Report to the Governor

2017-2019 Water System Capacity

September 2020

Safe Drinking Water Act

Prepared by
The Office of Drinking Water
Environmental Public Health

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This report satisfies a requirement of the Safe Drinking Water Act, requiring states to produce a report for their governor on the effectiveness of capacity development efforts. Information in this report also addresses the Environmental Protection Agency's (EPA) criteria for assessing the implementation of the Capacity Development Program in Washington state.

Executive Summary

The Washington State Department of Health, Office of Drinking Water (DOH) receives funding from the U.S. Environmental Protection Agency (EPA) to focus on capacity development assistance to small public water systems serving fewer than ten thousand people. Water system "capacity" is the technical, managerial, and financial (TMF) capability to operate in accordance with local, state, and federal drinking water standards. Maintaining adequate capacity is difficult for the roughly four thousand small systems in the state due to a variety of challenges in each of the TMF categories.

As part of our overall approach, DOH integrated capacity development into our programs and our local, state, and federal partnerships. Capacity development is a team effort. The information we gather and relationships we build through our programs help us assess the specific capacity challenges each small water system faces and focus our efforts on their needs. This 2017–2019 report outlines the work done over the three-year period to assist small water systems in our state and meets requirements embodied within the federal Safe Drinking Water Act. The Act requires each state to have a strategy to ensure water systems have the technical, managerial, and financial capacity to deliver safe water to their customers. This report satisfies the requirement for states to report to EPA each year on their strategy and provide a progress report every three years to the Governor.

In this reporting period, we supported our small water systems in a variety of ways.

- We continued financial assistance, especially to economically disadvantaged communities, through our Drinking Water State Revolving Fund Program.
- We continue to invest in statewide and regional partnerships such as the Small Communities Initiative (SCI) Program in concert with our colleagues at the departments of Ecology and Commerce.
- We formed a partnership in 2017 with the Department of Commerce to support water systems in Adams, Franklin, Grant and Lincoln Counties affected by groundwater depletion in the Mid-Columbia Basin. This effort led to the formation of the Columbia Basin Sustainable Groundwater Coalition.
- Our partnership with staff from Association of State Drinking Water Administrators (ASDWA), EPA, and other states on the Area Wide Optimization Program (AWOP) expanded and diversified. These new approaches included treatment technologies not historically included in AWOP and service to tribal water systems in support of EPA staff.
- As a result of our partnership with water utilities and other professionals, the chlorine residual measurement and lab skills classes we developed received national recognition from the American Water Works Association.
- We continued to monitor the effectiveness of our arsenic treatment optimization program to minimize the human health risk from this naturally occurring contaminant.
- Through our sanitary survey program, we continue to work face-to-face with individual water systems to address the unique needs of each water system. As a result, DOH and local

health staff connect one-on-one with more than seven hundred water systems in the state each year.

1.0 Introduction

DOH supports the capacity of all water systems to provide safe and reliable drinking water. We regulate water systems under state law and a formal "primacy" agreement with EPA to carry out the federal Safe Drinking Water Act (SDWA). EPA provides funding to states as part of this agreement. In Washington, EPA funds about 60 percent of the safe drinking water programs.

In the 1996 amendments to the SDWA, Congress mandated states to create capacity development strategies to enhance the ability of small public water systems to provide safe and reliable drinking water. These strategies focus on helping water systems build and maintain the ability to operate, manage, and finance their systems properly.

EPA refers to these strategies as a "Capacity Development Program" and can withhold up to 20 percent of a states' funding if the strategy is not sufficient. EPA regularly reviews the effectiveness of state programs, and Washington's Capacity Development Program is among the strongest in the nation.

Water system "capacity" is the technical, managerial, and financial capability to operate in accordance with applicable local, state, and federal drinking water standards. These three areas are interrelated and together form water system capacity.

- **Technical capacity** refers to the physical system, including source, treatment, storage and distribution, and the ability of skilled staff to operate the water system.
- **Managerial capacity** describes a system manager's ability to conduct necessary activities, such as staffing, planning, decision making, maintaining accountability, and interacting with customers and regulatory agencies.
- **Financial capacity** represents the system's ability to generate sufficient revenue, maintain credit worthiness, and manage funds through budgeting, accounting, and other methods of fiscal control.

Maintaining adequate capacity is a particular challenge for small water systems. EPA defines small water systems as those water systems supplying drinking water to fewer than ten thousand people. These systems face the following technical, managerial, and financial challenges, affecting their capacity to provide safe and reliable drinking water to customers.

Technical Challenges

Compared to larger water systems, small water systems have more water quality violations and are more likely to fail at properly monitoring for contaminants, making timely repairs, or replacing faulty materials. This can lead to decreased water system reliability, poor water quality, and failing water system infrastructure—all of which pose significant health risks to their customers. In addition, many small water systems, especially very small systems serving less than five hundred people, lack a full-time operator.

Managerial Challenges

Homeowners' associations—with volunteer board members—own and operate many small water systems. Oftentimes, these part-time volunteers do not have the background and training to understand their responsibilities to ensure the safe and reliable delivery of drinking water to their customers.

Financial Challenges

Small water systems struggle financially because there are fewer households to pay for the overall cost of maintaining and improving their water system. These costs include the capital financing to periodically replace physical assets such as wells, pumps, distribution mains, and reservoirs when they reach the end of their useful life. In addition, maintenance, monitoring and personnel costs also tend to be much higher per household for small systems.

As a result of these challenges, DOH works to support the consolidation of small water systems in urban and peri-urban areas with larger water systems that have great technical, managerial, and financial capacity to sustain the safe and reliable provision of drinking water. At the same time, consolidation is not a feasible option for many small and more rural water systems.

1.1 Water Systems in Washington State

There are about 4,100 water systems in Washington state that meet the definition of a public water system under the SDWA. These public water systems, commonly referred to as Group A water systems, are regulated under Chapter 246-290 WAC. These water systems range in size from those serving more than 100,000 people such as Tacoma Water to small campgrounds that seasonally serve a few dozen people.

In general, water systems that serve cities, towns, and homes where people live year round are called community water systems. Those that serve only schools or businesses where people use water at least 180 days per year are called nontransient, noncommunity water systems. Small water systems that serve recreational sites such as camps and campgrounds are called transient noncommunity systems. The monitoring and other regulatory requirements under the SDWA are tailored depending upon the size of the water system and frequency of access to water of the people the water system serves. That said, small water systems must manage complex regulations, keep up with new testing and monitoring methods, and improve water infrastructure—often with fewer resources than larger water systems.

