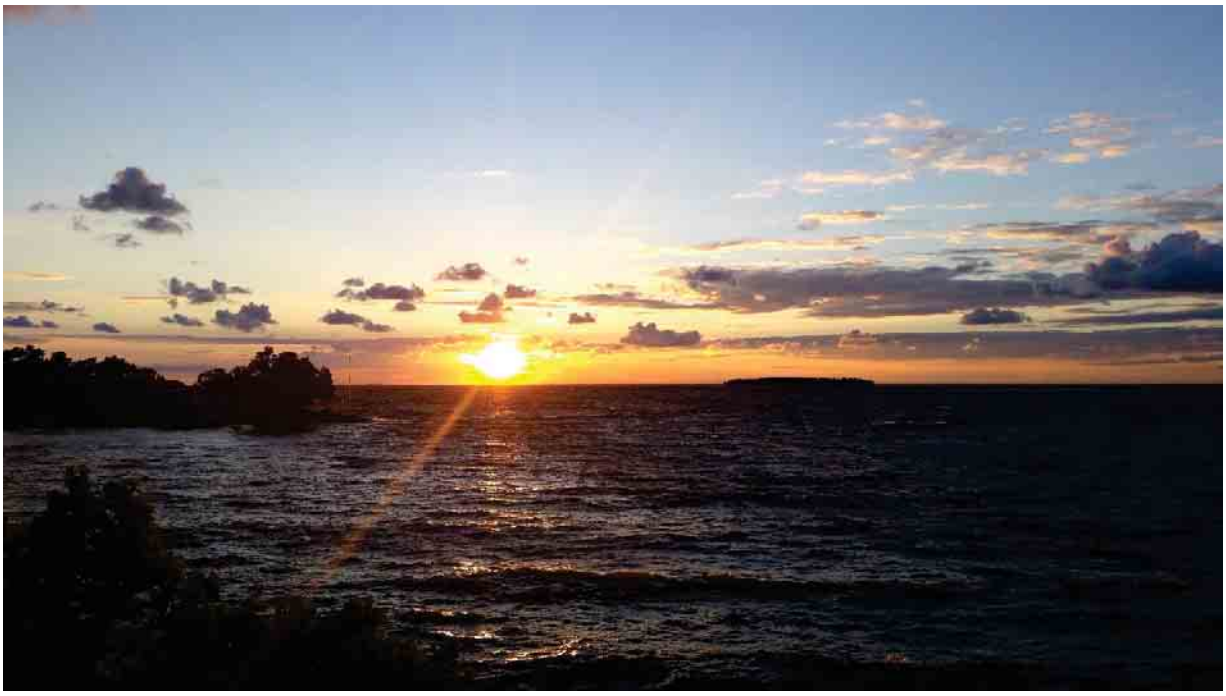
2014-2015 Annual Report

National Center for Water Quality Research
Heidelberg University

December 2015



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310 East Market Street, Tiffin, OH 44883

National Center for Water Quality Research
Heidelberg University

Heidelberg University
Purpose with distinction.

A Note from the Director

Dear Reader,

As summarized in the Highlights section of this report (p. 6), the staff of the National Center for Water Quality Research was exceptionally busy throughout Fiscal Year 2014-2015. We initiated and otherwise collaborated on several new inter-university and interagency research projects in response to the Toledo drinking water crisis of early August 2014, and we provided an unprecedented number of interviews to the news media (pp. 42-44) as the public focused attention on the origins of the excessive amounts of phosphorus and other nutrients that lead to harmful algal blooms in Lake Erie with negative consequences for drinking water supplies, sport fishing and other water uses. The chemical lab staff processed and analyzed more than 9,600 water samples. We filled a new postdoctoral position with an instrumental chemist who is renewing our focus on agricultural herbicide residues in surface water. The impact of NCWQR's work was publicly acknowledged through an award to Dr. Pete Richards (p. 9), three awards for research papers (p. 23), and citations by other scientists and policy analysts (p. 24).

Most of our major goals for Fiscal Year 2015-2016 (p. 7) are the same as for Fiscal Year 2014-2015. Still receiving emphasis but not listed as major goals are the Cooperative Private Well Testing Program, new collaborations through USDA's Long-Term Agro-Ecosystem Research Network (LTAR), and our transition to a younger staff. We added two major goals for the new fiscal year and beyond. First, the staff is eager to interact with the university administration and faculty to find mutually beneficial means to increase NCWQR's role in the formal science curriculum. Second, with my retirement at the end of 2015, a focused effort will be needed to maintain the longstanding biological research and monitoring program, and to do that might require resources for a new biologist or ecologist.

After 37-1/2 years in the NCWQR, including 5-1/2 years as director preceded by three months as interim director, it is now time for me to "turn the page". The programmatic and fiscal positions of the Center are strong. Its very capable and dedicated staff, including new director Dr. Laura Johnson, will undoubtedly ensure that it will continue to make major contributions to Great Lakes science and policy in the years to come.

Kenneth A. Krieger, Ph.D., Director

Cover Photo: Westward view of the western basin of Lake Erie on 15 July 2014 as seen from atop Gibraltar Island in Put-in-Bay. Peach Point of South Bass Island appears at the left (flagpole) and Rattlesnake Island is seen in the distance. Gibraltar Island and Peach Point are the locations of The Ohio State University's Franz Theodore Stone Laboratory, where for decades NCWQR staff members have taught courses, conducted research and attended conferences and numerous Heidelberg University students have taken field courses. (photo: Laura Johnson)

Table of Contents

2014-2015 Annual Report
of the
National Center for Water Quality Research
Heidelberg University

Mission

Our mission is to promote the sustainable use of water and soil resources while striving to protect ecosystem integrity. We accomplish this mission through a wide variety of research, outreach and educational activities.

About the NCWQR

The National Center for Water Quality Research (NCWQR) is a research arm of the science departments of Heidelberg University. Its current staff of eleven scientists and technicians (including founding director emeritus Dr. David B. Baker) assisted by student trainees encompasses expertise in fields ranging from water chemistry to watershed modeling and biomonitoring. Started by then Professor of Biology Dr. David Baker as the River Laboratory in 1969, the laboratory was renamed the Water Quality Laboratory in 1974. Early research projects centered on nutrient and sediment loadings from Ohio rivers flowing into Lake Erie. The lab extended its studies to Lake Erie in 1978 as a participant in the binational Lake Erie Intensive Study, added pesticide analyses to its monitoring programs in 1980, and incorporated three major tributaries of the Ohio River into its loading studies in the mid-1990s. Through a resolution of the U.S. House of Representatives introduced by Ohio's Congressman Paul E. Gillmor, the name changed to the National Center for Water Quality Research in 2004.

The National Center for Water Quality Research occupies the third floor of Gillmor Science Hall .
(photo: Ken Krieger, 20 December 2015)

All activities of the NCWQR, other than teaching, have always been supported entirely by extramural funds from federal and state governments, industries, foundations and individuals through research grants, monitoring contracts, analytical services and contributions. Details of the Center's history and current activities are available at http://www.heidelberg.edu/academiclife/distinctive/ncwqr.

Highlights of Fiscal Year 2015

- A peer-reviewed paper written by NCWQR staff members and another on which Pete Richards was a co-author received awards for their excellence and impact.
- We received four new research grants. In addition, we received three new grants and eight renewal awards in support of the Heidelberg Tributary Loading Program. Several other grants were ongoing.
- Four proposals were pending as of 30 June 2014, and all four were subsequently awarded.
- We administered 26 budget accounts for our research and monitoring projects, reflecting a broad diversity of our funding sources.
- Two monitoring stations were re-activated on Old Woman Creek, bringing the number of monitoring stations in the Heidelberg Tributary Loading Program to 18. As in previous years, staff members drove two routes weekly to collect water samples at our 11 tributary loading stations in northwestern and west-central Ohio and maintained automated samplers and pumping systems at 14 stations throughout Ohio and southeastern Michigan. Barb Merryfield, Ellen Ewing, Jake Boehler and Jack Kramer demonstrated remarkable dedication and perseverance in making the collection trips and keeping the systems operating throughout the past two severe winters!
- We analyzed 7,492 surface water samples for the Heidelberg Tributary Loading Program (HTLP), approximately 1,300 contracted samples, and 303 well water samples. Compounds tested included nutrients, suspended solids, microcystin (algal) toxin, and dissolved metals. In addition, 564 surface water samples were analyzed for pesticides as part of the HTLP. We posted the results for nutrients and suspended solids for most of our tributary monitoring stations on our data download web site.
- We hired postdoctoral researcher Dr. Saptashati (Tania) Biswas to renew our focus on our agricultural pesticide monitoring program and the interpretation of our long-term pesticide data set.
- We identified oligochaete worms from Lake Erie and the Niagara River for the Great Lakes Center at Buffalo State College (SUNY) and submitted a report interpreting data on sediment-dwelling invertebrates collected in Lake Erie by Ohio EPA.
- We made 42 presentations at professional conferences, meetings of civic groups, and other events. In addition, there were over 35 news media reports and interviews about NCWQR findings in relation to the Toledo drinking water crisis and harmful algal blooms.
- The staff published 6 peer-reviewed articles as senior authors or co-authors, and one interactive Web report (LakeErieAlgae.com).
- Senior researchers reviewed numerous journal manuscripts and grant proposals, and the director continued to serve as associate editor of an environmental journal.
- We employed 5 students, advised 4 students on undergraduate research projects, and served on one graduate advisory committee.
- The NCWQR staff hosted a community open house and conducted numerous lab tours.
- We hosted meetings of the NCWQR Advisory Council in June 2014 and July 2015.

Major Goals for 2015-2016

- Continue to seek input from the Advisory Council.
- Further diversify funding sources for core programs.
- Work with Institutional Advancement to grow the NCWQR's two endowments.
- Expand research on pesticides and pharmaceuticals and personal care products (PPCPs).
- Revise and update the NCWQR web site.
- Renew and increase NCWQR's role in the environmental science curriculum, especially with regard to participation in formal courses in the major.
- Maintain the biological monitoring and research program, potentially accompanied by addition of a new research scientist.

Staff – 2014-2015

(L to R) Dave Baker, Ellen Ewing, Barb Merryfield, Nancy Miller, Ken Krieger, Laura Johnson, Aaron Roerdink, Jake Boehler, Tania Biswas, Jack Kramer, Rem Confesor

(photo 15 December 2015 by Amor Confesor)

Current Staff

The NCWQR staff underwent some changes in 2014-2015 with the retirement of Dr. Pete Richards effective on 1 July 2014, Dr. Dave Baker's return to a volunteer status in July 2014, and the addition of Dr. Tania Biswas in January 2015. The staff members are listed below along with their degrees, job titles, expertise, and the year they joined the staff.

Saptashati (Tania) Biswas, B.S., chemistry, University of Calcutta, India; M.S., environmental sciences (chemistry), University of Kalyani, West Bengal, India; Ph.D., environmental science and technology, University of Maryland, College Park.
Postdoctoral Research Scientist (instrumental chemistry, 2015)

Jakob A. Boehler, B.S., environmental science, Heidelberg University
Research Assistant (biology and chemistry, 2011)

Remegio B. Confesor, Jr., B.S., M.S., agricultural engineering, University of the Philippines Los Baños; Ph.D., agricultural and biological engineering, Pennsylvania State University
Research Scientist (watershed and hydrologic modeling, 2008)

D. Ellen Ewing, B.S., biology, Heidelberg College
Laboratory Manager (chemistry, 1976)

Laura T. Johnson, B.S., biology, Virginia Polytechnic Institute and State University; Ph.D., biological sciences, University of Notre Dame
Research Scientist (nutrient processing in aquatic ecosystems, 2013)

Jack W. Kramer, B.S., chemistry, Heidelberg College
Laboratory Manager Emeritus (chemistry, 1969), part-time

Kenneth A. Krieger, B.S., M.S., Ph.D., biology, Emory University
Director; Professor of Biology (aquatic invertebrate ecology, limnology, 1978)

Barbara J. Merryfield, B.S., biology, Heidelberg College
Research Assistant (chemistry, 1978)

Nancy L. Miller, B.S., biology, Urbana College
Business Manager and Coordinator of the Private Well Testing Program (1986)

Aaron Roerdink, B.A., chemistry, Central College; Ph.D., analytical chemistry, University of Wisconsin-Milwaukee
Analytical Chemist, Assistant Professor of Chemistry (2006), part-time in NCWQR

Emeritus Staff

David B. Baker, B.S., biology, Heidelberg College; M.S., Ph.D., botany (plant physiology), University of Michigan
Director Emeritus; Professor Emeritus of Biology (1966-2014)

R. Peter Richards, B.A., geology and German, Oberlin College; M.S., Ph.D., geology, University of Chicago
Senior Research Scientist Emeritus (statistics and hydrology, 1978-2014)

Emeritus researcher Dr. Pete Richards is presented the 2014 Ohio Lake Erie Award by Ohio EPA director Craig W. Butler during the quarterly meeting of the Ohio Lake Erie Commission at the Ottawa National Wildlife Refuge on the shore of Lake Erie on 25 September 2014.
(photo: Rem Confesor)

Students Employed in the NCWQR in 2014-2015

- **Ryan Halloran** – Computer Science major, Biology minor
- **Jordan Keller** – Environmental Science major, Biology minor; also worked in summer 2015 following graduation
- **Ethan Riehl** – Chemistry major (holds B.S. in Environmental Science from Muskingum University)
- **Matthew Tussing** – Computer Science major, Sports Management minor
- **Lilian C. White** – Environmental Science major, Biology and Mathematics minors

Advisory Council

The NCWQR Advisory Council met on 17 June 2014 and 23 July 2015. The purposes of the Advisory Council are to maintain and enhance the relevance of the NCWQR to environmental concerns of researchers, managers, policymakers and citizens; develop a sustainable economic platform for the NCWQR; and identify emerging and expanding water quality issues at local through international scales that might provide new research opportunities for the NCWQR. The Advisory Council members in 2014-2015 are listed below.

