco Inlet. Average annual discharge (2008–2014) remained well below the limit at 0.3 mgd.

Similar to the Village of Moravia WWTP, there are seasonal limits in place for this plant to provide a higher level of water quality protection for designated uses during the summer period. The permit requirements are summarized in Table 3-11. Note the additional requirement to monitor for chlorine residual. The WWTP is in full compliance with its permit limits.

Table 3-11. Permit Requirements, Village of Groton WWTP

Parameter	Type of Limit (Compliance Assessment)	Limit & Units (concentration)	Limit & Units (mass load)
Year Round Limits			
Flow	30-day average	0.5 mgd	--
Suspended Solids	30-day average	30 mg/L	125 ppd
	7-day average	45 mg/L	188 ppd
Settleable Solids	7-day average	O.3 ml/L	--
pH	Range	6.0 – 9.0 SU	--
Phosphorus	30-day average	0.5 mg/L	2.1 ppd
Fecal coliform bacteria	30-day geometric mean	200 cells/100 ml	--
Fecal coliform bacteria	7-day geometric mean	400 cells/100 ml	--
Chlorine, Total Residual	Daily Maximum	0.1 mg/L	--
Summer Limits (June 1- Oct 31)			
Ultimate Oxygen Demand	30-day average	40 mg/L	167 ppd
Ammonia -N	30-day average	2.7 mg/L	--
Winter limits (Nov. 1 – May 31)			
5-day Biochemical Oxygen Demand (BOD_5)	30-day average	30 mg/L	125 ppd
	7-day average	45 mg/L	188 ppd
Ammonia -N	30-day average	9.6 mg/L	--

Abbreviations: mgd=million gallons per day; mg/L= milligrams per liter; ppd=pounds per day; SU=standard units

Both of the wastewater treatment plants discharging to Owasco Inlet have implemented treatment upgrades to effectively reduce the concentration (and mass loading) of phosphorus in their treated effluent. The progression of effluent total phosphorus reduction is plotted in Figure 3-4. To provide context, recall that the individual WWTP limits on mass phosphorus loading are 2.5 ppd for Moravia and 2.1 ppd for Groton, for a total load of 4.6 ppd. Since the upgrades to the Groton WWTP were completed in 2008, the average TP load from this facility for the last six years (2009–2014) has been 1.6 ppd.

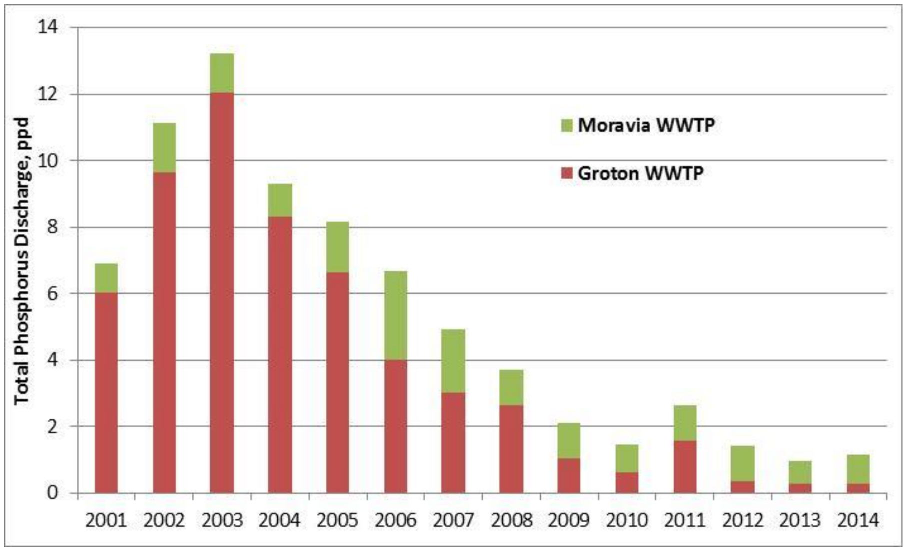


Figure 3-4. History of WWTP effluent TP loading to Owasco Inlet, 2001–2014

3.9.3 Onsite Wastewater Disposal Systems

The majority of residences and commercial properties within the Owasco Lake watershed rely on individual onsite wastewater disposal systems (septic systems) to dispose of wastewater. In recognition of the potential environmental impact of this common practice, the Cayuga County Sanitary Code was revised in 1994 to require periodic routine inspections of septic systems. Pump-out and inspections are also required when properties are transferred. The inspection schedule varies based on the property's proximity to the lake (Table 3-12). As an additional level of environmental protection, the Cayuga County Sanitary Code requires that all site evaluations and preparation of plans for the repair or replacement of individual onsite wastewater disposal systems be conducted and submitted by a licensed design professional.

Table 3-12. Cayuga County Requirements for Septic Systems within the Owasco Lake Watershed

Location (within Owasco Lake watershed)	Inspection Cycle	Estimated count (2014)
Adjacent to Owasco Lake shoreline	Every 2 years	569
Within 500 ft. of Owasco Lake shoreline	Every 3 years	83
Greater than 500 ft. from Owasco Lake shoreline (T. of Owasco, Niles, Moravia, Scipio & Fleming)	Every 5 years	1524 (includes all towns)
Greater than 500 ft. from Owasco Lake shoreline (other watershed towns in Cayuga County)	Every 7 years	1100

Since the revisions to the Cayuga County Sanitary Code were enacted, all septic systems within the Cayuga County portion of the Owasco Lake watershed have been inspected multiple times. As summarized in Table 3-13, between 1500 and 3200 systems are inspected annually throughout the county. Each year, plans for new septic systems are reviewed; plans for modifications or repairs are also subject to review and approval by the Cayuga County Health Department. Multiple complaint investigations and enforcement actions related to performance of individual septic systems are also completed each year.

In Tompkins County, the Sanitary Code was amended in 2012 to require permits and inspections of new onsite wastewater disposal systems. There are no specific requirements related to proximity to surface waters. In a similar manner, new onsite systems within the Town of Skaneateles, outside of the Skaneateles Lake watershed, require approval from the Onondaga County Health Department.

Table 3-13. Cayuga County Actions Related to Individual Septic Systems, 2006–2013 (all Cayuga County)

Activities	Annual Count							
Year	2006	2007	2008	2009	2010	2011	2012	2013
Investigations of nuisance complaints	53	47	37	41	57	57	41	41
Citations for violations	55	54	43	36	71	55	38	40
Approval of plans for a new septic system	109	94	104	79	58	58	66	48
Approval of plans for modifications to an existing septic system	101	110	87	86	76	102	92	84
Site visits for consultations (approximate count)	160	145	135	95	80	90	85	67
Enforcement actions	20	18	10	10	21	15	9	14
Number of (certified) septic systems inspections	2,450	2,300	3,200	1,558	2,200	2,840	2,298	2,003

Source: Annual reports, Cayuga County Health Department

3.10 Roads and Bridges

Dead vegetation along guard rail at the Route 38A crossing of Dutch Hollow Brook, Town of Niles, NY, August 5, 2014.

According to the 2000 *State of the Owasco Lake Watershed* report, there are about 480 miles of maintained roads within the Owasco Lake watershed. About one-quarter (120 miles) of these are classified as major roads (owned and maintained by state or county); the remainder are owned and maintained by the local municipalities. As shown in in Map 3-13, there are many bridges traversing the tributary streams, especially in the Owasco Inlet subwatershed. The summer 2014 field reconnaissance documented that many of the bridge crossings are associated with streambank erosion. It appears that some vegetated banks in the vicinity of bridge crossings are treated with herbicides as part of NYS highway maintenance practices; this practice may exacerbate erosion. Ditching practices may also have an adverse impact on water quality of streams and Owasco Lake.

3.11 CAFOs and Other Potential Sources of Pollution

The USEPA interactive GIS tool EnviroMapper was used to identify and locate federally regulated discharges within the watershed (Map 3-14). Consolidated Animal Feeding Operations (CAFOs) within one mile of the watershed boundary are also displayed on this map, because portions of the farming operation are within the Owasco Lake watershed. CAFOs are required to develop and implement a nutrient management plan, which encompasses manure handling and land application. The nutrient management plans are developed by certified agricultural planners, and are filed with the NYSDEC.

There are no active sanitary landfills in the Owasco Lake watershed; however, seven closed landfills (closed after 1960) were listed in the 2000 *State of the Owasco Lake Watershed* report. Generally, these solid waste facilities were closed according to the regulatory requirements in place at the time. There are six sand and gravel mines currently permitted to operate within the watershed (Map 3-15).

3.12 Summary of Changes in the Owasco Lake Watershed Since 2000

Population within the Owasco Lake watershed has increased by about 3.6% over the past two decades. Most of this growth appears to be occurring outside of areas served by public water supply and sewage treatment, based on an analysis of municipal subdivision approvals. The watershed remains very rural; almost 50% of the land is in active agricultural use. Agriculture represents a major source of livelihood in Cayuga County; the USDA reports that the market value of products sold in Cayuga County increased 37% from 2007 to 2012, from $214,403,000 to $293,474,000.

Since 2000, there has been a substantial investment of resources directed toward the Owasco Lake watershed. Multiple projects designed to identify potential sources of nutrients and sediment to the lake and define priorities for remedial measures have been completed. Site-specific remedial measures are being implemented as funding and labor resources become available. In addition, the Finger Lakes Institute has been conducting long-term stream monitoring to estimate the flux of key substances total phosphorus, soluble reactive phosphorus, nitrate- nitrogen, and suspended sediment from the landscape. This effort has provided documentation of the critical importance of weather and streamflow conditions on export of materials to the lake; the annual total P flux estimates are strongly correlated with precipitation over the monitored interval, as illustrated in Figure 3-5. This information can support an evaluation of the effectiveness of remedial measures as they come on line.

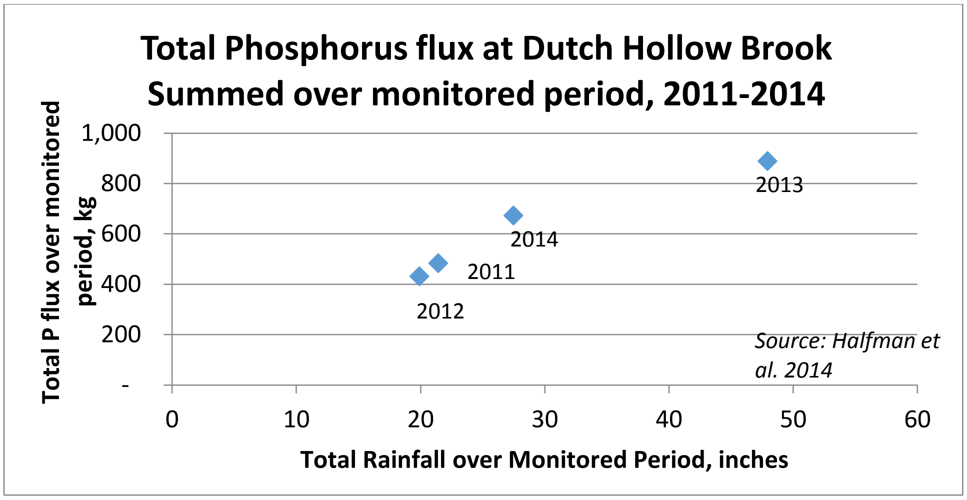


Figure 3-5. Total P Flux at Dutch Hollow Brook, 2011-2014 in Relation to Rainfall over Monitored Period

The investment in enhanced phosphorus removal has achieved a substantial reduction in point source phosphorus loading (Table 3-14).

Table 3-14. Decrease in Point Source Total P Load, 2001–2014

	Groton WWTP	Moravia WWTP
2001–2007:TP load, ppd	7.09	1.52
2008–2014:TP load, ppd	0.96	0.96
Percent decrease	86%	37%

Notes

[1] Wright, J. and D. Haight. 2011. *Owasco Lake Agriculture Conservation Blueprint. American Farmland Trust*. http://newyork.farmland.org/wp-content/uploads/2012/02/Owasco-Lake-Agriculture-Conservation-Blueprint-12-22-11.pdf

[2] USDA Census of Agriculture. 2012. New York, Census Volume 1, Chapter 2: County Level Data. http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/New_York/

[3] Reddy, J. E. 2014. *Groundwater Quality in Central New York, 2012:* U.S. Geological Survey Open-File Report 2014–1226, 13 p., *http://dx.doi.org/10.3133/ofr20141226*

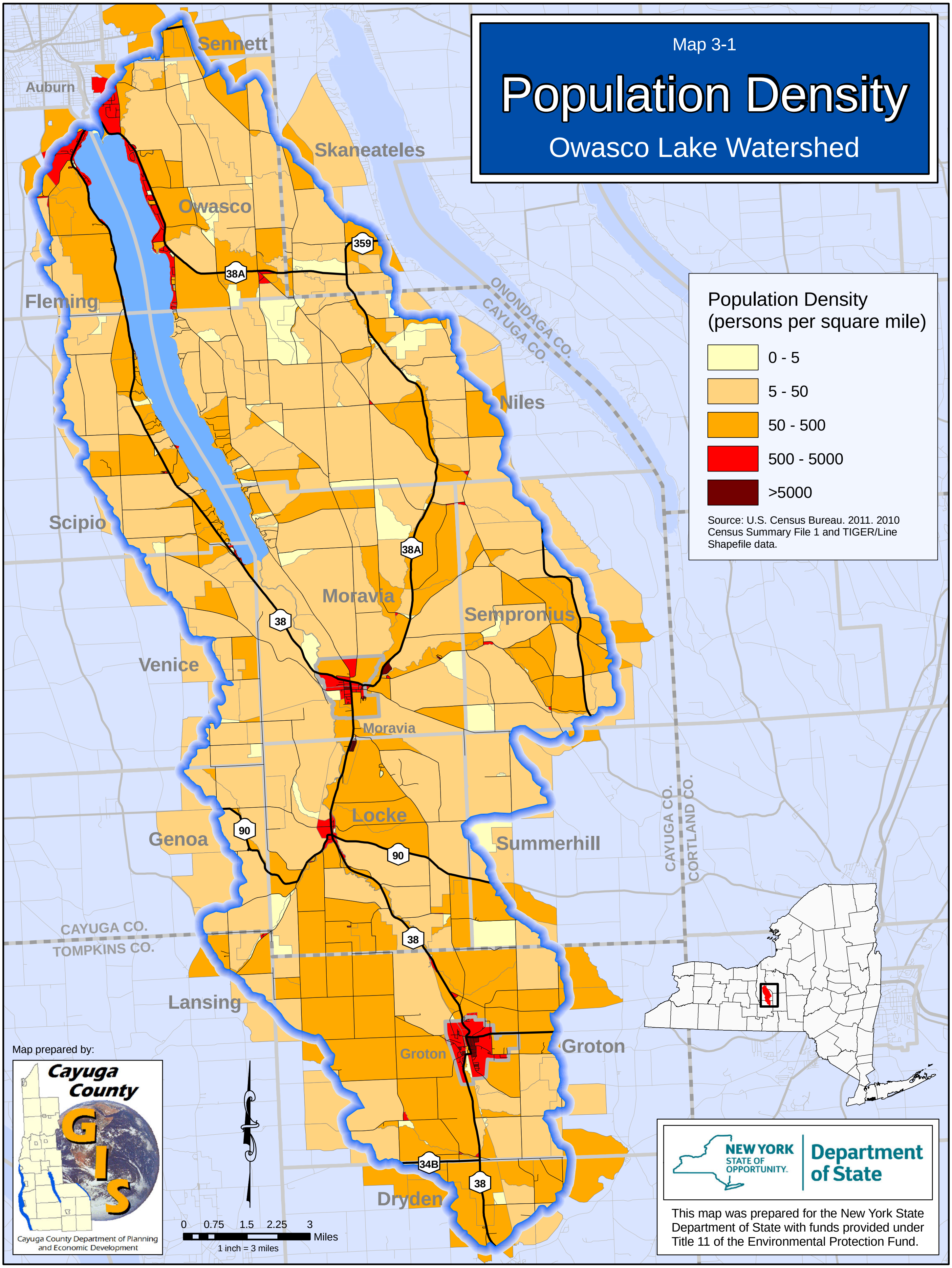
[4] Richards, B. K., S. Pacenka, A. E. Salvucci, S. M. Saia, L. F. Whitbeck, P. M. Furdyna, and T. S. Steenhuis. 2011. "Surveying Upstate NY Well Water for Pesticide Contamination: Cayuga and Orange Counties." *Groundwater Monitoring & Remediation* 32(1): 73–82. doi: 10.1111/j.1745-6592.2011.01366.x

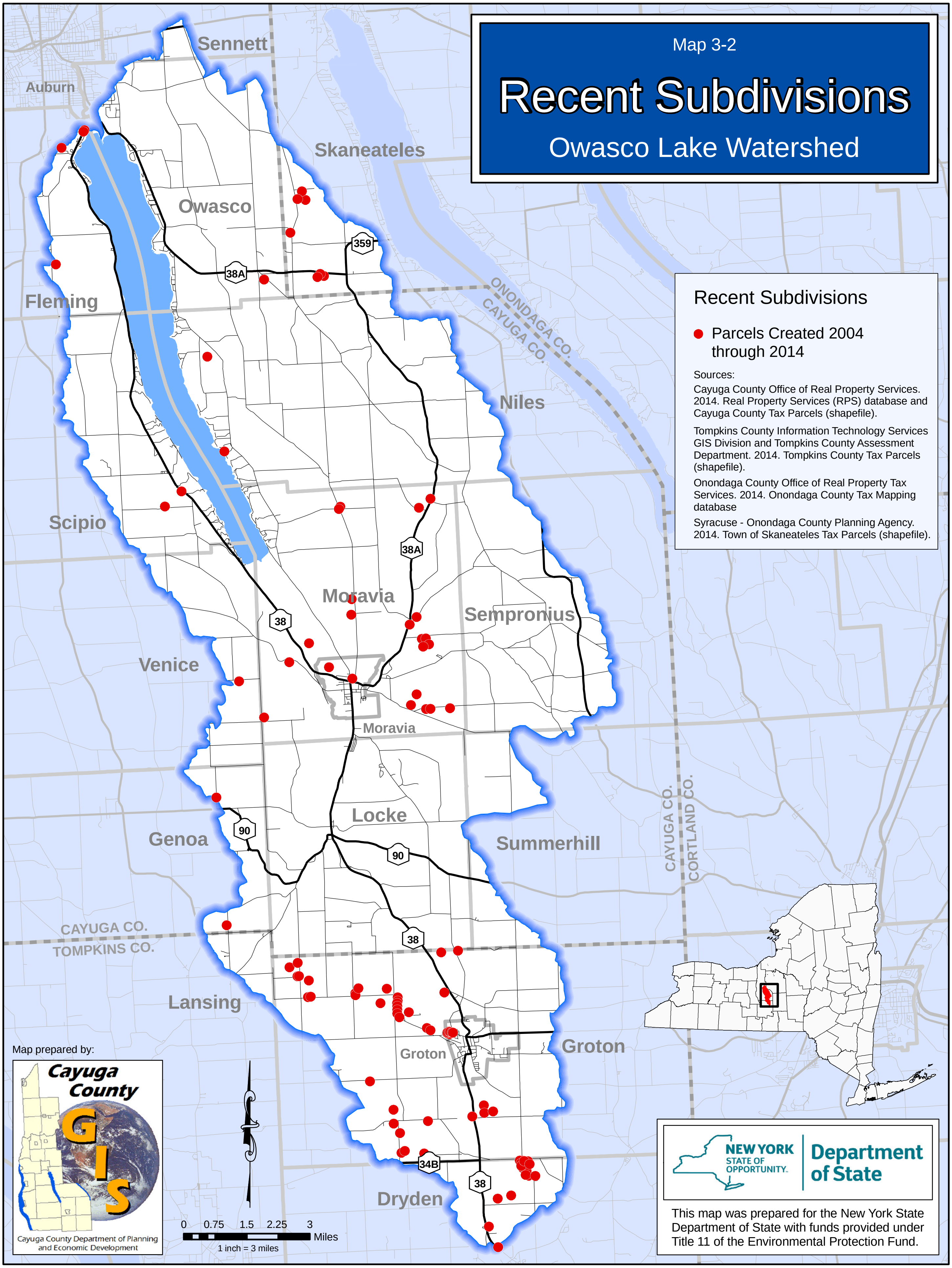
[5] Halfman, J.D., G. Moralez, K. Coughlin and N. Andrzejczyk. December 2014. *Owasco Lake, NY: Water Quality and Nutrient Sources, 2014 Findings*. Finger Lakes Institute, Geneva NY.

[6] Welch, E.B. 1980. *Ecological Effects of Wastewater*. Cambridge University Press.

[7] Bode, R. W., Novak, M. A., Abele, L. E., Heitzman, D. L., & Smith, A. J. 2004. *Thirty-Year Trends in Water Quality of Rivers and Streams in New York State Based on Macroinvertebrate Data*. New York State Department of Environmental Conservation, Division of Water. 384 pp. ***and*** Bode, R. W., Novak, M. A., Abele, L. E., Heitzman, D. L., & Smith, A. J. 2007. *Owasco Lake Inlet Biological Assessment*. New York State Department of Environmental Conservation, Division of Water. 48 pp.

[8] Evans, B. M. 2008. *Computer-Based Simulation of Loads and Water Quality Responses within the Owasco Lake Watershed, New York*. Report to the Institute for the Application of Geospatial Technologies, Auburn, NY. 18 pp.

