**August 2024** – Volume 10; Issue 3

# NEVADA WATER NEWS

NWRRI NEVADA WATER RESOURCES RESEARCH INSTITUTE

WRITTEN AND COMPILED BY: NICOLE DAMON
DESIGNED BY: LORI FULTON

## PROJECT SPOTLIGHT

## *"Monitoring Water Quality in the Las Vegas Valley with Nuclear Techniques"*

**This project is funded through the National Institutes for Water Resources (NIWR) 104(b) grant.**

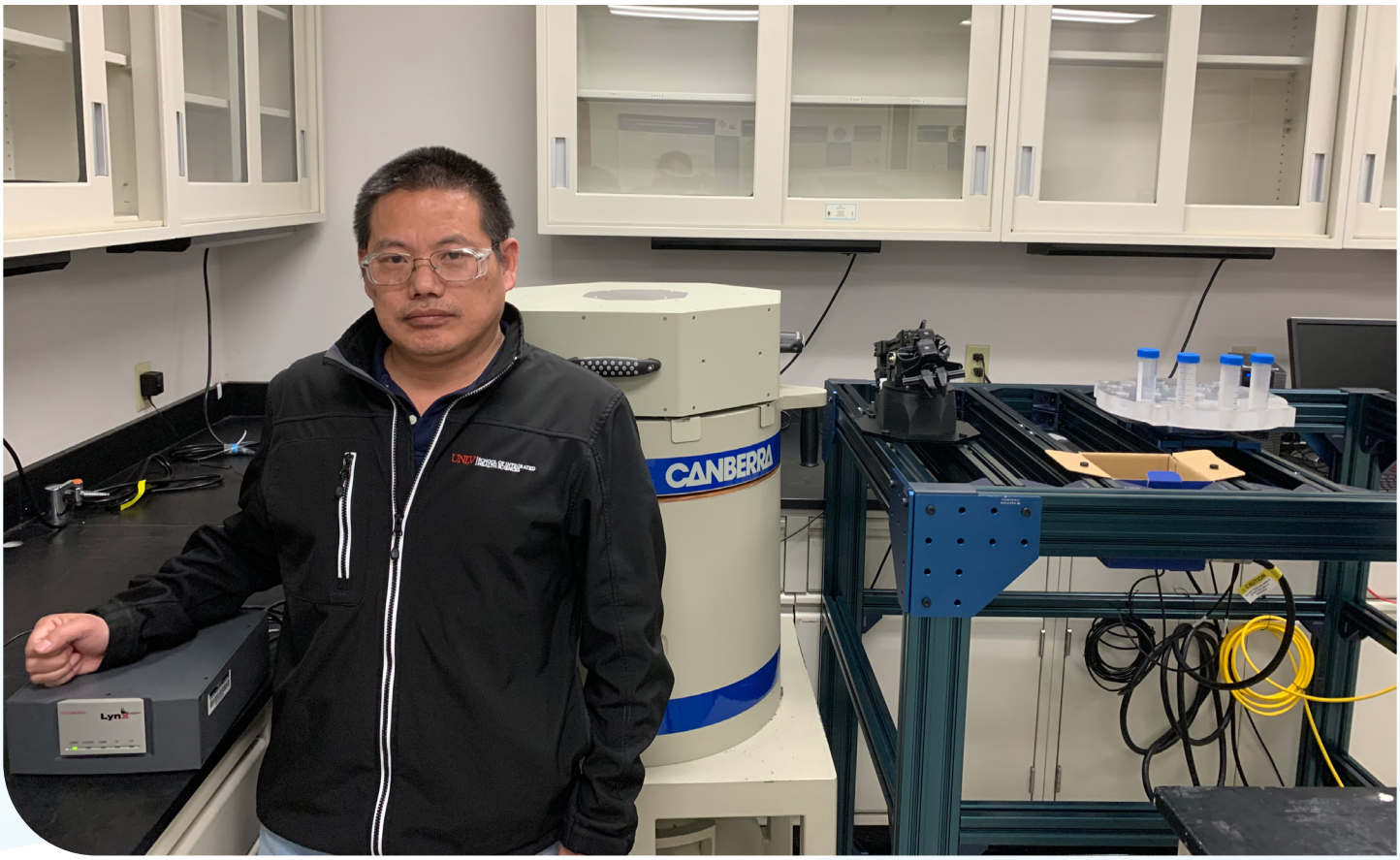
**Estefany Merino Rojas collecting water samples for analysis at the Las Vegas Wash (photo by Danesha Hunter).**

