Susquehanna River Basin Commission

UPPER SUSQUEHANNA RIVER SUBBASIN
Year-1 Survey

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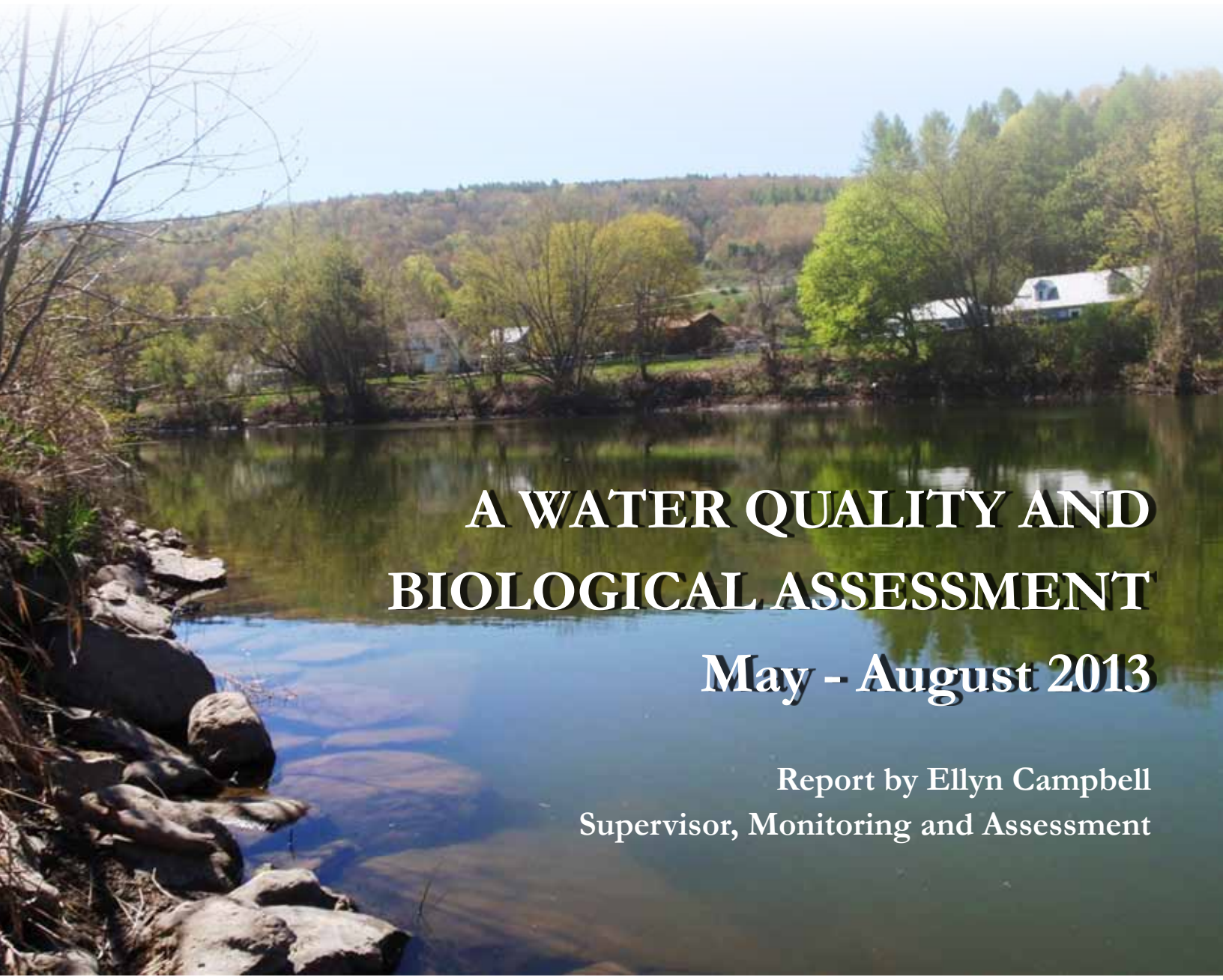

A WATER QUALITY AND BIOLOGICAL ASSESSMENT
May - August 2013

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Introduction

The Susquehanna River Basin Commission (SRBC) conducted a survey of the Upper Susquehanna River Subbasin from May through August 2013. SRBC conducted this survey through the Subbasin Survey Program, funded in part through the United States Environmental Protection Agency (USEPA). This program consists of two-year assessments in each of the six major subbasins (Figure 1) on a rotating schedule. The Year-1 survey aims to collect one-time samples of the macroinvertebrate community, habitat, and water quality at targeted sites in major tributaries and other areas of interest throughout a selected subbasin. In 2013, SRBC sampled 71 sites throughout the Upper Susquehanna River Subbasin as part of the Year-1 program. SRBC conducted previous surveys of the Upper Susquehanna River Subbasin in 1998 (Stoe, 1999) and 2007 (Buda, 2008). This report contains the results from the 2013 study and a comparative analysis of changes at the same sites from 1998, 2007, and 2013.

The associated Year-2 survey, which is designed to be a more focused, in-depth study of a specific area or issue, is focusing on collecting seasonal baseline data in areas of the Chemung and Upper Susquehanna River Subbasins that could potentially be opened up to unconventional drilling operations in the near future. Data collection for the Chemung/Upper Year-2 survey started in Spring 2013 and will continue through Fall 2014. Subbasin survey information is used by SRBC staff and others to:

- evaluate the chemical, biological, and habitat conditions of streams in the basin;
- identify major sources of pollution and lengths of stream impacted;
- identify high quality sections of streams that need to be protected;
- maintain a database that can be used to document changes in stream quality over time;
- review projects affecting water quality in the basin; and
- identify areas for more intensive study.

Description of the Upper Susquehanna River Subbasin

The Upper Susquehanna River Subbasin is an interstate watershed that drains approximately 4,520 square miles of southcentral New York and 424 square miles of northeastern Pennsylvania. The Susquehanna River flows from the headwaters at Otsego Lake, N.Y., to the confluence of the Susquehanna and Chemung rivers near Athens, Pa. Three major watersheds — the Unadilla, Chenango, and Tioughnioga rivers — as well as many smaller watersheds contribute water along the way.

Figure 1. Six Major Subbasins of the Susquehanna River

The Upper Susquehanna River Subbasin crosses 14 counties in New York, including Broome, Chemung, Chenango, Cortland, Delaware, Herkimer, Madison, Oneida, Onondaga, Otsego, Schoharie, Schuyler, Tioga, and Tompkins counties, and Bradford, Susquehanna, and Wayne counties in Pennsylvania. Binghamton, N.Y., is the only major population center in this subbasin (Figure 2). Several towns are located in the subbasin, including Cooperstown, Cortland, Norwich, Oneonta, Sayre, and Sidney.

Four Level IV ecoregions overlap with the Upper Susquehanna subbasin (USEPA, 2012; Figure 2):

- Northern Allegheny Plateau (Ecoregion 60)
  - 60a: Glaciated Low Allegheny Plateau
  - 60b: Delaware-Neversink Highlands
  - 60d: Finger Lakes Uplands and Gorges
- Eastern Great Lakes Lowlands (Ecoregion 83)
  - 83f: Mohawk Valley.

Almost the entire Upper Susquehanna subbasin (96 percent) is within previously glaciated Ecoregion 60, which is a combination of agriculture and forest. Ecoregion 60 functions as a transitional ecoregion between the more agricultural and urban ecoregions to the north and west and the more mountainous and forested ecoregions to the south and east. The agricultural lands in Ecoregion 60 are used mostly as pastures and for hay and grain

cultivation to feed dairy cattle. The forests are comprised of mostly oaks and northern hardwoods.

Four percent of the subbasin is within previously glaciated Ecoregion 83, which is also a combination of agriculture and forest. Agriculture in Ecoregion 83 is used for dairy cattle and crops. The forests are comprised of temperate deciduous species.

Figure 3 illustrates the land use coverage in the Upper Susquehanna subbasin. The primary land uses are natural vegetated areas and cultivated land, and the largest urban center is Binghamton, N.Y. Lakes and reservoirs are scattered throughout the landscape, especially in the northeast portion of the subbasin.

Other Subbasin Activities

Numerous watershed organizations are working in the Upper Susquehanna subbasin to educate and involve local citizens and to restore and protect watersheds. Many other local entities, such as county conservation districts and land conservation groups, protect and conserve land and water resources in the subbasin. In February 2012, the Southern Tier Central Regional Planning and Development Board in conjunction with Southern Tier East Regional Planning and Development Board developed the Susquehanna-Chemung Action Plan, which is an ecosystem-based watershed management plan for the Chemung and Upper Susquehanna River subbasins. The economic development community cooperated with stakeholders on flood mitigation, community planning, transportation, agriculture, recreation, and