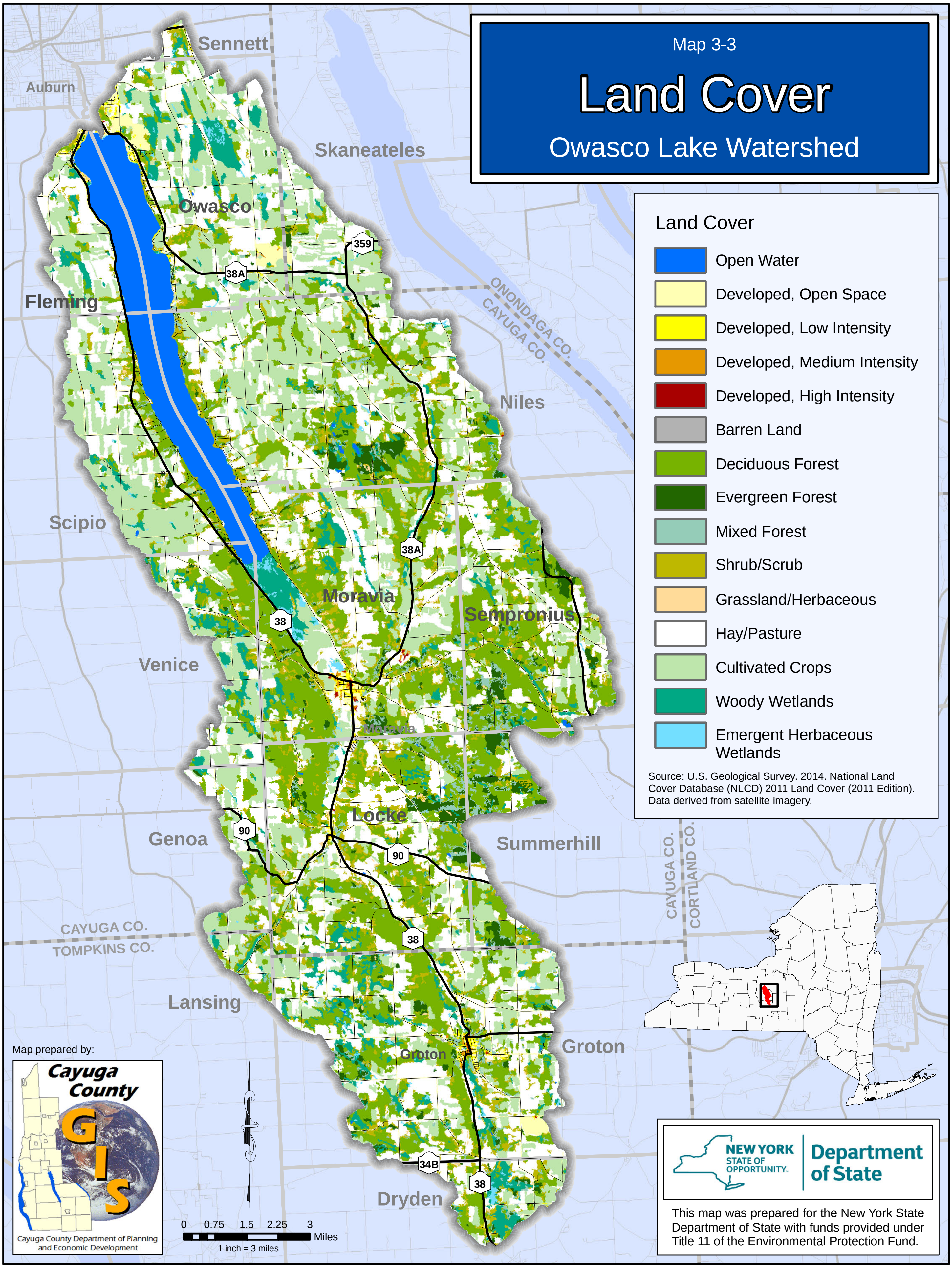

Map 3-1
Population Density
Owasco Lake Watershed
Population Density
(persons per square mile)
0 - 5
5 - 50
50 - 500
500 - 5000
>5000
Source: U.S. Census Bureau. 2011. 2010 Census Summary File 1 and TIGER/Line Shapefile data.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
CAYUGA CO.
TOMPKINS CO.
ONONDAGA CO.
CAYUGA CO.
CORTLAND CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

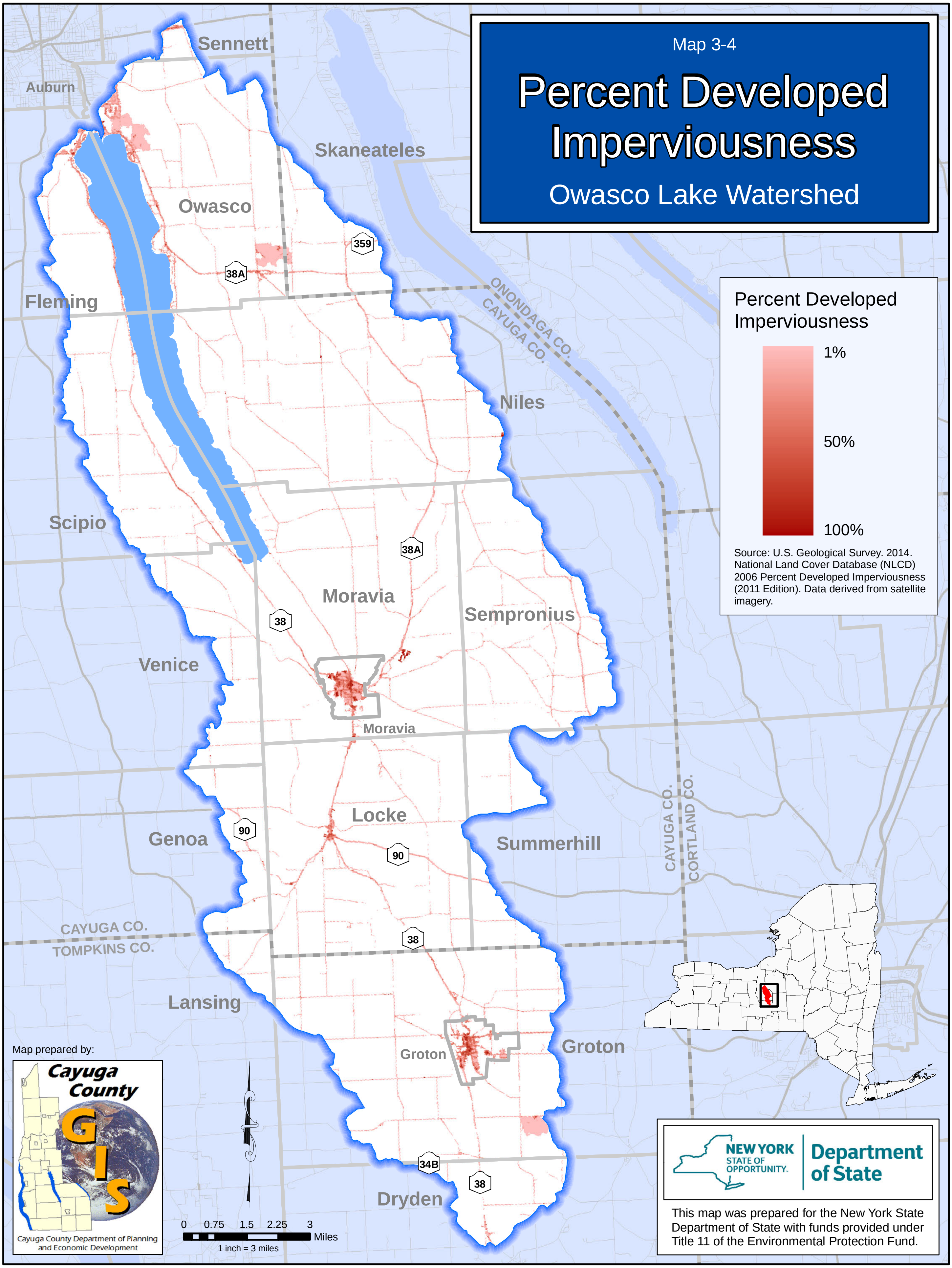

Map 3-2
Recent Subdivisions
Owasco Lake Watershed
Recent Subdivisions
Parcels Created 2004 through 2014
Sources:
Cayuga County Office of Real Property Services. 2014. Real Property Services (RPS) database and Cayuga County Tax Parcels (shapefile).
Tompkins County Information Technology Services GIS Division and Tompkins County Assessment Department. 2014. Tompkins County Tax Parcels (shapefile).
Onondaga County Office of Real Property Tax Services. 2014. Onondaga County Tax Mapping database
Syracuse - Onondaga County Planning Agency. 2014. Town of Skaneateles Tax Parcels (shapefile).
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
Lansing
Groton
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

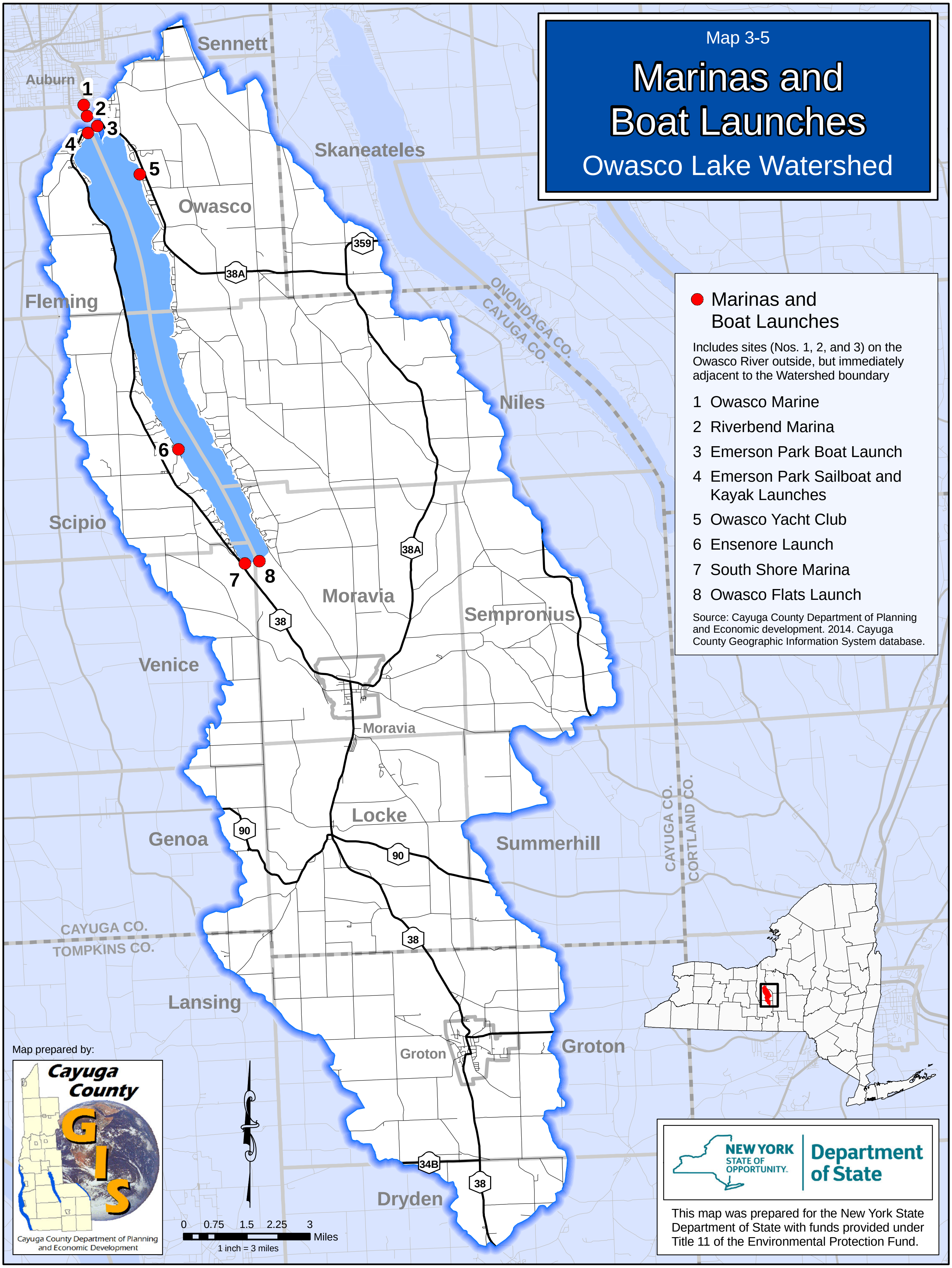
Map 3-3

Land Cover

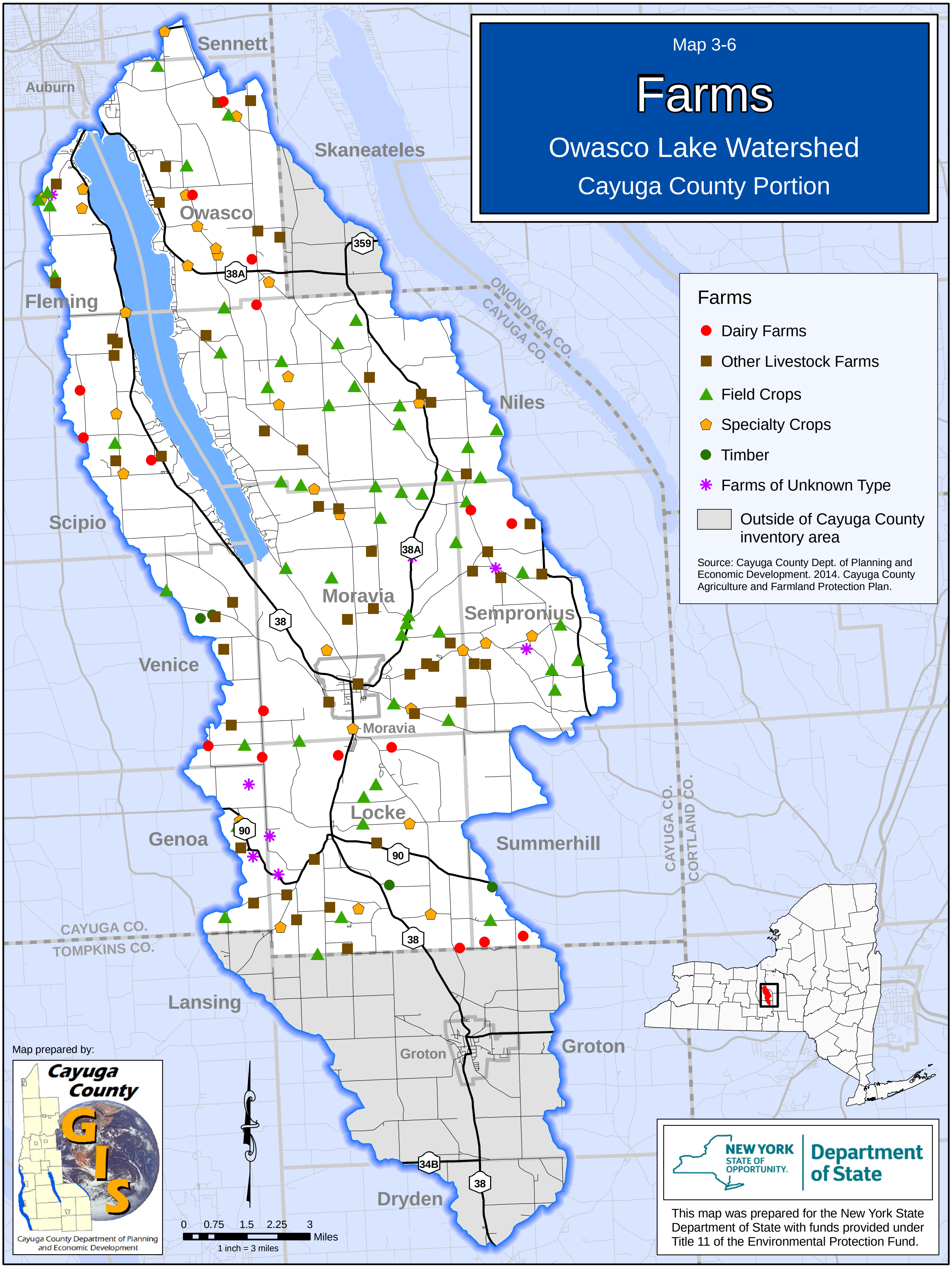
Owasco Lake Watershed

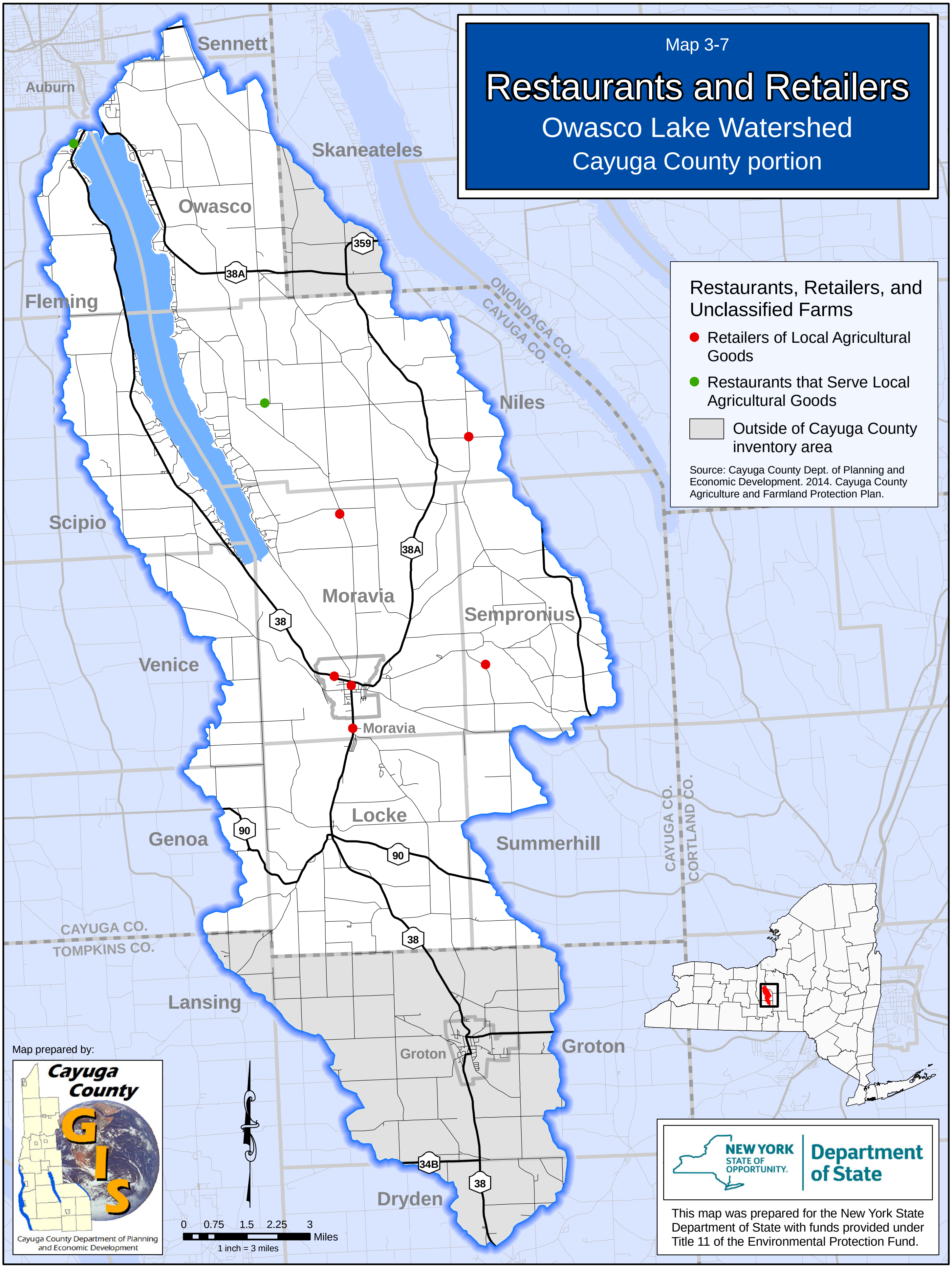


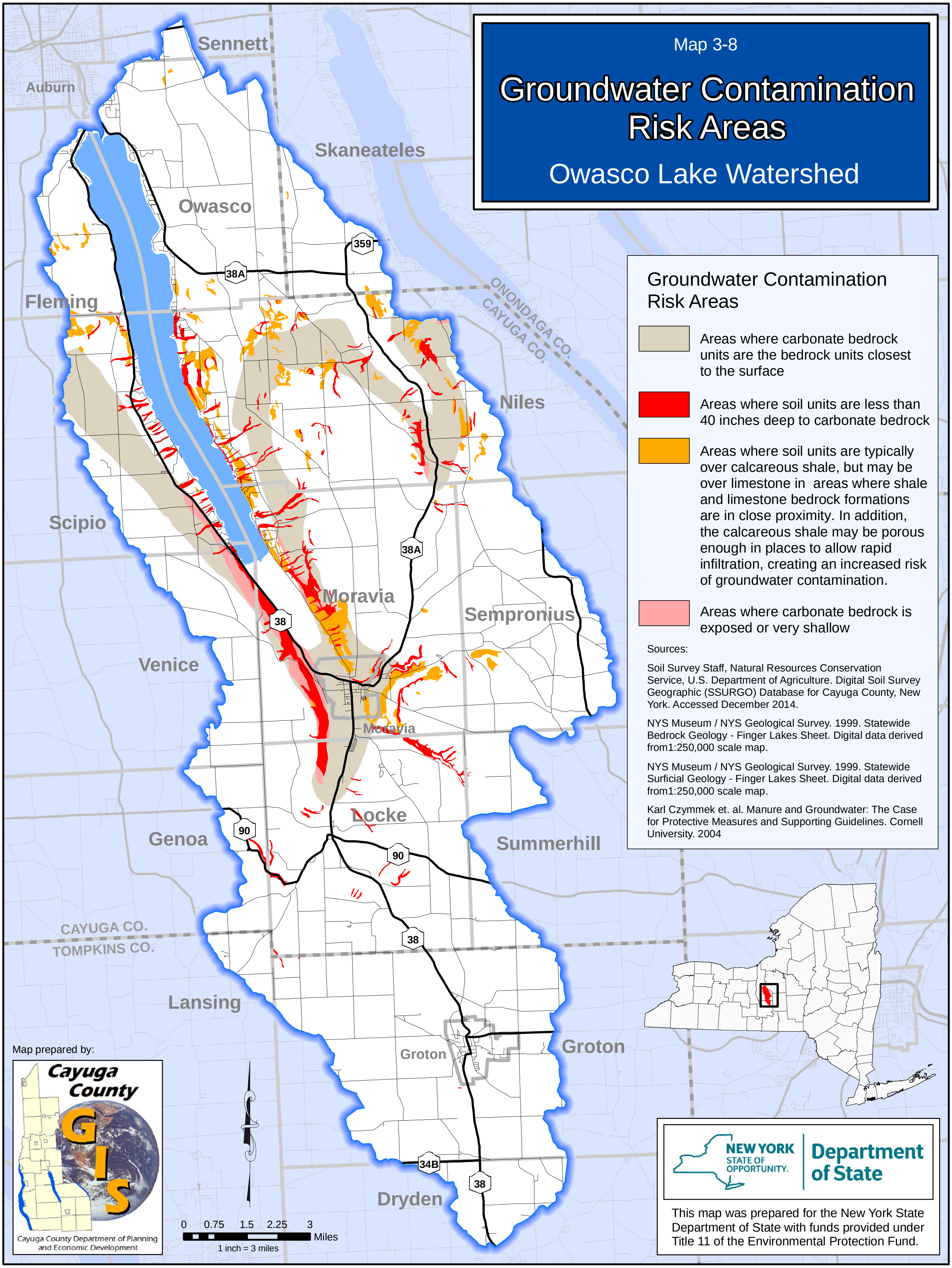

Map 3-4
Percent Developed Imperviousness
Owasco Lake Watershed
Percent Developed Imperviousness
1%
50%
100%
Source: U.S. Geological Survey. 2014. National Land Cover Database (NLCD) 2006 Percent Developed Imperviousness (2011 Edition). Data derived from satellite imagery.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Locke
Genoa
Summerhill
Lansing
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CORTLAND CO.
TOMPKINS CO.
359
38A
38
90
34B
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3 Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

