The Hudson River Subwatershed & Tributary (THuRST) Research Network and Monitoring Partnerships

Kate Meierdiercks

Department of Environmental Studies and Sciences, Siena College

Hudson River Watershed Alliance

Goals

- Discuss community-university-municipality WQ monitoring partnerships logistics and why these partnerships can be mutually beneficial
- Share best practices, some examples and lessons learned, and resources (where to find partners, funding opportunities) at the subwatershed scale
- Scaling up community-university-municipality partnerships: The Hudson River Subwatershed & Tributary (THuRST) Research Network
- Answer questions and encourage others to share their experiences, lessons learned, and best practices

Community-University-Municipality WQ Monitoring Partnerships

- Could partner with any combination of student(s), faculty, or staff
- Options for time commitment:
  - One-day volunteer, service, or citizen science events
  - Semester-long or multi-semester projects (course project, internship, independent study)
  - Long-term/multi-year research collaborations, often grant-funded

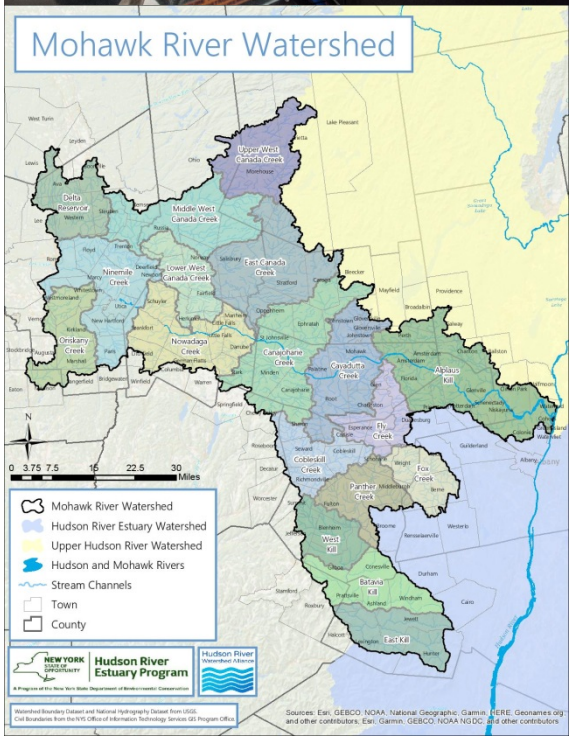
Community-University-Municipality WQ Monitoring Partnerships

Are a really great way to:

- Explore a personal curiosity: collect preliminary or screening data, test a hypothesis, execute a pilot or demonstration project
- Utilize technical services or equipment (ex. GIS software, laboratory equipment) that your organization does not have access to
- Fulfill your organization's outreach and/or education goals
- Meet MS4 requirements

Works well for projects that:

- Are not time-sensitive (the academic time scale is unique) but do have a defined beginning and end
- Have clear goals, objectives, and outcomes
- Involve faculty *and* students



Why college/university professors and researchers want to partner with you

- Provide learning and training experiences for future watershed professionals, stewards, and advocates
- We are always looking for new project ideas
- Partnerships increasingly more important for funding
- Provide resume building and networking opportunities for students
- Job/personal satisfaction
- Obtain “local knowledge”, unique insights

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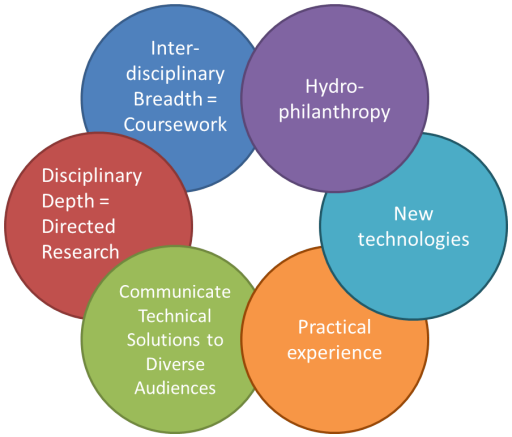
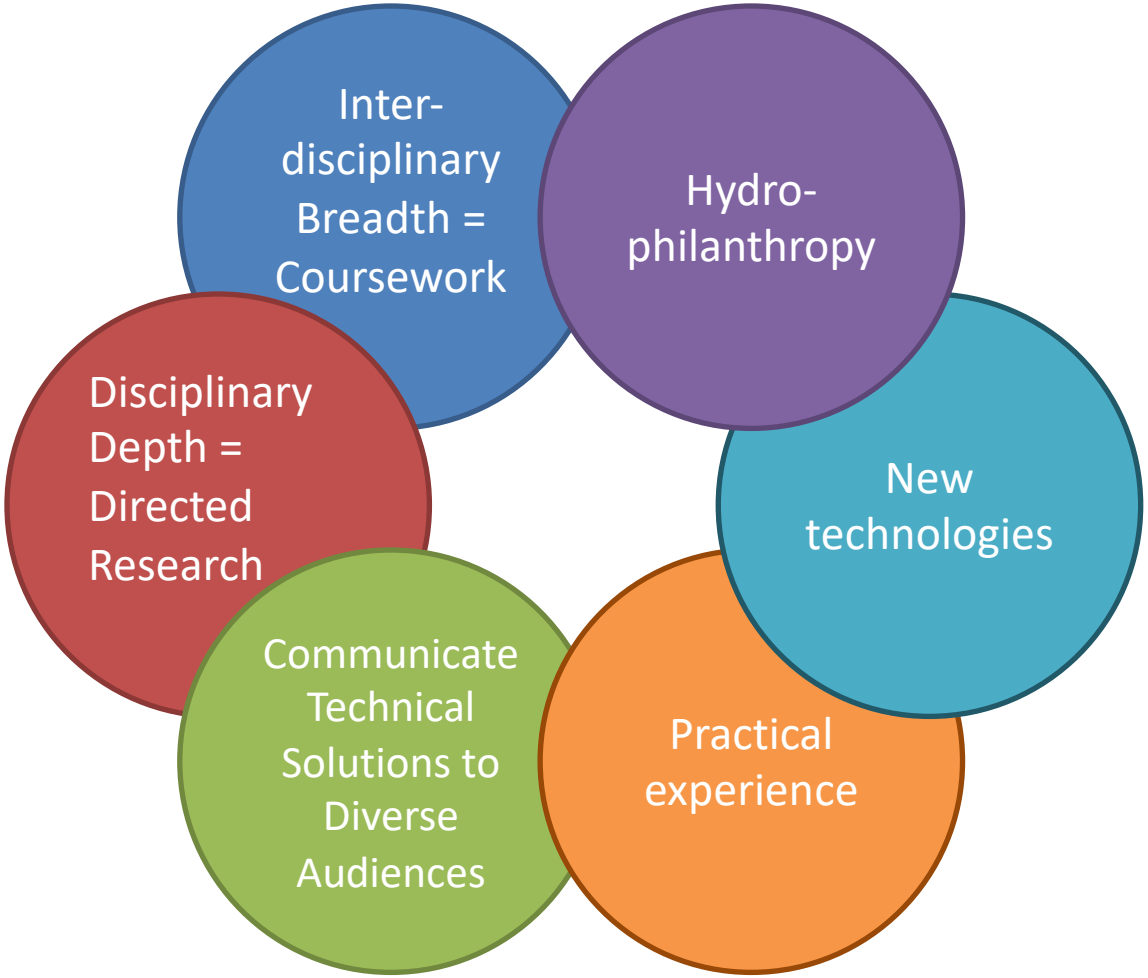
Training Future Water Scientists and Stewards

