Annual Update for the National Center for Water Quality Research

December 15, 2021

The National Center for Water Quality Research (NCWQR) at Heidelberg University is widely known for research on factors that influence the water quality of streams and rivers. The mission of our organization is to generate knowledge about the dynamics of water and soil resources in order to improve water quality and availability. Our ultimate vision is a world where scientific research informs the sustainable use of water and soils thereby preserving these resources for future generations.

The NCWQR is organized around 5 key focus areas: long-term research, short-term research, field and watershed scale modeling, education, and service. Below we summarize the current status and future goals for each of these focus areas. For other specific details on the NCWQR, please visit our website: https://ncwqr.org

Focus Area Updates

Long-term research:

The NCWQR is centered around the Heidelberg Tributary Loading Program (HTLP), where we monitor 22 rivers and streams primarily in Ohio (except for 1 in Michigan). The ultimate goal of the HTLP is to quantify the loads of sediment and nutrients that leave those watersheds. This data is instrumental in state and federal management of water quality in the region. Over the past year, we have replaced two retirements in the chemistry laboratory and reorganized other staff responsibilities to cover the needs of the HTLP among other laboratory activities. In addition, we updated our online data sharing website to a more functional data portal and are in the process of acquiring the necessary equipment to get our water quality sensors online in real time. We are learning some new sensor technology to consider using in conjunction with our current monitoring to improve our data output. We are also working closely with technology creators to help encourage the development of needed sensors in the water quality monitoring space.

Two of our monitoring locations associated with the HTLP are funded through the USDA Conservation Effects and Assessment Program (CEAP). Through a collaboration with Jay Martin at The Ohio State University, we'll be implementing agricultural best management practices in one of the watersheds through a newly funded project over the next five years. The other watershed will remain at current levels of implementation for comparison. This will be an excellent opportunity to provide real guidance on how to improve water quality at a large scale.

Historically, we have operated a pesticide monitoring program at a subset of the HTLP sampling locations. However, we have paused the continuation of the program because support for this program has long been waning, our trained analytical chemist retired, and our analytical instrumentation needs to be updated. While we're still in deliberations, our current plan is to

officially discontinue this program moving forward. We will focus on preparing the existing dataset for publication over the next couple of years.

Another project we recently have started that will likely become a long-term effort is monitoring wetlands constructed throughout the state as a part of the H2Ohio program. This effort being led by Kent State University and is in collaboration with other regional universities through the LEARN (Lake Erie Area Research Network). We will be greatly expanding our efforts in this project over the next year as we'll be responsible for monitoring an additional 10 wetlands along with the current 3 wetlands we already monitor. To meet this need we will be adding a new staff member to lead the field work and assist with chemistry analysis.

A final project we also recently began is a collaboration with the Department of Energy on the COMPASS project (coastal observations, mechanisms, and predictions across systems and scales). This work is led by Pacific Northwest National Laboratory and regionally by University of Toledo. While we are still in a pilot phase to establish the specific research plan, we are adding a TOC/TN analyzer to our suite of analytes to support this research and anticipate long-term research in river mouths and coastal estuaries starting in the near future.

Short-term research:

We are exploring a multitude of questions using shorter-term research funding which build on past knowledge and the HTLP findings. Current questions (see Appendix) include assessing in-stream processing of phosphorus, quantifying concentrations of veterinary antibiotics in Lake Erie tributaries, and testing new sensor technology. While it's hard to predict the availability of funds to support this type of research, there are a series of topics that could be explored, including colloidal phosphorus and bioavailability, in-stream practices that help or hinder phosphorus losses, nitrogen dynamics from field to watershed to lake, ways to encourage BMP implementation, etc. To continue the vitality of this work, we need to hold research needs workshops that suit our interests and bring in colleagues on a regular basis.

Field and Watershed Scale Modeling:

In this work, we are using and improving watershed-scale models (i.e., SWAT) and field-scale models (i.e., NTT) to examine the influence of agricultural practices on nutrient runoff and how climate change will influence these practices. Current research involves using NTT in market-based approaches for a pay-for-performance style practice implementation and using SWAT+ to understand the effect of BMPs on watershed loads in Shallow Run, the watershed ultimate receiving enhanced BMP implementation to reduce dissolved phosphorus loads. Over the past year, the lead researcher on this effort left the NCWQR for a new position and currently the program is being staffed by one person. Moving forward, we need to assess if we need to replace the research scientist for this program. We are currently exploring the idea of developing a contract approach to provide NTT and other field-specific services for the agricultural community.