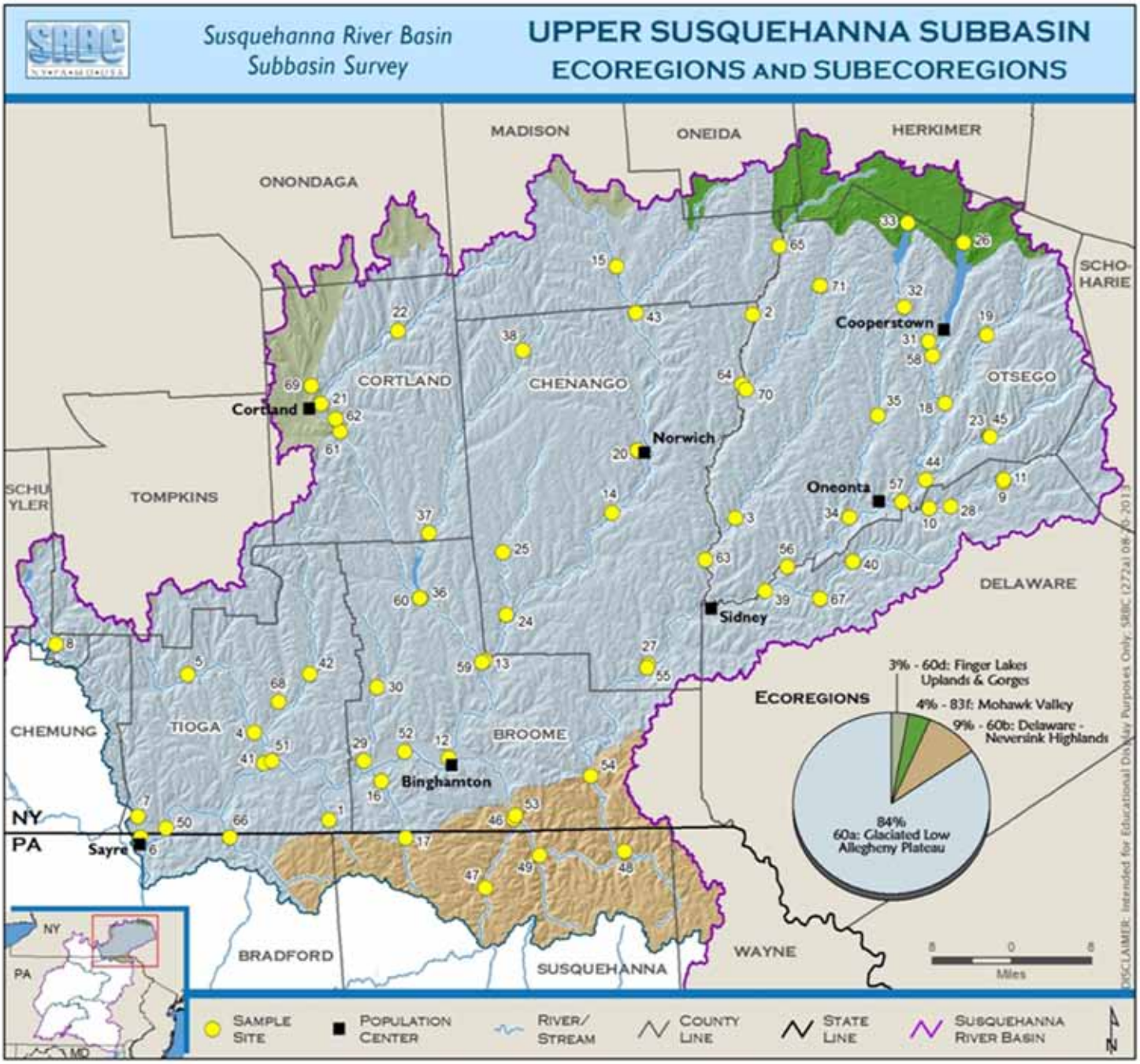


Figure 2. Upper Susquehanna Subbasin Ecoregions and Subecoregions

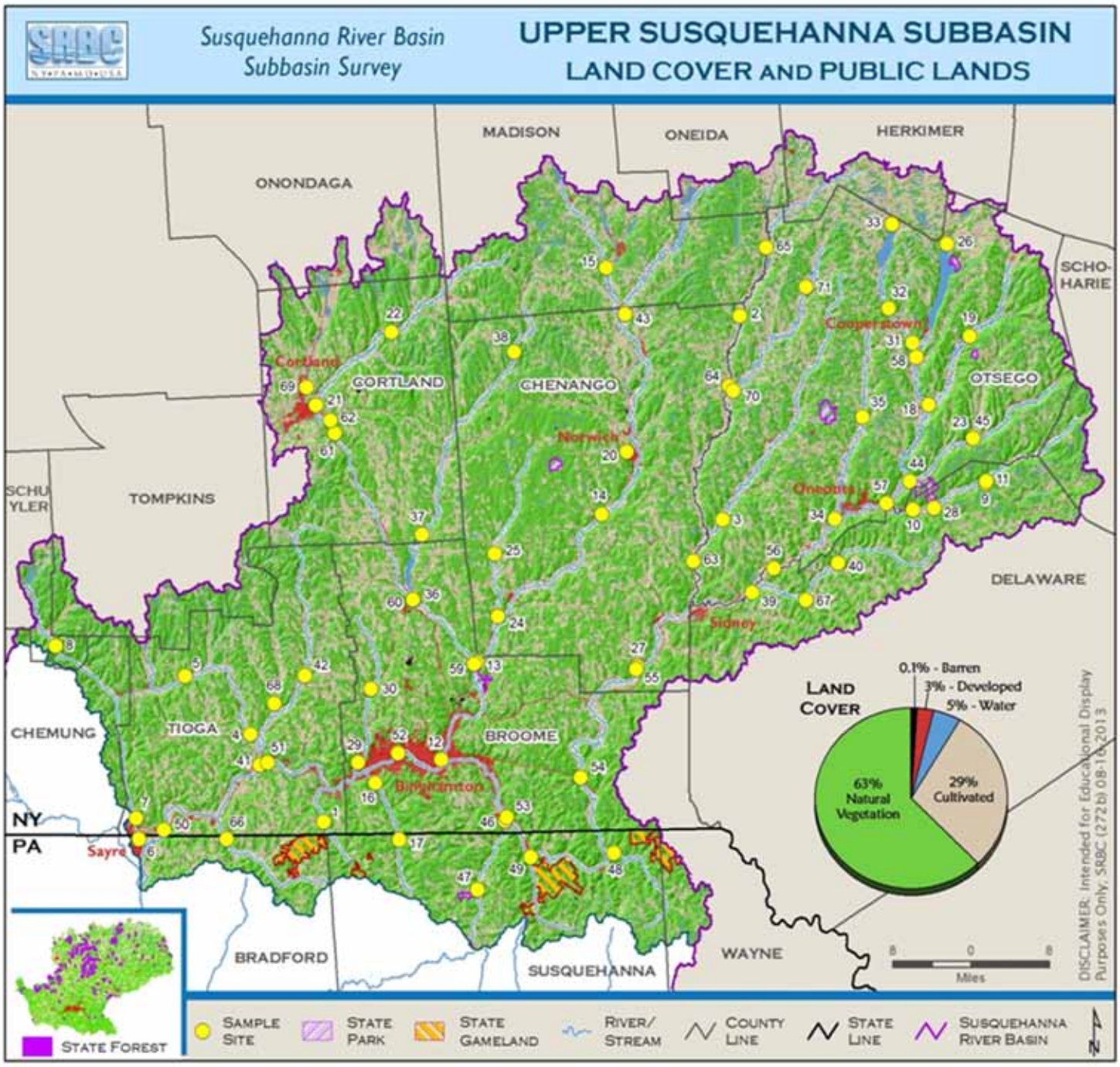


Figure 3. Upper Susquehanna Subbasin Land Cover and Public Lands

other issues to develop the Action Plan, which focuses on water resources. More information on the Susquehanna-Chemung Action Plan can be found at www.susquehanna-chemung.org.

The New York State Department of Environmental Conservation (NYSDEC) is sampling the Upper Susquehanna subbasin from 2013 through 2015 as part of the agency's Rotating Integrated Basin Studies (RIBS). More information on the program, which also involves sampling of lakes, reservoirs, and groundwater, is available at www.dec.ny.gov/chemical/30951.html. NYSDEC updates the Waterbody Inventory based on the data collected as part of this program, which is in turn then used as a basis for the New York State 303(d) list. Because of the overlapping sampling timeframe, SRBC collected and processed macroinvertebrate samples at ten of the RIBS sites on behalf of NYSDEC.

SRBC currently is engaged in six key monitoring and protection programs in the Upper Susquehanna subbasin:

- Sediment and Nutrient Assessment Program (SNAP),
- Interstate Streams Program,
- Early Warning System Program (EWS),
- Whitney Point Adaptive Management Plan,

Flow Monitoring Network (FMN), and

Remote Water Quality Monitoring Network (RWQMN).

Sediment and Nutrient Assessment Program (SNAP)

SRBC conducts the SNAP Program as part of the Chesapeake Bay Restoration Program, which involves routine monthly and storm event sampling of nutrients and sediment within this subbasin at sites on the Unadilla River at Rockdale, N.Y., the Susquehanna River at Conklin and Smithboro, N.Y., and at the Tioughnioga River at Itaska, N.Y. Data have been collected since October 2004 at the Susquehanna River at Smithboro, since October 2005 at the Susquehanna River at Conklin and at the Unadilla River, and from January 2012 through June 2013 at the Tioughnioga River. The SNAP data are used to calculate nutrient and sediment loads and trends and to calibrate watershed models. The data as well as additional information on the project can be found at www.srbc.net/programs/cbp/.

Interstate Streams Program

From 1986 to 2012, SRBC conducted the Interstate Streams Program along the border of New York and Pennsylvania. This program provides chemical, physical, and biological data from streams that cross the state border and are not routinely assessed by state agencies. In 2012, SRBC sampled the macroinvertebrate community, physical habitat, and water chemistry at 19 sites in the Upper Susquehanna subbasin, while more intensive water quality sampling and fish assessment occurred at a small subset of these sites. These sites were located on six streams that are part of the 2013 Year-1 survey, including Apalachin Creek, Choconut Creek, Cayuta Creek, Snake Creek, Susquehanna River, and Wappasening Creek. More information on the Interstate Streams Program can be found at www.srbc.net/interstate_streams/.

Early Warning System

SRBC established the Early Warning System (EWS) program in 2003 in Pennsylvania to inform public water suppliers that have intakes in the Susquehanna River about potential contaminant threats. In 2006, SRBC expanded the system into the New York portion of the basin and established two stations on the Susquehanna River, with one station at the City of Binghamton Water Department intake in Binghamton and a second station upstream at Kirkwood. Currently, the EWS helps protect the public drinking water supplies that serve about 700,000 people and provides data for improving day-to-day treatment options. The EWS provides a monitoring network that helps minimize the impact from any contaminant spills and helps ensure that the public has a safe water supply. More information on the EWS program is available at www.srbc.net/drinkingwater/index.htm.

Whitney Point Adaptive Management Plan

From 2008 to 2013, SRBC, the U.S. Army Corps of Engineers, and NYSDEC have been involved in a water management and environmental restoration project involving environmental releases from Whitney Point Lake to augment extreme low flow conditions downstream in the Otselic, Tioughnioga, Chenango, and Susquehanna Rivers. This project involved the five-year collection of water quality, physical habitat, and biological community data on Whitney Point Lake and 12 sites on streams in the study area. An inter-agency report documenting these five years of effort can be found at www.srbc.net/programs/whitneypoint.htm. SRBC is continuing to monitor this region for the next few years in the hopes of capturing a low flow event and assessing the impacts and benefits of flow augmentation from Whitney Point Lake.

Flow Monitoring Network

Guided by results from the Low Flow Pilot Study conducted by SRBC from 2010 to 2012, SRBC established a basin-wide Flow Monitoring Network (FMN) in 2012. The purpose of the FMN is to document stream discharge, physical habitat, water quality, and biological communities during the natural low flow period (June 1 through September 30; DePhilip and Moberg, 2010) in order to identify differences related to stream flow. Data collected from the FMN stations will be used to characterize and compare water quality, habitat, and biological communities (both benthic macroinvertebrates and fish) associated with varying flows. Two of the FMN stations are located within the Upper Susquehanna subbasin on Catatonk Creek near Spencer, N.Y., and on Choconut Creek south of Vestal, N.Y., and were sampled in June and September 2013. More information on the FMN can be found at www.srbc.net/programs/fmn.htm.

Remote Water Quality Monitoring Network (RWQMN)

In January 2010, SRBC initiated the RWQMN, which continuously measures and reports water quality conditions of smaller rivers and streams located in northern tier Pennsylvania and southern tier New York. SRBC located RWQMN stations in areas where natural gas drilling in the Marcellus shale is most active as well as in other locations where no drilling activities are planned so SRBC can collect baseline and control data. The collected data help agency officials track existing water quality conditions and provide an early detection alert for any changes on an ongoing, real-time basis. The RWQMN includes 10 stations within the Upper Susquehanna subbasin on the following streams: Cherry Valley Creek in the Headwaters Section of the subbasin, Sangerfield River in the Chenango Section, Trout Brook in the Tioughnioga Section, Starrucca and Snake Creeks in the Great Bend Section, and Upper Catatonk, Wappasening, Apalachin, Choconut, and Nanticoke Creeks in the Binghamton to Sayre Section. SRBC sampled sites on all these streams for the Year-1 survey, with five directly overlapping

RWQMN stations on Choconut Creek, Snake Creek, Trout Brook, Sangerfield River, and Cherry Valley Creek. More information on the RWQMN program is available at mdw.srbc.net/remotewaterquality/.

