EPA Research Grant Annual Report Web Summary

Period Covered by the Report: Y1, September 1, 2022 – August 31, 2023
Date of Report: November 30, 2023
EPA Agreement Number: 84046201-0, CFDA 66.511
Title: Unlocking the Nationwide Potential of Water Reuse
Investigators:

- PI: Miriam Hacker
- Co-PIs: Eric Dickenson, Karl Linden, Tzahi Cath

Institutions:

- The Water Research Foundation
- University of Colorado Boulder
- Southern Nevada Water Authority
- Colorado School of Mines

Research Category: Water Quality, Water, Water Treatment
Project Period: September 1, 2022 through August 31, 2026

Objective of Research:

This research aims to unlock the full nationwide potential of water reuse by aligning the development of science and technology with advances in social and organizational development of opportunities and barriers. Activities for this project are organized into four major research areas, the expected results of which will provide practitioners with user-friendly tools and materials to advance water reuse in their own community. At the end of Year 1, the project is approximately 15% complete.

Progress Summary/Accomplishments (Outputs/Outcomes):

Task A: Safeguarding public health through risk assessment

- Recommendations and contextualization of DPR pathogen LRV regulations were made to AZDEQ and published in AWWA Water Science.
- Data analysis is underway on SNWA pathogen data, with final data to be shared in its raw form in a published paper in the next reporting year.

Task B: Treatment models and risk mitigation techniques

- A four-page document, Contaminants of Concern for Reuse, was developed and sent for review by the research team and advisory committee. The document contains a list of specific compounds (and microbes) that are relevant for reuse based on state regulations and guidance, including surrogates.
- The research team started to engage with utility partners for data collection to support updating existing predictive algorithms for the Integrated Water Reuse Treatment Plant Model (WrTP).
- Colorado School of Mines is operating the DPR trailer 24/7 and generating water quality and operating data. In mid-April, the team conducted a thorough water quality analysis throughout the treatment train and generated more than 1500 data points for regulated and unregulated chemicals.

Task C: Social development and community engagement

- A conceptual framework was developed for how to quantify various drivers for water reuse applications and a technical advisory committee was formed for additional oversight.
- News media was collected and analyzed for patterns in how water reuse has been messaged and communicated to the general public across the United States. Findings are being synthesized into a publication.
- Existing academic and industry literature was collated into a review for community engagement and outreach practices related to water reuse in the United States.
- Initial outreach to utility partners has begun to identify organizations interested in partnering for identifying community engagement best practices for water reuse.

Task D: Successful and sustainable water reuse adoption pathways

- A systematic literature review was conducted to characterize drivers of and barriers to water reuse implementation globally. Factors from peer-reviewed literature were coded qualitatively and collated to begin understanding differences and similarities across studies and contexts.
- Based on the analysis of the literature review, we drafted a research protocol, including a data collection and analysis plan for our case study analyses with various water reuse projects. We also identified the first three case studies.
- We created and conducted a survey of the U.S. – relevant and quantifiable enablers and barriers to identify their relative importance for analysis with the subsequent national cast study analysis and comparison. That survey was completed by 10 water reuse experts. Then, an expert panel discussion, following a modified Delphi approach with the experts was planned.

Publications:

Gerrity, Daniel, Katherine Crank, Eva Steinle-Darling, and Brian M. Pecson. 2023. "Establishing Pathogen Log Reduction Value Targets for Direct Potable Reuse in the United States." *AWWA Water Science* 5 (5): e1353. https://doi.org/10.1002/aws2.1353.

Presentations:

- Minton, J., Hacker, M., Linden, K., Dickenson, E. 2023. "Unlocking the Nationwide Potential of Water Reuse", Panel Presentation, **WateReuse Symposium**, March 5-8, Atlanta, GA.
- Sardana, P. 2023. "Exploring the Drivers and Pathways to Water Reuse Adoption in Communities: Preliminary Results from Task D" Poster Presentation, **WateReuse Symposium**, March 5-8, Atlanta, GA.
- Summers, S. 2023. "Unlocking the Nationwide Potential of Water Reuse" Presentation, **2023 WateReuse Colorado Conference**, May 2, Denver, CO.
- Hacker, M. 2023. "Unlocking the Nationwide Potential of Water Reuse" Presentation, **York Region Water Reuse Workshop**, May 15, York Region, Ontario, Canada.
- Hacker, M. 2023. "Governance is Key: Strengthening the Integrated Approach to Water Reuse" Presentation, **UW Environmental & Occupational Health Seminar/Webinar**, June 1, Virtual.
- Peterson, E., S. Cook, and R.S. Summers. 2023. "Biofiltration after pre-chlorination: strategies for control of pre-formed disinfection byproducts and precursors." **AWWA Potable Reuse and Biological Treatment Symposium**, July 24-26, Salt Lake City, UT.
- Samples, S. 2023. "WRF's Water Reuse Research: Treatment, Monitoring, Water Quality, and Social Engagement" Presentation, **AWWA Potable Reuse and Biological Treatment Symposium**, July 24-26, Salt Lake City, UT.