Education:

Currently the NCWQR assists in teaching Watershed Science Specialization and Environmental Science courses at Heidelberg. We also have educational outreach in the form of tours and science days for K-12 students or assistance with other educational activities and/or development of curriculum, often through the efforts of the Sandusky River Watershed Coalition. Starting next summer, we will have a summer research program for undergraduate students to

get experience with research and help in the lab. For Environmental Science and Watershed Science, we're working with the department to develop strategic plans that improve recruitment and help the degrees align with new University goals regarding general education and assessment. Moving forward, we anticipate changes associated with the focus on water in the new strategic action plan for Heidelberg University.

Service:

Our current service includes the private well-testing program, contract sample analysis, the Sandusky River Watershed Coalition, and involvement in a multitude of advisory and task groups. The private well-testing program is long-running and has been waning in recent years. This is partly because of the pandemic, but also because of the need for other components that we don't analyze. We will be deciding how to proceed with the program over the coming year, specifically if we should add new analytes of interest to the community.

The Sandusky River Watershed Coalition (SRWC) is a stand-alone organization that is hosted by the NCWQR. Service through the SRWC includes the annual Sandusky River clean sweep, watershed tours, information sharing events, an annual meeting, and other outreach via small grants. For more information, see https://sanduskyriver.org/

Other service conducted at the NCWQR includes participation in various advisory groups, task teams, or workshops. This includes state efforts, such as development of total maximum daily loads (TMDLs) and aquatic use indicators; federal efforts such as the annual Science and Solutions workshop; and international efforts, such as the Great Lakes Water Quality Annex 4 adaptive management team. We also been involved in regional organizations such as the Ohio Lake Management Society and the Ohio Soil and Water Conservation Society.

Future Plans and Goals

Continue to be a premier center for water quality monitoring relative to watershed loadings

- Increase our capacity to take on additional monitoring needs (wetlands, coasts)
- Be open and supportive for testing new sensor technologies
- Consider adding new analytes when feasible and useful
- Be proactive in updating and upgrading field and analytical equipment to ensure successful operations and continued relevance
- Standardize annual reporting of HTLP watersheds along with quality control and assurance reporting
- Produce reports or papers focused on non-Lake Erie watersheds
- Host workshops to bring together researchers to develop new proposals

Help expand educational programs to train the next generation of water scientists

- Continue to teach and collaborate with the watershed science specialization
- Work with Heidelberg to further develop and/or expand the watershed science specialization
- Roll out the Baker Summer Scholar program
- Explore summer opportunities for high school students
- Develop career exploration opportunities through the SRWC

Expand service to the community

- Develop an outreach program for farmers, agricultural retailers, or local soil and water conservation districts based on our field scale modeling research (NTT/ACPF)
- Consider updating well testing capabilities to meet demand
- Expand and seek increased support for the Sandusky River Watershed Coalition
- Develop closer ties to other watershed groups, soil and water conservation districts, or municipalities within rivers that we monitor

Enhance our long-term stability through endowments and foundational support

- Work with Heidelberg office of advancement services to seek endowments
- Research and send inquiry letters to foundations for support
- Investigate ways to diversify funding streams

Increase our academic outputs and take better advantage of our long-term data sets

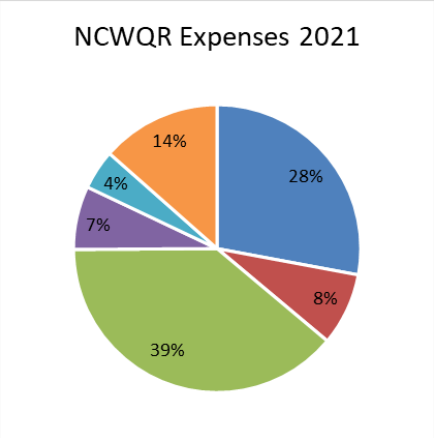
- Begin a rotating postdoctoral associate fellowship program
- Develop and maintain collaborative networks with regional universities and agencies to research questions related to our long-term data
- Develop a program to work with graduate students at other universities, such as supporting the summer stipend of a student at a nearby university

Expand our communications to the general public so people know what we do and why it matters