Table 1

Type	Number of Public Water Systems
Community (Total Number)	2,215
Community—serving more than 100,000 people	8
Community—serving 10,000 to 100,000 people	98
Community—serving 1,000 to 9,999 people	249
Community—serving less than 1,000 people	1,860
Nontransient noncommunity (NTNC)	319
Transient noncommunity (TNC)	1,602

Data updated: 07/01/2020.

This report highlights DOH's work helping small water systems build their technical, managerial and financial capabilities from 2017 through 2019. While this report identifies challenges that water systems, especially very small water systems, face in maintaining capacity of provide safe and reliable drinking water, it also highlights progress and successes. Many of these successes are outcomes from special projects, training, and relationships we developed with local, state, and other partners in support of water systems, especially smaller ones. We categorize our work with small systems to two areas: support and assessment. Small water system support describes the work we do to train and assist these small systems in developing their capacity. Water system assessment describes the work we do to monitor and evaluate system performance and respond to emergencies.

1.2 Partnerships to Support Water System Capacity

DOH staff are fortunate to have strong relationships with many of our key local, state, federal, and non-governmental partners that support the provision of safe and reliable drinking water to the people of Washington state.

At the local level, we partner with the thirty-five local health jurisdictions (LHJs) in Washington state. These LHJs serve one or more of the thirty-nine counties in the state, perform about half of all sanitary surveys, and are important partners in responding to water system emergencies. Our relationships with LHJs vary depending upon the financial support we are able to provide them, the capacity of the LHJ themselves, and the degree of support they receive from their governing bodies such as county councils.

We also have strong partnerships within Washington state government and our peers in other states. Our staff who support the financial capacity of water systems work closely with people at the Department of Commerce (Commerce), Department of Ecology (Ecology), and Utilities and Transportation Commission (UTC) to provide financing and financial literacy tools to people working with and for public water systems on topics such as asset management and rate setting. On water resources, our staff collaborate with people at Ecology, the state Department of Agriculture, Department of Natural Resources, and others on water rights and drought response. For emergency preparedness and response, we once again have strong relationships with other state agencies,

most notably Ecology and the Emergency Management Division of the Washington State Military Department to support water systems capacity to respond to emergencies. Our coordination with other state drinking water programs cuts across a multitude of technical, managerial, and financial frameworks. Last and certainly not least, Office of Drinking Water staff are proud to be part DOH. This placement keeps us focused on the essential public health service that is embodied within the provision of safe and reliable drinking water to people in Washington state. On specific topics such as responding to health risks posed by *Legionella pneumophila*, we coordinate closely with people throughout the agency as needs arise.

At the federal level, EPA is **the** key federal partner in the provision of safe and reliable drinking water as SDWA and National Primary Drinking Water Regulations are within the regulatory purview of EPA staff. DOH also coordinates with EPA on technical, managerial, and financial topics ranging from asset management to optimization of water treatment. In addition to EPA, we also have connections with other federal agencies that have a role with water supply forecasting, emergency preparedness and response, funding and financial management, and many other topics.

Outside of government, DOH works closely with many non-governmental organizations (NGOs) to sustain water system capacity. Within Washington state, organizations DOH partners with to provide technical, managerial and financial capacity development services include:

- Evergreen Rural Water of Washington (ERWOW).
- Pacific Northwest Section of the American Water Works Association (PNWS-AWWA).
- Rural Community Assistance Corporation (RCAC).
- Washington Association of Sewer and Water Districts (WASWD).
- Washington Certification Services.
- Washington Environmental Training Center (WETRC).
- Washington Public Utility Districts Association (WPUDA).
- Washington Water Utility Council (WWUC).

At the national level, DOH coordinates with NGOs that support the programmatic and capacity development of water systems in a variety of ways.

Water is essential for life. Without safe and reliable drinking water, our state economy would cease to function as it does; and without these partnerships, our part in supporting the capacity of water systems to provide this essential service would be challenging, to put it mildly. As such, these partnerships and the key ways that they support the technical, managerial, and financial are woven throughout this triennial report on capacity development in Washington state.

2.0 Water System Support

DOH supports capacity development within water systems at a multitude of levels ranging from investments in statewide and regional partnerships to direct, hands-on assistance for the operators and utility managers who run public water systems in our state. Our diverse approach reflects the diversity of water systems and needs among our partners to ensure safe and reliable drinking water.

2.1 Statewide and Regional Partnerships

Statewide and regional partnerships are an essential tool for building and maintaining water system capacity. In Washington state, we have an abundance of small water systems in rural areas that have challenges ranging from ageing infrastructure, declining aquifers, and limited technical expertise. By working with third parties like the Small Communities Initiative and utility partners such as Public Utility Districts, we can leverage our limited resources, pursue additional resources, and provide valuable training to those systems that have the greatest needs. Furthermore, through infrastructure investments, board and commission training, water quality monitoring, asset management, treatment optimization, and workforce development, we can help build water system capacity to meet the challenges of ensuring safe and reliable drinking water.

2.1.1 Small Communities Initiative

The Small Communities Initiative (SCI) Program provides technical advice and facilitation services to small public water systems across the state to develop infrastructure projects, makes strategic decisions, and identifies and accesses appropriate funding sources. This program is a collaborative effort among the departments of Health, Ecology, and Commerce. All three agencies fund the program, which assists communities that need to upgrade their drinking water or wastewater systems. More specifically, the SCI Program helps local elected officials, local staff, and residents define, prioritize, and identify links between public health, environmental protection, and local development issues. The program also develops and implements an action plan to make necessary infrastructure improvements.

Two staff members, make up the SCI Program and serve the west and east side of the state, respectively. SCI Program staff also participate in multiple inter- and intra-agency efforts to provide technical assistance and funding to water systems. This includes:

- Planning and facilitating the Infrastructure Assistance Coordinating Council (IACC) conference, including sessions and technical teams.
- Facilitate the Maximizing Resources workgroup.
- Coordinate with funding agencies on projects.
- Promote regionalization efforts in targeted geographic areas.

Over twenty water systems benefitted from their efforts between 2017 and 2019.

Success Story: Lewis County Water District 2, Onalaska—Water System Plan Update and Consolidation Project

The Lewis County Water District 2 (LCWD2) needed to update its Water System Plan and include consolidation of Evergreen Apartment's water system. Evergreen Apartments water system resides within LCWD2 service and is served by a well that exceeds the arsenic standard for drinking water. LCWD2 and Evergreen Apartments mutually agreed a consolidation of the two water systems was feasible and beneficial to both water systems. With the consolidation, LCWD2 would permanently serve Evergreen Apartments customers with water through a new intertie, allowing abandonment of the high arsenic well. SCI provided assistance with:

- Discussions between LCWD2 and Evergreen Apartment's owner for the consolidation.
- Water system plan updates.
- Drinking Water State Revolving Fund (DWSRF) application in 2019.

