



JULY 2023

# The Water bLog

newsletter

Utah Center for Water Resources Research at the Utah Water Research Laboratory

## Message from the Director



David G. Tarboton,  
UWRL/UCWRR Director

**W**hat a difference a year can make. After an especially wet spring on top of a record snowfall last winter, the drought outlook is considerably brighter than last year at this time when most of Utah was experiencing exceptional drought conditions. All that precipitation and snowmelt runoff turned the conversation from droughts to floods, but we're not out of the woods yet in terms of drought. The Great Salt Lake water level peaked for the year at 4,194.1 feet in June, up 4 feet from last year, but even with a high runoff behind us, the lake still needs an additional 4 to 6 feet to be considered healthy. Some of this increase was limited to the south arm as flow through the breach was reduced—see more in the story below.

In this issue we highlight a project that is working to build a more comprehensive understanding of salinity impacts within the Great Salt Lake and to model the processes that will allow managers to forecast effects to the lake and the surrounding communities based on different scenarios and adapt as needed. Water managers are grappling with similar large-scale water challenges all around the world. Our second research story highlights the progress of an international multi-year, multi-institutional project to establish a Center of Excellence for Water in Egypt. As part of this project, our faculty are sharing their expertise through curriculum development, visitor exchanges, and trainings to improve Egypt's education and applied water resources management and research through innovation and collaboration.

Ongoing research that addresses the needs of local, regional, and global water resources management stakeholders, such as that ongoing at the Utah Water Research Laboratory, continues to be essential to finding lasting solutions to these enduring challenges. ■

David Tarboton, UWRL/UCWRR Director

*The projects highlighted in this issue of the Water bLog represent only a fraction of the active research in which the faculty experts at the UWRL/UCWRR are engaged as they continue to generate the knowledge needed to solve water-related natural resources problems throughout Utah, the nation, and the world.*

Visiting scholars from Egypt learning about remote sensing in irrigation



Photo by Alyssa Regis

## Welcome!

The Water bLog is the semi-annual newsletter of the Utah Center for Water Resources Research, housed at the Utah Water Research Laboratory (UWRL).

The Center supports the development of applied research related to water resources problems in Utah and promotes instructional programs that will further the training of water resource scientists and engineers.

Each issue of The Water bLog reports on a small selection of current or recently completed research projects conducted at the center. More information is available online at:

<https://uwrl.usu.edu/research/ucwrr>

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# Salty Solutions: adapting to better manage Utah's Great Salt Lake

*Water overtopping the emergency berm at the  
Great Salt Lake's West Crack Breach*

Photo courtesy Brian Crookston

**F**lows through the Great Salt Lake's West Crack Breach are challenging to measure and predict due to their complexity, but these flows influence salt concentrations on both sides of the railroad causeway dividing the lake. As the ongoing drought drove lake levels toward historic lows, salinity levels were increasing, and the Utah Department of Natural Resources asked associate professor Brian Crookston (Utah Water Research Laboratory/USU Department of Civil and Environmental Engineering and assistant professor Som Dutta (USU Department of Mechanical and Aerospace Engineering) to study flows at the breach and model some possible solutions as they considered their options. The researchers modeled potential changes to the height of a rock berm at the breach that was designed to limit the inflow of high-saline water from the northern arm into the southern arm in an effort to keep the salt levels within a range that protects the economic and ecological health of the lake and the nearby communities. Graduate student Michael Rasmussen, with support from Holland Kartchner, performed the computational fluid dynamics modeling used in that effort.

## Raising the berm

“We tested various scenarios,” Dutta says, “and reported to Utah DNR [Department of Natural Resources] the effects of 2-, 4- and 6-foot increases in berm height.”

After considering these various height increases, Utah DNR chose to increase the height of the berm by about 4 feet with construction completed last summer.

“Based on measurements at the breach, our analysis was correct,” Dutta says. Early indications suggested that the 4-foot increase was successfully limiting the amount of high-saline water pouring into the southern arm.

But the lake is dynamic, and as the drought continued into the winter months salinity levels in the south arm became critical. Since the berm is considered an adaptable structure the Utah Department of Natural Resources made an emergency decision to modify the berm again, this time to completely seal the breach temporarily in an effort to deal with expected runoff and return to target salt levels in the south. The runoff from the record snowpack this year has raised lake levels enough that conditions are in a good

range for brine shrimp, but water has been overtopping the modified berm.

