POPULATION HEALTH INITIATIVE
UNIVERSITY of WASHINGTON

Climate Change Pilot Grant Application: Establishing Proof-of-Concept
Autumn 2023 Cover Sheet

Project Information
Please provide the following information.

Project Title	Taking the Pulse of the Community: A Survey of Public Perceptions on Wastewater Reuse in Three Western Washington Communities
Budget Request from Initiative	$50,000
Budget Match (if applicable)	$35,035 (request made to CSDE)
Total Project Budget	$85,035

Applicant Information
Please provide the following information for each member of the project team:

Lead PI
- Heidi Gough, Associate Professor
- College of the Environment, School of Environmental and Forest Sciences (SEFS)
- hgough@uw.edu

- Yen-Chu Weng, Lecturer
- College of the Environment, Program on the Environment (POE)
- yweng@uw.edu

A lead UW co-investigator will need to be designated for administration purposes. Please include the name and email address of the finance point-of-contact for that investigator's department.
- Finance point-of-contact (SEFS): Jenn Weiss, jenweiss@uw.edu

Abstract
Please provide a description of your project appropriate for a lay reader. Limit your description to no more than 250 words.

Reliable access to clean water is essential to human health. Communities in Western Washington face increased water scarcity due to longer and drier summers, sea water intrusion and population increases. To conserve water resources, water districts are implementing plans to reuse wastewater – sometimes with public pushback. Existing research on the public's perceptions of wastewater reuse (or "recycled water") predominantly comes from dry regions. No research has addressed what influences public perceptions on recycled water in Western Washington, where the general public may be unaware of the looming water crisis. Our project aims to survey residents of three communities in Western Washington (Silverdale, Friday Harbor, and Forks) on their perceptions on recycled water.

Our proposed hypotheses are: (1) Greater knowledge and awareness of water resources issues will increase acceptance of recycled water; (2) Higher acceptance of recycled water use for non-potable,

non-human contact purposes; (3) Greater trust of recycled water projects where the public is well informed and involved in the planning process; (4) Prior experience with water scarcity or residents who have lived in the region longer are more likely to regard water stress as a pressing issue in Western Washington.

Our project will engage with local communities and water resource managers and share information about water resources issues and current plans to expand recycled water use in Western Washington. Understanding the public's perceptions is critical for the success of recycled water projects. Findings from our project will also expand the understanding of this topic beyond the dry regions.

Research Plan

Please provide a narrative description of your proposed project. Your description must include your project aims, description of the problem to be addressed, and your proposed plan, design, and methods. Limit of two pages, including tables and visuals, but excluding references.

References, if needed, should be included as an appendix to the two-page research plan. Optional letters of support should also be included as an appendix to the two-page research plan.

Problem:

Increasing climate variability and population increases put humid regions such as Western Washington at risk of water scarcity. Aiming to find innovative solutions to limited freshwater resources in the region, the Washington State Legislature enacted the Reclaimed Water Use Act (Chapter 90.46 RCW) in 1992. Since then, guidelines for reclaimed water use have been established by the Washington Department of Ecology and the Washington State Department of Health. Reclaimed (or recycled) water is treated domestic wastewater that is tested and permitted for several non-potable uses, such as watering grass and plants at parks and golf courses, replenishing groundwater, flushing toilets in commercial and industrial buildings, or street washing and dust controls at construction sites (Department of Ecology, 2023). Whereas promoting the use of reclaimed water helps relieve the stress on limited freshwater resources, the public may have misconceptions of reclaimed water and oppose these projects (Fielding et al., 2019; Furlong et al., 2019; Hartley et al., 2019; Akpan et al., 2020;). Therefore, we see an urgent need to survey the public's perceptions on wastewater reuse in Western Washington to both gauge the public's opinions and to raise more awareness of this issue.

