

Restóre: Restoring vital water resources on the Navajo Nation

Presented by:

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Environmental Science and Natural Resources
Navajo Technical University

October 11, 2023

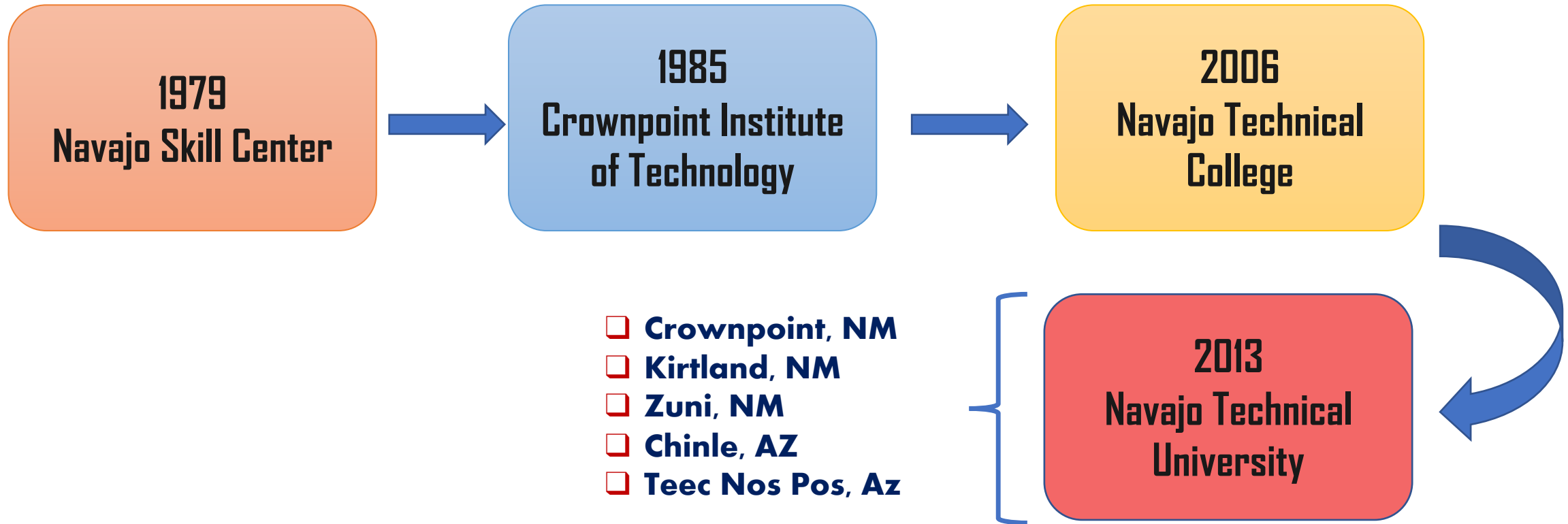


NTU: Who we are?

Navajo Technical University (NTU) is one of the premier institutions of higher education in the nation, providing a unique balance between science and technology and between culture and tradition. Much of what guides NTU's success is our mission and our identity rooted in the Diné Philosophy of Education.



Our Journey



[The first university established on the Navajo Nation]

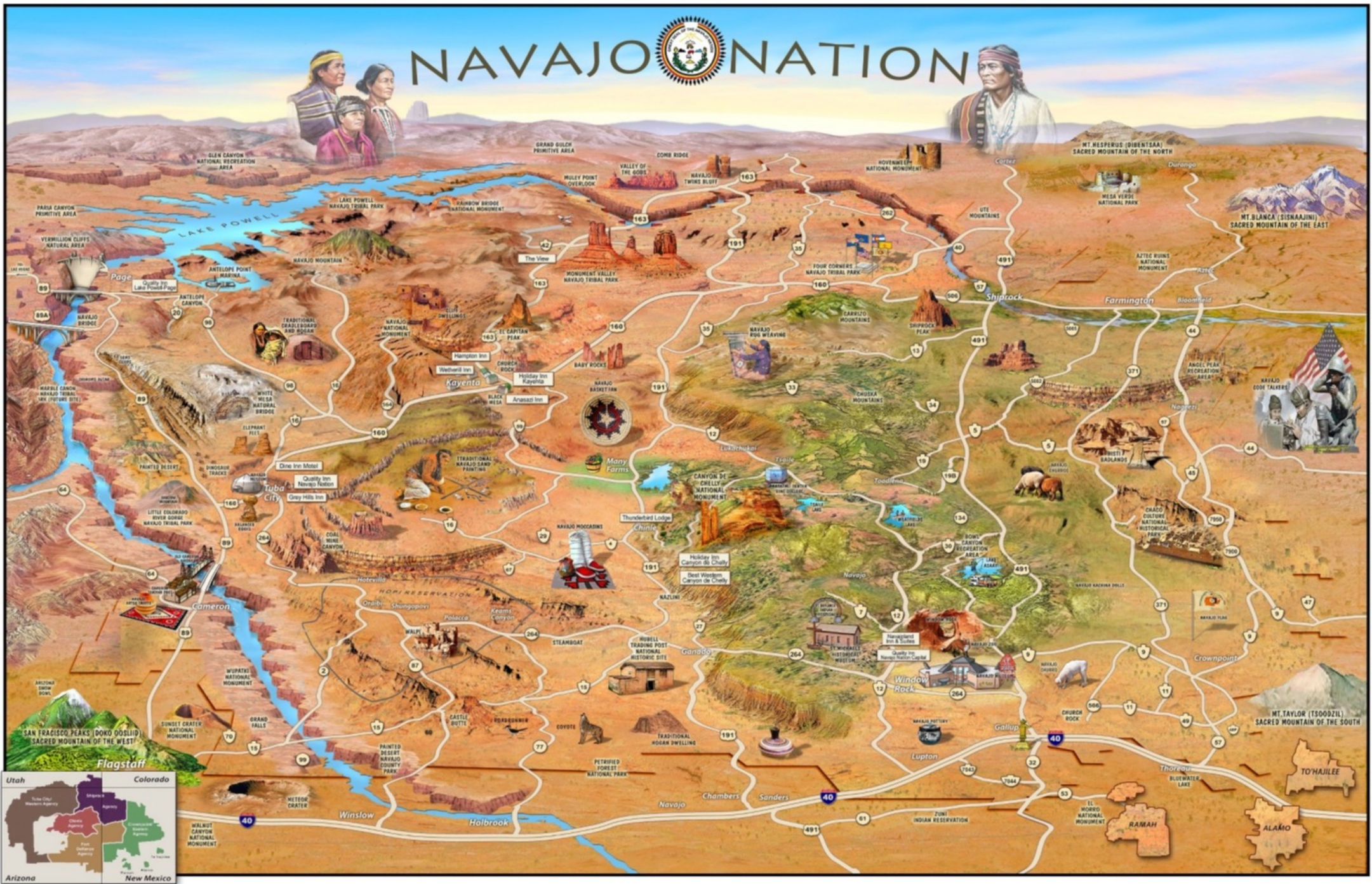
The Navajo Nation



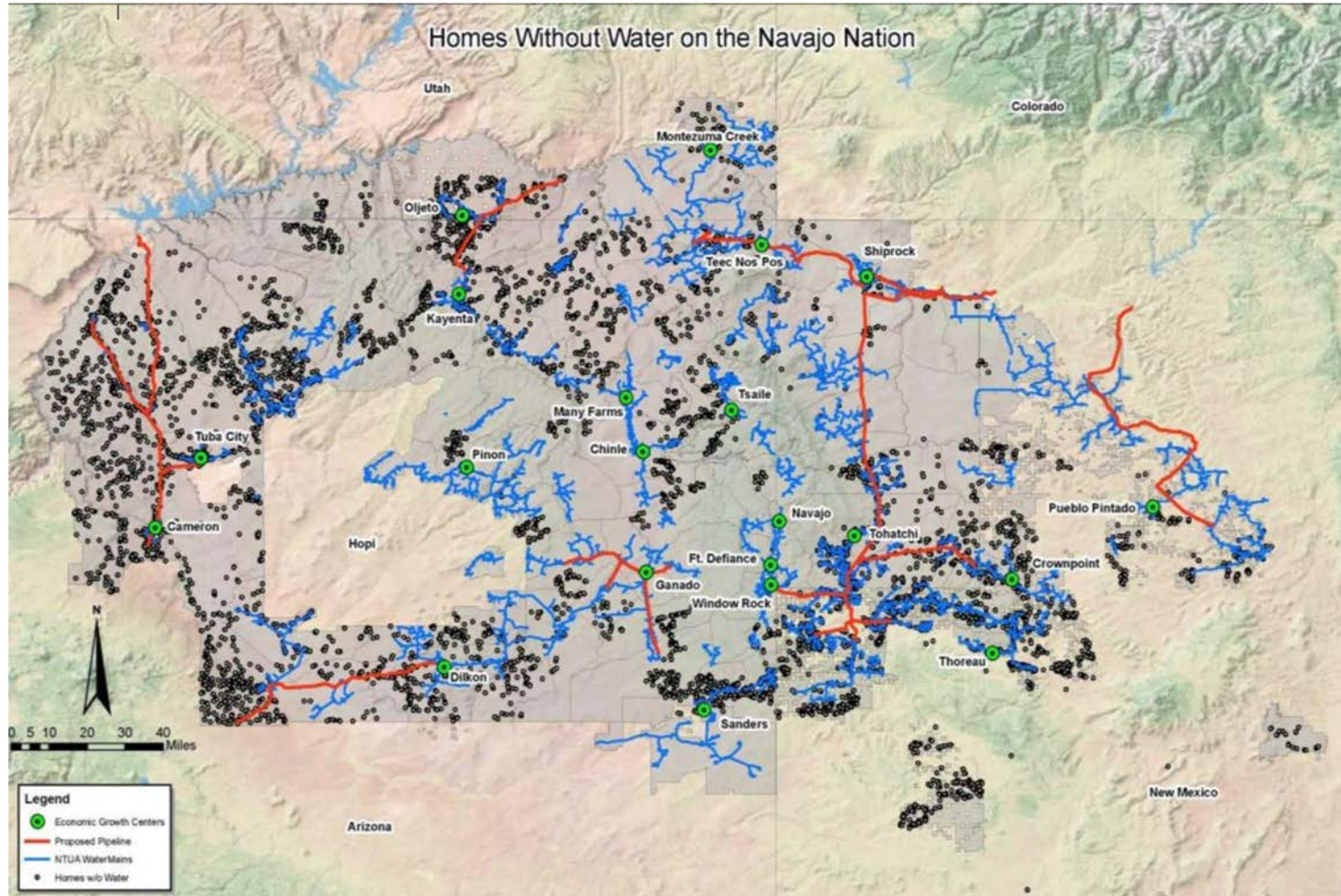
- ❖ The largest Native American Tribe in the U.S.
- ❖ 270,000 square miles of unparalleled beauty.
- ❖ Diné Bikéyah, or Navajoland, is larger than 10 of the 50 states in America.
- ❖ Rich History of the Navajoland
- ❖ The Navajo Code Talkers- WW II



