SUSQUEHANNA RIVER BASIN COMMISSION

Annual Report 2019

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On the cover: Sunset on the Susquehanna River in Binghamton, New York
Photo Credit: Bill Badzo

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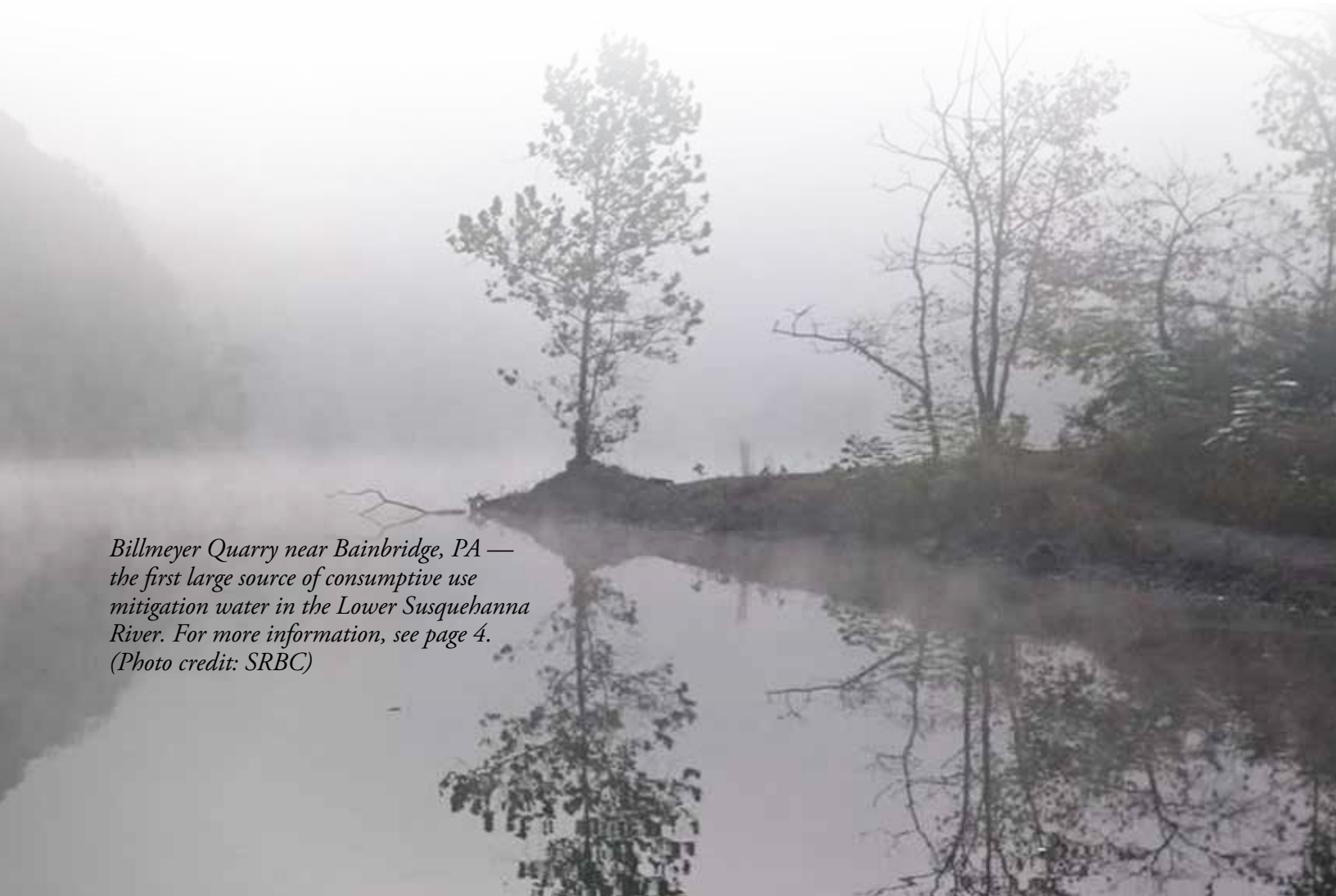

Billmeyer Quarry near Bainbridge, PA — the first large source of consumptive use mitigation water in the Lower Susquehanna River. For more information, see page 4. (Photo credit: SRBC)

EXECUTIVE DIRECTOR'S *Message*

Coordination and cooperation serve as the underpinning of nearly everything that SRBC does.