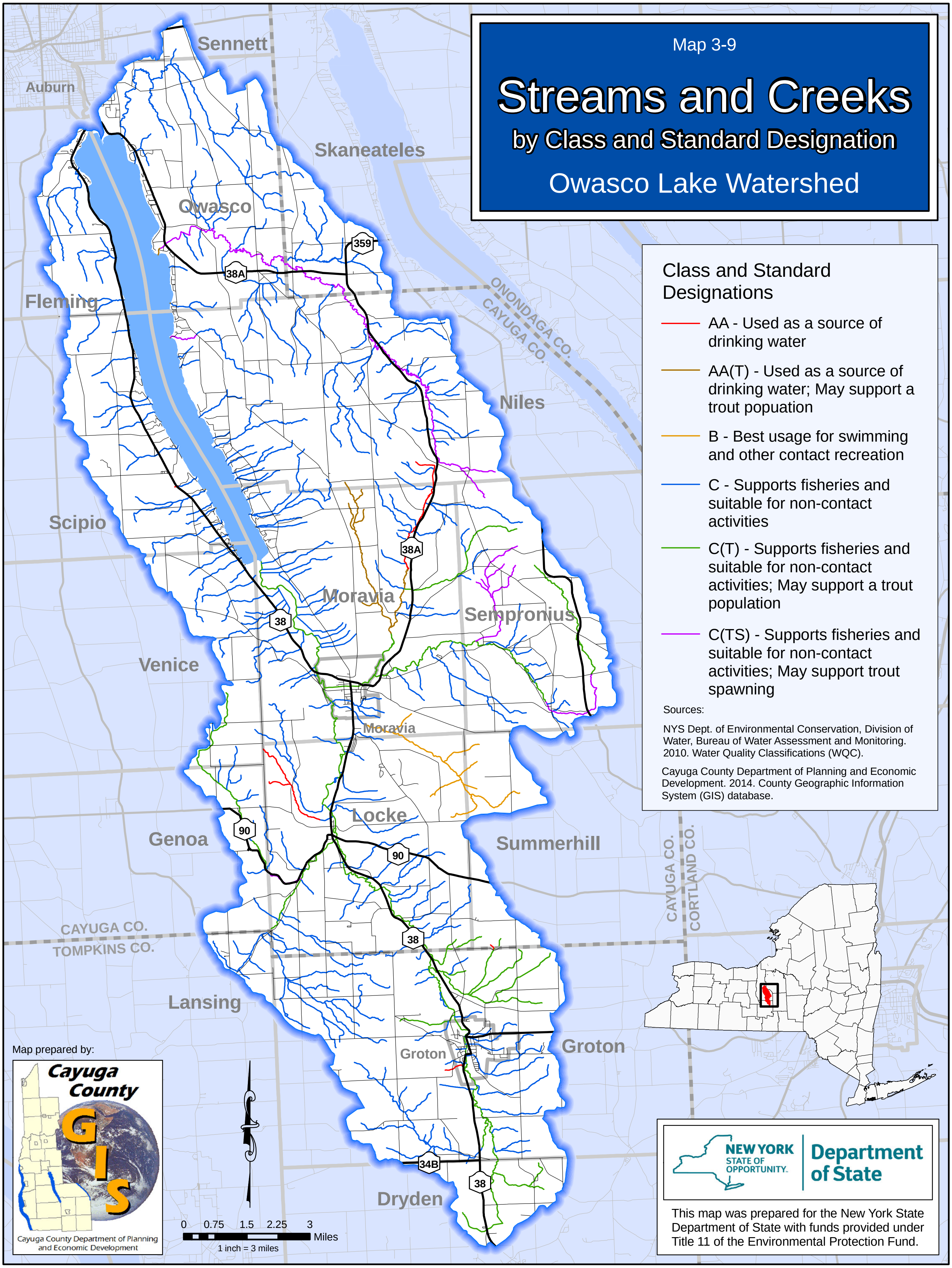


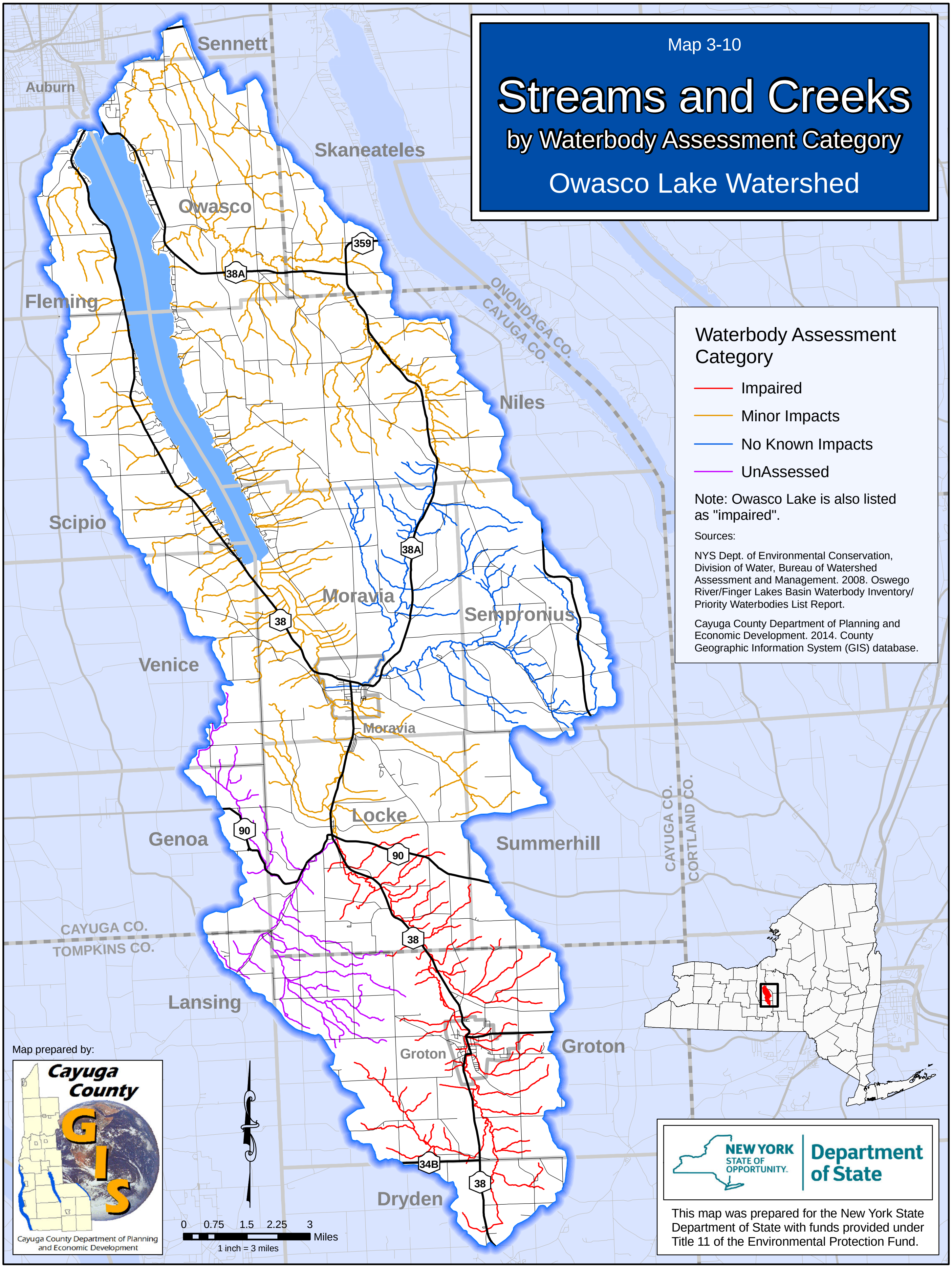
Map 3-5
Marinas and Boat Launches
Owasco Lake Watershed
Marinas and Boat Launches
Includes sites (Nos. 1, 2, and 3) on the Owasco River outside, but immediately adjacent to the Watershed boundary
1 Owasco Marine
2 Riverbend Marina
3 Emerson Park Boat Launch
4 Emerson Park Sailboat and Kayak Launches
5 Owasco Yacht Club
6 Ensenore Launch
7 South Shore Marina
8 Owasco Flats Launch
Source: Cayuga County Department of Planning and Economic development. 2014. Cayuga County Geographic Information System database.
Auburn
Sennett
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Locke
Genoa
Summerhill
Lansing
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CORTLAND CO.
TOMPKINS CO.
359
38A
38
90
34B
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.


Map 3-6
Farms
Owasco Lake Watershed
Cayuga County Portion
Farms
Dairy Farms
Other Livestock Farms
Field Crops
Specialty Crops
Timber
Farms of Unknown Type
Outside of Cayuga County inventory area
Source: Cayuga County Dept. of Planning and Economic Development. 2014. Cayuga County Agriculture and Farmland Protection Plan.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Scipio
Niles
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
Lansing
Groton
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

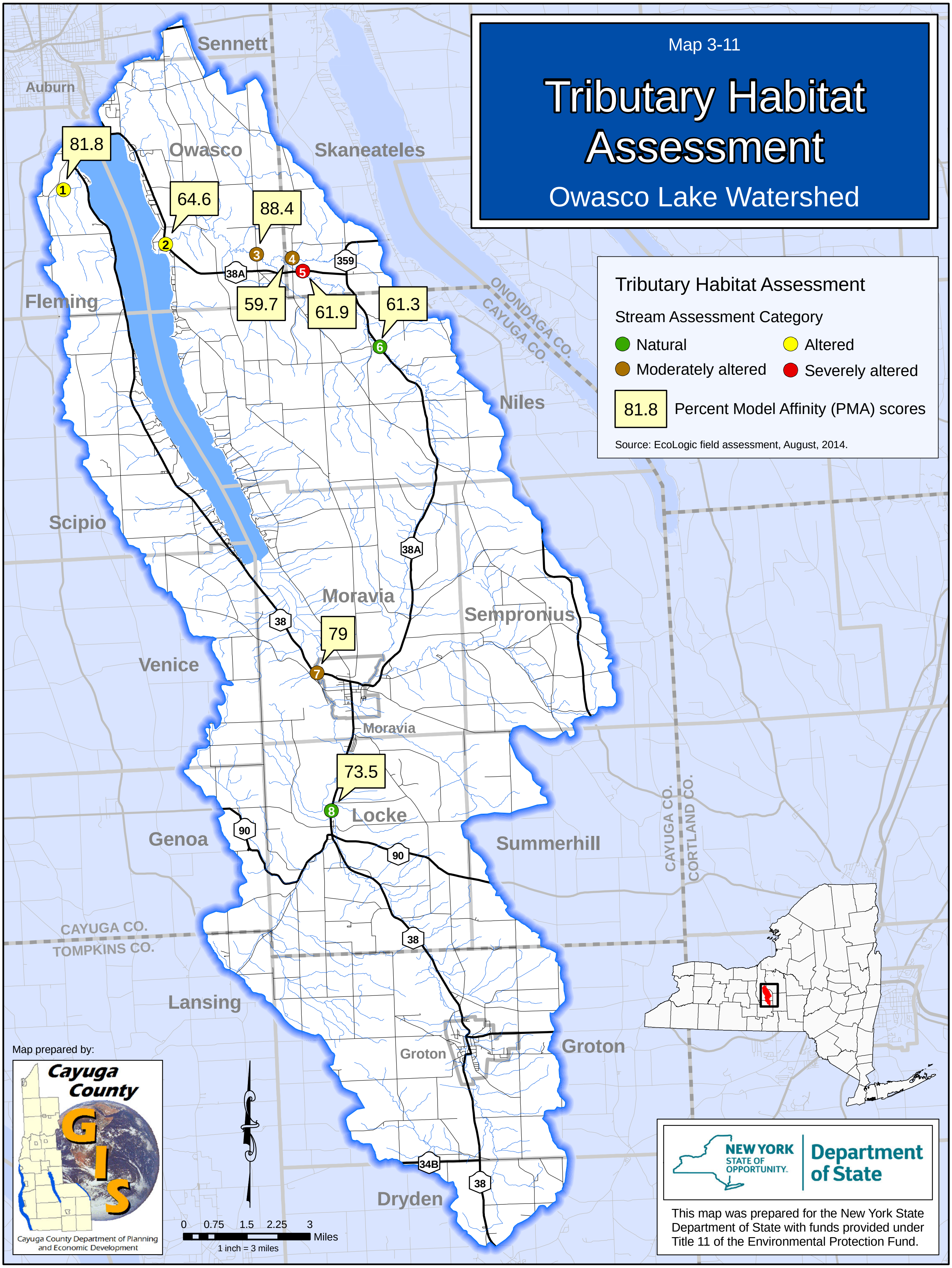

Map 3-7
Restaurants and Retailers
Owasco Lake Watershed
Cayuga County portion
Restaurants, Retailers, and Unclassified Farms
Retailers of Local Agricultural Goods
Restaurants that Serve Local Agricultural Goods
Outside of Cayuga County inventory area
Source: Cayuga County Dept. of Planning and Economic Development. 2014. Cayuga County Agriculture and Farmland Protection Plan.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
CAYUGA CO.
TOMPKINS CO.
ONONDAGA CO.
CAYUGA CO.
CAYUGA CO.
CORTLAND CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

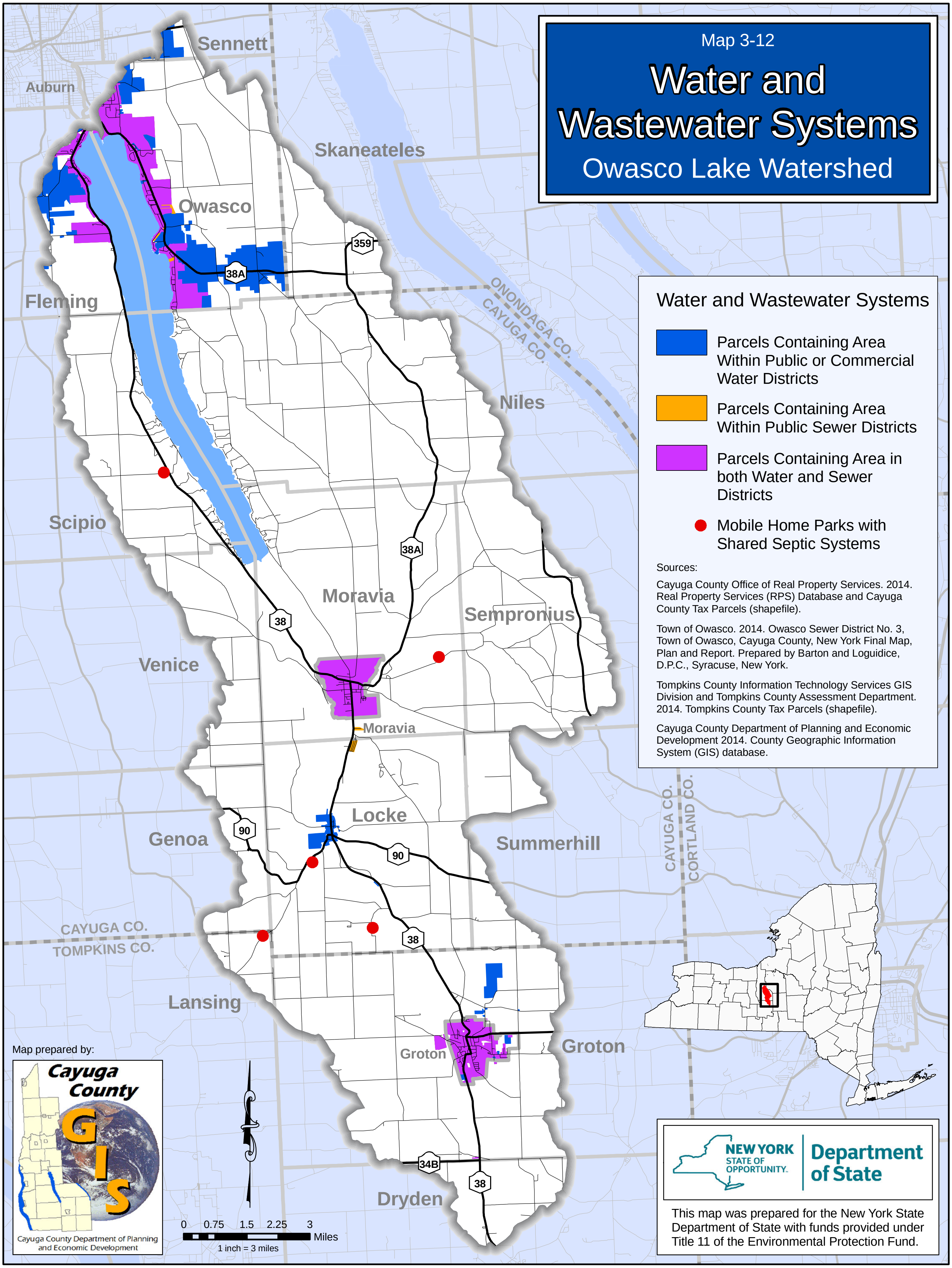

Map 3-8
Groundwater Contamination Risk Areas
Owasco Lake Watershed
Groundwater Contamination Risk Areas
Areas where carbonate bedrock units are the bedrock units closest to the surface
Areas where soil units are less than 40 inches deep to carbonate bedrock
Areas where soil units are typically over calcareous shale, but may be over limestone in areas where shale and limestone bedrock formations are in close proximity. In addition, the calcareous shale may be porous enough in places to allow rapid infiltration, creating an increased risk of groundwater contamination.
Areas where carbonate bedrock is exposed or very shallow
Sources:
Soil Survey Staff, Natural Resources Conservation Service, U.S. Department of Agriculture. Digital Soil Survey Geographic (SSURGO) Database for Cayuga County, New York. Accessed December 2014.
NYS Museum / NYS Geological Survey. 1999. Statewide Bedrock Geology - Finger Lakes Sheet. Digital data derived from1:250,000 scale map.
NYS Museum / NYS Geological Survey. 1999. Statewide Surficial Geology - Finger Lakes Sheet. Digital data derived from1:250,000 scale map.
Karl Czymmek et. al. Manure and Groundwater: The Case for Protective Measures and Supporting Guidelines. Cornell University. 2004
Sennett
Auburn
Skaneateles
Owasco
Fleming
ONONDAGA CO.
CAYUGA CO.
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
CAYUGA CO.
TOMPKINS CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY. Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.


Map 3-9
Streams and Creeks
by Class and Standard Designation
Owasco Lake Watershed
Class and Standard Designations
AA - Used as a source of drinking water
AA(T) - Used as a source of drinking water; May support a trout popuation
B - Best usage for swimming and other contact recreation
C - Supports fisheries and suitable for non-contact activities
C(T) - Supports fisheries and suitable for non-contact activities; May support a trout population
C(TS) - Supports fisheries and suitable for non-contact activities; May support trout spawning
Sources:
NYS Dept. of Environmental Conservation, Division of Water, Bureau of Water Assessment and Monitoring. 2010. Water Quality Classifications (WQC).
Cayuga County Department of Planning and Economic Development. 2014. County Geographic Information System (GIS) database.
Sennett
Auburn
Skaneateles
Owasco
Fleming
ONONDAGA CO.
CAYUGA CO.
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
Lansing
Groton
Groton
Dryden
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.



