

# NEVADA WATER NEWS

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## PROJECT SPOTLIGHT

### “Removal of Fluoride from Groundwater in Rural Communities of Nevada”

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



This project is using groundwater from Beatty, Nevada, as a pilot case to expand a combined MO/EC technique for reducing fluoride concentrations from lab scale to field scale (photo by BLM Nevada).

Increasing drought and changes in precipitation have led to an increased dependence on groundwater over the past few decades. However, minerals that naturally occur in groundwater, such as fluoride, can be present in concerning levels. In small doses, fluoride is beneficial, but long-term exposure to high concentrations of this mineral can have negative health effects, such as dental and skeletal fluorosis. In rural communities in Nevada, groundwater fluoride concentrations can exceed U.S. Environmental Protection Agency (EPA) maximum contaminant levels (MCLs). The Beatty Water and Sanitation

District (BWSD) has reported local groundwater sources with fluoride concentrations four times the EPA recommended limit, which is a significant concern for local water authorities. High fluoride concentrations can be complex for rural water authorities to address because they either lack a central public water system or the resources and technical support for treatment technologies that target fluoride.

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



(From left to right) Dr. Braimah Apambire (DRI-CIWAS team), Jasmine Olson (student intern), Amina Anderson (BWSD representative), and Palistha Shrestha (DRI-CIWAS team) at the field site in Beatty, Nevada (photo courtesy of Palistha Shrestha).

**A key component  
of this project  
is to raise  
awareness about  
critical water  
quality issues to  
ensure human  
health.**

The aim of the project “Removal of Fluoride from Groundwater in Rural Communities of Nevada” is to assess the use of a combination of *Moringa oleifera* (MO) extract and electrocoagulation (EC) technology developed by DRI to reduce fluoride concentrations in rural groundwater. The project team, which includes Palistha Shrestha and Dr. Braimah Apambire from the DRI Center for International Water and Sustainability (DRI-CIWAS) and Dr. Erick R. Bandala (a DRI expert/consultant), is using groundwater from Beatty, Nevada, as a pilot case to expand the technology from lab scale to field scale. The project team is collaborating with the BWSD to source groundwater samples and deploy the prototype technology in the field.

The EPA has set an MCL for fluoride in public drinking water at 4.0 mg/L with a secondary non-enforceable guideline of 2.0 mg/L. The World Health Organization has also set a maximum guideline limit of 1.5 mg/L for fluoride in drinking water. However, fluoride levels in rural wells can exceed these limits. “The well used for the Beatty experiments is currently non-operational due to high groundwater fluoride concentrations around 6 mg/L, which is well above the recommended limits, but removing excess fluoride from drinking water with preexisting technologies is difficult, especially in rural communities,” explains Palistha Shrestha. “Although there are several methods for defluoridation—such as coagulation and precipitation, membrane processes, and adsorption—these methods can be costly or require large quantities of chemicals.”

The technology being studied by DRI-CIWAS is a combined MO/EC technique. In a previous study the team conducted to assess the capacity

of MO to increase fluoride removal, they noted this plant extract was a natural fluoride adsorbent. The EC process involves running groundwater through electrodes connected to a power supply. The current releases charged metal cations that bind with impurities in the water. This process removes fluoride through complexation, precipitation, and direct adsorption. The MO/EC technology developed in this project is specifically designed for rural communities because it does not require additional chemicals, it is easy to maintain, and it can be run as an independent unit using solar panels.

The team deployed the MO/EC technology in Beatty in the summer of 2024 and they have successfully scaled up the experiments from the lab-scale capacity (1 L to 10 L) to a field-scale capacity (20 L) at the Beatty well site. The Beatty experiments also revealed important details about the design and overall efficiency of the MO/EC technology. “The results of the field experiments show that there is a slight reduction in fluoride removal efficiency due to the presence of preexisting ions in the Beatty groundwater, but it is theorized that a longer run time will yield a higher fluoride efficiency rate,” Shrestha explains. “Preliminary data show that the removal efficiency is approximately 90% fluoride removal in 60 minutes at a lower current density and approximately 75% fluoride removal in 15 minutes at a higher current density. With a slight increase in treatment time, the removal efficiency is also expected to increase. This is an integral insight that will inform future field experiments.”