In 1972, devastating, record-setting flooding from Tropical Storm Agnes set SRBC's course and agenda for many years to come. SRBC launched work on detailed mapping of flood plains and predicted depths of flood waters. In the mid-1980s, SRBC spearheaded an interagency committee that resulted in the establishment of a state-of-the-art flood forecast and warning system for the basin — one that has delivered an impressive 20 dollar benefit for every federal dollar invested in it.

The Susquehanna Flood Forecast and Warning System exemplifies good government by avoiding duplication of effort. Likewise, SRBC leaves water quality regulations largely to the states and serves to complement jurisdictional efforts with supporting monitoring and research. But no other agency has ever focused on the sustainable management of water supplies from an overall river basin, or watershed, perspective.

Regulations and water use planning help SRBC ensure that water use doesn't exceed available supplies while also avoiding conflicts among users and adverse impact to the environment. Without a check on the quantity and rate of water withdrawals, we would see the permanent loss of groundwater supplies, degraded water quality and habitat, and severely reduced stream flows.

SRBC also coordinates the management of interstate water resources and resolves issues and conflicts within the basin. It conducts a variety of studies and runs a number of stream and river monitoring networks, all of which provide scientific data from which to make sound management and policy decisions.

SRBC reports on the status of basin resources and helps municipalities advance public drinking water protection. We participate in cooperative management plans to address issues such as stream restoration, abandoned mine drainage remediation, invasive aquatic species and drought preparedness.

This cooperative spirit is exemplified by the projects highlighted in this 2019 Annual Report. By coordinating efforts with agencies and organizations such as the Lancaster County Solid Waste Management Authority, New York Department of Environmental Conservation, U.S. Army Corps of Engineers, and Pennsylvania Fish and Boat Commission, SRBC can deliver cost-effective programs that support water supply availability, water quality protection, community flood and drought preparedness, and natural habitat preservation.

SRBC serves as a model for interstate watershed management. It deserves the support of the federal and state signatory parties that created it, and its staff and commissioners look forward to continuing these critical water management services for the Susquehanna River Basin.

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ENSURING WATER AVAILABILITY

Project sponsors who receive a permit for consumptive water use—water removed from available supplies and not returned to a stream, river, or treatment plant—are required to mitigate this use in time of drought by returning water to the source. Since 1993, project sponsors have been permitted to pass the responsibility of this consumptive use mitigation over to the Commission by paying a fee that allows the Commission to replenish water to the Susquehanna from large-scale water storage projects during drought conditions.

Since 2016, the Commission has been working with the Lancaster County Solid Waste Management Authority (LCSWMA) to explore the use of the 29-acre Billmeyer Quarry near Bainbridge, PA, as the first large source of consumptive use mitigation water in the Lower Susquehanna River Basin. Currently, the main sources of this mitigation water are two U.S. Army Corps of Engineers reservoirs in northern Pennsylvania and New York and treated discharges of water from abandoned coal mines.

In 2016, a preliminary investigation found the quarry to be of sufficient size to provide consumptive use mitigation. Further study determined that the project would not adversely impact three endangered species known to the area, but an invasive species present within the quarry, the quagga mussel, would need to be eradicated. The mussel was subsequently eliminated using a proprietary copper-based treatment in 2017.

A pumping test run after the mussels were eliminated revealed that the volume of water available for mitigation was 425 million gallons with minimal impact to surrounding water users. SRBC entered into a water storage agreement with the LCSWMA, under which the Commission will pay the waste authority for water storage and any discharges during drought conditions. An operations plan was finalized in 2019.

Additional monitoring wells and the infrastructure needed to pump water from the quarry to provide mitigation to the Susquehanna River will soon be installed.

Before closing in 1957, the quarry produced dolomite, limestone and road stone. Today, it will be a source of clear water to sustain the river's flows during low flow periods.

SRBC staff Brianna Hutchison processes a biological sample from the Billmeyer Quarry.

ENHANCING ECOSYSTEMS

In 2009, SRBC worked closely with the U.S. Army Corps of Engineers and New York State Department of Environmental Conservation to finalize a new plan for Whitney Point Reservoir (Broome County, NY), which modified reservoir operations to maintain a constant year-round pool level and provide water storage to release during low flows or drought conditions. These low-flow augmentation releases are designed to reduce stress on the downstream aquatic ecosystems — including 60 miles of stream habitat in the Otselic, Tioughnioga, Chenango and Susquehanna Rivers — as well as minimize impacts to recreation and improve habitat in the lake.