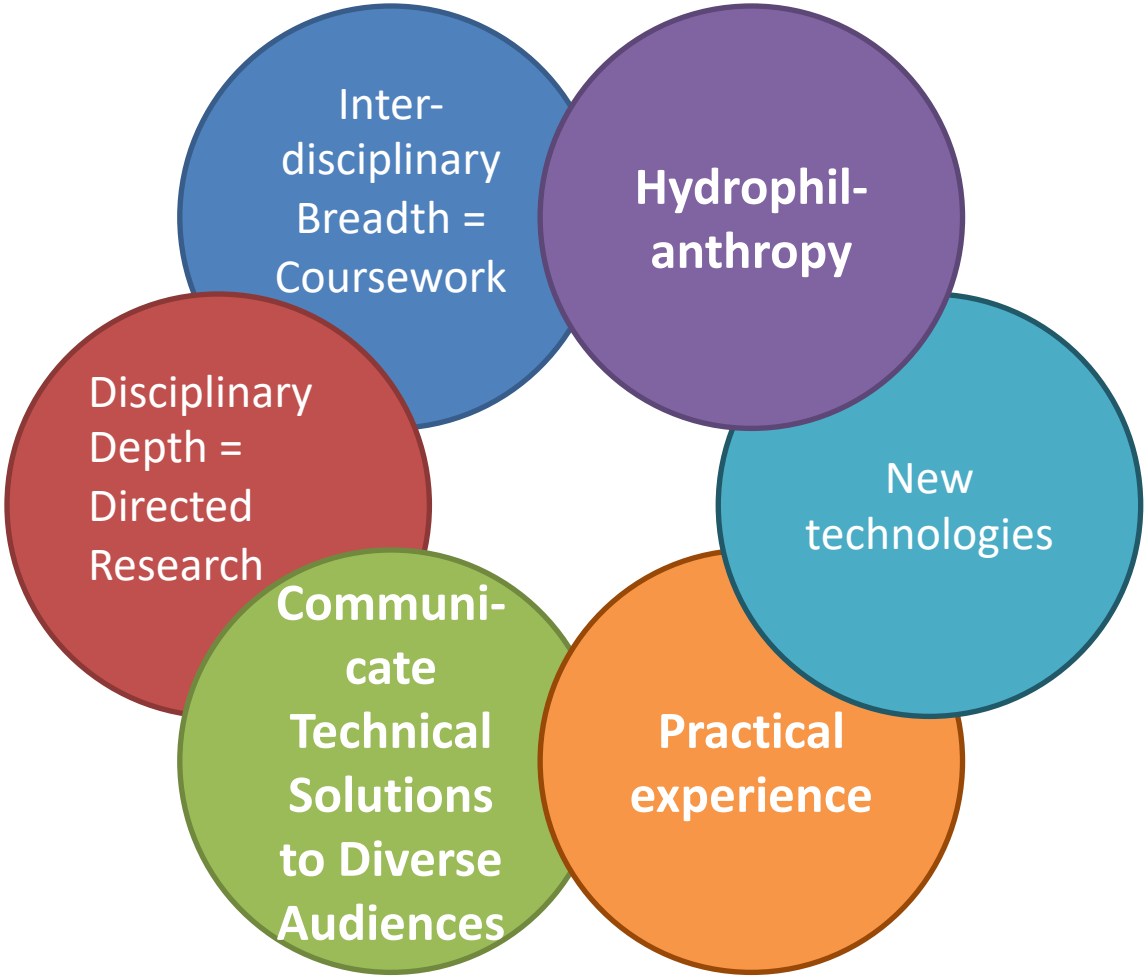
In order to solve the world's complex water problems, "It is important to cultivate hydrologic scientists and engineers with intellectual breadth and disciplinary depth and graduates with enriched communication skills to enable them to easily work on interdisciplinary teams. During the education experience, periods of practical experience using the laboratory and field, exposure to new technologies, and service-minded activities ("hydrophilanthropy") are all techniques to achieve this goal" (National Research Council, *Challenges and Opportunities in the Hydrologic Sciences* [2012]).



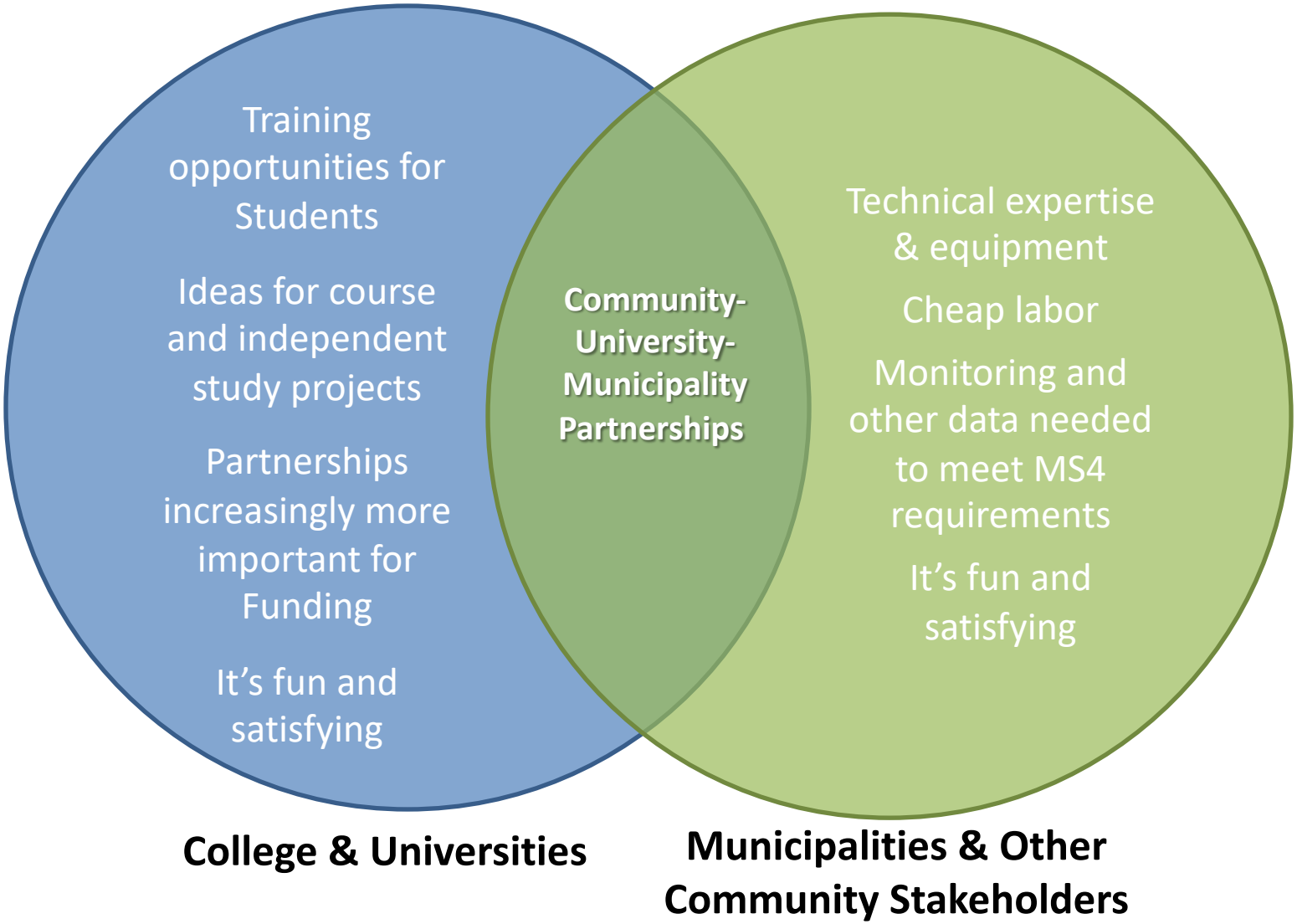
Training Future Water Scientists and Stewards