Dr. Larry Antosch, Ohio Farm Bureau Federation

Cindy Brookes, Sandusky River Watershed Coalition

Dr. Tom Bruulsema, International Plant Nutrition Institute

Doug Busdeker, The Andersons, Inc.

Karen Chapman, Environmental Defense Fund

Charlie Cole, Heidelberg University board of trustees

Tom Crane, Great Lakes Commission; alternate: **Gary Overmier**

Dr. Joe DePinto, LimnoTech

Jeff DeShon, Ohio EPA

Mike Ekberg, Miami Conservancy District

Kevin Elder, Ohio Department of Agriculture

Dr. Norm Fausey, USDA Agricultural Research Service; alternate: **Dr. Kevin King**

Lee Martin, Heidelberg University Development Office; succeeded by **John Wilkin**, Vice President for Administration and Business Affairs

Jim Morris, U.S. Geological Survey, Ohio-Michigan

Dr. Carol Stepien, University of Toledo Lake Erie Center

Dr. Mark Thomas, Monsanto

Carrie Vollmer-Sanders, The Nature Conservancy; alternate: **Lauren Lindemann**

David Zak, Seneca Industrial & Economic Development Corporation

Collaborators in Fiscal Year 2015

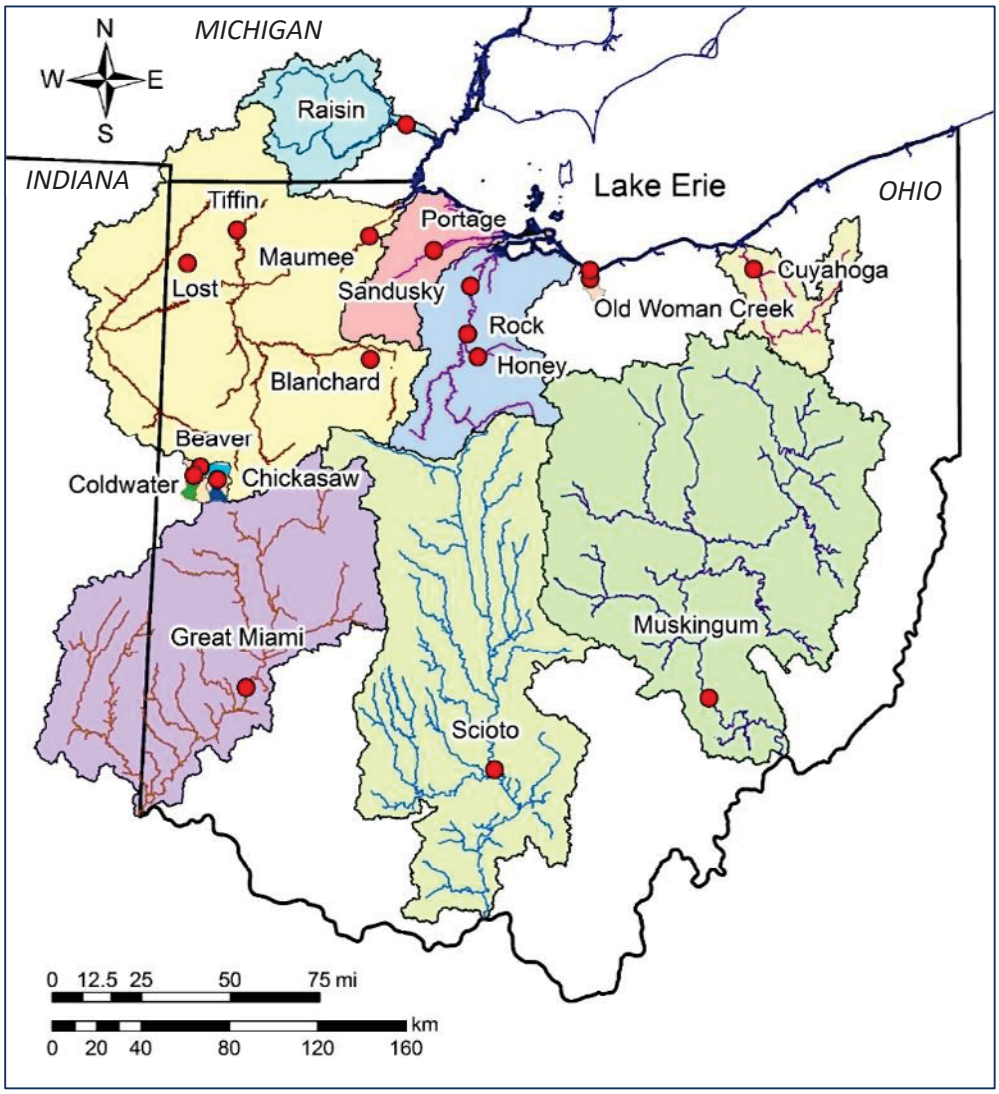
Members of the NCWQR staff collaborated with many colleagues who were co-authors of papers and presentations, co-investigators on grants and grant proposals, co-members of committees and task forces, and contacts at funding agencies for active grants. Our collaborators are listed in Appendix A, pages 39-41.

Current Research and Monitoring Activities

The Heidelberg Tributary Loading Program

Two stations were added to the Heidelberg Tributary Loading Program (HTLP) in the spring of 2015 at the Old Woman Creek National Estuarine Research Reserve on the Ohio shore of Lake Erie's central basin. Thus, 18 stations currently comprise the HTLP. The HTLP is the flagship research and monitoring program of the NCWQR. It began in 1974 and continues to be a specialized water quality monitoring program designed to measure accurately the total amounts (loads) of pollutants exported from watersheds by rivers and creeks. Such studies require both stream flow and pollutant concentration data during storm runoff events. The sampling program utilizes automatic

sampling equipment located at selected U.S. Geological Survey stream gaging stations across Ohio and into Michigan. More than 50% of Ohio's land area is upstream from HTLP stations in both the Lake Erie and Ohio River basins. The current network of 18 stations is unique within the United States in terms of its detail and duration. The sampling protocols and analytical methods are described on our web site at www.heidelberg.edu/academiclife/distinctive/ncwqr/data/guide. The HTLP provides information to support the development of effective and efficient nonpoint source management programs. It also supports the application of adaptive management to water resource protection programs by assessing program effectiveness and identifying emerging problems. Long-term data sets from most of our loading stations are accessible on our web site at www.heidelberg.edu/academiclife/distinctive/ncwqr/data/data. A special set of reports and interpretive summaries on the concentrations, loads and impacts of dissolved phosphorus in Ohio's rivers is available on our home page under "Focus on Dissolved Phosphorus" (www.heidelberg.edu/academiclife/distinctive/ncwqr). For the past four years, NOAA researchers have applied our Maumee River phosphorus loading data to a model that predicts the severity of the annual summer harmful algal bloom in Lake Erie.



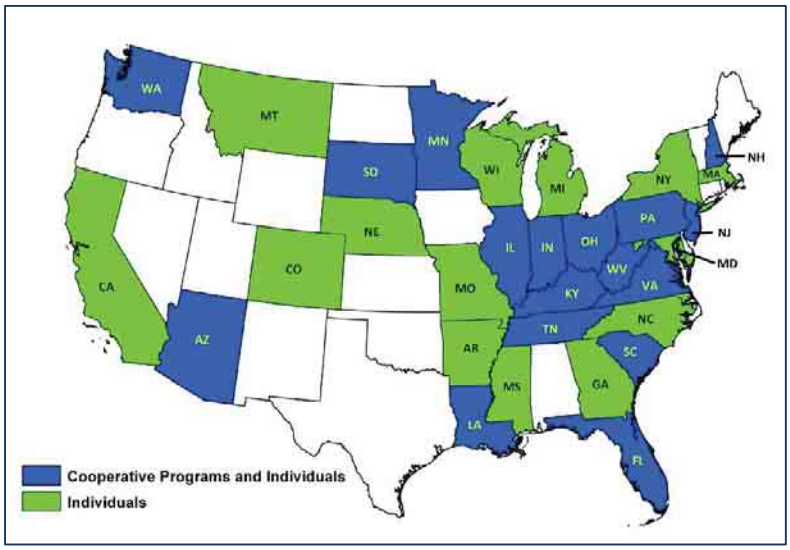
The eighteen stations (red dots) comprising the Heidelberg Tributary Loading Program in Fiscal Year 2014-2015 (map: Rem Confesor)

Funding for the HTLP has come from a combination of federal and state agencies, industries and foundations over the years. Most State of Ohio support has been passed to the HTLP through ODNR's Division of Soil and Water Resources, and most of that funding has been provided through a line item in every biennium budget since around 1990 with the exception of the 2010-2011 biennium. During that time we maintained the HTLP with grants and cooperative agreements from USDA's Natural Resources Conservation Service, the Ohio Lake Erie Protection Fund, the Ohio Water Development Authority, the Great Lakes Protection Fund, the Environmental Defense Fund, and the Michigan Department of Natural Resources. Funding through the state's biennium budget was restored in July 2011, and the HTLP is currently receiving $250,000 in State of Ohio funding each year of the 2016 and 2017 state biennium (July 2015 through June 2017).

In Heidelberg's Fiscal Year 2015, funding from all State of Ohio sources, including the Ohio Department of Natural Resources, supported 50.0% of the $652,772 cost of the HTLP (including nutrients, suspended solids and pesticides). Other sponsors in FY 2015 were the Ohio Water Development Authority, Michigan Department of Environmental Quality, National Science Foundation, National Oceanic and Atmospheric Administration, The Andersons Charitable Foundation, The Fertilizer Institute, Miami Conservancy District, Muskingum Watershed Conservancy District, City of Columbus, and Northeast Ohio Regional Sewer District. Monitoring of agricultural pesticides at a subset of stations has been sponsored for many years by Syngenta, Monsanto, Dow AgroSciences and several predecessor pesticide manufacturers. The three corporations contributed $85,236 to our pesticide monitoring program in FY 2015.

Private Well Testing Program

The Cooperative Private Well Testing Program was developed in 1987 with a grant from the State of Ohio to track nitrate (and later pesticide) concentrations in Ohio private drinking water wells. In 1990, under the sponsorship of the American Farm Bureau Federation, the program was expanded to other states. Since then, over 25,200 wells have been tested from all of Ohio's 88 counties. As of December 2015, we had tested over 61,553 well samples from 390 counties in 32 states, and the Cooperative Private Well Testing Program had been conducted in counties in 17 states. In Fiscal Year 2015, 303 individuals from 7 states participated in the well testing program, yielding $26,770 in gross revenue. This is a slight increase over the Fiscal Year 2014 revenue of $23,749. Nancy Miller coordinates this program.



The NCWQR has analyzed well water samples from 32 states (shaded green) since 1987 (map: Rem Confesor)

Phosphorus and Agricultural Nonpoint-Source Pollution Studies

A Phosphorus Soil Test Metric for Reducing Dissolved Phosphorus Loads

This project, funded by the Great Lakes Protection Fund, began in 2007 and neared its conclusion in FY 2014-2015. As one of the concluding elements of that project, the NCWQR hosted a research needs and coordination conference in March 2014. The outcomes of that conference were published in the September 2014 issue of the *Journal of Great Lakes Research* (L. Johnson et al., 2014). Additional wrap-up activities included collaboration with Resource Media to develop a website presentation on the study results (www.LakeErieAlgae.com). Also, work began on writing a manuscript on the results of the soil stratification studies for publication in a peer-reviewed journal. Dave Baker was the project director.