Source: Discover Navajo: The Official Navajo Nation Visitor Guide. <http://www.discovernavajo.com>



Source:
David Rumsey Historical Map Collection, 2012
Copyright Jean-Louis Rheault

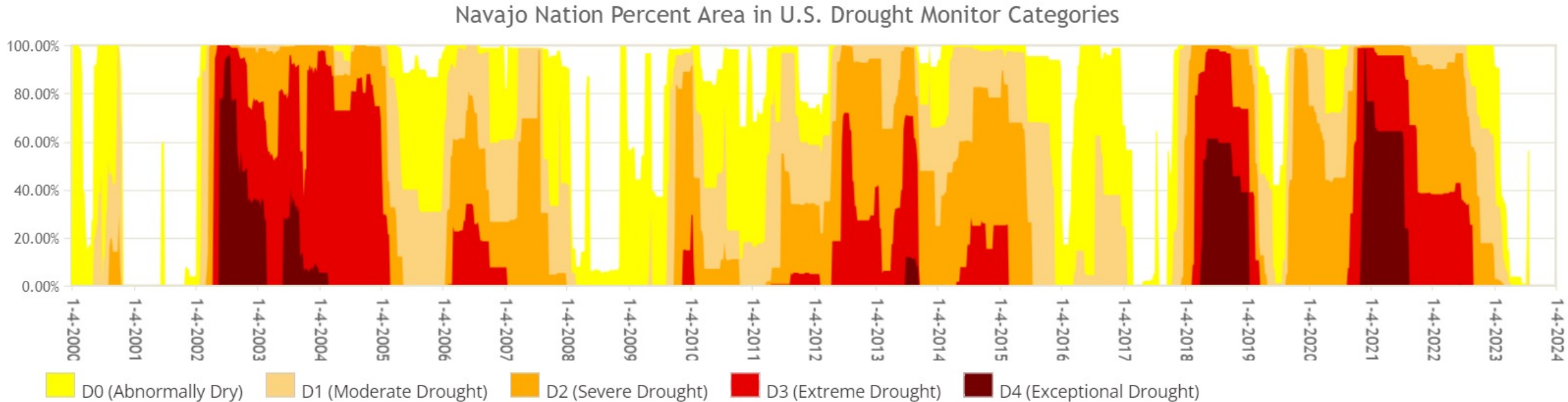


[Source: The Salt Lake Tribune. July 25, 2020]

Homes Without Water on the Navajo Nation

- 30% of the homes on the Navajo Nation have no direct access to public water systems
- The households haul water long distances to provide water for their families
- Navajo households are 19 times more likely than white households to be without running water

Water scarcity on Navajo Nation- Natural Causes



The U.S. Drought Monitor (USDM) data showing drought conditions in the Navajo Nation since 2000. Where D0: Abnormally Dry; D1: Moderate Drought; D2: Severe Drought; D3: Extreme Drought; and D4: Exceptional Drought.

(Source: The National Drought Mitigation Center, University of Nebraska-Lincoln, 2023)

Water scarcity on Navajo Nation - Anthropogenic Causes

- Long history of mining on the Navajo Nation:
 - Gold, Copper, Lead, and Silver since the mid-1800s
 - Uranium since the early 1900s
 - Coal since the 1960s
- Elevated levels of metals resulted from these mining activities in groundwater and surface water
- Unregulated wells and springs are contaminated with high levels of metals.



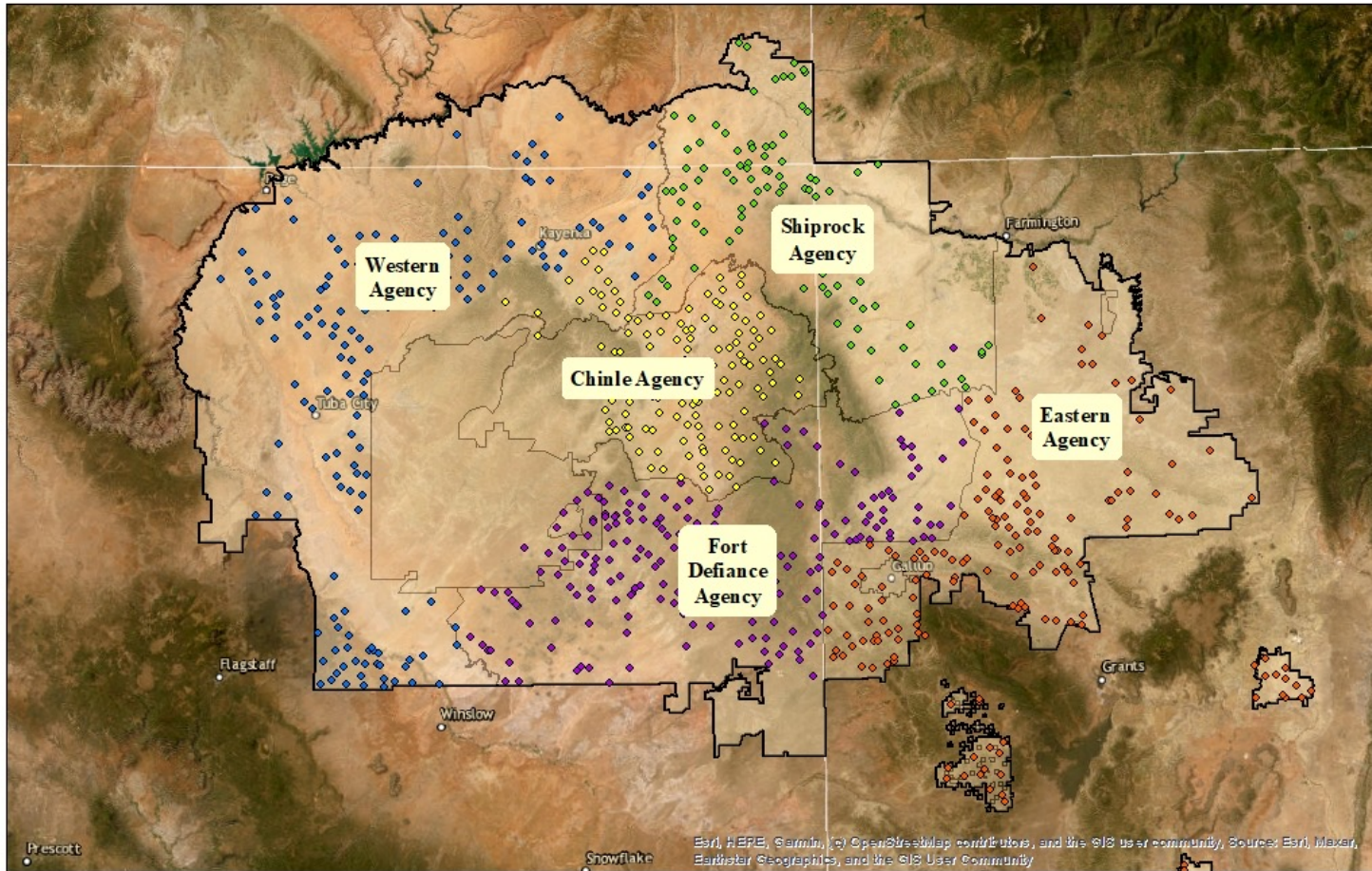
Water Scarcity on Navajo Nation



Water Hauling



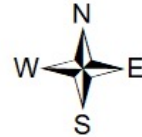
Over 770 livestock wells exists within the Navajo Nation



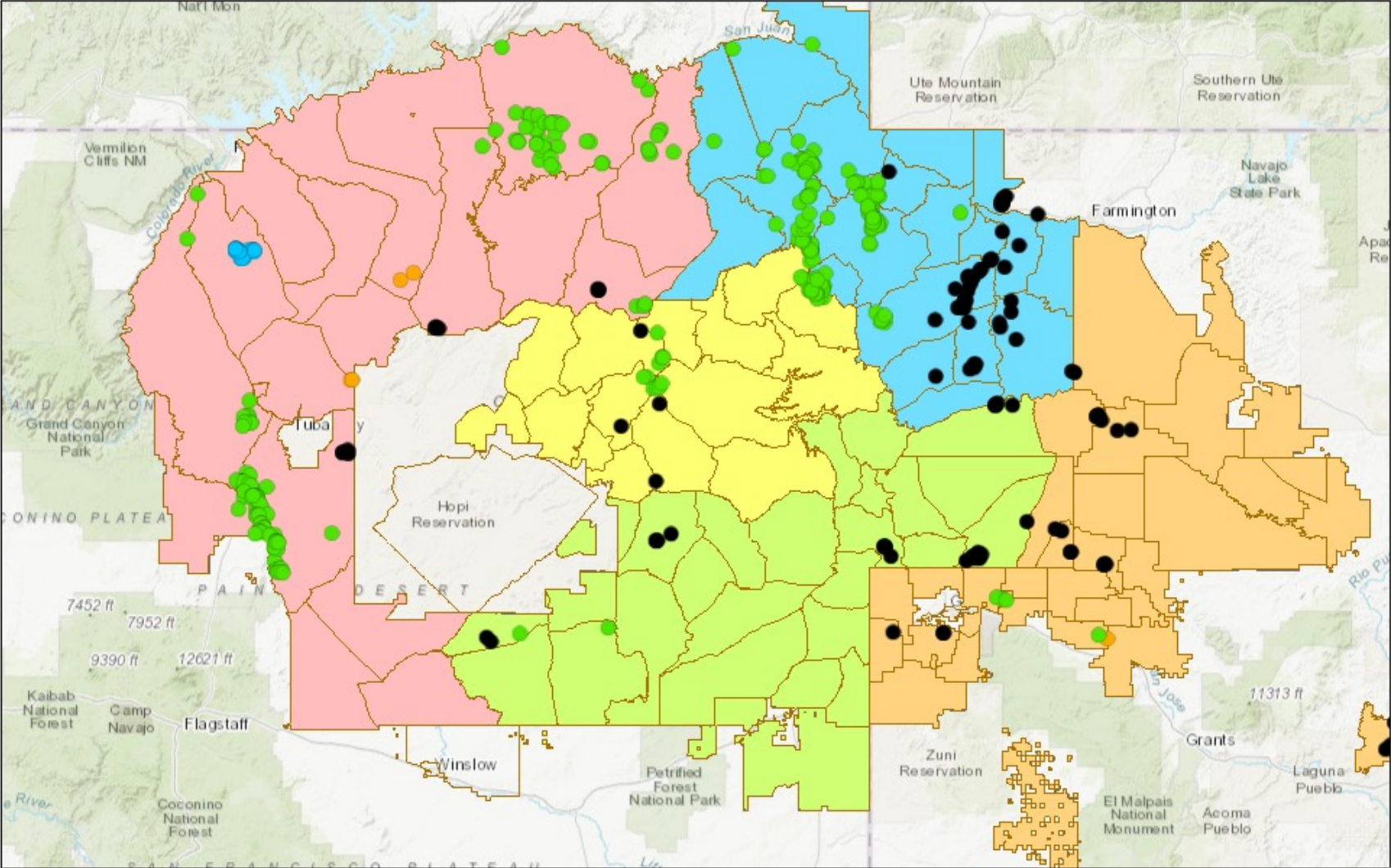
- ◆ Chinle Agency LSW
- ◆ Eastern Agency LSW
- ◆ Fort Defiance Agency LSW
- ◆ Shiprock Agency LSW
- ◆ Western Agency LSW
- agency polygon
- NN polygon

