Nebraska Water Center

Daugherty Water *for* Food Global Institute

# 2024 ANNUAL REPORT

# The Nebraska Water Center

The Nebraska Water Center (NWC) was established by Congressional mandate as one of 54 state-based Water Resources Research Institutes in 1964. We coordinate research and programs that support the University of Nebraska as an international leader in water research, teaching, extension, and outreach.

Our fundamental goals are to:

1. Coordinate a wide range of research impacting water issues
2. Foster a deeper understanding of water and its many beneficial uses
3. Help develop new water researchers
4. Train future water researchers and engineers
5. Extend research results to water professionals and the public through publications, seminars and conferences, electronic media, lectures, and tours

NWC is part of the Daugherty Water for Food Global Institute (DWFI) at the University of Nebraska and part of the University of Nebraska–Lincoln's Institute of Agriculture and Natural Resources. Financial support for NWC and the Water Sciences Laboratory comes from a combination of state, local, and federal funding, as well as through partnerships with NGOs and industry.

For more information » **watercenter.unl.edu**

## NWC 2024 SNAPSHOT

**27**
Undergraduate Student Interns

**11**
Graduate Student Researchers

**$2,294,394**
in Grants to Water Faculty and Staff

**23**
Journal Articles Published

**11,071**
YouTube Views

**2,148**
Water Current Readers

**57**
Events Hosted or Co-Hosted

USGS small grants support big ideas in water.

## U.S. Geological Survey grants support Nebraska-based research projects

The Nebraska Water Center awarded U.S. Geological Survey (USGS) 104b funding to four Nebraska-based research projects in 2024. 104b awards are geared towards early-career faculty who are conducting research in Nebraska that has unique applications both within and outside of the state. In 2024, a total of $75,249 was awarded.

- Grassroots Conservation: Engaging Communities in WaterSmart Lawn Care Practices. *PI Wei-zhen Liang and co-PI Xin Qiao.* **$19,374**
- Monitoring Monthly Groundwater Level Variation in the Nebraska Sandhills using Remote Sensing. *PI Nawaraj Shrestha, co-PIs Troy Gilmore, Aaron Mittelstet, Aaron Young, and R.M. Joeckel.* **$14,716**
- Growing Groundwater Science. *PI Chris Huber, co-PI Daniel Snow.* **$11,358**
- Is Fish Tissue Methylmercury Related to Lake Sediment Methylmercury? *PI Chad Brassil, co-PIs Karrie Weber and Matthew Larrey.* **$29,801**

Each year, USGS holds a nationally competitive grant application for 104g funding. 104g awards are asked to tackle projects that align with the national research priorities of the USGS. In 2024, only six projects were awarded throughout the country. Nebraska received funding for one of these six 104g awards.

- Physics-based crop, soil, and groundwater modeling of nitrate transport to understand and manage groundwater contamination in agricultural regions. *PI Abia Katimbo, co-PIs Sahila Beegum, Daniel Snow, Chittaranjan Ray, Sorab Panday, Arindam Malakar, Alakananda Mitra.* **$288,030**

For more information visit **go.unl.edu/USGS.**

Students collect data to better understand nitrate transport in the vadose zone.

## 2024 Research Publications

In 2024, Nebraska Water Center researchers published 23 journal articles and scientific publications in a variety of water-related topics, including:

- Assessing water-use efficiency in crops
- Nitrate transport in the vadose zone
- Impact of split nitrogen application on nitrate leaching and maize yield
- Soil carbon storage
- Predicting crop yields through machine learning and modeling
- Impact of pharmaceuticals on water quality
- Understanding climate effects on land surface, critical zone processes, soil carbon dynamics, and crop water usage

To view the full publication list and read the scientific articles, visit **go.unl.edu/NWCresearch.**

In addition to the research publications, Nebraska Water Center Director Dr. Chittaranjan Ray was included in the 2024 Stanford/Elsevier Top 2% of Scientists List. This list analyzed all peer-reviewed papers across scientific disciplines and measured the significance of the research, including how often each study is cited in the work of other scientists.

The Water Sciences Laboratory has specialized equipment for emerging contaminant testing.