Methods

Data Collection

The sample design for the Year-1 project provides a point-in-time picture of stream conditions throughout the whole Upper Susquehanna subbasin. SRBC collected samples using the protocol established in Pennsylvania Department of Environmental Protection's (PADEP's) Index of Biotic Integrity for Benthic Macroinvertebrate Communities in Pennsylvania's Wadeable, Freestone, Riffle-Run Streams (PADEP, 2013) and analyzed the data using a slightly modified version of USEPA's Rapid Bioassessment Protocol III (RBP III; Barbour and others, 1999).

From May to September 2013, SRBC staff sampled 71 sites throughout the subbasin. Appendix A contains a list with the sample site number, the site name (designated by approximate stream mile), the latitude and longitude, a description of the sampling location, the drainage area, and the reference designation. Because of budget limitations, SRBC dropped 11 sites from the 2013 survey previously assessed in the 2007 survey. SRBC assessed physical habitat and sampled macroinvertebrates and water chemistry at all 71 sites. In addition, SRBC shifted the previously sampled location of five sites slightly to overlap with NYSDEC RIBS monitoring sites to assist with NYSDEC's data collection efforts.

Water Quality

At each site visit, SRBC staff measured field chemistry instream while collecting water samples for laboratory analysis of parameters listed in Table 1. In light of more recent hydraulic fracturing activities within the region, in 2012, SRBC began sampling parameters that can be indicators of these activities

Severely eroded right bank on Wappasening Creek near the Pa./N.Y. state line (WAPP 2.5).

Table 1. Water Quality Parameters Sampled in the Upper Susquehanna Subbasin

Field Parameters	
Flow (instantaneous cfs)	Conductivity (µmhos/cm)
Temperature (°C)	Dissolved Oxygen (mg/l)
pH	
Laboratory Analysis	
Alkalinity (mg/l)	Total Magnesium (mg/l)
Total Dissolved Solids (mg/l)	Total Sodium (mg/l)
Total Suspended Solids (mg/l)	Chloride (mg/l)
Total Nitrogen (mg/l)	Sulfate (mg/l)
Nitrite-N (mg/l)	Total Iron (mg/l)
Nitrate-N (mg/l)	Total Manganese (mg/l)
Turbidity (NTU)	Total Aluminum (mg/l)
Total Organic Carbon (mg/l)	Total Phosphorus (mg/l)
Total Hardness (mg/l)	Total Orthophosphate (mg/l)
Total Calcium (mg/l)	Hot Acidity (mg/l)
Total Bromide (mg/l) [a]	Total Barium (mg/l) [a]
Total Strontium (mg/l) [a]	Total Lithium (mg/l) [a]
Gross Beta (pCi/l) [b]	Gross Alpha (pCi/l) [b]
cfs = cubic feet per second	NTU = nephelometric turbidity units
mg/l = milligram per liter	pCi/l = picoCuries per liter
µmhos/cm = micromhos per centimeter	
[a,b] only at select sites	

(i.e., bromide, barium, lithium, strontium, and gross alpha and beta radioactive nuclides) at select sites. SRBC staff measured all field chemistry parameters (i.e., temperature, conductivity, pH, and dissolved oxygen) simultaneously using a multi-meter YSI sonde. The probes of all meters were rinsed with distilled water and sample water prior to collecting water quality data and were calibrated as detailed in the Quality Assurance Project Plan (QAPP). Staff used a FlowTracker and standard U.S. Geological Survey (USGS) procedures (Buchanan and Somers, 1969) to measure flow at stations with no USGS gage. Water samples were collected using depth-integrated water sampling methods (Guy and Norman, 1969), placed on ice, and delivered to ALS Environmental, Inc., in Middletown, Pa., for analysis.

Macroinvertebrates

SRBC staff sampled the biological community along a 100-meter reach at each site by collecting benthic macroinvertebrates, which are organisms that live on the stream bottom, including aquatic insects, crayfish, clams, snails, and worms. Six D-frame (500-micron mesh) net samples were collected along the reach by allowing the dislodged material loosened through disturbance of the substrate of representative riffle/run areas to flow into

the net. SRBC staff composited these six D-frame samples into one sample, which was preserved in 95-percent denatured ethyl alcohol and returned to SRBC's lab for processing. Each sample was subsampled by a contractor biologist who picked approximately 200 (± 20 percent) organisms from the sample. Each organism was identified to genus when possible, except for midges, which were identified to family, and worms, which were identified to class.

Habitat

At each site visit, SRBC staff evaluated habitat conditions using a modified version of RBP III (Plafkin and others, 1989; Barbour and others, 1999), rating 11 physical stream characteristics pertaining to substrate, pool and riffle composition, shape of the channel, conditions of the banks, and the riparian zone on a scale of 0-20, with 20 being optimal. Staff noted any other observations regarding recent precipitation events, substrate material composition, surrounding land use, other relevant features in the watershed, and the presence of common terrestrial and aquatic invasive species at the site and surrounding area.

Data Analysis

Water Quality

SRBC assessed water quality by comparing field and laboratory results to water quality levels of concern based on current state

Table 2. Water Quality Standards and Levels of Concern

Parameters	Limits	Reference Code	Reference
Based on state water quality standards:			
Alkalinity	≥ 20 mg/l	a	a. *www.pacode.com/secure/data/025/chapter93/s93.7.html* b. *water.epa.gov/drink/contaminants/index.cfm* c. *www.pacode.com/secure/data/025/chapter93/s93.8.html* d. *www.dec.ny.gov/regs/4590.html#16132* e. *www.pabulletin.com/secure/data/vol42/42-27/1292.html* f. *www.dsd.state.md.us/comar/comarhtml/26/26.08.02.03-3.htm* g. Based on archived data at SRBC h. *www.uky.edu/WaterResources/Watershed/KRB_AR/wq_standards.htm* i. *wilkes.edu/include/waterresearch/pdfs/waterbooklet070610.pdf* j. *www.uky.edu/WaterResources/Watershed/KRB_AR/krww_parameters.htm* k. *www.vdh.virginia.gov/Epidemiology/DEE/publichealthtoxicology/documents/pdf/lithium.pdf* l. *water.usgs.gov/pubs/circ/circ1225/images/table.html* m. *water.usgs.gov/pubs/circ/circ1225/images/table.html* n. Hem (1970)
Dissolved Oxygen	≥ 4 mg/l	a	
Gross Alpha	< 15 pCi/l	b	
Gross Beta	4 millirems/yr	b	
pH	≥ 6.0 and ≤ 9.0	a	
Temperature	≤ 30.5 ºC	a	
Total Aluminum	≤ 0.75 mg/l	c	
Total Barium	< 2.0 mg/l	b	
Total Chloride	≤ 250 mg/l	a	
Total Dissolved Solids	≤ 500 mg/l	d	
Total Iron	≤ 1.5 mg/l	a	
Total Magnesium	≤ 35 mg/l	d	
Total Manganese	≤ 1.0 mg/l	a	
Total Sodium	≤ 20 mg/l	d	
Total Strontium	< 4.0 mg/l	e	
Total Sulfate	≤ 250 mg/l	a	
Total Suspended Solids	≤ 25 mg/l	a	
Turbidity	≤ 50 NTU	f	
Levels of Concern, based on background levels, aquatic life tolerances, or recommendations:			
Acidity	≤ 20 mg/l	g	
Calcium	≤ 100 mg/l	g	
Conductivity	≤ 800 µmhos/cm	h	
Total Bromide	< 0.05 mg/l	i	
Total Hardness	≤ 300 mg/l	j	
Total Lithium	< 0.7 mg/l	k	
Total Nitrate	≤ 0.6 mg/l	l	
Total Nitrite	≤ 1 mg/l	d	
Total Nitrogen	≤ 1 mg/l	m	
Total Organic Carbon	≤ 10 mg/l	n	
Total Orthophosphate	≤ 0.02 mg/l	m	
Total Phosphorus	≤ 0.1 mg/l	j	

Staff sampling macroinvertebrates on Otego Creek at Mount Vision, N.Y. (OTGO 13.1).

and federal regulations and recommendations, background levels for uninfluenced streams, or references for approximate tolerances of aquatic life (Table 2). For each site, SRBC compared the difference between each measured result and the corresponding level of concern value from Table 2. If the measured value exceeded the level of concern value, the difference between the two was recorded. If the measured value did not exceed the level of concern value, the difference was recorded as zero. An average of all the recorded differences for each site was calculated and assigned a classification based on the following scores:

- Higher quality (score of zero, indicating no parameters exceeded limits),
- Middle quality (score between zero and one), and
- Lower quality (score greater than one).

Habitat

Since 96 percent of the Upper Susquehanna subbasin falls within the Northern Allegheny Plateau Ecoregion, SRBC did not use ecoregions to create reference categories for macroinvertebrate and habitat data analysis as in other Year-1 subbasin survey reports. Instead, SRBC created reference categories based on the following drainage area sizes:

- Small (<100 square miles),
- Medium (100-500 square miles), and
- Large (>500 square miles).

SRBC compared the total habitat condition score of each site, calculated a percentage score of the corresponding reference site, and then assigned a habitat condition category of excellent, supporting, partially supporting, or nonsupporting to each site based on RBP III methods.

Biology

Seven metrics were derived from RBP III to analyze benthic macroinvertebrate samples including:

- taxonomic richness,
- modified Hilsenhoff Biotic Index,
- percent Ephemeroptera,
- percent contribution of dominant taxon,
- number of Ephemeroptera/Plecoptera/Trichoptera (EPT) taxa,
- percent Chironomidae (midges), and
- Shannon-Wiener Diversity Index.

SRBC compared each site's metric to the scores at the corresponding reference site and assigned a biological condition category of nonimpaired, slightly impaired, moderately impaired, or severely impaired based on RBP III methods. While these methods are designed to assess conditions at a site and provide some qualitative comparison across the subbasin, these impairment ratings are not designed to meet state regulatory standards.

Results/Discussion

Figure 4 depicts water quality, macroinvertebrate, and habitat conditions from 2013 for each of the 71 sampling sites in the Upper Susquehanna subbasin. Forty-four percent of the sampled sites had nonimpaired macroinvertebrate communities, and 47 percent had slightly impaired communities. Eight percent of the sampled sites had moderately impaired communities, and one site had a severely impaired community (Figure 5). Most degraded communities were affected by low overall diversity, low diversity of pollution-sensitive species, dominance of pollution-tolerant species, or a lack of organisms.

Sixty-seven percent of the evaluated sites had excellent habitat, 16 percent had supporting habitat, 14 percent had partially supporting habitat, and 3 percent had nonsupporting habitat (Figure 6). Most compromised habitat resulted from poorer substrate quality, riparian conditions, or flow regime. Habitat conditions could not be fully evaluated at two sites because of high water.

Fifty-five percent of the sites had no parameters that exceeded levels of concern and were designated as higher water quality (Figure 7). Forty-five percent of the sites were designated as middle water quality. No sites had lower water quality. Three sites had three or more parameters exceed levels of concern (Table 3). The site on West Branch Tioughnioga River (WBTF 3.3) had three parameters exceed levels of concern, and two sites — one on the Chenango River (CHEN 0.9) and one on Tioughnioga River (TIOF 28.7) — had four parameters exceed levels of concern.