Extreme Events Impacts on Water Quality in the Great Lakes: Prediction and Management of Nutrient Loading in a Changing Climate

This five-year project, funded at the University of Michigan by the Water Sustainability and Climate program of the National Science Foundation, started in October 2010. The overall goals of this project are (1) to enhance understanding of expected impacts of climate change-induced extreme events on water quality and ecology, with the Great Lakes, and Lake Erie specifically, as a case study; and (2) to develop a framework for integrating human and biogeochemical controls on water quality, ecology and climate that transcends and integrates across social, economic, ecological, hydrological, and geosciences perspectives. Building on the EcoFore project, the goal of this project is to use suites of models similar to those of EcoFore to explore the implications of projected climate change for the extent and abundance of harmful algal blooms in the western basin of Lake Erie and consequences for the productivity of the Lake Erie ecosystem, particularly the fisheries. The project examines not only direct climate effects on land use and water quality, but indirect effects – the impact of climate change on demography and the consequent effects on land use and water quality. The results of this project will advance the scientific understanding of coupled human-climate-water quality systems, and inform and influence decision-making in the Great Lakes region. One product of this project is an in-depth analysis of the causes of the major algal bloom of 2011, published in *Proceedings of the National Academy of Sciences*. Heidelberg's role in the project is directed by Rem Confesor following the retirement of Pete Richards.

Verification and Enhancement of NRCS-USDA Nutrient Tracking Tool with a Suite of Best Management Practices (BMPs)

The best way to entice producers to adopt and implement best management practices (BMPs) is for them to independently verify the effectiveness of BMPs in their own fields and on demonstration farms, in part using innovative user-friendly models (e.g., the web-based Nutrient Tracking Tool, NTT). The overall goal of this three-year project, funded by the USDA Natural Resources Conservation Service starting in October 2013, is to improve soil health and reduce nutrient and sediment exports from agricultural farms. The specific objectives are: 1) demonstrate and quantify the economic and environmental benefits of a suite of BMPs through edge-of-field studies, 2) calibrate and verify the Agricultural Policy Environmental eXtender (APEX) model and the Soil and Water Assessment Tool (SWAT) and examine the BMP effects at different spatial scales in northwest Ohio, 3) calibrate and verify the Nutrient Tracking Tool (NTT) for the Great Lakes basin, and 4) promote and train the producers and stakeholders of NTT to estimate farm yield and nutrient loss.

Project collaborators subcontracted through Heidelberg University are the Sandusky River Watershed Coalition, Texas Institute for Applied Environmental Research (TIAER) at Tarleton State University, IPM Institute of North America, five Soil and Water Conservation Districts (SWCDs) in the Sandusky River watershed, USDA Agricultural Research Service, and local farmers/producers. Rem Confesor is the project director.

Evaluating the 4R Nutrient Stewardship Concept and Certification Program in the Western Lake Erie Basin

Over the past two to three years, educational programs directed at growers and nutrient service providers (e.g., agricultural retailers, crop advisers) have emphasized the principles of 4R Nutrient Stewardship, which incorporate applying fertilizer using the right source at the right rate at the right time at the right place. A 4R certification program for nutrient service providers in the Western Lake Erie Basin (WLEB) was implemented in March 2014 with 49 applications by the end of June, and three retailers had completed certification by October 2014. The overall goal of the proposed project is to evaluate the specific impacts of the adoption of practices associated with 4R Nutrient Stewardship, and the impact of the WLEB 4R Certification Program itself, on crop productivity and profitability, water quality, and perceptions of growers, nutrient service providers, and residents in the WLEB. A multidisciplinary approach is being used for evaluation involving monitoring, modeling, and measurement of the impacts at the field, watershed, and lake scales. Funding for the project comes from the 4R Research Fund, which is supported in part by members of The Fertilizer Institute (TFI), the Canadian Fertilizer Institute (CFI) and multiple additional agricultural stakeholders. The fund is currently managed by the International Plant Nutrition Institute (IPNI). See more here: www.nutrientstewardship.org. The project is directed by Dr. Kevin King of the USDA ARS Soil Drainage Research Unit, and collaborators are LimnoTech, Ohio State University, USDA ARS National Soil Erosion Research Laboratory, The Nature Conservancy, Heidelberg University (Drs. Laura Johnson and Rem Confesor), and International Plant Nutrition Institute.

Assessment of Nutrient/Eutrophication Dynamics in Western Lake Erie

In recent years, nutrient loading to the western basin of Lake Erie has been recognized as a pivotal component in the recurrence of harmful and nuisance algal blooms throughout the lake and hypoxia in the Central Basin. Through a combination of in situ experiments, laboratory studies, and modeling, this project will improve current understanding of the roles of external and internal nutrient loading, especially as influenced by weather forcing events. Outputs and outcomes will include development of nutrient mass balance budgets for the western basin, including internal nutrient cycling; improved understanding of the causes of algal blooms; training future scientists; and publication of peer-reviewed journal articles. This two-year project is funded by the Great Lakes Restoration Initiative through the USEPA. The project director is Gail Hesse, director of the Ohio Lake Erie Commission, and collaborators are Heidelberg University (Drs. Laura Johnson and Rem Confesor), University of Toledo, Case Western Reserve University, Stone Laboratory of The Ohio State University, LimnoTech, and USGS Great Lakes Science Center.

Long-Term Agro-Ecosystem Research Program (LTAR)

In January 2014, the NCWQR formally joined with two research laboratories operated by the USDA Agricultural Research Service (ARS): the Soil Drainage Research Unit at The Ohio State University and the National Soil Erosion Research Laboratory at Purdue University. The three entities form the Eastern Corn Belt node of the LTAR network, one of eighteen nodes across the U.S. The goal of LTAR is to ensure sustained crop and livestock production and ecosystem services from agro-ecosystems,

and to forecast and verify the effects of environmental trends, public policies, and emerging technologies. A key expectation of the LTAR Network is the application of research results to solve critical challenges facing agriculture including: 1) a safe and plentiful food supply; 2) climate change adaptation/mitigation; 3) supplying sources of bioenergy; 4) improving water/air/soil quality; and 5) maintaining biodiversity. Funding for collaboration among the three laboratories was still pending from USDA ARS as of December 2015. (Drs. Confesor, Johnson, Krieger and Baker)

Forecasting Harmful Algal Blooms in Lake Erie's Western Basin

Harmful algal blooms (HABs) were a feature of the impaired Lake Erie of the 1970s, largely disappeared in the late 1980s and 1990s, but re-appeared in the 2000s, generally getting more severe as the decade progressed. Because of the negative economic impact of HABs on recreation, tourism, and drinking water production, and potential toxic effects in humans and animals, predicting the severity of a year's algal bloom early in the year is very beneficial. Currently, the NCWQR's Maumee River data are the basis for ongoing seasonal HAB forecasts for Lake Erie produced by NOAA. Dr. Richard Stumpf of NOAA uses a model linking March through July Maumee River discharge and phosphorus loads with the severity of HABs determined from satellite imagery and Dr. Thomas Bridgeman's (University of Toledo) measurements of *Microcystis* biovolume from western Lake Erie. In addition, our data are used in Dr. Daniel Obenour's (NC State University) Bayesian model that forecasts HABs using a similar time frame and by LimnoTech in their Western Lake Erie Ecosystem Model (WLEEM). In 2015, NCWQR staff worked with NOAA to produce weekly early season projections to inform the public of current Maumee loading and the possible influence on bloom size. (Drs. Johnson and Baker)

Identifying the Best Strategy to Reduce Phosphorus Loads to Lake Erie from Agricultural Watersheds

In the western Lake Erie basin, the current strategy to reduce phosphorus (P) exports from agricultural lands is to target hotspots in the watershed (e.g. the GLRI priority watersheds) that are a major source of dissolved P runoff. Yet, increasing evidence suggests we need a basin-wide management change because most farms are leaking a moderate amount of dissolved P that differs each year depending on precipitation and crop rotation. This project will confirm which strategy is the most appropriate in identifying management practices that effectively decrease the total nutrient and sediment exports out of the watershed. In addition, our project will provide a better fundamental understanding of how differing P sources and locations may contribute to dissolved P runoff from the WLEB watersheds. Ultimately, while part of this project will be focused in smaller watersheds of the WLEB, these data will be essential to improving existing watershed models that are required to predict the effects of best management practices as well as climate change across the entire WLEB. (Dr. Confesor)

An Online Tributary Loading Tool to Support Harmful Algal Bloom Forecasting in Lake Erie

As a part of the Heidelberg Tributary Loading Program (HTLP), the National Center for Water Quality Research (NCWQR) has been collecting samples for nutrient and sediment analysis 1-3 times a day, year round for up to 41 years. Samples are currently collected from 18 tributaries throughout Ohio and Michigan, but the longest-term data have been collected from the major external inputs to Lake Erie: the Sandusky, Maumee, Cuyahoga, and Raisin rivers. Although HTLP data are posted on the NCWQR website, to expand accessibility we have partnered with the Great Lakes Observing System (GLOS) and LimnoTech to provide HTLP's Lake Erie tributary data on GLOS for download and

visualization, updated quarterly. Because the Maumee River is the largest external input to Lake Erie and current seasonal western Lake Erie harmful algal bloom (HAB) forecasts are based on spring Maumee River phosphorus loads, we developed an expedited process to provide weekly data from the Maumee River from March through August. In addition to being available for download, these data can be visualized on GLOS using a new online tool that facilitates tracking spring loads from the Maumee River and comparisons with past years as well as other Lake Erie tributaries. (Dr. Johnson)

Rem Confesor and Ken Krieger beside new USGS stream discharge instrumentation on Rock Creek downstream of Republic, Ohio (USGS 04197152), on County Road 43 in Seneca County, December 2014.
(photo: Laura Johnson)

Watershed Modeling and River Monitoring in Collaboration with IPM Institute of North America

The NCWQR was subcontracted with the IPM Institute of North America on two grants that ended in 2013. One grant, from the USDA NRCS, was titled "Demonstrate a New Comprehensive Model to Increase Adoption to Improve Water Quality and Agricultural Land Economics on Critical Agricultural Lands". The second grant, from the Great Lakes Protection Fund, was titled "Transforming our Approach to Generate Conservation Benefits from Agriculture". Early in these projects, our staff participated in listening sessions and presented information on water quality issues in the Sandusky River watershed. Later we developed a user-friendly spreadsheet calculator/tool to predict nutrient [phosphorus (P) and nitrogen (N)] losses from a field using established efficiencies of implemented best management practices (BMPs). The goal of the calculator was to scale up the nutrient load reduction at the field/farm level to the sub-watershed/watershed level and predict nutrient reduction if a practice were implemented on all acreage in the watershed. We also developed a high-resolution map of the Sandusky watershed based on the Soil and Water Assessment Tool (SWAT) model output. The map can be used to identify critical areas that are most sensitive to BMP implementation in reducing total P and dissolved reactive P (DRP) exports. The NRCS subaward ended in September 2013 and the GLPF grant ended in October 2013. Results and findings from these projects will be used and expanded throughout the Great Lakes in new project proposals. (Dr. Confesor).

Identifying the Best Strategy to Reduce Phosphorus Loads to Lake Erie from Agricultural Watersheds

In the western Lake Erie basin (WLEB), the current strategy to reduce phosphorus (P) exports from agricultural lands is to target hotspots in the watershed (e.g., the Great Lakes Restoration Initiative priority watersheds) that are a major source of dissolved P runoff. Yet, increasing evidence suggests we need a basin-wide management change because most farms are leaking a moderate amount of

dissolved P that differs each year depending on precipitation and crop rotation. This project, funded by the Ohio Department of Higher Education and in collaboration with Ohio State University and Bowling Green State University, will confirm which strategy is the most appropriate in identifying management practices that effectively decrease the total nutrient and sediment exports out of the watershed. In addition, our project will provide a better fundamental understanding of how differing P sources and locations may contribute to dissolved P runoff from the WLEB watersheds. Ultimately, while part of this project will be focused in smaller watersheds of the WLEB, these data will be essential to improving existing watershed models that are required to predict the effects of best management practices as well as climate change across the entire WLEB. (Dr. Confesor)

Phosphorus Management Scenarios: Western Basin of Lake Erie

Six groups (University of Michigan, The Ohio State University, LimnoTech, Heidelberg University, The Nature Conservancy/USDA-ARS, USGS) collaborated in a multi-modeling approach to help policy advocates identify potential solutions to elevated phosphorus loads, and consequently harmful algal blooms (HABs) in Lake Erie. Five of the modeling groups independently set up and calibrated the Soil and Water Assessment Tool (SWAT) for the Maumee Basin. The USGS with its calibrated SPARROW (SPAtially Referenced Regressions On Watershed attributes) model will help identify hotspots. The calibrated SWAT models were validated and established baseline conditions using the same meteorological and point source data from 2005-2014. Next steps include identifying and running "extreme" and "optimal" suites of BMPs into SWAT. (Dr. Confesor)

Agricultural Pesticides – Data Analysis and Development of Analytical Methods

Our new postdoctoral researcher, Dr. Tania Biswas, who joined our staff in January 2015, initiated two areas of investigation. (1) Tania began to review and analyze NCWQR's long-term data set on agricultural pesticides dating back to 1983. She constructed numerous tables and graphs and performed statistical analyses as she began to develop a technical report on NCWQR's analytical methods and the pesticide patterns and trends revealed by the data. (2) Tania also began to develop expertise on NCWQR's Bruker EVOQ^{TM} triple quadrupole mass spectrometer (LC-TQ-MS) and started to develop analytical methods for herbicides such as dicamba, 2,4-D and glyphosate, which have not previously been analyzed by the NCWQR. Tania received hands-on training on an identical instrument at the Bruker facility in Fremont, California, in July 2015. (Dr. Biswas)