Map 3-10
Streams and Creeks
by Waterbody Assessment Category
Owasco Lake Watershed
Waterbody Assessment Category
Impaired
Minor Impacts
No Known Impacts
UnAssessed
Note: Owasco Lake is also listed as "impaired".
Sources:
NYS Dept. of Environmental Conservation, Division of Water, Bureau of Watershed Assessment and Management. 2008. Oswego River/Finger Lakes Basin Waterbody Inventory/ Priority Waterbodies List Report.
Cayuga County Department of Planning and Economic Development. 2014. County Geographic Information System (GIS) database.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Moravia
Locke
Genoa
Summerhill
CAYUGA CO.
TOMPKINS CO.
Lansing
Groton
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CAYUGA CO.
CORTLAND CO.
359
38A
38A
38
90
90
38
34B
38
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

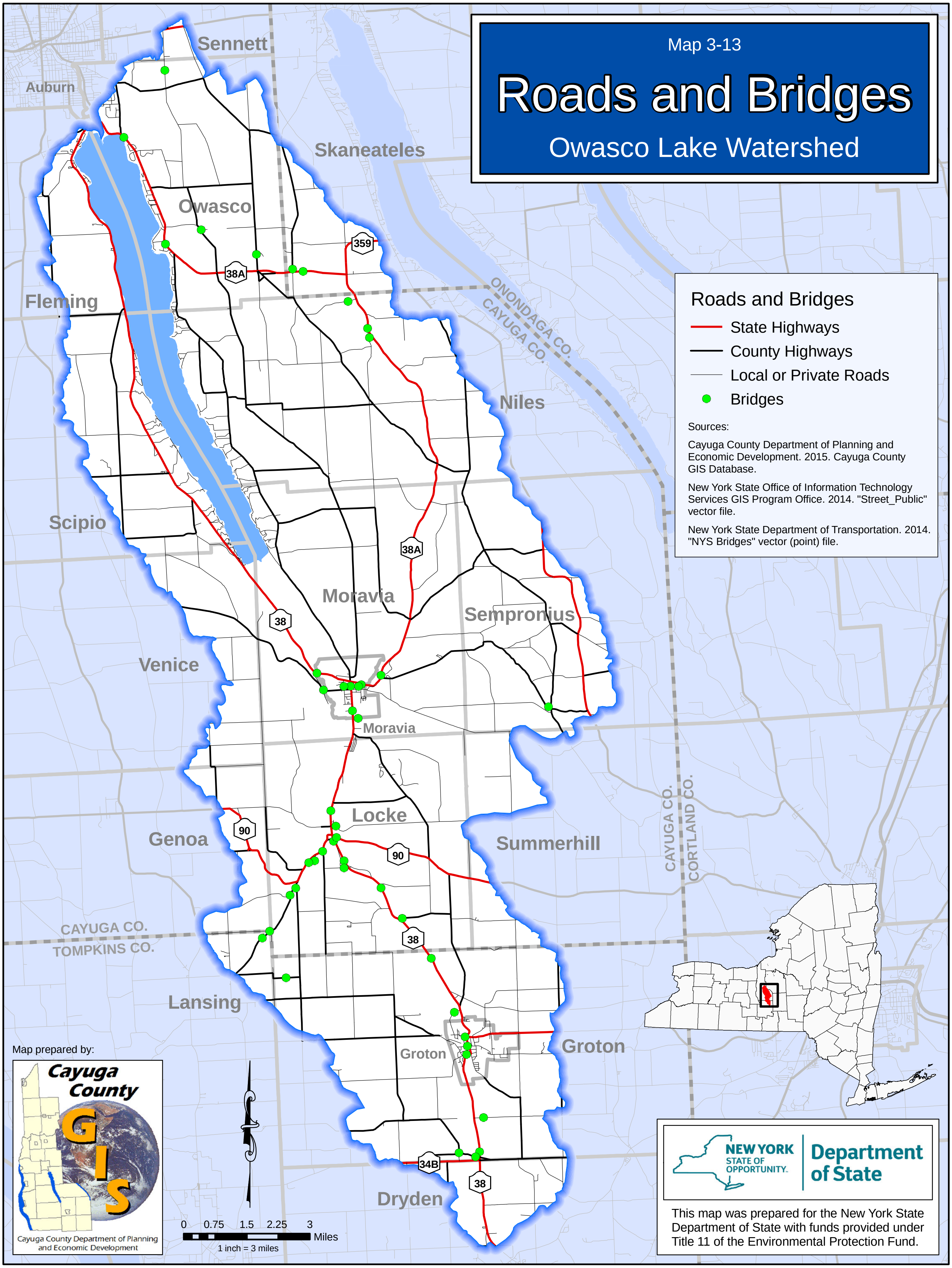

Map 3-11
Tributary Habitat Assessment
Owasco Lake Watershed
Tributary Habitat Assessment
Stream Assessment Category
Natural
Altered
Moderately altered
Severely altered
81.8
Percent Model Affinity (PMA) scores
Source: EcoLogic field assessment, August, 2014.
Sennett
Auburn
Owasco
Skaneateles
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Genoa
Locke
Summerhill
Lansing
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
81.8
64.6
88.4
59.7
61.9
61.3
79
73.5
1
2
3
4
5
6
7
8
38A
359
38
90
34B
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3 Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY. Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

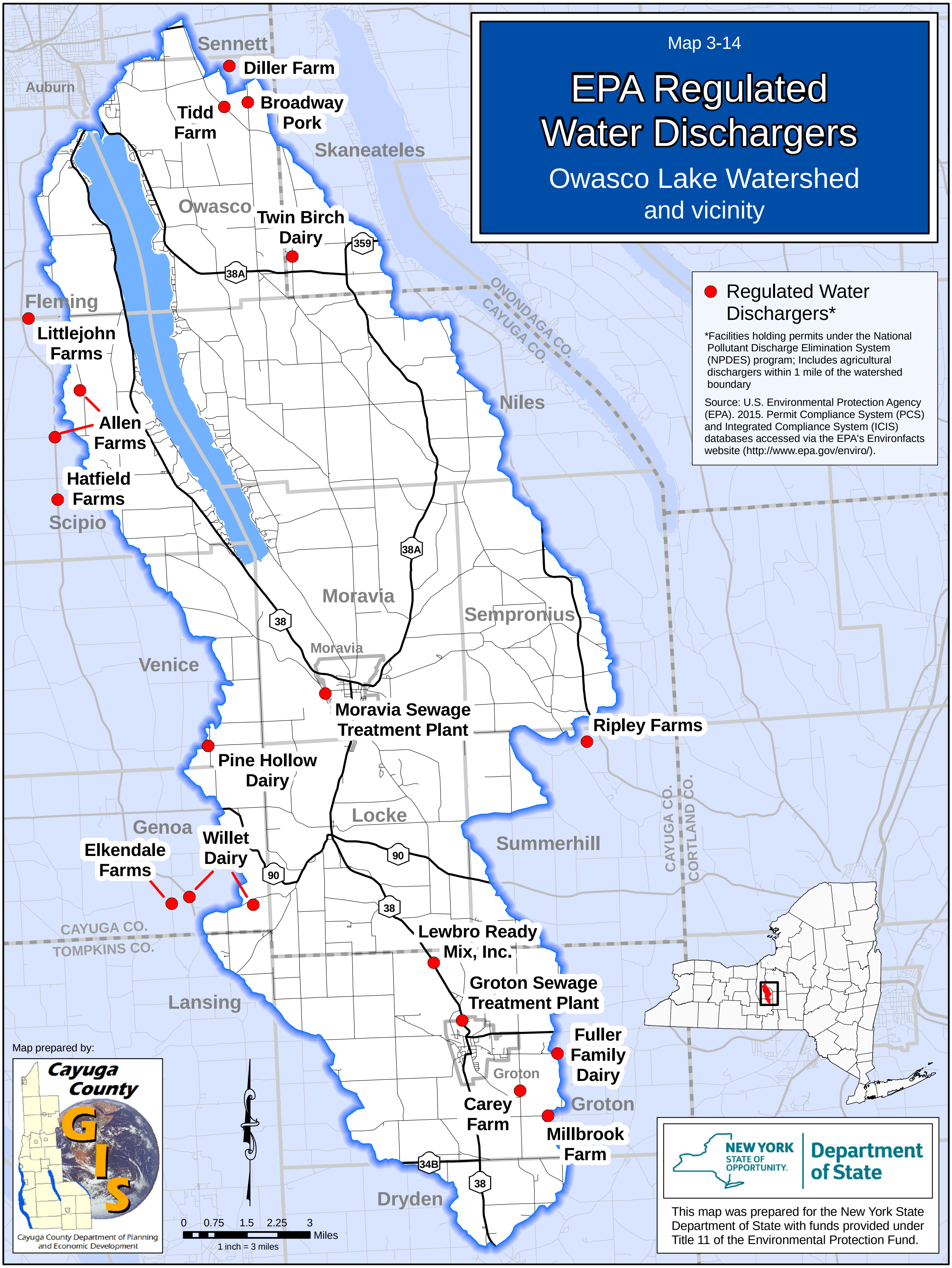

Map 3-12
Water and Wastewater Systems
Owasco Lake Watershed
Water and Wastewater Systems
Parcels Containing Area Within Public or Commercial Water Districts
Parcels Containing Area Within Public Sewer Districts
Parcels Containing Area in both Water and Sewer Districts
Mobile Home Parks with Shared Septic Systems
Sources:
Cayuga County Office of Real Property Services. 2014. Real Property Services (RPS) Database and Cayuga County Tax Parcels (shapefile).
Town of Owasco. 2014. Owasco Sewer District No. 3, Town of Owasco, Cayuga County, New York Final Map, Plan and Report. Prepared by Barton and Loguidice, D.P.C., Syracuse, New York.
Tompkins County Information Technology Services GIS Division and Tompkins County Assessment Department. 2014. Tompkins County Tax Parcels (shapefile).
Cayuga County Department of Planning and Economic Development 2014. County Geographic Information System (GIS) database.
Sennett
Auburn
Skaneateles
Owasco
359
38A
Fleming
ONONDAGA CO.
CAYUGA CO.
Niles
Scipio
38A
Moravia
Sempronius
38
Venice
Moravia
Locke
Genoa
90
90
Summerhill
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
38
Lansing
Groton
Groton
34B
38
Dryden
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3 Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

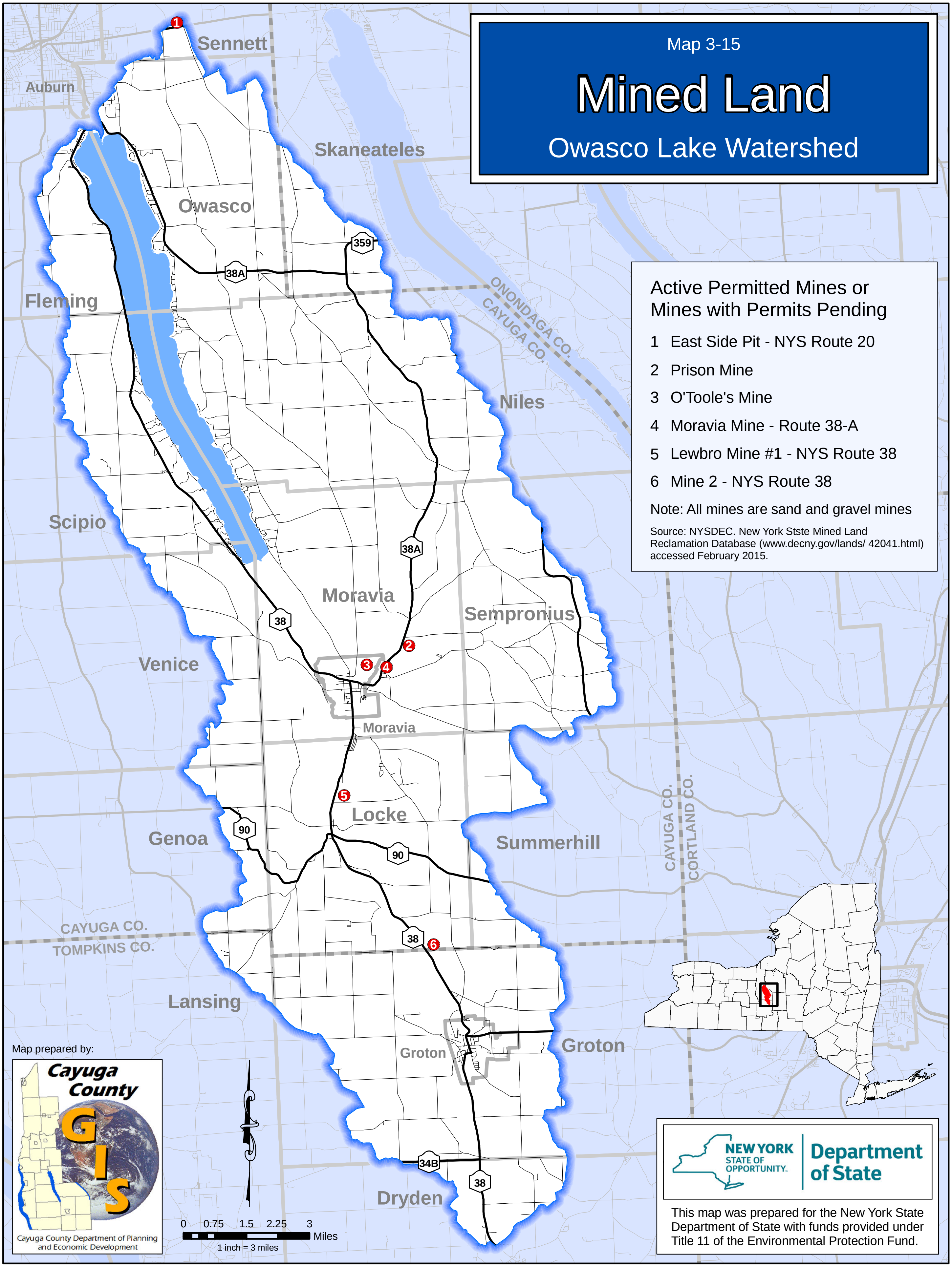
Map 3-13

Roads and Bridges

Owasco Lake Watershed




Map 3-14
EPA Regulated Water Dischargers
Owasco Lake Watershed and vicinity
Regulated Water Dischargers*
*Facilities holding permits under the National Pollutant Discharge Elimination System (NPDES) program; Includes agricultural dischargers within 1 mile of the watershed boundary
Source: U.S. Environmental Protection Agency (EPA). 2015. Permit Compliance System (PCS) and Integrated Compliance System (ICIS) databases accessed via the EPA's Envirofacts website (http://www.epa.gov/enviro/).
Sennett
Auburn
Diller Farm
Tidd Farm
Broadway Pork
Skaneateles
Owasco
Twin Birch Dairy
359
38A
Fleming
Littlejohn Farms
ONONDAGA CO.
CAYUGA CO.
Allen Farms
Niles
Hatfield Farms
Scipio
38A
Moravia
Sempronius
38
Moravia
Venice
Moravia Sewage Treatment Plant
Ripley Farms
Pine Hollow Dairy
Locke
Genoa
Willet Dairy
Elkendale Farms
Summerhill
90
90
CAYUGA CO.
CORTLAND CO.
38
CAYUGA CO.
TOMPKINS CO.
Lewbro Ready Mix, Inc.
Groton Sewage Treatment Plant
Lansing
Fuller Family Dairy
Groton
Carey Farm
Groton
Millbrook Farm
34B
38
Dryden
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3 Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.


Map 3-15
Mined Land
Owasco Lake Watershed
Active Permitted Mines or Mines with Permits Pending
1 East Side Pit - NYS Route 20
2 Prison Mine
3 O'Toole's Mine
4 Moravia Mine - Route 38-A
5 Lewbro Mine #1 - NYS Route 38
6 Mine 2 - NYS Route 38
Note: All mines are sand and gravel mines
Source: NYSDEC. New York Stste Mined Land Reclamation Database (www.decny.gov/lands/ 42041.html) accessed February 2015.
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Genoa
Locke
Summerhill
Lansing
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CORTLAND CO.
TOMPKINS CO.
359
38A
38
90
34B
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3
Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

Chapter 4: State of Owasco Lake

4.1 Classification and Designated Use

As described in section 3.6, the NYSDEC classifies surface waters-including lakes, rivers, streams, embayments, estuaries, and groundwater--with respect to their designated use. Owasco Lake is a Class AA (T) waterbody. According to NYCRR Part 701.5, the best usages of Class AA waters are:

- a source of water supply for drinking, culinary or food processing purposes;
- primary and secondary contact recreation; and
- fishing (the waters shall be suitable for fish, shellfish, and wildlife propagation and survival).

Further, this classification may be given to those waters that, if subjected to approved disinfection treatment, with additional treatment if necessary to remove naturally present impurities, meet or will meet New York State Department of Health drinking water standards and are or will be considered safe and satisfactory for drinking water purposes.

The (T) designation means that Owasco Lake water quality and habitat conditions are suitable for salmonids. In December, 2014 NYSDEC released an updated assessment of the extent to which Owasco Lake conditions are consistent with their designated use; the assessment (Priority Waterbodies List) is summarized in Table 4-1.

Table 4-1. Owasco Lake Priority Waterbodies List Status, Revised December 21, 2014

Lake Ecosystem & Human Use Metrics	Attainment Status & Severity	Documentation
Uses Evaluated		
Water supply	Impaired	Suspected
Public bathing	Impaired	Suspected
Recreation	Impaired	Suspected
Aquatic Life	Fully supported	Known
Fish consumption	Fully supported	Unconfirmed
Conditions Evaluated		
Habitat/Hydrology	Fair	
Aesthetics	Fair	

In their December 2014 revision, NYSDEC further reported on the types and sources of pollutants affecting the uses and conditions. The NYSDEC uses CAPITAL LETTERS to indicate their conclusions regarding the MAJOR Use Impacts/Pollutants/Sources.

<u>Type of Pollutant(s)</u>
Known: PATHOGENS, HARMFUL ALGAL BLOOMS, Algal/Plant growth (native)
Suspected: NUTRIENTS (phosphorus), Silt/Sediment

Source(s) of Pollutant(s)
Known: AGRICULTURE, OTHER SOURCE (waterfowl), Habitat alteration
Suspected: Hydrologic alteration, municipal discharges, onsite/septic systems

In 1998, NYSDEC included Owasco Lake on its inaugural List of Impaired Waterbodies, also known as the 303(d) list, in Part 1 - Individual Waterbody Segments with Impairment Requiring TMDL Development. Pathogens were the basis for the listing; the source is cited as wildlife/other. The 303(d) list is a compilation of lakes, streams, and coastal areas where water quality conditions are not adequate to support a designated use. Designated uses may be human-oriented (e.g. drinking water, swimming, boating, shellfish consumption) or ecologically-oriented (e.g. fish propagation, fish survival). The list is named for the section of the federal Clean Water Act requiring states, territories, and authorized tribes to assess water quality conditions within their jurisdictions. Water quality conditions are compared with criteria and standards defined in terms of the specific uses. The 303(d) list is a product of this assessment; water bodies are placed on the list when additional controls are needed to bring water quality into compliance with standards and criteria defined for designated uses.

The Section 303(d) List is updated every two years. The Final 2014 NYS Section 303(d) List (September 2014) which was "partially approved/partially disapproved" by USEPA in January 2015 is now in effect. In this current document, Owasco Lake continues to be listed in Part 1 as impaired by pathogens and requiring a TMDL. However, the NYSDEC December 2014 update to the Priority Waterbodies List notes that “the suspected impacts to water quality and uses may not be sufficient to warrant continued listing” and recommended a re-evaluation of listings for the lake during the 2016 listing cycle.

During the comment period on the draft 2014 listings, the Cayuga County Water Quality Management Agency submitted comments to NYSDEC stating that Owasco Lake should be added to the 303(d) list of impaired waters requiring a TMDL due to excessive phosphorus/nutrients, citing the presence of numerous and widespread cyanobacterial blooms in recent years. Excessive aquatic vegetation growth was also noted. NYSDEC responded that current data for phosphorus concentrations in Owasco Lake demonstrate that concentrations remain well below the agency’s assessment criteria and do not support a listing. However, the cyanobacterial blooms are of concern. Similar to their comments related to pathogens, NYSDEC recommended re-evaluating the lake’s regulatory listing during the 2016 cycle.

4.2 Public Water Supply

Owasco Lake serves as the drinking water supply for more than 44,000 residents of Cayuga County. Two water intakes extend into the lake’s northern basin; the City of Auburn draws water from a depth of 30 feet and the Town of Owasco draws water from a depth of 45 feet. Some lakefront property owners are also known to draw water directly from the lake. Many municipalities purchase treated water from the City of Auburn: Towns of Sennett, Throop, Brutus, Mentz, Aurelius, Springport, Fleming and Montezuma; the Villages of Weedsport, Port Byron, and Cayuga, the Thruway Authority, and the Cayuga County Water and Sewer Authority.[1] The Town of Fleming also purchases treated water from the Town of Owasco.

The City of Auburn is permitted to draw up to 15 million gallons of water per day (mgd) from Owasco Lake. According to their 2013 Annual Report, the transmission main serving the City of Auburn drinking water plant consists of approximately 8,800 feet of cast-iron pipe. The first 400 feet of transmission main was replaced in 2001 as part of the re-construction of the Owasco Lake Seawall**.** The City presently operates two filtration plants: a slow-sand plant, and a rapid-sand plant, which are operated in parallel. The slow-sand filtration plant, constructed in 1916-17*,* has four beds with a total capacity of about 7.5 mgd. The beds consist of about 42 inches of sand supported by 12 inches of gravel. The rapid-sand filtration plant was added in 1969. This plant consists of three dual-media filters with a combined capacity of about 7.25 mgd. In the rapid-sand filtration plant, water is pre-treated with poly-aluminum chloride to facilitate coagulation and sedimentation and settling prior to filtration. All water is disinfected with sodium hypochlorite prior to distribution. Activated carbon is used to prevent development of taste and odor that may be associated with the presence of certain algal species. Reservoirs on Franklin Street in Sennett and Swift Street in the City maintain reserves of 10.25 mg and 3 mg respectively. The City also adds sodium hypochlorite to its raw water intake, to prevent attachment of dreissenid mussels within the intake pipe. On an annual average, the City of Auburn water plant treats and distributes slightly over 4 mgd; the annual peak day produces about 5.6 mgd of water.

The quality of public water supplies is regulated by the NYS Department of Health (NYSDOH), which requires extensive monitoring and sets numerical limits on the presence of chemicals, turbidity (sediment particles), and certain microbes in the treated water supply. The reports of the City of Auburn indicate that the water supply is in full compliance with these regulatory limits and requirements.

The Town of Owasco draws less than 0.4 mgd of lake water to serve its customers in Owasco and Fleming. According to their Annual Report, this utility applies potassium permanganate to its raw water intake as a defense against dreissenid mussels. The lake water is pumped to the filter plant located on East Lake Rd where it is treated with polymer, filtered and chlorinated prior to distribution. Activated carbon is used to prevent development of taste and odor that may be associated with the presence of certain algal species. The water plant has the capacity to pre-chlorinate (ahead of polymer addition) but no longer does so. The NYSDOH-required monitoring indicates that this water supply is also in full compliance with the regulatory limits and requirements.

The NYSDEC reported in December 2014 that, while the City of Auburn and Town of Owasco public water supplies are in full compliance, there have been occasional exceedances in recent years of the limits on disinfection byproducts measured in some of the municipal systems that purchase treated Owasco Lake water. Both water supplies use chlorine for disinfection. Potentially harmful disinfection byproducts, such as trihalomethanes, haloacetic acids, and chlorite, can be formed when chlorine reacts with naturally-occurring organic matter present in the water. The detection of disinfection byproducts in these small municipal systems was cited to support the designation of the lake as impaired for its use as a water supply. The monthly average concentrations of total organic carbon (TOC) measured in the intake to the City of Auburn water treatment plant from 2001 to 2014 are summarized in Table 4-2. Note the variability among months; higher TOC levels are measured during the summer growing season when phytoplankton are at their annual maxima. The table also reveals that the minimum monthly average values over the 14 year period were measured earlier in the record, and the higher concentrations were measured later in the record. The annual average TOC concentrations over the 14 year period (Figure 4-1) confirm the trend of increasing concentration.