As a result of these efforts, LCWD2 is receiving grant funding for the new water main that allows connection of Evergreen Apartments. The project will be completed in late 2020.

2.1.2 Rural Community Assistance Corporation (RCAC)

The RCAC is a 501 (c)(3) nonprofit organization. The RCAC Program provides TMF capacity development assistance to dozens of small water systems each year. This program helps build small system capacity by providing a variety of services, such as board training, rate studies, planning assistance, and asset management planning. We contract with RCAC to provide a variety of technical, managerial, and financial capacity development assistance to our small systems across the state. RCAC has trained field staff in every region, and works closely with DOH staff to assist systems in becoming self-reliant and knowledgeable about roles and responsibilities.

Lincoln County Regionalization Project—Special Project: 236.5 Hours

Summary: Potential Regional Consolidation

At the request of the Office of Drinking Water/Department of Health, RCAC developed and facilitated a series of three workshops for drinking water systems in Lincoln County Washington to provide information, education, and opportunity to explore regional governance and resource efficiency.

The three workshops were held in Davenport, Washington on April 25, May 15, and June 13, 2019. Each workshop provided six hours of learning opportunity. RCAC provided workshop organization, notification, facilitation, equipment, supplies, refreshments, and workshop follow up. The Lincoln County Economic Development Council provided workshop notification, assistance, and refreshments. Meeting facilities were provided by Lincoln County Public Works Department.

The first workshop focused on the basics of regionalization, what it is and what it is not, common issues and potential solutions, history mapping, and community visioning.

The second workshop focused on governance structures plus and minus, drinking water system information, collaboration opportunities, context mapping, SWOT analysis and the development of a vision statement.

The third workshop provided time to revisit the vision statement and common issues, learn about decision grids, name stakeholders and establish a consensus goal, "Get all eight cities current with the plan to develop an asset management plan," and implementation plan with next steps.

Moving forward the group name will be Lincoln Communities Asset Management Plan (LCAMP) to show inclusion for all communities and that the group is autonomous.

Lind, Town of: 81 Hours

Summary: Median Household Income Survey

A Median Household Income Survey was conducted for the Town of Lind. The purpose of the survey was to establish a median household income (MHI) level and low-to-moderate income (LMI) level for state and federal funding programs. Median Household Income (MHI) is used to determine whether a project service area will meet Washington State Department of Health/Office of Drinking Water (Health) State Revolving Fund Funding program assistance related to median household income. To qualify for Community Development Block Grant (CDBG) funding, 51 percent or more of the community's population must be classified as Low-to-Moderate Income. The survey was designed and conducted in accordance with the 2017 Washington State Infrastructure Assistance Coordinating Council (IACC) Income Survey Guide.

The MHI for the Town of Lind is $36,500. Town of Lind has 245 parcels (households) to survey, 18 are vacant homes and one is a vacation home, leaving 226 households to survey. A service area with 226 households requires a sample size of 143 responses (63 percent) to meet the 2017 Washington State IACC Income Survey Guide. One-hundred fifty-six households responded to the survey, which accounts for a 69 percent response rate. Zero Artificial Household Responses (AHR) were used to validate the survey.

The Percentage LMI is 59.3 percent. For Adams County, the LMI classification varies from $36,400 or below for a one-person household to $109,964 for a twelve-person household. An analysis of the individual household data shows that 403 persons were living in the 156 households that responded. Of the 403 persons represented in the survey responses, 239 were living in LMI households. The percentage of LMI was calculated as 59.3 percent, (239 LMI persons ÷ 403 total persons) x 100 = 59.3 LMI. Zero Artificial Household Response (AHR) were used to validate the survey.

Home Valley Water District: 62 hours

Summary: Rates and financial analysis.

At the direction of DOH, the Home Valley Water District (HVWD) requested that RCAC complete a financial analysis, including Capital Improvement Planning (CIP) recommendations and an evaluation of current water user rates for the system. The financial analysis was developed and

completed using historical financial records provided by HVWD. The required information was difficult to receive from the responsible staff. One example of concern has been that there was no current method to correlate meter readings to specific customer accounts or addresses.

The results of the study established a blueprint for achieving strong financial performance in the future and sustaining efficient and effective services to the district's customers. The scope of the project included the assessment of revenue needs for a multi-year period that include adequate funding for operations and maintenance, capital projects, debt service, and other program activities; Projected long-term capital needs and incorporated those needs into a long-term funding forecast that includes rates, debt, connection fees and existing reserves. Further RCAC was able to develop and recommend rate structures that generated sufficient revenue to meet the utility's financial obligations on a standalone basis and promotes water conservation.

2.1.3 Mid-Columbia Basin Initiative

DOH formed a partnership in 2017 with the Department of Commerce, Small Communities Initiative (SCI) to work with water systems in Adams, Franklin, Grant and Lincoln Counties affected by groundwater depletion in the Mid-Columbia Basin. Previous studies by the Columbia Basin Groundwater Management Area (GWMA) showed that the majority of the groundwater demand comes from agriculture and most aquifers in the basin do not readily recharge because of the complex hydrogeology.

Some drinking water systems have already felt the effects of groundwater decline and are facing long-term challenges. These water systems are in an area where water is being withdrawn more quickly than it can be replaced and they have little control over the agricultural demand placed on the aquifers. These cities and towns are economically linked to the agricultural community and there is a lack of current data for decision-making purposes. The information gathered to date suggests that many water systems do not know if or how their wells are being affected.

This project built upon previous work DOH conducted with basin municipalities in 2014 and technical assistance on water level monitoring provided in 2015 and 2016. DOH directed this current effort to go beyond municipalities and Commerce reached out to 137 community water systems in the four-county area that rely on groundwater sources for drinking water. These systems serve approximately 92,000 residents.

Work completed as part of this effort includes:

- A survey of 137 Group A water systems in the four-county area.
- Analysis of existing water level data and identification of data gaps.
- Outreach meetings in each county to share survey results and discuss options for addressing groundwater declines.
- Coordination efforts with the Department of Ecology, Washington State University, and Columbia Basin Development League.

- Coordination meetings with federal, state and local agencies to brainstorm what type of long-term groundwater monitoring program could be developed with existing resources in each organization.
- Coordination meetings to support the formation of a coalition of water systems and other stakeholders in the area to address groundwater supply and monitoring issues. The Columbia Basin Sustainable Groundwater Coalition was formed from these meetings and continues to meet semi-monthly. To date the Coalition has developed a problem statement, vision and mission statement, and identified short- and long-term priorities and is evaluating funding opportunities to achieve their goals.

