

# **Air Force Civil Engineer Center**

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## **Cannon AFB PFAS Public Update**

**15 December 2021**

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***Battle Ready...Built Right!***



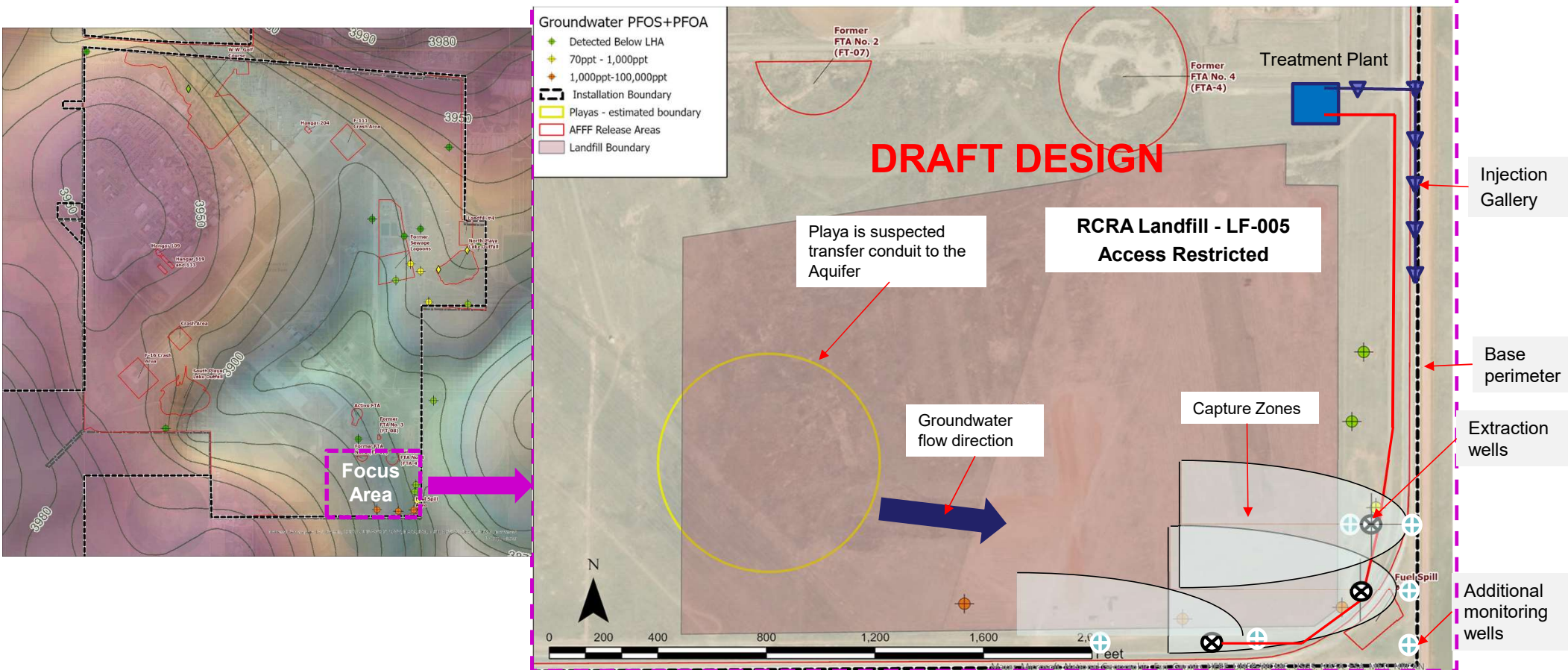
# Agenda



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- **Engineering Evaluation/Cost Analysis – Pilot Study**
  - **Remedial Investigation**
  - **PFAS Response Spending to Date**
  - **USGS**
  - **Going Forward**
  - **Additional Information**
  - **Common Acronyms**
  - **Open Discussion**



# Engineering Evaluation/Cost Analysis – Pilot Study Draft Design





# **Engineering Evaluation/Cost Analysis – Pilot Study Draft Timeline**

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- **Award completed - 27 May 2021**
- **Initial Site Visit completed - 2 Jun 2021**
- **Kick-Off Meeting completed - 8 Jun 2021**
- **Sampling Event completed - 14 Jun 2021**
- **Treatability Study in progress - Sep 2021**
- **Aquifer Test in progress - Nov 2021**
- **Design/Work Plan - Feb 2022**
  - (30-day NMED/EPA comment period)
- **Construction Start - Jul 2022**
- **Operation Start - May 2023**
- **EE/CA Final - Jan 2024**
  - (30-day NMED/EPA comment period)



# Remedial Investigation



- **Remedial Investigation (RI) Status – (Awarded 28 Aug 2020)**
  - **RI goal: define the nature and extent of impact in environmental media on and off base**
    - **New groundwater monitoring wells**
    - **Soil borings**
    - **Surface soil samples**
    - **Suction lysimeters installed at source locations**
  - **Work Plan completed - 1 Sep 2021**
  - **Field work in progress**