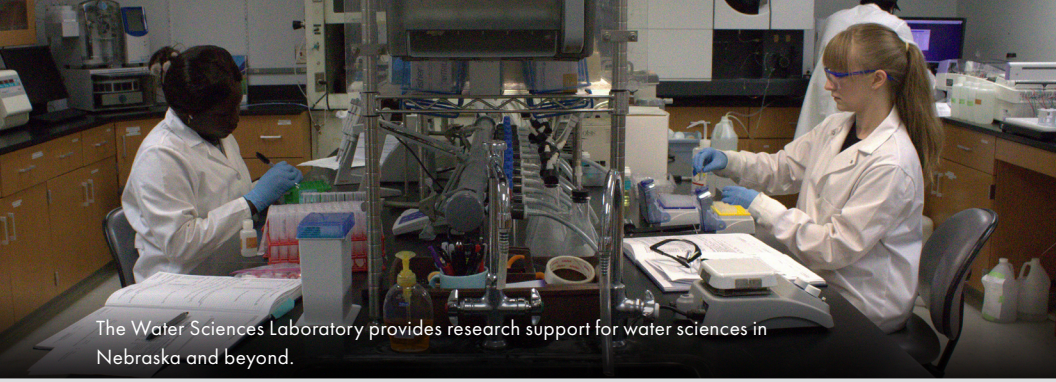
## Water Sciences Lab adds capabilities and continues student training in 2024

Part of the Nebraska Water Center, the Water Sciences Laboratory core facility has over 30 years of experience advancing the University of Nebraska's water and environmental research. With over $3 million in state-of-the-art equipment, the Water Sciences Laboratory supports 200+ custom and standard analytical methods that include rigorous performance evaluation monitoring. Thousands of samples are analyzed annually with quality controls demonstrating our commitment to provide high-quality data for our clients. The laboratory is located on the University of Nebraska – Lincoln East Campus.

### New laboratory equipment expands capabilities in stable isotope testing and erosion control

In 2024, the Water Sciences Laboratory installed new equipment to expand capabilities in stable isotope testing and erosion control. The new instrument, known as a compound specific isotope analyzer (CSIA), will allow the Water Sciences Laboratory to create new methods in measuring isotope composition of organic compounds like fatty acids. While there are numerous applications for this type of method, the first method to be developed is intended to provide researchers and resources managers with the tools to track erosion on a watershed level to determine the effectiveness of existing management strategies. The CSIA precisely measures the abundance of the stable isotopes of hydrogen, carbon, and nitrogen of organic compounds extracted from water, soils, and biological tissues.

The Water Sciences Laboratory is the only lab in the state with the capabilities to measure isotope abundance in organic compounds. The CSIA complements existing equipment measuring isotopes in nitrate, phosphate, bulk hydrogen, carbon, nitrogen, and oxygen. The new technology will provide the Water Sciences Laboratory with capabilities to help solve another piece of the water quality puzzle, improving research and resource management opportunities in Nebraska and beyond.



The Water Sciences Laboratory provides research support for water sciences in Nebraska and beyond.

## Student training opportunities at the Water Sciences Laboratory

In addition to new laboratory equipment and method development, in 2024 the Water Sciences Laboratory continued to provide opportunities for student training. Two main avenues of student training are undergraduate internships and graduate student users. In 2024, the Water Sciences Laboratory employed and trained twenty-two interns from the departments of Chemistry, Chemical Engineering, Natural Resources, Forensic Science, and Biological Systems Engineering. The lab was used by thirty-two graduate students from the departments of Earth and Atmospheric Sciences, Biological Sciences, Chemistry, Chemical Engineering, Civil and Environmental Engineering, Natural Resources, Agronomy, and Mechanical and Materials Engineering. Undergraduate and graduate students who use and work in the Water Sciences Laboratory are trained by staff members to successfully use specialized equipment and correctly process samples.