DOH continues to support the Columbia Basin Sustainable Coalition with organizational support and meeting facilitation, grant writing support for future grant applications and building a diverse, inclusive stakeholder group. DOH is working with the Coalition to realize their goal of establishing a long-term groundwater monitoring network in the basin and to develop a water level data reporting and repository. In late 2019 DOH collaborated with multiple stakeholders to support a successful application from the Washington State University for a Bureau of Reclamation WaterSMART Applied Science Grant. The grant proposal was a collaborative effort of Office of the Columbia River (OCR), DOH, Commerce, Lincoln County, multiple conservation districts, and drinking water utilities. The proposed project will establish a long-term, stakeholder-driven groundwater monitoring network. The network will expand existing sampling and include a minimum of fifty groundwater wells. Data from this study will help utilities and agencies better understand how groundwater supplies have changed over time. It will also establish a baseline for future groundwater level tracking.

All these efforts provide managers in the region with much needed data to support decision-making. DOH is also working with water systems in the area to consolidate water systems in an effort to increase operational efficiency, reduce customer costs, and improve service.

2.2 Organizational Partnerships

2.2.1 Organizational Partnership: ASDWA/EPA

Performance Based Training (PBT)

More than 60 percent of Washington citizens receive drinking water from a surface water source. Surface water treatment involves highly technical work and potentially significant risk to public health if not performed properly. The goals of performance based training (PBT) are to improve operator skills, encourage treatment performance that goes above and beyond the minimum regulatory requirements, and to simultaneously develop DOH staff skills.

PBT develops operator skills by maintaining long-term involvement with participating water systems and systematically training staff and administrators responsible for water treatment. Operators learn to implement process control, priority-setting, and problem-solving techniques. PBT training sessions help create an environment that motivates operators to produce high quality water. By emphasizing the significant role of operators in protecting public health and encouraging healthy

competition between operators at different treatment plants PBT inspires improved performance. DOH completed two PBT projects in 2017-18. To help us deliver an effective training, we hired EPA's national Area-Wide Optimization Program (AWOP) contractor, Process Applications, Inc. (PAI).

Small System PBT. Operators of seven small package plants that use contact absorption clarifier technology participated in the project. These small systems, located in southwest Washington, are challenged by limited budget, isolated location, and difficulty in recruiting and retaining qualified staff.

Treatment plant operators and DOH staff facilitators participated in six one-day PBT sessions led by PAI over a fifteen-month period ending in August 2018. DOH staff participated in each session as training facilitators who support operators and learn along with them. The project included a separate facilitator training session and development and delivery of six operator training sessions.

Operators gained valuable insights into their facilities, uncovering previously unrecognized problems and shortcomings at their plants. They corrected many of these during PBT. The training inspired operators to collaborate for on-going technical support, communication, knowledge sharing, and problem solving. With the training now complete, utilities have requested additional training to expand their water treatment knowledge.

Large System PBT. This project focused on the nine largest surface water treatment plants in our state. These rapid rate filtration plants supply drinking water to over half of our state's population. They typically have limited alternative supply options if their surface water supply is compromised. Large treatment plants face unique challenges. Layered management, staff specialization and multiple operators make communication and staff buy-in challenging.

Treatment plant operators and DOH staff facilitators participated in five three-day PBT sessions led by PAI over a fifteen-month period ending in June 2018. DOH staff participated in the sessions as training facilitators who support operators and learn along with them. The project included a two-day facilitator training and development and delivery of five training modules, with new content covering leadership, communication and management skills.

Organizational Partnership: Tribal Governments via Region 10 EPA

DOH participated in four Region 10 EPA-sponsored training events at EPA-regulated tribal water systems. The primary goal of the trainings was to respond to tribal requests for technical assistance and build capacity of the EPA Region 10 drinking water program.

In August, 2018 a distribution system optimization training event at the Muckleshoot Community water system gave DOH an opportunity to work alongside tribal operators and Region 10 EPA staff. Participants shared equipment, knowledge, and experience. DOH staff participated in a similar event at the Nisqually Public Works in June 2019.

In a May 2019 meeting of the Region 10 Area-Wide Optimization Program, staff from DOH and EPA conducted an optimization workshop at the Lummi Nation Arsenic Treatment Plant. The goal of the workshop was to gather plant-specific information and conduct studies to enhance the knowledge of both the Lummi Nation water operators and workshop participants. Findings and discussion in the final report from this workshop can be a part of a continuous improvement process for optimizing arsenic removal from the three wells supplying the Lummi treatment plant.

In August, 2019 DOH staff attended a weeklong training on Comprehensive Performance Evaluations (CPEs) at Spirit Mountain Casino in Oregon. The training location was a tribal system with membrane filtration. The CPE tool was only recently adapted to membrane filtration plants and we hope to apply the lessons learned in our state. EPA Region 10 funded the training, which was led by PAI, and ASDW provided travel support. Drinking water staff from EPA Regions 9 and 10, and Idaho, Oregon, and Washington participated alongside tribal operators.

2.2.2 Partnering with Local Health Jurisdictions (Regional Offices)

In addition to the statewide sanitary survey training for our LHJ partners who conduct surveys on our behalf, we also hold smaller, regional meetings with the LHJs. Topics covered in these meetings range from office updates, tips and reminders on conducting surveys, and continued professional development topics such as emergency response, chlorine residual testing best practices and well drilling and pump tests. Regional offices may also meet individually with each LHJ to review the DOH-LHJ contract and discuss items and issues in more detail in a smaller setting.

2.2.5 Partnering with Pacific NW Section American Water Works Assoc. (PNWS-AWWA)

2.2.5.1 Day with DOH

In 2017, DOH was approached by the officers of the Northwest Washington Subsection of the American Water Works Association and asked to present a one-day program to its members. The request provided an excellent opportunity to educate and inform water system operators and managers about our drinking water program and current water supply issues. In addition, the format we chose to present our information, through a series of panels, gave the attendees a chance to interact with DOH staff members on an informal basis and learn more about the people behind the regulation.

On the day of the event the venue was filled to capacity. DOH staff members mingled with the attendees prior to the start of the meeting, during breaks, and at lunch. Everyone appreciated the opportunity to meet one another face-to-face instead of by telephone, email, or the dreaded violation letter. The event was so successful and the reviews have been so great that we have been invited back each year. In fact, the Day With DOH has been so successful that it is now being sponsored by subsections all across the state.