## PFAS Response Spending to Date

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- **Expenditures to date \$32,324,869**
  - **Preliminary Assessment (PA): \$38,754**
  - **Site Inspection (SI): \$2,024,231**
  - **Expanded Site Inspection (ESI): \$505,000**
  - **Remedial Investigation (RI): \$10,377,619**
  - **United States Geological Survey (USGS) work to understand groundwater flow: \$735,000 in FY20, \$1,065,000 in FY21, \$987,000 in FY22**
  - **Engineering Evaluation/Cost Analysis (EE/CA) – Pilot System: \$16,592,265**





# USGS Cannon Air Force Base Program Update

In cooperation with Air Force Civil Engineer Center,  
with technical support provided by University of Florida



Stuart Norton, Ph.D., (USGS Program Manager)



December 15, 2021

## Outline:

- USGS Mission and Fundamental Science Practices
- Ongoing projects:
  - Per- and Polyfluoroalkyl Substances (PFAS) mass flux and Darcy flux measurements via passive flux meters (PFMs),
  - Potentiometric Surface Mapping:
    - Past Products: 2016 Potentiometric Surface (2013/2015) Scientific Investigative Map (SIM); SIM-3352,
  - Geophysical Logging of Dockum Group Surface; and,
  - PFAS Fate and Mobility (Geochemistry) Study.



# PFAS Passive Flux Meters



Stuart Norton, Erik Storms and Natalia Montero deploying a PFM at Cannon Air Force Base, June 2020, photo credit Erin Gray.

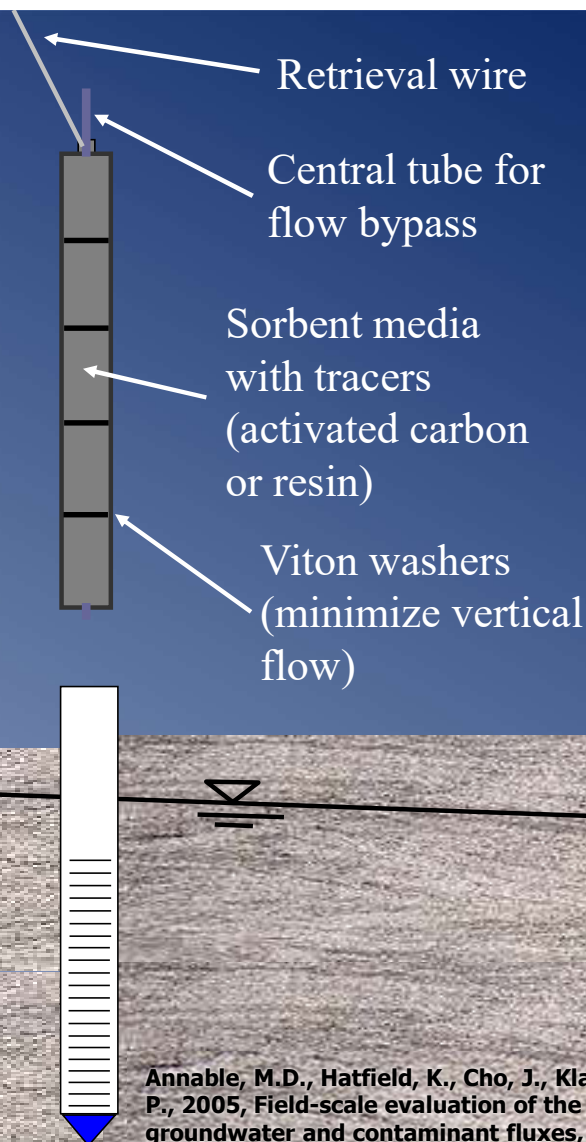
Project Managers: Erin Gray and Stuart Norton, Ph.D.

Problem: PFAS concentrations have been measured in monitoring wells at Cannon Air Force Base (AFB), but the rate of PFAS movement (mass flux) and the rate of groundwater movement (Darcy flux) has not been measured.

## Approach – PFMs



Erik Storms and Natalia Montero deploying a PFM at Cannon Air Force Base, June 2020, photo credit Erin Gray.



Objective: utilize passive flux meters (PFMs), samplers composed of sorbent media deployed into monitoring wells, to measure the rate of PFAS movement (mass flux) and rate of groundwater movement (Darcy flux).

