

**Iowa Water Center
Department of Agronomy**

**Annual Technical Report
2018**

General Information

Products

104(b) and 104(g) Grant Recipients:

Dana W. Keplin, Edward T. Furlong Luke R. Iwanowicz, Rebecca D. Klapper, Shannon Meppelink, Michael T. Meyer, Hui Zhi, Gregory H. LeFevre. Longitudinal pharmaceutical exposures in a temperate stream dominated by wastewater effluent. Emerging Contaminants in the Aquatic Environment Conference in Champaign, IL. June, 2018.

Rebecca Klaper, Jordan Crago , Dana Kolpin, Greg LeFevre. Assessing impacts of mixtures of emerging contaminants on endocrine activity and adverse outcome pathways: using a place-based approach. International Conference on Emerging Contaminants, Oslo, Norway, June 2018.

Emma B. Meade, Hui Zh, Gregory H. LeFevre, Dana W. Kolpin, Shannon M. Meppelink, Luke R. Iwanowicz, Rebecca D. Klaper, Rachael F. Lane. Using gene expression in zebrafish (*Danio rerio*) to quantify the biological impacts of exposure to complex mixtures of pharmaceuticals in Muddy Creek, an effluent-dominated stream in Iowa, September 2017 to August 2018. Midwest SETAC Conference in LaCrosse, WI. March 2019.

Hui Zhi, Gregory H. LeFevre, Dana W. Kolpin, Shannon Meppelink, Luke R. Iwanowicz, Emma B. Meade⁴, Rebecca D. Klaper⁴, Michael T. Meyer⁵. Quantifying the occurrence, fate, and implications of pharmaceutical mixtures in a temperate-region wastewater effluent-dominated stream, Muddy Creek, Iowa. American Chemical Society Spring National Meeting, Environmental Chemistry Division, Orlando, FL March 2019.

Gregory H. LeFevre, Hui Zhi, Dana W. Kolpin, Rebecca D. Klaper, Luke R. Iwanowicz, Emma B. Meade, Michael T. Meyer, Rachael F. Lane, Shannon M. Meppelink, Megan M. Powers, John Quin IV. Spatial and Temporal Variability of Pharmaceutical Mixtures and Potential Impacts to a Wastewater Effluent- Dominated Stream in Iowa, September 2017 to August 2018. American Chemical Society Spring National Meeting (Accepted Abstract), Environmental Chemistry Division, San Diego, CA Aug 2019.

Emma B. Meade, Hui Zhi, Gregory H. LeFevre, Dana W. Kolpin, Shannon M. Meppelink, Luke R. Iwanowicz, Rachael F. Lane, Rebecca D. Klaper. Transcriptome response of *Danio rerio* and *Promelas pimephales* to complex pharmaceutical mixtures in a WWTP effluent-impacted stream. SETAC North America (Submitted Abstract), Toronto, CA 2019.

Hui Zhi, Dana W. Kolpin, Luke R. Iwanowicz, Rebecca D. Klaper, Emma B. Meade, Shannon Meppelink, Michael T. Meyer, Megan Powers, John IV Quin, Gregory H. LeFevre. Pharmaceutical exposures in a temperate region wastewater effluent-dominated stream: Muddy Creek, Iowa. SETAC North America (Submitted Abstract), Toronto, CA 2019.

Iowa Water Center Staff:

Ackerman, Heidi and Hanna Bates. 2019. "Fill the Pantry with Iowa SWCS " Poster. 74th Soil and Water Conservation Society Annual Conference, Pittsburgh, PA

Ackerman, Heidi and Hanna Bates. 2019. "Holding Successful Meetings and Professional Development." 74th Soil and Water Conservation Society Annual Conference, Pittsburgh, PA. July 29, 2019

Bates, Hanna. 2019. "Bringing Diverse Perspectives Together to Support Watershed Management in Iowa." 74th Soil and Water Conservation Society Annual Conference, Pittsburgh, PA. July 29, 2019

Cruse, Richard. October 25, 2018. Iowa Daily Erosion Project. National Institutes for Water Resources Regional Symposium. Water Resources of the US Great Plains Region: Status and Future. Lincoln, NE.

Miller, Melissa. 2018. Building high-school youth conservation leadership capacity through project-based learning: a model for the Water Resources Research Institutes to engage the next generation. Presented at University Council on Water Resources/National Institutes for Water Resources Annual Water Resources Conference. Pittsburgh,

Pennsylvania. June 26, 2018.

Miller, Melissa and Jon Nania. 2018. Iowa WRRRI and USGS: Capabilities and Partnerships. 2018 National Institutes for Water Resources Regional Symposium October 24, 2018.

