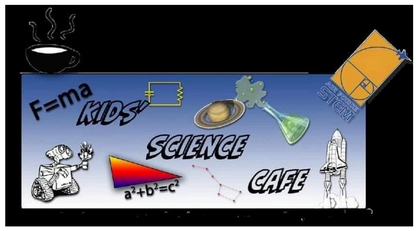


Magdalena Science Café Water Resources Science Project

Kassidy Brunson[1], Jeremiah Alvarez[1], Zeb Apachito[1], Cade Brunson[1], Tristin Alvarez[1], Jim Sauer[1,], Bonnie Frey[2], Nicole Hurtig[3], Laila Sturgis[2]

[1]Magdalena Teen Science Café, 202 Spruce St, Magdalena, NM 87825 **jsauer000@gmail.com**
[2]New Mexico Bureau of Geology and Geological Resources, New Mexico Tech, Socorro, NM 87801 bonnie.frey@nmt.edu; laila.sturgis@nmt.edu
[3]Dept. Earth and Environmental Sciences, New Mexico Tech, Socorro, NM, 87801

NEW MEXICO TECH
SCIENCE • ENGINEERING • RESEARCH UNIVERSITY

New Mexico Bureau of Geology and Mineral Resources
New Mexico Tech
Earth Science for the 21st Century

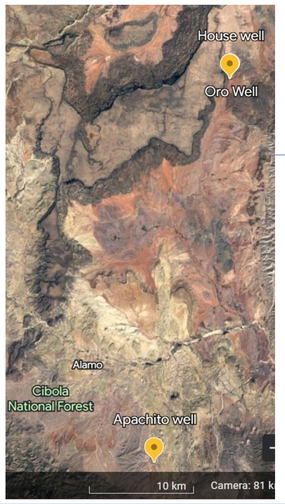
Introduction

The **Water Resources Education Program (WREP)** was established in 2021 and is funded by NSF for three years. WREP currently interacts with several local schools in New Mexico with the goal of engaging youth in water resources and water quality problems. The program provides field sampling activities, hands-on training in NMT laboratories and active discussion with Bureau staff and NMT faculty.

This water program in the Magdalena area is led by an engaged group of students from the **Magdalena Teen Science Café**, which was founded by Jim Sauer.

Over two years, two field areas were visited, and samples from six wells and stock tanks were collected. The pH, specific conductivity and dissolved oxygen were measured in the field using a YSI meter, and samples were collected for transport and subsequent analyses. The samples were analyzed in the Analytical Laboratory at the **New Mexico Bureau of Geology and Mineral Resources** at New Mexico Tech for major and trace elements, major and minor anions, specific conductivity and alkalinity.

Alamo Field Area – Sampling, October 2022



Overview of the Alamo field area, showing the locations of the **Apachito well**, the **Oro Well** and the **House well**.

Sampling at the **Oro Well** with Cade, Laila, Bonnie, Kassidy, Jeremiah and Zeb (left to right).

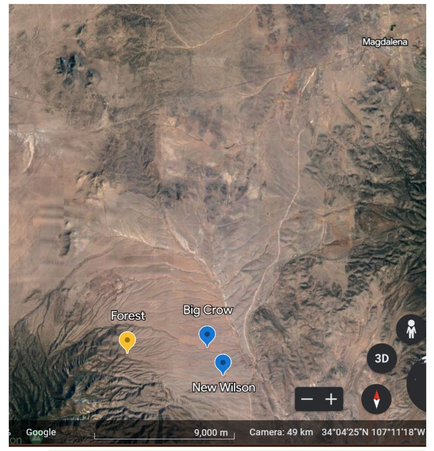
Zeb is entering data from the YSI-meter.

Magdalena Field Area – Sampling, April 2021

Measuring water samples using a YSI meter at the **New Wilson stock tank** with Cade, Tristin, Jeremiah, Falene, Kassidy and Ethan (left to right).

Measuring conductivity and pH at the Big Crow tank with Nicole, Kassidy, Jeremiah and Falene (front), Tristin and Cade (back).

Sampling at the **Forest well** with Dan, Jim, Ethan, Cynthia, Tristin, Cade, Jeremiah, Kassidy, Laila, Falene and Nicole (left to right).



Overview of the Magdalena field area showing the locations of **Forest**, **Big Crow** and **New Wilson wells**.