Training Future Water Scientists and Stewards



Community-University-Municipality Partnerships can be WIN-WIN



Best practices

- Meet with the professor/researcher to discuss potential project ideas; however, it could be several months before they can identify a student or course to work on the project. The pay off is that projects work best when there is a natural fit (course or student).
- Spend the time to make sure your goals are aligned with the professors/ researchers goals (could be a matter of framing the question ex. What is the water quality of the Patroon Creek versus is it safe to swim and fish in the Patroon Creek?) and that everyone is getting a ROI.
- Make sure everyone's expectations are clear from the beginning. Draft and sign a MOU.
- Ask for a certificate of insurance (they're easy for us to provide).
- Schedule your follow-up meeting BEFORE the project kicks off or in the very early stages. At the end of the semester students and faculty are exhausted and eager to move on to the next exciting project. If the meeting already in the calendar, it's more likely to happen.
- Undergraduate students working on a course project do have finite capabilities, time, and motivation. If the project doesn't meet your needs first time around, ask that another student pick up the project where the previous one(s) left off.

Where to find university and college partners

- Contact us directly, network at events like this
- Academic community engagement office
- Undergraduate research office

Example projects and lessons learned

- Day-long event: WAVE (macroinvertebrate) sampling
- Semester project: Unified Subwatershed & Site Reconnaissance, Outfall Reconnaissance Inventory, Unified Stream Assessment
- Multi-year project: long-term water quality monitoring

WAVE (macroinvertebrate) sampling

- Water Assessments by Volunteer Evaluators (WAVE) is citizen-based water quality assessment developed by DEC. The purpose of WAVE is to enable citizen scientists to collect biological data for assessment of water quality on wade-able streams in New York State.
- Relatively low-tech way to better understand water quality in a local stream
- Data may be useful for meeting MS4 requirements
- Excellent opportunity for education and outreach as well as to engage with technical experts
- Excellent way to dip your toes in the water (pun intended) on the way to more extensive water quality monitoring projects
- More info: https://www.dec.ny.gov/chemical/92229.html

Get Your Feet Wet!

Help monitor local streams in Albany County this August!

Citizen science volunteers needed for 2019!

August 20 and 27

Onesquethaw-Coeymans and Patroon Creek watersheds

Sponsored by the Stormwater Coalition of Albany County

The Stormwater Coalition of Albany County is an inter-municipal partnership of public institutions responsible for implementing Clean Water Act requirements. One requirement is to help the public get involved doing things to protect our streams.

Stream monitoring is fun. Plus the data collected helps us better understand which streams are healthy and which streams need help.

This year the Stormwater Coalition has selected two streams to monitor in Albany County. The data is collected using a method developed by the New York State Department of Environmental Conservation. It is called "WAVE" (Water Assessments by Volunteer Evaluators).

As a volunteer you'll collect "stream bugs" using nets, assess habitat, and fill out forms describing how you might want to use the stream (fishing, swimming, etc.). Your data is then sent to NYSDEC scientists. The bugs, or macroinvertebrates, are the "canaries in a coal mine" which tell us if a stream is affected by pollution or not.

Local WAVE coordinators from the Coalition lead these monitoring events. They locate sites, provide equipment. train volunteers, and share results once the monitoring is completed.

WAVE data is valued and the experience unforgettable.

Sign up today!

When & Where

(weather permitting, dates re-scheduled as needed)

Tuesday, August 20, Onesquethaw Creek
4:45pm to ~6:15pm (This creek drains to the Hudson River. The monitoring site is located in the Town of Bethlehem.)

Tuesday, August 27, Sand Creek 10:00am to ~Noon
(This creek drains to Patroon Creek, which drains to the Hudson River. The monitoring site is located in the Town of Colonie.)

How to Sign Up

Contact swcoalition@albanycounty.com or 518-447-5645.

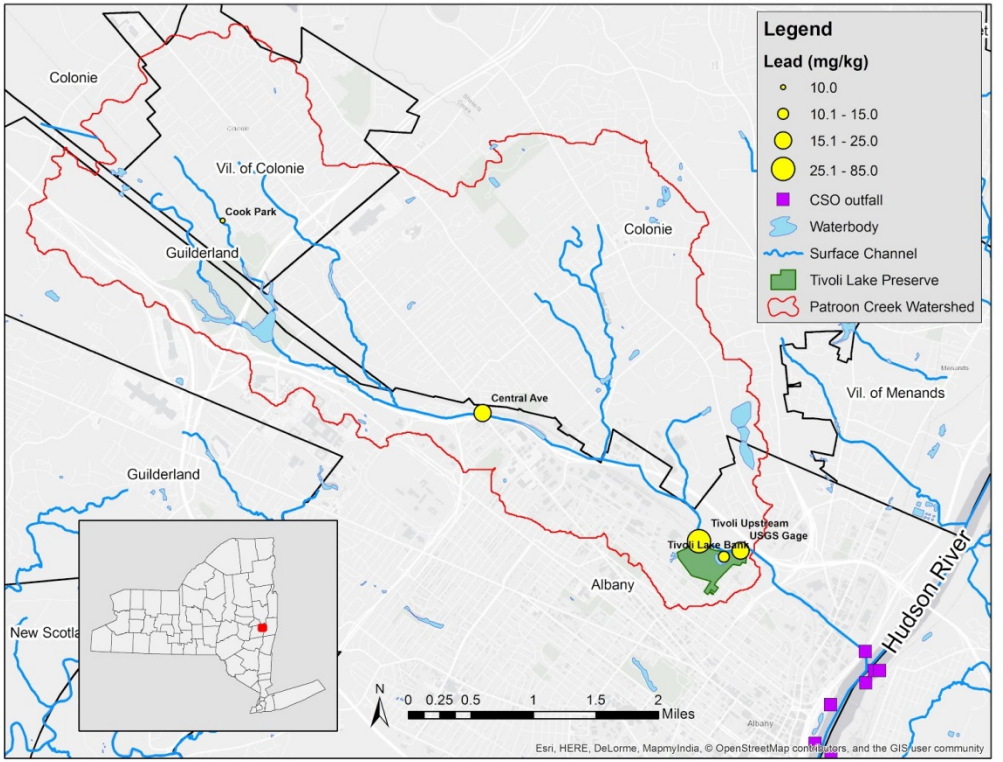
The Coalition coordinator will explain where to meet and what to bring. The meet up date and time may change depending on weather.