### Seeking a broader view

“It’s a balancing act,” says Crookston. “When we started this research, we were only looking at the area around the breach and we focused on the hydraulics of the exchange flows. Our research and collaborations with the State now and for the future has expanded to be more comprehensive.”

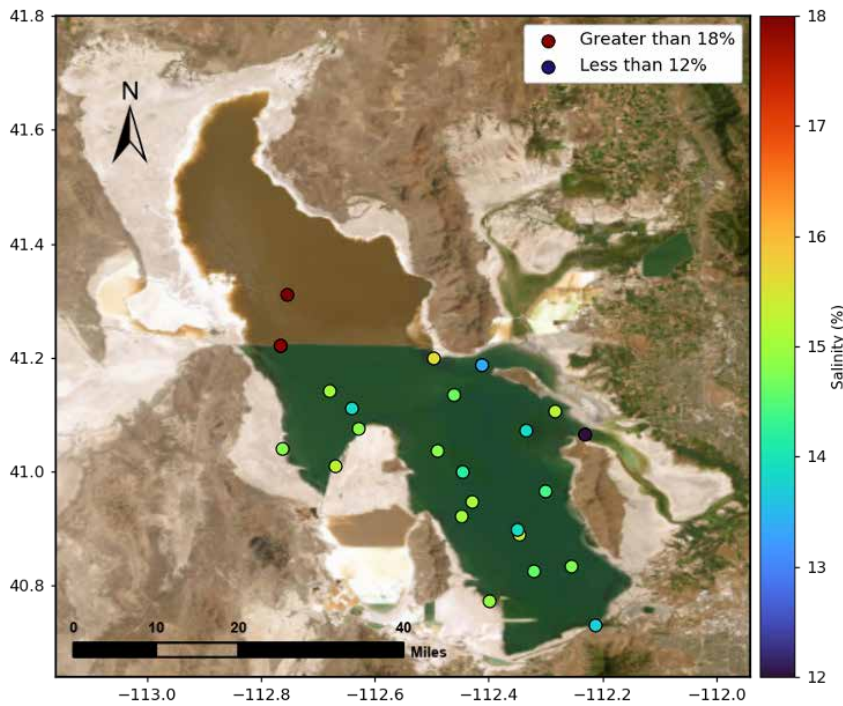
Graduate student Diana Dunn is looking at adaptive management of the berm.

She is compiling and analyzing all available data sets on the lake including salinity, inflow and weather data, including data from the US Geological Survey (USGS) and Utah Division of Water Resources. “We are working toward a more holistic understanding of lake processes, looking at data collected by various entities, and creating a salt balance model (in collaboration with USGS) for the lake as a whole, rather than just focusing on immediate conditions at the breach,” says Dunn. “We want to understand how exchange flows affect the entire south arm.”

### Why it matters

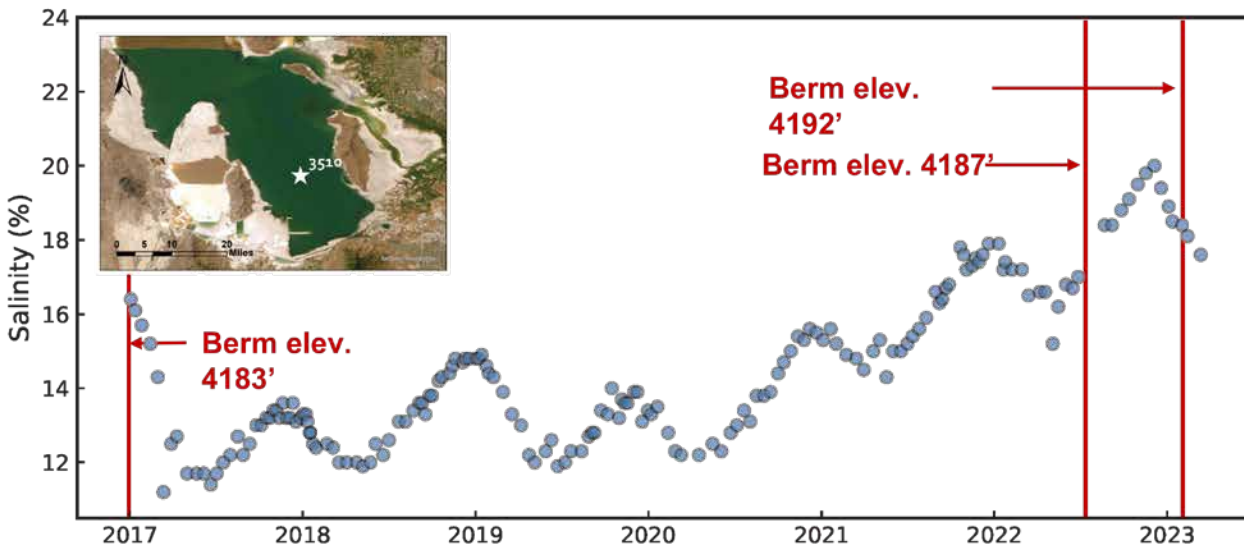
The focus is on the south arm because that’s where the biggest dangers exist for Utahns. As the northern lakebed dries, a crust of excess salt can be exposed, shielding the lakebed from wind disturbances. However, the south side would not have this crust and so would be more prone to winds carrying the lake dust along the Wasatch Front, which would be a health concern. Brine shrimp and recreation industries also rely on healthy southern lake salinity conditions, as do the millions of migratory birds that call the lake home.