Cade is taking pictures of critters collected from the traps at the Big Crow tank. Photos show a dive beetle, a dragon fly larva and another aquatic insect (from right top to bottom).

Collecting traps at the Big Crow tank with Kassidy, Falene (front) Jeremiah, Dan, Jim and Tristin (back).

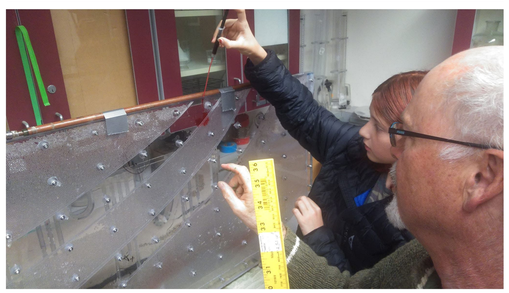
Wildlife at the **Big Crow tank**.

Laboratory Preparation and Experiments

Zeb, Tristin and Kassidy preparing water samples for metals analysis.

Cade observing the Metrohm automated titrator operated by Dustin Baca measuring alkalinity.

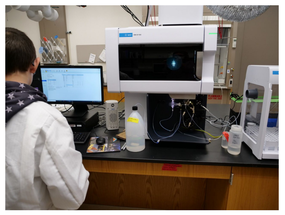
Jeremiah, Tristin, Kassidy, Kate Leary, Zeb and Leah Tavis (front left to back and front right) experiment with surface water flow and sediment transport in **Dr. Kate Leary's laboratory** at New Mexico Tech.

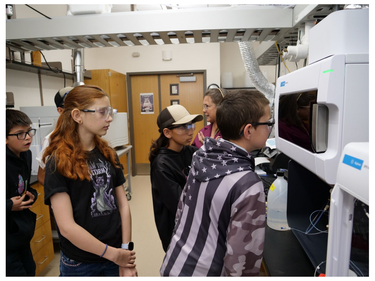


Kassidy adding dye to the **Hele-Shaw model**, which simulates contaminant flow in groundwater, under the supervision of Dr. Mark Person.

Analytical Methods

- **Major and minor elements** were measured using a new NSF-funded **Agilent 5900 ICP-OES** (Inductively coupled plasma optical emission spectrometer), photo to right
- **Trace elements** were measured using an Agilent 7900 ICP-MS (Inductively coupled plasma mass spectrometer)
- **Anions** were measured using a Dionex ICS-5000 ion chromatograph
- Alkalinity and pH were measured using a Methrohm Titrando automated titrator

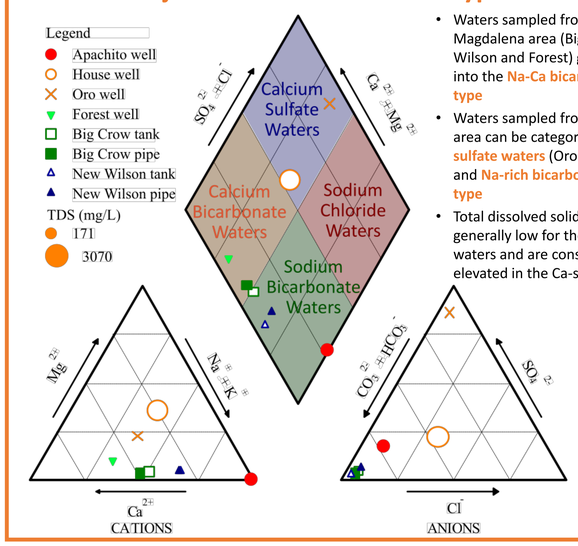




Above, the new Agilent ICP-OES. The plasma is the light seen in the center of the dark glass.

To the left, Jeremiah, Kassidy, Tristan and Cade observe the Agilent 5900 ICP-OES analyze water samples collected from the Big Crow tank and pipe. Bonnie explains that the plasma consists of atoms in an excited state. The instrument measures the emission of light released by the atoms when their electrons drop back to a lower energy state.