Study Sites:

Three communities in Western Washington are selected for our study: Silverdale, Friday Harbor, and Forks. These three communities are selected because they are located in places that depend on the rainfall from the rainy season and lack year-long reliable freshwater sources. Longer and drier summers, sea water intrusion, and population increases all pose direst stress on water resources in these communities. Dr. Gough has existing contacts in the wastewater treatment plants in these three communities and we have received support from these wastewater treatment managers in the planning phase of this project (summer 2023)

In the planning phase of this project (summer 2023), we met with recycled wastewater stakeholders in Silverdale to elicit their feedback. Of the three communities selected for our pilot research, Silverdale Water District already has several treatment and piping projects underway for reusing recycled wastewater. Silverdale Water District conducted a feasibility study in 2009 and identified the following as important stakeholders to engage with: commissioner and other elected officials, health districts, nearby water purveyors, permitting agencies, tribes, environmental interest groups, other NGOs, school districts, landowners, public at large. We plan to reach out to community members based on their 2009 feasible study and extend the same methods to reach out to communities in Friday Harbor and Forks.

Aim:

Based on the review of exiting literature on public perceptions and wastewater reuse (Wester et al., 2015; Fielding et al., 2019; Abdelrahman et al., 2020; Baawain et al., 2020; Flint and Koci, 2021), we identified five main themes to be include in our survey: (1) knowledge about local water resources, (2)

opinions and attitudes on local wastewater issues and management, (3) level of acceptance of different types of recycled water use, (4) communications and trust, and (5) factors influencing the acceptance of recycled water (demographic information).

Languages, or the labeling of "wastewater", mattered. We saw terminologies such as "wastewater", "reclaimed water", "cleaned water", "reused water", "recycled water" in the literature. Different terminologies have different connotations and influence people's perception and acceptance of wastewater reuse. After consulting with wastewater managers in our research area (Silverdale), they suggested that "recycled water" is the most commonly accepted term in our research area. Therefore, we will use "recycled water" in our research.

A preliminary survey was drafted this summer and we will continue to revise and refine the survey questionnaires with consultation with survey experts from the UW Office of Educational Assessment.

Our proposed hypotheses are: (1) Greater knowledge and awareness of water resources issues will increase acceptance of recycled water; (2) Higher acceptance of recycled water use for non-potable, non-human contact purposes; (3) Greater trust of recycled water projects where the public is well informed and involved in the planning process; (4) Prior experience with water scarcity or residents who have lived in the region longer are more likely to regard water stress as a pressing issue in Western Washington.

Overall, our project aims to survey residents of the three communities in Western Washington on their perceptions on recycled water and to test our hypotheses. Through the research process, we will engage with local communities and water resource managers to raise awareness of this topic in the region. Findings from this survey can provide policy recommendations for water resource managers and compare with results from other regions of the world where recycled water reuse projects are being considered. Understanding how communities in Western Washington perceive the potential use of recycled water is a critical step in promoting recycled water as an innovative solution to addressing impending water shortage challenges in the region.

Plan, Design and Methods:

In the winter 2024, we plan to finalize our survey questionnaire and complete the IRB review. In spring 2024, we will run pre-tests and visit the three research sites to engage with community members and water resource managers to elicit their feedback on the survey questions. We plan to send out survey invitations and collect data in summer 2024.

Table 1 shows the census data of population and households in our study sites based on the 2021 American Community Survey. We plan to sample 33.3% of households in each location using the USPS Direct Mail Campaign. With a 10% buffer, the total estimated number of survey invitations is 4,000. With the matching funds supported by the CSDE, we can increase our sample rate to 50% of the households.

Table 1: Sampling Design

	Zip Code	# of households	Population	33% # of Households	
Silverdale	98383	8351	21301	2783.67	Total: 3575.33
Friday Harbor	98250	1132	2587	377.33	+10% buffer: 3932.86
Forks	98331	1243	3373	414.33	(budget for N=4,000)

We aim for a 50% response rate (~2,000 responses). We will send out a second reminder to residents where the response rate is lower at the end of the summer to increase participation.