Like much of the Southwest, the population in the Las Vegas Valley has grown rapidly over the past decade. The added demand for the valley's water supplies is exacerbated by the persistence of a sever megadrought, which has raised concerns about the ability of traditional water monitoring techniques to keep up with these changes. "The growing population in the Las Vegas Valley has led to increased water consumption and a rise in solid waste that contains heavy metals, which alter groundwater chemistry," says Dr. Zaijing Sun, the principal investigator of the project that also includes graduate students Haven Searcy and Danesha Hunter and undergraduate student Estefany Merino Rojas. "As water levels recede due to the megadrought, the concentrations of heavy metals in Lake Mead and surrounding water sources in the valley have conceivably

## IN THIS ISSUE



***If you have questions about submitting a NWRRI proposal, email Suzanne Hudson at Suzanne.Hudson@dri.edu. Visit the NWRRI website at www.dri.edu/nwrri for current RFP information.***




**Dr. Sun with the low-background CosmicGuard HPGe detector system with an automatic sample exchanger (photo courtesy of Zaijing Sun).**

increased, which is concerning because the cumulative effects of heavy metals in water can significantly impact human health."

**This project aims to monitor heavy metals in water in the Las Vegas Valley and assess their toxicity using Instrumental Neutron Activation Analysis (INAA).**

This project aims to monitor heavy metals in water in the Las Vegas Valley and assess their toxicity using Instrumental Neutron Activation Analysis (INAA). This highly sensitive radioanalytical technique can detect multiple elements at parts-per-billion (ppb) levels. The researchers will use INAA to identify heavy metals in water samples collected from Lake Mead, as well as water sources around Lake Mead and some rural wells and springs in the Las Vegas Valley. INAA allows the researchers to measure the gamma rays emitted by the sample using high-purity germanium (HPGe) gamma spectrometers and identify the presence and concentrations of the elements in the sample. To understand the effects of seasonal changes on the concentrations of elements, the researchers will collect samples twice a year.

Traditional water monitoring techniques generally only target a few well-known heavy metals, such as mercury and lead. However, many other heavy metals have become of increasing concern because of their potential accumulation as water levels in Lake Mead have drastically decreased during the megadrought. Heavy metals such as arsenic, zinc, chromium,

cadmium, copper, iron, magnesium, nickel, tin, thorium, thallium, and uranium can significantly affect human health. "The accumulative health effects of these metals pose significant risks to people of all ages," Sun adds. "For example, exposure to these metals can impair cognitive development in youth, and both experimental and epidemiological evidence suggest associations between heavy metal exposure and Alzheimer's disease and related dementias in elderly populations."

INAA is used widely for environmental monitoring because it is based on well-understood nuclear processes that are highly reproducible. This technique has advantages over other analytical techniques, such as being able to detect a broad range of elements at a high sensitivity, particularly ones that other techniques miss. Because the process involves minimal handling, it doesn't require chemical reagents, significantly reducing the risk of contamination and leading to cleaner, more reliable results. Although these are significant advantages, there are a few drawbacks to INAA. The technique requires highly qualified personnel, and students need to be trained in nuclear safety and gamma spectroscopy. In addition, not every laboratory has access to the nuclear reactor needed to conduct INAA. For this project, the researchers will be performing the required neutron irradiation at the research reactor at UC Irvine. To address some of these drawbacks and enhance the effectiveness of using INAA for water monitoring, Sun plans to use this project to establish a radiological lab for food safety and water conservation at UNLV.