WAVE
Water Assessments by Volunteer Evaluators

www.dec.ny.gov/chemical/92229.html

Stormwater Coalition of Albany County
Albany County; City of Albany; Town of Bethlehem; City of Cohoes; Town of Colonie; Village of Green Island; Town of Guilderland; Village of Menands; Town of New Scotland; Village of Voorheesville; City of Watervliet; University at Albany-SUNY
www.stormwateralbanycounty.org

Long-term WQ Monitoring



Mean concentrations of lead in stream sediment (mg/kg) in the Patroon Creek watershed from samples taken summer 2016, spring 2017, and summer 2017.

What we are Learning in the Preserve

What do these Educators, Scientists, Students, Volunteers and Private Organizations, all have in common? **Tivoli Lake Preserve.** The City of Albany is building valuable public-private partnerships to better understand the environment in Tivoli, and to develop solutions for its successful and sustainable future.

Tivoli is inundated with invasive species, predominantly, phragmites—which greatly limits visibility on trails, and has reduced Tivoli Lake to half its size. Others found in the Preserve include: bush honeysuckle, Japanese knotweed, purple loosestrife, and oriental bittersweet.

Invasives species. Terrestrial (land-living) and aquatic (water-living) invasive species can negatively impact the growth, food support, and life-dependent resources that allow for native flora and fauna to thrive. The **City's Watershed Forester** has conducted a complete forest inventory of the Preserve, with an emphasis on inventorying and mapping existing invasive species. The inventory will be used to create an invasive species management plan, outlining proper and sustainable techniques to remove them—such as using sheep for targeted grazing.

Science and education. Tivoli is an "outdoor classroom," offering opportunities for all kinds of environmental science and education as it undergoes ecological change and restoration. From aquatic to terrestrial habitats, we are students learning how to gather and process information, and to grow and maintain a healthy and diverse nature Preserve, here in the City of Albany.

Volunteers partner together to study water quality, and the plants and animals in Tivoli Lake Preserve.

Bird and wildlife observation. From tree top to water-loving, Tivoli Lake Preserve has all the potential to grow and support a variety of wildlife. Though the Preserve is primarily deciduous forest, you will also find grassland, pond and stream habitats as well. Volunteer surveyors from the **Audubon Society of the Capital Region** observed over 87 bird species in the Preserve. Birds were either seen or identified by their song (*visit www.ebird.org/ebird/hotspot/L3480691 for a list of species*). Other wildlife that call Tivoli home, include: white-tailed deer, turkeys, muskrat, leopard frogs and garter snakes—to name a few. Observations from Audubon Volunteers are ongoing in the Preserve.

*Become a Volunteer animal observer at Tivoli Lake Preserve. Let's discover more animals and grow our bird count! Visit **www.captialregionaudubon.org** or contact the City's Planning Department for more information.*

Barred Owl.

Warbler.

Sediment samples are taken in Patroon Creek and analyzed for macroinvertebrates—tiny aquatic insects—which help determine the health of the water.

Water chemistry can be determined by analyzing water samples for a variety of physical properties—like water temperature and turbidity—and chemical properties—such as dissolved oxygen and pH. Monitoring these characteristics help to predict the natural processes of the waterbody and its environment.

Water quality assessments. Faculty and Students from the **Department of Environmental Science** at **Siena College** are working to evaluate water quality in Tivoli Lake and Patroon Creek. Throughout 2015 and 2016, Siena collected and evaluated water samples to better understand the current conditions and general health of these waterbodies. An active water level logger was installed to help continue information gathering.

Kick-sampling is a typical method used to collect macroinvertebrates from the riffles of a stream. Bottom sediments are literally kicked up—washing any inhabitants downstream into a mesh net. Sediments are dumped into buckets, and searched through for various specimens.

Evaluators sort out and identify macroinvertebrates from the sediment samples. Crayfish, scuds, midges, and aquatic worms are a few examples found in Patroon Creek.

WAVE. Water Assessment by Volunteer Evaluators (WAVE) is a NYSDEC program that creates and enables volunteers to become "citizen scientists" who collect and analyze biological data of "wadeable" streams for the NYSDEC's statewide stream biomonitoring inventory. **Siena College** conducted a WAVE event in the Patroon Creek. Students and area Volunteers collected stream bed sediments and searched for macroinvertebrate specimens that help determine its water quality.

SIENAcollege™ The education of a lifetime

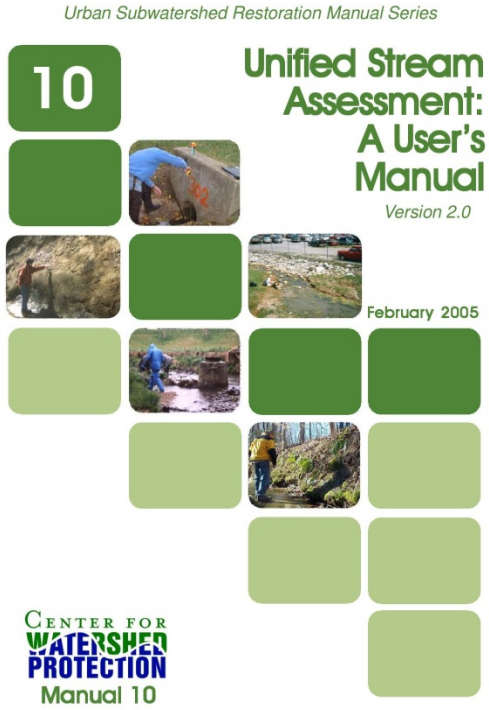
Audubon Society Capital Region

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Mayor's Office of Energy & Sustainability, City of Albany, NY

ALBANY 2030 your city. your future.

Semester-long Projects



A rapid stream assessment to locate and evaluate problems and restoration opportunities in the urban stream corridor.