2.2.5.2 Chlorine Residual Measurement and Lab Skills Class

Disinfection of drinking water is widely regarded as one of the most important advances in the field of public health. Chlorine, the primary disinfection method in Washington state, kills or inactivates harmful microorganisms present in source waters that can cause illnesses such as typhoid, cholera, hepatitis, and giardiasis, and provides a disinfection barrier in water distribution systems.

Accurately and precisely measuring chlorine residuals applies to all aspects of public water systems—surface and groundwater source treatment, distribution residual maintenance, installation, routine water quality monitoring, water main break repair, and investigation of potential cross connection backflow events and water quality investigations.

The need for increased operator training was a major recommendation of the Disinfection Data Integrity Project (2015). The yearlong study investigated disinfection measurement, recording, and reporting practices in thirty-three water treatment plants located in the northwest region of Washington state. Deficiencies were identified in all thirty-three treatment facilities that affect the accuracy of the calculated pathogen inactivation achieved by the disinfection processes. Pathogen inactivation level errors of over 100 percent were identified when more accurate data was used.

We developed the chlorine residual lab skills class in early 2018 as a “training in a box” to give drinking water staff and operators a better understanding of good chlorine measurement techniques and why they matter. The three and a half hour class provides operators with hands on lab skills to answer the question, “How do I know my instrument is working?” To maximize participation in the hands-on activities, class size is limited to twenty participants. Students work individually and in pairs to complete five workshops. Each participant is required to have their own chlorine test kit.

We are currently developing partnerships with PNWS-AWWA subsections to deliver the class to a wider audience. Our goal is to have all field staff proficient in chlorine residual measurement with multiple staff willing and able to teach these classes.

2.2.7 Public Works Board Trainings

Public Works Board (PWB) sponsors trainings at four locations around the state each year. These trainings are a collaboration of many state and federal agencies: DOH, Ecology, Commerce, Transportation, Rural Development, and Rural Community Assistance Corporation. The trainings are for small utilities and are free to anyone who wishes to attend. Attendees include board members, city council members, public works directors, water and wastewater operators, and consultants. Continuing education units are provided for all water and wastewater operators that attend. The

training topics include asset management, rate setting, and value planning. An infrastructure funding panel with state and federal funding agencies is also made available.

DOH staff support these trainings by planning and developing training material, presenting information on asset management or value planning, and participating in the funding panel.

2.2.8 WPUDA Consolidation Funding

DOH collaborated with Washington Public Utility District Association (WPUDA) on funding for consolidation projects. As result of these efforts, $5 million and $1.5 million of state appropriated funds were awarded to DOH for consolidation efforts in 2018 and 2019, respectively. This funding allows small, struggling water systems to become owned by a larger utility and for construction of needed water system improvements to achieve or maintain compliance with drinking water standards. A total of thirteen consolidation construction projects were funded that addressed:

- Existing public health issues, such as arsenic or nitrate exceedances; failing sources and distribution infrastructure; systems unable to maintain a functioning board to oversee water system operations and finances.
- In addition to the construction projects, two consolidation feasibility studies were funded ($30,000 each) to allow the study of a potential consolidation, costs of the consolidation, benefits of the consolidation, and public outreach to jurisdictions participating in the study.
- This grant funding is vital for consolidations to be successful as the system being consolidated typically bears all project costs. Without this grant source, the most likely path for a small struggling water system would be receivership. The grant allows for a more proactive and cost-effective approach to addressing issues faced by a number of small water systems.

2.3 Technical Assistance

2.3.1 Asset Management in the Office of Drinking Water

In April 2017, DOH established an Asset Management (AM) Work Group. This action was the result of a notice to the Drinking Water State Revolving Fund (DWSRF) team that EPA would soon request primacy agencies to incorporate additional asset management concepts into their planning programs.

The DOH Asset Management (AM) Work Group met regularly from April 2017 to April 2018 and was made up of eight DOH staff (three from DWSRF), a member of the Department of Ecology Waste Water Team, and our Region 10 EPA liaison. The Work Group's mission was to evaluate integration of AM concepts into the current DOH drinking water program. The end result was incorporation of key components of AM into DWSRF and water system planning requirements.

The AM Work Group approved the following definition through DOH management for statewide use: **Asset management** is the practice of managing all utility assets to address the total cost of owning, operating, upgrading, and replacing them, while delivering the appropriate level of service. Asset management, implemented through an **asset management program**, typically includes: asset

inventory, assessment of asset age, condition and remaining useful life; criticality assessment; and anticipated replacement date and cost.

AM plays a substantial role in assuring that water systems have the technical means to provide safe and reliable drinking water. A complete AM program will help a system budget to replace old and failing infrastructure. DOH wants water systems to realize that managing assets is a way of identifying and prioritizing systems needs for money, staff resources, both O&M, capital, etc. Each utility needs to know its own "the good, bad, and the ugly" list. Prioritizing what will cause the most liability or greatest loss of service is something that comes from an AM criticality assessment.

Every Group A water system is required to have a water system plan (WSP) or a Small Water System Management Program (SWSMP). DOH has included asset management concepts in planning requirements for some time, however, clarified requirements have been added to the draft Water System Planning Guidebook (to be published in 2020) and asset inventory tables were already provided in the SWSMP Guidebook. Over the last three years, the regional planners have begun to emphasize AM concepts at preplan meetings for WSPs and SWSMPs. In order to fully integrate AM into the Planning Program, the revised Guidebook will require a more detailed asset inventory and analysis of asset age, condition, remaining useful life, criticality, and cost of replacement in order to financially plan for replacement at or near the time of asset failure.

In order for a water system to be eligible for DWSRF loans, the water system is required to have a current WSP or SWSMP. Additionally, in an effort to promote AM, the DWSRF program started awarding bonus points on construction loan applications in 2017 for AM training attendance and/or for having an asset inventory. Starting in 2019, all funded DWSRF applicants are required to develop an AM program as part of their funded project (if they do not have one). Up to $40,000 of additional funding may be included in the funding package to assist systems with program development. Asset inventories can be provided in a variety of different formats, depending on system needs. DOH does not suggest, nor require, water systems buy expensive software or hire consultants to make an AM program. DOH and DWSRF recommend most water systems use the Rural Community Assistance Corporation's (RCAC) free excel spreadsheet (link on our DWSRF webpage).

2.3.2 Arsenic Treatment Optimization Program (ATOP)

Over the past decade in Washington state, more than 130 public water systems had to address naturally occurring arsenic concentrations above the maximum contaminant level (MCL) of 0.010 mg/L (milligrams per liter) in their water sources. Of these, more than 60 water systems installed new treatment facilities, mostly with oxidation-coagulation-filtration or iron-based adsorbents.