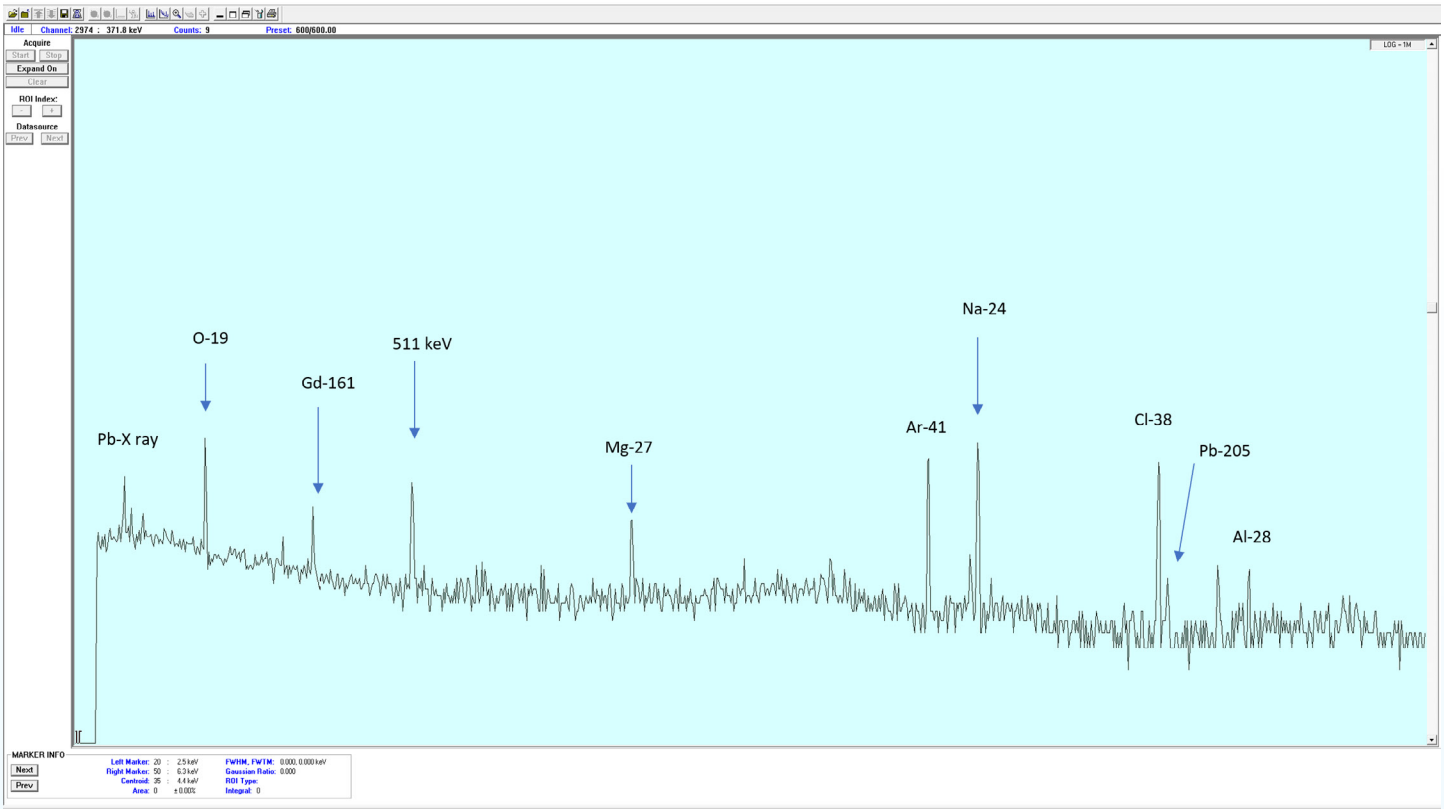
**Haven Searcy (left) receiving the Young Investigator Award at the 31st CIRMS conference with Amitava Adhikary (center) and Frédéric Tessier (right), who at the time of the photo were the CIRMS President and First Vice President, respectively (photo courtesy of Jacob Lambeck of CIRMS).**

"This new laboratory will train qualified personnel in environmental monitoring using nuclear techniques," Sun says. He also plans to strengthen collaborations with universities that have access to research reactors, such as UC Irvine and UC Davis.