Ten sites had the optimal combination of nonimpaired macroinvertebrate communities, excellent habitat, and higher water quality. Eleven sites had nonimpaired macroinvertebrate communities, excellent habitat, and middle water quality. Nonimpaired macroinvertebrate communities, supporting habitat, and middle or higher water quality designations were found at an additional four sites.

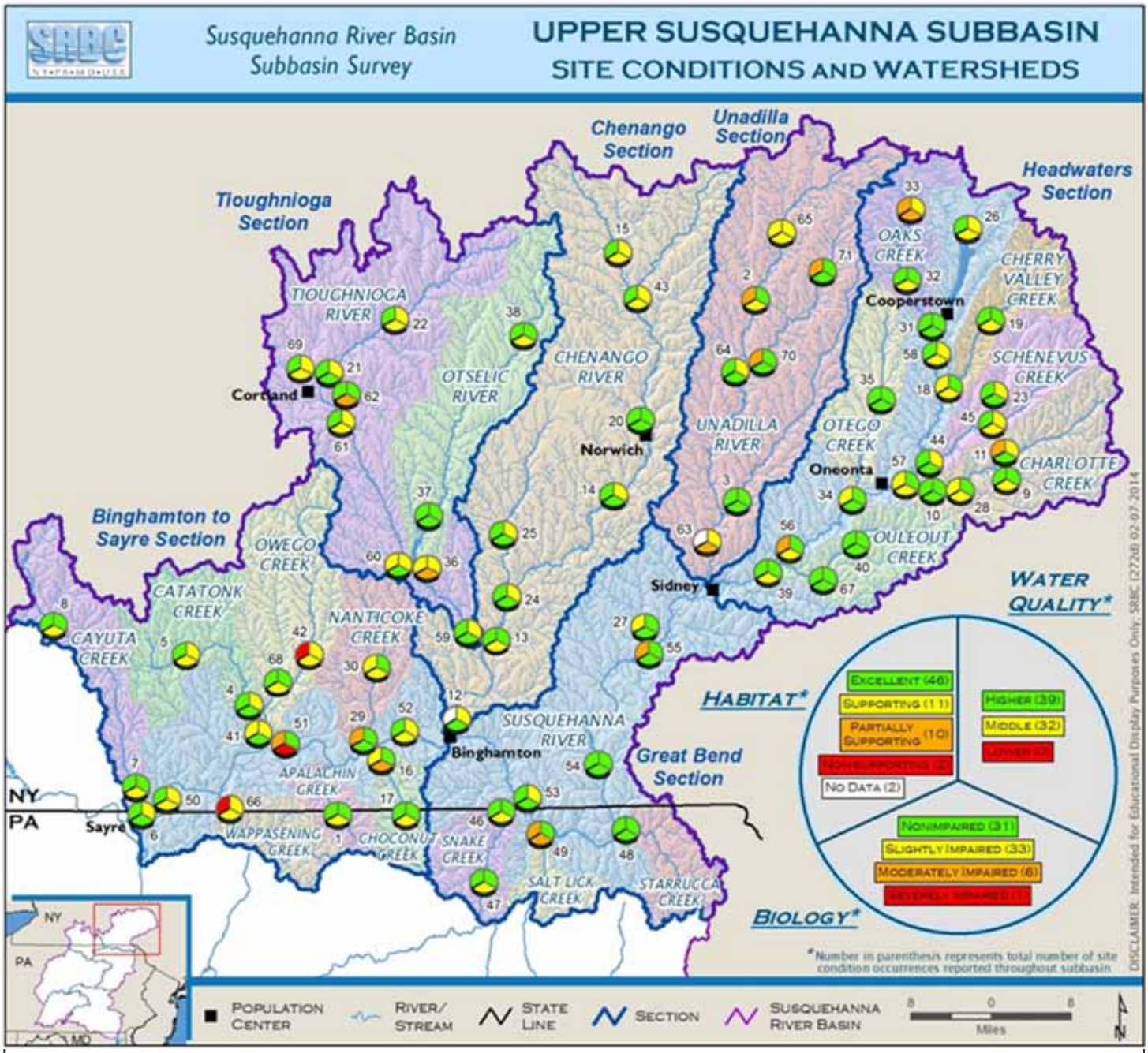


Figure 4. Upper Susquehanna Subbasin Site Conditions and Watersheds

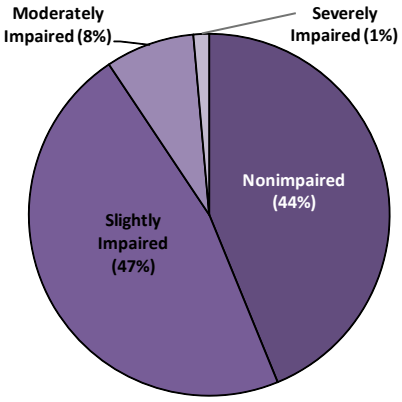


Figure 5. 2013 Biological Condition Categories for Sampled Upper Susquehanna Subbasin Sites

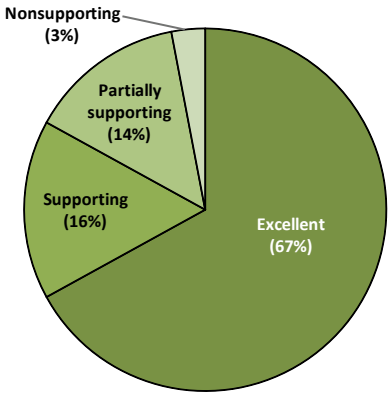


Figure 6. 2013 Habitat Condition Categories for Sampled Upper Susquehanna Subbasin Sites

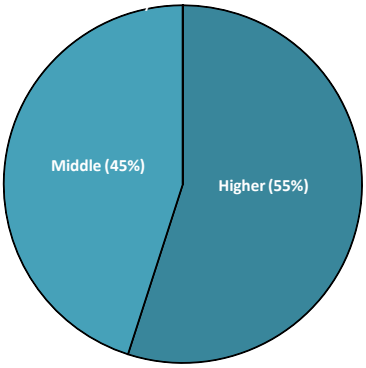


Figure 7. 2013 Water Quality Condition Categories for Sampled Upper Susquehanna Subbasin Sites

Nutrients were the most common parameter category to exceed levels of concern. Total nitrate was the single most widespread parameter exceeding levels of concern at 27 percent of sites, and total nitrogen was elevated at 14 percent of sites (Table 3). Since Pennsylvania and New York have not yet developed numeric nutrient standards, SRBC set threshold values for total nitrate (0.6 mg/l) and total nitrogen (1 mg/l) based on natural background concentrations (Table 2) published by the USGS (1999). Values higher than these background levels indicate the potential presence of nitrate and nitrogen sources such as agriculture or urbanization in the watershed. The highest total nitrate concentration measured during this study was 2.0 mg/l at a site on the Unadilla River (UNAD 42.7), and the highest total nitrogen concentration was 2.6 mg/l at a site on the Tioughnioga River (TIOF 28.7). Total orthophosphate exceeded levels of concern at 17 percent of sites, with the highest concentration of 0.25 mg/l sampled at Cayuta Creek (CAYT 1.6).

Depressed alkalinity and elevated total phosphorus, total sodium, total aluminum, total iron, and turbidity were found at a handful of sites. No sites had exceeding levels of hot acidity, total calcium, total chloride, hardness, total magnesium, total manganese, total nitrite, sulfate, total organic carbon, total suspended solids, dissolved oxygen, field pH, or conductance.

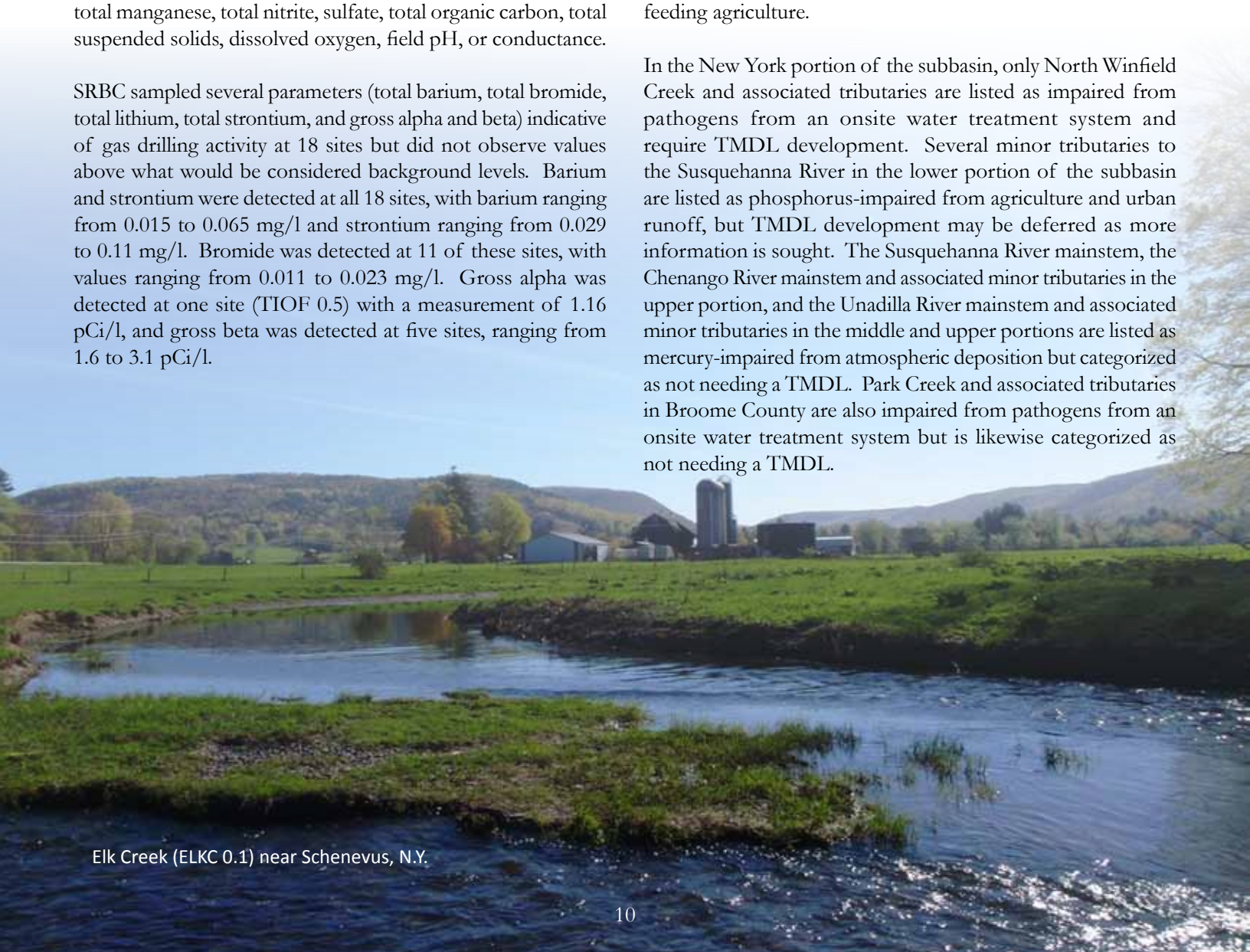
SRBC sampled several parameters (total barium, total bromide, total lithium, total strontium, and gross alpha and beta) indicative of gas drilling activity at 18 sites but did not observe values above what would be considered background levels. Barium and strontium were detected at all 18 sites, with barium ranging from 0.015 to 0.065 mg/l and strontium ranging from 0.029 to 0.11 mg/l. Bromide was detected at 11 of these sites, with values ranging from 0.011 to 0.023 mg/l. Gross alpha was detected at one site (TIOF 0.5) with a measurement of 1.16 pCi/l, and gross beta was detected at five sites, ranging from 1.6 to 3.1 pCi/l.