Miller, Melissa. 2019. Iowa's Watershed Management Authorities. Getting into Soil and Water 2019. Iowa Water Center. Ames, IA. (non-refereed)

Miller, Melissa, J. Baumann, B. Beldon. Southfork Watershed Alliance. Presented to the Iowa Senate Natural Resource and Environment Committee. Des Moines, Iowa. March 19, 2019.

Allen, James and M. Miller. 2019. One Strange Rock: Agricultural production versus soil and water resources. Presented to five sections of Physical Science at Iowa Falls-Alden High School. Iowa Falls, Iowa. May 16, 2019.

Cook, Chad and M. Miller. 2019. Connecting Extension and Water Resources Research Institutes to Advance Harmful Algal Bloom Research and Outreach. Presented at University Council on Water Resources/National Institutes for Water Resources Annual Water Resources Conference. Snowbird, Utah. June 13, 2019.

Information Transfer Program

IWC's information transfer program is a comprehensive, coordinated effort that promotes the state's water resources research and applied activities. It leverages relationships with other organizations to reach a wide audience. Products include:

- Vast web presence: website, blog, bi-monthly e-newsletter, Twitter, Facebook, YouTube, with continually growing reach.
- Iowa Water Conference: two-day event that attracts 400-500 attendees from students and researchers to water resource professionals. Led by IWC with twelve outside organizations on planning committee.
- Watershed Management Authorities of Iowa Annual Meeting: one day event for intergovernmental coalitions charged with watershed management at local levels. Led by IWC with involvement from state agencies and universities.
- Getting Into Soil and Water: ~30 page publication published annually with the Soil and Water Conservation Club at Iowa State University. Articles on current research are written by researchers for the high school teacher and distributed to approximately 1500 Iowans each year.
- Presentations: IWC staff and funded faculty/students speak publicly to many audiences, ranging from K-12 students, volunteer organizations, governmental/quasi-governmental committees, and academic communities.
- Service on statewide and regional boards/committees: IWC staff represent the Iowa research community on the Iowa Chapter of the Soil and Water Conservation Society, Iowa Agriculture Water Alliance Advisory Council, Southfork Watershed Alliance, Agricultural Conservation Planning Framework Steering Committee, 2020 International Soil and Water Conservation Society Annual Meeting, 2020 University Council on Water Resources meeting

In addition, IWC is involved with several statewide and multi-state projects, attending/leading meetings across the state with many stakeholders, giving the appearance of a ubiquitous presence in Iowa.

Student Support

Undergraduate: 5 Graduate: 3 Postdoc: 2

Notable Achievements and Awards

Graduate student Hui Zhi's PhD dissertation focuses on the research at Muddy Creek supported by the NIWR grant. She used the findings from this 104(g) funded study to leverage into the student-only proposal competition at the Iowa Water Center, which was awarded to her in Spring 2019.

The 13th Annual Iowa Water Conference in 2019 was the largest event ever with approx. 550 attendees, 42 exhibitors, and 39 posters. We attribute this to both the quality of past programs as well as a strengthened partnership with the Iowa Agriculture Water Alliance, an organization that represents agricultural commodity groups.

Over the course of the year, IWC increased its online presence across all channels. Iowa Water Center website: total views 27,931, +4,861 views Blog: 2,466 views, 1,282 visitors, +215 total views Bi-monthly Newsletter: open rate average of 45%, 293 total subscribers, +46 subscribers Twitter: +257 followers, 1,317 total followers Facebook: 426 likes total, +69 YouTube: 17 videos, 583 total views

IWC staff led a 12-state effort to coordinate 104(b) research conducted on harmful algal blooms and related Extension education efforts in the North Central Region. This project resulted in a white paper providing recommendations for future regional research and educational resources and has been presented at national and state conferences, a regional webinar, and to EPA Region V's HABs team.

IWC was awarded funding to create an interdisciplinary faculty learning community for water at ISU for the 2019-2020 academic year. This will serve as a pilot for a statewide program.

Projects

Fate and Ecological Impacts of Pharmaceuticals in a Temperate Stream Dominated by Wastewater Effluent