In the first year of the project, the researchers focused on collecting water samples around the Las Vegas Valley with the support of SNWA. They also conducted Monte Carlo simulations of the neutron flux in the reactor using the software toolkit Geant4. The students conducted passive nuclear assays using the CosmicGuard low-background gamma

*"Applying INAA techniques to this research will provide baseline data on heavy metals in Lake Mead and facilitate the ongoing monitoring of water quality in southern Nevada. This initiative will keep residents and policymakers informed about the looming challenges of water conservation facing the Las Vegas Valley and, ultimately, it will improve the health and quality of life for the local communities."*

**–ZAIJING SUN**




**Gamma spectra for short-lived isotopes in a water sample collected for the project (figure courtesy of Zaijing Sun).**

spectra collection system at UNLV to prepare the samples to be sent to the reactor for neutron activation. Their plan for the upcoming second year of the project is to irradiate the samples and collect the gamma spectra data using HPGe detectors. The baseline data generated in this project will provide valuable insights into water quality in the Las Vegas Valley. Once the project is complete, Sun plans to disseminate the results within the radioanalytical community and give community talks to inform residents on how to better manage drinking water during the megadrought. He will also give seminars at local high schools to attract more students to STEM fields.

A key component of the NWRRI projects is to train the next generation of water researchers, and this project provided a unique opportunity for the students to learn specialized skills. Danesha Hunter, Haven Searcy, and Estefany Merino Rojas primarily worked on the project over the summer. "All three of these students are pursuing degrees in environmental health physics at UNLV, which is the only ABET-accredited health physics program in Nevada," Sun says. "The students, who come from communities traditionally underrepresented in STEM, have gained valuable skills in radiation safety, gamma-ray spectroscopy, Monte Carlo simulation, and neutron activation analysis through their involvement in this project. Notably, Haven Searcy recently won the Junior Investigator Award for his presentation at the 31st Annual CIRMS Meeting in Rockville, Maryland."

In addition to the scientific and educational merits of the project, the results of the project will also have a significant social impact. "Applying INAA techniques to this research will provide baseline data on heavy metals in Lake Mead and facilitate the ongoing monitoring of water quality in southern Nevada," Sun explains. "This initiative will keep residents and policymakers informed about the looming challenges of water conservation facing the Las Vegas Valley and, ultimately, it will improve the health and quality of life of local communities."

## NWRRI GRAD STUDENT INTERVIEW:

# *Danesha Hunter*


*Photo by Nicole Damon*

We asked Danesha Hunter, who is a graduate student pursuing her master's degree in environmental health physics at UNLV and worked on the NWRRI project "Monitoring Water Quality in the Las Vegas Valley with Nuclear Techniques," about her current studies and plans for the future. Here's what she had to say:

**1) What are you currently studying and what sparked your interest in that field?**

I am studying environmental health physics. I was introduced to health physics as a sophomore in high school through the Mathematics, Science, and Engineering Academy (M-SEA) while I was taking part in an early intervention, precollegiate STEM program at Fort Valley State University in Georgia. Participation in that academy led me to apply for the Cooperative Developmental Energy Program's (CFDEP) dual-degree scholarship, where I received my Bachelor of Science in chemistry at Fort Valley State University and later attended UNLV to pursue a Master of Science in environmental health physics.