Table 4-2. History of Total Organic Carbon (TOC) Concentrations Measured at the City of Auburn Water Intake, 2001–2014

Month	Total Organic Carbon. mg/L				
	Average (2001-2014)	Minimum	Minimum Year	Maximum	Maximum Year
January	5.4	1.8	2001	25.0	2013
February	4.3	2.2	2002	7.2	2013
March	5.4	2.5	2002	15.0	2012
April	4.1	2.4	2002	7.1	2010
May	4.4	2.4	2002	6.3	2008
June	6.9	2.2	2001	21.0	2011
July	7.7	2.9	2001	20.0	2011
August	7.3	2.6	2004	20.0	2010
September	6.2	2.9	2002	11.0	2008
October	4.3	2.3	2001	6.2	2010
November	5.1	2.4	2003	8.6	2010
December	4.8	2.4	2004	8.7	2013

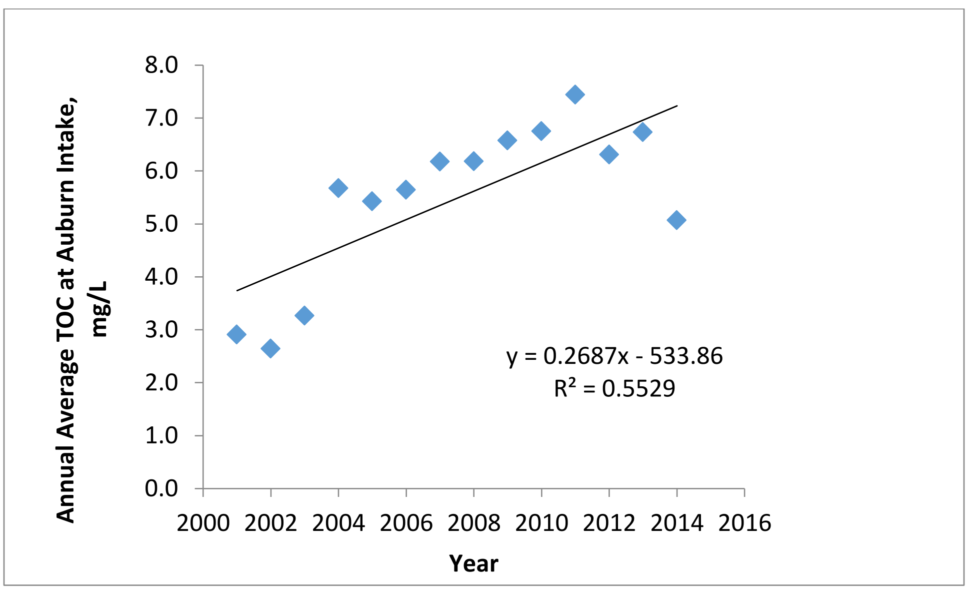


Figure 4-1. Annual Average Total Organic Carbon Concentrations at City of Auburn Water Intake, 2001–2014

4.3 Trophic State Assessment

The level of productivity (trophic state) of a lake is typically defined by three parameters: total phosphorus concentration, Secchi disk transparency, and chlorophyll-*a* concentration (a measure of algal abundance). Trophic state of lakes is a continuum, without clear demarcations of boundaries between nutrient-poor conditions (oligotrophic), moderate levels of nutrients and aquatic productivity (mesotrophic), and productive systems (eutrophic).

In turn, lake productivity is related to the dissolved oxygen (DO) content of the water column, notably the deep waters of thermally stratified lakes such as Owasco Lake. Algal cells produced in the upper waters are decomposed by microorganisms as they settle to the lake sediment. In productive lakes with abundant algal growth, DO concentrations decline in the deeper waters during the summer. When DO is depleted, chemical changes at the sediment surface promote the flux of phosphorus from sediments into the water column. This sediment phosphorus, which may have entered the lake long ago, can eventually become available to support algal production.

In the following sections, the status and trends in the trophic state of Owasco Lake, including deep water DO conditions, are reviewed. The primary data source is the Finger Lakes Institute annual monitoring program led by Professor Halfman of FLI and Hobart William Smith Colleges.

4.3.1 Total Phosphorus, Chlorophyll-a, and Secchi Disk Transparency

Various investigators and regulatory agencies have advanced numerical thresholds to categorize lakes productivity level. As shown in Table 4-3, the limits outlined by USEPA[2] are typically used for New York lakes. Owasco Lake is described as oligo-mesotrophic.[3]

Table 4-3. Limits for Demarcation of Trophic State Condition, Compared with Owasco Lake Measurements, 2006–2014

Metric	Oligotrophic	Mesotrophic	Eutrophic	Owasco Lake (2006–2014)
Summer average total phosphorus, upper waters (µg/L)	<10	10-25	>25	10.5
Summer average chlorophyll-a, upper waters (µg/L)	<4	4 - 8	>8	2.6
Average Secchi disk transparency, m	>4	2-4	<2	4.1
Dissolved oxygen in lower waters (% saturation)	80 – 100	10-80	Less than 10	50-80

Summer average total phosphorus (TP) is used as an index of the lake's trophic state and suitability for use in water supply and recreation. Elevated TP concentrations are coupled to algal abundance and water clarity. NYSDEC has adopted a guidance value for TP in lakes of 20 µg/L summer average (defined as the four month period from June 1 to September 30) to protect recreational uses. NYSDEC is considering adopting numerical nutrient criteria for lakes to protect water supply uses as well; these criteria may be lower or may extend over a longer averaging period. The summer average TP concentrations in Owasco Lake's upper waters are consistently below the current regulatory guidance value of 20 µg/L for recreational uses (Figure 4-2).

There is also a narrative standard in place for phosphorus and nutrients in waters "None in amounts that will result in growths of algae, weeds, and slimes that will impair the waters for their best usages". In the summer of 2014, two bathing beaches were closed due to algal blooms. In addition, some residents report that excessive macrophyte growth limits their recreational access to the lake. These observations indicate that the narrative nutrient standard may not be consistently met in Owasco Lake.

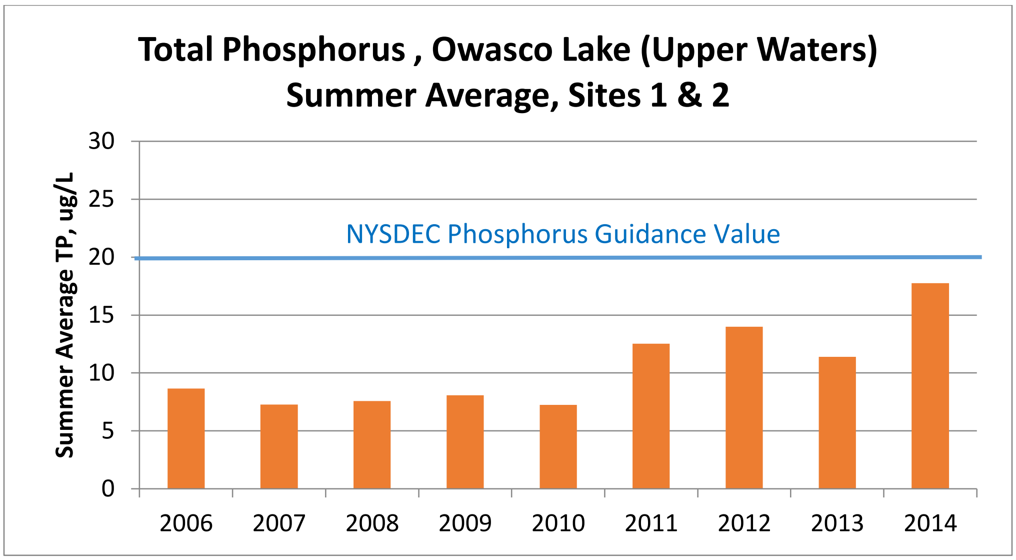


Figure 4-2. Total Phosphorus Concentration, Owasco Lake Upper Waters, 2006–2014 Compared to the Regulatory Threshold for Use Impairment for Recreation

There is no regulatory limit for chlorophyll-*a* concentration in the state's lakes and reservoirs as of February 2015. However, NYSDEC has been working for several years to develop nutrient criteria that will be protective of surface waters used for potable water supply. While the proposed nutrient criteria are not yet released for public review and comment, the draft revisions to NYSDEC Consolidated Assessment and Listing Methodology (CALM) cites a threshold of 4 µg/L chlorophyll-*a* for Class AA waters, such as Owasco Lake. Eventually, statistical modeling will be used to relate this level of algal abundance to ambient phosphorus concentrations. The objective of managing lakes to keep chlorophyll-*a* levels low is to reduce the risk of formation of disinfection byproducts. The chlorophyll-*a* concentrations measured in Owasco Lake are consistently below this threshold, indicating that algal levels are low and the lake's use as a public water supply is not at risk (Figure 4-3). However, conditions in some years (2005, 2009, 2014) approach the proposed threshold of 4 µg/L chlorophyll-*a* for Class AA waters.

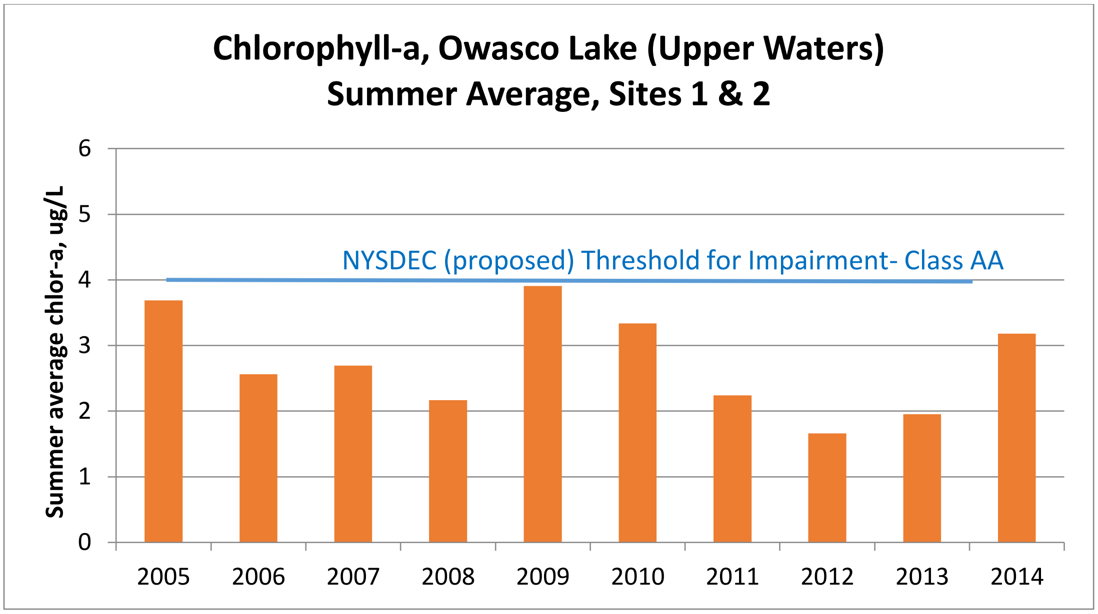


Figure 4-3. Chlorophyll-a Concentration, Owasco Lake, 2005-2014 Compared to the (proposed) Threshold for Use Impairment for Public Water Supply

The third classic metric of trophic state is Secchi disk transparency, a measure of water clarity. The utility of Secchi disk transparency is limited by the extent to which algal particulates are the primary factor affecting water clarity. The NYSDOH has a swimming safety guidance value of 1.2 m (4 ft.) for public beaches. The water quality of Owasco Lake is consistently above this threshold as shown in Figure 4-4.

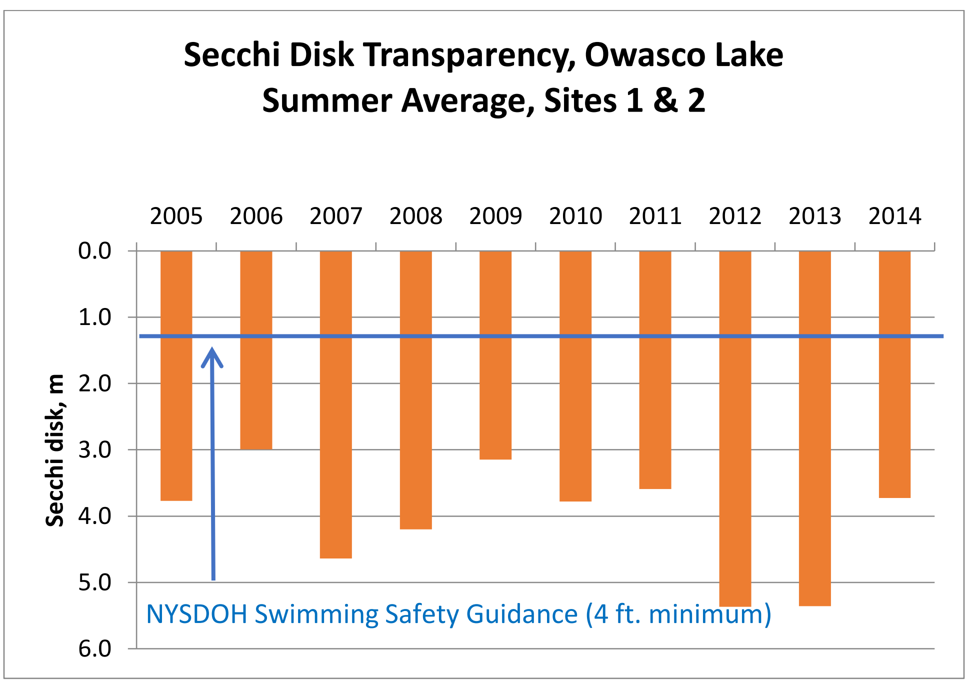


Figure 4-4. Secchi Disk Transparency, Owasco Lake 2005–2014 Compared to Swimming Safety Guidelines

4.3.2 Dissolved Oxygen

The deep waters of Owasco Lake exhibit a progressive decline in DO concentration as the summer period of thermal stratification progresses. These data are documented in the annual reports of the Finger Lakes Institute lake monitoring program (2010–2014). There is much interannual variability, as evident in Figure 4-5. The differences among the years are the result of a complex interaction of weather, i.e., the timing of the onset of stable thermal stratification, and productivity.

There are two important implications to these data. First, the DO concentrations in the deeper colder waters are sufficient to support the cold water fish community. Second, Owasco Lake does not develop seasonal anoxia in the deepest waters, which prevents phosphorus flux from the sediments to the overlying waters.

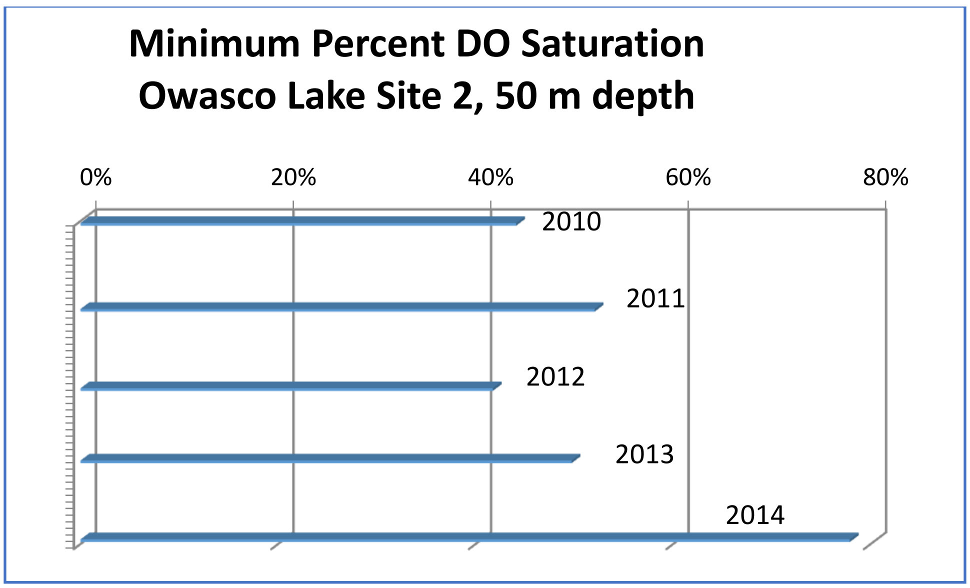


Figure 4-5. Minimum Percent Saturation of Dissolved Oxygen in Owasco Lake's Deepest Waters, 2010–2014

4.4 Bacteriological Quality

Since 1999, the Owasco Watershed Lake Association (OWLA) has conducted a volunteer monitoring program during the summer recreational period, collecting water samples from multiple locations in Owasco Lake and its tributary streams for analysis of fecal coliform bacteria. The program is jointly funded by Cayuga County and OWLA and administered by the Cayuga County Department of Planning & Economic Development. The Cayuga County Department of Environmental Health monitors the bacteriological quality of permitted bathing beaches, including those associated with children's camps. These extensive data sets demonstrate the high degree of variability in laboratory counts of fecal coliform bacteria, both spatially and temporally. A strong correlation between rainfall and bacteria counts is evident in both in the lake and stream samples.

Fecal coliform bacteria are used as an indicator of recent contamination of water by fecal material. While the coliform bacteria may not be pathogenic (disease-causing), their presence means that other harmful microbes may be in the water. Fecal coliform bacteria can originate from wildlife, waterfowl, humans and other mammals including livestock. As reported in the 2000 *State of the Owasco Lake Watershed*, DNA testing of the fecal coliform bacteria was conducted to identify the major source of bacteria in the Owasco Lake samples. Dr. Mansour Samadpour from University of Washington's Department of Environmental Health analyzed microbial DNA from water samples collected in 1998 from Emerson Park beaches, from the confluence of Owasco Inlet, Sucker Brook, Veness Brook, and Dutch Hollow Brook with Owasco Lake, and from the lake outlet. This study concluded that there are multiple sources of fecal contamination to Owasco Lake. For the beaches at Emerson Park, the major source is wildlife, particularly waterfowl (ducks and geese). Agriculture was classified as an intermediate source of fecal coliform bacteria at Emerson Park; human and pet waste was classified as a minor source. Within the tributaries, agriculture and wildlife were the major sources; human and pets were classified as minor sources.

In recent years, the Cayuga County/OWLA monitoring program has collected samples each week at a defined network of monitoring sites: seven lake sites and four stream sites. The volunteers also report their observations of algal type and abundance and rainfall over the week. The New York State ambient water quality standard for fecal coliform bacteria is 200 cells per 100 mL of water, calculated as the geometric mean of a minimum of five samples per month; however, the monitoring program is not designed to assess compliance with this standard. In addition, the NYSDOH applies a single sample limit of 1000 cells/100 mL for bathing beaches. Waters with indicator bacteria counts below these thresholds are considered safe for water contact recreation. The microbiological monitoring data from 2010 - 2014 are summarized in Table 4-4. While the results are variable, conditions appear to be improving. Bacteriological data tend to be highly variable, because the microbial cells may not be dispersed uniformly in the water samples, and due to documented variability among analytical laboratories. The laboratory used for the fecal coliform analysis was changed in mid-2013.

Table 4-4. Summary of OWLA Bacteriological Monitoring of Owasco Lake and Streams, 2010–2014

Location	Type	Percent of samples >1000 cells/100 mL				
		2010 (7 events) Rain- 4.03"	**2011** (12 events) Rain-12.06"	**2012** (11 events) Rain-4.89"	**2013** (12 events) Rain-12.47"	**2014** (15 events) Rain-15.72"
Sucker Brook	Stream	29%	17%	9%	0%	0%
Dutch Hollow	Stream mouth	43%	25%	0%	0%	no samples
Long Point	Lake	0%	0%	0%	0%	0%
Seward Point	Lake	0%	17%	0%	0%	0%
FL 34 E	Lake	0%	8%	0%	0%	0%
Rounds Lane (Inlet)	Stream	86%	83%	82%	25%	7%
Long Hill Rd. (Inlet)	Stream	86%	92%	55%	25%	7%
Cascades Restaurant	Lake	14%	0%	0%	8%	0%
Fays Point	Lake	0%	42%	0%	0%	0%
Buck Point	Lake	14%	8%	0%	0%	7%
Gleason Drive	Lake	no samples	0%	0%	0%	0%

4.5 Lake Biota

4.5.1 Fish Community

At least 49 fish species have been reported from Owasco Lake or its tributaries (Table 4-5). Gamefish present include lake trout, brown trout, rainbow trout, smallmouth bass, largemouth bass, walleye, northern pike, and chain pickerel. Panfish present include pumpkinseed, bluegill, rock bass, bullhead, and yellow perch. The major forage fish species are alewife and yellow perch. Owasco Lake is stocked annually by the New York State Department of Environmental Conservation with approximately 10,500 lake trout, 5,000 rainbow trout and 10,000 brown trout. Owasco Inlet is stocked with 20,000 rainbow trout. Walleye were stocked into the lake from 1996 – 2006; however, walleye stocking was discontinued due to a decline in the rainbow and brown trout fishery that coincided with the emergence of walleye in the fishery.

Owasco Inlet supports notable spawning runs of lake-resident brown and rainbow trout, as well as resident populations of these species. This stream and the other larger tributaries in the watershed also support populations of non-game species such as white sucker, central stoneroller, creek chub, fallfish, blacknose dace, longnose dace, eastern silvery minnow, fantail darter, and tessellated darter, among others.

Table 4-5. Scientific and Common Names of Fish Species Reported from the Owasco Lake Watershed

SCIENTIFIC NAME	COMMON NAME
Anguillidae--freshwater eels	
Anguilla rostrata	American eel
Clupeidae--herrings	
Alosa pseudoharengus	Alewife
Ictaluridae--bullhead catfishes	
Ameiurus nebulosus	Brown bullhead
Noturus flavus	Stonecat
Noturus gyrinus	Tadpole madtom
Noturus insignis	Margined madtom
Catosotmidae--suckers	
Catostomus catostomus	Longnose sucker
Catostomus commersoni	White sucker
Hypentelium nigricans	Northern hog sucker
Cyprinidae--carps and minnows	
Campostoma anomalum	Central stoneroller
Couesius plumbeus	Lake chub
Cyprinus carpio	Common carp
Cyprinella analostana	Satinfin shiner
Exoglossum maxillingua	Cutlips minnow
Hybognathus regius	Eastern silvery minnow
Luxilus cornutus	Common shiner
Notropis hudsonius	Spottail shiner
Notropis spilopterus	Spotfin shiner
Notemigonus crysoleucas	Golden shiner
Pimephales promelas	Fathead minnow
Pimephales notatus	Bluntnose minnow
Rhinichthys atratulus	Blacknose dace
Rhinichthys cataractae	Longnose dace
Scardinius erythrophthalmus	Rudd
Semotilus atromaculatus	Creek chub
Semotilus corporalis	Fallfish

Salmonidae—trouts	
Coregonus artedi	Cisco
Oncorhynchus mykiss	Rainbow trout
Salmo salar	Atlantic salmon
Salmo trutta	Brown trout
Salvelinus fontinalis	Brook trout
Salvelinus namaycush	Lake trout
Osmeridae--smelts	
Osmerus mordax	Rainbow smelt
Umbridae–mudminnows	
Umbra limi	Central mudminnow
Esocidae--pikes	
Esox lucius	Northern pike
Esox niger	Chain pickerel
Fundulidae--killifishes	
Fundulus diaphanus	Banded killifish
Gasterosteidae--sticklebacks	
Culaea inconstans	Brook stickleback
Centrarchidae--sunfishes	
Ambloplites rupestris	Rock bass
Lepomis gibbosus	Pumpkinseed
Lepomis macrochirus	Bluegill
Micropterus dolomieu	Smallmouth bass
Micropterus salmoides	Largemouth bass
Percidae--perches	
Etheostoma flabellare	Fantail darter
Etheostoma olmstedi	Tesselated darter
Perca flavescens	Yellow perch
Percina caprodes	Logperch
Sander vitreus	Walleye
Cottidae--sculpins	
Cottus cognatus	Slimy sculpin

Sources: Smith 1985; NYSDEC's Fish Atlas Maps of New York

4.5.2 Macrophytes

The littoral zone of lakes, defined as the region where sunlight reaches the sediment, can support the growth of rooted aquatic plants and algae (macrophytes) if temperature and nutrient conditions are favorable. Owasco Lake has a relatively small amount of littoral habitat, due the lake's depth and bottom contours. The lake's shallow southern basin, northern basin, and limited areas of the eastern and western nearshore areas have suitable conditions for macrophytes.