Navajo Nation Agency Livestock Wells (LSW)

0 20 40 80 Miles

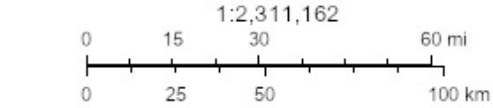


NAMLRD Project Web Map



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- Coal Project
- Sand and Gravel Project
- Copper Project
- Uranium Project
- Chapters
- Navajo Agencies
- Chinle Agency
- Eastern Navajo Agency
- Western Navajo Agency
- Fort Defiance Agency
- Shiprock Agency

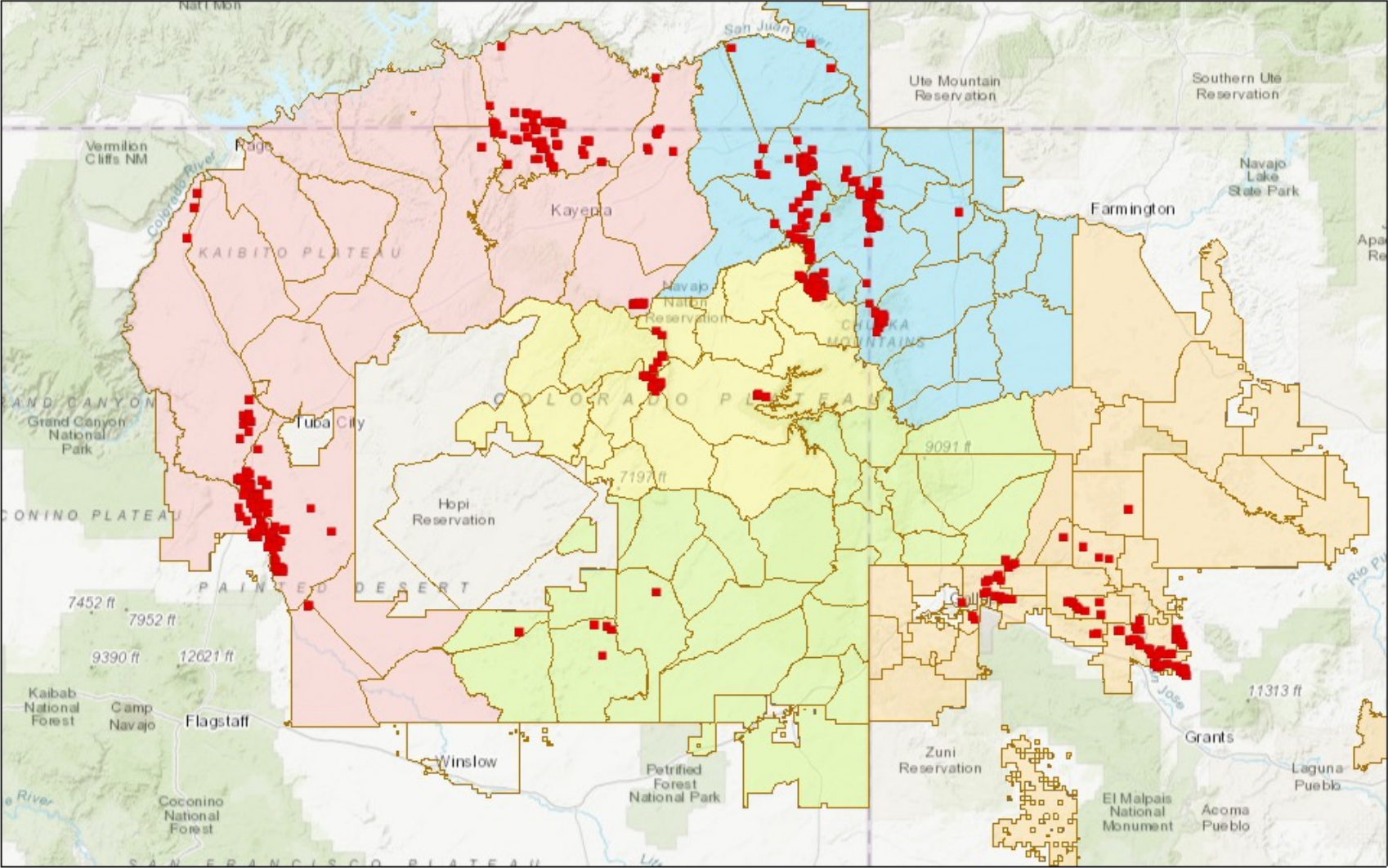


Esri, HERE, Garmin, FAO, USGS, EPA, NPS

NAMLRD
 Esri, HERE, Garmin, FAO, USGS, EPA, NPS |

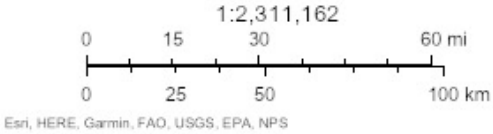
Source:
www.aml.Navajonnsn.gov

NAMLRD Project Web Map



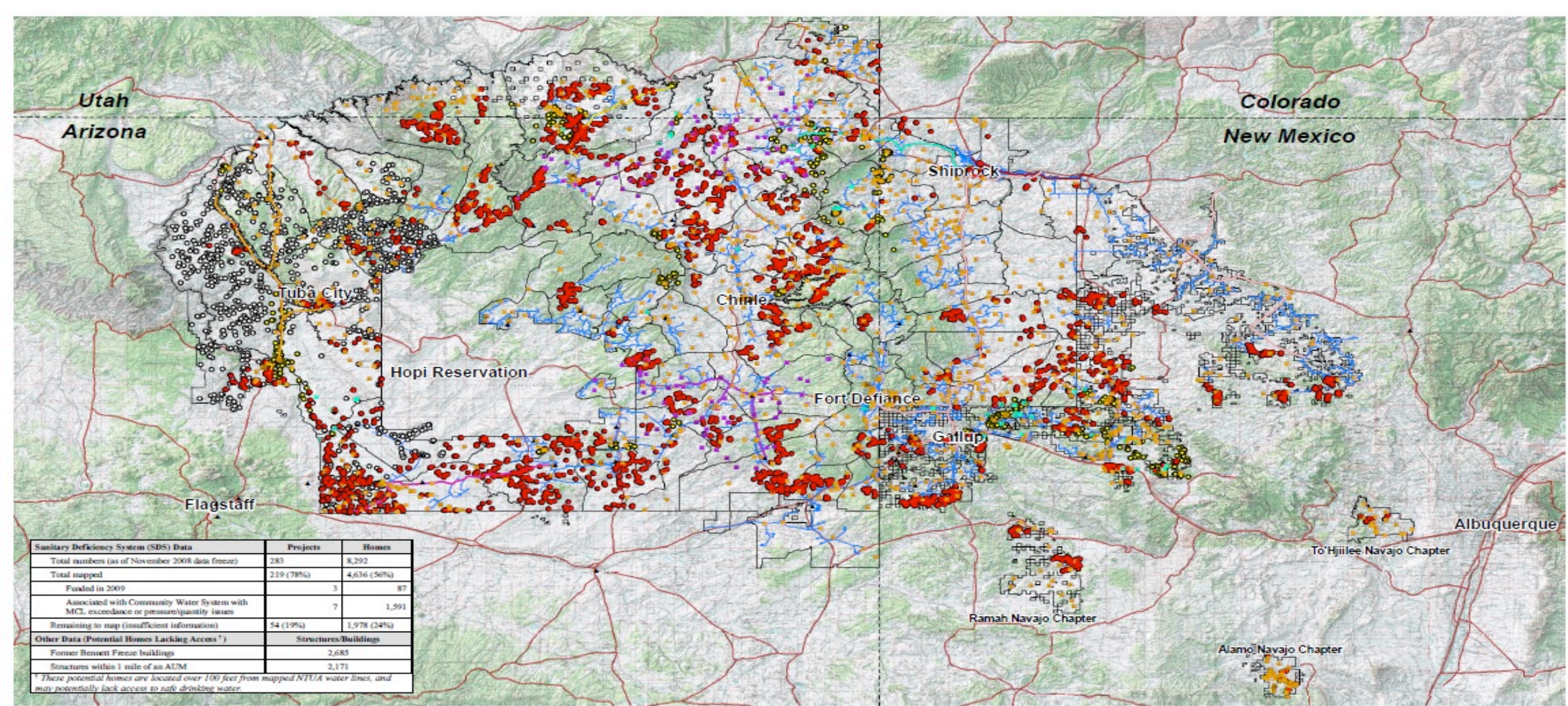
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- Abandoned Uranium Mine
- Chapters
- Navajo Agencies
- Chinle Agency
- Western Navajo Agency
- Fort Defiance Agency
- Shiprock Agency
- Eastern Navajo Agency



NAMLRD
 Esri, HERE, Garmin, FAO, USGS, EPA, NPS |

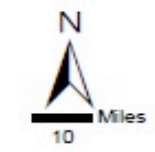
Source:
www.aml.Navajo-nsn.gov



Legend

- State Line
- Navajo Chapter
- Major Roadway
- Home without Access to Safe Drinking Water and/or Basic Sanitation *
- Former Bennett Freeze Home Potentially not Connected to a Public Water System (PWS) **
- Structure within 1 Mile of Abandoned Uranium Mines (potential homes without connection to a PWS) **
- EPA Sampled Well
- CDC Sampled Well
- Regulated Safe Drinking Water Hauling Point
- Unregulated Livestock Watering Point
- Navajo Tribal Utility Authority Existing Pressurized Water Main
- Proposed Western Navajo Pipeline Project
- Proposed Navajo-Gallup Water Supply Project

- Proposed Utah Water Supply Project
- Proposed Leupp-Dilcon Water Supply Project
- Proposed Ganado Groundwater Supply Project
- Proposed Farmington-Shiprock Water Supply Project
- Proposed Shiprock to Sweetwater Pipeline Project



**Navajo Nation:
Homes without Access
to Basic Sanitation Facilities**

* This map does not represent all the known homes lacking access to safe drinking water or basic sanitation in the IHS database. These are only those that had sufficient information to be mapped at the time of this study.
** Former Bennett Freeze homes, and Structures within 1 mile of Abandoned Uranium Mines were sorted to identify potential homes without access to safe drinking water and/or basic sanitation.