Biological Studies

Analysis and Interpretation of Aquatic Macroinvertebrate Data for Ohio EPA's Lake Erie Nearshore Monitoring Program

The NCWQR contracted in 2011 with the Ohio EPA Division of Surface Water to perform laboratory analysis of benthic invertebrate samples as part of a Lake Erie nearshore monitoring program initiated with funding from the Great Lakes Restoration Initiative. We analyzed approximately 100 grab samples of bottom mud and 20 artificial substrate (Hester-Dendy) samples accompanied by qualitative samples collected by Ohio EPA in 2011 and 2012. We completed our sample analyses in December 2013. In April 2015 Ohio EPA contracted us to interpret the data, and in September 2015 we submitted the report, "Utility of Ponar samples for interpretation of environmental quality in Lake Erie river mouths, lacustuaries, bays and harbors." (Jake Boehler, Dr. Krieger)

Oligochaete Worm Species Distributions and Abundances in the Great Lakes

Differences in the co-occurrence of oligochaete worm species and their abundances relative to one another can serve as a useful indicator of the degree of environmental degradation of lakes and changes in lake quality over time. In the deep, sometimes oxygen-poor areas of many lakes, oligochaetes are the primary or only macroinvertebrates living in the bottom sediments. For these reasons, it is important to characterize oligochaete communities. Beginning in the fall of 2014, the NCWQR began to identify and count thousands of oligochaetes in sediment samples collected from parts of the Laurentian Great Lakes under a subcontract to the Great Lakes Center of Buffalo State College (SUNY). The Buffalo scientists collected the samples as part of their Lake Erie and Lake Michigan Benthos: Cooperative Science and Monitoring Initiative multi-year project funded by the USEPA Great Lakes National Program Office. (Jake Boehler)

The winters of 2014 and 2015 were particularly severe, requiring much effort in the field to maintain the sampling stations. At right, Jake Boehler gets water flowing through the Honey Creek sampling lines again in January 2015. Above, ice moves down a thawed Sandusky River in Tiffin in March 2015. (Photos: Laura Johnson)

Responses of Aquatic Biological Communities to Land-Use and Ditch Maintenance Practices in Agricultural Landscapes

As part of the Honey Creek-Sandusky River Targeted Watershed Project (see a description in the 2013-2014 annual report), this study was aimed at understanding how quickly, and to what extent, the aquatic habitats of maintained agricultural ditches become more complex and develop beneficial fish and macroinvertebrate communities in response to a variety of best management practices (BMPs). Each summer and fall from 2008 through 2011, biologists surveyed fish and macroinvertebrates in 20 segments of maintained ditches in the Sandusky and nearby watersheds. Fish were sampled by University of Toledo biologists (headed by Dr. Hans Gottgens), and NCWQR biologists (including student assistants) sampled invertebrates. We submitted a final report on the macroinvertebrates in March 2014 and are presently developing a manuscript based on that work. (Jake Boehler, Drs. Krieger and Johnson)

Grants and Proposals

Ongoing Grants and Contracts in Fiscal Year 2014-2015

(received before July 2014)

Grants and Contracts in Support of the Heidelberg Tributary Loading Program

The grants and contracts listed here have funded one or more HTLP stations for multiple years, and most, as shown, were renewed in FY 2015 for another one or two years. They are not listed a second time under “new grants”. All are administered by the NCWQR director.

- **State of Ohio** (via Department of Natural Resources): "Heidelberg Water Quality Lab" line item in ODNR budget for fiscal years 2016 and 2017. $500,000 ($250,000/year). Support for western Lake Erie basin stations other than the Maumee River. (See discussion on pages 10-12.)
- **The Andersons Charitable Foundation**: Support for Maumee River station. Renewed for FY 2016. $15,000.
- **The Fertilizer Institute**: Support for Maumee River station. Renewed in FY 2014 for three years. $15,000 ($5,000/year).
- **National Science Foundation** (through **University of Michigan**): Support for Maumee River station. $21,000.
- **Miami Conservancy District**: “Monitor Nutrient Concentrations in the Great Miami River at Miamisburg”. Renewed for calendar year 2015. $30,000.
- **Ohio Department of Natural Resources**: Operation of monitoring stations on Coldwater Creek and Beaver Creek near Grand Lake Saint Marys. Renewed for fiscal years 2016 and 2017. $148,000 ($74,000/year).
- **Ohio Water Development Authority**: Continued operation of monitoring station on Chickasaw Creek, a tributary of Grand Lake Saint Marys. Renewed for calendar year 2015. $37,000.
- **Michigan Department of Environmental Quality**: Continuation of sample collections and analyses for the River Raisin upstream of Monroe, Michigan; indefinite period. ~$22,000.

- **Northeast Ohio Regional Sewer District:** Support for Cuyahoga River monitoring station. Renewed for calendar years 2015 and 2016. $68,000 ($34,000/year).
- **Syngenta Crop Protection, Inc.**: Support for the pesticide monitoring program. Renewed for calendar year 2015. $40,000.
- **Monsanto**: Support for the pesticide monitoring program. Renewed for calendar year 2015. $20,000.
- **Dow AgroSciences**: Support for the pesticide monitoring program. Renewed for calendar year 2015. $7,500.

Research Grants

- **U.S. Department of Agriculture – Natural Resources Conservation Service**, Conservation Innovation Grant: "Verification and Enhancement of NRCS Nutrient Tracking Tool with a Suite of Best Management Practices (BMPs)". $591,655. Ends 30 September 2016. Project director: Rem Confesor. (See description on pages 13-14.)
- **U.S. Department of Agriculture – Natural Resources Conservation Service**, Conservation Innovation Grant (through **Ohio Environmental Council**): "Comprehensive Analysis of CIG Projects Conducted in Ohio". $12,856. NCWQR lead: Ken Krieger. Ended in October 2015.
- **U.S. Environmental Protection Agency – Great Lakes Restoration Initiative** (through **Ohio Lake Erie Commission**): "Assessment of Nutrient/Eutrophication Dynamics in Western Lake Erie". Subaward to Heidelberg: $116,687. No-cost extension beyond end date of 30 September 2015. Heidelberg project directors: Laura Johnson and Rem Confesor. (See description on page 14.)

Autosampler bases containing samples collected every eight hours from six HTLP stations at the end of one of the two weekly (Monday) collection trips by the chemistry laboratory staff (Jake Boehler, Ellen Ewing and Barb Merryfield) on 16 March 2015. (photo: Laura Johnson)

- **U.S. Environmental Protection Agency – Great Lakes Restoration Initiative** (through **Ohio Environmental Protection Agency**): Aquatic macroinvertebrate identification and enumerations for Ohio EPA's nearshore biomonitoring program. $52,545. Project Co-directors: Jakob Boehler and Ken Krieger. Ended December 2014. (See description on page 17.)
- **USDA – Agricultural Research Service** (through **4R Research Fund**): "Evaluating the 4R Nutrient Stewardship Concept and Certification Program in the Western Lake Erie Basin". Subaward to Heidelberg: $169,941 over five years. Ends 30 September 2019. Heidelberg project directors: Laura Johnson and Rem Confesor. (See description on page 14.)
- **Great Lakes Protection Fund**: "A Phosphorus Soil Test Metric for Reducing Dissolved Phosphorus Loads". Grant #833. No-cost extension into fiscal year 2016. Project director: Dave Baker. (See description on page 13.)
- **National Science Foundation** (through **University of Michigan**): "Extreme Events Impacts on Water Quality in the Great Lakes: Prediction and Management of Nutrient Loading in a Changing Climate". Ends in FY 2016. NCWQR lead: Rem Confesor. (See description on page 13.)

New Grants and Contracts Received in Fiscal Year 2014-2015

Grants and Contracts in Support of the Heidelberg Tributary Loading Program

Renewal grants, which are extensions of prior grants, are listed above under "Ongoing Grants and Contracts." The three new grants for the HTLP below are administered by the NCWQR director.

- **City of Columbus – Division of Sewerage and Drainage:** Support for Scioto River monitoring station at Chillicothe in calendar years 2014 and 2015 plus additional water quality analyses and calculation of NPDES inputs. $80,000 ($40,000/year).
- **Muskingum Watershed Conservancy District**: Partial support for Muskingum River monitoring station at McConnelsville in calendar year 2015. $16,000.
- **National Oceanic and Atmospheric Administration (through ODNR)**: Field assistance, water sample analysis, and data interpretation for two monitoring stations on Old Woman Creek starting winter 2015. $42,020.

Research Grants and Contracts

- **Ohio Department of Higher Education** and **Ohio State University Field to Faucet**, 2015-2017. "Identifying the Best Strategy to Reduce Phosphorus Loads to Lake Erie from Agricultural Watersheds." Lead Principal Investigator: Laura Johnson, NCWQR. $182,600 to Heidelberg. (See description on page 15.)
- **National Oceanic and Atmospheric Administration, Great Lakes Observing System**, 2014-2015. "An Online Tributary Loading Tool to Support Harmful Algal Bloom Forecasting in Lake Erie." Lead Principal Investigator: Tad Slawecki, LimnoTech; Heidelberg lead: Laura Johnson. $25,000 to Heidelberg. (See description on pages 15-16.)
- **U.S. Environmental Protection Agency** (through **SUNY Buffalo State College**). Began fall of 2014, end date undetermined. Identification and enumeration of oligochaete worms. P.I.: Jake Boehler. $11,060 as of December 2015. (See description on page 18.)

- **U.S. Environmental Protection Agency – Great Lakes Restoration Initiative** (through **Ohio Environmental Protection Agency**): Analysis and interpretation of aquatic macroinvertebrate data for Ohio EPA's nearshore biomonitoring program. Ended October 2015. P.I.: Ken Krieger. $6,278. (See description on page 17.)

Grant Proposals Pending as of 30 June 2015

- **University of Michigan Water Center**: "Western Lake Erie Basin Modeling Comparison." Heidelberg P.I.: Rem Confesor. $17,670. Awarded July 2015.
- **Ohio Lake Erie Protection Fund**: "Gene Sequencing as a Tool for Identifying Native and Invasive Sphaeriid Clams in Lake Erie." Project director: Ken Krieger, with Jakob Boehler and Dr. Kylee Spencer (Biology and Environmental Sciences Dept.). $14,994. Awarded July 2015.
- **Ohio Sea Grant:** "Opening the Black Box of Nutrient Processing in a Great Lakes Coastal Wetland." Lead P.I.: Lauren Kinsman-Costello, Kent State University. Heidelberg project director: Laura Johnson. Pre-proposal submitted April 2015; full proposal submitted July 2015. Total $54,366; $2,543 to Heidelberg). Awarded Fall 2015.
- **Castalia Trout Club**: "Water Quality and Biological Monitoring to Provide Baseline Data on the Spring and Streams at the Castalia Trout Club." $111,380. Reduced project titled "Water Quality Monitoring to Provide Baseline Data on the Spring and Streams at the Castalia Trout Club" was funded in November 2015 at $13,175. Project Director: Laura Johnson. (Dec. 2015 – Nov. 2016)

Certifications, Training and Other Professional Development

- David Baker: Ohio EPA Level 3 (highest) Qualified Data Collector for Chemical Water Quality Assessment, QDC No. 00003.
- Saptashati Biswas: Professional User Training on EVOQ™ triple quadrupole mass spectrometer (LC-TQ-MS) by Bruker Corporation at Bruker Daltonics Inc. Research Institute, Fremont, California, 28-30 July 2015.
- Jakob Boehler: Ohio EPA Level 3 (highest) Qualified Data Collector for Chemical Water Quality Assessment, QDC No. 00926. Level 3 certification training in macroinvertebrates at the Northeast Ohio Regional Sewer District, August 2014.
- Ellen Ewing: Seal AAIII training (in house), 2015; Ohio EPA Level 3 (highest) Qualified Data Collector for Chemical Water Quality Assessment, QDC No. 00060.
- Jack Kramer: Ohio EPA Level 3 (highest) Qualified Data Collector for Chemical Water Quality Assessment, QDC No. 00062.
- Barbara Merryfield: Ohio EPA Level 3 (highest) Qualified Data Collector for Chemical Water Quality Assessment, QDC No. 00061.
- Aaron Roerdink: Ohio EPA Level 3 (highest) Qualified Data Collector for Chemical Water Quality Assessment, QDC No. 00057.
- The chemistry laboratory operates under approved Quality Assurance Project Plans that require approval by the USEPA.