“The overall salt balance and other numerical models our team is creating will support the State in adaptively managing the berm at the breach,” explains Crookston. “We’re grateful to be working with the State and the USGS, supporting and informing their efforts to protect the lake, the industries that rely on it, and the surrounding communities.” ■



USGS, UGS, DWR (Great Salt Lake Ecosystem Program) percent salinity data within the Great Salt Lake, UT, 4/16/2021 – 4/23/2021.

**Project PIs:**  
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**Student Researchers:**  
**Diana Dunn** (UWRL/CEE),  
**Michael Rasmussen** (UWRL/CEE),  
**Holland Kartchner** (MAE)



DWR (GSLEP) percent salinity data at site 3510 within Gilbert Bay in Great Salt Lake, UT from 2017 to 2023.



Visiting exchange students from Egypt during spring semester 2023

Photo by Sydney Danley

# Classes and collaborations: supporting Egypt's Center of Excellence for Water

The Utah Water Research Laboratory (UWRL) recently bid farewell to another group of visiting scholars and students and welcomed another 15 for a two-week summer workshop. These visitors are part of an ongoing exchange program through the Center of Excellence for Water, a USAID-funded project in Egypt based at the American University in Cairo. The ambitious project, which began in 2019 and continues through February 2026, is now in full swing, with classes, workshops, and research collaborations with new friends and colleagues.

USU is one of five American universities selected as partners in the project. The USU team heads the instructional innovation and curriculum development "pillar" and supports and participates in the other pillars, which are research and policy, exchange and training, governance, and sustainability. Professors Ryan Dupont (UWRL), David Stevens (UWRL), and Kurt Becker (Engineering Education)

are leading the USU effort, with many other UWRL collaborators participating in the project goals and activities. The Center of Excellence itself has other project teams at the University of California, Santa Cruz; Washington State University; Temple University; and the American University in Cairo.

## Education

From the beginning of the project, the USU team has led the "Education" pillar of the project and has been establishing classes and curricula to make water engineering education in Egypt more relevant to the needs of industry, government, and Egyptian society.

The goals for this project pillar are to (1) assess and suggest modifications to the existing water science and engineering curricula at Egyptian national universities and (2) provide training in the use of modern teaching strategies and methods and classroom technology in delivering course materials.

## CURRICULUM PROGRESS

**Reviewing and completing 17 undergraduate courses** in water science and engineering, with a subset being converted to e-learning modules, to provide a set of state-of-the-practice learning modules for water engineering programs throughout Egypt

**Developing 18 graduate level courses** for a Master of Science program in sustainable water resources management for implementation at the five Egyptian Partner Institutions through the Center of Excellence for Water

"We are working to provide a subject matter and teaching strategy roadmap that will place Egypt at the forefront of water education in the Middle East and North Africa," says Stevens. "Populations are



increasing, but the Nile River water supply is limited, and it's already straining to meet the national needs. This effort will help Egypt to meet those sorts of challenges."

## Exchange visitors

The visiting students are juniors or graduate students in civil and environmental engineering or other water- and climate-related fields of study. So far, USU has hosted the most exchange visitors in the program (22 undergraduates and 1 graduate student as of spring 2023).