RESTÓRE

Restoring vital water on the Navajo Nation.



NTU-NMT Navajo Nation
Water Purification Project



www.navajotech.edu/Restore



NTU-NMT Navajo Nation Water Purification Project (N⁴WPP)

www.navajotech.edu/restore

Overview

The N⁴WPP is a joint endeavor to install water filtration equipment testing facilities on the Navajo Nation. These sites will be used to train students to test water quality and maintain filtration units to provide sustainable long-term water resources suitable for agriculture and livestock use, cleaning, and eventually clean drinking water.

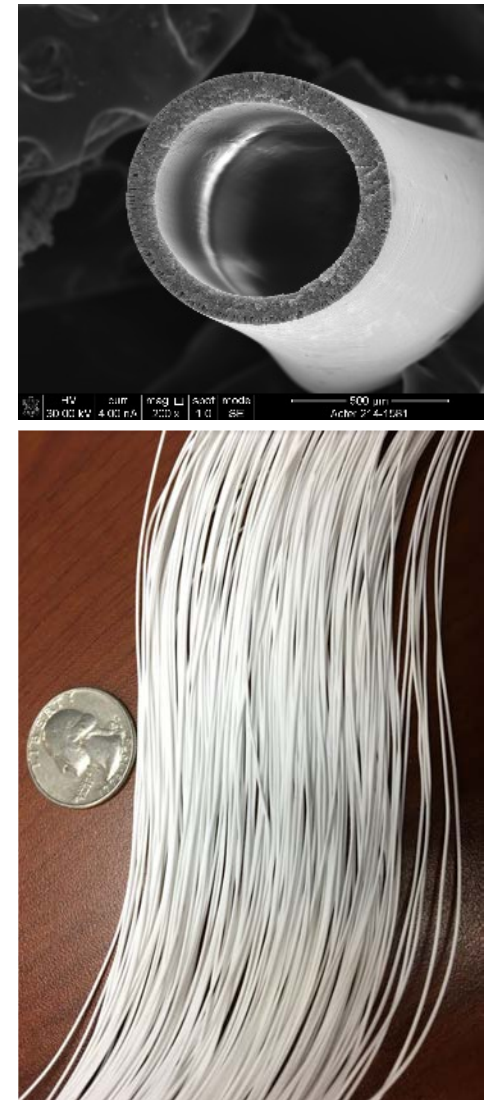


NTU-NMT Navajo Nation
Water Purification Project

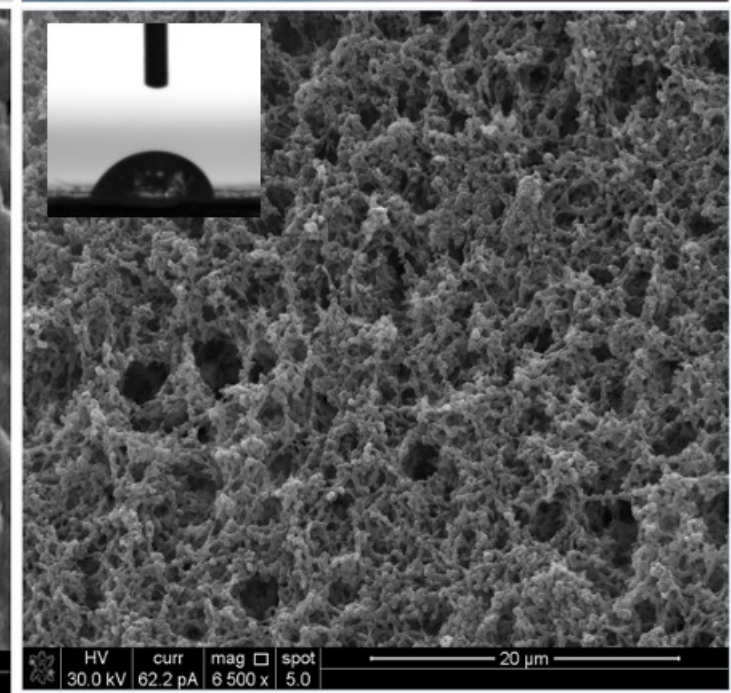
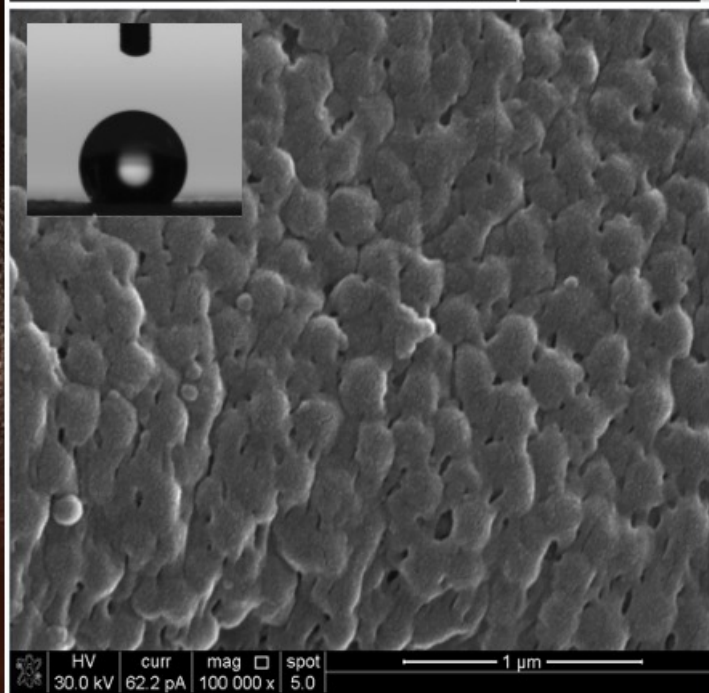
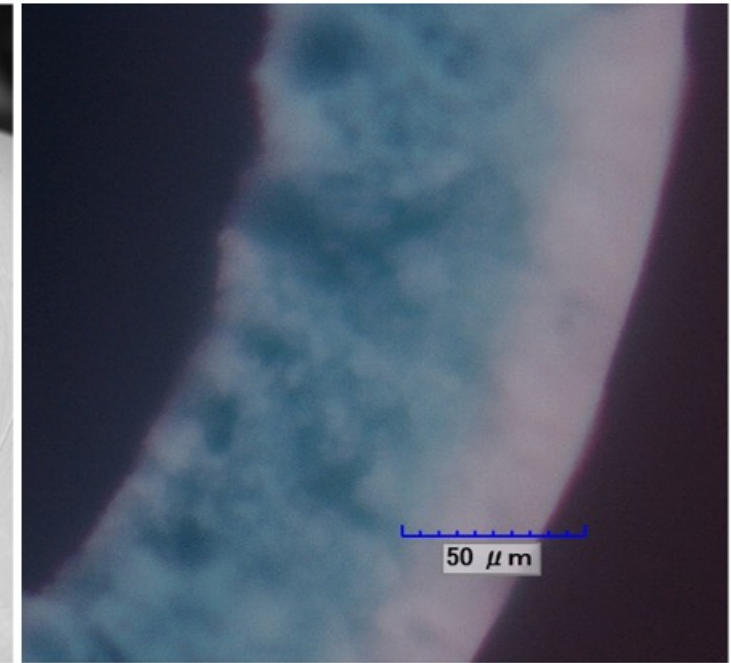
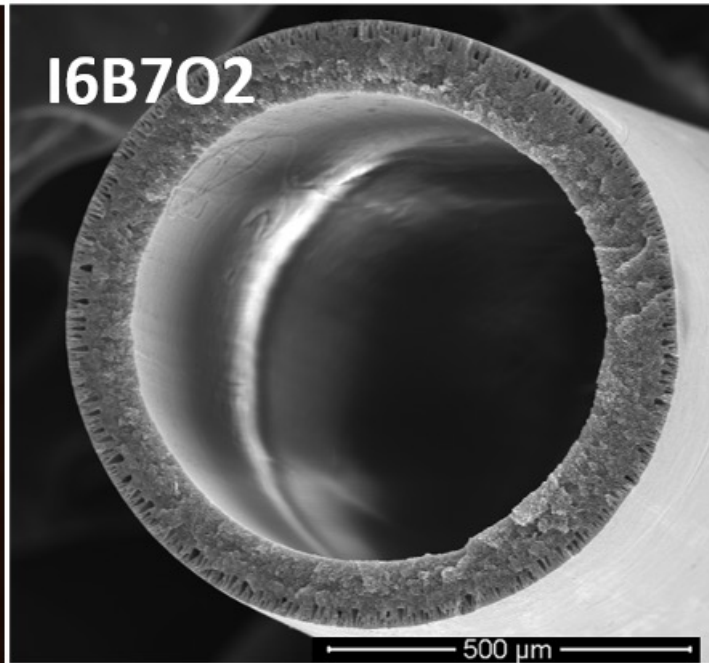


The Water Purification Technology

- The filtration technology to be used was developed by research scientists at the Petroleum Recovery Research Center (PRRC) at New Mexico Tech (NMT).
- It involves the application of a hollow fiber membrane-based direct contact membrane distillation (DCMD) process.
- Unusable water will be channeled through the bundles of hollow fiber membrane to filter out salt, phosphates, nitrates, and metals.
- Previous studies showed the efficiency of this process for desalinization.



The hollow fiber membrane



What kind of membrane is used for DCMD?