Publications in Fiscal Year 2014-2015

Publication Awards

- The following paper received the **2015 Chandler-Misener Award** of the International Association for Great Lakes Research. "The Chandler-Misener Award is presented annually to the author(s) of the peer-reviewed paper in the current volume of the *Journal of Great Lakes Research* judged to be 'most notable.' Papers are evaluated on the basis of originality, contribution and presentation." Scavia, D., J.D. Allan, K.K. Arend, S. Bartell, D. Beletsky, N.S. Bosch, S.B. Brandt, R.D. Briland, I.Daloğlu, J.V. DePinto, D.M. Dolan, M.A. Evans, T.M. Farmer, D. Goto, H. Ha, T.O. Höök, R. Knight, S.A. Ludsin, D. Mason, A.M. Michalak, **R.P. Richards**, J.J. Roberts, D.K. Rucinski, E. Rutherford, D.J. Schwab, T.M. Sesterhenn, H. Zhang, Y. Zhou. 2014. Assessing and addressing the re-eutrophication of Lake Erie: Central basin hypoxia. *Journal of Great Lakes Research* 40:226–246.
- In October 2015, the publisher **Elsevier** cited the same article by Scavia et al. (2014) as being among the "top 10 most downloaded Environmental, Aquatic and Agriculture Sciences articles published since 1 January 2014 by US-based authors".
- The Soil and Water Conservation Society presented its 2015 "**Best Research Paper Award for Impact and Quality**" to the article by **Richards, R.P., D.B. Baker, J.P. Crumrine, and A.M. Stearns.** 2010. Unusually large loads in 2007 from the Maumee and Sandusky Rivers, tributaries to Lake Erie. *Journal of Soil and Water Conservation* 65:450-462.

Refereed Journal Publications

Baker, D.B., **R. Confesor**, **D.E. Ewing**, **L.T. Johnson**, **J.W. Kramer**, and **B.J. Merryfield**. 2014. Phosphorus loading to Lake Erie from the Maumee, Sandusky, and Cuyahoga rivers: The importance of bioavailability. *Journal of Great Lakes Research* 40:502-517.

Baker, D.B., **D.E. Ewing**, **L.T. Johnson**, **J.W. Kramer**, **B.J. Merryfield**, **R.B. Confesor**, **R.P. Richards**, **and A.A. Roerdink**. 2014. Lagrangian analysis of the transport and processing of agricultural runoff in the lower Maumee River and Maumee Bay. *Journal of Great Lakes Research* 40:479-495.

Smith, D., K. King, **L.T. Johnson**, W. Francesconi, **R.P. Richards, D. Baker**, and A. Sharpley. 2014. Surface runoff and tile drainage transport of phosphorus in the Midwestern United States. *Journal of Environmental Quality* 44:495-502.

Stow, C.A., Y. Cha, **L.T. Johnson**, R. Confesor, and R.P. Richards. 2015. Long-term and seasonal trend decomposition of the Maumee River nutrient inputs to Western Lake Erie. *Environmental Science & Technology* 49: 3392-3400.

Kleinman, P.J.A., A.N. Sharpley, P.J.A. Withers, L.Bergstrom, **L.T. Johnson**, and D.G. Doody. 2015. Implementing agricultural phosphorus science and management to combat eutrophication. *AMBIO* 44:S297-S310.

Zhou, Y., A.M. Michalak, D. Beletsky, Y.R. Rao, and **R.P. Richards**. 2015. Record-breaking Lake Erie hypoxia during 2012 drought. *Environmental Science and Technology* 49: 800-807.

Other Publications

Resource Media. 2015. *LakeErieAlgae.com*. Interactive website explaining the importance of agriculturally derived phosphorus in the development of harmful algal blooms in Lake Erie, describing the history and programs of the NCWQR, and much more. (Dave Baker and Laura Johnson were consultants on the project.)

Publications by Others Citing NCWQR Impact and Data

The partial list below cites publications written by others that pointed to the impact of the NCWQR tributary loading studies and or used the NCWQR data sets in their research.

Betanzo, E.A., A.F. Choquette, K.H. Reckhow, L. Hayes, E.R. Hagen, D.M. Argue and A.A. Cangelosi. 2015. *Water data to answer urgent water policy questions: Monitoring design, available data and filling data gaps for determining the effectiveness of agricultural management practices for reducing tributary nutrient loads to Lake Erie*. Northeast-Midwest Institute Report, 169 p., http://www.nemw.org/.

Hirsch, R.M. 2014. Large biases in regression-based constituent flux estimates: causes and diagnostic tools. *Journal of the American Water Resources Association.* 50(6):1401-1424.

Jarvie, H.P., A.N. Sharpley, P.J.A. Withers, J.T. Scott, B.E. Haggard, and C. Neal. 2013. Phosphorus mitigation to control river eutrophication: murky waters, inconvenient truths, and "postnormal" science. *Journal of Environmental Quality* 42:295-304.

LaBeau, M. B., H. Gorman, A. Mayer, D. Dempsey, and A. Sherrin. 2013. Tributary phosphorus monitoring in the U.S. portion of the Laurentian Great Lake Basin: Drivers and challenges. *Journal of Great Lakes Research* 39:569-577.

Landscape Metrics. 2015. *A resource out of place: the story of phosphorus, Lake Erie, and toxic algal blooms*. http://www.resourceoutofplace.com/

Raymond, S., A. Mailhot, G. Talbot, P. Gagnon, A.N. Rousseau, and F. Moatar. 2014. Load estimation method using distributions with covariates: a comparison with commonly used estimation methods. *Journal of the American Water Resources Association* 50:791-804.

Yeager-Kozacek, Codi, at Circle of Blue. 2013. Great Lakes drinking water fouled by toxic algae. http://www.circleofblue.org/waternews/2014/world/choke-point-index-great-lakes-drinking-water-fouled-by-toxic-algae/

Education

Courses

Dr. Aaron Roerdink taught four chemistry courses and Dr. Ken Krieger taught one environmental science course in FY 2014-2015. The catalog descriptions of those courses are provided here.

Fundamentals of Chemistry (CHM 103) – Aaron Roerdink (3 sem. hrs.) A study of basic chemical principles and how chemistry relates to topics of current interest, such as energy and environmental matters. This course is designed specifically for non-science majors. Fall semester.

Introduction to Forensic Chemistry (CHM 105) – Aaron Roerdink (4 sem. hrs.). A survey of the field of Forensic Chemistry - the application of chemistry to the law. Topics include a discussion of forensic science careers and their relationship to the legal system. Additionally crime scene collection and analysis of physical, biological, and chemical evidence will be discussed. Students will explore some of the concepts discussed in lecture and will gain hands-on laboratory experience related to forensic science. Fall and spring semesters.

Environmental Chemistry (CHM 205) – Aaron Roerdink (4 sem. hrs.). Students will study the chemistry of the air, water and soil. The reaction, movements and fates of anthropocentric and naturally occurring compounds will be investigated. Students will use contemporary sampling and analytical techniques to examine matrices such as surface water, groundwater, and sediment samples. In addition, students will employ appropriate documentation and quality control procedures, interpret data and learn to communicate water quality data. Spring semester.

Quantitative Analysis (CHM 305) – Aaron Roerdink (5 sem. hrs.). Students study both theoretical and practical aspects of quantitative chemical analysis, including classical and modern methods. Theoretical emphasis is on treatment of data, acid-base, solubility, oxidation-reduction, and complex ion equilibria, electrochemistry and spectrophotometry. Laboratory work includes quantitative gravimetric, volumetric, and instrumental analysis. Fall semester.

Water Pollution Biology (BIO 324) – Ken Krieger (4 sem. hrs.). The biological effects of water pollution will be studied through lectures, experimentation, field sampling, laboratory analysis, and data interpretation. Students will employ up-to-date methods of stream biomonitoring and will be introduced to methods of toxicity testing. Spring semester.

Undergraduate Research

NCWQR staff members advised three undergraduate students on research projects during FY 2014-2015:

Jakob Boehler and Ken Krieger: (Faculty Adviser – Dr. Kylee Spencer)

> **Brittany Labry**: "Genetic Comparison and Identification of Different Pill Clam Species within the Family Sphaeriidae". Honors 455 project, Spring 2014; Honors Presentations, Heidelberg University, 23 April 2014. (Oral and written reports)

Aaron Roerdink:

> **G. Samenuk**: "Method Development for the Quantification of Glyphosate and Dicamba in Surface Water Using Anion-Exchange LC-MS/MS," Heidelberg University Senior Honors Project, spring 2015 and 249th American Chemical Society National Meeting, Denver, CO (March 2015).
>
> **A. Bauer** and **A. Perry**: "Study Towards the Selective Digestion of Glyphosate in Surface Water," 249th American Chemical Society National Meeting, Denver, CO (March 2015)

Graduate Research Advising

Ken Krieger:

> **Nathaniel Marshall**, Doctor of Philosophy in Environmental Science at the University of Toledo. Started summer of 2014 (Adviser: Dr. Carol Stepien)

Outreach and Service

The NCWQR in the News Media

Many news stories about NCWQR activities and research findings appeared in Fiscal Year 2015 in newspapers and newsletters, on the Internet and as radio and television interviews. Because of their large number, largely in response to the Toledo drinking water crisis of early August 2014, many of those stories are listed with their web links in **Appendix B** rather than in the body of the annual report.

Ellen Ewing (L) explains NCWQR sample analytical protocols to U.S. Senator Rob Portman (second from left) on 5 December 2014. Looking on are (L to R) Tiffin mayor Aaron Montz, director Ken Krieger, SIEDC president David Zak, Heidelberg University president Rob Huntington, and Heidelberg provost Dave Weininger. (photo: Rem Confesor)

Open Houses and Tours of the NCWQR

- Throughout the year: Tours for prospective students and their parents (Ewing and others)
- 18 September 2014 – NCWQR community open house (approximately 45 visitors) (entire staff)
- 5 December 2014 – U.S. Senator Rob Portman (entire staff)
- 17 January 2015 – Ohio Farm Bureau, Conservation District Board (Ewing, Baker) (~15 visitors)

- 10 February 2015 – Chase Eikenbary, liaison to Governor Kasich (Baker, Johnson, Krieger)
- 18 February 2015 – Clyde-Green Springs Young Farmers (Baker, Boehler, Ewing)
- 28 February – Ohio Farm Bureau Federation (Boehler, Ewing, Johnson, Krieger) (~15 visitors)
- 2 April 2015 – Tiffin Middle School visit (Boehler, Ewing) (29 students, two adults)
- 21 April 2015 - Jean Chruscicki and Paul Thomas, USEPA, and Bruce Cleland, TetraTech (Confesor, Johnson)
- 22 April 2015 – Rick Brown, Toledo Maritime Academy (Baker, Confesor, Johnson, Krieger)
- 22 April 2015 – Demonstration at Bascom WSOS Pre-school (Boehler) (34 students, 5 adults)
- 25 April 2015 – Heidelberg Science Alumni Reunion open house (Baker, Boehler, Ewing, Johnson, Kramer, Krieger, Merryfield) (approximately 12)
- 27 June 2015 – Heidelberg Alumni Weekend open house (Baker, Boehler, Ewing, Johnson, Krieger) (approximately 20)

Presentations

- 10 July 2014. **Spring Discharge and Dissolved Phosphorus Loading from the Maumee River in 2014**. Seasonal Western Lake Erie Harmful Algal Bloom forecast at The Ohio State University's Stone Laboratory. Gibraltar Island, Ohio. (Laura Johnson)
- 11 July 2014. **Learning from the Past to Plan for the Future: Historic Nutrient Fluxes in Lake Erie Triburaries.** Soil and Water Conservation Society Annual Meeting. (Helen Jarvie, Andrew Sharpley, Peter Richards, David Baker and Laura Johnson)
- 5 August 2014. Briefing of U.S. Senator Sherrod Brown on Lake Erie water quality issues. Catawba Island and Put-in-Bay, Ohio. (Ken Krieger)
- 11 August 2014. **Where Does the Phosphorus Come From?** Lake Erie Policy Briefing. Cleveland, Ohio (Laura Johnson)
- 14 August 2014. **The Heidelberg Tributary Loading Program**. Healthy Water Ohio meeting, Celina, Ohio. (Laura Johnson)
- 15 August 2014. Testimony before state legislators at Lake Erie Legislative Caucus forum, Maumee Bay State Park, Ohio. (Ken Krieger)
- 18 August 2014. **Understanding Nutrients, Runoff, and Loading**. Science writers' workshop at Ohio State University's Stone Laboratory. Gibraltar Island, Ohio. (Laura Johnson)
- 27 August 2014. Taping for WBGU Public Television, *Northwest Ohio Journal*. **Agriculture and Lake Erie**. (David Baker, Rem Confesor, and Laura Johnson)
- 8 September 2014. **Grand Lake St Marys Tributary Monitoring**. Invited talk at the Ag solutions meeting. Chickasaw, Ohio. (Laura Johnson)
- 11 September 2014. **Understanding nutrients, runoff, and loading**. Ohio Department of Natural Resources meeting. Columbus, Ohio. (Laura Johnson)
- 23 September 2014. **Understanding Nutrients, Runoff, and Loading**. Coastal Resource Advisory Committee meeting. Sandusky, Ohio. (Laura Johnson)