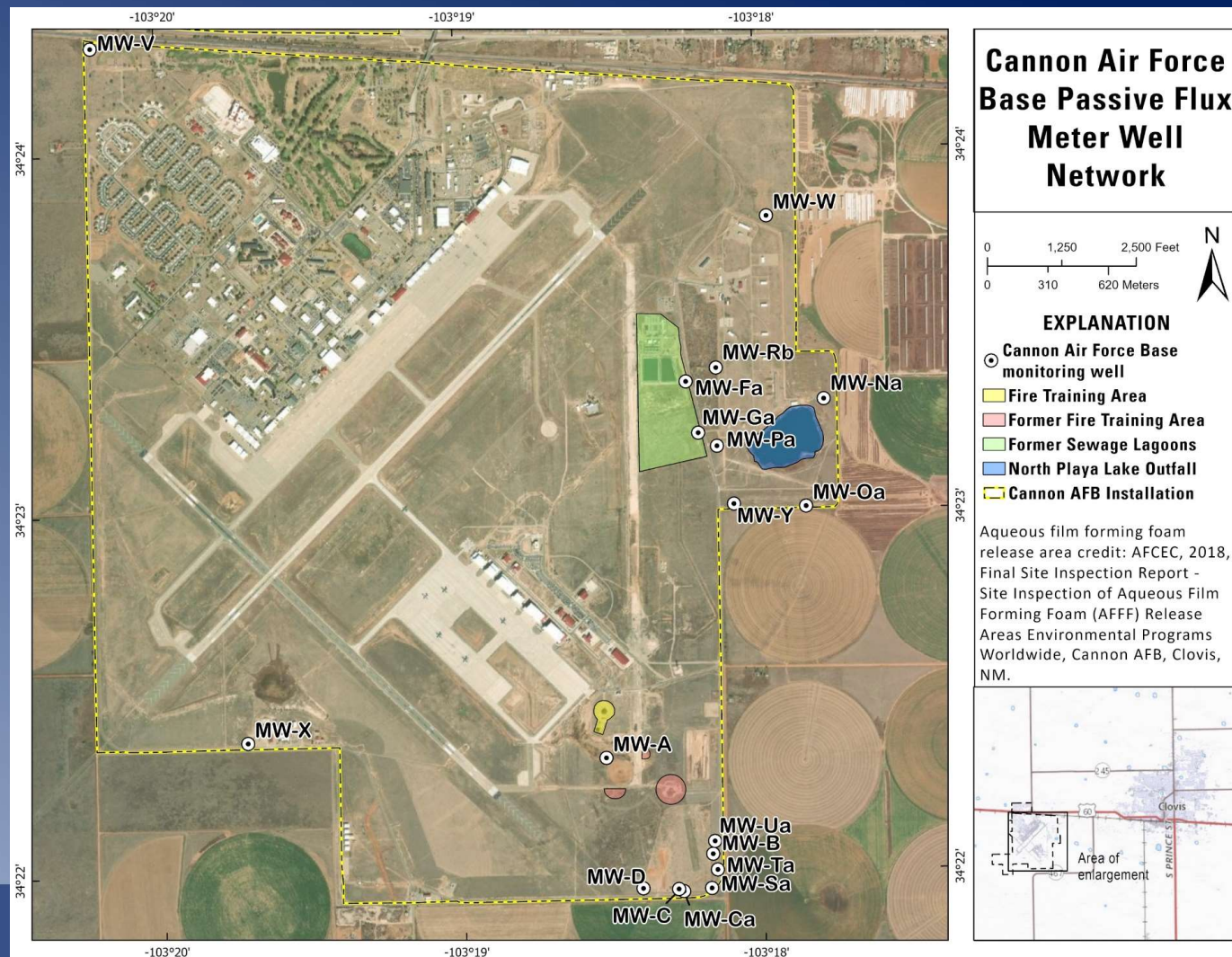
Annable, M.D., Hatfield, K., Cho, J., Klammler, H., Parker, B.L., Cherry, J.A., and Suresh C. Rao, P., 2005, Field-scale evaluation of the passive flux meter for simultaneous measurement of groundwater and contaminant fluxes, *Environmental Science & Technology*, v. 39, no. 18, p. 7194–7201, accessed November 12, 2021, at <https://doi.org/10.1021/es050074g>.