We plan to analyze the collected survey data in autumn 2024, including descriptive statistics of the survey questions and testing our proposed hypotheses. The final report and deliverable will also include an informational brochure of the key findings of our research for the general public and water resource managers.

References:

Abdelrahman, R. M., Khamis, S. E., & Rizk, Z. E. (2020). Public attitude toward expanding the reuse of treated wastewater in the United Arab Emirates. Environment, Development and Sustainability., 22(8), 7887–7908.

Akpan, V. E., Omole, D. O., & Bassey, D. E. (2020). Assessing the public perceptions of treated wastewater reuse: opportunities and implications for urban communities in developing countries. Heliyon, 6(10).

Baawain, M. S., Al-Mamun, A., Omidvarborna, H., Al-Sabti, A., & Choudri, B. S. (2020). Public perceptions of reusing treated wastewater for urban and industrial applications: challenges and opportunities. Environment, Development and Sustainability., 22(3), 1859–1871.

Fielding, K. S., Dolnicar, S., & Schultz, T. (2019). Public acceptance of recycled water. International Journal of Water Resources Development., 35(4), 551–586.

Flint, C. G., & Koci, K. R. (2021). Local resident perceptions of water reuse in Northern Utah. Water Environment Research: a Research Publication of the Water Environment Federation., 93(1), 123–135.

Furlong, C., Jegatheesan, J., Currell, M., Iyer-Raniga, U., Khan, T., & Ball, A. S. (2019). Is the global public willing to drink recycled water? A review for researchers and practitioners. Utilities Policy., 56, 53–61.

Hartley, K., Tortajada, C., & Biswas, A. K. (2019). A formal model concerning policy strategies to build public acceptance of potable water reuse. Journal of Environmental Management., 250, 109505–109505.

Silverdale Water District (2009) “Dyes Inlet Water Reclamation Facility Feasibility Study”, Golder Associates.

Washington State Department of Ecology (2023) “Reclaimed Water”, https://ecology.wa.gov/Water-Shorelines/Water-quality/Reclaimed-water/

Wester, J., Timpano, K. R., Çek, D., Lieberman, D., Fieldstone, S. C., & Broad, K. (2015). Psychological and social factors associated with wastewater reuse emotional discomfort. Journal of Environmental Psychology., 42, 16–23.

Project Timeline

Please include a brief description of the timeline for the major milestones of the project you are proposing.

Winter 2024 - Survey design & consultation, IRB review

Spring 2024 - Site visits, pre-test, feedback from water resource managers

Summer 2024 - Survey execution & data collection

Autumn 2024 - Data analysis and reporting

Biographies

Please include a brief biography for each investigator listed on the cover sheet of this application that highlights relevant experience in terms of the work proposed. Please use the biographies to illustrate how each investigator's experience will contribute to the overall collaborative effort. Limit of 250 words per investigator.

Dr. Heidi Gough

Dr. Heidi Gough in the School of Environmental and Forest Sciences is a researcher focused on harnessing naturally occurring microbial populations to create clean water and recover energy from water pollutants, addressing three themes: biodegradation of trace organic contaminants; high-strength wastewater treatment and recovery; and waste as a resource. Her findings in the lab and the field are critical for understanding the most sensitive steps in waste-to-energy methane production. These results can then inform environmental outcomes addressed toward societal challenges. Dr. Gough approaches her service within UW and beyond with attention to advancing collegiality and collaborations across disciplines and across institutions, in particular international engagement, and advancing equity for women and marginalized communities in STEM.

Dr. Yen-Chu Weng

As a human-environment geographer, Dr. Yen-Chu Weng's research focuses on exploring the interactions between human societies and the environment. She has broad training in both the biophysical sciences and the social sciences and integrates quantitative, qualitative, and GIS methods into her research. Dr. Weng is highly experienced in social science research methods, including surveys, interviews, focus group discussions, and participant observation. Since joining the UW as a teaching faculty in 2013, her work primarily has focused on teaching and scholarly research on teaching and learning. She teaches courses on research methods and data analysis both at the undergraduate and graduate levels at the UW and advises students on their capstone research and thesis projects.