The preliminary results from the experiments have provided significant information that the team will



(From left to right) Palistha Shrestha with student interns Jasmine Olson and Victoria Beecham running the MO/EC experiments (photo courtesy of Palistha Shrestha).

use to refine the design of the technology so that a full-scale process can be implemented in other rural communities. “Because this was the first field experimental design, the preliminary data are expected to show that the MO/EC technology is also capable of removing other inorganic minerals from the groundwater, which would account for the reduced fluoride removal efficiency,” Shrestha says. “These data would greatly increase the scope of the water treatment possibility for the MO/EC technology. Using real groundwater for the experiments also revealed several new parameters that need to be studied further, such as electrical conductivity, which will inform the next phase of field experiments.”

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*“Because this was the first field experimental design, the preliminary data are expected to show that the MO/EC technology is also capable of removing other inorganic minerals from the groundwater, which would account for the reduced fluoride removal efficiency. These data would greatly increase the scope of the water treatment possibility for the MO/EC technology.”*

–PALISTHA SHRESTHA

A key component of this project is to raise awareness about critical water quality issues to ensure human health, and therefore the team has focused on communicating their work and findings with the local community. “Since the field site was directly next to the town park, we were able to showcase and share our experiments with the larger community every day we were there,” Shrestha says. “In addition, as the experiments were conducted in partnership with the BWSO, our project has already been introduced to the community at several different water board agenda meetings. Furthermore, DRI-CIWAS presented the findings of the study via a Zoom presentation at the August town board meeting.”

An important goal of the NWRRI program is to train the next generation of water scientists. Jasmine Olson and Victoria Beecham, two students from Beatty, worked with the DRI-CIWAS team on this project over the summer. By participating in the project, the students gained direct experience in the research methods and scientific instruments used in the experiment and insight into applications of water chemistry. The opportunity also sparked their interest in water resources research and provided them with strong science foundation for future academic and career opportunities.

## ***NWRRI Program Announcements***

We are excited to announce the newly funded NWRRI 104(b) project “Comparative Analysis of Climate Driven Shifts in Streamflow Trends for the Upper Carson and Walker River Basins.” In this project, Dan Saftner (PI) and Dr. Rishi Parashar (co-PI) of DRI will study the effects of climate change on streamflow in the Carson and Walker River Basins. Under a warming climate, streamflow starts earlier in the spring. This shift makes it difficult for farmers and water managers to plan for changing water availability. The project will focus on rivers in the Sierra Nevada that flow from California into Nevada, where the water is used primarily for agriculture.



The researchers will analyze historical streamflow trends from the two basins to determine changes in timing and magnitude, and they will use historical weather and water data to assess the impact of temperature on surface water flows. They will also use observational streamflow and climate data to identify the factors in the basins that are affecting these trends. Using this information, they will then examine the connections between streamflow, temperature, precipitation, and snow water equivalent, as well as the interdependencies of hydrometeorological variables and watershed characteristics. The results of this project will be shared with farmers, water managers, and other stakeholders, which will give them data that can be used to make informed decisions and improve community resilience to climate change.

**The Carson River (photo by BLM Nevada).**

## NWRR I UNDERGRAD INTERNSHIP INTERVIEW:

### *Lauren Broncho*

Lauren Broncho participated in the NWRR I Undergraduate Internship Immersion Program in the summer of 2024. She 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 Lauren about her experience during the internship, current research, and plans for the future. Here’s what she had to say:

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

I’m currently majoring in chemistry at Truckee Meadows Community College (TMCC). I was looking for internships in the chemistry field, but I also wanted to keep my options open to explore other areas of science that I might be interested in branching off into as I move along in my college career. I’ve heard great things about DRI from people I’ve met and professors who work there, so when I started looking into applying for scholarships, I went to DRI’s website to see if there were internships available and found this project.

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

We are about a month into the project and we have a team of five interns. Currently, we are working with Keep Tahoe Blue and ECO-CLEAN Solutions, who collect litter from the beaches using a robot called the BEBOT. Once the litter is collected, our team sorts, analyzes, and categorizes it to identify any spatial and temporal trends along each beach at Lake Tahoe. This helps us understand where litter is accumulating.