Total Maximum Daily Loads

Section 303(d) of the Clean Water Act requires a Total Maximum Daily Load (TMDL) to be developed for any waterbody designated as impaired or not meeting the state water quality standards or designated use. In Pennsylvania, PADEP assesses streams as part of the State Surface Waters Assessment Program. In New York, NYSDEC assesses streams through the Statewide Waters Monitoring Program. If streams are found to be impaired, a TMDL may be established for the corresponding watershed. Both PADEP and NYSDEC issued revised 303(d) lists in 2014 (PADEP, 2014; NYSDEC, 2014).

In Pennsylvania, about 40 miles of streams in the Upper Susquehanna, most of it along the Susquehanna River mainstem, are listed as impaired and requiring the development of a TMDL. Thirty-six miles of the Susquehanna River are impaired for fish consumption caused by mercury and/or PCBs from unknown sources. An additional 2.5 miles are also listed for aquatic life impairment caused by metals from an unknown source. Almost two miles of Prince Hollow Run in Bradford County are listed for aquatic life impairment caused by nutrients from animal feeding agriculture.

In the New York portion of the subbasin, only North Winfield Creek and associated tributaries are listed as impaired from pathogens from an onsite water treatment system and require TMDL development. Several minor tributaries to the Susquehanna River in the lower portion of the subbasin are listed as phosphorus-impaired from agriculture and urban runoff, but TMDL development may be deferred as more information is sought. The Susquehanna River mainstem, the Chenango River mainstem and associated minor tributaries in the upper portion, and the Unadilla River mainstem and associated minor tributaries in the middle and upper portions are listed as mercury-impaired from atmospheric deposition but categorized as not needing a TMDL. Park Creek and associated tributaries in Broome County are also impaired from pathogens from an onsite water treatment system but is likewise categorized as not needing a TMDL.



Elk Creek (ELKC 0.1) near Schenevus, N.Y.

Table 3. Upper Susquehanna Subbasin Sites with Water Quality Values Exceeding Levels of Concern										
Site	Alkalinity	Nitrate-N	Total Nitrogen	Total Orthophosphate	Total Phosphorus	Total Sodium	Turbidity	Total Aluminum	Total Iron	TOTAL
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	NTU	mg/l	mg/l	
CATK 1.4		1	1							2
CATK 14.4		0.84		0.023						2
CAYT 1.6				**0.25**	**0.26**					2
CHAR 13.2	**16**									1
CHEN 0.9				0.023			**59.1**	0.9	1.7	4
CHEN 38.6		0.82								1
CHEN 69.3		0.92								1
EBTF 1.6		0.91	1.91							2
EBTF 15.1		1.3	1.3							2
ELKC 0.1		0.9								1
GENE 1.6			1.68							1
GENE 10.9	18		1.1							2
HAYD 0.7		1.2	1.2							2
OCQU 1.1		0.66								1
OTSL 0.1				0.032						1
OWGO 0.1		0.66								1
OWGO 12.4		0.64	2.54							2
SANG 1.5		1								1
SHEN 1.7				0.022						1
SHEN 11.5		0.74								1
SUSQ 291				0.025						1
SUSQ 325				0.022						1
SUSQ 341.5				0.025						1
SUSQ 442				0.028						1
TIOF 0.1								**1.1**	**2.2**	2
TIOF 9.5		0.94								1
TIOF 28.7		1.5	**2.6**	0.035		**24.9**				4
UNAD 5.4		0.7		0.026						2
UNAD 26.7		0.98								1
UNAD 42.7		**2**	2							2
WAPP 2.5				0.022						1
WBTF 3.3		1.4	1.4			21.7				3
TOTAL	2	19	10	12	1	2	1	2	2	
% of sites *	3%	27%	14%	17%	1%	3%	1%	3%	3%	

Red bolded values were the most extreme values for that parameter measured during this study.

Headwaters Section

Charlotte Creek in Butts Corner, N.Y. (CHAR 13.2).

The headwaters section of the Upper subbasin includes the Charlotte Creek, Cherry Valley Creek, Oaks Creek, Otego Creek, Ouleout Creek, and Schenevus Creek Watersheds. There were 21 sites located in these watersheds in the most upstream portions of the Susquehanna River. Nearly all of the sites had either nonimpaired or slightly impaired biological communities. Most of the sites had either excellent or supporting habitat conditions. Five of the sites in the Headwaters section had the optimal combination of nonimpaired macroinvertebrate communities, excellent habitat, and higher water quality, including Charlotte Creek (CHAR 3.6), Oaks Creek (OAKS 2.0), Otego Creek (OTGO 13.1), Ouleout Creek (OULT 12.0), and West Branch Handsome Brook (WBHB 0.1).

One site (OCQU 1.1) on Ocquinous Creek had a moderately impaired biological community likely resulting from partially supporting habitat conditions including the predominance of silty substrate, poor bank stability, and abundance of trash within the stream. Partially supporting habitat conditions at sites on Charlotte Creek (CHAR 13.2) and the Susquehanna River (SUSQ 406) resulting from poor riparian and flow conditions had little effect on the nonimpaired or slightly impaired biological communities. Most of the sites (67 percent) had higher water quality. Middle water quality at the remaining 33 percent of sites largely resulted from elevated nutrient concentrations.

Unadilla Section

SRBC located seven sites in the Unadilla section of the subbasin, which includes the Unadilla River as well as tributary watersheds of Beaver, Butternut, and Wharton creeks. Eighty-six percent of these sites had either nonimpaired or slightly impaired biological communities. One site on Butternut Creek (BUTT 2.8) had the optimal combination of nonimpaired macroinvertebrate communities, excellent habitat, and higher water quality.

Half of the evaluated sites had either excellent or supporting habitat, and the other half had partially supporting habitat largely resulting from compromised bank and riparian conditions and issues with substrate quality. One site on the lower portion of the Unadilla River (UNAD 5.4) had a moderately impaired biological community from low EPT diversity and dominance of oligochaetes. Most of the sites (57 percent) had higher water quality. The remaining sites, all of which were located on the Unadilla mainstem, had middle water quality resulting from elevated nutrients. The most upstream site on the Unadilla (UNAD 42.7) had the highest concentration of total nitrate (2 mg/l) in the study, perhaps caused by surrounding agricultural land use.

Chenango Section

Eight sites were located in the Chenango River section in the Canasawacta Creek, Genegantslet Creek, and Sangerfield River Watersheds as well as along the mainstem Chenango River. Most sites had nonimpaired biological communities, and slightly impaired biological communities were found at two sites on the Chenango River (CHEN 13.5 and CHEN 69.3) and at one site on the Sangerfield River (SANG 1.5). The site on the Canasawacta Creek (CNWT 1.6) was the only site in this section to have had the optimal combination of nonimpaired benthic community, excellent habitat, and higher water quality.

All sites had excellent habitat, with the exception of the most downstream site on the Chenango River (CHEN 0.9), which could not be completely assessed because of high water conditions. Most sites had middle water quality resulting from slightly elevated nitrates, except for CHEN 0.9, which had elevated orthophosphate, aluminum, iron, and the highest turbidity levels seen during the study (59.1 NTU). CHEN 0.9 is downstream of much of Binghamton and is heavily disturbed. The upstream site on Genegantslet Creek (GENE 10.9) had slightly depressed alkalinity (18 mg/l)

Unadilla River at Rockdale, N.Y. (UNAD 5.4).

Chenango River north of Route 17 bridge in Binghamton, N.Y. (CHEN 0.9).

and elevated nitrogen (1.1 mg/l), while the downstream site on Genegantslet Creek (GENE 1.6) also had elevated nitrogen (1.68 mg/l). These total nitrogen values were influenced by high total Kjeldahl nitrogen values caused by unknown sources within the watershed.

Tioughnioga Section

Ten sites were located in the Tioughnioga Section, which includes the Otselic and Tioughnioga River Watersheds. Eighty percent of the sites had either nonimpaired or slightly impaired biological communities. One site on the Otselic River (OTSL 8.7) had the optimal combination of nonimpaired biological community, excellent habitat, and higher water quality. The most downstream site on the Otselic River (OTSL 0.1) and the site on Trout Brook (TRBK 0.1) each had moderately impaired biological communities despite supporting or excellent habitat. OTSL 0.1 is located just below the Whitney Point Lake dam. Each of these sites had low EPT diversity and a dominance of one taxon (*Gammarus* (Amphipoda) at OTSL 0.1 and Chironomidae (Diptera) at TRBK 0.1) which weighted the biological community metrics negatively.

Eighty percent of the sites had excellent habitat, and the only other site besides OTSL 0.1 to have supporting habitat was the midstream site on the Tioughnioga River (TIOF 9.5). Only 30 percent of the sites had higher water quality. The remaining 70 percent of sites had middle water quality largely resulting from slightly elevated nutrients. The most upstream site on the Tioughnioga River (TIOF 28.7) had the highest concentrations of total nitrogen (2.6 mg/l) and total sodium (24.9 mg/l) observed during the study. Elevated sodium levels were also documented at West Branch Tioughnioga (WBTF 3.3). The highest elevated levels of total aluminum and iron in the study were found at the most downstream site on the Tioughnioga River (TIOF 0.1). While elevated sodium levels have been previously documented in the Tioughnioga watershed (Buda, 2008), elevated total aluminum and iron have not. The stream was extremely turbid at the time of sampling but not apparently resulting from a recent storm. TIOF 9.5 was the only site in the study to have gross alpha at detectable levels (1.16 pCi/l).

Great Bend Section

Salt Lick Creek at Hallstead, Pa. (STLK 0.5).

The Great Bend Section of the subbasin contains eight sites located in the Kelsey Brook, Snake Creek, Salt Lick, and Starrucca Creek Watersheds as well as on the Susquehanna River mainstem. Eighty-eight percent of sites had excellent or slightly impaired biological communities, and 75 percent of sites had excellent or supporting habitat. Two sites on Starrucca Creek (STAR 0.9) and the Susquehanna River (SUSQ 365) had the optimal combination of nonimpaired biological communities, excellent habitat, and higher water quality. Nonimpaired communities with either a mix of excellent and supporting habitat and middle or higher water quality were found at Kelsey Brook (KELS 0.6) and on a site on the Susquehanna River (SUSQ 341.5). SUSQ 384 also had partially supporting habitat from substrate and flow regime issues, but the biological community was not affected.