SRBC staff monitor fish populations using electrofishing in the Tioughnioga River, five miles upstream of the Whitney Point Reservoir dam.

A long-term monitoring plan set out to evaluate the impact of the reservoir's operational changes on downstream hydrology and ecosystems and in-lake conditions. Monitoring results spanning ten years are now available in a technical report *Investigating Low Flow Augmentation Impacts on Whitney Point Lake and Adjacent Rivers from 2009-2017: A 10-Year Review*.

Luanne Steffy, SRBC Aquatic Biologist and lead researcher, reports that ten years of monitoring have provided valuable insights into this type of monitoring and the evaluation of low flow augmentation.

First, quantifying the impact of low-flow augmentation on water quantity, or hydrology, is easier than definitively demonstrating the direct benefit to complex ecosystems. Monitoring showed downstream impacts of reservoir operations were minimal, and water releases kept downstream flows above dangerously low levels.

Ecosystem health, on the other hand, is influenced by temperature, nutrient enrichment, and stream flashiness, in addition to high, median, and low stream flows. While some correlations were found between these factors and macroinvertebrates and fish species, metrics varied across years and monitoring sites and were impacted by the relative lack of low flow conditions during the study period. Results show the value of looking at annual conditions compared to long-term data.

During the ten-year monitoring period, there was only one persistent dry period that triggered a 16-day release of water from Whitney Point Lake to enhance downstream river habitat. The release in 2016 was enough to noticeably alter the low-flow statistics downstream, which means such releases could reduce impacts to stream ecology during low-flow events. However, in large systems like the Tioughnioga and Chenango Rivers, which are wide and low gradient, the amount of water released helps preserve water depth and velocity more than wetted habitat area. Subsequent studies should include continuous instream monitoring that would better quantify water quality benefits.

ASSESSING STREAM HEALTH

Electrofishing briefly stuns fish without causing lasting harm, allowing scientists a quick and safe way to evaluate fish populations.

In 2010, SRBC launched the Remote Water Quality Monitoring Network (RWQMN) in areas of Pennsylvania and New York that are underlain by the Marcellus Shale Formation. The network provides a scientific framework to evaluate important water resource problems that could result from shale gas extraction.

Within three years, RWQMN grew to 60 stations. Ten stations are located on Pennsylvania state forest lands, and half a dozen others are located on streams that drain significant portions of state forest lands. A new report summarizes the results of monitoring these stations located in and near state forest lands.

The main feature of each RWQMN station is continuous in-stream monitoring (CIM) technology; electronic sensors that measure the following water quality indicators every 15 minutes: water temperature, pH, dissolved oxygen, turbidity, and specific conductance. CIM data are relayed from the stream by cellular modem, and readings are publicly available in real-time on SRBC's website. Although CIM technology is the cornerstone of the RWQMN, other key measures expected to be sensitive to change are part of the program, including annual surveys of biology and quarterly sampling and lab analyses for 20 substances in water.

According to a report specific to the RWQMN stations tied to Pennsylvania state forest lands released by SRBC in 2019, eight years of monitoring data showed no adverse effects from shale gas production to water quality. The report covers predominantly forested watersheds in six northcentral counties, most of which include High Quality or Exceptional Value streams.