Outfall Reconnaissance Inventory/ Sample Collection Field Sheet

Section 1: Background Data

Subwatershed:	Outfall ID:
Today's date:	Time (Military):
Investigators:	Form completed by:
Temperature (°F): Rainfall (in.): Last 24 hours:	Last 48 hours:
Latitude: Longitude:	GPS Unit: GPS LMK #:
Camera:	Photo #s:
Land Use in Drainage Area (Check all that apply):	
☐ Industrial	☐ Open Space
☐ Ultra-Urban Residential	☐ Institutional
☐ Suburban Residential	Other: _____
☐ Commercial	Known Industries: _____
Notes (e.g., origin of outfall, if known):	

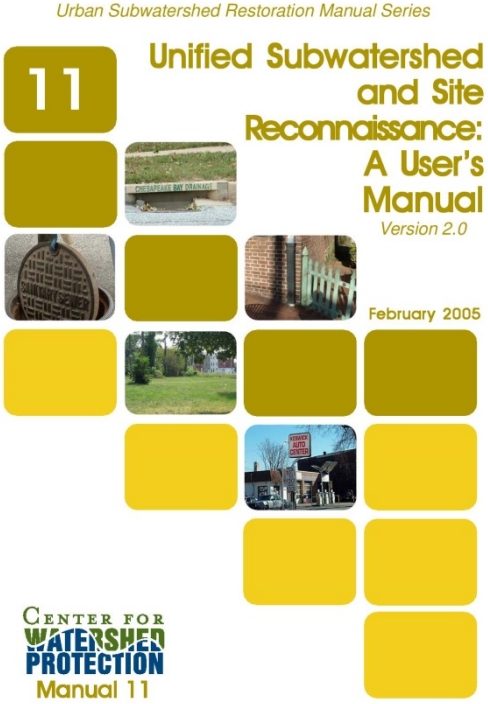
Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE	DIMENSIONS (IN.)	SUBMERGED
☐ Closed Pipe	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☐ Circular ☐ Single ☐ Elliptical ☐ Double ☐ Box ☐ Triple ☐ Other: ____ ☐ Other: ____	Diameter/Dimensions: _____	In Water: ☐ No ☐ Partially ☐ Fully With Sediment: ☐ No ☐ Partially ☐ Fully
☐ Open drainage	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: ____	☐ Trapezoid ☐ Parabolic ☐ Other: ____	Depth: ____ Top Width: ____ Bottom Width: ____	
☐ In-Stream	(applicable when collecting samples)			
Flow Present?	☐ Yes ☐ No	*If No, Skip to Section 5*		
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial			

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		RESULT	UNIT	EQUIPMENT
☐ Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐ Flow #2	Flow depth		In	Tape measure
	Flow width	____' ____"	Ft, In	Tape measure
	Measured length	____' ____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature			°F	Thermometer
pH			pH Units	Test strip/Probe
Ammonia			mg/L	Test strip

Identify the location and record basic characteristics of individual storm drain outfalls, evaluate suspect outfalls, and assess the severity of illicit discharge problems in a community.



Identify pollution sources and restoration potential within upland areas of urban subwatersheds.

Water quality monitoring lessons learned

- Look for projects with a well-defined scope and start and end date
- Look for overlapping questions – ex. what is the water quality of Patroon Creek? and is it safe to swim and fish in the Patroon Creek?
- Monitoring projects can be surprisingly inexpensive especially when the college/university already has the equipment
- Opportunities for funding through the NYS Water Resources Institute, NYSDEC Estuary Program, and EPA
- Staff turnover can be a challenge
- Be wary/understanding of academic time-scales

“Scaling up” water quality monitoring partnerships

- Many examples of successful partnerships at the subwatershed scale
- How do we build those partnerships at the Hudson River Watershed scale?
- The Hudson River Subwatershed & Tributary (THuRST) Research Network is working to answer that question

The Hudson River Subwatershed & Tributary (THuRST) Research Network

What?

The Hudson River Subwatershed & Tributary (THuRST) network is a partnership of Colleges, Universities, and research institutions working in their respective, local watersheds, but using common methodologies, to answer a set of unifying research questions with answers of both scientific and community significance.

Research, support & network, advocate

Who?

SIENA college · Bard College · PACE UNIVERSITY · Cornell University · SUNY Cobleskill · Sarah Lawrence College Center for the Urban River at Beczak · MARIST

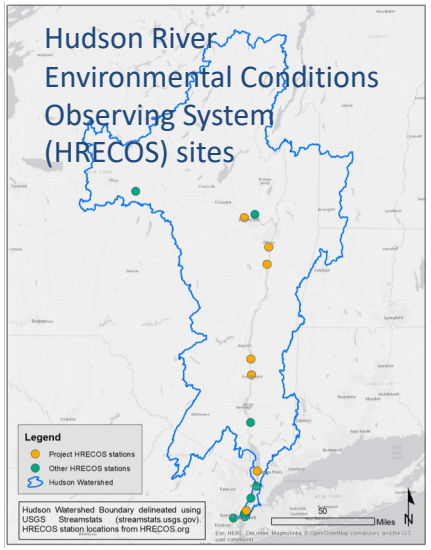
And others

Why?

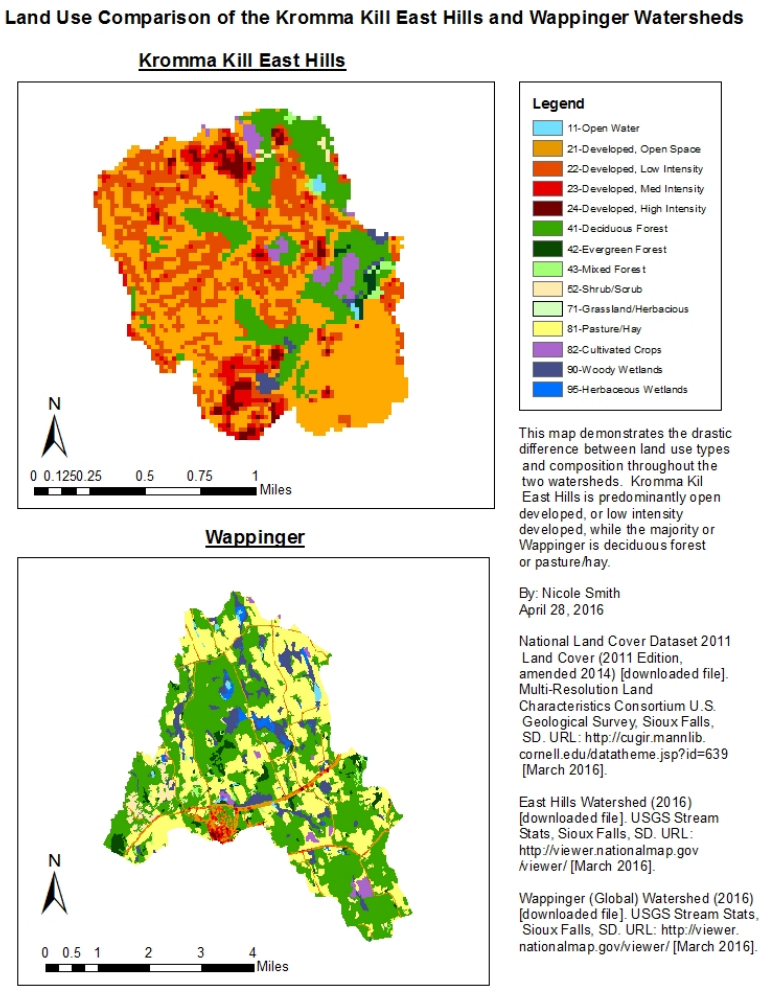
- Understanding water quality in the tributaries is crucial for protecting and restoring the Hudson River.
- There are many colleges and universities working in their local watersheds; THuRST provides a network for pooling resources and expertise because “the whole is greater than the sum of its parts”.
- By examining a set of common research questions, we can identify commonalities (and differences) between the Hudson subwatersheds and translate this new knowledge to the Hudson community.
- A partnership between colleges and universities provides a collaborative learning space for students and allows them to contextualize their local watershed within the larger Hudson watershed community.