#### **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?**

During this research, we have noticed a trend in the litter we collected—that it does not simply disappear but becomes buried in the sandy beaches of Lake Tahoe. In the case of plastic, items such as toys, straw wrappers, and other plastic items can break or tear into

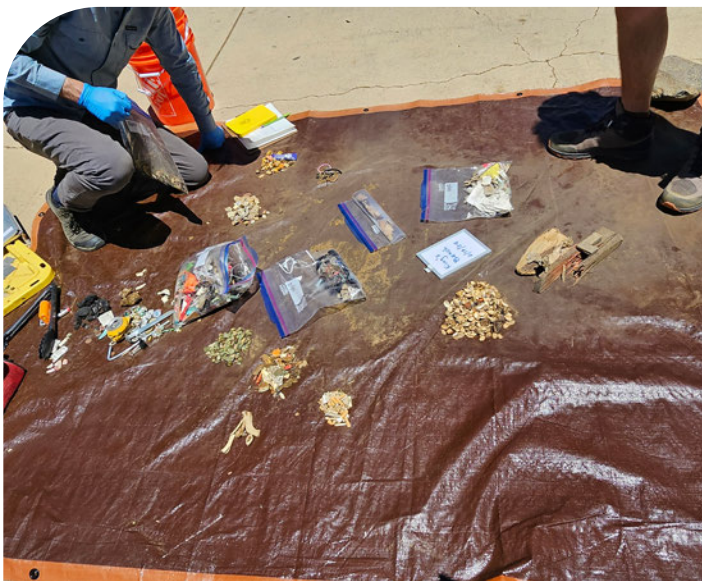


Photo by Lauren Broncho

“Participating in this internship has profoundly impacted my perspective on the harm litter is creating to the ecosystem and how consumables that we find convenient will negatively impact Lake Tahoe if they are left on the beach.”

—LAUREN BRONCHO

NWRR I



**Litter collected from the beach by the BEBOT being sorted and identified by type (photo by Lauren Broncho).**

pieces small enough to be categorized as microplastics or even smaller, nanoplastics, which then enter the water. These plastics have the potential to cause harm to the ecosystem and aquatic life. By doing this research, we can quantify and identify the trends of litter that are accumulating in our freshwater lake. When we can find origins based on these trends, it makes the process of pollution reduction easier to pinpoint and policies can be adopted to rid beaches of problematic waste that is being left on the shores, which only happens when beachgoers bring those items to Lake Tahoe.

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

We've collected litter from about six locations so far. I initially expected to see a lot larger food packaging, like cans and bottles. Although I have noticed that we do get a lot of random plastic packaging, I'm more surprised by the number of small pieces of plastic, like Capri-Sun straws, that may seem insignificant to a beachgoer, but the small pieces add up over time. Something else that surprises me during every sort is how many food items we collect that a person may think is biodegradable, so it's left on the beach. Some

common items are orange peels, a lot of pistachio shells, and pits from cherries and peaches. I was also shocked and disgusted by the state of Lake Tahoe that was reported on the news in 2023 after the Fourth of July. I'm happy to say that in 2024, we visited Zephyr Shoals, which was said to be the worst littered last year and this year it was not as bad as I had expected. This is excellent because it means visitors to the beach are being more conscientious about how they are leaving the shore.

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

Participating in this internship has profoundly impacted my perspective on the harm litter is creating to the ecosystem and how consumables that we find convenient will negatively impact Lake Tahoe if they are left on the beach. I look forward to seeing the further research and analysis strategies my mentors have performed on similar projects and I am excited to learn more about our project. I'm also drawn to the idea of how plastics degrade over time and the broader scale of litter pollution on the environment, from a macroscale to a microscale.

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

I plan to continue my studies in chemistry at TMCC and I plan to further my studies at the University of Nevada, Reno (UNR). Although I'm still exploring various fields of study, my experience at DRI has been incredibly fascinating and has sparked my interest in environmental research. I'm particularly drawn to learning more about this area.

ENVIRONMENTAL RESEARCH



Photo by Melanie G. Paz Flores

## NWRR I UNDERGRAD INTERNSHIP INTERVIEW:

# Melanie G. Paz Flores

Melanie G. Paz Flores participated in the NWRR I Undergraduate Internship Immersion Program in the summer of 2024. She 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 Melanie about her experience during the internship, current research, and plans for the future. Here’s what she had to say:

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

I am currently studying environmental sciences and I hope to get my bachelor’s degree in environmental management. I found out about the internship from my chemistry professor, who sent me the link to the informational web page.

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

This project focuses on analyzing data found across many beaches in Lake Tahoe. These data are collected through collaboration with ECO-CLEAN Solutions and their innovative BEBOT, which goes three inches into the sand and collects and sifts litter from the beach. Our team takes this litter and sorts through it. As intimidating as it sounds, it gives us a clear picture of the culture and customs of each beach and resort and how many pieces of one type of litter end up in different areas. We can also get information on the presence of invasive species, such as Asian clams, which ideally should not be present at the beach.