- Produce more consistent annual reporting
- Start the process of being able to create a press release for major findings
- Send regular updates to Heidelberg to post in announcements or news
- Update website(s) more regularly
- Increase social media presence
- Develop story maps, infographics, podcasts, and/or videos on our research
- Investigate the potential for funding a dedicated person for this work

Financial Summary 2021

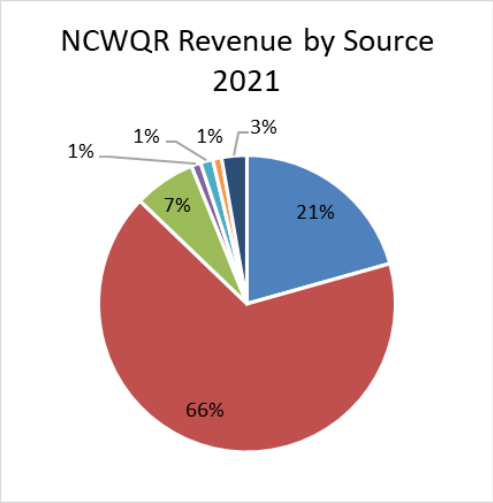
In fiscal year 2021 (July 1, 2020- June 30, 2021), our overall expenses were $1,492,066. Most of our expenses (75%) were in personnel (salaries, wages, and benefits) or supplies and equipment costs, with the remaining 25% in outside contracts, other, or indirect costs. Other expenses include electricity for sampling stations, internal sampling charge, membership dues, food service, professional development, mileage, and Heidelberg's overhead charge. The proportion of expenses by category were similar to the average of 2016-2020, though the total was slightly higher this year with the onset of two new research projects.



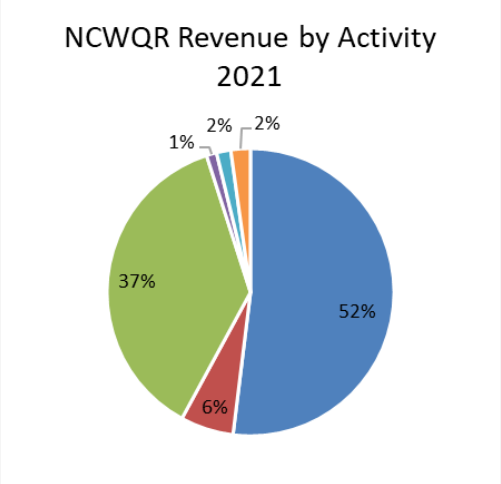
Expenses	2021	Average (2016-2020)
Salaries and Wages	$ 416,730	$ 441,153
Fringe Benefits	$ 121,739	$ 122,214
Supplies and Equipment	$ 579,237	$ 250,124
Outside Contracts	$ 106,329	$ 149,005
Other	$ 66,721	$ 126,204
Indirect Costs	$ 201,309	$ 193,246
Total	$ 1,492,066	$ 1,281,946
Carry Over	*$ 131,555*	*$ 157,662*

A majority of the revenue to support the NCWQR activities was from the State of Ohio (66%), either as the line item in the state operating budget, through the capital budget under the OPWICS (Ohio Partnership for Water Industrial and Cyber Security) agreement, or from various state agencies (Ohio DNR, Ohio EPA, Ohio Dept of Higher Education). We also received substantial support from the Federal Government (21%) through USDA-Natural Resources Conservation Service, NOAA Ohio Sea Grant, EPA Great Lakes Restoration Initiative, or Department of Energy. The remaining revenue was from various sources including other municipalities or state governments, non-profit and for-profit organization, endowments, and contract or well test analyses.

Most revenue was for support of the HTLP or short-term research. This year most of the short-term research revenue was for the OPWICS partnership. Other revenue was to support the field and watershed scale modeling, well testing, contract analyses, and miscellaneous activities (SRWC, endowments).