## Water Sciences Laboratory publishes new price list

The Water Sciences Laboratory has updated and reorganized their price list to be easier to navigate and more accessible. This user-friendly update includes all sample workflow and requirements and the available test methods in a single file. Available tests are organized into four categories: standard methods, trace elements, environmental, and stable and radiogenic isotopes. The online PDF is searchable and includes embedded navigation to make it easy for lab users to find exactly what they are looking for. Additional details about standard quality assurance practices, sample sizes, preservation, turnaround time, training requirements and much more are spelled out in great detail to help clients understand and better use the laboratory services.

The new Water Sciences Laboratory price list can be found at **watersciences.unl.edu/price-lists**. Printed copies are available upon request.

The 2024 Water and Natural Resources Tour visited southeast Nebraska.

## Spring Seminar Series features water, wildlife, and livestock

The Spring Water Seminar Series was held again in 2024. This seminar series is offered as a one-credit hour undergraduate/graduate course in UNL's School of Natural Resources and is open to the public. The 2024 seminar theme was "Water, Wildlife, and Livestock." The following speakers presented during the Spring Water Seminar Series:

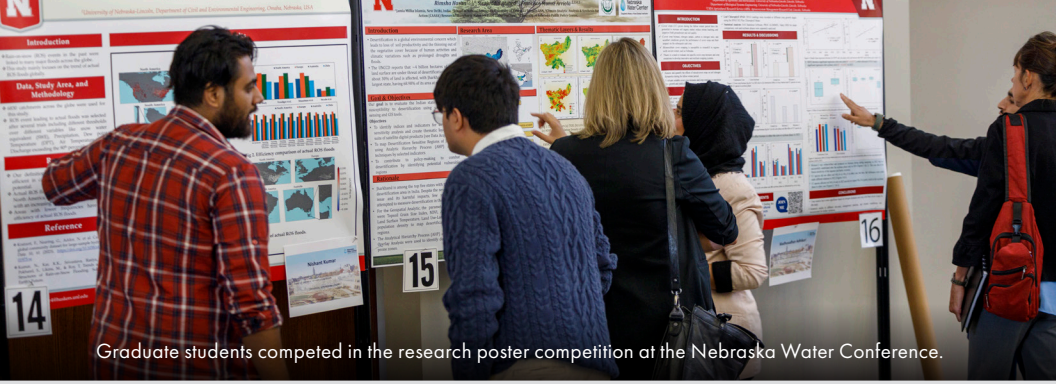
- January 31 – Liz Van Wormer, UNL, One Health
- February 14 – Scott White, Klamath Drainage District in Oregon –Drought, water policy, and impacts to wildlife and livestock
- February 28 – Mark Vrtiska, UNL, Waterfowl and endangered species in Nebraska
- March 20 – Miranda Meehan, North Dakota State University, Livestock health and water
- April 3 – Jessica Corman, UNL, Aquatic ecology and water quality
- April 17 – Amy Schmidt, UNL, Manure management and water quality
- May 1 – Jonathon Spurgeon, Nebraska Cooperative Fish and Wildlife Unit, Fisheries and prairie streams

Videos of the 2024 Spring Seminar Series are available at **go.unl.edu/2024SeminarVideos.**

## 2024 Water and Natural Resources Tour

This summer, the 2024 Water and Natural Resources Tour, *Discovering southeast Nebraska*, took industry experts to explore water practices in the region.

Hosted by the Nebraska Water Center and Central Nebraska Public Power and Irrigation District on June 17 and 18, 2024, the Tour featured projects and challenges faced by the Nemaha Natural Resource District, water use in orchards, urban growth water projects, water treatment, and more.



Graduate students competed in the research poster competition at the Nebraska Water Conference.

"Southeast Nebraska provided such an interesting tour because it's different from the rest of the state," said Ann Briggs, Nebraska Water Center's Public Relations and Engagement Coordinator. "This area receives more rainfall and is not connected to the High Plains Aquifer, requiring unique water management strategies. In addition, Nebraska City and the surrounding areas have a long and rich history due to its location on the banks of the Missouri River."

Learn more about the 2024 Water and Natural Resources tour at **go.unl.edu/2024WaterTour.**

## 2024 Nebraska Water Conference

The Nebraska Water Center hosted the annual Nebraska Water Conference in Lincoln on October 9 and 10, 2024. The 2024 conference theme was "Collaboration and Innovation in Nebraska Water."