# Approach – PFM deployments

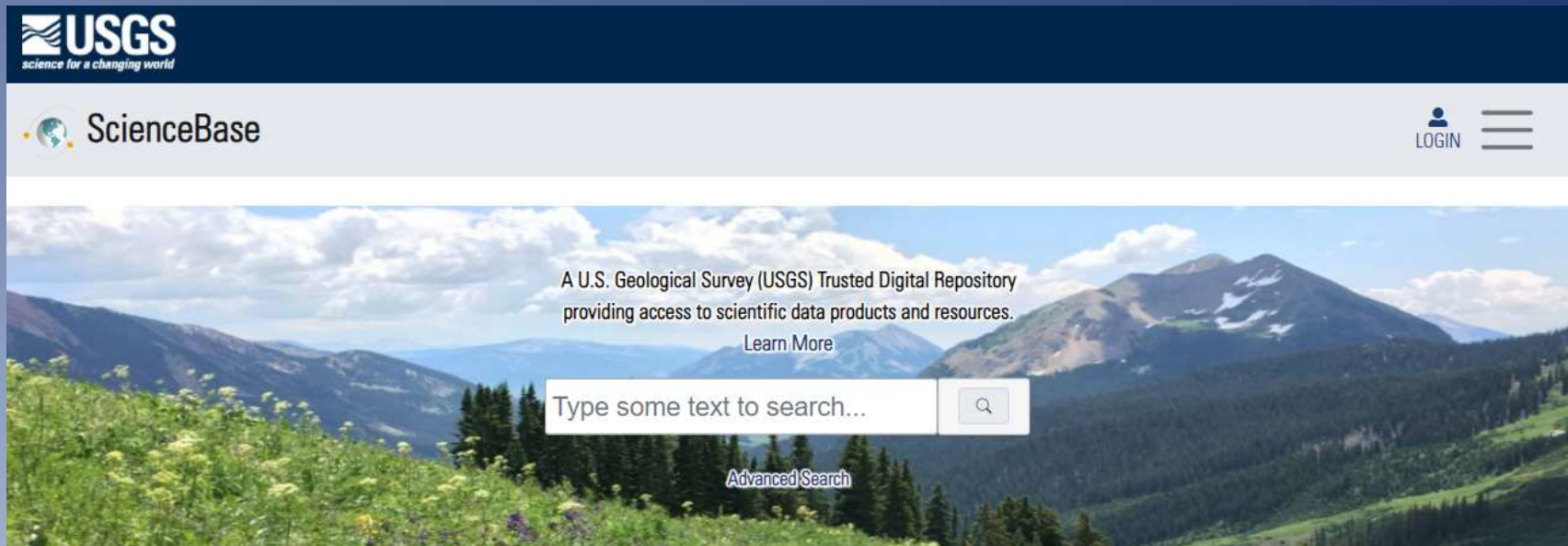
- Initial deployment in 2020 focused on smaller network (10 wells) for initial evaluation of the use of PFMs for PFAS,
- Expanded deployment in 2021 to additional wells (18 total),

Amec Foster Wheeler Programs, Inc., 2018, Final Site Inspection Report, Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas Environmental Programs Worldwide, Cannon Air Force Base, Clovis, New Mexico, August 2018.



# Deliverables

- PFM data release via USGS ScienceBase planned for Spring/Summer 2022,
- Draft publication expected Fall 2022,
- Final publication (journal article) expected Summer 2023





# Potentiometric Surface Map



Brandon Waters and Jason Payne measuring a groundwater level in 2019 at Cannon Air Force Base, 2019, photo credit Fred Gebhardt, USGS.

Project Manager: Meghan Bell

Problem: local hydrologic conditions (groundwater depth, flow direction and change from historical measurements) need to be understood to support ongoing PFAS remedial investigations,

Objectives: map the groundwater (potentiometric) surface and evaluate water-level change.

Approach: collect groundwater depth measurements regionally and locally at Cannon AFB and use statistical methods to map the groundwater surface.

# USGS Potentiometric Surface Maps

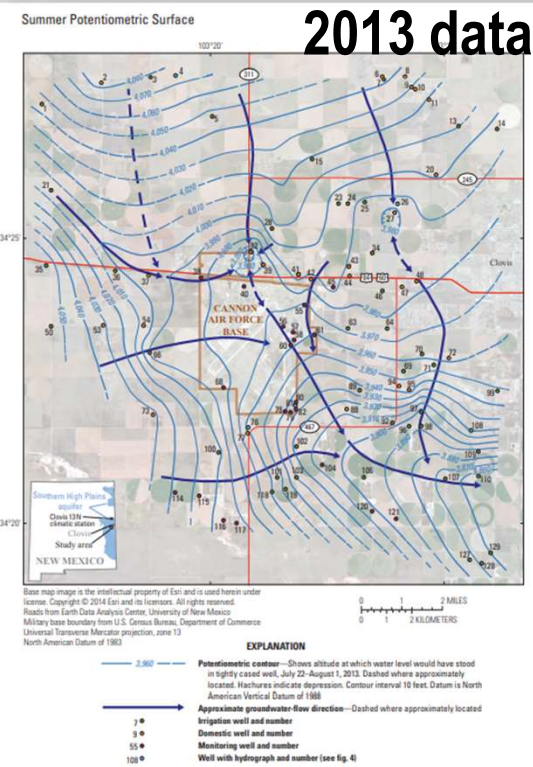


Figure 1. Potentiometric surface of summer groundwater conditions on and around Cannon Air Force Base, July 22–August 1, 2013, Curry County, New Mexico. Data shown in table 1.