"The faculty visitors are here to gain new research and teaching experiences, the undergraduates get to learn in a US education system, and the graduate students get a taste of both," says UWRL faculty member and USU project co-lead Ryan Dupont. "This is a life-changing experience for these students," he continues, "getting to experience our innovative and project-based learning here at USU. The point of this project is that, in the future, some of these students will become water experts in their country, and others will become the professors who will bring these hands-on teaching methods to students in Egypt far into the future."



Two of the most recent visiting scholars, professors Mai Badr and Abdelazeem Eltaweil, were able to work with UWRL environmental faculty Yiming Su, Joan McLean, Ryan Dupont, and Randy Martin on research related to PFAS, microplastics, and nanoparticles. A third scholar, professor

Elsayed Elkamhawy, teamed up with Civil and Environmental Engineering faculty member John Rice on research related to drainage, dams and levees.

Badr, has applied for 6-month Fulbright Fellowship to come back and continue

## VISITING SCHOLARS

### Fall 2022

**7** undergraduate students  
**1** visiting scholar

**Participating universities:**  
Alexandria, Ain Shams

**UWRL mentors:** David Stevens, Ryan Dupont

### Spring 2023

**15** undergraduate students  
**1** graduate student  
**3** visiting scholars

**Participating universities:**  
Alexandria, Ain Shams, and Zagazig

**UWRL mentors:** Ryan Dupont, Randy Martin, Joan McLean, Yiming Su

### Fall 2024

**3** undergraduate students  
**3** graduate students  
**2** visiting scholars

**Participating universities:**  
Alexandria, Ain Shams, Aswan, Beni Suef, and Zagazig

**UWRL mentors:** Ryan Dupont, Joanna Hou, Joan McLean, Yiming Su, David Stevens, Alfonso Torres

◀ Summer 2023 workshop participants gained classroom and hands-on field experience in advanced irrigation topics (left, photos by Alyssa Regis).

Visiting scholar Mai Badr gained experience in sample handling and in using the advanced equipment in the UWRL's Environmental Quality Laboratory (pictured below with graduate student Victoria Krull. Photo courtesy Ryan Dupont) ▼



her work. That's just the sort of success the Center is hoping to catalyze as they work to offer this experience to as many participants as possible.

This fall, a new set of students and scholars will work with different faculty on various projects, including on water reuse.

## Training workshops

UWRL faculty have participated in and presented various meetings, workshops, and trainings since 2019 at USU, at other US partner universities, and in Egypt to establish the program, share new curriculum, and teach Egyptian partners about learning management systems, innovative teaching strategies, and design of a state-of-the-art curriculum.

This summer, UWRL faculty members Alfonso Torres-Rua and Burdette Barker presented a two-week

workshop titled, "Remote Sensing Applications for Field Evaluation of Irrigated Agriculture, that brought **15 visiting scholars** from Egypt to learn how state-of-the-art remote sensing technology, from drones to satellites, can be used to understand and improve irrigation efficiency. Graduate students Karem Meza-Capcha, Anderson Safre, Katherine Osorio-Diaz, Sheridan Stewart, Moises Duran-Gomez, and Sergio Alvarez helped to make the workshop a success.

## Other activities

Although USU is the lead institution for the Education component, our faculty are supporting other aspects of the project, as well, such as:

- Welcoming students and faculty as part of the Exchange, Training and Scholarships pillar led by Temple University.
- Improving the research enterprise in Egypt as part

of the Research and Policy Committee led by Santa Cruz.

- Supporting the Governance and Sustainability pillars led by Washington State University and the American University in Cairo. Stevens is the USU contact for these pillars.

## Why it matters

Effective water management is a global issue, and many of the water challenges in Egypt are similar to those in Utah. "Enhancing the capacity of faculty, researchers, and students is how we enable a new generation of knowledgeable water engineers," explains Dupont. "We hope that our efforts to improve Egypt's education and applied water resources management research through innovation and collaboration will have positive effects on water management around the world." ■

## Other Recent Workshops

- 2nd meeting on the Egyptian National Water Resources Research Roadmap to help update the **National Water Research Roadmap**, which will help the Center identify critical issues for future research and education training in Egypt.  
**Participant:** Ryan Dupont
- Phase V of **Learning Management Systems**  
**Presenters:** Kurt Becker, Ernesto Lopez.
- Phase IV of **Innovative Teaching Strategies**  
**Presenters:** Kurt Becker, Oenardi Lawanto
- Workshops on **Sustainability** (led by American University of Cairo) and **Governance** (led by Washington State University) at Alexandria University focused on helping the Center's leadership establish linkages between research efforts, policy considerations, funding sources, and industry needs in water applications that will allow the Center to continue making a difference far into the future once the initial project timeframe ends.  
**Participant:** David Stevens