Project Budget (add additional pages if funding is matched by more than three entities)

	Requested from Initiative	Funding Match by: _____*CSDE*_____	Funding Match by: _____	Funding Match by: _____
Salaries				
Faculty	27,600			
Staff				
Student (RA)		17,689		
Student (Hourly Undergraduate Research Assistant)	4,120			
Benefits Fringe Benefits Based on Payroll Load Rate In Effect	$7,525	$3,219		
Supplies and Materials Supplies, Equipment Under $2,000, etc.	$6,400	$3,200		
Equipment Equipment Over $2,000				
Travel Per Diem Lodging/Meals/Expenses, Air Fare, Mileage, Car Rental	$3,255			
Tuition For graduate students		$8,077		
Other	$1,100	$2,850		
Total Direct Costs	**$50,000**	**$35,035**		

Budget Justification

Salaries: Funds cover ~1 month of summer salary for Dr. Gough (PI) for administration of the project and for participation during field trips and meetings. Funds cover ~2 months of summer salary for Dr. Weng (coPI) for oversight of survey distribution (including coordination with IRB), work with survey consultants, management/mentoring of student activities, and coordination of field trips.

An hourly undergraduate research assistant will be funded for the summer and fall quarters. Funds will cover approximately 10 hours per week for 2 quarters. The hourly student will assist with data collection, compilation, and processing. They will additionally assist with preparation of materials for data sharing with partners during field visits.

Benefits: Benefits were calculated at a rate of 24.1% for faculty salaries, and 18.2% for student salaries.

Supplies and Materials: $6400 is requested to cover costs for postage and postcards for recruiting participants ($0.60 each for 4000 pieces = $2400) and for survey participant gift cards ($20 each for 200 cards = $4000). These costs allow recruitment of ~33% of the households in the study communities.

Travel: Funds are requested for 2 site visit trips including 3 UW personnel to each of 3 partner sites. anticipated to include the Silverdale Water District (80 miles at $0.655 per mile, $52.5 ferry crossing, and breakfast/lunch per diem at $28 each person = $189 for each visit), City of Forks (274 mile, $52.5 ferry crossing, and overnight lodging and meal per diem at $107 and $59 respectively for each person = $730 per visit), and Friday Harbor Wastewater Treatment Plant (194 miles, $90 ferry crossing, and overnight lodging and meal per diem at $107 and $59 respectively for each person = $715 per visit).

Other: $1,100 is requested to engage the resources and services of UW Surveys, operated through the Office of Educational Assessment (https://www.washington.edu/surveys/). Based on a quote provided by the UW Survey team, these funds will cover ~11.5 hours of assistance to the project.

Explanation of Matching Funds.

Matching funds have been requested through CSDE as follows:

Salary/Benefits/Tuition: Two quarters of RA support expanding the scope of the project. Matching funds cover two quarters (6 months) of Graduate Research Assistant salary and 2 quarters of GSRA tuition (1 summer quarter and 1 academic quarter). The graduate student will assist with data collection, compilation, and processing. They will additionally assist with data sharing with partners during the fall quarter field visits.

UW Survey Center: $2850 – for an additional 30 hours of Center support to the project.

Supplies and Materials: $1,200 additional postage and $2000 for gift cards to expand recruitment to represent a total of ~50% of the households in the study communities.

Explanation of Other Resources:

Additional undergraduate student participation is anticipated in this project. The project will be advertised to students majoring in Environmental Studies (PoE) and Environmental Science and Terrestrial Resource Management (ESRM in SEFS) as a capstone opportunity. We anticipate supporting 1-3 capstone students. Though capstone students are not funded by a research grant, they would contribute by assisting with literature review, data compilation and results presentation as it relates to the capstone project that they define with their faculty mentor(s).