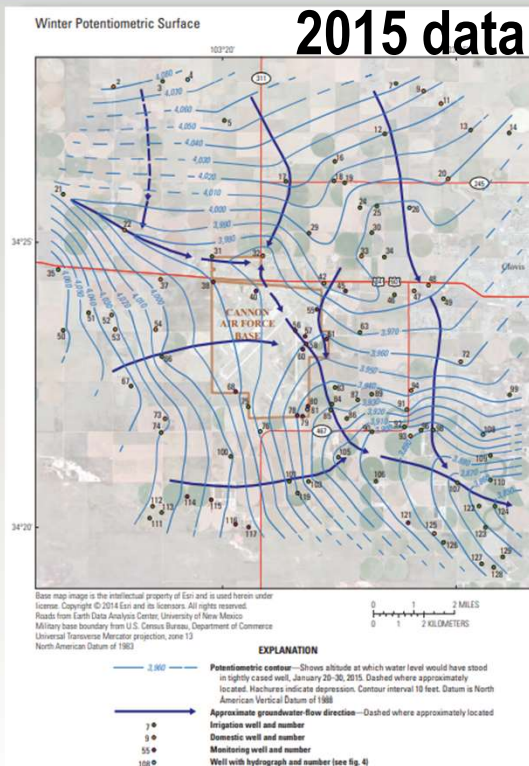


Figure 2. Potentiometric surface of winter groundwater conditions on and around Cannon Air Force Base, January 20–30, 2015, Curry County, New Mexico. Data shown in table 1.

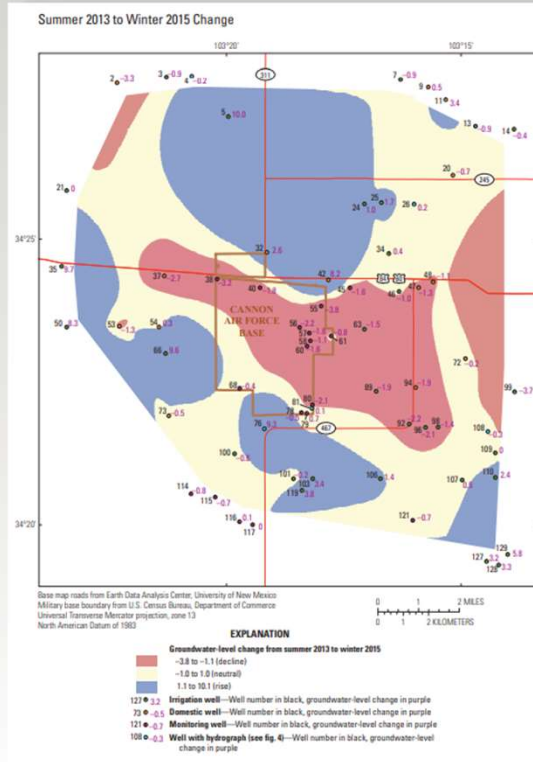


Figure 3. Map of groundwater-level change between summer 2013 (July 22–August 1) and winter 2015 (January 20–30) on and around Cannon Air Force Base, Curry County, New Mexico.

Collison, Jake, 2016, Potentiometric surfaces, summer 2013 and winter 2015, and select hydrographs for the Southern High Plains aquifer, Cannon Air Force Base, Curry County, New Mexico: U.S. Geological Survey Scientific Investigations Map 3352, <http://dx.doi.org/10.3133/sim3352>.

## Deliverables

- Scientific Investigations Map (SIM) detailing study findings is in review and expected to be published in early 2022.
- Online interactive map that integrates the 2020 potentiometric surface with historical potentiometric surfaces is in progress and expected to be available mid-2022.
- All groundwater-level data are available on NWIS Mapper:
  - <https://maps.waterdata.usgs.gov/mapper/index.html>



# Geophysical Logging

Project Manager: Meghan Bell

Problem: Hydrologic conditions including aquifer thickness and elevation of the base of the aquifer (confining layers locally called “Red Beds” or Dockum Group) should be known as these may impact PFAS transport.

Objective: Map the surface of the “Red Beds” (Dockum Group) using borehole and surface geophysical resistivity methods to identify locations of potential paleochannels in the top of the Red Beds.