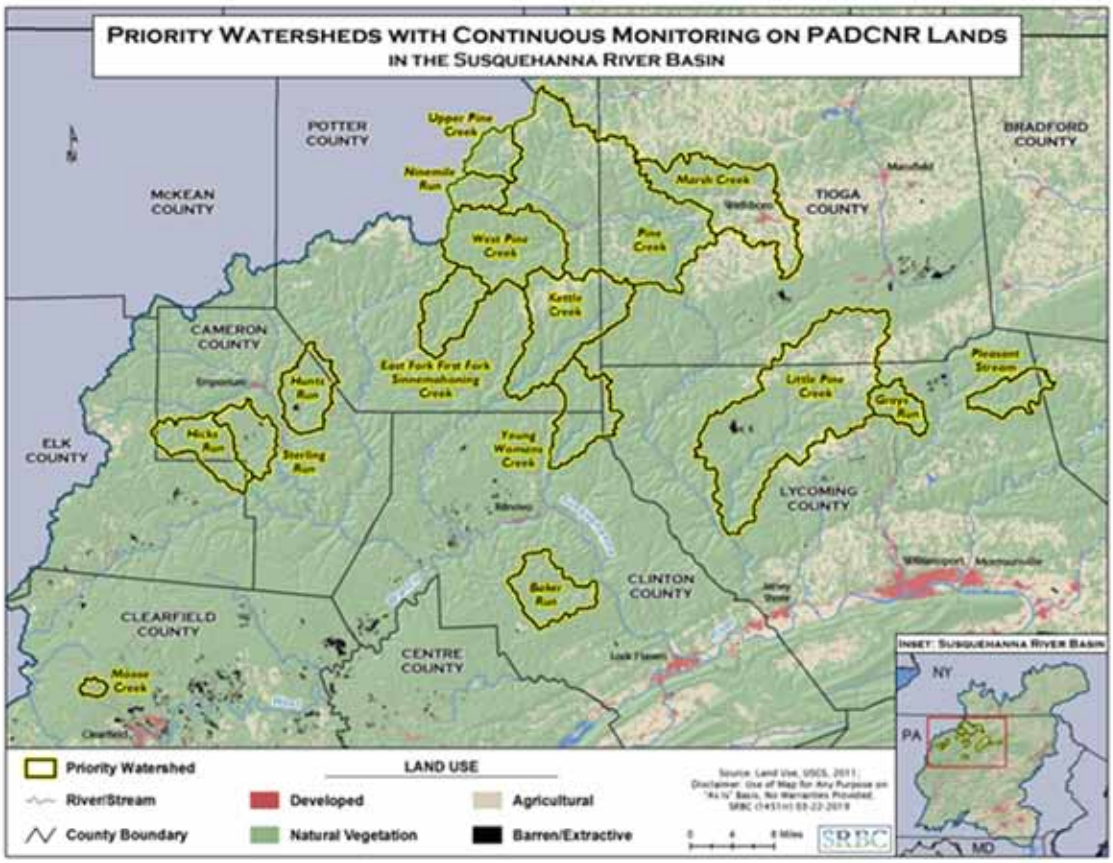
KEY FINDINGS:

- All stations exhibited low specific conductivity. Fluid wastes produced by fracking typically have very high specific conductance, and spill or leak of such wastes would raise the specific conductance of the stream.

- Of the 20 water chemistry parameters measured four times each year, the overwhelming majority of substances met human health and aquatic life water quality standards during each sampling event. Only concentrations of nitrate and sodium were detected at concentrations higher than corresponding water quality standards, and such occurrences were limited to just a handful of samples spread across eight years. Both nitrate and sodium are associated with various sources and, based on the full context of information provided by the RWQMN, neither substance was attributed to shale gas production.

- The majority of stations support excellent biological communities.

- Average stream temperatures were year-round cool — water temperatures consistently were supportive of trout and other cold water fish.



Priority watersheds with continuous monitoring on PA DCNR lands. SRBC launched the Remote Water Quality Monitoring Network (RWQMN) in areas of Pennsylvania and New York that are underlain by the Marcellus Shale Formation.

- Average turbidity concentrations were low for these sites. Turbidity measures the relative clarity of water; higher concentrations indicate cloudier water and, in general, turbidity increases as land development in a watershed intensifies.

Compared to other RWQMN stations, most sites within state forest lands represent healthier stream conditions, an outcome that is expected because forested watersheds generally protect streams from disturbances that diminish water quality and stream health.

SRBC will continue to monitor the health of these streams within state forest land that are of interest to the Pennsylvania Department of Conservation and Natural Resources (PA DCNR) and all Commonwealth residents.

It is important to note that the applicability of real-time CIM and related monitoring network data is not limited to potential impacts of shale gas production. Beginning in 2015, the Commission expanded RWQMN stations to areas of the basin outside the area of shale gas production.

No matter where stations are located, RWQMN data are used by the Commission and others to evaluate whether water quality and biologic conditions are changing over time and to gain a better understanding of the environmental factors that influence water resource conditions.

Wild brown (above) and brook (below) trout caught during electrofishing surveys within PA state forest lands (scales show centimeters). Scientists identify and count all fish captured, measure length and weight of certain types of fish, and note signs of disease, injury, or ill health before fish are released.

RESTORING LEGACY MINE LANDS

For decades, land reclamation efforts introduced grass, shrubs and non-native plants to areas that had been surface mined in the Appalachian region. The once forest-dominated landscape became grassland, where significant soil compaction and competition with other plants impeded the establishment of trees. Grassland-based reclamation has consequently altered wildlife habitat, compromised forest production, and affected local water and air quality.