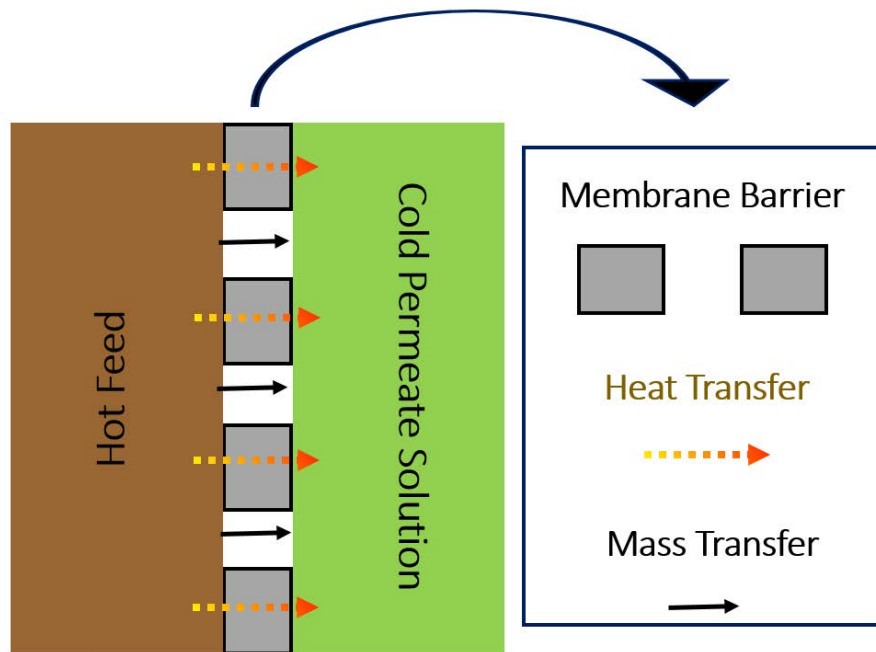


Fig. 1 Basic principle of DCMD processes.

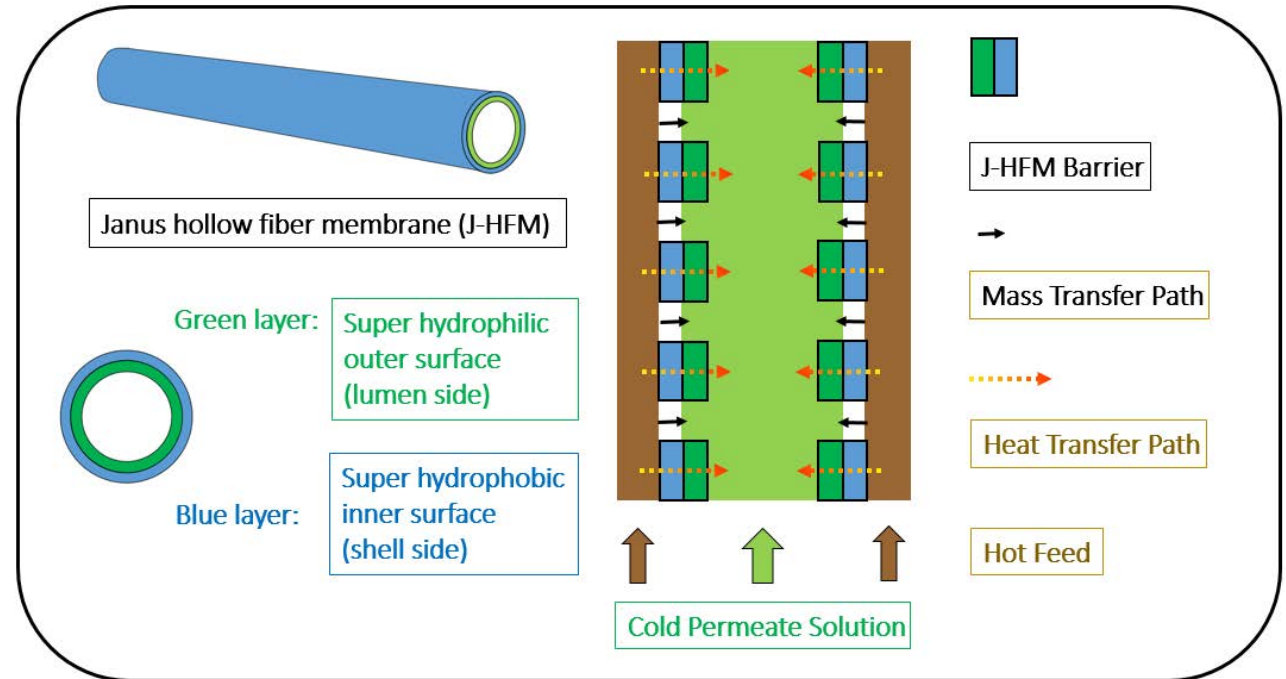
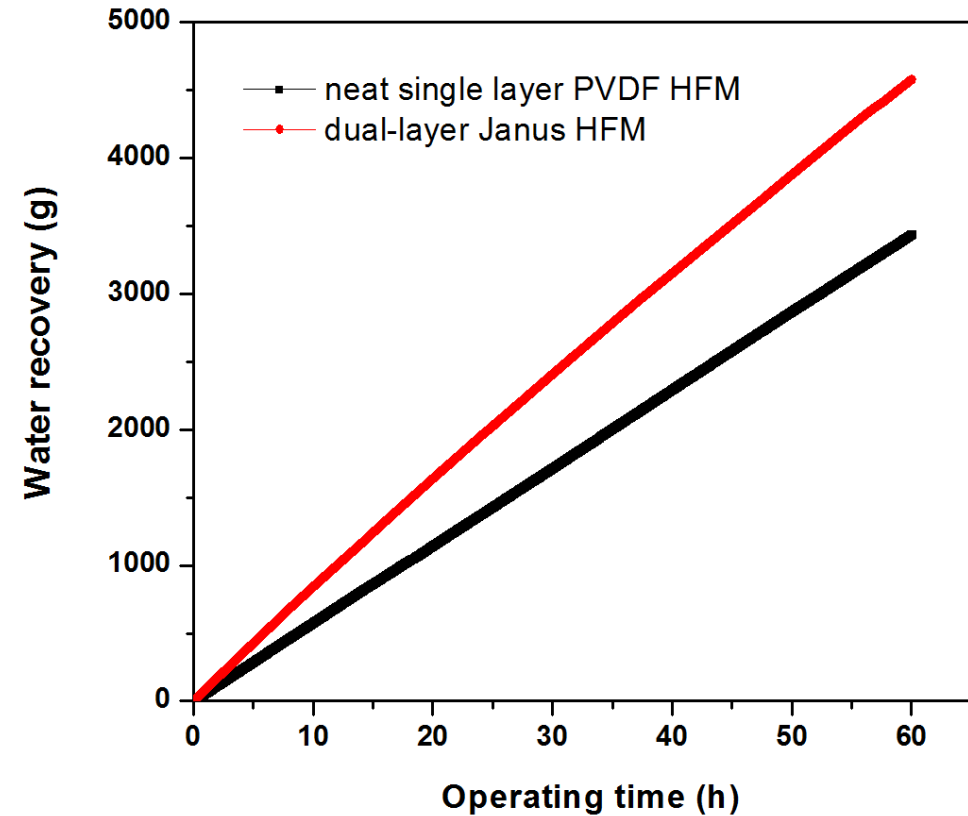
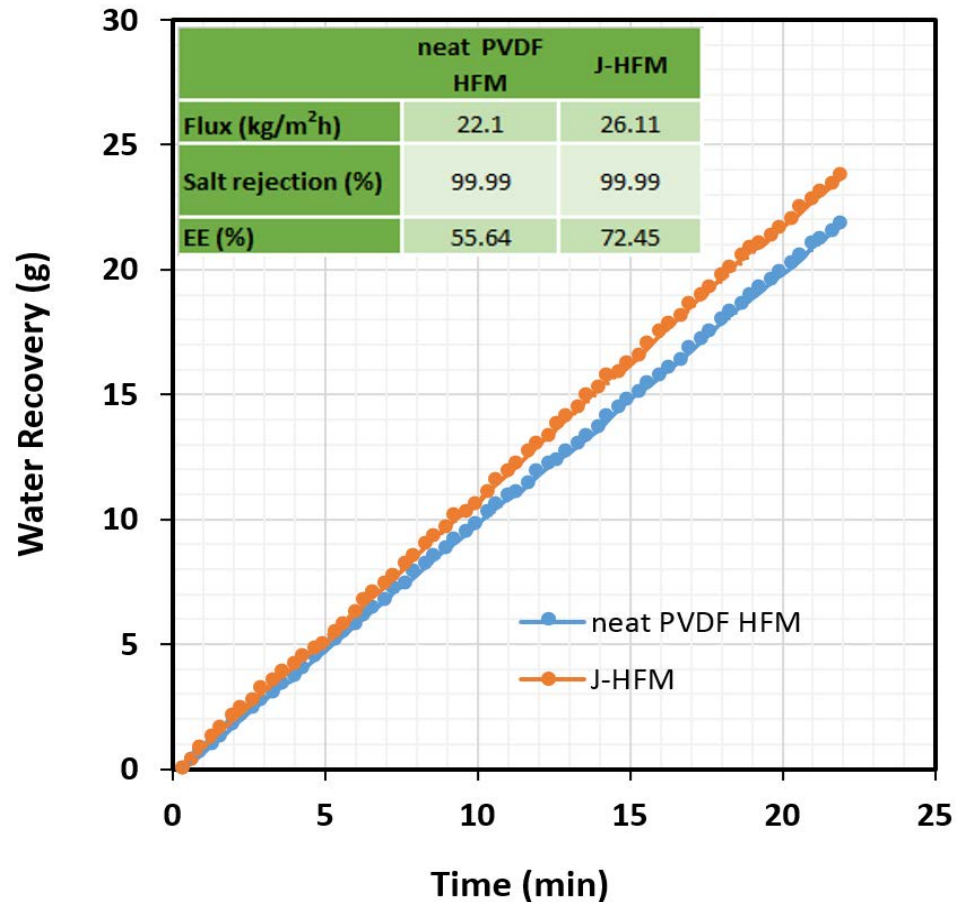