Macrophytes are a vital component of the lake food web. Not only do the aquatic plants capture radiant energy from sunlight and convert it to living tissue through photosynthesis, they provide surface area for colonization by algae and tiny aquatic insects, mollusks, and worms. These macroinvertebrates are an important food source for fish and other aquatic animals. A vegetated littoral zone provides cover and refuge for adult fish as well as spawning habitat and nursery areas for juveniles. Macrophytes help stabilize sediments, thus reducing the potential resuspension of particles by winds and waves.

In 2007, Bruce Gilman and John Foust (Finger Lakes Community College) and Bin Zhu (Finger Lakes Institute) surveyed the Owasco Lake macrophyte community. The three investigators designed their survey to assess the species richness and relative abundance of the lake's macrophyte community, estimate productivity, and evaluate the environmental conditions that influence the community structure and distribution (Gilman et al. 2008).[4] A total of 18 species were identified in Owasco Lake in 2007; this species richness is comparable to that of other regional lakes. Two of the macrophyte species detected in 2007, Eurasian watermilfoil and curly-leafed pondweed, are invasives. However, neither invasive species dominated the macrophyte community, as summarized in Table 4-6. Note the shift in macrophyte community composition over the sampling periods. The two plants contributing the most to the overall biomass standing crop are stonewort (a low-growing species of the green alga *Chara*) and elodea, a native submerged plant.

Table 4-6. Percent Distribution of Macrophyte Standing Crop Biomass Owasco Lake, 2007

Common name	Scientific name	Percent Contribution of each Species to Total Biomass			
		June (n=27)	July (n=27)	Aug (n=39)	Total (n=93)
Coontail	*Ceratophyllum demersum*	2.3	0.6	1.4	1.3
Stonewort	*Chara* sp.	36.1	35.3	45.8	40.3
Elodea	*Elodea canadensis*	25.7	37.7	19.8	27.1
Aquatic moss	*Fontinalis antipyretica*	0.0	0.0	0.0	0.0
Water stargrass	*Heteranthera dubia*	0.4	0.4	3.4	1.8
Eurasian watermilfoil	*Myriophyllum spicatum*	9.8	9.2	7.8	8.7
Slender naiad	*Najas flexilis*	0.0	0.4	2.1	1.1
Southern naiad	*Najas guadalupensis*	0.0	0.0	0.0	0.0
Large leaf pondweed	*Potamogeton amplifolius*	0.2	0.2	0.0	0.2
Curly-leafed pondweed	*Potamogeton crispus*	7.3	0.9	1.7	2.5
Leafy pondweed	*Potamogeton foliosus*	11.8	9.2	0.5	5.7
Grass leaf pondweed	*Potamogeton gramineus*	0.0	0.0	0.1	0.0
Sago pondweed	*Potamogeton pectinatus*	5.6	0.0	0.0	1.1
Spotted pondweed	*Potamogeton pulcher*	0.0	0.0	0.1	0.1
Small pondweed	*Potamogeton pusillus*	0.1	0.2	3.6	1.7
Flat stem pondweed	*Potamogeton zosteriformis*	0.0	0.5	0.3	0.3
Stiff whitewater buttercup	*Ranunculus longirostris*	0.2	0.2	0.3	0.2
Eel grass	*Vallisneria americana*	0.5	1.9	11.7	6.1

Source: Gilman et al. 2008

The most dominant macrophyte species in Owasco Lake are displayed in Figure 4-6. The figure denotes the percent contribution of each major species to the total biomass measured in 2007. In addition, the percent occurrence of each species within the sampled plots is included. Taken together, this information demonstrates that four macrophyte species: elodea, Eurasian watermilfoil, leafy pondweed, and eel grass are fairly ubiquitous in their distribution, occurring in more than 55% of the sampled quadrats. However, these species vary widely with respect to their contribution to the plant biomass. The distribution of macrophyte species is patchy in Owasco Lake. Elodea is the most abundant (27.1% of the total macrophyte biomass in 2007), followed by Eurasian watermilfoil (8.7%), eel grass (6.1%) and leafy pondweed (5.7%). Some of this variation in distribution and biomass is due to the size and growth form of the plants.

Physical conditions also affected the standing crop biomass; macrophyte abundance was lower at the deep edge of the littoral zone, especially on coarse substrates, and near the shoreline subject to wave action. Biomass was higher in loam and silt loam substrates enriched with organic matter. Overall productivity of the macrophyte community was high, with a maximum standing crop biomass estimated at 1263 g/m^2 (Gilman et al. 2008).

The Cayuga County Soil & Water Conservation District manages a mechanical harvesting program in several County lakes, including Owasco, to maintain recreational uses. The efficacy of the program in removing weeds varies each year, depending on the number of days of harvesting, the overall plant density, and conditions on the lake during the operation. As shown in Figure 4-7, the mass of plant material removed from Owasco Lake by Cayuga County's mechanical harvesting program can range from a few hundred to over one thousand cubic yards of plant material.

Based on anecdotal information and complaints of shoreline residents, macrophyte abundance in Owasco Lake can reach nuisance levels, interfering with recreational use and access to navigation.

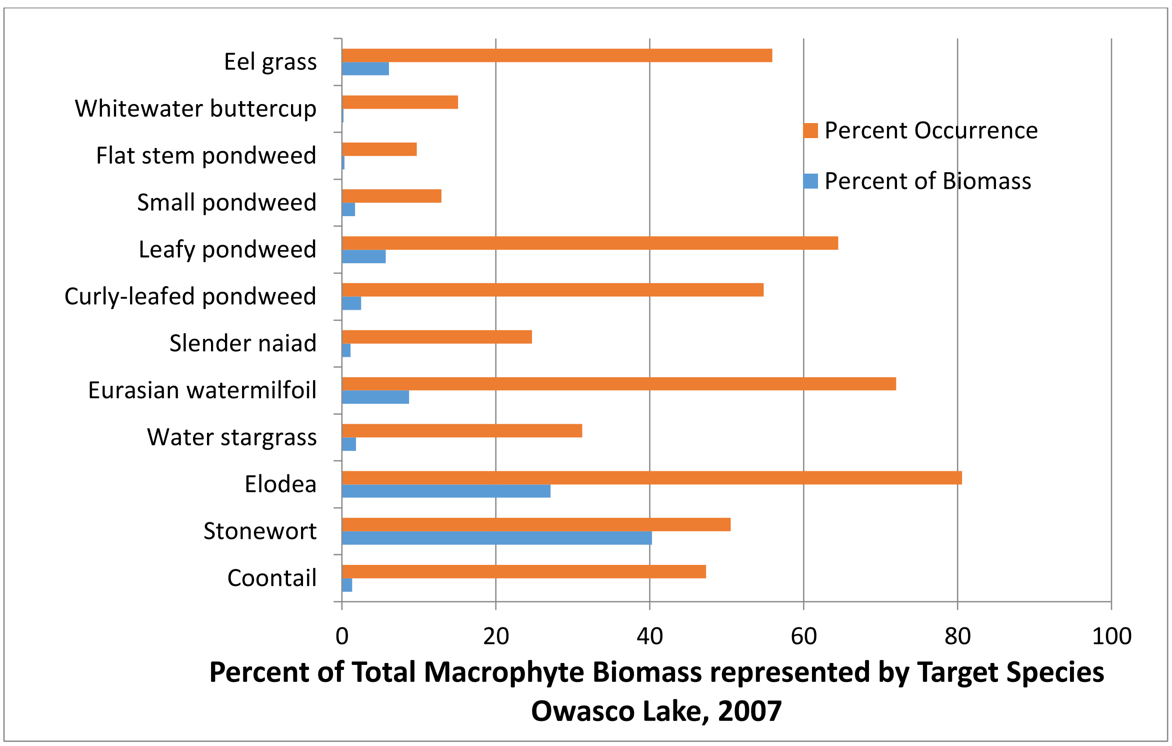


Figure 4-6. Relative Standing Crop of Macrophyte Species (percent of biomass) Plotted with Percent Occurrence (presence/absence) of those Species in 97 Sampled Points (Gilman et al. 2008)

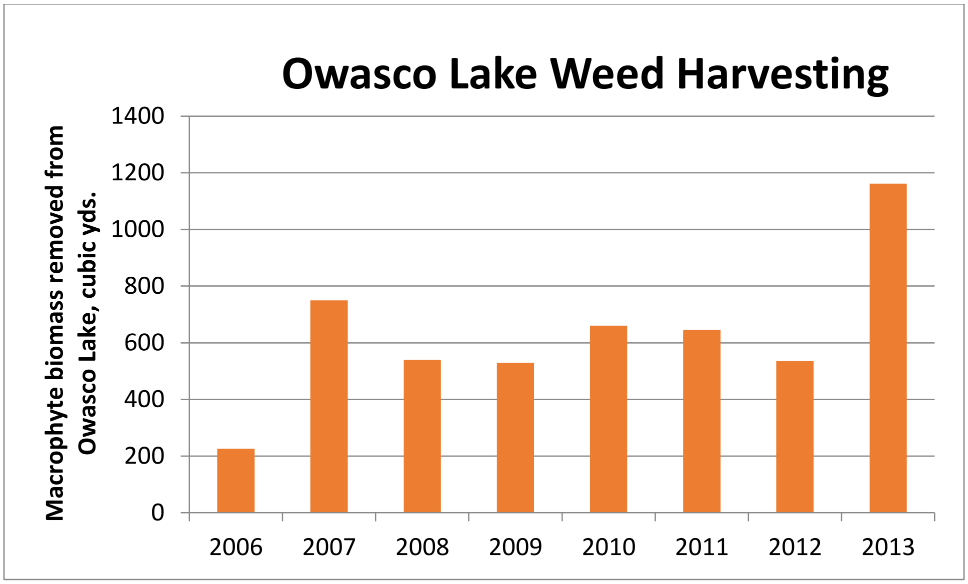


Figure 4-7. Estimated Biomass of Aquatic Plants Removed from Owasco Lake by the Cayuga County SWCD Mechanical Harvesting Program, 2006–2013

4.5.3 Plankton Community

Since 2005, the FLI annual monitoring program has pulled a fine-meshed net through the water column to sample the plankton community, including phytoplankton (microscopic plants and cyanobacteria) as well as zooplankton (microscopic animals). According to Halfman et al. (2014), results are relatively consistent from year to year. The phytoplankton community is dominated by various species of diatoms, especially early in the annual cycle. Diatoms are adapted to low light and cold temperature conditions, and comprise the major component of the spring phytoplankton bloom in many New York lakes. Diatoms are characterized by a siliceous skeleton (frustule). In many lakes, the spring diatom bloom is associated with a rapid decline in the concentration of silica dissolved the lake's upper waters. Once the lake begins to warm, other phytoplankton species become dominant components of the community as well. In Owasco Lake, the plankton net tows tend to capture various species of dinoflagellate in July and August. Cyanobacteria typically appear in the phytoplankton community later in the season. In 2007 and 2010, the cyanobacteria *Microcystis* represented up to 40% of the phytoplankton during late-summer blooms. A second genus of cyanobacteria, *Anabaena,* was a major component of the phytoplankton in 2013, comprising about 30% of the late bloom.

In 2014, multiple samples of Owasco Lake waters were submitted to the NYSDEC Harmful Algal Bloom (HAB) program for microscopic examination and, when appropriate, chemical analysis for the presence and concentration of microcystins and other harmful exudates. Cyanobacterial bloom conditions were confirmed as of September 1, and persisted into the fall. The major species were *Microcystis* and *Anabaena*. Several near-shore samples tested positive for microcystins and exceeded the "high toxins" criteria.

The lake's zooplankton community is dominated by small organisms, namely *Copepods*, *Nauplius*, *Polyarthra* and *Vorticella* with some cladocerans, such as the invasive species *Cercopagis pengoi* (fishhook water flea). The predominance of small zooplankton is considered by limnologists to indicate intense grazing pressure on the zooplankton community by fish (herbivory). The alewife is one of the major forage fish in the Owasco Lake fish community; the presence of this clupeid is correlated with an absence of larger cladocerans such as *Daphnia* in the zooplankton community (Brooks and Dodson 1972). Smaller zooplankton are less efficient grazers of phytoplankton, thus making alewife foraging another factor affecting water clarity. The FLI investigators also reported finding dreissenid (zebra and quagga mussel) larvae in the plankton tows.

4.5.4 Asian Clam

In addition to the invasive species cited above, Owasco Lake has a population of the Asian clam, *Corbicula fluminea.* First detected in September 2010, the area of infestation appears to be limited to the lake's northern basin. This mollusk is considered to pose a threat to the lake benthic community, as it can out-compete native species and may reduce biodiversity. There are water quality impacts as well; the Asian clam is an effective filter feeder and can recycle nutrients into the water column where they are available for the phytoplankton community. The potential impact of the Asian clam on cyanobacteria is not yet fully understood. In other lakes with Asian clam, the most serious impact of the infestation is on biofouling of water intake pipes. To date, no complaints of biofouling have been reported to the Health Department. The Cayuga County water resources management agencies have created a task force to conduct detailed surveys of distribution and abundance of this invasive species, develop an effective public information campaign, and investigate effective means for control.

4.6 Sediment Quality

A sediment core was collected from one location in Owasco Lake during the NYSDEC synoptic survey of the Finger Lakes, which was conducted between 1997 and 1998 (Callinan 2001).[5] The core, collected off Burtis Point at a water depth of 35 m, penetrated approximately 61 cm into the lake bottom. Various chemical parameters were measured at depth horizons within the core, and radiometric dating with the isotope ^{137}Cs allowed the investigators to assign dates to the depth horizons.

The sediment accumulation rate for Owasco Lake was estimated at 0.38 cm/yr. This estimate is comparable to the finding of a sedimentation rate in Owasco Lake of 0.5 cm/yr reported in Brown et al. 2012[6]. Sediments were tested for approximately 25 organic compounds; only a few were present at detectable concentrations. In Owasco Lake, the NYSDEC only reported detectable levels of PCB congeners at the sediment depth horizon estimated to correspond to 1987. These organic compounds were detected throughout the Finger Lakes, suggesting atmospheric deposition as the source.

The results of sediment testing for inorganic compounds are summarized in Table 4-7. The NYSDEC summary of Owasco Lake sediment quality notes the following:

- Arsenic and copper levels demonstrate a slight increase over the past decades, and are above the threshold where sensitive benthic aquatic organisms may be affected
- Calcium levels in sediment have increased since the 1960s
- Nickel concentrations vary, with no trend. Some levels are above the threshold where sensitive benthic aquatic organisms may be affected
- Chromium, manganese, zinc and lead levels are variable with depth. Some measurements are above the threshold where sensitive benthic aquatic organisms may be affected

Table 4-7. Summary of Results of NYSDEC Sediment Sampling Program, 1997–1998 (Source: Callinan 2001)

Inorganic Chemical	Peak Concentration , parts per million (ppm)	Depth Horizon and Estimated Date of Peak Concentration
Arsenic	14 ppm	3-4 cm; 1987
Cadmium	Below detection	Not applicable
Calcium	90,200 ppm	3-4 cm; 1987
Chromium	52 ppm	12-13 cm; 1964
Copper	44 ppm	0-1 cm; 1995
Lead	73 ppm	12-13 cm; 1965
Manganese	3630 ppm	0-1 cm; 1995
Mercury	Below detection	Not applicable
Nickel	66 ppm	12-13 cm; 1964
Zinc	180 ppm	15-16 cm; 1957

Source: Callinan 2001[2]

4.7 Lake Level Management

The outflow of water from Owasco Lake, and thus the lake level, is controlled by the operation of the State Dam, which is located 7,500 feet downstream of the lake outlet. The dam structure is comprised of five lift gates and a taintor gate along the west bank of the outlet channel. The City of Auburn is responsible for operation of the dam and maintaining the lake level, under a set of operating conditions known as the Owasco Lake rule curve. Lake level management throughout the Seneca-Oswego-Oneida basin is coordinated by a series of rule curves to provide protection from flooding while maintaining adequate water levels and flows for the multitude of users and interests; these interests include water supply, navigation, fish and wildlife habitat, recreational use, power generation, and assimilation of treated wastewater.

The current Owasco Lake rule curve (Figure 4-8) was formalized in 1984 by the U.S. Army Corps of Engineers (USACOE) following a systematic analysis of the effect of seasonal water levels on the lake's capacity to support and balance these multiple uses (USACOE 1984)[7]. Currently, lake levels are managed seasonally, higher during the summer recreational period and lower in the winter to provide storage capacity for spring rains and snow melt. The lake level is to be maintained at 713 feet above mean sea level (AMSL) from May through September. The elevation is then dropped sharply during October to a level of 710 feet and maintained at this level during the months of November-February. Beginning on

March 1, the outlet dam is managed to bring the lake level back up to summer conditions (713 feet) by May 1. There is a provision to allow a lower winter water level (to 708 feet) during years with a substantial snowpack when spring runoff conditions are projected to be high and there is an elevated risk of flooding.

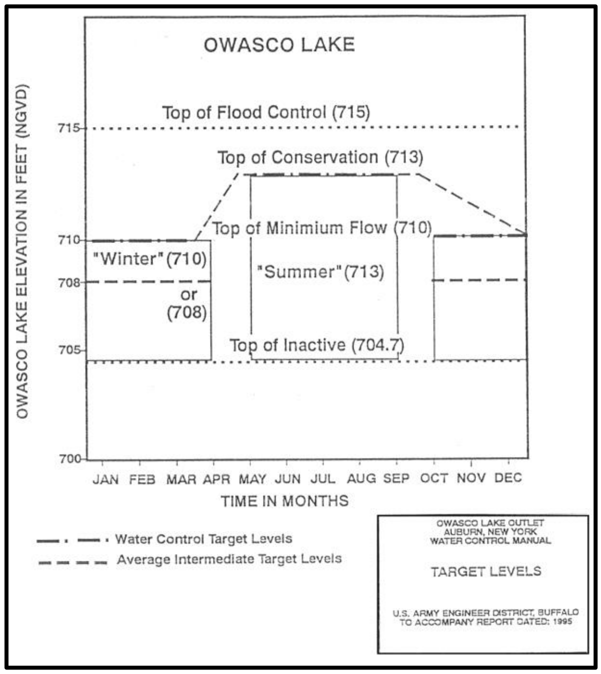


Figure 4-8. Rule Curve Governing Owasco Lake Water Level Management

The rule curve was adopted based on an understanding of the environmental and cultural conditions at that time. The USACOE considered that many shoreline residents draw water from the lake for their domestic supply, and that these lines would be vulnerable to freezing if water levels fell below 709 feet during the winter. Based on a 1984 survey of docks and boat launches (public and private) and boats, the USACOE established a summer water level of 713 feet as the elevation that would optimize this recreational use and economic benefit. A minimum discharge of 30 cfs must be maintained in the lake outlet to provide assimilative capacity for treated wastewater (60 cfs during the month of June). The requirements of the fish community were considered as well. Lake trout spawn in early November in the littoral zone. A drawdown of more than one foot following spawning would place the viability of the eggs of this important fishery at risk of desiccation. Another game fish, the northern pike, spawns in the spring in the wetlands associated with the Owasco Inlet. Water levels must reach 712 feet by March 21st in order to inundate the spawning grounds; this water level should be maintained for about six weeks.

In recent years, the Cayuga County Water Quality Management Agency (WQMA) has expressed their reservations regarding the rule curve to the USACOE and NYSDEC and requested a reanalysis, stating that water quality considerations may support a policy of lower target water levels during the summer. The NYSDEC is responsible for ongoing maintenance of federal flood control works. Four points of consideration have been brought forward by the WQMA:

- A lower lake water level would improve the performance of shoreline onsite wastewater disposal (septic systems) by providing additional separation distance between the leach field and the water table;
- A lower lake level would reduce shoreline erosion and the resulting flux of sediments and sediment-borne phosphorus into the lake;
- Hydrodynamic modeling analysis of the lake's northern basin (Owens 2004[8]) indicated that additional water release through the outlet could improve circulation at the Emerson Park beaches and thus reduce the risk of elevated bacteria counts that may limit recreational usage.
- A lower lake level in the winter would reduce the Asian clam population and may also provide control of certain susceptible species of nuisance macrophytes.

At a meeting in October 2013 with the USACOE and NYSDEC, Cayuga County representatives were informed that the cost of a detailed analysis would be borne locally. Moreover, the USACOE would require reimbursement of its costs to review the submittal (at an estimated cost of $100,000).

4.8 Summary of Changes in Owasco Lake Since 2000

A major change in the state of Owasco Lake since 2000 is its regulatory status as an impaired waterbody. In December 2014 NYSDEC updated the Owasco Lake Priority Waterbodies List assessment to include a designation as impaired by excessive phosphorus. The justification offered includes the increased observation of cyanobacteria, the occasional exceedances of disinfection byproducts in water supplies purchased from the City of Auburn, and the use of activated carbon to control taste and odor at the two water treatment plants. In addition, runoff of liquid manure in the winter of 2014 was noted as a contributing factor. However, phosphorus and chlorophyll-*a* concentrations in Owasco Lake continue to comply with existing and proposed numerical criteria to protect its designated use for water supply and recreation.

Owasco Lake continues to exhibit a low to moderate level of primary productivity, consistent with its designation as an oligo-mesotrophic lake. Water quality conditions are variable and respond to external loading conditions, which are greatly affected by weather. The lake's littoral zone supports a diverse community of macrophytes, with widespread presence of two invasive species—Eurasian watermilfoil and curly-leafed pondweed—in the assemblage. The 2010 discovery of a new invasive species, the Asian clam, in the lake's northern basin is a potentially significant factor affecting water quality and habitat conditions. In 2011, hydrilla was confirmed present in neighboring Cayuga Lake; this invasive macrophyte species has the potential to severely degrade the lake ecosystem. The response to the detection of hydrilla has been aggressive, with application of herbicides, extensive monitoring, and a massive public outreach campaign.