In 2019, SRBC began a partnership with the Pennsylvania Department of Environmental Protection, federal Office of Surface Mining (OSM), Pennsylvania Environmental Council, Chesapeake Bay Foundation, and others to complete large-scale reforestation projects on legacy mine lands throughout the Susquehanna River Basin.

Using OSM's Forest Reclamation Approach, the compacted soil of a legacy mine site is "ripped" with a large bulldozer and four-foot ripping shank, creating loose, rooting soil material that trees prefer. Sites are ripped in a checkerboard fashion with 8-foot-by-8-foot centered spacing. At each center, a tree seedling is planted, with focus on high value hardwoods, conifers, and wildlife shrubs. Approximately 680 tree seedlings per acre are planted, a density that overcomes loss from deer browse and general mortality.

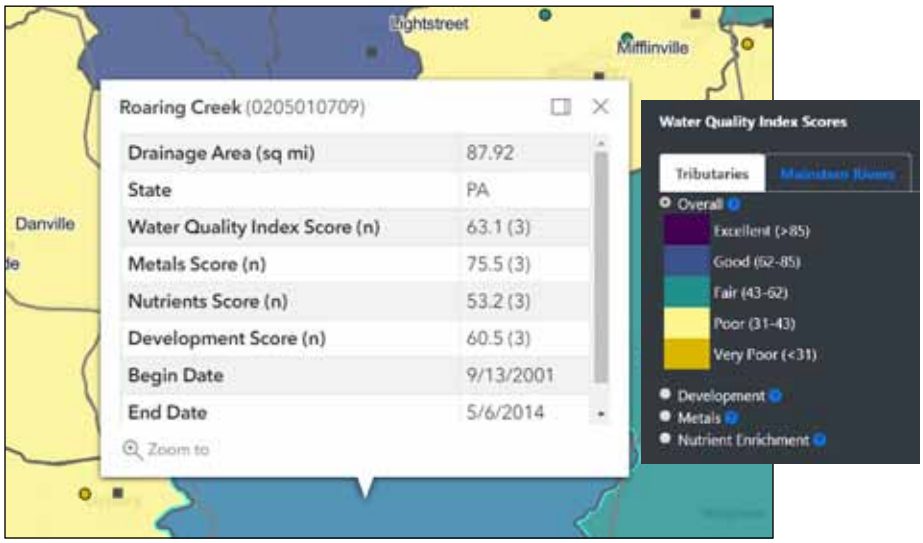
Reforesting these legacy surface mine sites has many benefits. Ripping of the site helps recreate the natural hydrology of the area, allowing for groundwater recharge instead of sending surface flow to a stream, which can exacerbate flooding issues. Whereas rainfall on compacted grassland quickly flows off and into nearby streams, the ripping and reforestation process keeps the rain on site and drastically reduces the amount of sediment entering waterways. Trees also have the ability to absorb, use, and transpire water, which means less water makes it to the substrate, effectively reducing mine drainage production. (A fully grown tree may lose several hundred gallons of water through its leaves on a hot, dry day.) In addition to the water quality and quantity benefits, a reforested site serves as a significant source of carbon sequestration, which is becoming more vital as our climate changes.

SRBC worked with its partners to reforest roughly 120 acres in Huntingdon, Clearfield, Clinton, and Cambria counties, planting approximately 80,000 tree seedlings in 2019. The success of this approach is fueling additional funding, and plans are underway for additional reforestation projects for 2020 and beyond.

Tom Clark, SRBC Mine Drainage Program Coordinator, stands next to a sycamore seedling. The Forest Reclamation Approach can lead to tremendous growth — this seedling was planted only six months prior to taking this photo.

COMMUNICATING *the* SCIENCE

How can scientists best translate technical data into something stakeholders and the public can readily understand and use? How do scientists know the importance of water quality concentrations across rivers and streams if they meet basic water quality standards? How can scientists show improvement in water quality across time?



Example of site level WQI data available using the interactive map. Scoring is comprised of three category scores and an overall water quality score. All sites on the map have at least one category score, but may not have all three scores or an overall score.

SRBC staff scientists recently developed a Water Quality Index (WQI) for the Susquehanna River Basin to help answer these and other challenging questions. The Susquehanna WQI was completed in 2019 with three main objectives: 1) assess water quality at a stream site over time and allow for comparisons between sites within the river basin during baseflow conditions, 2) allow water quality information to be easily understood and used by decision makers and the public, and 3) serve as the basis for linking chemical stressors (water quality parameters) to potential biological responses.