Project 1: Salt Budgets and Winter Road Salt Delivery Mechanisms

- **Question**: how do land use and watershed structure control delivery of winter salt to the stream channel network, and ultimately, the Hudson River?
- **Motive:** Some studies have shown that salt concentrations can increase in surface waters without increases in urbanization or salt applications; these studies suggest that road salt is persisting in the environment and entering surface water streams through groundwater baseflow during non-winter months (Kelly et al., 2007; Corsi et al., 2015)
- Communities may not see immediate water quality improvements when salt use is reduced
- **Approach**: (1) characterize land use and watershed structure in the Hudson and its subwatersheds through geospatial analyses; (2) analyze specific conductance data to identify hotspots, and examine spatiotemporal variability of salt contamination; and (3) correlate geospatial characteristics with average annual and seasonal conductivity concentrations.
- **Status**: Continuing to collect water quality data. Students finishing up GIS analyses and tackling water quality analyses



Approach: land surface characteristics



Land use and watershed structure characteristics computed for the Hudson and its subwatersheds using readily available data from federal, state, and local GIS data repositories (ex. NYSGIS Clearinghouse, NationalMap.gov) and analysis tools (USGS Streamstats). ESRI ArcGIS Model Builder is used for many of these GIS analyses.

- Land use types
- Soil types
- Imperviousness (total, distance-weighted)
- Road lane density
- Home density
- Average distance between road and stream channel
- Managed drainage/MS4 area
- Riparian buffer area
- Waterbody density/waterbody area
- Outfall density
- Channel density
- Channel slope
- Basin slope

Approach: salt concentrations

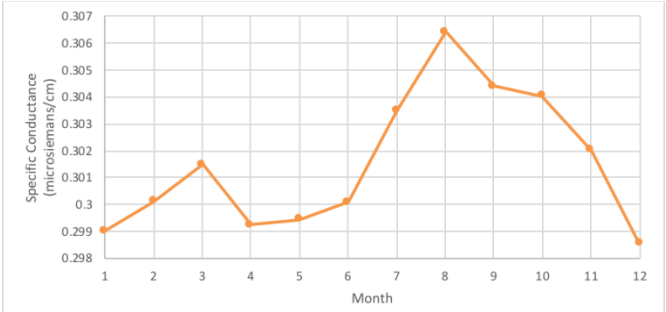
Loggers:

Meters:

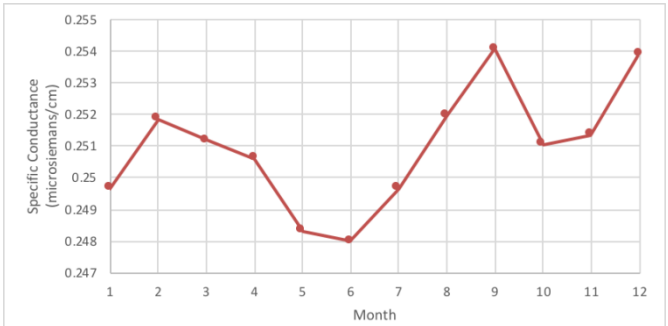
Laboratory analysis:

Preliminary Results

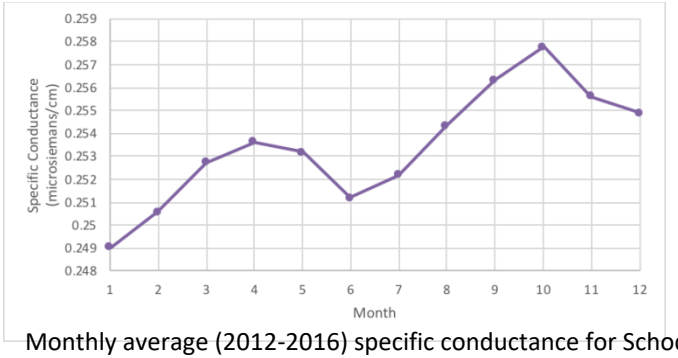
- Preliminary analyses of HRECOS data done as part of this THuRST project show increasing SpC concentrations over the last several years consistent with larger, regional trends
- Average monthly plots of SpC data for 2012-2017 from several of the HRECOS stations appear to have a bi-model response: concentrations are high in the spring and again in the fall, motivating a further examination of whether salt is persisting in the environment and entering surfaces streams through groundwater baseflow.
- HYPOTHESIS: differences between seasonal salt concentrations will be more pronounced in rural watersheds (the more urban the watershed, the less opportunity there is for salt to persist in the environment)
- More to come…



Monthly average (2012-2016) specific conductance for Mohawk River @ Lock 8



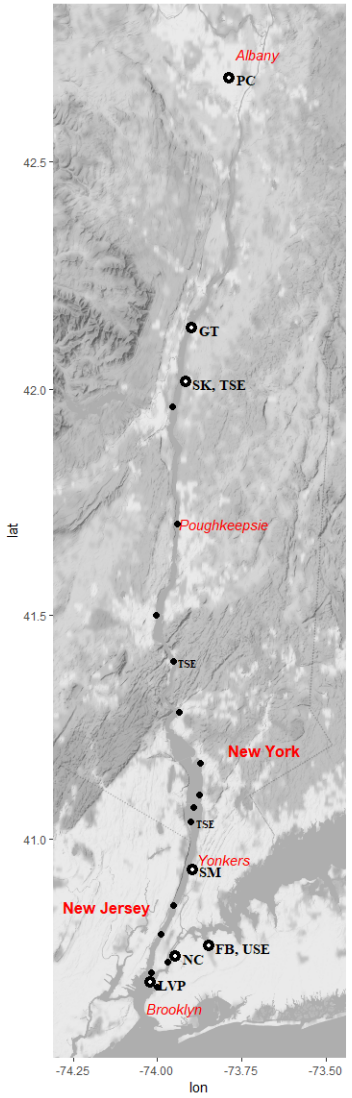
Monthly average (2012-2016) specific conductance for Port of Albany



Monthly average (2012-2016) specific conductance for Schodack Island

Project 2: Bacteria contamination in surface streams

- **Approach**: Monitoring enterococcus, coliform, and E. coli fecal indicator bacteria (FIB) and endotoxins in surface waters spanning a gradient of urbanization and salinity in the Hudson River Estuary
- **Motive:** Endotoxins are an emerging contaminant in public waterways, particularly waterways receiving high levels of both treated and untreated sewage. Given their association and detectability in both treated and untreated sewage, endotoxins may serve as a useful water quality indicator, particularly in areas prone to sewage contamination.
- Typically tests for these FIB can take 24 to 48 hours to process whereas tests for endotoxins take 15 minutes and can be completed on-site
- **Status**: Data collection more or less completed; currently analyzing data and working on manuscripts. Project requires ELAP certification, so no immediate plans to apply for additional THuRST funding to continue the project.