- Summers, R.S. 2023. “The Future of Biofiltration,” Invited presentation, **AWWA Potable Reuse and Biological Treatment Symposium**, July 24-26, Salt Lake City, UT.
- Summers, R.S., and N. Jorgenson. 2023. “Granular Activated Carbon Adsorption of Preformed Unregulated Disinfection By-Products for Water and Potable Water Reuse.” **AWWA Potable Reuse and Biological Treatment Symposium**, July 24-26, Salt Lake City, UT.
- Hacker, M. 2023. “Unlocking the Nationwide Potential of Water Reuse: A Closer Look at Social Engagement Research in Arizona” Invited Presentation, **Arizona Water Reuse 2023 Symposium**, July 24-25, Flagstaff, AZ.
- Hacker, M. 2023. “The Foundation of Research Supporting Water Reuse” Invited Presentation, **2023 Annual WateReuse Texas Conference - Research Workshop**, September 20-22, Frisco, TX.

Future Activities:

Task A: Safeguarding public health through risk assessment

- Data analysis is underway on SNWA pathogen data, with final data to be shared in its raw form in a published paper in the next reporting year.
- Pathogen data will be fit to distributions as well in a form that can be used in the DPR web application and distributions will be shared in a published paper in the next reporting year.
- The DPR web application with expanded reuse scenarios including agricultural reuse scenarios will be created and shared next year.

Task B: Treatment models and risk mitigation techniques

- Continue to analyze treatment data and algorithms that predict the performance processes under drinking water conditions.
- Begin to integrate predictive algorithms into a comprehensive model: Water Reuse Treatment Plant (WrTP) model and Trace Organic Compound (TrOC) model.
- Continue developing advanced control system and integrate techno-economic analysis (TEA) module into the SCADA system.

Task C: Social development and community engagement

- Begin to compile and analyze data for integration into the drivers-based index for water reuse potential.
- Interview utilities to create a baseline understanding for community engagement practices across a variety of water reuse applications.
- Organize and facilitate regional workshops for utilities, community organizations, and other key stakeholders for a co-production of best practices and research needs on engagement for water reuse projects.

Task D: Successful and sustainable water reuse adoption pathways

- Systematic literature review: We will analyze the literature review data, including the evaluation of relative frequency and co-occurrence of themes for barriers and drivers to successful water reuse implementation.

- Expert panel: We will facilitate discussions during an expert panel; the discussion will include an in-depth discussion of each factor and case study data collection methodology.
- Case studies: We will update our case study data collection and analysis protocols based on expert panel discussion. Then we will begin our interviews with case studies.

Supplemental Keywords:

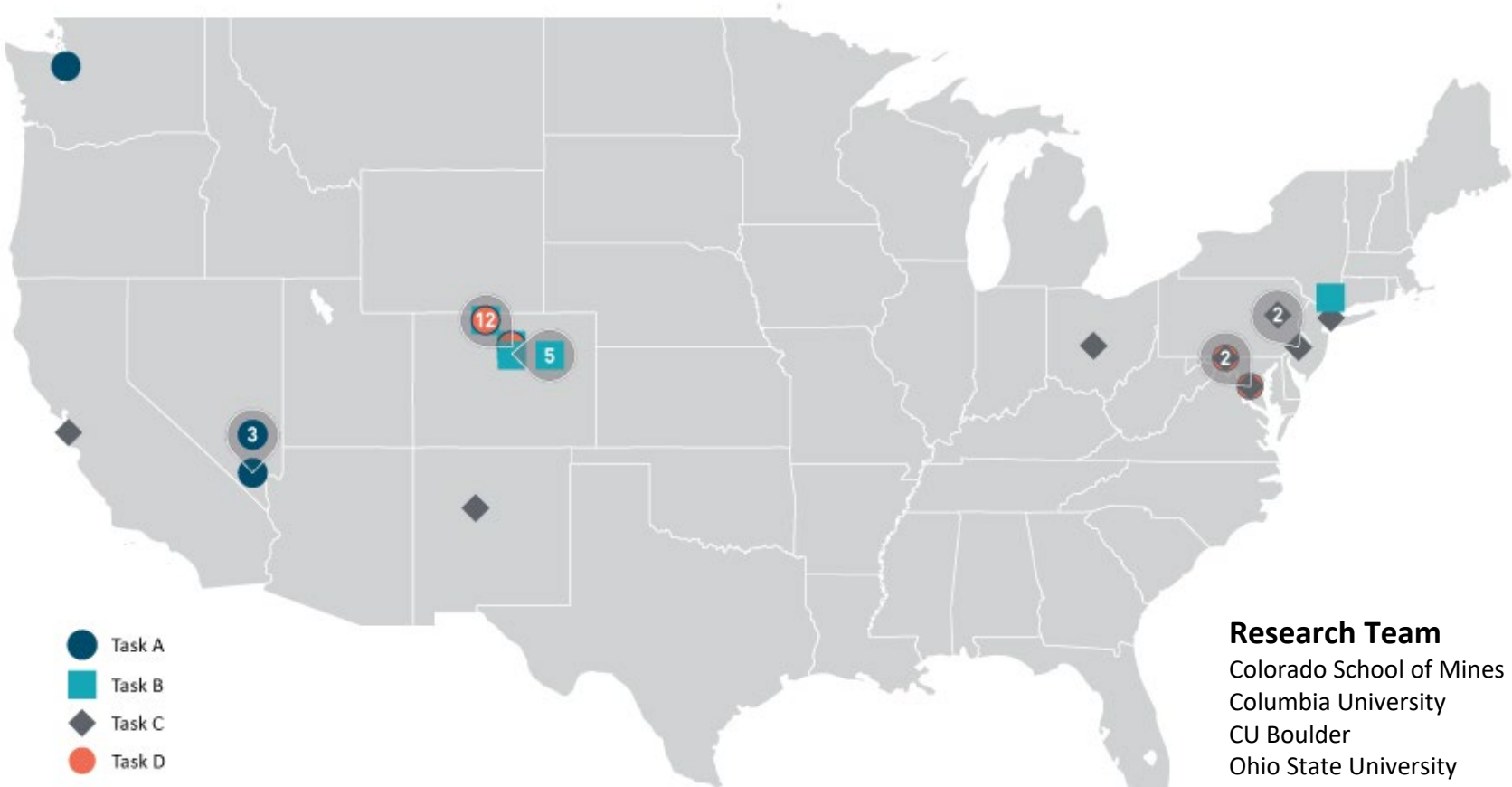
Water reuse, public health, risk mitigation, treatment, community engagement, sustainability assessment

Relevant Websites:

https://watereuse.org/research/unlocking-potential-research/

https://www.waterrf.org/unlocking-nationwide-potential-water-reuse

Attachment B: Research Team Map



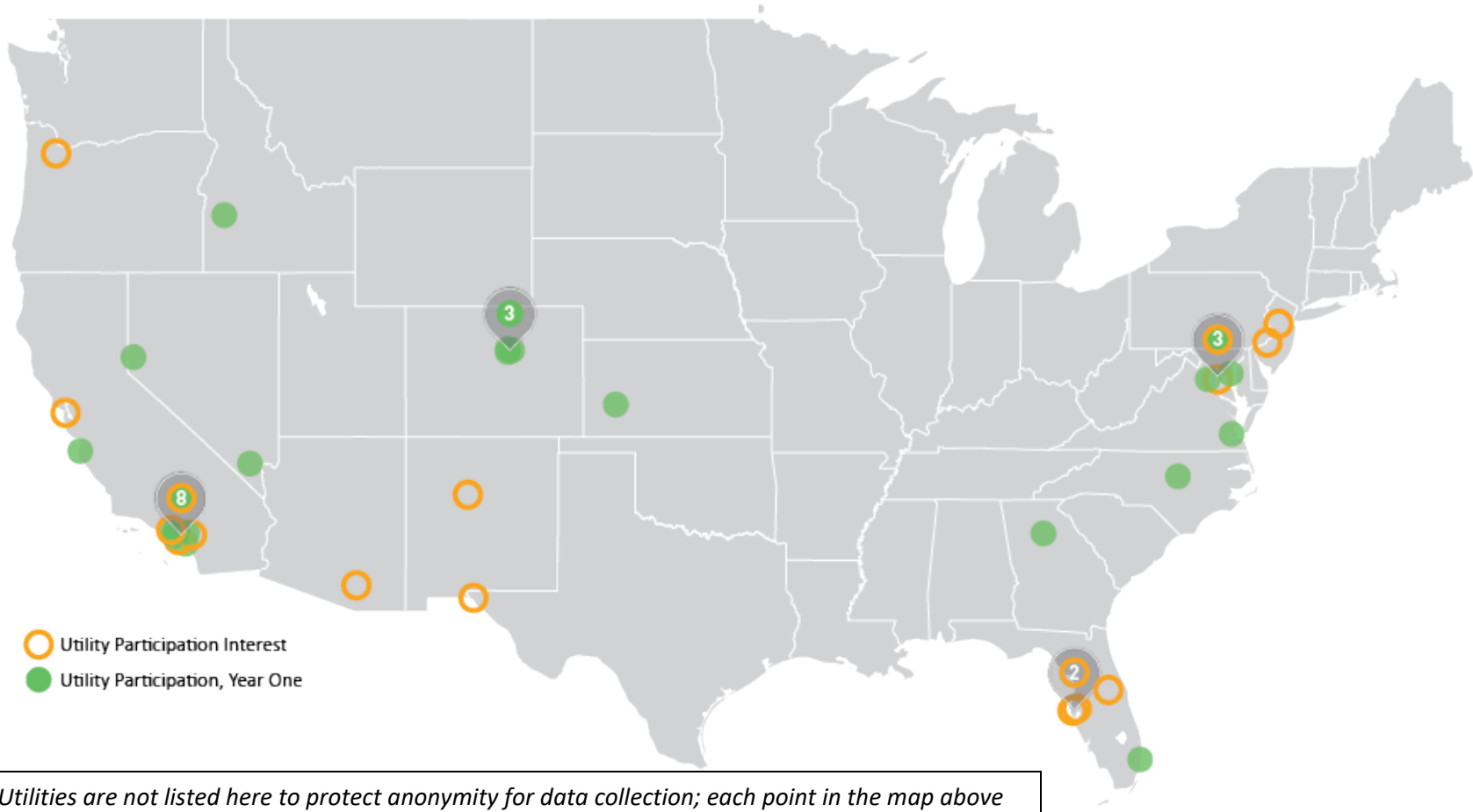
Each point on the map represents a key personnel individual with either the PI, Co-PI or subrecipient.

The Research Team meets every quarter, with email updates in-between.

Research Team

Colorado School of Mines
Columbia University
CU Boulder
Ohio State University
Southern Nevada Water Authority
Stanford
United States Military Academy West Point
University of New Mexico
University of Pennsylvania
University of Washington
Water Research Foundation
WateReuse Association