The Susquehanna WQI was developed using Commission monitoring data collected during the ten-year period 2008-2017 from throughout the river basin. The final dataset includes 8,119 records from 1,394 unique stream sites. The Susquehanna WQI converts raw concentrations of nine commonly monitored parameters into an index number between 0 and 100 — the greater the number, the better the water quality. The nine parameters are grouped into three category scores:

- metals (aluminum, iron, and manganese);
- nutrient enrichment (nitrate, total phosphorus, and total organic carbon); and
- development (chloride, sodium, and sulfate)

The user-friendliness of the tool and an intuitive 0-100 scoring scale are two of its greatest strengths, along with the ability to easily track changes in water quality across spatial and temporal scales. In addition to the overall WQI score, each category score can be used individually as a mechanism to compare specific water quality issues in certain geographical regions of the Susquehanna River Basin.

One of the first large-scale applications of the Susquehanna WQI was to calculate WQI scores for all sites with sufficient data from 2000-2018 and average these scores for each Hydrologic Unit Code (HUC) 10 watershed in the basin. An interactive map was created to allow users to view color-coded water quality ranks (excellent, good, fair, etc.) at the broad scale level as well as zoom in to individual streams and sites. (https://www.srbc.net/portals/water-quality-projects/water-quality-index/)

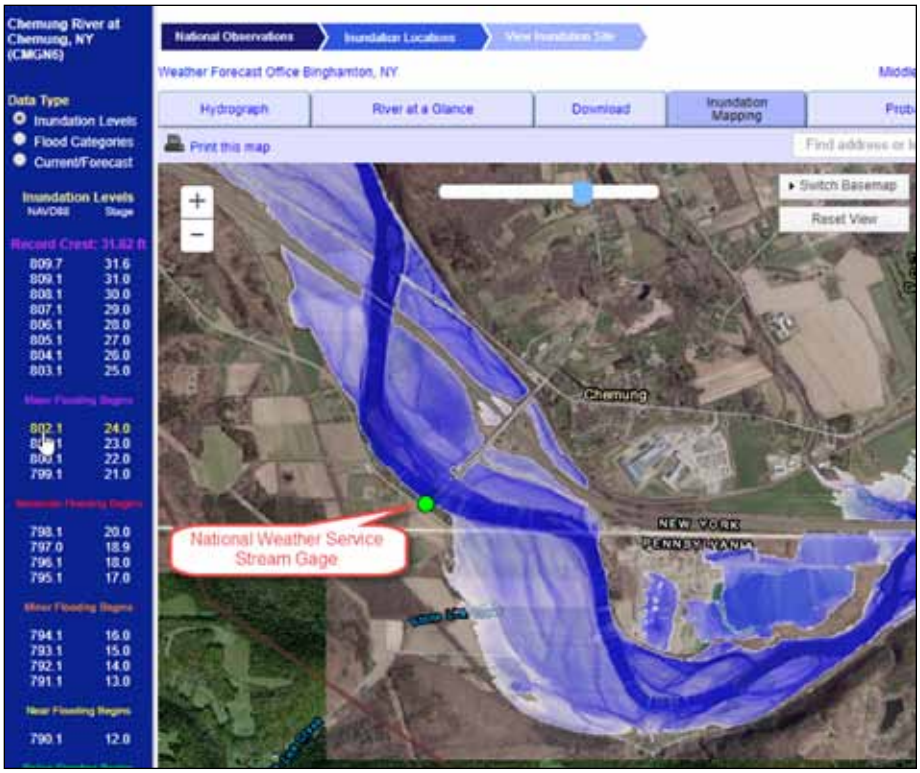
Given its long-standing mission in water quality monitoring, the Commission is pleased to introduce an easily understandable WQI that will meet a wide variety of needs and serve multiple purposes for the Susquehanna River Basin. The clarity and simplicity of its output coupled with its ease of use make this tool applicable for the technical scientific user as well as water resource managers, policymakers, and non-scientists alike.

FLOOD WARNING *for* EARLY RESPONSE

SRBC continues to actively support and promote development of online flood inundation maps that show the extent of flooding relative to a local forecast. The web-based maps inform the general public, local officials, and emergency managers of flooding risks based on forecast "stage" at National Weather Service river gages (NWS forecast points) along the main stem Susquehanna River and tributary rivers.