Almost all sites had higher water quality, with the exception of SUSQ 341.5, which had middle water quality from elevated orthophosphate. While higher water quality was present, Salt Lick Creek (STLK 0.5) was the only site with a moderately impaired biological community from low EPT and overall diversity and a dominance of midges likely resulting from partially supporting habitat of muddy substrate, slower velocity water, and poor quality streambanks.

Binghamton to Sayre Section

Seventeen sites were located within this section containing the Apalachin, Catatonk, Cayuta, Choconut, Nanticoke, Owego, and Wappasening Creek Watersheds as well as sites on the Susquehanna River. Sixty-five percent of sites in this section had slightly impaired biological communities, while 23 percent had nonimpaired biological communities. Seventy-six percent of sites had excellent or supporting habitat. Fifty-three percent of sites had higher water quality, and the remaining 47 percent had middle water quality resulting from elevated nutrients.

Sites on Apalachin Creek (APAL 4.4) and West Branch Owego Creek (WBOC 5.4) had slightly impaired biological communities, excellent habitat, and higher water quality. Sites within the Catatonk and Cayuta Creek Watersheds had either nonimpaired or slightly impaired biological communities, excellent habitat, and either higher or middle water quality.

Sites in the Nanticoke and Owego Creek Watersheds also had nonimpaired or slightly impaired biological communities, with either middle or higher water quality, but had a range of habitat scores from supporting to nonsupporting (at OWGO

12.4, because of channel dredging). The sites on Choconut Creek had either supporting or excellent habitat and higher water quality but also had slightly impaired (CHOC 8.4) or moderately impaired (CHOC 1.7) biological communities from low EPT diversity and dominance of midges. The site on Wappasening Creek (WAPP 2.5) had a slightly impaired biological community and middle water quality as well as nonsupporting habitat from marginal substrate and poor bank conditions.

SUSQ 307, located in Owego, N.Y., had partially supporting habitat from muddy substrate and a severely impaired biological community from low numbers of organisms. The highest levels of orthophosphate and total phosphorus in the study (0.25 and 0.26 mg/l, respectively) were seen on Cayuta Creek at CAYT 1.6.

Comparison to Historical Data

Condition Categories

SRBC compared the data collected in the subbasin at the 71 sites that were sampled in 1998, 2007, and 2013. Figures 8 through 10 depict the results for biological, habitat, and water quality conditions for these three years. Table 4 shows how condition categories within each section changed from the last survey. Overall, a large percentage of biological, habitat, and water quality condition categories remained stable or improved since the last subbasin survey.

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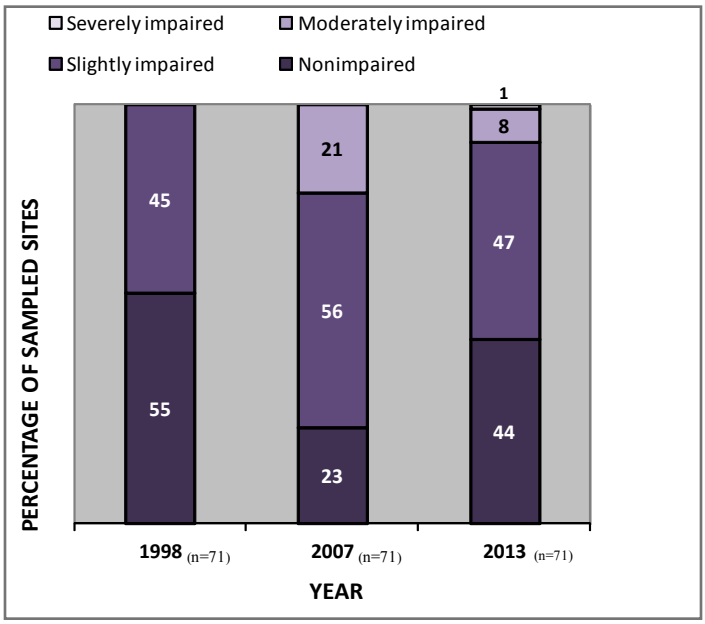

Figure 8. Historical Biological Condition Categories Among Sampled Sites in the Upper Susquehanna Year-1 Subbasin Surveys

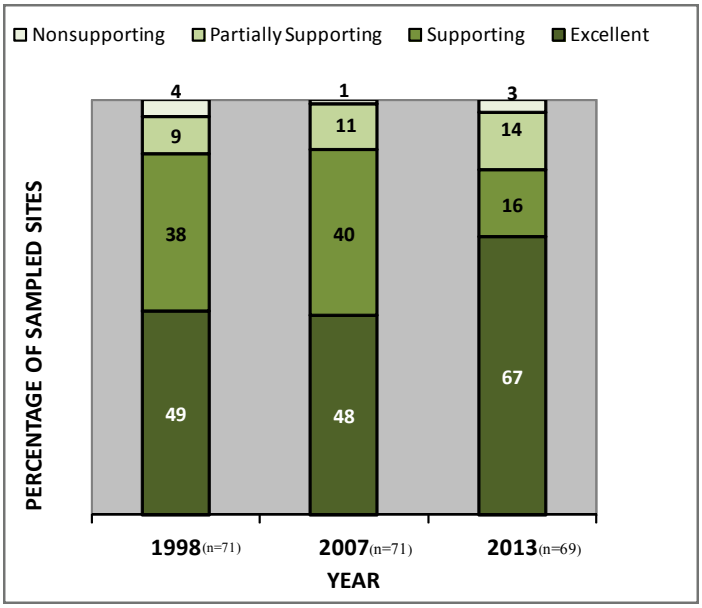

Figure 9. Historical Habitat Condition Categories Among Sampled Sites in the Upper Susquehanna Year-1 Subbasin Surveys

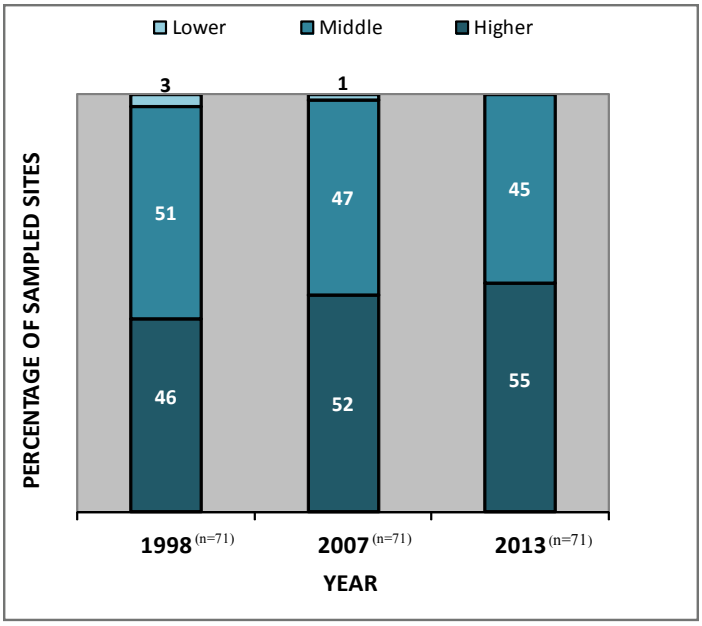

Figure 10. Historical Water Quality Categories Among Sampled Sites in the Upper Susquehanna Year-1 Subbasin Surveys

Biology

The 2013 biological results fall between the 1998 and 2007 results (Figure 8). Nonimpaired communities were seen at 44 to 55 percent of sites over the life of the study, and slightly impaired communities were seen in similarly ranging proportions. In 2007, moderately impaired communities were documented for the first time in the study. This year, the number of moderately impaired communities decreased, but one site (SUSQ 307) was ranked as severely impaired for the first time.

SRBC compared 2013 biological condition categories to those determined in 2007 for each site (Table 4). Throughout the Upper Susquehanna subbasin as a whole, approximately 56

percent of sites demonstrated no change in biological condition rating, with the Tioughnioga section having the most stability in site ratings (70 percent of sites). Thirty-seven percent of sites throughout the subbasin improved biological conditions, and the most improvement was observed in the Unadilla section (43 percent of sites). Degraded conditions were noted in 7 percent of sites overall but were concentrated in the Binghamton to Sayre section (18 percent of those sites). No degradation was observed in the Great Bend, Chenango, or Tioughnioga sections.

All biological ratings that changed moved only one category in either direction with the exception of Kelsey Creek (KELS 0.6) which shifted two categories from moderately impaired to nonimpaired because of a shift in the community towards pollution-intolerant EPTs.

Habitat

Throughout the subbasin, the percentage of sites having excellent habitat increased overall from 1998 through 2013 while the percentages of sites with supporting habitat decreased overall (Figure 9). The total percentage of sites with combined excellent and supporting habitat in 2013 (approximately 83 percent) was less than the 87 percent observed in 1998 and 2007. The percentage of partially supporting habitat steadily increased from 1998 to 2013. The percentage of sites with nonsupporting habitat was similar in 1998 and 2013 and dropped in 2007. Making detailed comparisons between habitat assessments between sampling event years is difficult due to greater variability in subjective scoring judgments; however, nonsupporting conditions in 2013 were caused by temporary stream disturbances.

SRBC compared 2013 habitat condition categories to those determined in the previous sampling event for each site in the subbasin. Overall, 48 percent of sites showed no change in habitat classification from the previous year's assessment. The most stability was observed in the Chenango section, with 57 percent of sites showing no change. Thirty-five percent of sites within the subbasin showed improvement, with the Tioughnioga section having most of the improved sites (60 percent). Within the subbasin as a whole, 17 percent of sites were degraded. Both the Unadilla and Binghamton to Sayre sections saw the most degradation, with 33 and 35 percent of sites, respectively, worsening. No degradation was observed in the Chenango and Tioughnioga sections.

Most of the habitat ratings that occurred shifted only one category in either direction. Four sites increased ratings at least two categories to excellent ratings, largely due to better scores for instream conditions such as substrate, embeddedness, flow regime, and instream cover and better riparian conditions. Four additional sites decreased ratings at least two categories to either partially supporting or nonsupporting for lower scores for the same stream and riparian features.

Water Quality

Overall, water quality in the Upper Susquehanna subbasin appears to have improved over the years (Figure 10). The percentage of sites with higher water quality in 2013 exceeded the percentages observed in 2007 and 1998. In contrast, the percentage of sites with lower water quality continually decreased from 1998 to 2013, with no sites having lower water quality in 2013. The percentage of sites with middle water quality in 2013 also continuously fell from 2007 and 1998.

SRBC compared water quality conditions in 2013 with conditions determined from the previous sampling event for each site (Table 4). Similar to the trends mentioned above, 73 percent of sites overall showed no change in condition category, while 16 percent showed an improvement. Eleven percent of sites showed a degradation in water quality condition categories. The most stable conditions were found in the Tioughnioga section (80 percent of sites). Improved conditions were observed more often in the Headwaters section (24 percent), and the Chenango section had the most degradation (38 percent of sites). Water quality ratings for all sites that changed shifted only one category in either direction.