Arsenic is a known human carcinogen that can also cause non-carcinogenic health effects including high blood pressure, narrowing of the blood vessels, nerve damage, anemia, diabetes, stomach upset, and skin changes. In general, the lower the exposure, the lower the associated health risk.

Most of these treatment installations demonstrated they could produce reliable and consistently treated water that meets regulatory standards. However, in 2011, we found that 24 percent of

arsenic treatment facilities were unable to get results below the arsenic MCL. Some small water systems were struggling to get their arsenic treatment processes to work effectively.

We developed criteria to prioritize systems that needed help and began targeted technical assistance in 2012. Since then, we have seen an increase in the number of arsenic treatment facilities successfully treating below the arsenic MCL. As part of this ongoing effort, we:

- Examined different ways to evaluate arsenic treatment processes.
- Developed criteria for optimized operation of arsenic treatment to encourage water systems to make operational adjustments to provide a greater level of public health protection than that associated with just meeting the arsenic MCL.
- Mailed laminated copies of posters with the optimization goals to water system owners to post in the buildings that house their arsenic treatment facilities.
- Developed a monthly operations report for treatment plants, and collected detailed operational parameters.
- Tracked treatment performance based on monthly sample results.
- Provided technical assistance to systems and operators of arsenic treatment plants.
- Obtained monitoring equipment to allow basic troubleshooting of the plants.

To date, Washington's DWSRF Program has provided $21.3 million for water systems to install treatment facilities and implement non-treatment options to comply with the arsenic MCL. Most water systems that installed treatment facilities to remove arsenic have done so successfully. In many ways, the ATOP program has been built upon the ideas developed within the successful Area Wide Optimization Program (AWOP), supported by the Association of State Drinking Water Administrators (ASDWA) and EPA.

DOH continues to work with water systems to more closely monitor their treatment processes, provide technical assistance, and take compliance action in some cases. Due to these efforts, the concentration of arsenic in treated water has declined significantly over time.

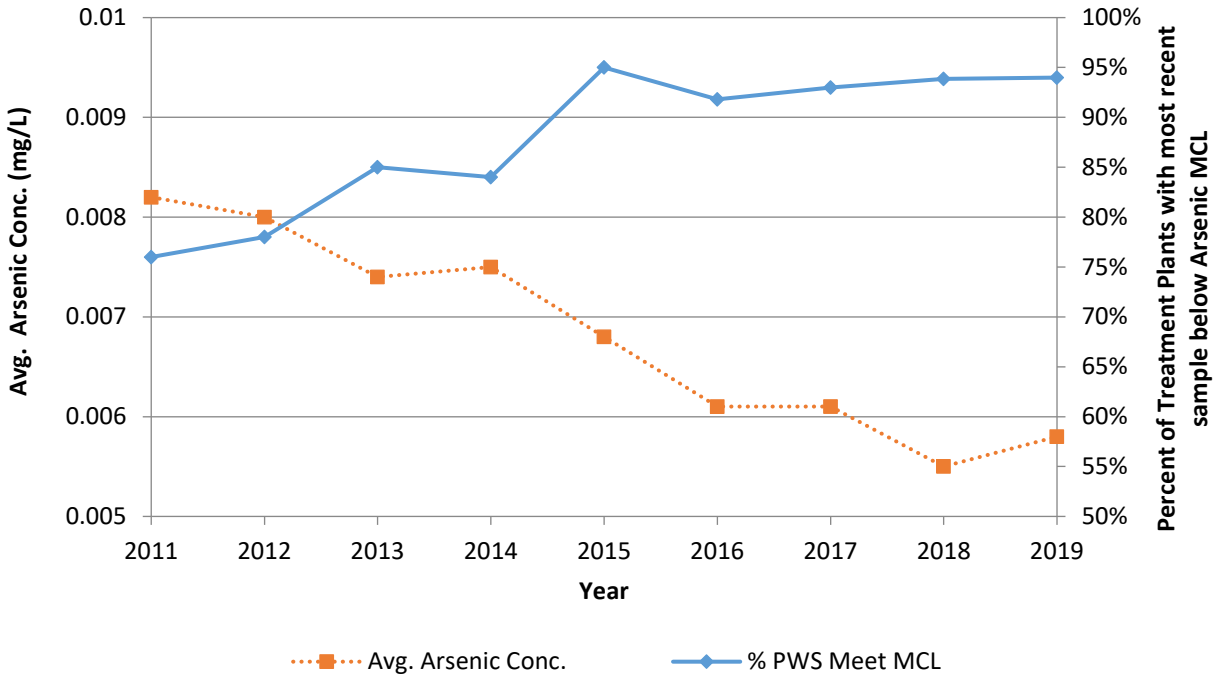


Figure 1: Improvement of water treatment plant performance to remove naturally occurring arsenic.

2.3.3 Surface Water

2.3.3.1 Area Wide Optimization Program (AWOP)

As an active participant in EPA's Area Wide Optimization Program (AWOP), our vision is to protect public health by assuring that surface water treatment facilities are properly designed, constructed, staffed, operated and maintained. We meet three time per year with staff from other Region 8 and 10 states, Region 10 EPA, ASDWA, and EPA's Technical Service Center to improve our capacity to achieve our public health mission. Maximizing performance of existing drinking water facilities is a key focus of AWOP. The training, tools and networking we receive through AWOP participation has yielded enormous benefits to our staff, utility operators and drinking water consumers. Most of the programs and initiatives described below stem from our AWOP participation.

Optimized Rapid Rate Awards Program. DOH recognizes water utilities that meet voluntary turbidity goals. A measurement of the cloudiness of water, turbidity is a key parameter to evaluate how well rapid rate filter plants are working. Low turbidity means better water treatment and better public health protection. DOH staff review turbidity data submitted by all fifty-nine rapid rate treatment plants on their monthly operations reports to ensure compliance with regulations. In addition, maximum daily turbidity values from the reports are entered into the AWOP Optimization Assessment Software computer program. Using this software, we rank systems according to their relative performance. We present bronze, silver, gold and platinum certificates or plaques to systems the first time they meet the turbidity goals for three, five, ten, and fifteen consecutive years, respectively. In 2019, four utilities achieved eighteen consecutive years of optimization (2001

to 2018). During the eighteen-year life of the program we have presented seventy-eight total awards and recognized thirty-six individual systems.