Currently, there are 14 New York and 9 Pennsylvania NWS forecast points with available online inundation maps. The most recently available maps in Pennsylvania cover a 100-mile stretch of the Susquehanna River in the Wyoming Valley area (Wilkes-Barre, Bloomsburg, Danville, and Sunbury), a 53-mile stretch along the Swatara Creek in Dauphin, Lebanon, and Schuylkill counties, and the West Branch Susquehanna River at Jersey Shore. In New York, maps were recently completed for the Chemung River at NWS forecast points for the towns of Chemung, Corning, and Elmira. All of the SRBC supported inundation map libraries are available online at www.srbc.net.

The most recent New York maps are the result of a collaborative effort by the New York "Silver Jackets" team. Team members include the U.S. Army Corps of Engineers, National Weather Service, Federal Emergency Management Agency, New York State Department of Environmental Conservation, U.S. Geological Survey and SRBC.



Stream gage information is vital in the creation of flood inundation maps, which allow users to enter a property address and view the extent of flooding at different flood stages. This view shows the extent of flooding around Chemung, NY at a stage of 24 feet (major flood stage). In addition to online maps, SRBC maintains an archive of inundation maps that can be accessed by sending an e-mail request to inundationmaps@srbc.net.

Facilitated at the state level across the nation, Silver Jackets teams leverage available resources to provide technical tools, public outreach, and support to flood impacted communities with the ultimate goal of reducing damages and protecting lives during flood events.

Inundation maps are a valuable tool for first responders, municipal officials, and community residents to plan for and respond to a current flood event of specified magnitude.

REACHING OUT *in* 2019

While raising the eels in their classrooms, students at Lewisburg Area High School, Lewisburg, PA, will learn about water quality, ecology and migratory fishes. At the end of the program the eels will ultimately be returned to the Susquehanna River to complete their life cycle.

SRBC SUPPORTS EELS IN THE CLASSROOM

Fisheries Biologist Aaron Henning is SRBC's representative on the basin's interagency migratory fish restoration cooperative and has championed the return of the American Eel by working closely with the Pennsylvania Fish and Boat Commission and the U.S. Fish & Wildlife Service. One-million American Eels have been recovered and stocked upstream of the Conowingo Dam. The potential ecological benefits of migratory fish restoration have been known for years, but only now is their value beginning to be realized.

For example, eels serve as an intermediate host species for some freshwater mussels, another imperiled group of animals that filter pollutants out of our streams and rivers. In streams where eels and mussels once again co-exist, the mussels are now successfully reproducing thanks in part to the return of the eel.

Through an internal funding award directly from SRBC, seven Pennsylvania schools and the Bradford County Conservation District each received 15 juvenile eels to raise in 2019.

Eels were collected from elver ramps located on the Octoraro Creek and the Susquehanna River at Conowingo Dam and given to the local students and educators. The 2019 participants include: Lewisburg Area High School, Bradford County Conservation District, Mifflin County Junior High School, Valley View High School, Abington Heights School District, Milton Area School District, Loyalsock Township School District, and East Pennsboro High School.

LOCAL CONCERNS ARE HEARD

Improving the public's understanding of the Commission's water management responsibilities and fully considering public concerns over water withdrawal decisions are important responsibilities of SRBC. In some cases, it may take months, or even years, to fully gather and review pertinent information regarding withdrawal applications.

A case in Luzerne County, PA, illustrates the due diligence that SRBC staff give application reviews. A request to withdraw groundwater for a bottled water facility drew concerns from area residents including Beech Mountain Lakes Association. At the request of Butler Township, SRBC staff attended several public meetings to hear concerns over how the withdrawal could adversely impact local drinking water supplies, water quality, and downstream flows.

While not all concerns raised are under the jurisdiction of SRBC, staff continue to communicate with concerned parties and will evaluate the ability of the aquifer to provide water for both the local community and the requested withdrawals. Such a process often involves revised withdrawal applications, aquifer testing, and consideration of efforts to mitigate potential impacts.

2019 ANNUAL EXCELLENCE AWARD

Aaron Henning, CFP

Fisheries Biologist

AFS Certified Fisheries Professional

Aaron Henning advanced and fulfilled the mission of the Commission by consistently and exceedingly demonstrating teamwork, professionalism, and quality.