Table 4. Comparison of Condition Categories (2007 and 2013 Data)

Section	Percent of sites with a change in Condition Categories (2007 and 2013 data)								
	Biology			Habitat			Water Quality		
	Improved	Degraded	No Change	Improved	Degraded	No Change	Improved	Degraded	No Change
Headwaters	33	5	62	38	10	52	24	5	71
Unadilla River	43	14	43	17	33	50	14	14	71
Great Bend	37	0	63	25	25	50	13	13	75
Chenango	37	0	63	43	0	57	0	38	63
Tioughnioga	30	0	70	60	0	40	10	10	80
Binghamton to Sayre	41	18	41	24	35	41	18	6	76
Overall*	**37**	**7**	**56**	**35**	**17**	**48**	**16**	**11**	**73**

* Values are calculated from overall dataset and are not averages.

Water Chemistry

SRBC analyzed water quality data from the last three surveys (1998, 2007, and 2013) and compared results to isolate consistently problematic parameters and to identify sites that have chronic issues (Table 5). Of all parameters, total nitrogen exceeded levels of concern most frequently, followed by nitrate, orthophosphate, and sodium. Six streams had chronically elevated total nitrogen, including Catatonk, Hayden, and Owego Creeks, the Unadilla River, and the East and West branches of the Tioughnioga River. These six streams as well as six other streams, including Elk, Ocquinous, and Schenevus Creeks, Chenango River, Sangerfield River, and the Tioughnioga River mainstem had chronically exceeding nitrate.

Cayuta Creek was the only stream to have consistently exceeding levels of orthophosphate, and the West Branch Tioughnioga River was the only stream to have consistently elevated sodium. Other parameters that exceeded and occurred much less frequently included phosphorus, alkalinity, aluminum, and iron.

Two sites previously discussed as having three or more parameters exceeding levels of concern in 2013 have had regular problems with those parameters in past surveys. TIOF 28.7 and WBTF 3.3, both of which are in the Tioughnioga section, have a history of elevated nitrogen, nitrate, and sodium. TIOF 28.7 has also had problems with orthophosphate.

Water chemistry data collected in July 2013 at the five Year-1 sites that also function as RWQMN sites — Cherry Valley Creek, Sangerfield River, Trout Brook, Snake Creek, and Choconut Creek — are consistent with previously documented continuous data and grab sample results at these sites.

Conclusions

SRBC is careful to point out that the results of this survey, as with all Subbasin Year-1 assessments, were based on a one-time sampling event at sites that were chosen for ease of access. For this reason, replicate and more representative sampling along additional segments in watersheds would be needed to truly identify and isolate problems in these watersheds, and statistically valid inferences of the Upper Susquehanna River Subbasin as a whole cannot be accurately stated from the results of this survey.

In general, the streams sampled during the 2013 survey of the Upper Susquehanna subbasin had good biological, habitat, and water quality conditions, but problems persist in certain locations. The vast majority of sites sampled (91 percent) had benthic macroinvertebrate communities that were either nonimpaired or slightly impaired, with only one site having a severely impaired community. Most biological impairment resulted from a dominance of midges, which are pollution-tolerant and adaptable to compromised conditions, as well as decreased numbers of EPTs, which are generally pollution-intolerant and less adaptable.

Most sites (83 percent) also had excellent or supporting habitat, and only 3 percent of sites had nonsupporting habitat. The poorer habitat scores resulted most often from less than optimal flow regimes, sedimentation, embeddedness, and instream cover as well as less vegetated banks which inhibit bank stability. Compromised riparian conditions can result in increased streambank erosion and subsequent sedimentation in downstream reaches, affect the temperature of the stream

Table 5. List of Sites with Parameters Chronically Exceeding Levels of Concern (1998, 2007, and 2013 Data)

Parameter		Number of Exceeding Measurements				Number of Streams with Chronic Issues						
		Total	Value			Total	Within each region					
			Minimum	Maximum	Median		Headwaters	Unadilla	Great Bend	Chenango	Tioughnioga	Binghamton to Sayre
Total Nitrogen	mg/l	59	1	2.78	1.395	6	1	1			2	2
Nitrate-N	mg/l	40	0.64	2.4	1.2	12	4	1		2	3	2
Total Orthophosphate	mg/l	29	0.022	0.32	0.038	1						1
Total Sodium	mg/l	21	20.2	42.2	22.3	1					1	
Total Phosphorus	mg/l	5	0.119	0.349	0.23	1						1
Alkalinity	mg/l	3	16	18	17	1	1					
Total Aluminum	mg/l	3	0.9	1.1	1	0						
Total Iron	mg/l	2	1.7	2.2	1.95	0						
TSS	mg/l	1	30	--	--	0						
Turbidity	NTU	1	59.1	--	--	0						

and associated dissolved oxygen levels, and reduce the input of organic material into the stream that organisms require as a food source. Degraded instream conditions provide less varied habitat to support a diversity of macroinvertebrates and can allow pollution-tolerant and adaptable species to dominate the community. This kind of shift in macroinvertebrate community can affect the food web and the efficiency of energy processing within the stream.

The slight majority of sites had higher water quality (55 percent), and no sites had lower water quality. Forty-two percent of sites had elevated nutrient concentrations from total nitrogen, nitrate, orthophosphate, or some combination thereof. Elevated nutrients were observed throughout all sections, although nitrate and nitrogen were higher more consistently in the Tioughnioga section, and orthophosphate concentrations were most notable in the Binghamton to Sayre section. Elevated nitrate and nitrogen may result from too much fertilizer used on agricultural fields and residential lawns, uncontrolled barnyard runoff, direct access of livestock to streams, increased loads from point sources, leaking septic tanks, outdated sewage treatment plants, or combined sewer overflows.

Elevated sodium concentrations, which can be an indicator of urbanization, were found only in the Tioughnioga section. Elevated aluminum and iron were only observed in the Chenango and Tioughnioga sections. Only one site (CHEN 0.9) had an elevated turbidity level, which is not surprising since the site is located in a large urban center and has been exposed to heavy bridge construction disturbance and storm activity.

SRBC did not observe elevated parameters indicative of unconventional drilling activities at any of the 19 targeted sites or at any of the five Year-1 sites that overlap with RWQMN stations. As mentioned previously, ten RWQMN stations are located throughout the Upper Susquehanna subbasin, and real-time measurements for temperature, dissolved oxygen, pH, conductivity, and turbidity can be found at mdw.srbc.net/remotewaterquality/monitoring_parameters.aspx.

Some of the highest quality watersheds in this survey included Butternut Creek, Canasawacta Creek, Center Brook, Elk Creek, Genegantslet Creek, Oaks Creek, Otego Creek, and Starrucca Creek. Almost all of the watersheds documented in the 2007 study as being impaired showed signs of improvement, including Apalachin Creek, Kelsey Brook, and Kortright Creek.

Efforts should be made to restore the most degraded watersheds and protect the higher quality ones within this subbasin. Information on agricultural best management practices and other conservation methods to limit the impacts associated with farming operations can be obtained from county conservation district offices (www.pacd.org and www.nyacd.org/districts.html).

Low impact development and incorporating groundwater recharge areas can help minimize urban stormwater problems. Both the Center for Watershed Protection's Urban Subwatershed Restoration Manual series (www.cwp.org) and the PADEP's Pennsylvania Stormwater Best Management Practices Manual (PADEP, 2006) provide more information on remediating urban pollution.

While unconventional natural gas drilling activities have been occurring in Pennsylvania since 2008, New York currently remains under a moratorium on the use of this methodology. Once the moratorium is lifted, hydraulic fracturing could be allowed on an experimental basis in the three southern tier counties of Chemung, Tioga, and Broome, located in the Chemung River Subbasin and Upper Susquehanna River Subbasin. Consequently, by combining the Year-2 studies for these two subbasins, SRBC is collecting intensive baseline data in streams that are located in this tri-county area before drilling occurs. By combining the Chemung and Upper Susquehanna Year-2 assessments, SRBC will undertake two years of collecting quarterly water quality samples, assessing seasonal macroinvertebrate communities, and evaluating fish communities at 22 sites. Data will be collected from April 2013 through November 2014, and a final report will be available in 2015. More information on this project is available from SRBC.

Upstream of West Branch Handsome Brook near Franklin, N.Y. (WBHB 0.1)