Turbidity monitoring results show that our conventional and direct filtration surface water treatment plants continue to perform above regulatory standards. Washington State Rapid Rate Treatment Plant Performance Trends (PDF) illustrates turbidity reduction performance improvement by all rapid rate treatment plants in Washington as a group from 2001 through 2018.

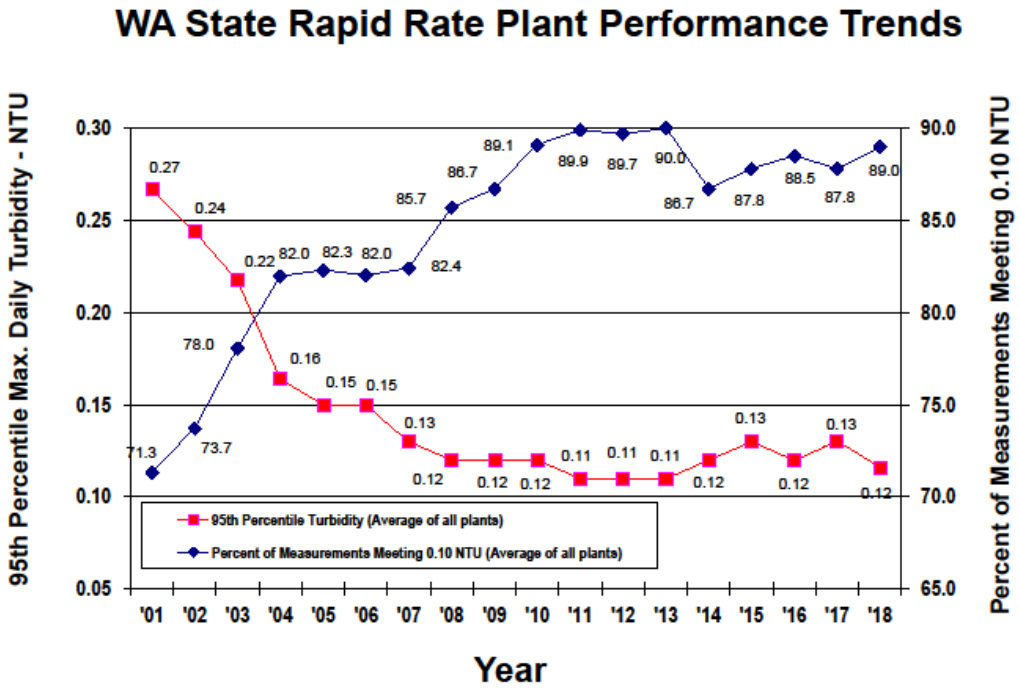


Figure 2: Optimization of rapid rate water treatment plants for turbidity removal in Washington state.

2.3.3.2 Washington Optimization Network (WON)

WON grew from and sustains the capacity-developing elements which were identified and strengthened with the Large System PBT program. A culminating objective of PBT was nurturing the formation of a self-directed alliance of large system operators for on-going technical support, knowledge-sharing, and problem-solving. WON operators (and some managers) from eight of the original nine PBT systems continue to meet for optimization workshops held approximately twice per year on a rotating basis at participating plants.

2.3.3.3 Slow Sand Filter (SSF) Optimization Guidance.

SSF offers advantages which make them useful in rural communities. Even though SSF are not difficult to design and operate, special care must be taken to ensure their efficient performance. Working with our AWOP partners in Oregon and Idaho, we developed comprehensive state of the art guidance for the design and operation of this technology.

2.3.4 Data Integrity Initiatives

2.3.4.1 Monitoring guidance document for treatment plants.

To reach our goal that all water quality information gathered is trustworthy over its entire life cycle—from the point of sample collection through analysis, storage, retrieval, and reporting to managers, customers, and regulatory agencies, we published a new guide for managers and operators of surface water treatment facilities. The thirty-nine-page document, "Monitoring Surface Water Treatment Processes," incorporates tips and lessons learned from several data integrity efforts. It covers a broad array of topics including an overview of Surface Water Treatment rules, creating a monitoring plan, acceptable analytical methods, collecting samples, measuring water quality and physical parameters, standard operating procedures, recordkeeping and reporting, and resources for more information. Treatment plant operators gave us positive feedback and we published an updated version in late 2019 based on their input. Nearly all of the topics covered in this monitoring best practices document also apply to any type of water treatment facility. We are preparing to expand the distribution of this document to all water utilities.

2.3.4.2 ASDWA sponsored Webinar Series.

ASDWA hosted a series of three national webinars with DOH on Drinking Water Data Integrity in January and February 2018. Two of DOH's data integrity leaders were the lecturers. The webinars were free and the first two were open to anyone interested. The third webinar was limited to state regulatory agencies.

Unlocking the Black Box—Exploring Turbidity Data Integrity at Water Treatment Plants; reviewed project findings, recommended instrument settings, and identified best practices to ensure that turbidity data is correct, and that filtration plants are providing effective treatment. This information was based on DOH's study of turbidity monitoring, recording and reporting practices in twenty-five rapid sand filter plants located in the Northwest Region of Washington where deficiencies were found in all twenty-five plants that could or did affect the accuracy of the turbidity data reported to the state.

Opening Pandora's Box—Disinfection Data Accuracy for Water Systems; shared study findings and explored ways to improve utility practices. This information was based on DOH's Disinfection Data Integrity Project that investigated disinfection measurement, recording and reporting practices in 33 surface water treatment plants located in the Northwest Region of the state.

Shining the Light on Data Integrity: a State Perspective' targeted other state drinking water programs. It included a brief recap of findings from the first two webinars and focused on implementation issues from a state regulatory agency perspective. Topics included lessons learned, dealing with limited resources, follow up activities and potential compliance/public health issues that can arise during a research effort. Recordings of the three webinars are posted on the ASDWA webinar recordings webpage.

2.3.5 Technical Assistance—Engineering and Planning Review

DOH's three regional offices provide several services to the over four thousand Group A public water systems. Each region has a team of engineers and planners that are the main points of contact with these systems. DOH staff review engineering reports, construction documents, and planning documents. Regional engineers review these documents with a focus on risk reduction and public health. They ensure compliance with regulatory standards, but also to share our collective experience. DOH's ultimate goal is to help the design engineer and the water system owner build a project that will be safe and reliable now and into the future. We strive to ensure our review is value added, by asking questions, exploring risk versus resources in the design phase, and helping owners and design engineers identified potential consequences of operational failure.

The following are the combined regional offices engineering projects and water system plans.