Net Revenue by Source	2021	Average (2016-2020)
Federal	$ 307,938	$ 225,001
State of Ohio	$ 992,855	$ 644,799
Other Government	$ 100,125	$ 122,885
Nonprofit	$ 15,410	$ 103,983
For-Profit	$ 20,227	$ 104,789
Endowments	$ 14,506	$ 3,050
Contract	$ 41,005	$ 77,439
Total	$ 1,492,066	$ 1,281,946



Net Revenue by Activity	2021	Average (2016-2020)
HTLP	$ 775,145	$ 732,286
Modeling	$ 89,342	$ 165,037
Short-term Research	$ 553,681	$ 194,787
Well Testing	$ 17,037	$ 29,863
Contract	$ 23,968	$ 47,577
Miscellaneous	$ 32,893	$ 112,397
Total	$ 1,492,066	$ 1,281,946

National Center for Water Quality Research
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Appendix:

Currently Funded Projects

**Does not include contracts totaling $540,000, annually*

Project Duration	Project Title	Lead PI	Funding to Heidelberg	Funder	Co-PIs
2017-2022	Expanding the Heidelberg Tributary Loading Program.	Laura Johnson, Heidelberg	$1,000,000	Ohio EPA/Ohio Department of Higher Education	Ohio EPA
	Addition of 5 new stations to our monitoring program with focus on smaller watersheds				
2017-2022	Assessing the watershed scale effects of implementing conservation management practices.	Kevin King, USDA-ARS	$425,000	USDA NRCS Conservation Effects Assessment Project.	USDA-ARS, NRCS
	How effective are agricultural best management practices at improving water quality?				
2020-2023	Occurrence and sources of veterinary pharmaceuticals in Lake Erie tributaries.	Laura Johnson, Heidelberg	$33,900	Ohio Sea Grant	University of Nebraska, Lincoln
	What are the concentrations and forms of antibiotics from livestock in the Sandusky River Watershed?				
2020-2022	Evaluating the impact of rivers on phosphorus delivery to western Lake Erie.	Jim Hood, OSU	($72,450	Ohio Department of Higher Education Harmful Algal Bloom Research Initiative	OSU, USGS, ONU
	At what capacity will streams and ditches retain or release phosphorus? How does that influence target reductions?				
2020-2022	H2Ohio ODNR Wetland Monitoring Program.	Lauren Kinsman-Costello, Kent State University	$85,000	Ohio Department of Natural Resources	KSU, OSU, BGSU, UT, WSU
	How effective are constructed wetlands at improving water quality throughout Ohio?				
2021-2023	Farming for Cleaner Water in the Upper Scioto River Watershed.	Brian Brandt, American Farmland Trust	$64,000	US EPA Gulf of Mexico Division's Farmer to Farmer Program	AFT, USGS, City of Columbus, OSU
	How effective are best management practices at reducing nitrate runoff in the Upper Scioto River watershed?				

Project Duration	Project Title	Lead PI	Funding to Heidelberg	Funder	Co-PIs
2021-2023	Coastal Observations, Mechanisms, and Predictions Across Systems and Scales (COMPASS).	Vanessa Bailey, Pacific Northwest National Laboratory	$365,000	Department of Energy Biological and Environment Research Program	Pacific NW, Argonne, Berkeley, Los Alamos, and Oak Ridge National Labs, Smithsonian Env Res Ctr, U Toledo
	How important are coastal wetlands and river mouths at transforming carbon and nutrients?				
2020-2022	Phosphorus Load Reduction Trading Program.	Mike Komp, Conservation Technology Information Center	$130,637	US EPA Great Lakes Restoration Initiative	CTIC, Ecosystems Services Market, SMUM
	How can we use a field-scale model to determine credits for a water quality trading program?				
2020-2022	Conservation Kick.	Nicole Zacharda, Great Lakes Commission	$35,000	US EPA Great Lakes Restoration Initiative	GLC, City of Defiance
	How can we use a field-scale model to determine credits for a water quality trading program?				
2019-2024	Water Quality Measurement and Modeling in the Eastern Corn Belt	Kevin King, USDA-ARS	$50,000	USDA Long Term Agroecosystem Research Program	Multiple USDA-ARS labs
	How well does a field scale model represent the effects of best management practices from fields throughout the US?				
2021-2023	Development and Implementation of Low-Cost, On-Site, Real-Time Ionic Sensors for Assessing Water Quality from Land to Lake	Laura Johnson, Heidelberg	$39,000	Ohio Department of Higher Education Harmful Algal Bloom Research Initiative	Bionymer
	Will new technology using smart materials be able to measure water quality in rivers and streams?				
2021-2022	Enhancing the accessibility of the Heidelberg Tributary Loading Program	Laura Johnson, Heidelberg	$60,500	Smart Great Lakes Mini-Grant Program	Great Lakes Observing System
	How can we better share data from sensors deployed throughout the Lake Erie watershed?				