Sample Site #	Site Name	Location Description	County	Latitude	Longitude	Section	Drainage (sq mi)	Category Description
1	APAL 4.4	Apalachin Creek 350m east of PA Ave, access behind ball fields	Tioga/N.Y.	42.01682	-76.150352	Bing. to Sayre	25.36	Small
2	BEAV 0.7	Beaver Creek downstream of Route 8 bridge near South Edmeston, N.Y.	Chenango/N.Y.	42.72582	-75.30257	Unadilla	32.57	Small
3	BUTT 2.8	Butternut Creek downstream of Route 3 bridge at Copes Corner, N.Y.	Otsego/N.Y.	42.43667	-75.34556	Unadilla	121.86	Medium
4	CATK 1.4	Catatonk Creek 30m DS of Glen Mary Drive bridge	Tioga/N.Y.	42.1417	-76.2947	Bing. to Sayre	149.41	Medium
5	CATK 14.4	Catatonk Creek along West Candor Rd. near West Candor, N.Y.	Tioga/N.Y.	42.22528	-76.42472	Bing. to Sayre	73.1	Small
6	CAYT 1.6	Cayuta Creek at Milltown, N.Y.	Tioga/N.Y.	41.99394	-76.51847	Bing. to Sayre	140.48	Medium
7	CAYT 3.7	Cayuta Creek downstream of Route 34 bridge near Waverly, N.Y.	Tioga/N.Y.	42.02417	-76.52389	Bing. to Sayre	136.64	Medium
8	CAYT 24.5	Cayuta Creek upstream of Route 224 bridge at fishing access near Cayuta, N.Y.	Schuyler/N.Y.	42.26889	-76.6825	Bing. to Sayre	50.73	Small
9	CEBR 0.1	Center Brook upstream of Route 9 bridge at Butts Corner, N.Y.	Delaware/N.Y.	42.47972	-74.81694	Headwaters	51.53	Small
10	CHAR 3.6	Charlotte Creek upstream of bridge at West Davenport, N.Y.	Delaware/N.Y.	42.445	-74.96361	Headwaters	167.12	Medium
11	CHAR 13.2	Charlotte Creek upstream of Route 9 bridge at Butts Corner, N.Y.	Delaware/N.Y.	42.48306	-74.81556	Headwaters	60.74	Small
12	CHEN 0.9	Chenango River Lockwood St, 0.2 mi above Rt 17 bridge	Broome/N.Y.	42.1031	-75.915	Chenango	3212.54	Large
13	CHEN 13.5	Chenango River adjacent to intersection of Route 12 and 79 at Chenango Forks, N.Y.	Broome/N.Y.	42.24083	-75.84111	Chenango	725.16	Large
14	CHEN 38.6	Chenango River downstream of Route 220 bridge at Oxford, N.Y.	Chenango/N.Y.	42.44778	-75.58694	Chenango	460.17	Medium
15	CHEN 69.3	Chenango River downstream of Middleport/Randallsville Road bridge at Randallsville, N.Y.	Madison/N.Y.	42.7975	-75.57056	Chenango	51.84	Small
16	CHOC 1.7	Choconut Creek downstream of Main Street bridge at Vestal, N.Y.	Broome/N.Y.	42.07139	-76.04667	Bing. to Sayre	55.18	Small
17	CHOC 8.4	Choconut Creek at T693/Kellum Road bridge, Pa.	Susquehanna/Pa.	41.98972	-76.00028	Bing. to Sayre	25.38	Small
18	CHRV 0.3	Cherry Valley Creek downstream of Route 35 bridge near Milford, N.Y.	Otsego/N.Y.	42.59306	-74.9275	Headwaters	91.81	Small
19	CHRV 10.2	Cherry Valley Creek upstream of Route 35 bridge at Middlefield, N.Y.	Otsego/N.Y.	42.68889	-74.84222	Headwaters	65.97	Small
20	CNWT 1.6	Canasawacta Creek downstream of Pleasant Street/Red Mill Road bridge at Norwich, N.Y.	Chenango/N.Y.	42.53611	-75.53583	Chenango	60.39	Small
21	EBTF 1.6	East Branch Tioughnioga River upstream of Route 81 bridge at park at Cortland, N.Y.	Cortland/N.Y.	42.60806	-76.15778	Tioughnioga	194.23	Medium
22	EBTF 15.1	East Branch Tioughnioga River upstream of South Hill bridge at Crains Mills, N.Y.	Cortland/N.Y.	42.71056	-76.00472	Tioughnioga	104.79	Medium
23	ELKC 0.1	Elk Creek downstream of Route 7 bridge near Schenevus, N.Y.	Otsego/N.Y.	42.545	-74.84167	Headwaters	32.94	Small
24	GENE 1.6 *	Genegantslet Creek adjacent to Slater Road near Greene, N.Y.	Chenango/N.Y.	42.305	-75.79861	Chenango	104.42	Medium
25	GENE 10.9	Genegantslet Creek upstream of Rt 41 bridge, DS of confluence with tributary	Chenango/N.Y.	42.394358	-75.803481	Chenango	82.37	Small
26	HAYD 0.7	Hayden Creek upstream of Route 53 bridge near Smithfield Corner, N.Y.	Otsego/N.Y.	42.82111	-74.88278	Headwaters	9.69	Small
27	KELS 0.6	Kelsey Creek upstream of Route 7 bridge at Afton, N.Y.	Chenango/N.Y.	42.23111	-75.52167	Great Bend	30.03	Small
28	KORT 0.7	Kortright Creek downstream of abandoned bridge below Route 23 at Davenport Center, N.Y.	Delaware/N.Y.	42.44667	-74.92139	Headwaters	28.16	Small
29	NANT 1.4	Nanticoke Creek at Glendale Park near West Corneus, N.Y.	Broome/N.Y.	42.10056	-76.08111	Bing. to Sayre	111.49	Medium
30	NANT 9.6	Nanticoke Creek DS of Union Center Maine Highway/Rt 26	Broome/N.Y.	42.204795	-76.053689	Bing. to Sayre	48.15	Small
31	OAKS 2.0	Oaks Creek upstream of abandoned bridge near Toddsville, N.Y.	Otsego/N.Y.	42.6825	-74.9575	Headwaters	100.76	Medium
32	OAKS 6.4	Oaks Creek upstream of Cat Town Road/Hoke Street bridge near Cattown, N.Y.	Otsego/N.Y.	42.7312	-75.0033	Headwaters	78.39	Small
33	OCQU 1.1	Ocquinous Creek upstream of Bronner Street bridge above lake at Richfield Springs, N.Y.	Otsego/N.Y.	42.85083	-74.99361	Headwaters	20.58	Small
34	OTGO 0.1	Otego Creek downstream of bridge on Pony Farm Road near Oneonta, N.Y.	Otsego/N.Y.	42.43472	-75.12056	Headwaters	108.91	Medium
35	OTGO 13.1	Otego Creek upstream of Route 11B bridge at Mount Vision, N.Y.	Otsego/N.Y.	42.57833	-75.06028	Headwaters	50.68	Small
36	OTSL 0.1	Otselic River at mouth at Whitney Point, N.Y.	Broome/N.Y.	42.33056	-75.96583	Tioughnioga	257.43	Medium
37	OTSL 8.7	Otselic River downstream of Route 169 bridge near Landers Corners, N.Y.	Cortland/N.Y.	42.4225	-75.94861	Tioughnioga	216.59	Medium
38	OTSL 32.7	Otselic River upstream of Route 26 bridge at fishing access near South Otselic, N.Y.	Chenango/N.Y.	42.68028	-75.75889	Tioughnioga	54.01	Small

Sample Site #	Site Name	Location Description	County	Latitude	Longitude	Section	Drainage (sq mi)	Category Description
39	OULT 0.5	Ouleout Creek downstream of Covered Bridge Road bridge near Unadilla, N.Y.	Delaware/N.Y.	42.3328	-75.2887	Headwaters	109.64	Medium
40	OULT 12.0 *	Ouleout Creek downstream of Chamberlain Hill Road bridge near Leonta, N.Y.	Delaware/N.Y.	42.37167	-75.11583	Headwaters	37.43	Small
41	OWGO 0.1	Owego Creek downstream of Route 17C bridge at Owego, N.Y.	Tioga/N.Y.	42.09833	-76.27694	Bing. to Sayre	342.01	Medium
42	OWGO 12.4	Owego Creek downstream of Route 44 bridge at Newark Valley, N.Y.	Tioga/N.Y.	42.22417	-76.185	Bing. to Sayre	84.25	Small
43	SANG 1.5	Sangerfield River upstream of Cove Road bridge near Earlville, N.Y.	Chenango/N.Y.	42.73111	-75.53417	Chenango	62.16	Small
44	SHEN 1.7	Schenevus Creek downstream of Route 28 bridge near Colliersville, N.Y.	Otsego/N.Y.	42.48583	-74.96889	Headwaters	118.51	Medium
45	SHEN 11.5	Schenevus Creek upstream of Route 41 bridge at Schenevus, N.Y.	Otsego/N.Y.	42.54409	-74.84052	Headwaters	51.47	Small
46	SNAK 0.2	Snake Creek downstream of Erie-Lackawanna RR bridge at Corbettsville, Pa.	Broome/N.Y.	42.015	-75.78861	Great Bend	75.03	Small
47	SNAK 9.0	Snake Creek upstream of Forks Hill Road bridge at Franklin Forks, Pa.	Susquehanna/Pa.	41.91778	-75.84611	Great Bend	17.98	Small
48	STAR 0.9	Starrucca Creek upstream of SR 1009 bridge near Lanesboro, Pa.	Susquehanna/Pa.	41.96667	-75.57361	Great Bend	72.97	Small
49	STLK 0.5	Salt Lick Creek upstream of SR 1010 bridge at Hallstead, Pa.	Susquehanna/Pa.	41.9625	-75.73944	Great Bend	39.6	Small
50	SUSQ 291	Susquehanna River at Route 17 bridge near Litchfield, Pa.	Tioga/N.Y.	42.0075	-76.46861	Bing. to Sayre	4758.57	Large
51	SUSQ 307	Susquehanna River at Route 96 bridge at Owego, N.Y.	Tioga/N.Y.	42.10111	-76.26111	Bing. to Sayre	4225.09	Large
52	SUSQ 325	Susquehanna River upstream of turnaround area near Endwell, N.Y.	Broome/N.Y.	42.1125	-76.00083	Bing. to Sayre	3933.95	Large
53	SUSQ 341.5	Susquehanna River upstream of Conklin Island, N.Y.	Broome/N.Y.	42.02028	-75.78611	Great Bend	2202.18	Large
54	SUSQ 365 *	Susquehanna River upstream of Route 28 bridge at Windsor, N.Y.	Broome/N.Y.	42.07417	-75.63722	Great Bend	1858.09	Large
55	SUSQ 384	Susquehanna River downstream of Route 41 bridge at Afton, N.Y.	Chenango/N.Y.	42.22694	-75.52389	Great Bend	1721.95	Large
56	SUSQ 406	Susquehanna River downstream of abandoned bridge at Wells Bridge, N.Y.	Otsego/N.Y.	42.36667	-75.245	Headwaters	847.19	Large
57	SUSQ 422.5	Susquehanna River upstream of bridge at fishing access near Oneonta, N.Y.	Otsego/N.Y.	42.45528	-75.01667	Headwaters	482.49	Medium
58	SUSQ 442	Susquehanna River downstream of Route 11C bridge near Hyde Park, N.Y.	Otsego/N.Y.	42.66139	-74.95	Headwaters	196.25	Medium
59	TIOF 0.1	Tioughnioga River upstream of Route 12 bridge at Chenango Forks, N.Y.	Broome/N.Y.	42.23833	-75.8475	Tioughnioga	763.47	Large
60	TIOF 9.5	Tioughnioga River downstream of Route 11 bridge at Whitney Point, N.Y.	Broome/N.Y.	42.33083	-75.96694	Tioughnioga	458.97	Medium
61	TIOF 28.7	Tioughnioga River upstream of bridge at Blodgett Mills, N.Y.	Cortland/N.Y.	42.56833	-76.12111	Tioughnioga	346.43	Medium
62	TRBK 0.1	Trout Brook downstream of Route 11 bridge near Cortland, N.Y.	Cortland/N.Y.	42.58611	-76.12917	Tioughnioga	40.52	Small
63	UNAD 5.4	Unadilla River upstream of Route 1 bridge at Rockdale, N.Y.	Otsego/N.Y.	42.37861	-75.40611	Unadilla	519.79	Large
64	UNAD 26.7	Unadilla River downstream of Route 80 bridge at New Berlin, N.Y.	Otsego/N.Y.	42.62583	-75.32722	Unadilla	204.61	Medium
65	UNAD 42.7	Unadilla River upstream of abandoned Kaneatles Turnpike bridge near Leonardsville, N.Y.	Madison/N.Y.	42.82167	-75.24833	Unadilla	88.49	Small
66	WAPP 2.5	Wappasening Creek downstream of Route 187 bridge near Pa./N.Y. state line	Bradford/Pa.	41.99361	-76.34417	Bing. to Sayre	63.13	Small
67	WBHB 0.1	West Branch Handsome Brook upstream of Route 357 bridge near Franklin, N.Y.	Delaware/N.Y.	42.32056	-75.18139	Headwaters	26.6	Small
68	WBOC 5.4	West Branch Owego Creek upstream of West Creek Road bridge near Weltonville, N.Y.	Tioga/N.Y.	42.18528	-76.24639	Bing. to Sayre	73.54	Small
69	WBTF 3.3	West Branch Tioughnioga River upstream of bridge at Homer, N.Y.	Cortland/N.Y.	42.6332	-76.1768	Tioughnioga	71.97	Small
70	WHAR 0.6	Wharton Creek downstream of Route 18 bridge near New Berlin, N.Y.	Otsego/N.Y.	42.61972	-75.31944	Unadilla	92.71	Small
71	WHAR 16.8	Wharton Creek at Route 19 bridge at Beverly Inn Corners, N.Y.	Otsego/N.Y.	42.7645	-75.1693	Unadilla	32.53	Small

* Sites serving as reference sites for the 2013 survey.

Sites that were shifted slightly from previous locations to overlap with NYSDEC RIBS sites .

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