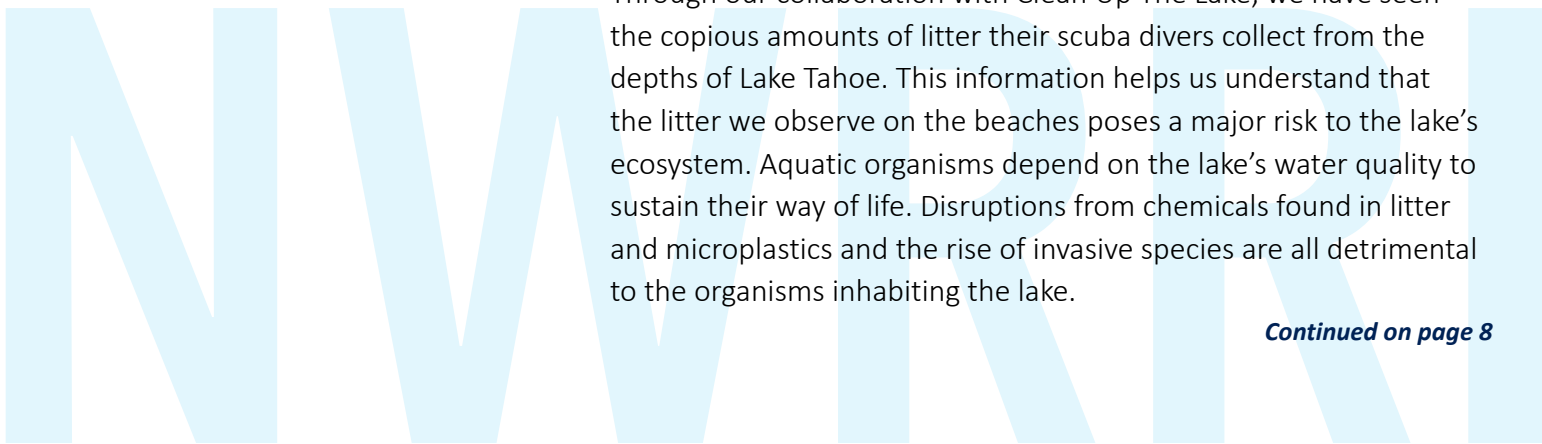
Through our collaboration with Clean Up The Lake, we have seen the copious amounts of litter their scuba divers collect from the depths of Lake Tahoe. This information helps us understand that the litter we observe on the beaches poses a major risk to the lake’s ecosystem. Aquatic organisms depend on the lake’s water quality to sustain their way of life. Disruptions from chemicals found in litter and microplastics and the rise of invasive species are all detrimental to the organisms inhabiting the lake.



*“Hydrology is a fascinating sector of environmental sciences and with this experience, I can confidently say my passion for the sciences has grown more than before along with my desire to make positive changes in my life and the lives of others.”*

–MELANIE G. PAZ FLORES

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The BEBOT from ECO-CLEAN Solutions collecting litter from Kings Beach at Lake Tahoe (photo by Melanie G. Paz Flores).

My participation in the project included digitizing the data we collected, categorizing the different litter types with my team, going out into the field, collaborating with other organizations and collecting their data, and overall being an innovative thinker with the support of my team.

### **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?**

I have learned that different beaches have different audiences and customs, and that the litter present can put the native organisms at high risk for effects from microplastics. Because resorts have more of an adult audience, we see more cigarette butts and marijuana items present in that data, whereas public beaches have a more family culture, so we see more plastic Capri-Sun straw wrappers and plastic toy pieces on the beach.

Many different types of litter can be found either in resorts or public beaches, but the main takeaway is the harmfulness of this litter, which poses significant risks to the native species. This information helps us get a clearer picture of how we can prevent massive

amounts of litter going into the lake, especially because they are not biodegradable. By doing so, not only will the beaches be cleaner, but there will also be less microplastic and more awareness of how harmful these substances are to the environment.

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

I have learned how to take proactive feedback when collecting and analyzing data. The other team members come up with innovative questions and brainstorming ideas, which has rubbed off on me in the best way possible. This is a valuable experience because it is my first time working with a research team.

One thing that is both interesting and surprising is the number of acrylic nails we have found on the beaches. It is surprising to see how many people leave acrylic nails behind in massive amounts. No need to go to the nail salon—I've collected a full set! Another thing I found baffling was the presence of charcoal pieces. Charcoal burning is not allowed at many of these beaches, so I'm puzzled as to how people are sneaking it in.