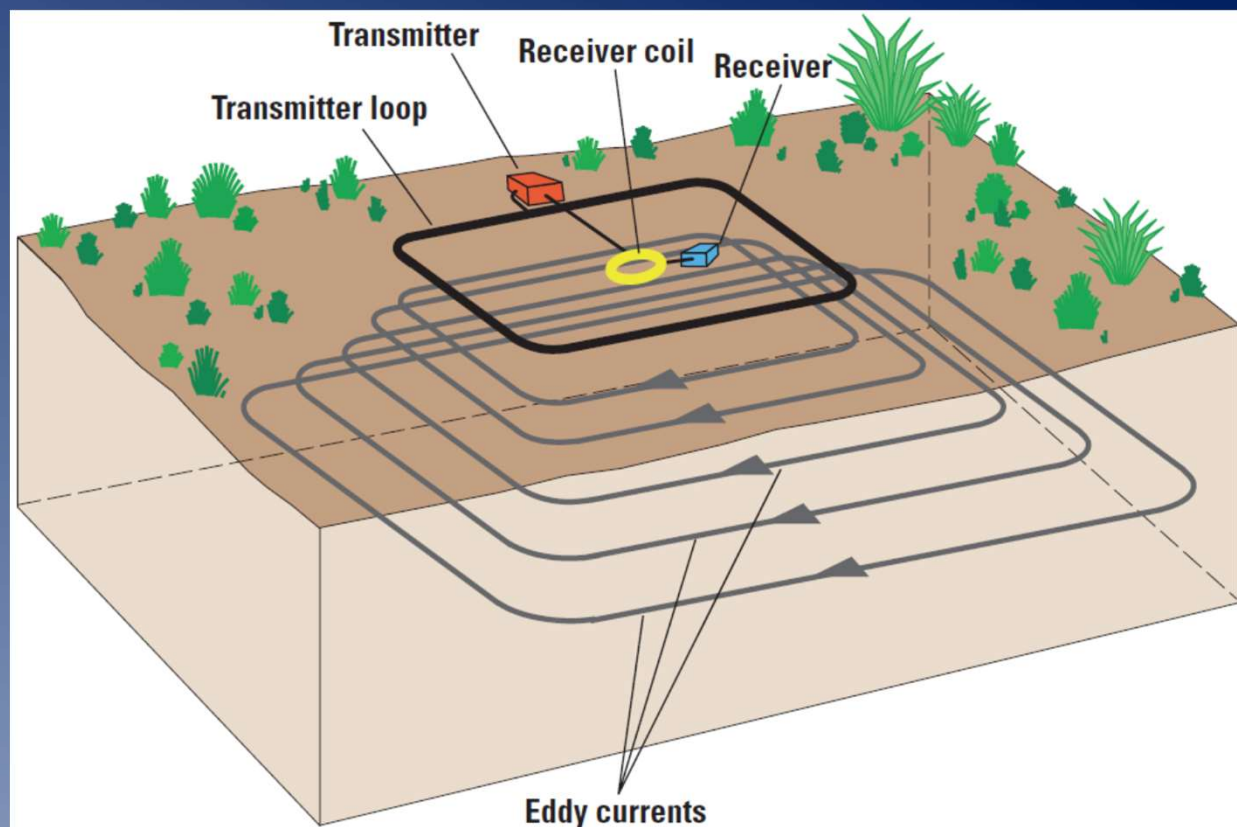
Hydrologist Blake Goodwin sets up geophysical equipment. Photo credit: Fred Gebhardt



Hydrologist Andy Teeple monitors geophysical measurements. Photo credit: Fred Gebhardt

# Approach – Time Domain Electromagnetics (TDEM)

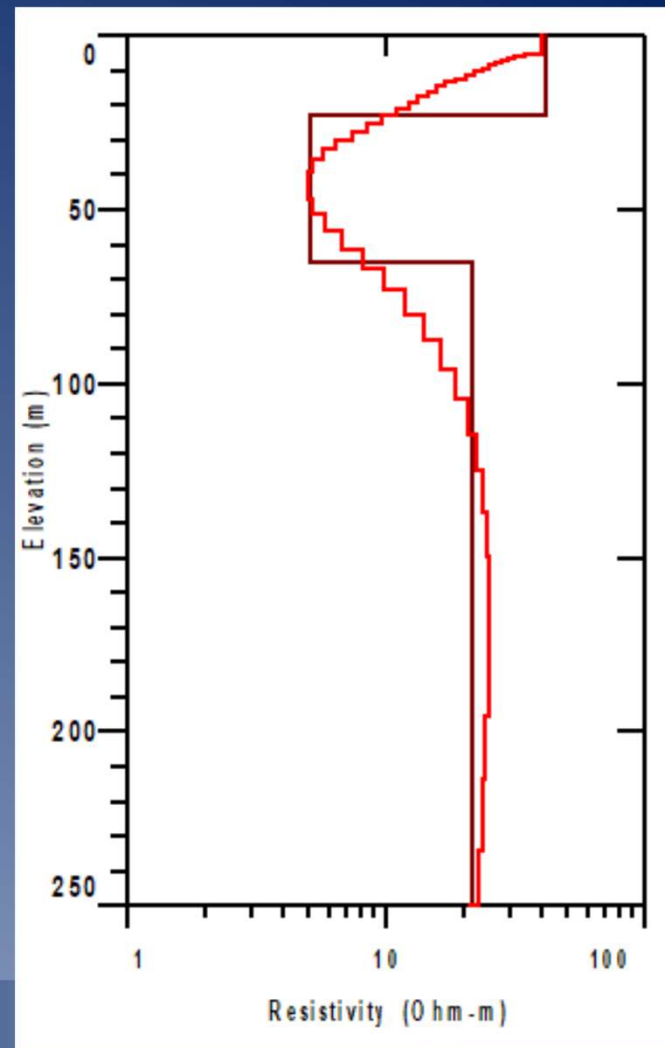
- Measures the bulk properties (resistivity) of the subsurface by producing an alternating electrical current in a loop at the land surface via a Transmitter.
- Induces electrical (Eddy) currents in the ground, which decay, produce secondary electrical fields, a portion of which bounce back to the surface and are measured at the Receiver.