Project Type: National Competitive Grant **Project ID:** 2017IA276G

Project Impact: This project reporting period has been very successful. On the chemical measurements front, we are nearing completion of Year 2 pharmaceutical measurements. During Year 1, monthly samples were analyzed for 110 compounds by USGS and the most common 13+metabolites were measured biweekly (Year 1 and 2). Both methods were not significantly different and explained >85% of the loading. We captured low-flow, effluent dominated sampling conditions, with effluent comprising 70->95% of flows. The Top 13 pharma compounds were detected ubiquitously, with combined concentrations up to >37,000 ng/L. We report very interesting trends in a draft manuscript. There was major seasonal variability in the wastewater effluent pharmaceutical loading and composition. We attribute this mainly to increased usage of seasonal drugs. We also quantify the attenuation of pharmaceuticals through the stream reach. The composition of the complex mixture changes through space and time, which is attributed to a combination of changing inputs and differential compound attenuation; this creates constantly evolving exposure conditions for biota. Throughout Year 1 of the study (through Aug 2018), monthly water samples were collected, and zebra fish embryos have/are being exposed to the waters to measure differential hormone responses at the gene expression level. The results shown indications of elevated estrogen responses in the upstream site as well, suggesting anthropogenic influence besides the WWTP. RNAseq data are just now available. In addition to fish studies, we have "added on" by leveraging this field study site to measure PFAS, illicit drugs, neonicotinoid insecticides, antibiotic resistance genes all forthcoming.

Fate and Ecological Impacts of Pharmaceuticals in a Temperate Stream Dominated by Wastewater Effluent

Project Type: Annual Base Grant **Project ID:** 2017IA276G

Project Impact: This project reporting period has been very successful. On the chemical measurements front, we are nearing completion of Year 2 pharmaceutical measurements. During Year 1, monthly samples were analyzed for 110 compounds by USGS and the most common 13+metabolites were measured biweekly (Year 1 and 2). Both methods were not significantly different and explained >85% of the loading. We captured low-flow, effluent dominated sampling conditions, with effluent comprising 70->95% of flows. The Top 13 pharma compounds were detected ubiquitously, with combined concentrations up to >37,000 ng/L. We report very interesting trends in a draft manuscript. There was major seasonal variability in the wastewater effluent pharmaceutical loading and composition. We attribute this mainly to increased usage of seasonal drugs. We also quantify the attenuation of pharmaceuticals through the stream reach. The composition of the complex mixture changes through space and time, which is attributed to a combination of changing inputs and differential compound attenuation; this creates constantly evolving exposure conditions for biota. Throughout Year 1 of the study (through Aug 2018), monthly water samples were collected, and zebra fish embryos have/are being exposed to the waters to measure differential hormone responses at the gene expression level. The results shown indications of elevated estrogen responses in the upstream site as well, suggesting anthropogenic influence besides the WWTP. RNAseq data are just now available. In addition to fish studies, we have "added on" by leveraging this field study site to measure PFAS, illicit drugs, neonicotinoid insecticides, antibiotic resistance genes all forthcoming.

Spatial Potential for Enhanced In-field Denitrification from Perennial Vegetative Filter Strips

Project Type: Annual Base Grant **Project ID:** 2018IA278B

Project Impact: The overall research objective was to determine the effects of perennial vegetation strips (PVS) on the surrounding soil. The objective of this additional study was to use a three-dimensional data to support the creation of a potential denitrification (PD) map with respect to a new management practice, PVS. Findings: The soil environment across the two are predicted be to support a range of denitrification. Visual inspection of the resulting

map highlights a relationship between hillslope position and PD. On the Basswood field, the PVS were somewhat useful in reflecting the relationship in a similar way as reported in Linton (2018), where the PVS change the distribution of some surficial soil processes and related soil properties. The areas where high PD is predicted reflect areas open depressions, areas where water can pond for extended periods of time and the footslope positions. Full length core analysis revealed differences in the particle size distribution within the profiles which may have an impact on water storage and denitrification dynamics. While crude representations of soil properties were useful in construction of the PD map, spatial modeling using standard techniques was limited by the low sample size. Samples showed differences given their relative hillslope positions however, their relationships were able to be extracted using multiple linear regression. Measurements of soil properties were made from 0- 25cm at 5cm increments to take advantage of relatively simple modeling at the surface, however the range in patterns observed complicated the initial approach.

The Economic Benefits of Mitigating Harmful Algal Blooms in Iowa Annual Report

Project Type: Annual Base Grant **Project ID:** 2018IA277B

Project Impact: We have worked with the Center for Survey Statistics & Methodology at Iowa State University through the survey design and distribution. In May, we have conducted cognitive interviews with six interviewees for better designing the survey questionnaire. A report summarizing the method and findings of the cognitive interviews is attached in Appendix 2. In June, we also sent out invitations for pretesting the survey to 200 households in Iowa. The final version of the survey instrument is created based on the feedback and comments from the cognitive interview and pretest. The invitations for participating in the survey have been sent 2,800 Iowa households on July 23, 2019. By the end of July 29, we have collected 160 completed responses through online portal. We will be sending out the reminder letter with paper version of the survey to the households that have not yet completed the survey online on August 5. On August 19, we will send out the final reminder postcard to the households that still have not completed the survey. We anticipate to complete the data collection and entry by early September. The data analysis will be conducted as soon as the data collection is completed. We anticipate to have a report summarizing the findings from the survey by the end of November.