With safety in mind, Aaron adeptly led field work during a rain-plagued field season to collect high quality data. Aaron leveraged his involvement with the Susquehanna River Anadromous Fish Cooperative to repatriate an important fish species, the American Eel, to its former habitat in the Susquehanna River Basin. In large part due to Aaron's efforts, eels have now been observed as far west as the Sinnemahoning Creek and as far north as Colliersville Reservoir, near the source of the Susquehanna River. Aaron's foresight to implement a monitoring project in watersheds where eels are being reintroduced is recognized nationally. Aaron was also instrumental in establishing a successful educational initiative called *Eels in the Classroom* for middle and high school students. (See article on page 11.)

Due to Aaron's leadership of the Large River Monitoring program, the program has matured into a comprehensive assessment of the Basin's largest waterways that yields insight to initiatives of the Commission and sister agencies. He is nationally recognized for his expertise in fish taxonomy and is also an integral part of the Susquehanna River Anadromous Fish Cooperative, which is tasked with the important responsibility of improving fish passage operations at hydroelectric projects in the lower Susquehanna River.

2019 EMPLOYEE SPOTLIGHT AWARDS

Chad Martier

Compliance Specialist

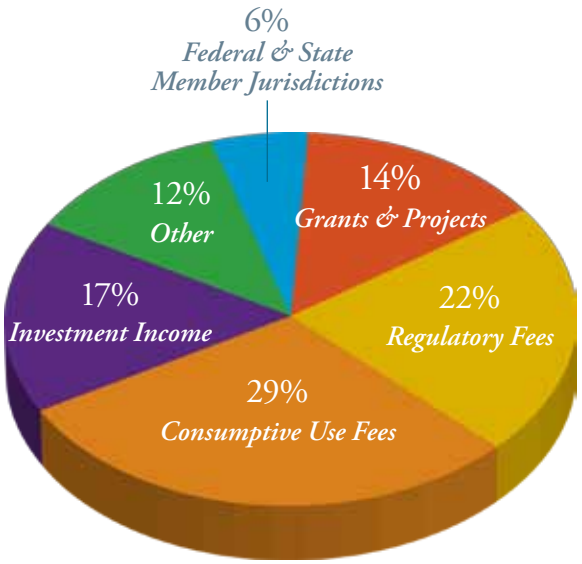
Dawn Hintz

Environmental Scientist

FISCAL YEAR 2019 FINANCIAL SUMMARY

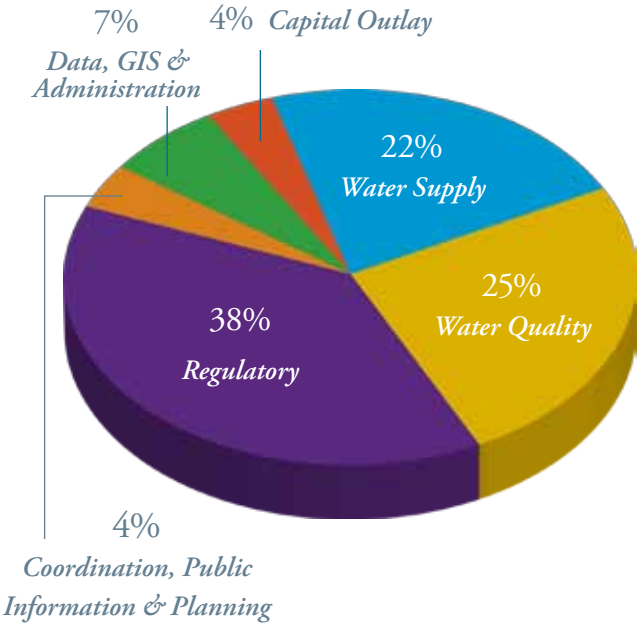
REVENUE

		Fiscal Year 2019 Total
Federal & State Member Jurisdictions	$	890,689
Grants and Projects	$	2,292,765
Regulatory Fees	$	3,476,056
Consumptive Use Fees	$	4,670,787
Investment Income	$	2,657,250
Other	$	1,857,893
TOTAL	*$*	*15,845,440*



EXPENDITURES

Water Supply	$	2,631,574
Water Quality	$	2,982,715
Regulatory	$	4,546,132
Coordination, Public Information, and Planning	$	476,328
Data, GIS, and Administration	$	796,473
Capital Outlay	$	436,433
TOTAL	*$*	*11,869,655*



COMMISSION FUNDS - ADDITIONS (REDUCTIONS)

Fiscal Stabilization Fund	$	(901,202)
Sustainable Water Resources Fund	$	(36,230)
Water Management Fund	$	4,913,217
TOTAL	$	3,975,785