Attachment C: Utility Partners Map

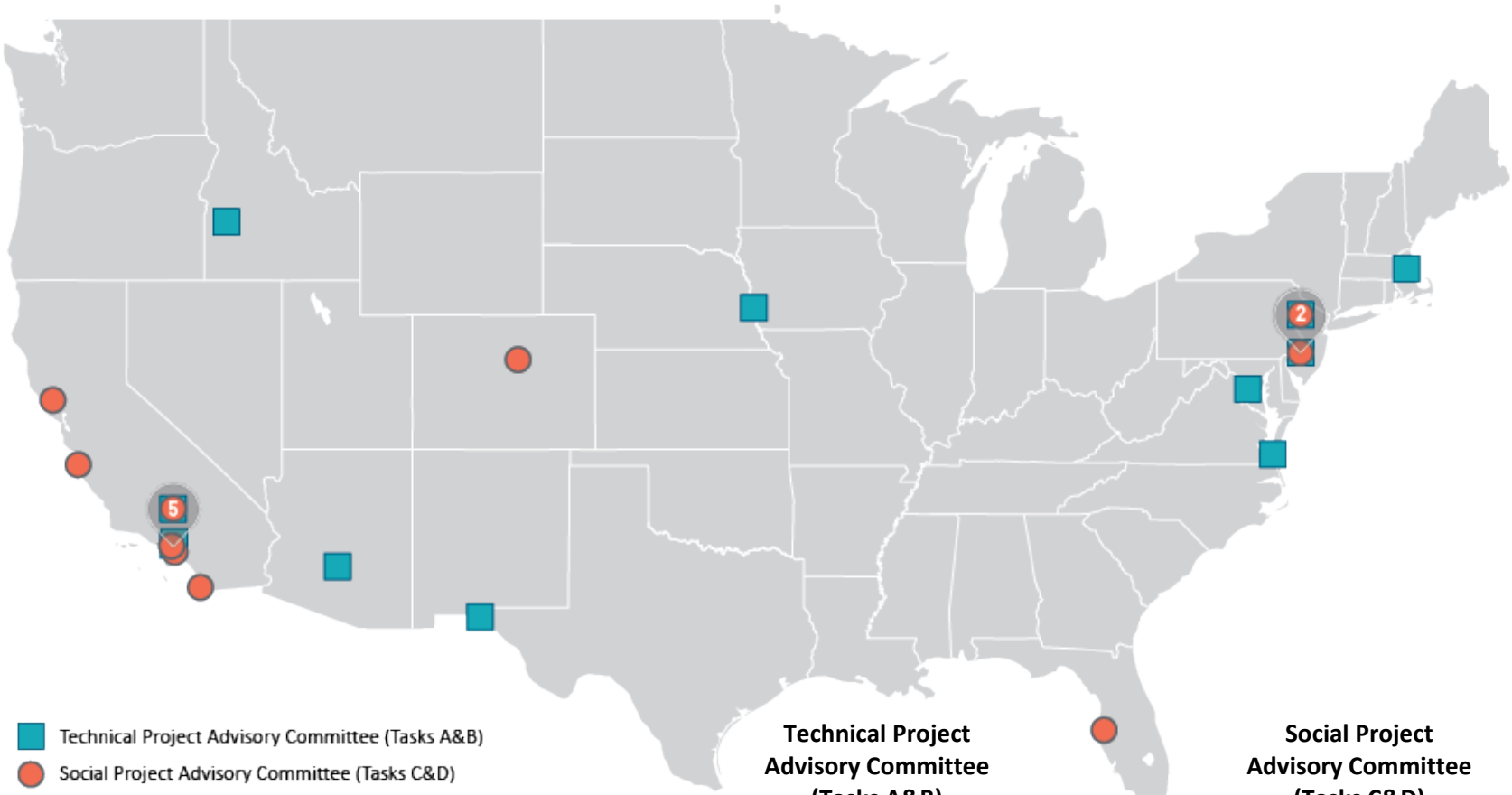


Utilities are not listed here to protect anonymity for data collection; each point in the map above represents an organization that has either expressed interest in participating (via Letters of Support – see yellow points) or has agreed to actively participate (see green points).

WRF and the Research Team met with utility partners during a kick-off meeting in January 2023 and an update meeting in October 2023.

Participation -shown as green identifiers in the map above- include providing wastewater samples (Task B), hosting the mobile DPR unit (Task B), agreeing to interviews on utility engagement practices (Task C), and agreeing to interviews on factors for successful adoption (Task D).

Attachment D: Project Advisory Committee Map



WRF and the Research Team met with both Project Advisory Committees (PACs) during a kick-off meeting in January 2023 and an update meeting in September 2023. Additionally, the PACs reviewed an interim project report in June 2023 and provided feedback.