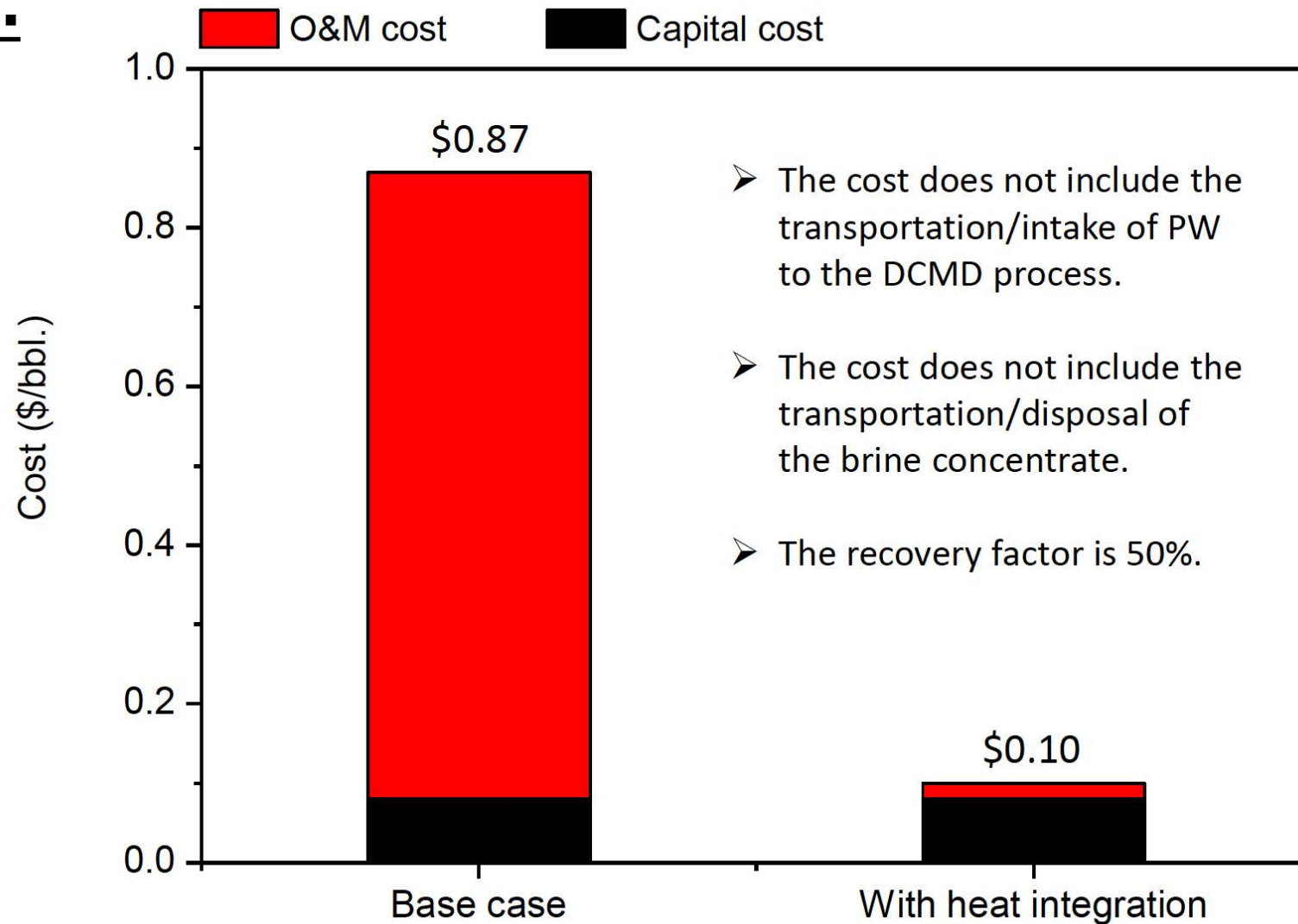
Fig. 2 Schematic drawing of Janus hollow fiber membrane (J-HFM) for DCMD.

Desalination performance of the Janus HFM DCMD process:

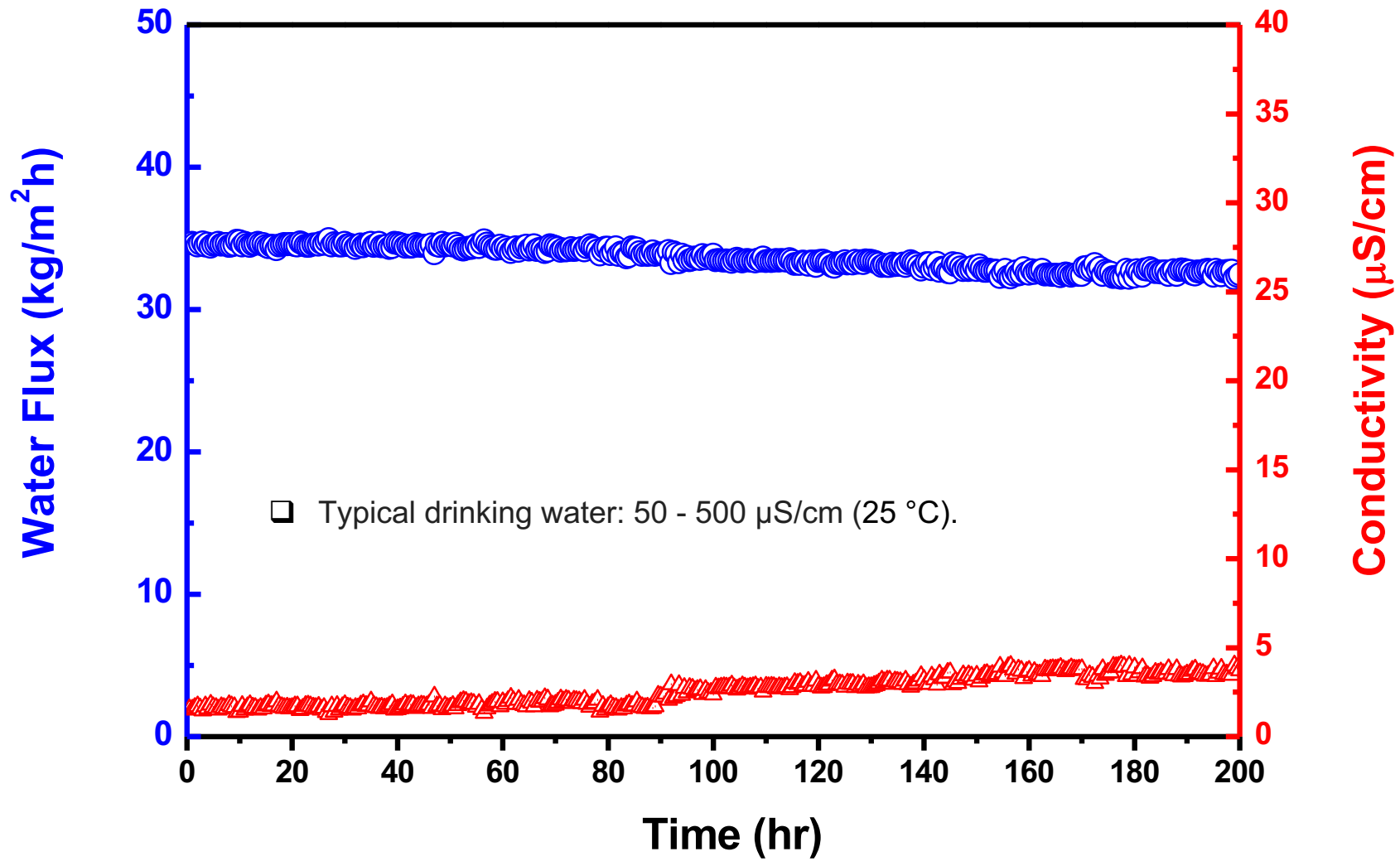


Desalination performance of single layer neat PVDF HFM and the double layer J-HFM.

Cost analysis:



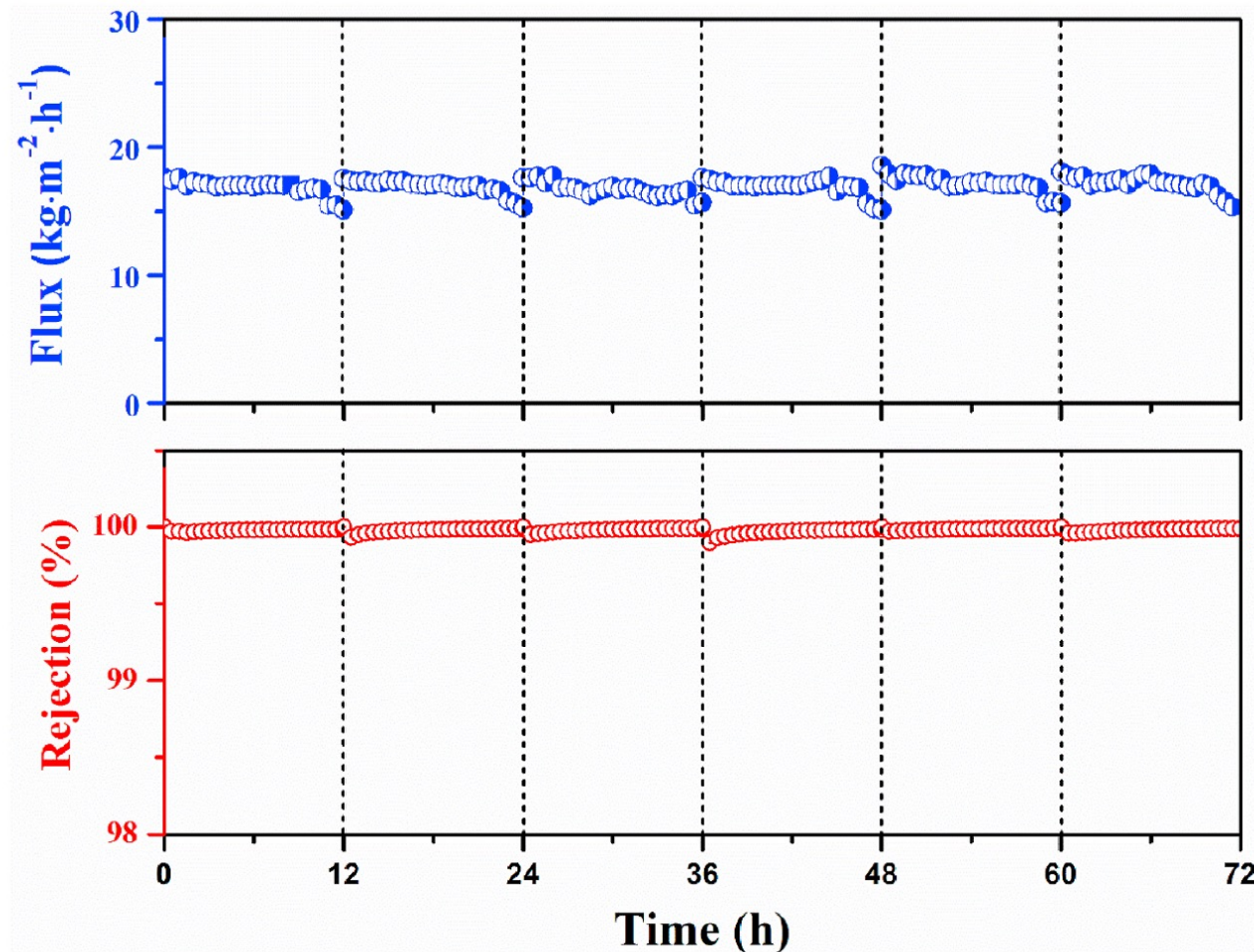
Long-term desalination performance:



SW: TDS=35,000 mg/L

- Operating conditions:
T-feed: 60°C;
T-permeate: 20°C;
v-feed: 0.8 m/s
v-permeate: 0.6 m/s
- No significant scaling and wetting during a continuous 200 hours of DCMD operation.