## Approach:

TDEM measurements were combined with borehole geophysics and geologic data collected during previous investigations to interpret the surface of the “Red Beds” (Dockum Group) in the study area

## Example results:



# Deliverables

- Report (SIR) detailing the interpreted surface of the top of the Dockum Group is currently in review and expected to be published in early 2022.
- Online interactive map that integrates the geophysical surface of the Dockum Group with the potentiometric surface is in progress and expected to be available in mid 2022.
- Geophysical logs are available through GeoLog Locator:
  - <https://webapps.usgs.gov/GeoLogLocator>
- Data release of the surface geophysical data used for mapping the top of Dockum surface is available through ScienceBase:
  - <https://www.sciencebase.gov/catalog/item/5f2978e682cef313ed9e82aa>



# Understanding the mechanisms controlling PFAS fate and mobility at Cannon Air Force Base, Clovis, New Mexico.

Project Managers: Ben Linhoff, Ph.D. and Michelle Lorah, Ph.D.

# Problem and Objectives:

## Problem:

- PFAS are anthropogenic (human-made) toxic compounds known to cause a variety of health problems including cancer, birth defects, obesity, and many more.
- PFAS have been detected in the High Plains Aquifer beneath Cannon Air Force Base and to the southeast of the base.

## Objectives:

- Evaluate geochemical and microbial changes that may impact PFAS composition, distribution, and mobility in sediments and soils,
- Define the 'fingerprints' of PFAS sources to assess the sources of groundwater PFAS plumes; and,
- Determine if changing conditions (oxygen content and microbial community) could accelerate PFAS degradation at Cannon Air Force Base.

# Approach, Timeframe and Deliverables:

## Approach:

- Collect groundwater and sediment samples and complete geochemical analyses and microbial tests,
- Build statistical models to help fingerprint PFAS sources; and,
- Run a series of laboratory experiments designed to determine how PFAS compounds function in the aquifer and soils and what might speed up their degradation.

Timeframe: Project is just getting underway with initial soil cores collected August 2021.

Deliverables: Two scientific journal articles to be completed by the end of 2023.

- First paper focused on fingerprinting PFAS sources and chemical transformations between source areas and groundwater.
- A second paper focused on the impact of soil chemistry and microbiology on PFAS transformations, degradation, and transport through soils and aquifer materials.





# Going Forward

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- **EE/CA - Pilot Study**
  - Aquifer Test
  - Treatability Study
  - Design Phase
- **Remedial Investigation**
  - Field work
- **Next Public Quarterly Update**
  - Tentatively planned 16 Mar 2022



## Additional Information



- **Admin Record Links to Cannon Air Force Base reports:**
  - Admin Record <https://ar.afcec-cloud.af.mil/>
  - PA: AR# 1941
  - SI: AR# 1938
  - Off base SI: AR# 1940
  - RRSE: AR# 2063
  - Treatability Work Plan: AR# 2072
  - RI Work Plan: AR# 2074
  - Aquifer Test Work Plan: AR# 2075
- **DAF Response**  
<https://www.afcec.af.mil/WhatWeDo/Environment/Perfluorinated-Compounds/>



# Common Acronyms

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- **Administrative Record (AR)**
- **Aqueous Film Forming Foam (AFFF)**
- **Agency for Toxic Substances and Disease Registry (ATSDR)**
- **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)**
- **Department of the Air Force (DAF)**
- **Department of Defense (DoD)**
- **Engineering Evaluation/Cost Analysis (EE/CA)**
- **Environmental Protection Agency (EPA)**
- **Food and Drug Administration (FDA)**
- **Lifetime Health Advisory (LHA)**