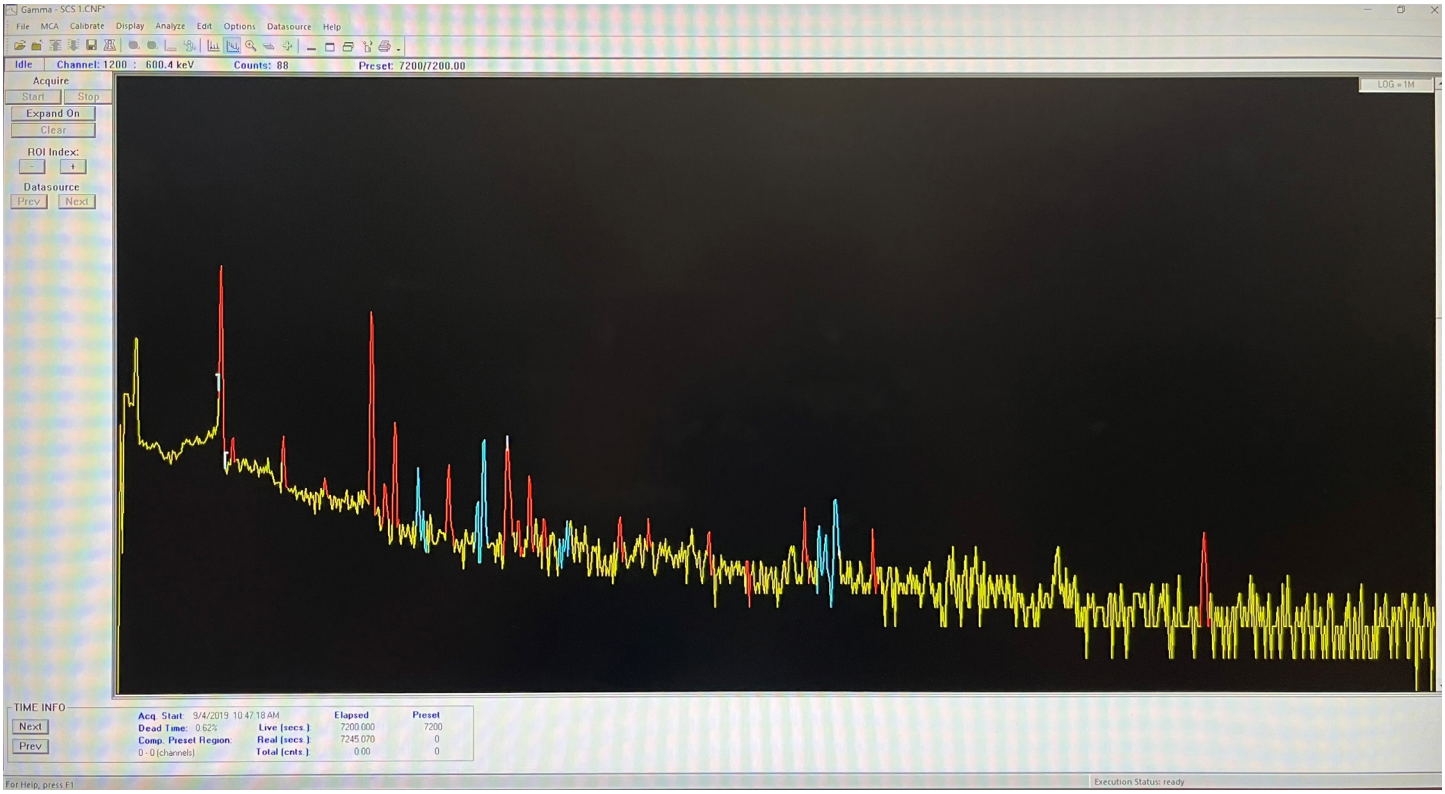
**2) You worked on the NWRRI project "Monitoring Water Quality in the Las Vegas Valley with Nuclear Techniques." What did you learn from your experience on that project? Was there anything particularly interesting/surprising?**

I am not a Nevada native, so the historical aspect of the project was very interesting. It is amazing to see how a twentieth-century marvel like nuclear technology continues to provide its resources to several states and two countries. It is also interesting to see STEM from the last century survive and positively impact millions of lives. I was surprised that Instrumental Neutron Activation Analysis (INAA) techniques are so sensitive that they can characterize even trace elements in the samples from Lake Mead to identify heavy metal concentrations. I learned that with effort and technology, the Colorado River Basin and Lake Mead can continue to support the millions of residents of the basin states with quality water.