- 24 September 2014. T**he Heidelberg Tributary Loading Program**. Tiffin Rotary Club. Tiffin, Ohio (Laura Johnson)
- 23 October 2014. **Agricultural Phosphorus and Lake Erie**. Invited seminar at Indiana University in Bloomington, Indiana. (Laura Johnson)
- 29 October 2014. **Updates from the Heidelberg Tributary Loading Program with a Focus on the Maumee River**. Western Lake Erie Basin Partnership Leadership Executive Session. Toledo, Ohio. (Laura Johnson)
- 31 October 2014. **Complex Macroinvertebrate Communities Occupy Agricultural Ditches of Lake Erie Tributaries.** Water Research Symposium at Kent State University. Kent, OH. Poster. (J. Boehler)
- 19 November 2015. **Water Quality of Grand Lake St. Marys Tributaries and Potential for In-Lake Nutrient Processing**. 43rd annual Water Management Association of Ohio Conference (WMAO). Columbus, OH. (Laura Johnson)
- 3 December 2014. **State of the Sandusky River Watershed: Recent Research from the National Center for Water Quality Research**. Sandusky River Watershed Coalition Annual Meeting Plenary. Tiffin, Ohio. (Laura Johnson)

Buffalo State College (SUNY) senior research support specialist Susan Daniel (Heidelberg alumna, center) discusses zebra mussel and quagga mussel impacts on native invertebrate communities in Lake Erie with Dave Baker as Heidelberg alumnus Chris Osborne (graduate student at Buffalo State), Laura Johnson and Tania Biswas look on during the Annual Conference on Great Lakes Research at the University of Vermont, 26 May 2015. (photo: Rem Confesor)

- 5 December 2014. **The Heidelberg Tributary Loading Program: Contributions to the Understanding of Lake Erie**. Special visit from US Senator Rob Portman, Tiffin Mayor Aaron Montz, and SIEDC director David Zak. (Laura Johnson)
- 17 December 2014. **Heidelberg Water Quality Laboratory Tour and Discussions**. Area Farm Bureau Council Members. (David Baker and Ellen Ewing)
- 8 January 2015. **Lake Erie Re-eutrophication: Where is the Phosphorus Coming From?** EPA-NRCS-SERA17 Information Exchange Webinar. (Laura Johnson)
- 12 January 2015. **Practical Causes of Harmful Algal Blooms in Lake Erie**. Michigan Agri-Business Association Winter Conference. Lansing, Michigan. (Laura Johnson)
- 22 January 2015. **Lake Erie Western Basin Phosphorus Sources**. Lake Erie Sources and Solutions workshop hosted by TMACOG (Toledo Metropolitan Area Council of Governments). Toledo, Ohio (Laura Johnson)
- 3 February 2015. **Practices to Reduce Dissolved Phosphorus Runoff**. Natural & Environmental Resources Advisory Committee of the Michigan Farm Bureau. Lansing, Michigan (webinar). (Laura Johnson)
- 11 February 2015. **Scioto River at Chillicothe: 2014 Update**. Columbus Division of Sewerage and Drainage. Columbus, Ohio. (Laura Johnson)
- 18 February 2015. **Heidelberg Water Quality Laboratory Tour and Discussions**. Sandusky County Farm Leaders. (David Baker and Ellen Ewing)
- 20 February 2015. **Lake Erie Algal Pollution.** Honors Service Learning Class, Heidelberg University. (David Baker)
- 28 February 2015. **Lake Erie Algae: Causes and Solutions**. Farmer tour and presentation at the NCWQR. Tiffin, Ohio. (Laura Johnson)
- 2 March 2015. **Agricultural Runoff and Lake Erie: Past, Present, and Future**. Iowa Water Conference Plenary. Ames, Iowa (webinar due to weather). (Laura Johnson)
- 4 March 2015. **The Heidelberg Tributary Loading Program**. Workgroup for Water Resources Monitoring (USGS Ohio water monitoring conference). Columbus, Ohio. (Ken Krieger and Laura Johnson)
- 16 March 2015. **Long-term Trends in Agricultural Runoff to Lake Erie: Causes, Consequences and Remedies.** Michigan Chapter, Soil and Water Conservation Society. East Lansing, Michigan (David Baker)
- 26 March 2015. **Effects of Clearing the Great Black Swamp (and other parts of Ohio)**. Presentation as part of Tiffin-Seneca Public Library discussion of *Thieving Forest* by Martha Conway, the 2015 Community Read selection. (Ken Krieger)
- 8 April 2015. Hot Topics participant at the Ag & Natural Resources Day for the Seneca Leadership Group. Republic, Ohio. (Laura Johnson)

- 8 April 2015. **Where Did the Phosphorus Come From?** Cleveland Water Alliance Innovation/Research Showcase & Cocktail Reception for the Association of Water Technologies training seminar. Cleveland, Ohio (Laura Johnson)
- 13 April 2015. **Nutrient Sources and Land-Lake Management in the Lake Erie Basin.** Invited Presentation – Global Solutions to Regional Problems: Collecting Global Expertise to Address the Problems of Harmful Algal Blooms, Bowling Green State University. (David Baker)
- 23 April 2015. **Nutrient Loading to Lake Erie**. Northeast Section of the Ohio Water Environment Association (OWEA). Richfield, Ohio (Laura Johnson)
- 6 May 2015. **Nutrient Sources and Land-Lake Management in the Lake Erie Basin, USA.** Centre for Ecology and Hydrology. Wallingford, Oxfordshire, England. (David Baker)
- 7 May 2015. **Agriculture and Lake Erie**. Community Affairs Program at BASF. Whitehouse, Ohio (Laura Johnson)
- 27 May 2015. **The Heidelberg Tributary Loading Program: Sharing Forty Years of Data Online**. 58th Annual Conference on Great Lakes Research, International Association for Great lakes Research. Burlington, VT. (Laura Johnson)
- 28 May 2015. **Changing Location, Timing and Composition of Total Phosphorus Inputs to Lake Erie: Challenges for Modelers.** 58th Annual Conference on Great Lakes Research, International Association for Great lakes Research. Burlington, VT. (David Baker)
- 28 May 2015. **Dynamics of an Emerging Contaminant in Soil-Water Systems.** 58th Annual Conference on Great Lakes Research, International Association for Great lakes Research. Burlington, VT. (Saptashati Biswas)

NCWQR Director Ken Krieger testifies before a panel of Ohio state legislators on 15 August 2014 at Maumee Bay State Park following the Toledo drinking water crisis. (photo: Laura Johnson)

- 24 June 2015. **Spring 2015 Nutrient Loading Update**. Ohio Lake Erie Commission Meeting. Tiffin, Ohio. (Laura Johnson)
- 26 June 2015. **Spring 2015 Maumee Nutrient Loading Update**. Ohio Phosphorus Taskforce meeting. Columbus, Ohio. (Laura Johnson)

Miscellaneous Conferences and Meetings Attended

(Refer to the list of presentations above for other events.)

- 21 August 2014. Public hearing by Ohio EPA on the proposed removal of the Ballville Dam. Fremont, Ohio. (Ellen Ewing, Jack Kramer, Ken Krieger)
- 10 September 2014. Meeting of representatives of the Eastern Corn Belt node of the USDA Long Term Agro-ecosystem Research network. Purdue University. (Ken Krieger)
- 25 September 2014. Meeting of Ohio Lake Erie Commission. Ottawa National Wildlife Refuge, Ohio. (Dave Baker, Ken Krieger, Laura Johnson, Rem Confesor)
- 30 September – 3 October 2014. Meetings of the Ohio River Basin Alliance and America's Watershed Initiative. Louisville, Kentucky. (Ken Krieger)
- 25 November 2014. Hosted meeting of Ohio Board of Regents for planning research on Lake Erie harmful algal bloom causes and consequences. (entire staff)
- 3 December 2014. Hosted annual meeting of Sandusky River Watershed Coalition (entire staff)
- 11 December 2014. Akron Roundtable, Akron, Ohio. (Rem Confesor, Laura Johnson, Ken Krieger)
- 23 March 2015. Lake Erie Water Technology Business Summit. (Laura Johnson)
- 20 March 2015. Lake Erie Waterkeeper Conference. (Laura Johnson)
- 15 May 2015. Western Lake Erie Monitoring Methods Workshop at the University of Toledo, Lake Erie Center (Laura Johnson, Jack Kramer, Ken Krieger)
- 25-29 May 2015. 58th Annual Conference of the International Association for Great Lakes Research. Burlington, Vermont. (Dave Baker, Saptashati Biswas, Rem Confesor, Laura Johnson)
- 24 June 2015. Hosted quarterly meeting of the Ohio Lake Erie Commission (entire staff)

Committees, Reviews and Consultancies

Dave Baker: Member, Great Lakes Water Quality Agreement, Annex 4. Objectives and Loads Task Group, International Joint Commission

Member, Ohio Lake Erie Phosphorus Task Force 2

Tania Biswas: Manuscript Reviewer: *Journal of Environmental Quality, Soil Science Society of America Journal, International Journal of Environmental Science and Technology*

Rem Confesor: Member, steering committee, Sandusky River Watershed Coalition.

Manuscript reviewer: *Journal of the American Water Resources Association (JAWRA), American Journal of Agricultural Economics (AJAE)*

Laura Johnson: Member, Green Infrastructure Advisory Committee at the Cleveland Metroparks Watershed Stewardship Center

Member, Phosphorus Sustainability Research Coordination Network (P RCN) "Coordinating Phosphorus Research to Create a Sustainable Food System." Co-leader of Umbrella Group D “Ecosystem services, nexus, and meta-analysis.” 2015-2017.

Member, Ohio Lake Erie Phosphorus Task Force

Manuscript reviewer: *Journal of Environmental Quality, Freshwater Biology, Journal of Great Lakes Research, Global Change Biology*

Proposal reviewer: North Carolina, Maryland, and Ohio Sea Grant; NSF Ecosystem Studies external reviewer

Ken Krieger: Member, science advisory board, Lake Erie Center, University of Toledo

Member, Sandusky River Watershed Coalition

Member, Sandusky Scenic River advisory council

Member, advisory panel, Western Lake Erie Basin CEAP Biological Endpoints Partnership

Associate Editor, *Wetlands Ecology and Management*

Manuscript reviewer: *Journal of Great Lakes Research, Wetlands Ecology and Management*

Proposal reviewer: Wisconsin Sea Grant

Aaron Roerdink: Member, Higher Learning Commission Reaffirmation of Accreditation Steering Committee – Heidelberg University

Miscellaneous Activities

Dave Baker: Aided in launching GLPF supported website for NCWQR – LakeErieAlgae.com (taping, teleconferences, review)

Multiple two-day Annex 4 (of the Great Lakes Water Quality Agreement) meetings in Ann Arbor, MI, and teleconferences and material submission

Professional Memberships

Dave Baker: Soil and Water Conservation Society, International Association for Great Lakes Research

Tania Biswas: Soil Science Society of America (SSSA), International Union of Soil Science, American Chemical Society (ACS), Society of Environmental Toxicology and Chemistry (SETAC), International Association for Great Lakes Research

Rem Confesor: American Society of Agricultural and Biological Engineers (ASABE), American Water Resources Association (AWRA), International Association for Great Lakes Research, Soil Science Society of America

Laura Johnson: Society for Freshwater Science, International Association for Great Lakes Research, Soil and Water Conservation Society, Water Management Association of Ohio

Ken Krieger: American Association for the Advancement of Science (AAAS), International Association for Great Lakes Research, Society of Environmental Toxicology and Chemistry, Society for Freshwater Science

Aaron Roerdink: American Chemical Society (ACS)

Director Emeritus Dave Baker makes a point with Toledo TV 24 news anchor Hubert Wiggins during the NCWQR open house held on World Water Monitoring Day, 18 September 2014. (photo: Rem Confesor)

Budget

Expenses and revenues of the NCWQR in Fiscal Year 2014-2015 are summarized on the following pages. Net expenses totaled $967,288.83 and net revenues totaled $987,695.38, leaving a positive balance of $20,406.55 in our general fund (1150) to be added to our reserve funds carried over from prior years. Our budget was distributed among 26 different funds, which are listed on page 36.

Fiscal Year 2014-2015 Expenses

The table below shows NCWQR expenses according to major categories. Salaries of our permanent staff members totaled $436,717.75 and in addition we paid $13,309.00 in student

wages. Fringe benefits for staff and students totaled $119,597.77. Therefore, total salaries, wages and benefits amounted to $569,624.52. Other major expense categories are shown in the table below.

"Outside services" of $132,589.59 consisted mostly of pass-through funds, including $88,597.59 from the NRCS Conservation Innovation Grant and $26,600.00 from the Great Lakes Protection Fund grant. Those funds were largely paid to county soil and water conservation districts for various services they provided as part of those grants. Most of the remaining "outside services" funds were paid to our cooperators who collect water samples and exchange sampler bases at several of our tributary monitoring stations. Spending on the "supplies" category, which for this report includes equipment <$5,000, was larger in FY 2015 than the previous year; the increase was from purchases of field instrumentation needed for the 4R grant.