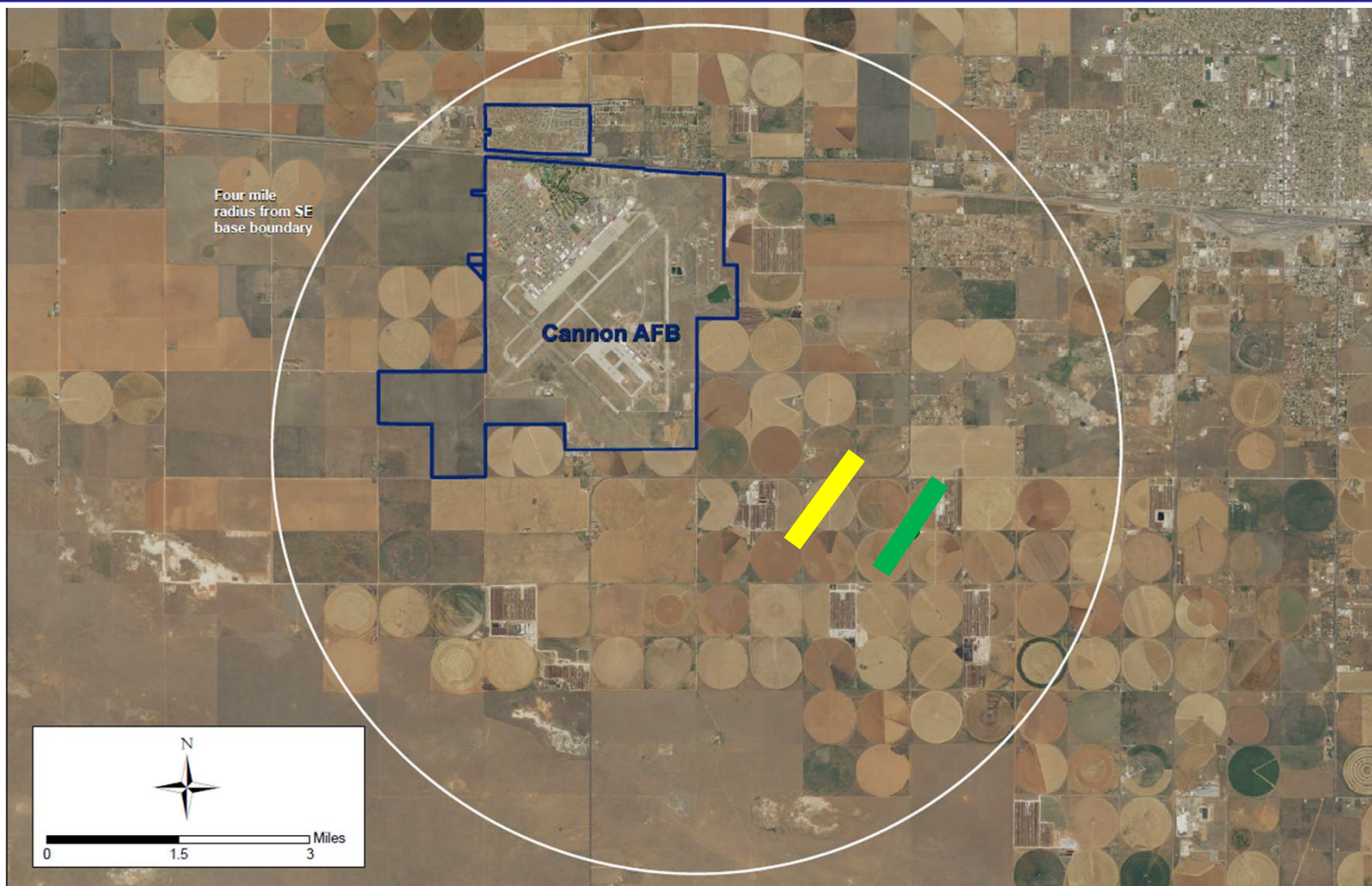
## Common Acronyms



- **National Defense Authorization Act (NDAA)**
- **Parts Per Trillion (ppt)**
- **Per- and polyfluoroalkyl substances (PFAS)**
- **Perfluorooctanesulfonic acid (PFOS)**
- **Perfluorooctanoic acid (PFOA)**
- **Preliminary Assessment (PA)**
- **Remedial Investigation (RI)**
- **Relative Risk Site Evaluation (RRSE)**
- **Site Inspection (SI)**
- **United States Geological Survey (USGS)**



# Open Discussion





# Open Discussion

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- **Questions**
  - **Environmental Protection Agency (EPA); Greg Lyssy**
  - **Agency for Toxic Substances and Disease Registry (ATSDR); Patrick Young**
  - **United States Geological Survey (USGS); Stuart Norton**
  - **Brice; Corey Schwabenlander**
  - **Bristol; James Pratt**
- **Topic idea for next meeting**



**Any question please contact [27SOCES.cannon.rpm@us.af.mil](mailto:27SOCES.cannon.rpm@us.af.mil)  
<https://www.cannon.af.mil/Environmental/>**