> *"I learned that with effort and technology, the Colorado River Basin and Lake Mead can continue to support the millions of residents of the basin states with quality water."*
>
> **–DANESHA HUNTER**

**3) What do you find most interesting about water resources research, particularly working in an arid/semiarid environment such as Nevada?**

With the Las Vegas Valley being such an arid environment, it is interesting to research the socioeconomic drought and its effects




**Isotope peak analysis of a water sample collected from Lake Mead (photo by Nicole Damon).**

on the Colorado River Basin water crisis. Las Vegas will continue to grow in population and drought effects will continue to plague the region. Therefore, characterizing the region's water is important for predicting future water quality and providing a means to offset the effects of that water quality on both the economy and population health.

### 4) What are some of your goals for the next steps in your studies and career?

After graduation, I plan to pursue the Certified Health Physicist (CHP) exam and further enhance my career opportunities.

### 5) What is one of your favorite movies or books and why?

As a millennial, I was introduced to climate change and its possible effects at an early age. I have also always been intrigued by science and research, so of course my all-time favorite movie is a sci-fi film; I love *The Day After Tomorrow*! It proves the scientific method in "real time." It also shows not only how important research is, but also the importance of conveying a research objective and its result(s) to a nonscientific community.

### 6) If you could go on vacation anywhere in the world, where would you want to go, why would you want to go there, and what would you want to do there?

I was born and raised in Anchorage, Alaska. I have never traveled far beyond Anchorage (in Alaska) and would love to further explore the last frontier. Alaska is so vast with many different ecosystems and terrains; it would be the perfect vacation spot to explore!

### 7) Cake or Pie?

Neither! I have a terrible sweet tooth, but it only applies to ice cream. I need ice cream to enjoy both cake and pie, so neither are the perfect dessert because they're both missing the key piece—ice cream!

*Photo by Sabbathiel Greene*

> *"I have learned invaluable lessons when it comes to fieldwork, data quality, and the use of good scientific methods through research, which are all things I am so grateful to our mentors for facilitating."*
>
> **–SABBATHIEL GREENE**

## NWRRI UNDERGRAD INTERNSHIP INTERVIEW:

# *Sabbathiel Greene*

Sabbathiel Greene participated in the NWRRI Undergraduate Internship Immersion Program in the summer of 2024. He worked on the project "Are Beaches a Source of Litter to Lake Tahoe?" and was mentored by Dr. Monica Arienzo of DRI. The focus of the project was to measure and categorize the litter on Lake Tahoe's beaches in collaboration with ECO-CLEAN Solutions to identify sources of litter in Lake Tahoe. We asked Sabbathiel about his experience during the internship, current research, and plans for the future. Here's what he had to say:

**1) What are you currently studying and how did you find out about the internship?**

Currently, I'm studying environmental engineering at UNR. I work as a laboratory assistant in the Division of Atmospheric Sciences at DRI, so I have been keeping an eye on various research projects for a while now, but I found out about this internship through a poster at the Undergraduate Research Symposium this past spring at Truckee Meadows Community College (TMCC). I received my associate's degree in science, math, and physical sciences from TMCC about a year ago and still take classes there when I can.

**2) The project you are working on is "Are Beaches a Source of Litter to Lake Tahoe?" What does this project entail and in what ways are you participating?**

For this project, the student interns and our DRI mentors—Dr. Monica Arienzo, Daniel Saftner, and Angelique DePauw—are working in conjunction with ECO-CLEAN Solutions and The League to Save Lake Tahoe to collect data on the quantity and composition of litter on the beaches of Lake Tahoe. ECO-CLEAN Solutions collects the litter using a beach-cleaning robot, BEBOT, which combs the shores to collect litter from under the surface of the sand.