Approach

- All methods developed at Bard College and adapted for use at Siena College and other institutions through THuRST
- Samples were collected from a variety of locations, including urban estuarine, rural estuarine, freshwater sites streamside, rural freshwater mid-channel, treated and untreated sewage, tide pools and puddles, and the entire Hudson River Estuary system during a full day mid-channel voyage

- Methods include using lab-on-a-chip technology (Endosafe system, Charles River Inc.) to detect endotoxins and community-accessible IDEXX culture-based assays to detect FIB's (Enterococcus, coliform, and E. coli).

Results

Endotoxins are present at all 49 sites sampled and concentrations are highest in sewage and stagnant water

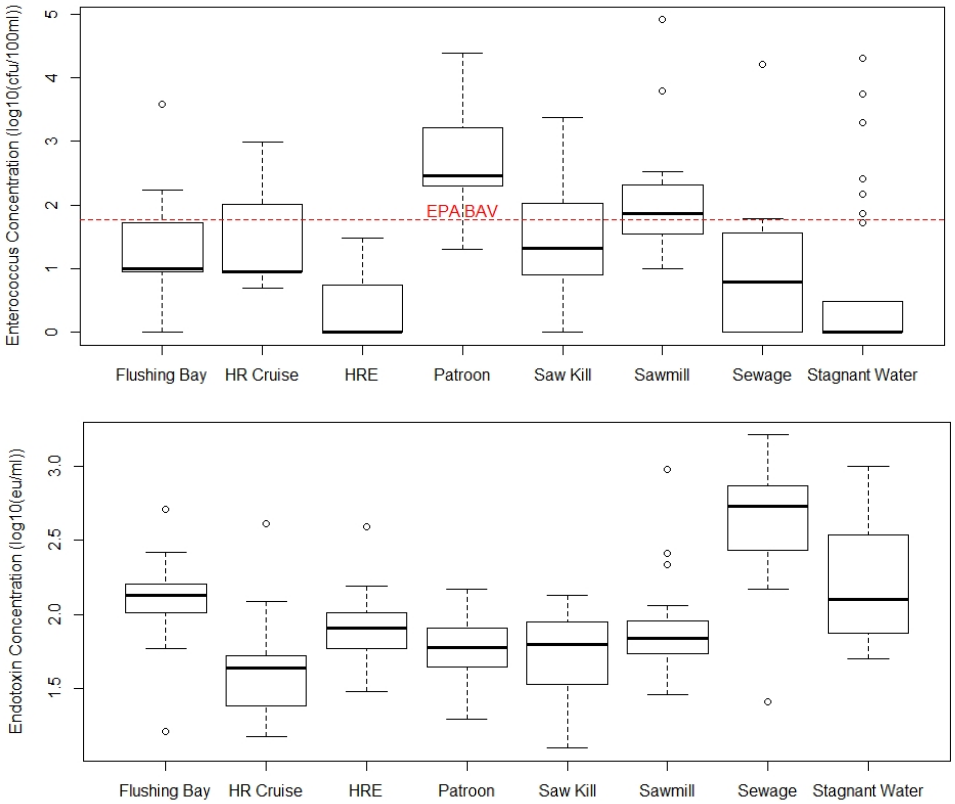


Figure by Dr. Eli Dueker, Bard College

Mean endotoxin (eu/ml) and enterococcus (cfu/100ml) concentrations by site.