Expenses by Major Categories in FY 2014-2015	
Staff Salaries	$ 436,718
Student Wages	13,309
Fringe Benefits	119,598
Supplies	120,310
Equipment >$5,000	7,178
Travel	8,295
Mileage, Gasoline	25,432
Electricity	9,848
Postage, Shipping	13,461
Maintenance Agreements	52,978
Outside Services	132,590
Indirect Costs returned to Business Office	35,000
Other	14,813
Cost Recovery (minus $35,000 to HU)	(120,427)
Net Total Direct Costs	**$799,103**
Indirect Costs Charges (collectible)	168,187
Net Total Collectible Costs	**$967,290**
Uncollectible (matched) Indirect Costs	167,890
Deferred Expenses from FY13-14	0
Net Total Expenses	**$ 1,135,180**

Most of the additional expenses were directly related to operating the Heidelberg Tributary Loading Program, hosting several major workshops on campus, and participating in extension activities throughout the region. The cost of maintenance agreements on specific laboratory instrumentation continues to increase as both the instrumentation hardware and software become increasingly sophisticated.

"Cost Recovery" in the amount of -$155,427.43 represents expenses that were "recovered" during the year from sources outside the NCWQR and thus reduced our total expenses. In FY 2015 cost recovery included $2,560.00 for printing large posters for student and faculty presentations as well as for several administrative offices, reassignment of mileage costs on the NCWQR vans to individual grants totaling $19,650.68, indirect costs of $133,187.40 received from grants, and $29.35 for reassignment of copier costs. Of the total indirect costs (also called "facilities and administration" costs), we returned $35,000 to Heidelberg University to offset costs related to our use of Gillmor Science Hall and assistance rendered to the NCWQR by various administrative offices on campus. The university permits us to retain the remainder of indirect cost revenue to apply to needs not covered by specific grants, such as the writing of grant proposals, and equipment and vehicle repair and replacement. Most of our granting organizations do not permit us to collect the full amount of indirect costs at the rate established for Heidelberg University by the U.S. Department of Health and Human Services. The difference between the amount of indirect costs we could have collected at our federally established rate and the indirect costs we actually received are shown as uncollectible indirect costs.

Fiscal Year 2014-2015 Revenue

The tables below show our revenue both by type of funding source and type of activity. The revenue shown in each category includes indirect costs received as well as direct costs, whereas direct and indirect costs are shown separately in the table of FY 14-15 expenses above. The "miscellaneous" category in the table of net revenue by activity includes a number of adjustments to revenue that resulted in a negative value just as our expenses table includes negative expenses under "cost recovery". Deferred revenue of $17,000.00 received in FY 14-15 for expenditure in FY 15-16 for monitoring the Cuyahoga River is not included in the figures below. Revenue received from individual sources is shown in the table on the next page.

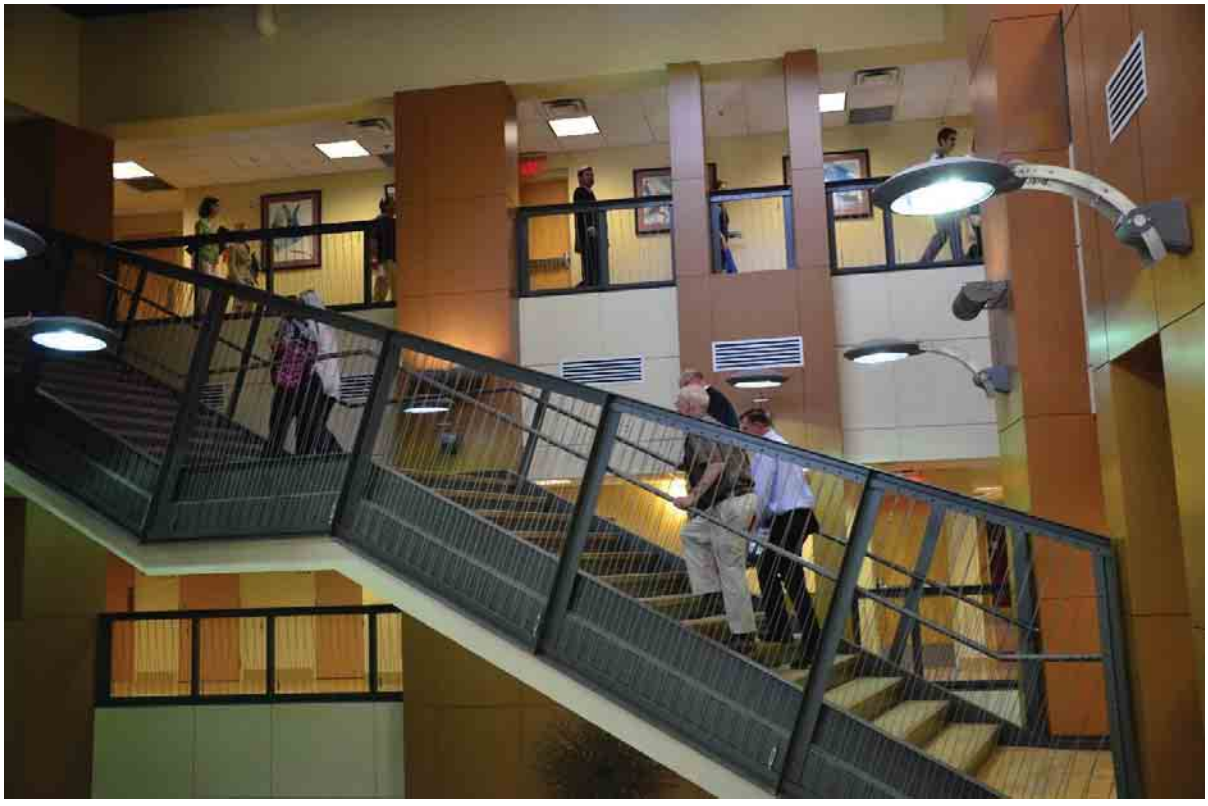
Net Revenue by Source, FY 2014-2015

Federal	$271,844	27.5%
State of Ohio	326,101	33.0%
Other Government	195,378	19.8%
Nonprofit	50,116	5.1%
For-Profit	85,236	8.6%
Endowments	2,789	0.3%
Other	56,232	5.7%
ALL SOURCES	$987,695	100.0%

Net Revenue by Activity, FY 2014-2015

HTLP	$645,821	66.3%
Tributary Data Applications	146,866	14.9%
Modeling, Other Research	122,063	12.4%
Well Testing	26,770	2.7%
Contract Analyses	75,020	7.6%
Miscellaneous	(37,845)	-3.8%
ALL ACTIVITIES	$987,695	100.1%*

*Percentages do not total 100.0% because of rounding.



Members of the Ohio Lake Erie Commission make their way to the NCWQR laboratories on 24 June 2015 following their quarterly meeting held on the Heidelberg University campus. (photo: Rem Confesor)

Summary of Revenue and Carryover Balance for Fiscal Year 2014-2015

Fund	Project Reference	Funding Source	Net Revenue
General and Contract Analyses			
1150	General	NCWQR	$(40,634.09)
1160	Contract Work	Various sources	70,095.59
2217	Well Testing	citizens, soil & water districts, etc.	26,770.00
		Subtotal	$ 56,231.50
For-Profit Corporations			
1152	Pesticides	Dow AgroSciences, Monsanto, Syngenta	85,236.16
		Subtotal	$85,236.16
Federal Agencies			
2107	4Rs	USDA ARS	55,907.98
2108	Ohio Lake Erie Commission - GLRI	USEPA GLNPO	25,775.18
2109	Ohio Environmental Council CIG	USDA NRCS	7,923.52
2128	NSF-WSC (MI)	NSF (through Univ. of Michigan)	23,049.24
2147	OWC	NOAA National Ocean Service	7,157.92
2148	GLOS	NOAA Great Lakes Observing System	11,224.10
2149	OEPA 2015	Ohio EPA	239.60
2162	CIG/Rem	USDA NRCS	135,641.57
2163	BuffSt Worms	USEPA GLNPO	4,924.74
		Subtotal	$271,843.85
State of Ohio Funding			
2282	State of OhioTRIBS	Ohio DNR (state line item)	250,000.00
2286	BeaverCreek/Coldwater	Ohio DNR	74,000.00
2287	OBOR	Ohio Dept. of Education	2,101.04
		Subtotal	$326,101.04
Other Governmental Sources			
2249	MDEQ Raisin	Michigan DEQ	22,233.33
2283	OWDA Chickasaw	Ohio Water Development Authority	37,000.00
2311	Scioto-Columbus	City of Columbus, Ohio	39,075.00
2405	Miami MCD	Miami Conservancy District	38,291.32
2408	NEORSD-Cuyahoga	NE Ohio Regional Sewer District	34,000.00
2409	Muskingum WCD	Muskingum Watershed Conservancy District	24,778.30
		Subtotal	$195,377.95
Foundations, Other Not-for-Profit			
1153	Maumee River	The Andersons, Inc., The Fertilizer Institute	20,000.00
2275	GLPF-Phosphorus	Great Lakes Protection Fund	30,115.65
		Subtotal	$50,115.65
Endowments			
1563	Noss/Knoblaugh Student Support	Heidelberg Endowment	555.81
1672	NCWQR Director Endowment	Heidelberg Endowment	2,233.42
		Subtotal	$2,789.23
Total Net Revenue			**$987,695.38**
Total Net Expenses			**$967,288.83**
Balance at End of Year			**$20,406.55**
Carryover Brought Forward from FY 2014*			**$199,102.75**
Carryover Brought Forward to FY 2016			**$219,509.30**
Revenue Deferred to FY 2016			**$17,000.00**
Expenses Deferred to FY 2016			**$0.00**

*Carryover brought forward to FY 2015, reported in the FY 2014 annual report as $175,414.16, but the year-end balance reported initially as $34,680.74 was later increased by $3,619.99 plus a balance of $20,068.60 in Fund 2309 POCIS that we were able to retain after the project ended.

Projected Budget for Fiscal Year 2016

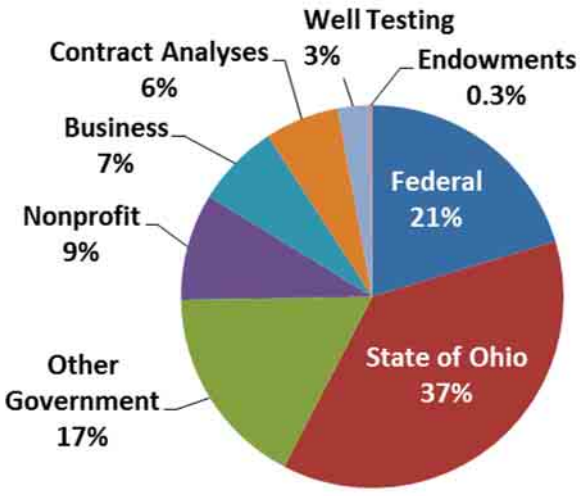
Total anticipated revenue usually increases as each fiscal year progresses. Anticipated revenue can change because of a number of factors. For example, revenue will increase with the receipt of new grants, contracts and contributions. Projected revenue will decline from such causes as an unexpected delay in the start date of a new grant until the next fiscal year. As of December 2015 our revenue for Fiscal Year 2016 was projected to exceed $957,000, as shown below, which includes all new grants, contracts and contributions received since 30 June 2015. The table and pie chart below show the estimated amounts and relative contributions of different types of funding sources to our overall projected income stream as of December 2015. The projected revenue for FY 2016 is similar to that projected last year around the same time of year.

Projected expenses for FY 2016 as of December 2015 included $571,000 for salaries and fringe benefits. Other operational expenses, projected on the basis of the expenses incurred in FY 2015 and anticipated additional expenses, were estimated around $307,000 excluding pass-through funds to organizations outside Heidelberg University. Therefore, as of December 2015 we projected total expenses of around $878,000 and expected a positive balance at the end of the year.