Our team takes the material collected from the BEBOT and we remove any materials native to the beach and return them to the environment. This leaves us with all the non-native materials, which includes both organic matter (such as pistachio shells and fruit pits) and conventional trash (such as plastic, metal, glass, and hygiene

**Research team members (from left to right) Sabbathiel Greene, Rachel Eves, Lauren Broncho, Melanie Paz Flores, and Daniel Saftner sort through the litter collected by the BEBOT (photo by Morgan McLachlan).**

products). This is where the emphasis of the project comes in: data collection. We categorize the litter into material types, and then into specific subcategories such as bottle caps, beach toys, coins, etc. We count every cigarette butt, cherry pit, and juice box straw, then weigh each subcategory.

The project is mainly data-driven because there has not been much research conducted on litter collected from beneath the surface of the sands at Lake Tahoe. Because of this, we want to get the best possible body of information we can. The League to Save Lake Tahoe has been instrumental in this regard given their experience in data collection from surface-cleans of the lake's shores. This data can then be used to aid further studies of litter and microplastic characterization in the soils, sands, and waters of Lake Tahoe. They can also help enact policy changes in the communities surrounding the lake regarding the types of materials allowed to enter the local environment. In addition to categorization and data collection, our team is developing a protocol that can be used by future groups on similar projects.

**3) What have you learned about the presence of litter in Lake Tahoe? How does this research improve our understanding of the sources of litter and the potential effects on freshwater lakes and the surrounding environment?**

Unfortunately, a lot of the litter is small, uncategorizable pieces of material that cannot confidently be identified. This is the case in both the sand and water at Lake Tahoe. We can take these pieces into a lab and learn their chemical compositions, but it doesn't tell us much about where the litter is coming from. With this research, we can build a substantial dataset of categorized, identifiable litter in addition to the locations and distribution densities of specific types of litter. Using these data and chemical comparisons, we can hopefully begin to bridge the gap in this understanding.

Litter affects every aspect of the lake and its surrounding environment, from social and economic disparities to public health and ecosystem crises. The more we understand what exactly is making its way into the watershed and where it originates, the better

equipped we will be to address the associated environmental risks. Preventing litter from entering the ecosystem is key and understanding where it's coming from is a crucial step to keeping it out of our watersheds.

**4) What have you learned so far from your experience on the project? Is there anything you have found particularly interesting or surprising?**

I have learned invaluable lessons when it comes to fieldwork, data quality, and the use of good scientific methods through research, which are all things I am so grateful to our mentors for facilitating. I have also learned quite a bit about the unusual kinds of things that get left behind on our beaches; each beach seems to have its own "litter personality," as Dr. Arienzo would say. At one beach, it might be a myriad of lost sandbox toys; at another, it might be a particularly high density of acrylic nails. It is safe to say that I will never be able to look at sand the same way again.

**5) Has participating in this internship given you any ideas for your future studies that you may not have thought about otherwise?**

I had always tiptoed around the idea of graduate school. It is difficult to entertain the idea of more school, especially while currently working on a degree. But through this internship, I've had the opportunity to work with and get to know amazing scientists and graduate students who have inspired me to pursue my master's degree. This internship has reignited my passion for environmental research and fieldwork, reminding me of the reason I wanted to obtain my degree in the first place.

**6) What are your goals for the next steps in your studies and what career direction are you pursuing?**

Right now, I am focused on finishing my bachelor's degree. After that, I hope to pursue my master's degree in hydrogeology or a similar field. As far as my career goes, it would be my dream to continue working in the research arena. Having

**The ECO-CLEAN Solutions BEBOT traverses the beach, collecting litter beneath the sand that can then be identified and categorized (photo by Lauren Broncho).**

the opportunity to work at DRI, both through this internship and in the lab, has opened my eyes to a career path that I would have never thought possible. Research allows you to dedicate your work to causes and concepts that you're passionate about. It also presents a wealth of opportunities for travel and hands-on work. Most importantly, it allows you to give back and contribute to the global community through science, which is a major source of motivation for me.