Long-term desalination performance:



PW: TDS=155,000 mg/L

➤ Operating conditions:

T-feed: 60°C;

T-permeate: 20°C;

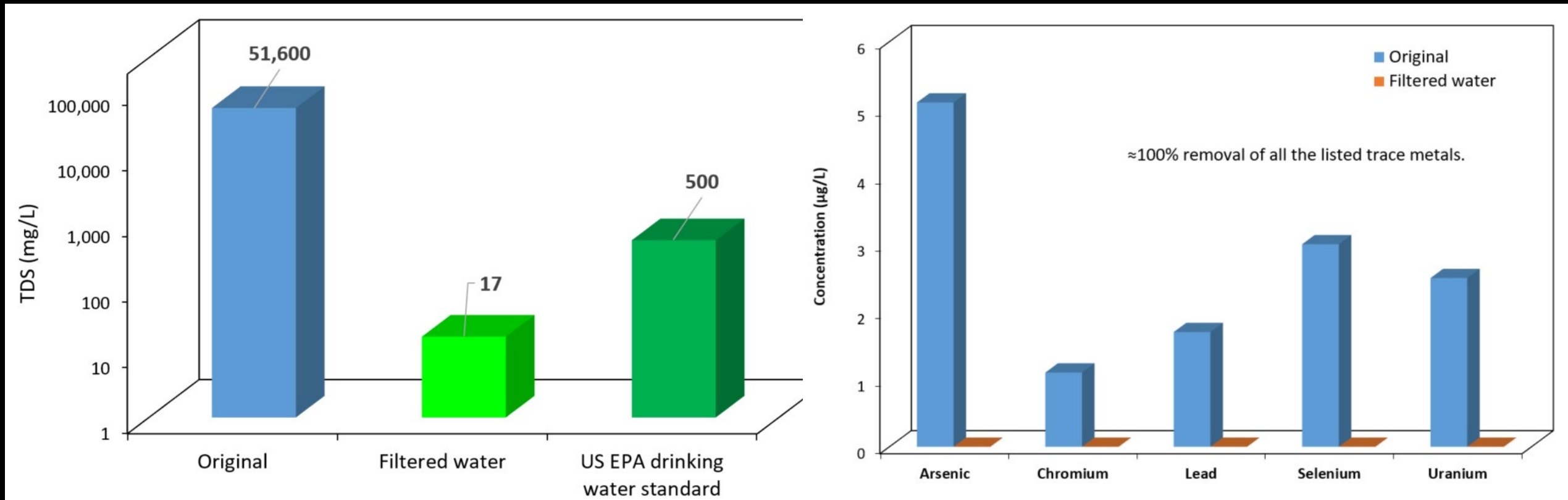
v-feed: 0.8 m/s

v-permeate: 0.6 m/s

➤ Salt rejection is >99.9%.

➤ Flux can be almost 100% recovered by membrane regeneration.

Preliminary Results- Lab Study



Proposed Work Plan

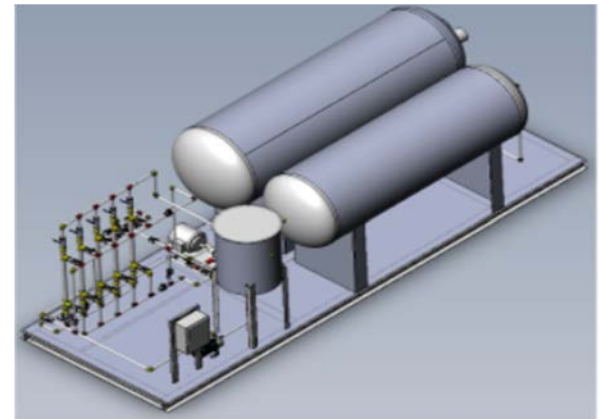
I) Site selection:

- NTU students are working with the N⁴WPP team members.
- Initially, water at windmills, tanks and wells are being collected and analyzed at New Mexico Bureau of Geology and Mineral Resources at NMT.
- We are proposing to install 10 filtration units across the Navajo Nation.

Proposed Work Plan

II) Installation of the filtration unit(s):

- Obtaining required permits.
- Unit installation and continuous monitoring.
- Students are involved in all aspects of permitting, installation, operation, maintenance, and monitoring.



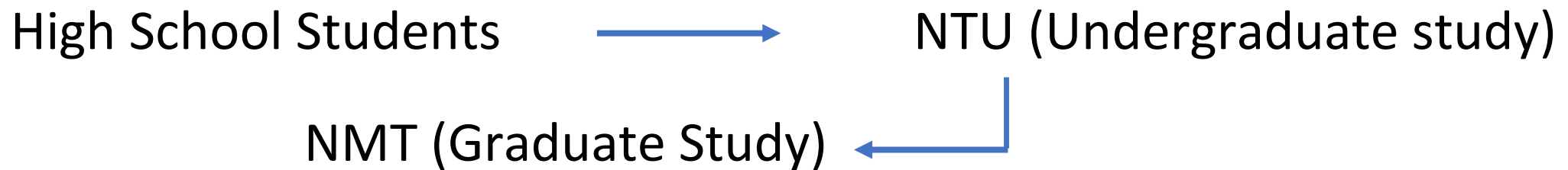
Proposed Work Plan

III) Long-term Goals:

- Educating members of the community about water quality, the filtration system, system maintenance, and simple repairs for long-term use.
- Install similar filtration units across the Navajo Nation.
- Transfer the ownership of the units to the community.
- Train a workforce with the knowledge to guide decisions and long-term water planning as well as the skills to operate and maintain these systems

Educational Component

- Local workforce building: Local students are being trained in database management, water sampling and analysis techniques, unit operations, and data analysis.
- Classroom learning are being augmented with field sampling, planning, critical thinking, and communication skills.
- NTU and NMT is in the process of making an education model:





NTU students are receiving hands-on training

We are working with the communities



THE NAVAJO NATION

JONATHAN NEZ PRESIDENT
MYRON LIZER VICE PRESIDENT

LAKE VALLEY CHAPTER

Mark Freehand, Council Delegate | Tony Padilla, President | Edison Tso, Vice President | Betty S. Dennison, Secretary/Treasurer
Janice Padilla, Land Board | Lucinda Regay, Community Services Coordinator | Accounts Maintenance Specialist - Vacant

LVC-APR24-029

RESOLUTION OF LAKE VALLEY CHAPTER

SUPPORTING THE INVESTIGATION OF WATER QUALITY AND PERFORM SITE EVALUATIONS FOR INSTALLATION OF A WATER FILTRATION UNIT WITHIN LAKE VALLEY CHAPTER.

WHEREAS:

1. Lake Valley Chapter is a certified Navajo Nation Chapter Government, which was created pursuant to the Navajo Nation Council Resolution No. C-125-55, is delegated governmental authority with respect to local matters consistent with Navajo laws, including customs, traditions, and fiscal matters; and
2. Lake Valley Chapter is empowered by the Navajo Nation Council to review all matters affecting the community to make favorable decisions in the best interest for the general health, safety and welfare of chapter membership through implementation solutions for economic development, cultural preservation, recreation, solid waste management, elderly care, quality housing, public safety, road maintenance, educational support for community students; and
3. Lake Valley Chapter communities understand that in pursuant to the Navajo Nation Code (NMC) Title 26, Local Governance Act, which allows chapters to make decisions over local matters. This authority in the long run will improve community decision-making by allowing committees to excel and flourish, enable Navajo leaders to lead toward a prosperous future, and improve the strength and sovereignty of the Navajo Nation; through adoption of this Act, chapters are compelled to govern with responsibility and accountability to the local citizens; and
4. Lake Valley Chapter community met on April 15, 2022 Planning Meeting to discuss and plan upcoming business items to be placed on the agenda which Darlene Wilson, student at NTU (Dual Major: Biology/Environmental Science) provided information to conduct the whole water system testing for Lake Valley Chapter; that the goal is to provide education to the community about drinking safe water and the main focus is one windmill located east of LVC across the road. She also provided a resolution template for approval to do water testing at Lake Valley Chapter community for the Regular Chapter Meeting; and
5. Lake Valley Chapter is aware that poor water quality has limited the use of some of its wells, acknowledges the need for additional water quality testing and site assessments to determine the best treatment options for these impacted wells; and
6. Lake Valley Chapter furthermore acknowledges that the NAMWP (Navajo Tech-New Mexico Tech-Navajo Nation Water Purification Project) team has expressed interest in aiding the Chapter in documenting water quality and filtering one well if possible; and
7. Lake Valley Chapter acknowledges that the research is free to the Chapter, but the extent of sampling will be limited by project funds; and with this understanding, Lake Valley Chapter adopted Resolution No. LVC-APR24-029 on April 24, 2022 to support its request to install water filtration unit for testing which is the best interest of community people within Lake Valley Chapter.

NOW THEREFORE BE IT RESOLVED THAT:

Lake Valley Chapter of the Navajo Nation hereby approves to support the Investigation of Water Quality and Perform Site Evaluations for Installation of a Water Filtration Unit within Lake Valley Chapter.

CERTIFICATION

WE HEREBY CERTIFY that the foregoing resolution was duly considered by the Lake Valley Chapter at a duly called chapter meeting at Lake Valley (New Mexico) Navajo Nation, at which a quorum was present and that same was passed by a vote of ten (10) in favor, zero (0) opposed and three (3) abstained on this 24th day of April 2022. Motion by: Larry Montoya; and second by: Stella Yaldez.

Mr. Tony Padilla Jr., Chapter President

Mr. Edison Tso, Chapter Vice President

Mrs. Betty Dennison, Chapter Secretary / Treasurer

Mr. Mark Freehand, Council Delegate



Lake Valley Chapter Resolution

Navajo Nation RDC

Students are getting trained on public outreach



AISES, 2021



N⁴WPP Water Symposium, 2022

Public Outreach Component

- Students are participating in outreach activities to Navajo Nation communities
- The team is attending local Chapter House meetings and is organizing water symposiums and other public outreach campaigns.
- Educate members about water quality, the filtration system, system maintenance and simple repairs.
- Foster the importance of **Tó éí ííná** (Water is Life).

