

Research Update

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Bottom Line

This research project provided an off-grid solar photovoltaic desalination system to treat brackish groundwater for livestock water, with a further goal to develop potable water for members of the Navajo Tribe who live outside the traditional power and water infrastructure systems.

Better, Faster, Cheaper

This research could provide closer, cheaper water for people who sometimes drive up to 50 miles to obtain water, and who pay the highest percentage of their disposable income for water.

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Solar Photovoltaic Desalination Using Distillation

Off-grid solar photovoltaic desalination on the Navajo Nation Reservation

Problem

The Navajo population live in remote and rural areas where little access to water and power infrastructure exist. Studies report that over 35 percent of the Navajo people live without access to the electric grid and public water systems, haul their potable and livestock water long distances from their homes, and pay the highest price-per-thousand gallons of water. Numerous studies have shown that populations with inadequate water and sanitary services have higher incidents of health problems. An off-grid, inexpensive system is needed to provide closer and cleaner sources of water.

Solution

To begin addressing the water supply, quality, and quantity problems, a Reclamation Science and Technology Program solar desalination research project was conducted on the Navajo Nation Reservation near Leupp, Arizona. The University of Arizona, a collaborating partner, developed a system that produces up to 1,000 gallons of water per day for livestock consumption. This system uses off-the-grid solar energy to heat and pump water through a distillation desalination system. This research project entailed installing this system to treat the brackish groundwater from a well near the area on the Navajo Nation Reservation where water is needed. This research project provided water for livestock, and the basic knowledge gained from this research will be the foundation for follow-on research to provide potable water.

Steps in the process included:

1. **Assessing Potential Sites.** Well site 5T-529 was selected because of the water quality and its centralized location to the residents, and because it was up on a bluff where this water could be distributed to other locations using gravity without the need of pumping.

2. **Constructing a Research Facility with a Secure Area for the Research Equipment.**

A solar-powered pump was installed into the well and immediately provided an additional water supply for the local livestock. An off-the-shelf Concentrated Photovoltaic-Thermal

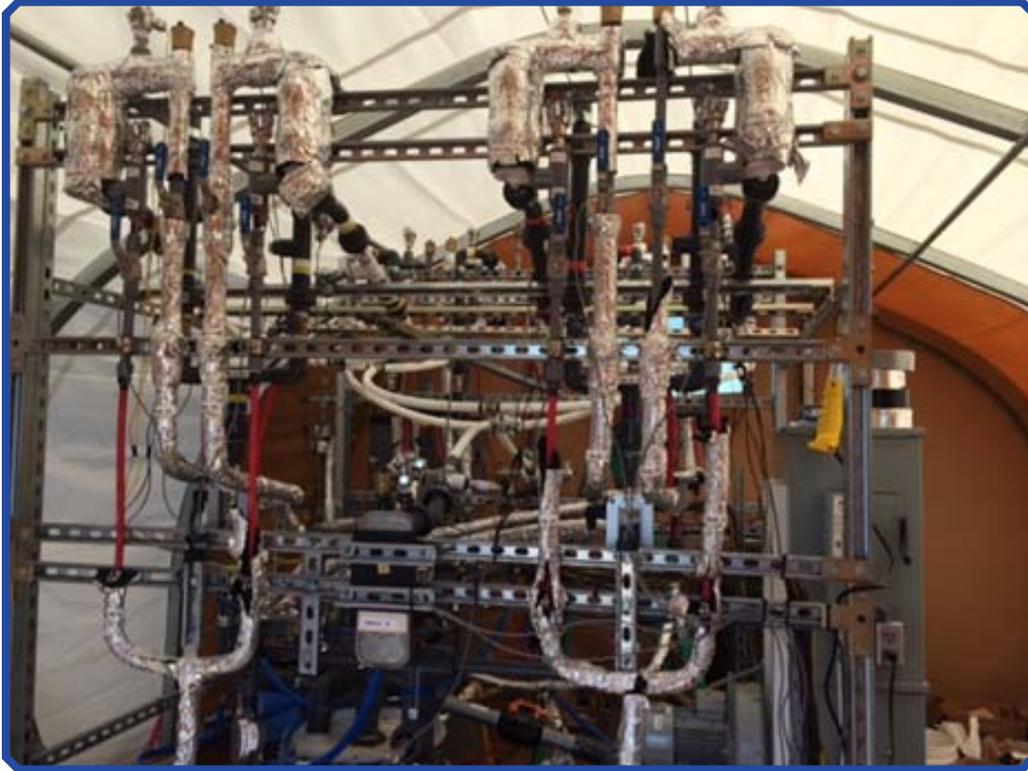
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Solar powerplant.

Hybrid System solar powerplant produces 5.4 kilowatts of electrical power along with 800,000 British thermal units of heat.

- 3. Constructing and Installing a Desalination Prototype.** On July 10, 2014, the first distilled water was produced with a total dissolved solids (TDS) reading of 5 parts per million.
- 4. Installing Many Monitoring Points to Fine-Tune the System.** System controls are now being developed and will continue under a separate Science and Technology Program research project.



Membrane distillation equipment.

Application and Results

This off-grid, stand-alone system produced distilled water from brackish groundwater. This system is now in the commissioning stages of the distillation equipment and operational protocols are being developed. The next season of data collection, using the many control sensors, will help optimize the system.

Future Plans

What researchers learned from this first phase of livestock water production will help with developing a potable water treatment system.

A separate Reclamation Science and Technology Program research project will entail monitoring the water quality data. This research will provide a final report, including a full plan for replication of the desalination equipment.

“This research project will allow the 150 families in this area of the Navajo Nation much closer access to better quality water. These families now travel to Leupp, or even Flagstaff, Arizona, to obtain their livestock and drinking water. This will reduce their travel time and associated costs. Moreover, this concept can be replicated anywhere in the world where people need better quality water and do not have access to the traditional water and electrical infrastructure.”

Mitchell Haws
Water Resources Planner
Reclamation’s Lower Colorado
Region

Collaborators

- Reclamation
 - ◇ Native American Affairs Office
 - ◇ Phoenix Area Office
 - ◇ Provo Area Office
- Navajo Nation Department of Water Resources
- Grand Canyon Trust
- University of Arizona
- Northern Arizona University

More information

www.usbr.gov/research/projects/detail.cfm?id=4850

www.usbr.gov/research/projects/detail.cfm?id=6806