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

Most definitely! I now have an idea of how the scientific method is used in an experiment and how important it is to have a keen eye for details. Hydrology is a fascinating sector of environmental sciences and with this experience, I can confidently say my passion for the sciences has grown more than before along with my desire to make positive changes in my life and the lives of others.

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

My goals for the next steps in my studies are to obtain my bachelor's degree in environmental management at the University of Nevada, Reno (UNR), and then hopefully gain more experience working in my field.



# EVENTS

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

## 2024 ASA, CSSA, SSSA International Annual Meeting

November 10–13, 2024; San Antonio, TX

[www.acsmmeetings.org/](http://www.acsmmeetings.org/)

## AEG Southern Nevada Chapter: “The Community Environmental Monitoring Program” by Beverly Parker

November 12, 2024; Las Vegas, NV

[www.aegsnv.org/meetings](http://www.aegsnv.org/meetings)

## AGU24

December 9–13, 2024; Washington D.C.

[www.agu.org/annual-meeting](http://www.agu.org/annual-meeting)

## NGWA Groundwater Week

December 10–12, 2024; Las Vegas, NV

[groundwaterweek.com/](http://groundwaterweek.com/)

## AEG Southern Nevada Chapter: “Toward a More Heat Resilient Nevada” by Dr. Tom Albright

January 14, 2025; Las Vegas, NV

[www.aegsnv.org/meetings](http://www.aegsnv.org/meetings)

## 2025 NWRA Annual Conference

January 27–30, 2025; Sparks, NV

[www.nvwra.org/2025-jan-water-rights-class](http://www.nvwra.org/2025-jan-water-rights-class)

## AEG Jahns Lecture: “Advanced Edge-AI Monitoring Technologies for Combating the Geologic and Hydrologic Hazards Associated with Climate Change” by Dr. John Kemeny

February 11, 2025; Las Vegas, NV

[www.aegsnv.org/meetings](http://www.aegsnv.org/meetings)

## Chapman Conference: Particle Precipitation

February 14–21, 2025; Melbourne, Australia

[www.agu.org/chapman-particle-precipitation](http://www.agu.org/chapman-particle-precipitation)

## AEG Southern Nevada Chapter: Flood-Managed Aquifer Recharge, and Modeling Contaminant Movement in the Central Valley of California” by Dr. Zach Perzan

March 11, 2025; Las Vegas, NV

[www.aegsnv.org/meetings](http://www.aegsnv.org/meetings)

## Ocean Visions Biennial Summit

March 25–27, 2025; Vancouver, British Columbia

[www.agu.org/events/meetings/ocean-visions-2025](http://www.agu.org/events/meetings/ocean-visions-2025)

## 2025 Amargosa Valley Tour

March 27 & 28, 2025; Las Vegas, NV

[www.nvwra.org/2025-amargosa-valley-tour](http://www.nvwra.org/2025-amargosa-valley-tour)

## 2025 Cordilleran Section Meeting

April 1–4, 2025; Sacramento, CA

[www.geosociety.org/GSA/Events/Section\\_Meetings/GSA/Sections/cd/2025mtg/home.aspx?hkey=88411fd7-3278-41be-aa78-f451032e17f3](http://www.geosociety.org/GSA/Events/Section_Meetings/GSA/Sections/cd/2025mtg/home.aspx?hkey=88411fd7-3278-41be-aa78-f451032e17f3)

## AEG Southern Nevada Chapter: “70 Years of Flood Control in the Las Vegas Valley: Historical Floods and the District’s Response” by Andrew Trelease

April 8, 2025; Las Vegas, NV

[www.aegsnv.org/meetings](http://www.aegsnv.org/meetings)

## AEG Southern Nevada Chapter: Field trip to Tropicana Detention Basin led by Andrew Trelease

April 12, 2025; Las Vegas, NV

[www.aegsnv.org/meetings](http://www.aegsnv.org/meetings)

## AWRA 2025 Spring Conference

April 28–30, 2025; Anchorage, AK

[www.awra.org/Members/Events\\_and\\_Education/Events/2025%20Landing%20Pages/01\\_SPRING/Spring2025.aspx](http://www.awra.org/Members/Events_and_Education/Events/2025%20Landing%20Pages/01_SPRING/Spring2025.aspx)



**Bearpoppy and Joshua trees at Gold Butte National Monument in Clark County, Nevada (photo by T. Stephanova).**

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.

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