Microbiological monitoring occurs each summer. Overall, bacterial counts in lake and stream samples appear to be in decline, as indicated by the percent of samples that exceed a NYSDOH limit of 1000 cells of fecal coliform bacteria per 100 ml of water. However, fecal coliform data are known to be highly variable. Changes in the analytical laboratories further complicate an ability to draw conclusions.

Notes

[1] NYSDEC. December 2014. Waterbody Inventory for Seneca River (Lower) Watershed. http://www.dec.ny.gov/docs/water_pdf/pwlorflsenl.pdf.

[2] USEPA. 1974. “National Eutrophication Survey Methods for Lakes Sampled in 1972.” Working Paper No. 1. EPA Office of Research and Development, Washington, DC 20460, 40 pp.

[3] Halfman, J.D., G. Moralez, K. Coughlin and N. Andrzejczyk. December 2014. *Owasco Lake, NY: Water Quality and Nutrient Sources, 2014 Findings*. Finger Lakes Institute, Geneva NY.

[4] Gilman, B. A., J. C. Foust and Bin Zhu. 2008. *Composition, Seasonal Standing Crop Biomass and Estimated Annual Productivity of Macrophyte Communities in Owasco Lake*. Report to the Finger Lakes Institute.

[5] Callinan, C. E. 2001. *Water Quality Study of the Finger Lakes*. NYSDEC, Albany, NY. 147 pp. http://www.dec.ny.gov/lands/25576.html

[6] Brown, M., T. Curtin, C. Gallagher and J. Halfman. 2012. “Historic Nutrient Loading and Recent Species Invasions Caused Shifts in Water Quality and Zooplankton Demography in Two Finger Lakes (New York, USA).” *J. Paleolimnol.* 48:623-639.

[7] U.S. Army Corps of Engineers. 1984. *Oswego Basin NY Management Plan Analysis.* Owasco Lake, NY (Final Feasibility Report). 136 pp.

[8] Owens, E. 2004. *Application of a Hydrodynamic Model Related to Coliform Contamination of Beaches in Emerson Park.* Report prepared for Cayuga County, NY. 56 pp.

Chapter 5: Current Restoration and Protection Efforts

5.1 Introduction

The many stakeholders actively working to restore and protect the Owasco Lake watershed have made substantial progress with implementing the recommendations set forth in the 2001 *Owasco Lake Watershed Management Plan*. Several ongoing initiatives and projects designed to reduce nonpoint sources of pollution are described in this chapter. These projects illustrate the extent of institutional collaboration that has been fostered through the efforts of Cayuga County agencies and their partners.

5.2 Streambank Restoration and Protection Projects

In 2004, the Cayuga County SWCD received a $750,000 grant from the Great Lakes Coastal Restoration Program to implement stream restoration measures along the Owasco Inlet at priority sites that were identified during a 2002 field survey. The Cayuga County SWCD partnered with Tompkins County SWCD to implement natural streambank protection and fluvial geomorphological practices along a two-mile stretch in Groton and Locke north and south of the County Line. Additional funds in 2007 from the NYS Department of State and the federal Environmental Protection Agency supported installation of five in-stream rock vanes in the Owasco Inlet in the Town of Locke south of Booth Road. Other improvements to this stream segment included alterations to the bank slope and installation of riparian buffers. In 2012, the Cayuga County SWCD installed riprap and vegetative plantings and reshaped a gravel bar at a priority site on Booth Road in the Town of Locke.

Owasco Inlet before stream stabilization (2007)

Owasco Inlet after stream stabilization (2007)

The Veness, Sucker and Dutch Hollow Brook management plans, discussed in Chapter 3, provided a foundation for requesting implantation funds for recommended remedial projects. New York State funding supported phased streambank stabilization projects along Veness Brook and Sucker Brook. The phased project included planning, design, construction, and planting vegetation along eroding stream segments. Restoration techniques integrated natural streambank stabilization and "soft" structural practices where possible, and hard armoring where necessary. The overall objective was to improve water quality, reduce erosion and turbidity, and improve and restore aquatic and streambank habitat. Funding included two awards from the competitive Nonpoint Source Abatement and Control—Water Quality Improvement Program; and the Finger Lakes-Lake Ontario Watershed Protection Alliance (FLLOWPA).

Additional work was conducted on Sucker Brook using Cayuga County FLLOWPA funds. This work included completing deferred maintenance of a sedimentation pond that had reached 40% capacity, reconstruction of a retaining wall, and streambank stabilization using a combination of stone and vegetation.

Critical sections of Dutch Hollow Brook have also been stabilized over the past decade, with grant funds from the Great Lakes Basin Program. Dutch Hollow was identified as a priority due to its inclusion on the Priority Waterbodies List as a significant source of sediment to Owasco Lake, its proximity to the public water supply intakes, and the degradation of aquatic habitat. Various best management practices (BMPs) suitable for specific stream reaches were identified, using the principles of fluvial geomorphology. The final installed BMPs included in-stream rock structures (cross vanes and J-hooks), erosion control blankets, and vegetative plantings.

The stream restoration efforts along Dutch Hollow Brook were boosted in early 2014, when New York State Senator James L. Seward (51st District) announced an award of $200,000 for implementation of BMPs in this subwatershed. The award will support a collaborative effort that includes municipalities, farmers, and landowners. A "before and after" stream monitoring program is in place to document the effectiveness of the selected BMPs on reducing sediment flux.

5.3 Lakeshore and Lake Restoration and Protection Projects

As recommended in the 2001 *Owasco Lake Watershed Management Plan*, a portion of the southern end of Owasco Lake was dredged parallel to the shoreline. This project, completed in 2005, removed approximately 6,000 cubic yards of accumulated sediment, along with the associated nutrients and pathogens present in the material. The project improved navigational access and fish habitat in addition to its water quality benefits.

Multiple projects have been conducted in Emerson Park at the northern end of the lake. Cayuga County FLLOWPA funds were utilized to stabilize the lake shoreline in the region of the sailboat launch. Stone rip-rap was installed in this area of Emerson Park to address the problem of continuing wintertime erosion from ice scour. The sediment and nutrients from this erosion affected the water quality in the north end of Owasco Lake. The east bank of the Owasco Outlet was also stabilized through the replacement of a failing concrete wall with rip-rap.

Stormwater runoff from Emerson Park is another important issue that has been addressed to protect the lake. In 2006, Cayuga County converted a single deep pond created in the 1970's for sediment control that into a three bay sediment pond. In 2014, FLLOWPA funds were used to further enhance the effectiveness of the sediment pond; the third bay was converted into a sand filter and mycillin plugs were added in an effort to reduce bacteria entering Owasco Lake. Another stormwater management project was completed in 2011, when a 0.25 acre bioretention basin was constructed adjacent to the Emerson Park Pavilion to collect and filter stormwater runoff generated from the pavilion and surrounding area.

Owasco Lake at Emerson Park, before bank stabilization

Owasco Lake at Emerson Park, after bank stabilization

5.4 Agricultural Best Management Practices

The Cayuga County Soil and Water Conservation District (CCSWCD) is actively working with landowners to plan, design, construct, and monitor all types of BMPs designed to reduce the loss of sediment, nutrients, and other materials from the landscape. In partnership with the federal Natural Resources Conservation Service (NRCS), the CCSWCD directs a majority of its resources to reducing nonpoint source pollution from agriculture, which is the dominant watershed land use.

The Agricultural Environmental Management (AEM) program is a major program to direct the resources of CCSWCD and NRCS toward reducing agricultural nonpoint source pollution. AEM is a voluntary, incentive-based program that provides the information and technical support needed to make practical and science-based decisions that will conserve soil and water resources. The program is designed to assist agricultural producers with developing and implementing comprehensive farm plans. The AEM program has five tiers:

Tier 1 – Inventory current activities, future plans and potential environmental concerns.
Tier 2 – Document current land stewardship; assess and prioritize areas of concern.
Tier 3 – Develop conservation plans addressing concerns and opportunities tailored to farm goals.
Tier 4 – Implement plans utilizing available financial, educational and technical assistance.
Tier 5 – Evaluate to ensure the protection of the environment and farm viability.

To date, 133 farms have completed Tier 1 of the program, representing two-thirds of the approximately 200 farms in the Owasco Lake watershed, and 55 farms have implemented their tailored farm conservation plans (Table 5-1).

Table 5-1. Farms in the Owasco Lake Watershed that Have Completed Agricultural Environmental Management Tiers

AEM Planning Level	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Number of watershed farms	**133**	**100**	**60**	**55**	**42**

Grants from the Agricultural Nonpoint Source Abatement and Control Program have supported barnyard improvements, runoff management, fencing to exclude cattle from streams, prescribed grazing, erosion control measures, cover crops, terracing, and other measures. Member item awards through the NYS Legislature have also enabled the implementation of BMPs on lands within the Owasco Lake watershed. A summary of practices implemented within the watershed since the completion of the 2001 *Owasco Lake Watershed Management Plan* is included as Table 5-2. The practice standard references are included in parentheses.

Table 5-2. Summary of Best Management Practices Installed in the Owasco Lake watershed

BMPs Installed	Definition	Purpose
Sediment & Control Structure (NRCS 350)	A basin constructed with an engineered outlet, formed by an embankment or excavation or a combination of the two.	Capture and detain sediment laden runoff, or other debris for a sufficient length of time to allow it to settle out in the basin.
Fluvial Geomorphology (NRCS 580)	A stream restoration approach that uses the principles of natural river design to stabilize and protect waterways (including banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries).	Prevent the loss of land or damage to land uses, or facilities adjacent waterways, including the protection of known historical, archeological, and traditional cultural properties.
Dredging of Owasco Inlet	Remove accumulated sediment by mechanical means.	Improve recreational access and navigation.
Prescribed Grazing (NRCS 528)	Manage the harvest of vegetation with grazing and/or browsing animals.	Protect surface and/or subsurface water quality and quantity, reduce soil erosion, and maintain or improve soil condition. Also, improve or maintain the quantity and quality of forage.
Secondary Fuel Containment (NRCS 701)	Above-ground structures designed to provide storage, or storage and secondary containment of on-farm fuel.	Minimize the risk of accidental release of stored fuels, used in agricultural operations, into ground and surface waters.
Animal Trail & Access (NRCS 575)	Established lanes or travel ways that facilitate animal movement	Provide or improve access to forage, water, working/handling facilities, and/or shelter.
Forage & Biomass Planting (NRCS 512)	Establishing adapted and/or compatible species, varieties, or cultivars of herbaceous species suitable for pasture, hay, or biomass production.	Provide or increase forage supply during periods of low forage production.
Roof Runoff Structure (NRCS 558)	Structures that collect, control, and transport precipitation from roofs.	Direct precipitation away from barnyards, manure storage areas, or other critical areas.
Farm Ditch Cleanout	Maintenance to ensure that ditches are in good condition and maintain capacity to convey flows.	Improve water quality, reduce soil erosion, increase infiltration, protect structures, and/or increase water quantity.
Critical Area Planting (NRCS 342)	Establish permanent vegetation on sites that have, or are expected to have, high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices.	Reduce erosion by stabilizing critical areas.

BMPs Installed	Definition	Purpose
Cover Crops (NRCS 340)	Vegetation including grasses, legumes and forbs that are planted for annual cover and other conservation purposes.	Reduce erosion by wind and water.
Stormwater Runoff Control (NRCS 570)	Measures to control the quantity and quality of stormwater runoff from disturbed lands.	Minimize erosion and sedimentation during and following construction activities.
Riparian Herbaceous Cover (NRCS 390)	Grasses, sedges, rushes, ferns, legumes, and forbs tolerant of intermittent flooding or saturated soils, established or managed as the dominant vegetation in the transitional zone between upland and aquatic habitats.	Improve and maintain water quality.
Waste Storage (NRCS 313)	A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure.	Provide capacity to store (on a temporary basis) wastes such as manure, wastewater, and contaminated runoff, as part of an overall waste management system.
Nutrient Management (NRCS 590)	Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.	Minimize agricultural nonpoint source pollution of surface and groundwater resources.

SOURCE: This list was provided by Cayuga County SWCD and is current as of April 2015.

The total investment in agricultural BMPs within the Owasco Lake watershed since 2001 is over 6.6 million dollars. These funds have come from state and federal sources. The publically-funded share has been augmented with funds and/or labor from the affected landowners.

- Ag. Nonpoint State Funds **$3,252,906.00**
- Environmental Protection Agency Funds **$1,021,062.00**
- NRCS federal funds (EQIP, CSP) **$2,397,721.00**
- Total Funds Allocated to Owasco Lake Watershed **$6,671,689.00**

5.5 Farmland and Open-Space Conservation Initiatives

Recognizing that the land base for agriculture is a critical and irreplaceable resource, the New York State Department of Agriculture and Markets (NYSDAM) promotes programs to help farmers keep their lands in production. The NYSDAM oversees Agricultural Districts and the Agricultural and Farmland Protection Program (AFPP). There are two primary grant programs associated with the state's AFPP, Farmland Protection Planning Grants and Farmland Protection Implementation Grants. These programs provide matching grants to counties and municipalities to promote local initiatives for agricultural and farmland protection. The grants provide funding to develop county and municipal farmland protection plans (such as the 2014 *Cayuga County Agriculture and Farmland Protection Plan*) and assistance payments to purchase development rights on farmland. By helping to protect farmland from conversion to non-farm uses, important water quality benefits typically derived from an open space landscape are retained.

The purchase of development rights (PDR) programs are targeted toward protecting the highest quality agricultural lands, those with prime soils and well-managed farming enterprises, and those which are most vulnerable to conversion to non-agricultural uses. The PDR is a voluntary legal agreement or conservation easement that restricts all future non-farm development while encouraging farming, forestry, and other land uses that are compatible with agriculture. Lands remain in private ownership and on the tax rolls.

Since 2001, Cayuga County has secured funds, and helped towns secure funds, to protect a total of 7,232 acres in the Towns of Fleming, Scipio, Springport and Aurelius. Seven farms are protected by permanent conservation easements that are currently held, monitored, and enforced by land trusts including the American Farmland Trust and the New York Agricultural Land Trust. Several hundred additional acres are currently under consideration for protection (Map 5-1).

According to the Cayuga County Department of Planning & Economic Development, the success of the Cayuga County program is attributed to the strong partnerships that have been developed among the farming community, land trusts such as the American Farmland Trust and the New York Agricultural Land Trust, and the state and federal funding partners.

The Finger Lakes Land Trust is also active in the Owasco Lake watershed, helping landowners find conservation strategies and funding for ecologically significant parcels. The Trust purchased 2000 feet of frontage along the Owasco Inlet in the Owasco Flats area and has conducted habitat restoration; in addition, they assisted the Owasco Flats Nature Reserve in purchasing a parcel on the northern end of the Owasco Flats.

The 2014 update of the New York State Open Space Conservation Plan cites the Finger Lakes Shorelines and Riparian Zones as regional priority conservation areas within NYSDEC Regions 7 and 8. This priority area encompasses the Owasco Flats, which is described as a 2,000-acre region along Owasco Inlet with opportunities for acquisitions or cooperative management agreements.

5.6 Lake and Watershed Monitoring

As discussed in Chapters 3 and 4, multiple agencies and organizations monitor the quality of Owasco Lake and its tributary streams for a variety of reasons (Table 5-3).

Table 5-3. Summary of Lake and Watershed Monitoring Programs

Entity	Objective	Program Design and Timing	Reporting
Finger Lakes Institute/HWS/ Cayuga County	Trophic state assessment, external load estimates	Varies each year; lake monitoring during summer recreational period, stream monitoring may extend from spring to fall	Annual report, public presentations
Water purveyors	Compliance with drinking water standards	As required by NYSDOH (year-round)	Annual report, notifications to users
Wastewater treatment facilities	Compliance with limits (mass load and/or concentration) per discharge permit	As required by NYSDOH (year-round)	Monthly Discharge Monitoring Reports (DMR)
OWLA/ Cayuga County	Surveillance	Bacteria counts, lake and streams (recreational season)	Annual report
Cayuga County Health Dept.	Compliance w/ bathing beach standards	Public bathing beaches (recreational season)	Per request
SWCD and partners	Monitor the effectiveness of installed BMPs	Site-specific. Before and after loading estimates (year-round)	Summarized in annual District report (data on request)
NYSDEC	Evaluate whether surface waters support their designated uses	Every 5 years during Rotating Integrated Basin Surveys (variable, spring-fall)	Inform the state Priority Waterbodies List and other programs
USGS	Evaluate groundwater quality (organic, inorganic, radiological)	Every 5 years – private and public wells (variable, spring-fall)	Data and reports on-line at USGS
USGS/Cayuga County Planning	Water stage recorder on Owasco Inlet near Moravia	Discharge and gauge height (year-round)	Data and reports on-line at USGS
USGS/City of Auburn	Water stage recorder on Owasco Outlet and Owasco Lake near Auburn	Discharge and gauge height at the Owasco Outlet. Water surface elevation for the Owasco Lake gauge. (year-round for both)	Data and reports on-line at USGS

5.7 Waterfront and Parks

5.7.1 Emerson Park Updated Master Plan

Emerson Park, located at the northern end of Owasco Lake, is the principal public lake access point. The 135-acre parcel has been in public use since the 1880s and has been owned by Cayuga County since the 1940s. Many attractions have come and gone over the years. Current amenities include two swimming beaches, boat launches, picnic sites, canoe and kayak rentals, a disc golf course, baseball fields, the Merry-Go-Round Theater, a large pavilion, rest rooms, parking lots, an agricultural museum, paths and trails, and smaller shelters. In March 2015, Cayuga County Department of Planning & Economic Development and the Cayuga County Parks Commission released the draft update of the Emerson Park

Master Plan; this document provides a framework for evaluating how future proposals for improvements and new amenities fit into the community's vision for the park.

The steering committee began by framing a goal to guide the development of the Master Plan:

> *The Major Goal of the 2015 Master Plan is to deliver cost effective year-round park and recreation facilities and programs at Emerson Park that are attractive, well maintained, accessible, protective of natural resources, respectful of the park's cultural history, and continue to provide memorable experiences for visitors of all ages from both inside and outside Cayuga County for many years to come.*

A robust public outreach and engagement process took place over the summer of 2014, with more than 125 respondents describing what changes and improvements to Emerson Park they would like to see. The steering committee sorted through all the comments and suggestions, and categorized them into five themes to help inform decisions on programs and projects.

- Establish a design-focused approach to project development;
- Provide programming and marketing support for park programs and amenities;
- Establish and model environmentally-sound design, practice, and education;
- Address infrastructure and capital planning needs; and
- Incorporate public art, amenities and outdoor furniture.

The initial round of priority projects reflect the overarching goals of encouraging active recreation for all ages, enhancing the natural resources of the park, and respecting the cultural heritage of this unique community asset.

5.7.2 Owasco Flats Nature Reserve

Owasco Flats Nature Reserve is located at the southwest corner of Owasco Lake and includes an 86-acre property jointly owned by Cayuga County and the City of Auburn and a 17-acre parcel purchased by the Owasco Flats Nature Reserve, Inc. The site includes a boat launch and trails.

The Owasco Flats Nature Reserve Inc. has installed a handicapped-accessible parking area, boardwalk and fishing platform, upgraded the trail system, and installed water control structures to restore the wetlands. They have also worked on removing invasive species in the Owasco Flats and the Lake.