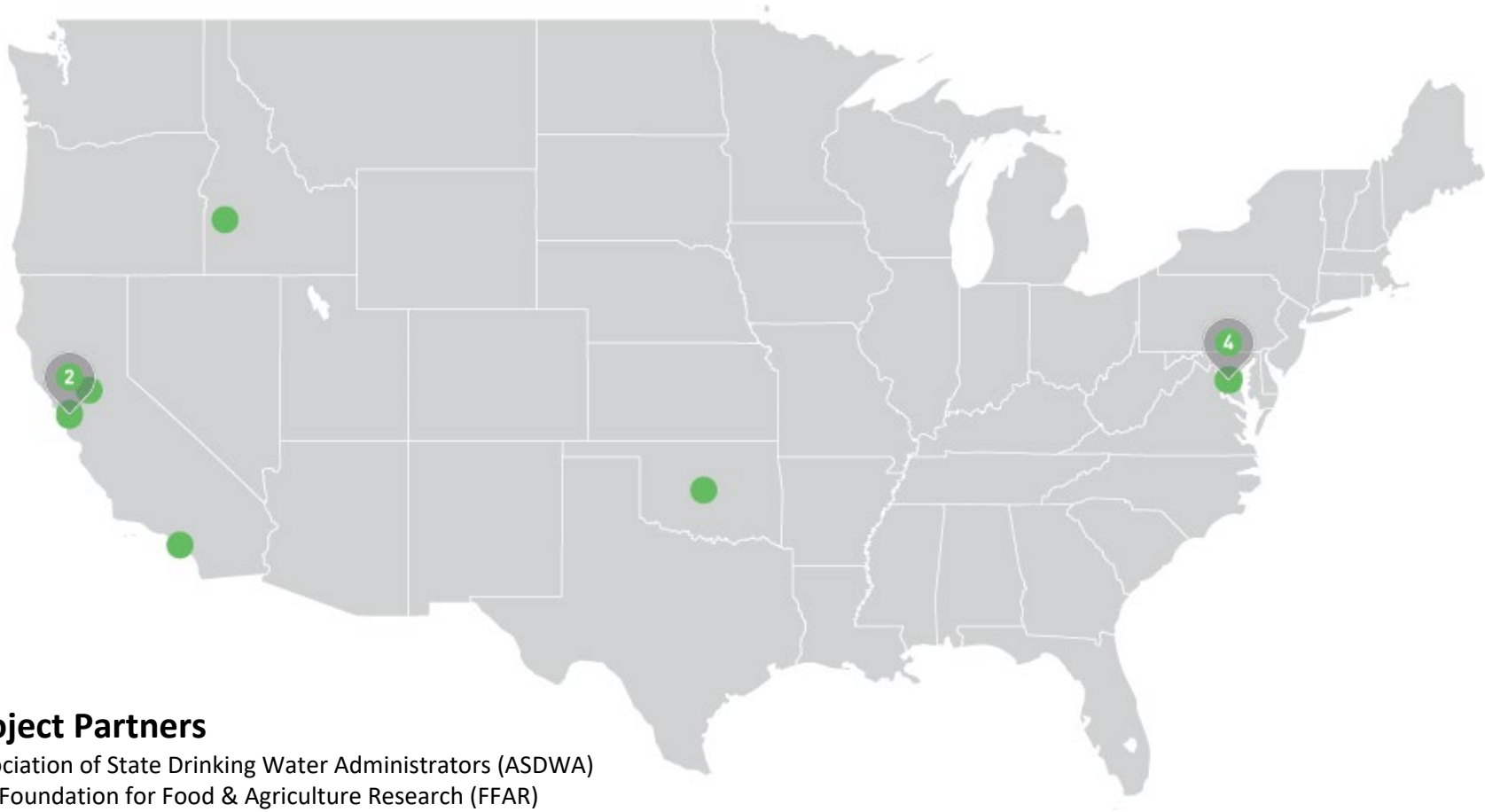
Technical Project Advisory Committee (Tasks A&B)

Trussell Technologies
HDR
Carollo Engineering
CDM-Smith
Hazen and Sawyer
LA Sanitation District
Hampton Roads Sanitation District
El Paso Water
City of Boise,
American Water

Social Project Advisory Committee (Tasks C&D)

Data Instincts
Katz & Associates
Jacobs
Monterey One Water
Hillsborough County Public Utilities
Denver Water
Water Replenishment District
Brown and Caldwell
American Water

Attachment E: Project Partner Map



Project Partners

Association of State Drinking Water Administrators (ASDWA)
The Foundation for Food & Agriculture Research (FFAR)
National Alliance for Water Innovation (NAWI)
National Association of Clean Water Agencies (NACWA)
National Water Research Institute (NWRI)
Oklahoma Department of Environmental Quality
State of Idaho Department of Environmental Quality
State Water Resources Control Board of California
Pacific Institute
US Water Alliance

WRF and the Research Team met with Partner Organizations during a kick-off meeting in January 2023 and an update meeting in October 2023.