Results

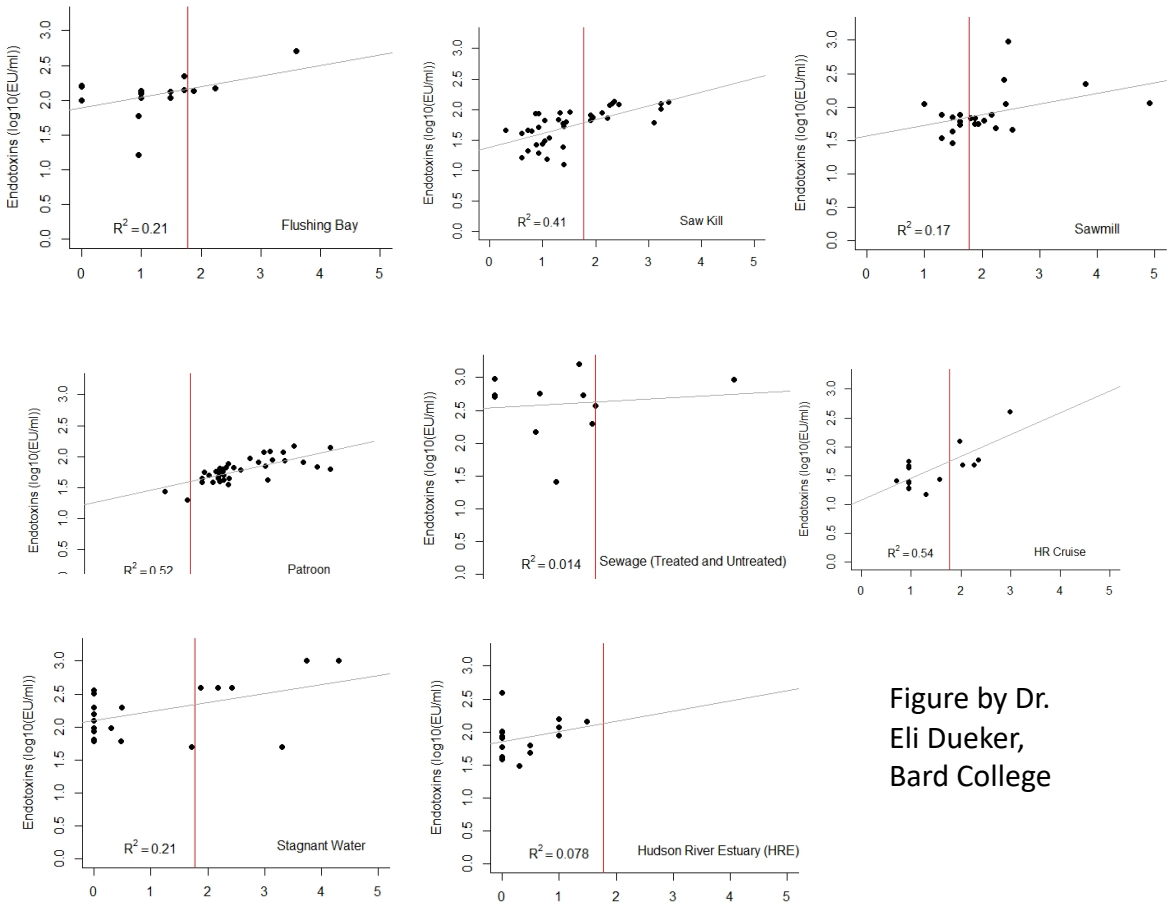


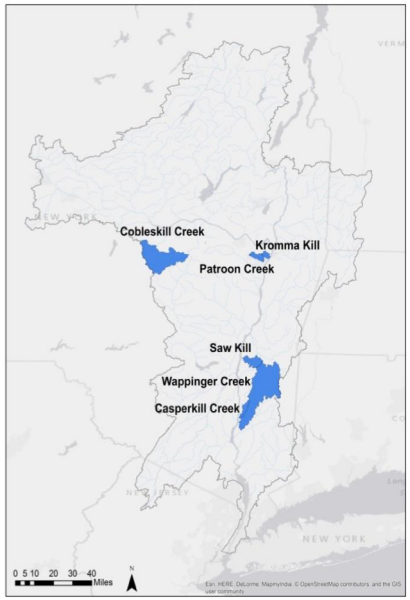
Figure by Dr. Eli Dueker, Bard College

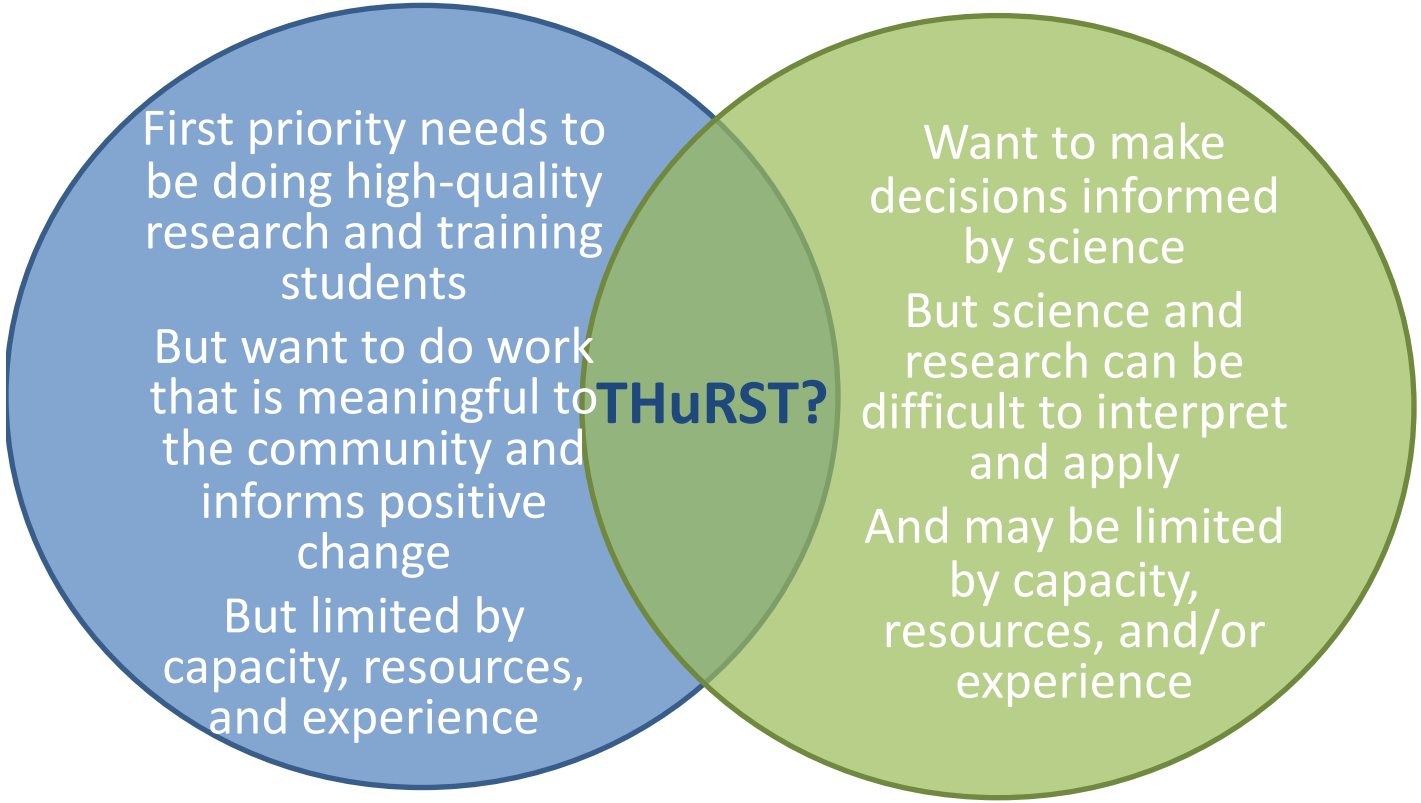
Correlation of paired endotoxin and enterococcus concentrations by site.

- Endotoxin concentrations correlate with enterococcus most strongly at sites known to experience untreated sewage.
- At sites with treated sewage, samples had high endotoxin concentrations even when enterococci counts were low, suggesting the endotoxins may persist in the environment even when FIB bacteria are removed or inactivated through the wastewater treatment process.
- Seasonal variation, urban infrastructure, varying treatment processes, and other environmental factors may all impact endotoxin concentrations and the relationship between endotoxins and other FIB. More to come…

“Scaling up” WQ Monitoring Partnerships

How can we involve watershed stakeholders earlier in and throughout the process of doing this research? Unique challenges: projects are broad in scale (geographic and time); subwatershed communities have distinct needs, dynamics, and politics. Furthermore…





“Scaling up” WQ Monitoring Partnerships

- *THuRST can help scale up WQ monitoring partnerships.* THuRST is, in part, a support network for watershed researchers, providing a collaborative space to share knowledge and resources and develop guidance documents and best practices for watershed research. Not only can we pool technical expertise, but also success stories, lessons learned, and best practices when engaging with the watershed community
- Next steps:
  - Summer 2020 meeting and workshop focused on this topic
  - Develop a plan for involving watershed stakeholders sooner in and throughout the THuRST research process
  - Develop a guidance document with best practices and templates for all Hudson River Watershed researchers and plan for how to apply the best practices to current and future THuRST projects
- More to come…

Concluding remarks

- Community-University-Municipality water quality monitoring partnerships can take many forms: volunteer/service activities, semester-long projects, long-term research collaborations
- Can be a win-win *if* some thought is given to the project and best practices are followed
- Ideal learning and training opportunities for students, our future watershed and environmental professionals and advocates
- THuRST is working to build a watershed-wide network of researchers. The network can be a mechanism for "scaling up" monitoring partnerships to the Hudson Watershed scale

Acknowledgements

- This work has been funded by the Hudson River Estuary Program, New York State Water Resources Institute, New England Interstate Water Pollution Control Commission, Siena College, and Bard College
- Thank you to the many students who contributed to these projects

NEW YORK STATE OF OPPORTUNITY | Hudson River Estuary Program

A Program of the New York State Department of Environmental Conservation

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