N4WPP Water Symposium



Announcing the 2022 N⁴WPP Water Symposium

The Navajo Tech-New Mexico Tech Navajo Nation Water Purification Project (N⁴WPP) is excited to invite you to the 2022 Water Symposium. Four Corners area high school students are invited to help solve some of the most important water challenges in New Mexico and across the Navajo Nation. Students will have the opportunity to hear from leading water conservation experts, talk to college students presenting their research in a poster session, and get hands on experience with the problem by participating in the Water Challenge. Prizes and awards include cash and scholarships.

When: April 23, 2022

Where: Farmington High School - Farmington, NM

Public Outreach Component



Announcing the 2023 N⁴WPP Water Symposium

What is the N⁴WPP Water Symposium?

N⁴WPP—the Navajo Technical University-New Mexico Tech Navajo Nation Water Purification Project—aims to train students in the water sciences and in the technical aspects of water filtration at sites on the Navajo Nation using technology developed at NMT in partnership with PESCO.

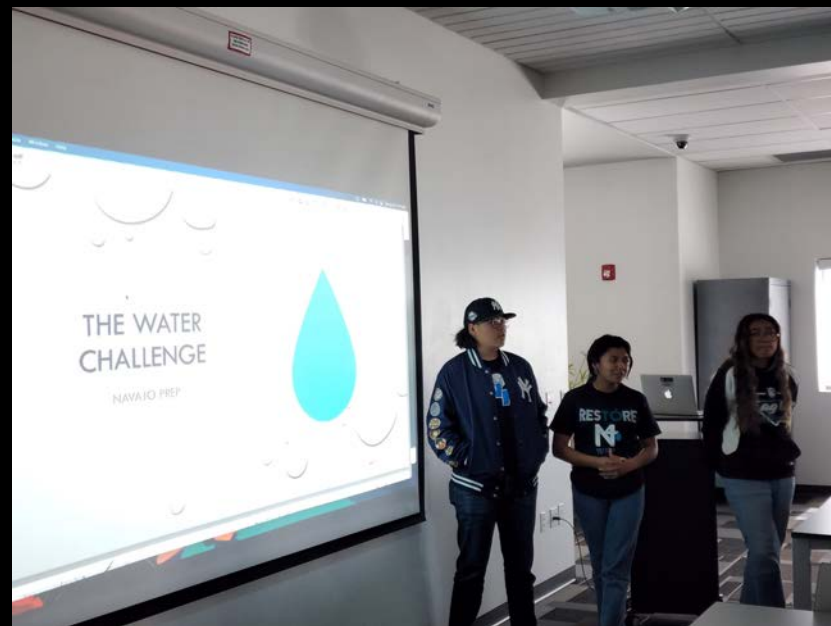
Part of the N⁴WPP mission is to engage high school students through an annual water symposium held at locations on or near the Navajo Nation.

When: 11/3/23

Where:
UNM-Gallup
705 Gurley Ave., Gallup, NM



N⁴WPP Water Symposium

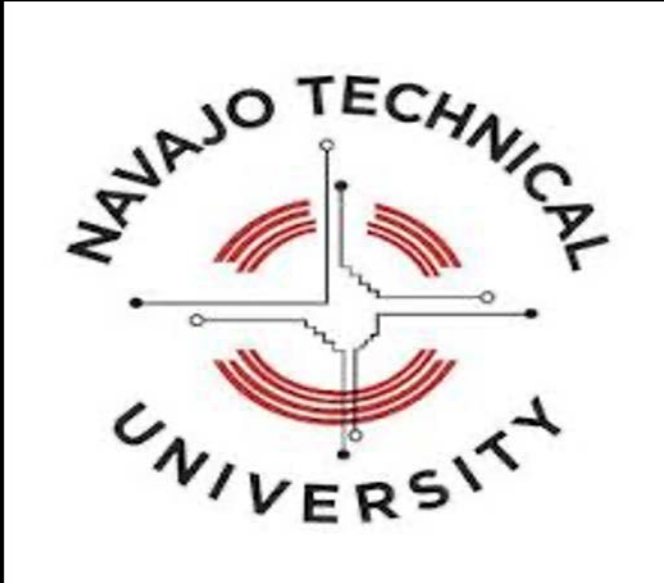


N⁴WPP Water Symposium





Database Management Platform



- ❑ A collaborative effort is ongoing to develop a secure database management platform at NTU to store water data.
- ❑ We are following Navajo Nation's data sovereignty policies.

Water Filtration Unit Ready for Operational Testing



What's next?



Minority Serving Institution (MSI)

Environmental Justice Grant



Acknowledgement

- ❖ I-WEST
- ❖ N⁴WPP Team
- ❖ Our Students
- ❖ Our Sponsors: USDOE-LM, USDOI-BIA, NMOGA, Alfred P. Sloan Foundation



I-WEST

EXIT



RESTORE
WPP
To us water is life

NAVAJO TECHNICAL
UNIVERSITY

NEW MEXICO TECH
SCIENCE • ENGINEERING • RESEARCH UNIVERSITY

RESTORE
WPP

RESTORE



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Water Purification Project

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PESCO:

Steven Grey

Consultant to PESCO

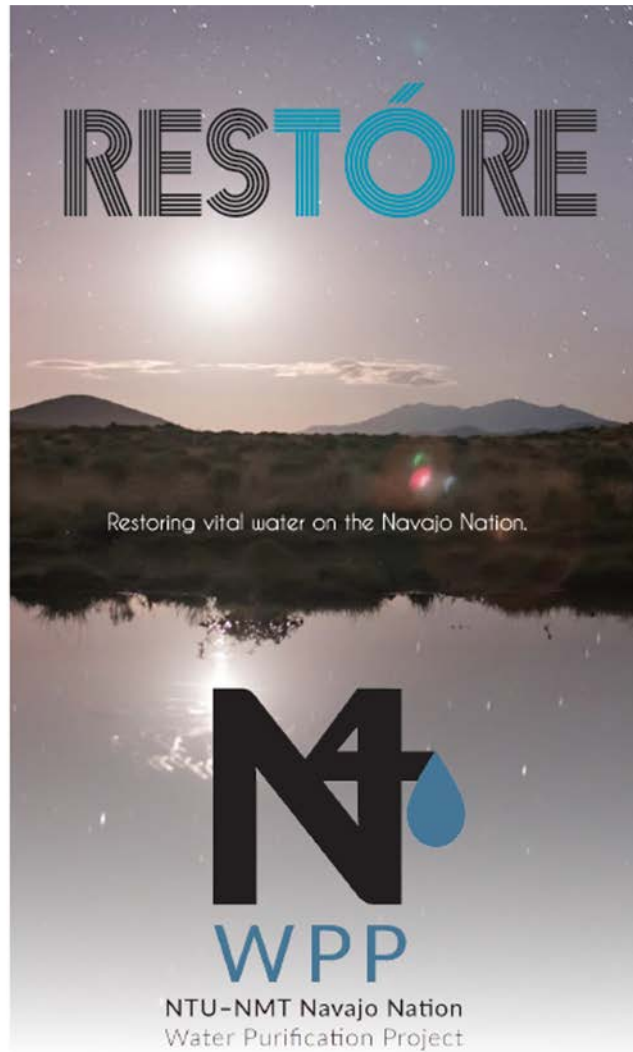
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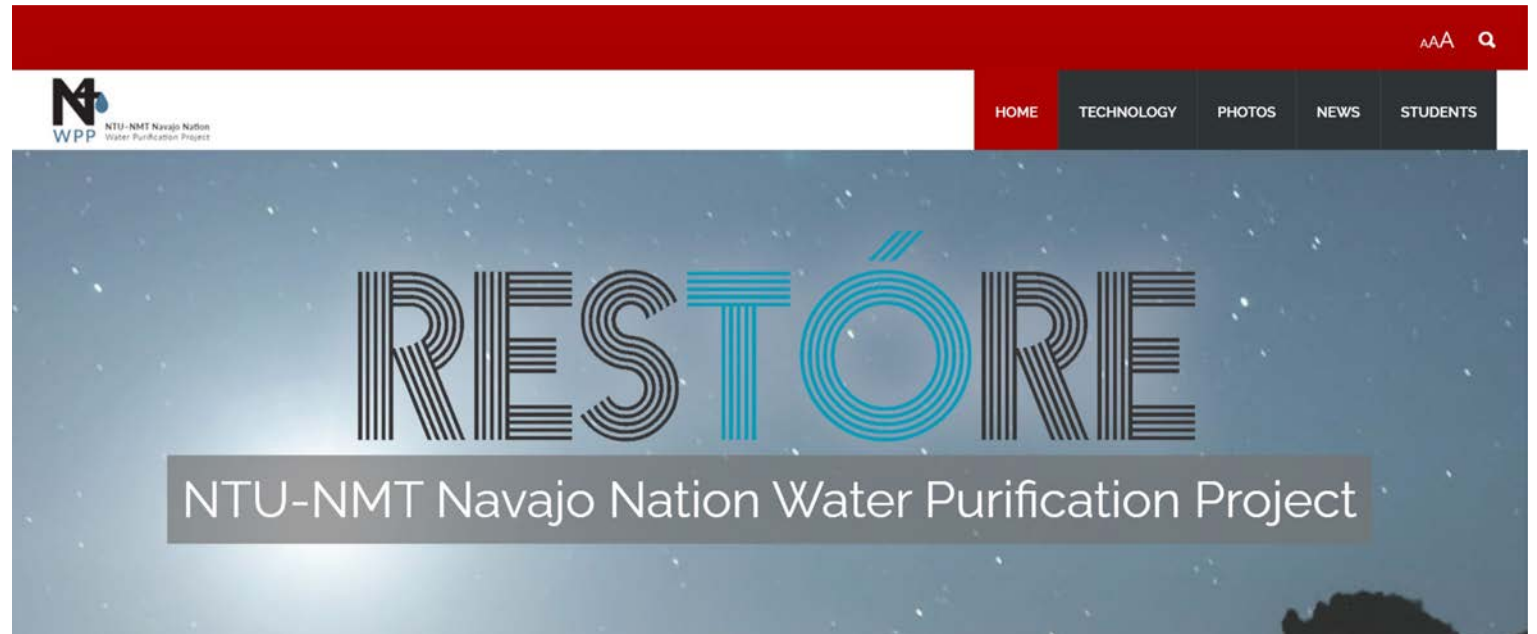
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www.navajotech.edu/Restore



Questions?

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Thank You

Please visit: <http://www.navajotech.edu/restore/>