Results: Major Elements and Water Types

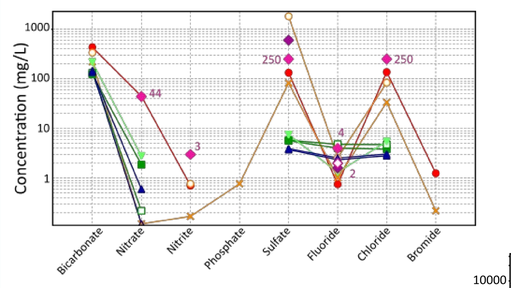


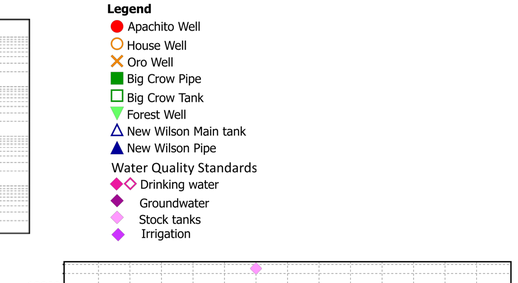
- Waters sampled from the Magdalena area (Big Crow, New Wilson and Forest) generally fall into the **Na-Ca bicarbonate water type**
- Waters sampled from the Alamo area can be categorized as **Ca-sulfate waters** (Oro and House well) and **Na-rich bicarbonate water type**
- Total dissolved solids (TDS) are generally low for the bicarbonate waters and are considerably elevated in the Ca-sulfate waters

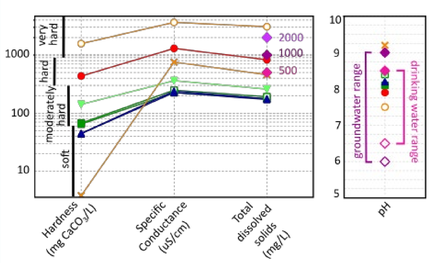
Results: Water Quality, pH, Anions and Metals

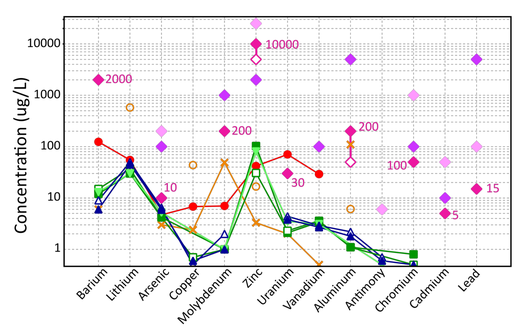
Name	TDS mg/L	Sulfate mg/L	Fluoride mg/L	Calcium mg/L	Sodium mg/L	Potassium mg/L	Magnesium mg/L	Lithium ug/L	Arsenic ug/L	Uranium ug/L	Vanadium ug/L
Apachito well	**828**	133	0.75	70.8	126	2.63	62.4	55	4.7	**71**	29
House well	**3070**	**1820**	2.58	402	405	28	137	578	ND	ND	ND
Oro well	458	83	1.02	1.09	163	4.7	0.263	ND	3	2	0.5
Forest well	259	7.5	1.31	48	29.3	1.67	5.2	30	5.2	3.5	3.1
Big Crow well	177	5.7	**4.02**	24.4	31.3	1.11	1.53	30	4.2	2.1	3.4
New Wilson well	171	3.8	2.34	15.3	36.5	0.608	1.45	45	5.9	3.8	2.7
Drinking water‡	**500**	**250**	**4.00**						**10 (0)†**	**30 (0)†**	

‡MCL (mg/L) Maximum Contaminant Level – Highest allowed level of a contaminant in drinking water; enforceable standards.
†MCLG (mg/L) Maximum Contaminant Level Goal – Non-enforceable level of contamination below which no known or expected health risk exists.
TDS = Total Dissolved Solids









Conclusions

1. The **bicarbonate waters** generally have **good water quality**, however, some of the stock tanks show elevated fluoride, likely due to evaporation
2. The **sulfate waters** have **high TDS and elevated sulfate and uranium**. Filtration and retesting are recommended before safe consumption
3. Arsenic values are measurable but not above enforceable limits

Acknowledgments

We would like to thank Ethan Mamer, Cynthia Connolly and Dan Jones for their help sampling waters around the communities of Magdalena and Alamo; Dustin Baca and Hannah Juan Han for assistance with laboratory measurements and analysis; Kate Leary, Leah Tavis and Mark Person for their great instructions during laboratory experiments; Amanda Montoya, Bud Montoya, Diana Sauer, Kenneth Apachito, and Mark and DeAnne Chavez for access to their wells and stock tanks and for driving students during field work. This project is supported by **NSF-EAR 2054299**.

NSF