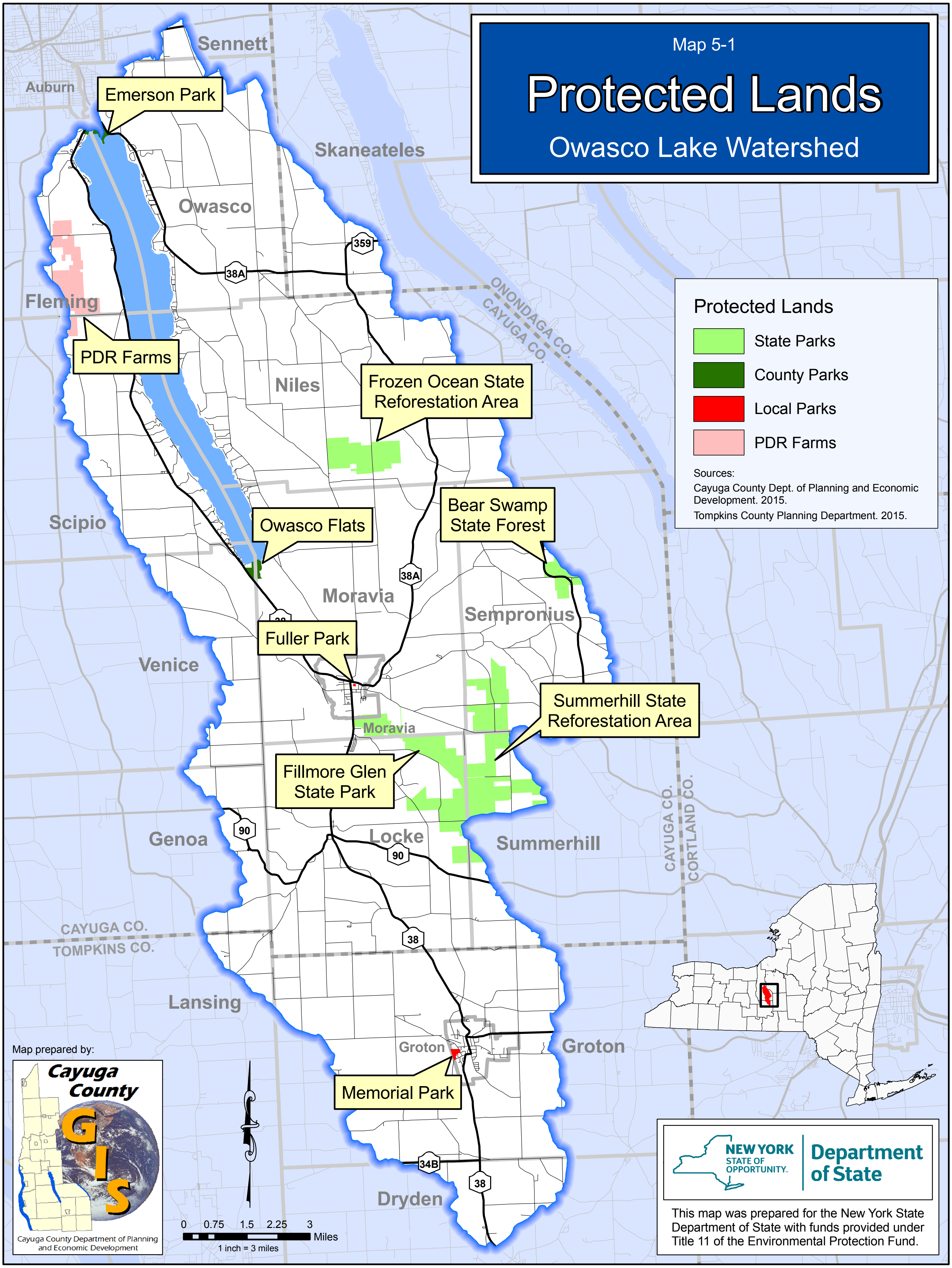
5.7.3 Owasco Flats Wildlife Management Area

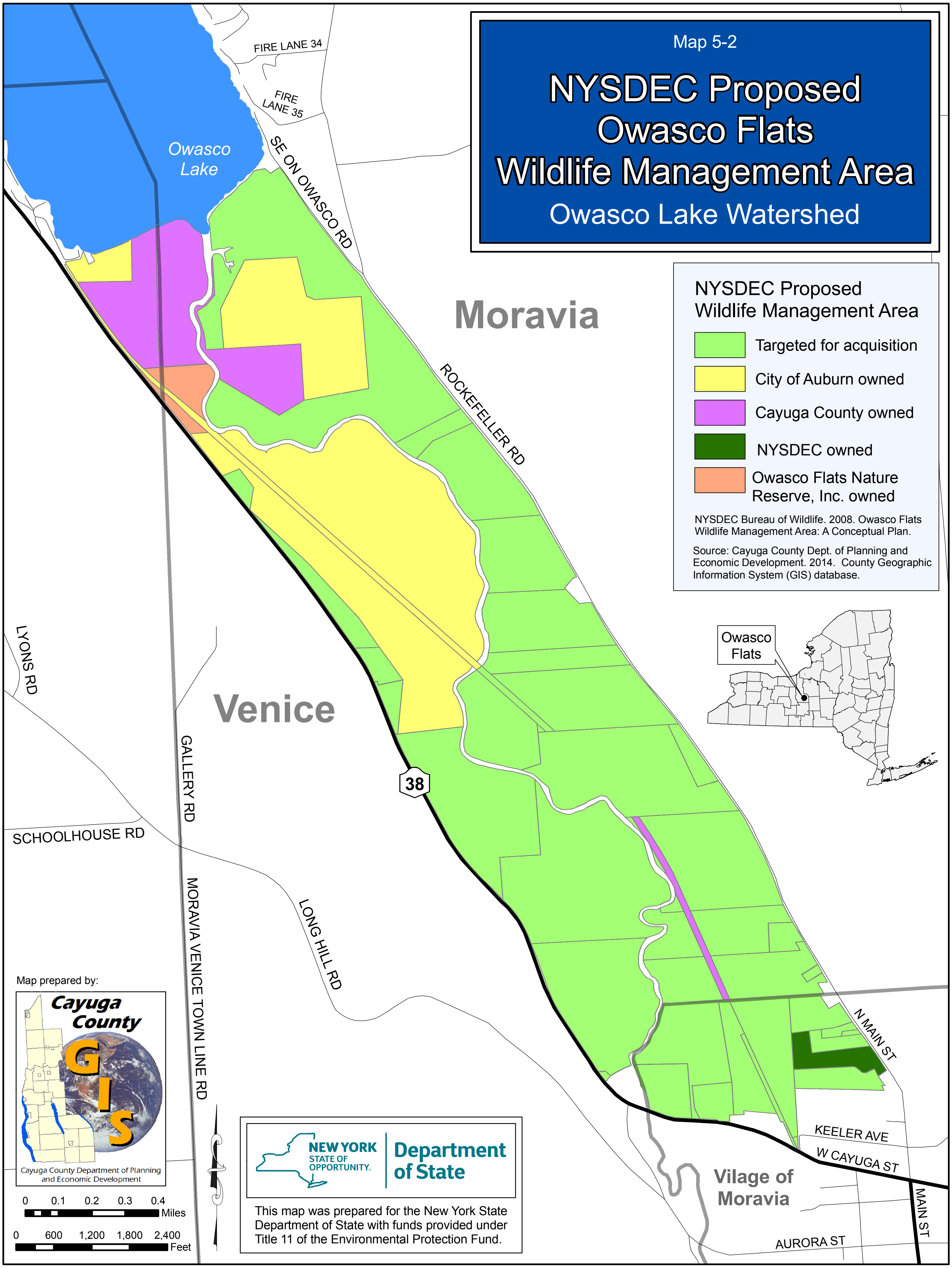
In 2008, NYSDEC released a conceptual management plan for the Owasco Flats Wildlife Management Area. The Owasco Flats Wildlife Management Area encompasses 1500 acres at the southern end of Owasco Lake within Cayuga County. At present, the landscape is a patchwork of croplands, fallow fields, emergent marsh and wetlands. The Owasco Inlet flows through on its path north to the lake. The Owasco Flats region is used for recreation, including fishing, hunting and trapping, birdwatching, paddling, and winter snowshoeing and cross-county skiing. The Owasco Flats is home to a diverse assemblage of plants and animals, as summarized in section 2.7.

The water quality monitoring data collected by Professor Halfman and others demonstrate that the Owasco Inlet is a major source of sediment and particulate phosphorus to the lake. The data are reinforced by seeing the sediment plumes that flow into the lake through the Inlet during high flow periods. Thus, protection of the Owasco Flats area will accrue multiple benefits to the ecosystem, including humans.

The NYSDEC intends to acquire lands on the flats and consolidate the parcels into a Wildlife Management Area (WMA), as displayed in Map 5-2. Acquisition will be only from willing sellers and, by law, must be at fair market value. Eleven acres were acquired in 2011.

Cayuga County has received $712,500 in funds from the New York State Environmental Facilities Corporation's Green Innovation Grant Program for the Owasco Flats Wetland Restoration and Riparian Buffers Initiative. This project will be located on City of Auburn-owned land off Route 38 in the Town of Moravia. The Owasco Inlet will be reconnected with its floodplain with water control structures so that during high flow events water will flow into created and existing wetlands to filter out nutrients and sediment. The created wetlands will be similar to natural vernal pools; these wet areas retain standing water for a week or two after storm events. These ephemeral pools are good habitat for amphibian reproduction and will limit predatory fish species, nesting waterfowl, and mosquitoes. The restoration project also includes adding riparian buffers along the Owasco Inlet and associated drainage ways to help retain nutrients and sediment. Overall, the project will reduce phosphorus and sediment inputs to Owasco Lake while improving habitat for invertebrates, reptiles, amphibians, and birds.


Map 5-1
Protected Lands
Owasco Lake Watershed
Protected Lands
State Parks
County Parks
Local Parks
PDR Farms
Sources:
Cayuga County Dept. of Planning and Economic Development. 2015.
Tompkins County Planning Department. 2015.
Emerson Park
PDR Farms
Frozen Ocean State Reforestation Area
Owasco Flats
Bear Swamp State Forest
Fuller Park
Summerhill State Reforestation Area
Fillmore Glen State Park
Memorial Park
Sennett
Auburn
Skaneateles
Owasco
Fleming
Niles
Scipio
Moravia
Sempronius
Venice
Genoa
Locke
Summerhill
Lansing
Groton
Dryden
ONONDAGA CO.
CAYUGA CO.
CAYUGA CO.
CORTLAND CO.
CAYUGA CO.
TOMPKINS CO.
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.75 1.5 2.25 3 Miles
1 inch = 3 miles
NEW YORK STATE OF OPPORTUNITY.
Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.


Map 5-2
NYSDEC Proposed Owasco Flats Wildlife Management Area
Owasco Lake Watershed
NYSDEC Proposed Wildlife Management Area
Targeted for acquisition
City of Auburn owned
Cayuga County owned
NYSDEC owned
Owasco Flats Nature Reserve, Inc. owned
NYSDEC Bureau of Wildlife. 2008. Owasco Flats Wildlife Management Area: A Conceptual Plan.
Source: Cayuga County Dept. of Planning and Economic Development. 2014. County Geographic Information System (GIS) database.
Owasco Flats
Owasco Lake
FIRE LANE 34
FIRE LANE 35
SE ON OWASCO RD
Moravia
ROCKEFELLER RD
Venice
LYONS RD
GALLERY RD
38
SCHOOLHOUSE RD
MORAVIA VENICE TOWN LINE RD
LONG HILL RD
N MAIN ST
KEELER AVE
W CAYUGA ST
MAIN ST
AURORA ST
Vilage of Moravia
Map prepared by:
Cayuga County GIS
Cayuga County Department of Planning and Economic Development
0 0.1 0.2 0.3 0.4 Miles
0 600 1,200 1,800 2,400 Feet
NEW YORK STATE OF OPPORTUNITY. Department of State
This map was prepared for the New York State Department of State with funds provided under Title 11 of the Environmental Protection Fund.

Chapter 6: Emerging Issues

6.1 Introduction

An impressive amount of data is available to characterize the state of Owasco Lake and its watershed. While some indicators of progress are positive, particularly the strong institutional capacity dedicated to water resources management, there are other signs that Owasco Lake is trending toward a less stable condition. Changes in agricultural practices have led to more animals and more cultivated lands in the watershed. Episodes of intense rainfall carry phosphorus, both dissolved and particulate, and other pollutants from the landscape to the lake. Invasive species pose a threat to aquatic habitat, nutrient cycling, and the lake's capacity to fully support its designated uses for recreation and water supply. Cyanobacterial blooms have become increasingly problematic for many lakes in New York, and Owasco Lake has not escaped this potentially serious threat to public health. Influencing the severity of all of these issues to various degrees is the reality of climate change. Warmer weather and more variable precipitation complicate our ability to manage lakes and watersheds.

The four emerging issues: agronomic practices, invasive species, cyanobacteria, and climate change adaptation are the focus of research and public education efforts across the Finger Lakes. Knowledge developed through these collaborative efforts will, to a large extent, guide the recommended actions that form the *Owasco Lake Watershed Management Plan*. Clearly, each of these emerging issues requires actions far beyond the boundaries of the Owasco Lake watershed.

6.2 Agronomic Practices

Because Owasco Lake is a phosphorus-limited system, the external loading of this essential nutrient to the lake is a determinant of its primary productivity. Excessive phosphorus will promote the growth of phytoplankton, as described in Chapter 4. Agricultural nonpoint source pollution contributes to phosphorus loading to Owasco Lake; consequently, managing this source is a key goal for protecting the future designated uses of the lake for water supply and recreation.

There are extensive federal, state and county resources dedicated to helping agricultural producers minimize the potential for adverse environmental impacts of their operations. The Natural Resources Conservation Service (an agency of the USDA) is responsible for developing a series of standards that are designed to incorporate best practices for agricultural producers across the country. Each state is required to review and may supplement the applicable national practice standards to ensure that they meet state and local criteria or regulations that may be more restrictive. The standards are reviewed and updated every five years. NRCS practice standard 590, which was last updated in 2012, addresses nutrient management: managing the amount (rate), source, placement (method of application), and timing of nutrients and soil amendments. The standard applies to small grains, row crops, orchards and vineyards farmed with conventional fertilizers as well as applied with organics including manure.

In New York, state policy requires that the NRCS standard 590 for nutrient management be implemented on all consolidated animal feeding operation (CAFO) farms as well as any animal feeding operation (AFO) receiving state or federal cost share funds for manure storage and other related practices. To comply with standard 590, each regulated farm is required to have a comprehensive nutrient management plan (CNMP) that addresses fertilizers and manure, and includes testing of all fields to measure the soil phosphorus levels and assess the risk of runoff. The New York Phosphorus Index (NY-PI) was developed by Cornell University to aid farmers in ranking their fields with respect to the relative risk of P runoff, as required to meet the NRCS 590 standard. In addition, the NY-PI provides a rational foundation for requiring reduction or elimination of P application to fields where runoff risk is substantial and soil test P levels exceed the agronomic optimum range.[1] The index is site-specific and science-based, and has been effective in reducing fertilizer application rates, while maintaining dairy profitability.

If a significant portion of fields have very high NY-PI ratings, the CNMP must document:

- the soil phosphorus levels at which it is desirable to convert to phosphorus-based planning;
- the potential plan for soil test phosphorus drawdown from the production and harvesting of crops;
- management activities or techniques used to reduce the potential for phosphorus transport and loss;
- for livestock farms with manure, a quantification of manure produced in excess of crop nutrient requirements; and
- a long-term strategy and proposed implementation timeline for reducing soil P to levels that protect water quality.

Each field is further required to have a calculated New York Nitrate Leaching Index (NY-NLI), designed to assess and manage the risk of nitrate leaching below the root zone. Finally, the CNMP must address field-specific management techniques that will keep average annual soil erosion rate at or below the estimated soil formation rate. Landowners are required to manage erosion from gullies and rivulets within the fields.[2]

New York producers are supported in their efforts to comply with the requirements of their CAFO permits, including NRCS standard 590, by a collaborative network of trained professionals from Cornell University and Cornell Cooperative Extension, the SWCD, and a network of certified nutrient management planners. Funding from both the state and federal government has been essential in supporting research, training, and outreach activities. The NYSDEC has been tasked with assessing compliance with the CNMPs as part of the CAFO permits. Training of the NYSDEC inspectors is an important component.

Manure management is a topic of great local concern as well. Following a well-attended public forum in late October, 2014, two working groups have formed to help tailor recommendations for manure management to conditions specific to Cayuga County (chaired by Cayuga County planning professionals) and for the larger Finger Lakes region (chaired by Cornell University's Pro-Dairy program). Both groups are making excellent progress in fostering dialogue among representatives of the agricultural community and the resource management agencies. One possible outcome is a revised suite of recommended management actions for use in phosphorus-sensitive watersheds such as the Finger Lakes. The recommendations that emerge from these working groups will be reflected in the *Owasco Lake Watershed Management Plan*.

6.3 Invasive Species

Many invasive species have become firmly established in the Finger Lakes over the past decades, and many others threaten to join. Both aquatic and terrestrial invasive species have the potential to affect the ecosystem, altering the cycling of nutrients and energy as well as the human-centered uses of the lakes and watersheds. Several invasive species are currently in Owasco Lake, including Eurasian watermilfoil, curly-leaf pondweed (problematic in the spring) and the Asian clam, are discussed in Chapter 4. Recognizing the threat, resource management agencies have collaborated on information development and dissemination, surveillance and monitoring, and rapid response activities.

Cayuga County utilizes Finger Lakes Lake Ontario Watershed Protection Alliance funding for invasive species monitoring, education, control and prevention. This work includes the installation of invasive species disposal stations at boat launches around Owasco Lake, an invasive species kiosk at Emerson Park, Asian clam surveys and aquatic vegetation harvesting.

Cayuga, Tompkins and Onondaga Counties participate in the Finger Lakes PRISM (Partnership for Regional Invasive Species Management), an information-sharing group created by New York State to foster a regional approach to managing invasive species, both aquatic and terrestrial. This program is administered through the Finger Lakes Institute at Hobart William Smith Colleges in Geneva, NY. Cayuga County Department of Planning & Economic Development staff members are active participants in the New York State network.

In August 2011, hydrilla was discovered in Cayuga Inlet, a major tributary to Cayuga Lake. Due to its reproductive and growth habits, hydrilla is a particularly worrisome invasive plant for the Finger Lakes region and other areas of New York. The discovery of hydrilla led to enhanced commitment to prevention (including boat launch stewards to inspect boats and inform the public), monitoring and surveillance, and inter-agency coordination.

6.4 Cyanobacterial Blooms

NYSDEC and NYSDOH have been very active in responding to the increased frequency and duration of cyanobacterial blooms in recreational and water supply lakes across New York. The agencies have expanded the Citizens Statewide Lake Assessment Program (CSLAP) to encourage additional sample collection in suspected bloom areas. In addition to analyzing water samples for the presence of toxins and using microscopy to identify species, the state is working with State University of New York partners to develop additional regional laboratory capacity for analysis. NYSDEC has developed an informative website, Blue-Green Harmful Algal Blooms, to disseminate factual information on harmful algal blooms and provide weekly updates on the status of affected water bodies. Environmental scientists and engineers at NYSDEC are gathering nutrient, weather, and physical data to elucidate the underlying causes of the recent blooms, and are partnering with experts in the field. Although Owasco Lake is not part of the Citizens Statewide Lake Assessment Program, engineers and scientists from NYSDEC and SUNY are testing samples from Owasco Lake and advising the Health Department regarding risks to recreational users posed by cyanobacterial blooms.

6.5 Climate Change

To help inform New York State's response to climate change, the New York State Energy Research and Development Authority (NYSERDA) published *Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation.* This ClimAID integrated assessment, updated in 2014[3], provides decision-makers with information on the state's vulnerability to climate change, with the expectation that the information provides a foundation to develop meaningful strategies for adaptation. The report discusses a range of climate change impacts, adaptation strategies, equity, and economics affecting sectors such as water resources, coastal zones, ecosystems, agriculture, energy, transportation, telecommunications, and public health.

Future climate conditions are projected for seven distinct regions of the state. The Owasco Lake watershed is within Region 1—Western New York and the Great Lakes Plain (Table 6-1). This region, which includes all of the Finger Lakes, is forecast to experience increases in temperature and precipitation as a result of climate change. Rainfall intensity is projected to increase, as are periods of drought. Overall, extreme events will become more common. The growing season is projected to extend by a month.

Table 6-1. Projected Changes in Temperature and Precipitation Resulting from Climate Change in Region 1

Temperature Baseline (1971-2000) 47.7 °F	Low Estimate (10th Percentile)	Middle Range (25th–75th Percentile)	High Estimate (90th Percentile)
2020s	+ 1.8°F	+ 2.3 to 3.2°F	+ 4.0°F
2050s	+ 3.7°F	+ 4.3 to 6.3°F	+ 7.3°F
2080s	+ 4.2°F	+ 5.7 to 9.3°F	+ 12.0°F
2100	+ 4.6°F	+6.3 to 11.7°F	+ 13.8°F
Precipitation Baseline (1971-2000) 34 inches	**Low Estimate (10th Percentile)**	**Middle Range (25th–75th Percentile)**	**High Estimate (90th Percentile)**
2020s	0%	+2 to +7%	+ 8%
2050s	+2%	+4 to +10%	+ 12%
2080s	+1%	+4 to +13%	+ 17%
2100	-3%	+4 to +19%	+ 24%

The status of water resources depends on multiple interacting factors. With respect to climate change, increasing average air temperature, possible future changes in timing and quantity of snow, increased frequency and intensity of rainfall, longer dry periods in summer, and evaporation rates will all affect water resources. Increasing air temperatures will intensify the water cycle by driving increased evaporation and precipitation, resulting in heavier rainfall events with longer dry periods in between. Heavier downpours increase localized flash flooding and erosion, which will potentially transport more pollutants to waterbodies. Water temperature increases along with air temperature. Higher water temperatures will have direct impacts on certain elements of water quality such as dissolved oxygen content and the toxicity of ammonia-N to sensitive aquatic organisms.

Warming conditions and changes in precipitation patterns will affect the ecosystem balance of New York State. The ClimAID report identified major ecosystem vulnerabilities for New York, including widespread shifts in species composition of natural landscapes and favored expansion of some invasive species such as kudzu and hemlock wooly adelgid. Coldwater fisheries will be negatively impacted by warmer water temperatures, unless the waterbody is sufficiently deep or shaded to keep the water cooler. Lakes, streams, inland wetlands, and associated aquatic species will be highly vulnerable to changes in the timing, supply, and intensity of rainfall and snowmelt, groundwater recharge, and duration of ice cover.

Climate change will likely have a direct impact on crops, livestock, and pests, as well as an indirect impact on New York State's economy. These impacts will include both challenges and opportunities as farmers adjust to a longer growing season and warmer temperatures. The projected impacts on agriculture include increased risk of summer drought and increased frequency of heavy rainfall events. New York is likely to remain relatively water-rich as compared with other agricultural regions.

The warmer annual air temperatures will increase water temperatures. With the potential for increased nutrient loading from the watershed as a result of expanding agriculture and changes in precipitation patterns, algal blooms may become more common in the warmer lake waters. The warmer waters of the lake will continue to sustain the productive warmwater fishery for sportfish and panfish, though eventually coldwater fisheries may decline as their habitat is restricted. Warmer waters may also adversely affect native species of plants and animals, while creating more suitable conditions for non-native species originating from warmer climates, some of which may be invasive.

The NYSDEC has developed a "climate smart community" initiative, recognizing that local governments have some control or influence over most of the state's greenhouse gas emission sources (including buildings, transportation, land use and community services), so local action is critical to reducing heat-trapping emissions. Cities, towns, villages and counties also are best able to assess their own vulnerability to a changing climate, and to initiate adaptation measures when changes cannot be avoided. In the Owasco Lake watershed, the Towns of Niles and Owasco have adopted the Climate Smart Communities Pledge, as has the City of Auburn.

In September 2014, New York Governor Andrew Cuomo signed the Community Risk and Resiliency Act (CRRA), which requires State agencies to consider future physical climate risks caused by storm surges, sea level rise or flooding in certain permitting, funding and regulatory decisions. The standards would apply to smart growth assessments, siting of wastewater treatment plants and hazardous waste transportation, storage and disposal facilities, design and construction regulations for petroleum and chemical bulk storage facilities and oil and gas drilling permits, and properties listed in the states Open Space Plan, as well as other projects. The NYSDEC and NYSDOS will prepare model local laws to help communities incorporate measures related to physical climate risks into local laws, as well as provide guidance on the implementation of the Act, including the use of resiliency measures that utilize natural resources and natural processes to reduce risk.[4]

Notes

---

[1] Ketterings, Q. and K. Cyzmmek. 2012. "Phosphorus Index as a Phosphorus Awareness Tool: Documented Phosphorus Use Reduction in New York State." *J. Environ. Qual.* 41:1767-1773.

[2] NRCS 590 Standard Update for New York. http://efotg.sc.egov.usda.gov/references/public/NY/nyps590.pdf

[3] Horton, R., D. Bader, C. Rosenzweig, A. DeGaetano, and W.Solecki. 2014. *Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information*. NYSERDA, Albany, NY.

[4] "Governor Cuomo Signs Community Risk and Resiliency Act," Sept. 22. 2014. https://www.governor.ny.gov/news/governor-cuomo-signs-community-risk-and-resiliency-act