Held at the Nebraska Innovation Campus conference center, this two-day event featured discussions on emerging contaminants, drought preparedness, nutrient management, climate smart practices, water and climate resilience, and modeling. Experts from the state and region shared their work and led discussions on future opportunities for innovative partnerships.

Each day offered breakout sessions where attendees had the opportunity to interact with session speakers through Q&As and networking. The conference also included student research poster sessions where students competed for a cash prize followed by a reception where the poster competition winners were announced.

One hundred and sixty people attended the conference, coming from five states and representing researchers, policy makers, students, stakeholders, and partners.

Learn more about the 2024 Nebraska Water Conference at **go.unl.edu/WaterConference.**

The Critical Zone Research Group applies biochar to research fields to better understand how soil amendments impact nitrogen and carbon dynamics in agricultural soils.

## Ongoing research in crop modeling, critical zone, and bioplastic development

### Continuing to Improve Process-Based Crop Models: A Collaboration Between the Nebraska Water Center and the United States Department of Agriculture's Agricultural Research Service

Sahila Beegum and Alakananda Mitra, Research Assistant Professors at NWC, and Aditya Kapoor, Postdoctoral Research Associate at NWC, closely collaborate with USDA ARS Adaptive Cropping Systems Laboratory (USDA ARS ACSL). Since 2021, this collaboration has consistently improved the process-based crop models developed jointly by USDA ARS ACSL and NWC.

Recent improvements and updates include incorporating greenhouse gas (GHG) emission modeling, yield quality modeling, AI-based crop models, biogeochemistry integration, and graphical interface development. The team also taught several workshops to train researchers in the use of the new crop models.

To learn more, visit **go.unl.edu/modeling**.

### Updates from the Critical Zone Research Group

The Critical Zone Research (CZR) Group, organized under Principal Investigator Dr. Arindam Malakar (Nebraska Water Center and School of Natural Resources (SNR)), investigates hydrogeochemical dynamics that impact processes within the critical zone (which covers Earth's land surface extending from the top of the vegetation canopy through the soil to subsurface depths at which fresh groundwater freely circulates) that may ultimately impact transport of contaminants like nitrate into groundwater. The critical zone emerges as a focal point for understanding the delicate balance of carbon and nitrogen cycles.

Research in the CZR group includes laboratory-scale column experiments and field-scale experiments, with work from graduate students within SNR


The BioWRAP project is using agricultural byproducts to create a new product that is effective for weed suppression in agricultural production.

and students co-advised in the department of Agronomy and Horticulture. Areas of study include nitrate transport and biogeochemical transformation, using biochar as a soil amendment to improve nitrogen and carbon dynamics in agricultural soils, and complete nitrogen budgeting in the vadose zone.

To learn more, visit ⋙ **go.unl.edu/CZR**.

### Bioplastics with Regenerative Agricultural Properties: BioWRAP

Researchers at the University of Nebraska, including Nebraska Water Center Director Dr. Chittaranjan Ray and Associate Director Dr. Karina Schoengold are working with researchers at UNL, Kansas State University, and South Dakota School of Mines and Technology on a National Science Foundation funded project called BioWRAP.

The acronym BioWRAP stands for Bioplastics with Regenerative Agricultural Properties. The goal of the BioWRAP project, which started in March 2022, is to create a new product that is effective for weed suppression in agricultural production. BioWRAP are biological products produced from agricultural byproducts.

The overarching goal of the project is to reduce the use of plastics, herbicides, and associated environmental impacts in agricultural production. The long-term goal is to create locally sourced, customizable, spray-on biopolymer-based films to serve as soil cover that can be synchronized to crop growth cycles under differing climatic conditions and applied using precision agricultural equipment.

To learn more, visit ⋙ **go.unl.edu/BioWRAP.**

Know Your Well provides hands-on training in water quality testing for high school students.

## Know Your Well builds curriculum and community impact

Know Your Well is a youth-driven education and outreach program designed to train high school students to sample and test domestic well water quality, as well as evaluate factors leading to groundwater contamination. Since starting in 2016, the project involved students and teachers from 27 schools across Nebraska who sampled over 270 wells.