Projected Revenue for Fiscal Year 2016

as of December 2015

Projected Revenue by Source FY 2014-2015	
Federal	$ 194,550
State of Ohio	356,765
Other Government	164,000
Nonprofit	86,290
Business	67,500
Contract Analyses	60,000
Well Testing	25,000
Endowments	2,950
ALL SOURCES	$ 957,055



Acronyms Used in this Report

ARS – Agricultural Research Service of the USDA

BMP – best management practice

CEAP - Conservation Effects Assessment Project

CIG – Conservation Innovation Grant

DEQ – (Michigan) Department of Environmental Quality

DNR – Department of Natural Resources

DRP – dissolved (soluble) reactive phosphorus

EcoFore– Ecological Forecasting

EPA – Environmental Protection Agency

FY – fiscal year

GLNPO – Great Lakes National Program Office of the USEPA

GLOS – Great Lakes Observing System

GLPF – Great Lakes Protection Fund

GLRI – Great Lakes Restoration Initiative grant program of the USEPA and other federal agencies

HAB – harmful algal bloom

HTLP – Heidelberg Tributary Loading Program

HU - Heidelberg University

IPM – Integrated Pest Management

LC-MS/MS – liquid chromatograph-mass spectrometer

LTAR – Long-Term Agro-Ecosystem Research program of USDA ARS

MCD – Miami Conservancy District (Ohio)

MWCD – Muskingum Watershed Conservancy District

MDEQ – Michigan Department of Environmental Quality

NCWQR – National Center for Water Quality Research of Heidelberg University

NEORSD - Northeast Ohio Regional Sewer District

NOAA – National Oceanic and Atmospheric Administration

NPDES – National Pollutant Discharge Elimination System

NRCS – Natural Resources Conservation Service of the USDA

NSF – National Science Foundation

OBOR – Ohio Board of Regents

ODNR – Ohio Department of Natural Resources

OWC – Old Woman Creek National Estuarine Research Reserve of NOAA

OWDA – Ohio Water Development Authority

QDC – qualified data collector under Ohio EPA's Credible Data Program

SIEDC – Seneca Industrial & Economic Development Corporation

SUNY – State University of New York

SWAT – Soil and Water Assessment Tool

TIAER – Texas Institute for Applied Environmental Research at Tarleton State University, Texas

USDA – U.S. Department of Agriculture

USEPA – U.S. Environmental Protection Agency

USGS – U.S. Geological Survey

WLEB – Western Lake Erie Basin

WSC – Water Sustainability and Climate grant program of the National Science Foundation

Appendix A
Collaborators in Fiscal Year 2015

Ohio

- Noel R. Aloysius, Department of Food, Agricultural and Biological Engineering, The Ohio State University (co-investigator)
- Kristen Arend, Old Woman Creek National Estuarine Research Reserve, Ohio DNR (co-investigator)
- Richard Bartz, USGS-Ohio Water Science Center (co-investigator)
- Richard H. Becker, Department of Environmental Sciences, University of Toledo (co-investigator, co-author)
- Thomas B. Bridgeman, Department of Environmental Sciences, University of Toledo (co-investigator, co-author)
- Cindy Brookes, Watershed Coordinator, Sandusky River Watershed Coalition, Fremont, OH (co-investigator)
- George Bullerjahn, Department of Biological Sciences, Bowling Green State University (co-author)
- Justin D. Chaffin, Stone Laboratory, The Ohio State University, Put-in-Bay, OH (co-author, co-investigator)
- Fang Cheng, City of Columbus (project officer, co-investigator)
- Kevin Elder, Ohio Department of Agriculture (co-member, Ohio Lake Erie Phosphorus Task Force)
- Norm Fausey, Soil Drainage Research Unit, USDA ARS, OH (co-investigator)
- Johan Gottgens, Department of Environmental Sciences, University of Toledo (journal editor)
- Gail Hesse, Ohio Lake Erie Commission (chair, Ohio Lake Erie Phosphorus Task Force, co-investigator)
- Guy M. Jamesson, City of Columbus (co-investigator)
- Kevin King, USDA Agricultural Research Service (at The Ohio State University; co-investigator)
- Lauren Kinsman-Costello, Department of Biological Sciences, Kent State University (co-investigator)
- Greg LaBarge, Ohio State University Extension (co-investigator)
- Frank Lopez, Old Woman Creek National Estuarine Research Reserve, Ohio DNR (co-investigator)
- Ron Maichle, Northeast Ohio Regional Sewer District, Cleveland, OH (trainer, co-investigator)
- Bret Margraf, Seneca County (Ohio) Soil and Water Conservation District (co-investigator)
- Jay Martin, Department of Food, Agricultural and Biological Engineering, The Ohio State University (co-investigator)
- Phil Martin, Blanchard River Watershed Partnership (co-investigator)
- Gerald Matisoff, Department of Earth, Environmental and Planetary Sciences, Case Western Reserve University (co-investigator)

- Christine Mayer, Dept. of Environmental Sciences and Lake Erie Center, University of Toledo (co-investigator)
- Kevin McCluney, Department of Biological Sciences, Bowling Green State University (co-investigator)
- Robert Midden, Department of Chemistry, Bowling Green State University (co-investigator)
- Paula Mouser, Civil, Environmental, and Geodetic Engineering, Ohio State University (co-investigator)
- Song Qian, Department of Environmental Sciences at The University of Toledo (co-investigator)
- Jeffrey M. Reutter, Ohio Sea Grant, The Ohio State University (co-member, Ohio Lake Erie Phosphorus Task Force; co-author, co-investigator)
- Tia Rice, Seneca (Ohio) Soil and Water Conservation District (co-investigator)
- Brian Roe, Department of Agricultural, Environmental and Developmental Economics, The Ohio State University (co-investigator)
- Youngwoo Seo, Departments of Chemical & Environmental Engineering and Civil Engineering, University of Toledo (co-investigator)
- Peter Smiley, Jr., Soil Drainage Research Unit, USDA ARS, OH (co-investigator)
- Kylee Spencer, Department of Biology and Environmental Sciences, Heidelberg University (co-investigator)
- Elizabeth Toot-Levy, Geosyntec, formerly with Northeast Ohio Regional Sewer District, Cleveland, OH (co-investigator)
- Michael Weintraub, Department of Environmental Sciences, University of Toledo, (co-investigator)
- Mark Williams, Soil Drainage Research Unit, USDA ARS, OH (co-investigator)
- Robyn Wilson, School of Environment and Natural Resources, The Ohio State University (co-investigator)
- Scott Winkler, Division of Surface Water, Ohio Environmental Protection Agency (project officer)

Other U.S. Institutions

- Elin Betanzo, Northeast-Midwest Institute, Washington, DC (co-investigator)
- Lyubov Burlakova, The Great Lakes Center, Buffalo State, State University of NY
- Jill Carlson, IPM Institute of North America, Madison, WI (co-investigator)
- YoonKyung Cha, School of Natural Resources and the Environment, University of Michigan (co-author)
- Ann Choquette , U.S. Geological Survey, Nashville, TN (co-investigator)
- Susan Daniel, The Great Lakes Center, Buffalo State, State University of NY (co-investigator)
- Joseph DePinto, LimnoTech, Ann Arbor, MI (co-investigator, co-author)
- Jim Elser, School of Life Sciences, Arizona State University (co-investigator)
- Mary Anne Evans, School of Natural Resources and Environment, University of Michigan (co-investigator)
- Dennis Flanagan, National Soil Erosion Research Laboratory, USDA ARS, IN (co-investigator)
- Javier Gonzalez, National Soil Erosion Research Laboratory, USDA ARS, IN (co-investigator)

- Tom Green, IPM Institute of North America, Madison, WI (co-investigator, project director)
- Robert Hirsch, U.S. Geological Survey, Reston, VA (co-investigator)
- Chi-Hua Huang, National Soil Erosion Research Laboratory, USDA ARS, IN (co-investigator)
- Peter Kleinman, Pasture Systems and Watershed Management Research Unit, USDA-ARS (co-author)
- Steve Powers, Center for Environmental Research Education and Outreach (CEREO), Washington State University (co-investigator)
- Helen Rowe, School of Life Sciences, Arizona State University (co-investigator)
- Ali Saleh, TIAER, Tarleton State University, TX (co-investigator)
- Don Scavia, Graham Sustainability Institute and School of Natural Resources and Environment, University of Michigan (co-investigator, co-author)
- Andrew Sharpley, Department of Crop, Soil and Environmental Sciences, University of Arkansas (co-investigator, co-author)
- Tad Slawecki, Great Lakes Observing System, LimnoTech, Ann Arbor, MI (co-investigator)
- Doug Smith, National Soil Erosion Research Laboratory, USDA ARS, IN (co-investigator)
- Craig Stow, Great Lakes Environmental Research Laboratory, NOAA, Ann Arbor, MI (co-author)
- Rick Stumpf, NOAA, Silver Spring, MD (co-investigator)
- Ed Verhamme, LimnoTech Inc., Ann Arbor, MI (co-author, co-investigator)
- Carrie Vollmer-Sanders, The Nature Conservancy, IN (co-investigator)

International Institutions

- Tom Bruulsema, International Plant Nutrition Institute (IPNI), Guelph, ON, Canada (co-investigator)
- Donnacha Doody, Agri-food and Bioscience Institute, UK. (co-author, co-investigator)
- Lars Berström, Department of Soil and Environment, Swedish University of Agricultural Sciences (Co-author)
- Phil Haygarth, Lancaster Environmental Centre, Lancaster University, UK (co-investigator)
- Helen Jarvie, Centre for Ecology and Hydrology, UK (co-investigator)
- Graham MacDonald, Department of Geography, McGill University, Canada (co-investigator)
- Michael Miyittah, Department of Environmental Sciences, University of Cape Coast, Ghana (co-investigator)
- Jianbo Shen, China Agricultural University (co-investigator)
- Paul Withers, School of Environment, Natural Resources and Geography, Bangor University, UK. (co-author, co-investigator)
- T.Q. Zhang, Soil Fertility & Chemistry, Water Quality, Science and Technology Branch Agriculture and Agri-Food Canada (co-investigator)

Appendix B
News Media Reports about the NCWQR in FY 2015

- 13 June 2014. "Mayflies mostly missing after years of swarms: weather, algae may be causes," by Maya Averbuch, *Toledo Blade*. http://www.toledoblade.com/State/2014/06/13/Mayflies-mostly-missing-after-years-of-swarms.html
- 11 July 2014. "Harmful algae bloom forecast," by Vicki Johnson, Tiffin *Advertiser Tribune*. http://www.advertiser-tribune.com/page/content.detail/id/568965/Harmful-algae-bloom-forecast.html
- Following the Toledo Drinking water ban from 3-20 August 2014:
  - Video interview with Joe Thompson WNWO Channel 24 NBC News, Toledo: https://www.youtube.com/watch?v=Cwr1sXXIM9A&list=UU1qJzOLtUKbTV7YrnF7ys9A
  - Phone interview with Laura Arenschield, *Columbus Dispatch*: http://www.dispatch.com/content/stories/local/2014/08/04/this-bloom-is-in-bad-location.html
  - Phone interview with Jolie Lee, *USA Today*: http://www.usatoday.com/story/news/nation-now/2014/08/04/toledo-ohio-water-toxin-explainer/13563805/
  - Interview with Peter Moskowitz with Vice media for Munchies food blog: http://munchies.vice.com/articles/what-its-like-to-run-a-coffee-shop-during-a-water-ban/
  - Video interview with Roseanne Skirble, Voice of America: http://www.voanews.com/content/algal-overload-infects-global-waterways/1973015.html
  - John Seewer with Associated Press in Toledo: http://bigstory.ap.org/article/farms-are-focus-studies-drinking-water-toxin
  - Vicki Johnson with Tiffin *Advertiser Tribune*. Featured in Sunday paper: http://www.advertiser-tribune.com/page/content.detail/id/570261/Algae-in-bloom.html?nav=5060
  - Ali Hoxie with WTOL TV, Toledo. (not online)
  - Shaun Hegarty 13ABC TV, Toledo: http://www.13abc.com/clip/10494738/monitoring-the-root-cause-of-the-algal-bloom
- 10 August 2014. "Algae in bloom; long season likely for communities relying on lake for drinking water," by Vicki Johnson, Tiffin *Advertiser Tribune*: http://www.advertiser-tribune.com/page/content.detail/id/570261/Algae-in-bloom.html
- 15 August 2014. Lake Erie Caucus meeting at Maumee Bay State Park: http://www.cleveland.com/outdoors/index.ssf/2014/08/there_are_many_questions_but_n.html
- 18-19 August 2014. Science writers workshop:
  - http://www.toledoblade.com/Technology/2014/08/19/Algae-forecast-detailed-at-Stone-Lab-gathering.html
  - http://www.toledoblade.com/local/2014/08/21/Algae-produced-microcystin-may-follow-blooms-across-lake.html
- 21 August 2014. Interview with Michael Uva for *Clean Water Works*, a NEORSD publication.
- 4 September 2014. WBGU TV interview with Dave Baker and Rem Confesor: http://video.wbgu.org/video/2365318299/
- 9 September 2014: Blog post by Tom Henry (*Toledo Blade)*: http://toledoblade.typepad.com/ripple-effect/2014/09/leave-no-stone-unturned-in-the-quest-for-truth-about-what-ails-lake-erie.html
- 18 September 2014. NCWQR open house: http://www.nbc24.com/news/story.aspx?id=1098599#.VCr74_ldWSp

- 6 October 2014. "Center offers water insight," by Tim White, *Ohio Farmer*, following a presentation by Laura Johnson to the Ag Solutions organization on Grand Lake St. Marys: http://magissues.farmprogress.com/OFM/OF10Oct14/ofm010.pdf
- 11 October 2014. "Discerning solutions to phosphorous [sic] issues." Letter to the editor by John Crumrine, Tiffin *Advertiser Tribune*: http://www.advertiser-tribune.com/page/content.detail/id/573066/Discerning-solutions-to-phosphorous-issue.html
- 4 December 2014. "Phosphorous [sic] levels concern watershed group," by Vicki Johnson, Tiffin *Advertiser Tribune*: http://www.advertiser-tribune.com/page/content.detail/id/575479/Phosphorous-levels-concern-watershed-group.html
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Rock Creek and Gillmor Science Hall on the Heidelberg University campus, 8 October 2015
(photo: Laura Johnson)