# EVENTS

**Please keep an eye on the event websites for changes in conference schedules.**

**2024 Floodplain Management Association Annual Conference**
September 3–6, 2024; Las Vegas, NV
floodplain.org/page/AnnualConference

**Tour of the Marlette Water System**
September 11, 2024; Carson City, NV
nvwra.org/2024-marlette-lake-tour

**2024 Fall Symposium**
September 12, 2024; Reno, NV
nvwra.org/2024-fall-symposium

**AWRA Webinar: Are You Driving Your Career or Simply Along for the Ride?**
September 18, 2024; Online
awra.org/Members/Events_and_Education/2024-Webinars/WEBINAR_Driving_Career.aspx

**GSA Connects 2024**
September 22–25, 2024; Anaheim, CA
community.geosociety.org/gsa2024/home

**Meeting the Challenges of Groundwater in Fractured Rock**
September 23–24, 2024; Burlington, VT
ngwa.org/detail/event/2024/09/23/default-calendar/24sep5017

**AWRA, UCOWR, NIWR 60th Anniversary Joint Water Resources Conference**
September 30–October 2, 2024; St. Louis, MO
ucowr.org/conference

**2024 ASA, CSSA, SSSA International Annual Meeting**
November 10–13, 2024; San Antonio, TX
acsmeetings.org

**AGU24**
December 9–13, 2024; Washington D.C.
agu.org/annual-meeting

**NGWA Groundwater Week**
December 10–12, 2024; Las Vegas, NV
groundwaterweek.com

**2025 NWRA Annual Conference**
January 27–30, 2025; Sparks, NV
nvwra.org/2025-jan-water-rights-class

**Chapman Conference: Particle Precipitation**
February 14–21, 2025; Melbourne, Australia
agu.org/chapman-particle-precipitation

**2025 Cordilleran Section Meeting**
April 1–4, 2025; Sacramento, CA
geosociety.org/GSA/Events/Section_Meetings/GSA/Sections/cd/2025mtg/home.aspx?hkey=88411fd7-3278-41be-aa78-f451032e17f3

**AWRA 2025 Spring Conference**
April 28–30, 2025; Anchorage, AK
awra.org/Members/Events_and_Education/Events/2025%20Landing%20Pages/01_SPRING/Spring2025.aspx

**21st Annual Truckee River Field Study Course**
May 1–2, 2025; Reno, NV
nvwra.org/2025-truckee-river-tour

**Storm clouds and rainbow over High Rock Lake in Nevada. Photo by DRI Science.**

Success and dedication to quality research have established DHS at DRI as the Nevada Water Resources Research Institute (NWRRI) under the Water Resources Research Act of 1984 (as amended). The continuing goals of NWRRI are to develop the water sciences knowledge and expertise that support Nevada's water needs, encourage our nation to manage water more responsibly, and train students to become productive professionals. The work conducted through the NWRRI program is funded through the National Institutes for Water Resources (NIWR), which is supported by the U.S. Geological Survey under Grant/Cooperative Agreement No. G21AP10578. DRI administratively houses and logistically supports the operations of NWRRI.

## CONTACTS

NWRRI

**Dr. Sean McKenna**
*Director*
Sean.McKenna@dri.edu
775.673.7305

**Matt Bromley**
*Deputy Director*
Matt.Bromley@dri.edu
775.673.7683

**Suzanne Hudson**
*Program Administrator*
Suzanne.Hudson@dri.edu
702.862.5464

**Nicole Damon**
*Communications/Information Transfer*
Nicole.Damon@dri.edu
702.862.5531