### Know Your Well builds curriculum to support teachers

As Know Your Well enters its eighth year of bringing collaborative citizen science and science literacy to high schools throughout Nebraska, the program is building key upgrades to make it even more accessible for teachers and students.

The University of Nebraska and Daugherty Water for Food Global Institute were awarded an Environmental Education Grant of $99,795 from the U.S. Environmental Protection Agency (EPA). “The University of Nebraska – Lincoln will use the funding to expand the Know Your Well project and develop a science curriculum that will be rolled out to over 100 rural Nebraska high school students with the goals of increasing science literacy, awareness of agricultural practices, and groundwater stewardship,” said Shannon Beisser, Lead Press Officer for EPA’s Region 7.

A team of high school teachers, students, staff, and faculty at the University of Nebraska – Lincoln, University of Nebraska – Kearney, and Chadron State College are working together to develop the new curriculum. The Know Your Well classroom curriculum will outline key science concepts used in collecting samples and understanding the results. The curriculum will be designed to support state education standards for science and can be used as a unit or as individual lessons.

For more information, visit **knowyourwell.unl.edu.**

Know Your Well engages students in their community's water quality.

## Research publication studies the impact of citizen science on community

A new publication in the American Chemical Society's Environmental Science and Technology Water journal highlights early achievements and observations made possible through the Know Your Well project. The paper reports how youth-led citizen science can improve monitoring coverage, provide data, and integrate local communities to better evaluate and respond to growing concerns over domestic well water quality.

Eighty-five percent of Nebraskans get their drinking water from groundwater sources, and it is estimated that more than 360,000 residents throughout the state use private wells that are exempt from regulated testing.

Know Your Well brings a unique collaboration between water scientists, well owners, high school teachers, and students. This collaboration trains high school students to become citizen scientists and connects them with well owners in their community. By providing local access to groundwater samples and the tools to analyze results, Know Your Well builds citizen scientists who are engaged in their local groundwater quality.

Citizen science provides a pathway for communities to be trained in data collection and personally involved in understanding their local water quality and being empowered to do something with that knowledge. Citizen scientists can readily make observations, collect water quality data, effectively address gaps on site-specific water quality especially in rural areas, and likely provide an effective means for influencing local decision making to protect public health.

For read the full study, visit » **go.unl.edu/KYWstudy.**

Master Irrigator focuses on leading innovation in irrigated farming.