### Project PIs

**Ryan Dupont**, Cazier Professor, Civil and Environmental Engineering (CEE) and UWRL, [ryan.dupont@usu.edu](mailto:ryan.dupont@usu.edu);

**David Stevens**, Professor (CEE/UWRL), [david.stevens@usu.edu](mailto:david.stevens@usu.edu)

**Kurt Becker**, Professor, Engineering Education, [kurt.becker@usu.edu](mailto:kurt.becker@usu.edu)

### Collaborators:

**Hoda Suoussa**, Pillar II coordinator (Ain Shams University, Cairo), **American University Cairo, Temple University** (Pennsylvania), **Washington State**

**University, UC Santa Cruz, Utah State University, Ain Shams University, Alexandria University, Aswan University, Beni Suef University, Zagazig University**

### USU Faculty and Participants:

**Burdette Barker** (CEE/Extension/UWRL), **Janis Boettinger** (USU Global Engagement), **Joanna Hou** (CEE/UWRL), **Mac McKee** (Emeritus), **Joan McLean** (CEE/UWRL), **Bethany Neilson** (CEE/UWRL), **John Rice** (CEE), **David Rosenberg** (CEE/UWRL), **Yiming Su** (CEE/UWRL), **Alfonso Torres-Rua** (CEE/UWRL), **David Tarboton** (UWRL Director)

*UWRL faculty members Alfonso Torres-Rua and Burdette Barker (two at bottom right below), leading a field excursion in Cache Valley, Utah, during the summer 2023 workshop (photo by Alyssa Regis)*



# In the News:

## Awards and Achievements



### Faculty Award

The American Society of Civil Engineers Environmental and Water Resources Institute (ASCE-EWRI) recently

honored professor David Rosenberg with a 2023 Planning and Management Council Service to the Profession Award. David received the award at the 2023 World Environmental and Water Resources Congress in Henderson, NV, June 21-25, 2023.

### Student Awards

Graduate student Victoria Krull brought home a first-place award in the MS category of the student poster competition at the Air and Waste Management Association conference in Orlando, FL, in early June.

## Other News

### Conference Support

The UWRL helped to sponsor the Utah-focused Air Quality: Science for Solutions – 2023 conference. The conference hosted a record number of registrants, and several students working with professor Randy Martin won both the graduate and undergraduate outstanding student poster awards: Ashton Young in biological engineering won the graduate award, while Megan Lambright, Megan Wilson, and Ian Parvin collectively won the undergraduate prize.

### New Instrumentation

The UWRL Environmental Quality Laboratory received funding to upgrade their ion chromatograph, a workhorse instrument for water quality analysis. The lab is also working to obtain new equipment to facilitate nanoparticle and nano plastics research. These will enhance the lab's capabilities and support early career faculty research areas.

### Faculty Promotions

UWRL faculty members Brian Crookston, Belize Lane, and Alfonso Torres-Rua have received tenure and were promoted to Associate Professor status.

[READ MORE](#)



### Alumni Award

Recent alumnus Irene Garousi-Nejad was awarded the American Water Works Association's 2023 2nd place Academic Achievement Award for her doctoral thesis. Irene completed her PhD with UWRL Director David Tarboton in 2022 and is now working as a Research Scientist at the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI).

### ILWA Grant Support

In a collaborative partnership with the Janet Quinney Lawson Institute for Land, Water, and Air, the UWRL made possible six additional ILWA Impact Grants this year with the support of additional Mineral Lease Funds received from the State of Utah. The UWRL is investing in these projects to further advance water research and optimization efforts in the region.

[READ MORE](#)

### Media Attention

Randy Martin has been receiving media attention for his work on identifying the sources of halogens and other chemicals that worsen air pollution around the Great Salt Lake. Martin is a UWRL faculty member and heads the Environmental Engineering Academic Program at USU.

VIDEO LINKS: [KSL News story](#), [Utah State Today story](#)

## FUTURE ISSUES:

*“Laying the groundwork to manage mountains of data in support of the CIROH project”*

(UWRL researchers have reached a key milestone in developing an Advanced Hydrologic Information System for a 5-year, multi-institutional project that is working to improve the nation's ability to effectively manage water resource and provide warning or protection around water-related hazards)



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Photo courtesy Brian Crookston