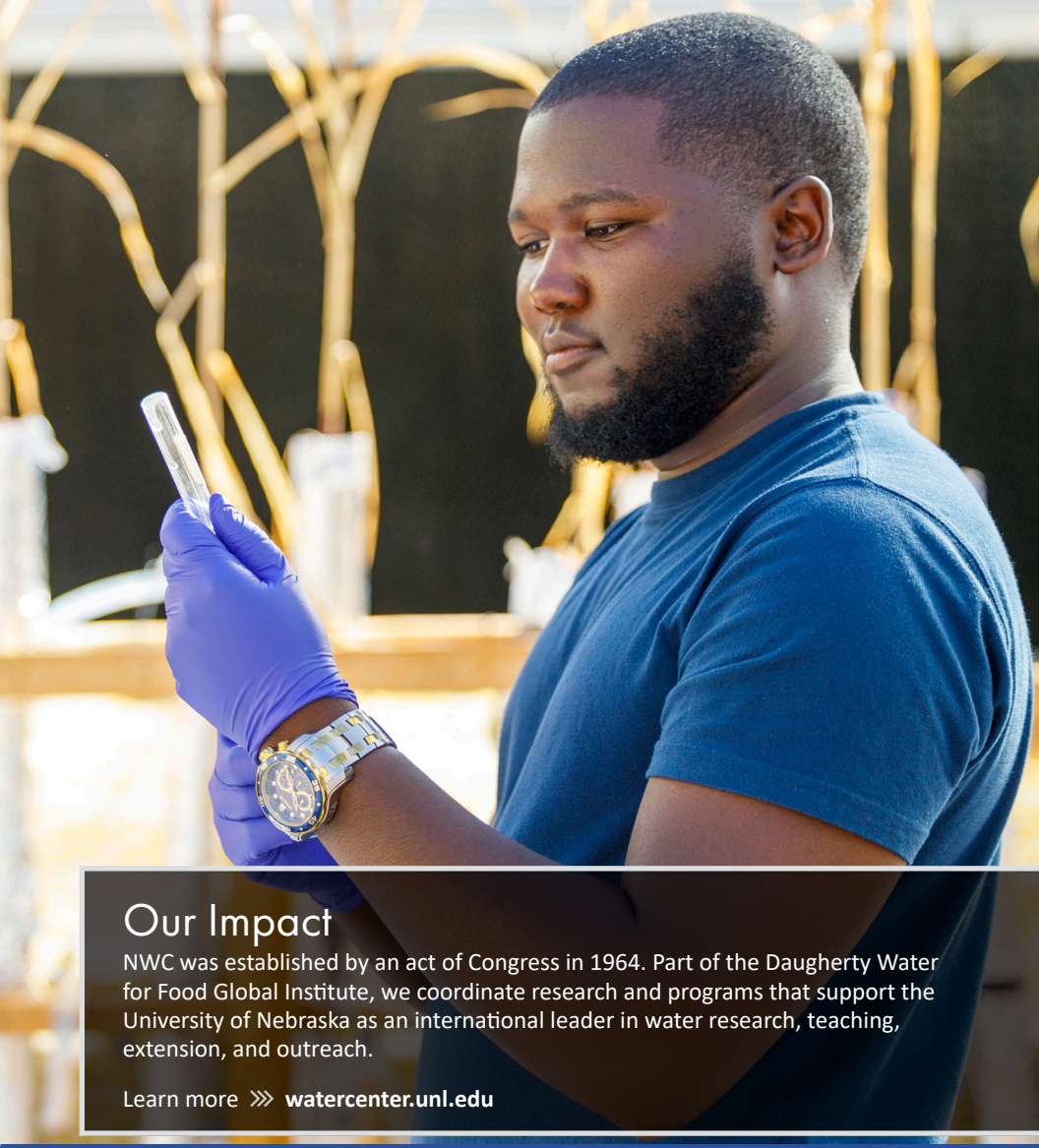
## Nebraska Master Irrigator Launch

Groundwater is critical for agriculture across the High Plains. Several states have started programs focused on leading innovation in irrigated farming to preserve the use of groundwater for agriculture into the future. Nebraska is working with partners across the other High Plains Ogallala Aquifer states to expand Master Irrigator and Testing Ag Performance Solutions (TAPS).

The success of these programs has been allowing the focus to be farmer driven, connecting the latest agriculture technology with practical experience, and connecting farmers, ag business, and natural resource agencies in a pursuit of excellence. Nebraska Water Center Extension Educator Crystal Powers is coordinating Nebraska Master Irrigator and hosted Master Irrigator partners from across eight states in North Platte this fall. The focus was sharing lessons learned from the program so far and finding opportunities to work together for greater impact. Master Irrigator partners from eight states met in North Platte this fall to discuss future opportunities to work together.

Nebraska is looking forward to bringing together an elite cohort of farmers interested in taking their irrigated farmland to the next level. In winter 2025, we'll be hosting a series of regional Master Irrigator kickoffs. You will hear takeaways from growers who competed in TAPS, connect with the latest tech companies, and attendees will provide leadership on developing Nebraska Master Irrigator. Some of the themes are how to level up your irrigation and soil (including discussion on nitrogen & carbon incentives), navigating agriculture and water policy, and running your farm like a CEO.

Master Irrigator is partially sponsored by a multi-state NRCS Technical Agreement. If you would like to learn more contact **cpowers2@unl.edu**.



## Our Impact

NWC was established by an act of Congress in 1964. Part of the Daugherty Water for Food Global Institute, we coordinate research and programs that support the University of Nebraska as an international leader in water research, teaching, extension, and outreach.

Learn more ⋙ **watercenter.unl.edu**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