Table 2

Items	2017	2018	2019	Total
Engineering	328	377	328	1,033
Planning	73	93	71	237
Grand Total	401	470	399	1,270

Prior to many of water systems even submitting an engineering project for DOH's review our engineers and planners spend countless hours on technical assistance, discussing treatment options, design constraints, operational concerns, and funding opportunities with system owners, operators and design engineers.

Below are a sampling of some of the projects we have reviewed and approved over the last three years.

Representative Projects

Corrosion Control—Lead and Copper Reduction at customers taps

- City of Spokane (Spokane—Removed more than 200 lead service lines.
- Lake Margaret Water (King)—Modified corrosion control treatment to restore compliance with the lead action level.
- Olympia (Thurston)—Installed system wide corrosion control treatment reducing lead levels by 85 percent and copper levels by 90 percent at customer's taps.

Perfluorinated Alkyl Substances (PFAS) Treatment

- JBLM McChord Field (Pierce)—Installed four granular activated carbon (GAC) treatment plants at four wells to lower PFAS levels to below the EPA's Lifetime Health Advisory level.
- Lakewood Water District (Pierce)—Installed granular activated carbon (GAC) at a wellfield for PFAS removal. Replaced existing air stripper towers for tetrachloroethylene removal at the same wellfield.

- Town of Coupeville (Island)—Installed granular activated carbon (GAC) at a wellfield for PFAS removal. Extended the distribution system to property owners whose wells were contaminated with PFAS.
- City of Issaquah (King)—Installed granular activated carbon (GAC) at a shallow well for PFAS removal.
- Airway Heights/Fairchild AFB (Spokane)—Installed granular activated carbon (GAC) at the main producer well and used during the summer to provide peak water needs. City of Spokane still supplies all their drinking water needs at this time.

Surface Water Treatment

- City of Walla Walla (Walla Walla)—Upgraded treatment infrastructure to meet the requirements of the LT2ESWTR.
- Town of Cusick (Pend Oreille)—Completed filter plant upgrades included adding filter to waste, replacing the deteriorated control system, and replacing the gas chlorine with a liquid hypochlorination system.
- City of Port Townsend (Jefferson)—Installed and commissioned filter plant on their previously unfiltered source.
- Boistfort Valley (Lewis)—Install new membrane plant at Adna to replace aging treatment plant.

Consolidations for Public Health Protection

- Lorayne J (Benton) water system consolidated into the City of Richland water system to resolve high nitrate levels.
- Green Ridge Estates (Spokane) and East Side Liberty Lake Improvement Club consolidated into Liberty Lake Sewer and Water District to resolve E. coli and aging infrastructure issues.
- My Bar & Grill (Spokane) consolidated into City of Spokane to resolve source protection issues.

Disinfection Treatment

- Cove Beach (King)—Installed 4-log virus inactivation hypochlorination treatment.
- Sallal Water Association (King)—Installed hypochlorination treatment due to *E coli* detections in the distribution system.
- Silverline Resort (Okanogan)—Installed hypochlorination system to resolve source protection issues.
- Jameson Lake Resort (Douglas)—Installed hypochlorination system to resolve source protection issues.
- Skookumchuck 612 (Thurston)—Install 4-log virus inactivation hypochlorination treatment

2.3.6 Water System Design Manual

DOH released the third edition of the Water System Design Manual (WSDM) in December 2009. Over the past several years, there have been many changes in the drinking water profession. As a result, in 2015, we convened a group of senior DOH engineers to start to the process to update this widely used reference. After years of work and input from dozens of people in the drinking water

profession, we released the fourth edition of the WSDM in October 2019. This comprehensive technical reference for engineers and water system staff now weighs in at more than five hundred pages and about 150,000 words.

While the WSDM is used as an essential reference in Washington state, it is also widely used by drinking water professionals in other states and countries. For example, both the Indian Health Service (IHS) and the United States Agency for International Development (USAID) use it as technical reference. As such, it supports the technical capacity of water systems throughout the world.

2.3.7 Seawater RO Program

Desalinating seawater using reverse osmosis (RO) treatment has proven technically and financially feasible for several of our island located water systems that have very limited groundwater and surface water supplies. There are currently fourteen active seawater sources that use reverse osmosis with chlorination for treatment. All of the systems are located on islands with the majority of the systems located in San Juan County and one system each in Skagit, Snohomish, and Whatcom Counties. Several of these systems use Seawater RO as their primary water source throughout the year. These systems serve either very small communities or small business entities.

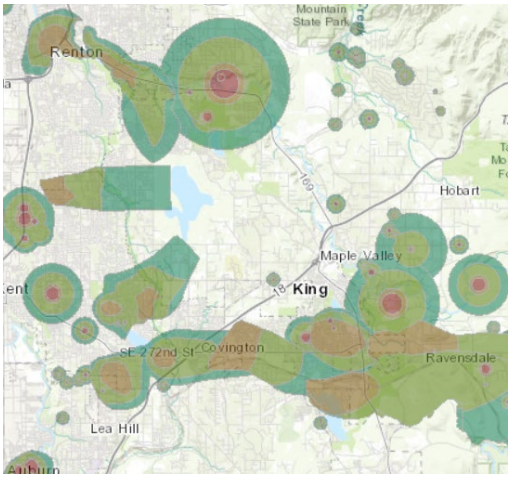
Continued reviews and on-site investigations have led to better understanding of best practices such as required pH/alkalinity treatment and recognition of concentrated brine production streams as a useful commodity. The WSDM update included an expanded section on seawater RO. It covers not only design but also operation and maintenance considerations for design engineers and operators. One of DOH's ongoing partnerships is to support the training provided by PNWS-AWWA Northwest Washington Sub-Section specifically for RO design engineers and operators. DOH staff participated in the last training session that was held in 2017.

2.3.8 Source Water Protection Program

DOH's Source Water Protection Program (SWP) provides information, tools, resources, guidance, and support to water systems and others to promote and achieve source water protection statewide. DOH priorities include:

- Providing technical assistance and grants to help water systems develop, enhance, and implement their source water protection plan (using SWP DWSRF set-aside funds).
- Maintaining and enhancing a public geographic information system (GIS) mapping database that includes source water protection areas, potential contaminant sources, water system service area boundaries, and other key information.
- Establishing interagency partnerships with key federal, state, and local agencies to ensure their programs, messages, and decisions incorporate source water protection as appropriate.

Mapping Tool and data



DOH maintained and improved our SWAP GIS web-mapping tool with source water protection area data. This tool is an important part of Washington's approach to educating and informing agencies and the public about source water protection. The SWAP site is a valuable resource, with an average of approximately 18,000 webpage visits each month. DOH provided Source Water Assessment Program (SWAP) GIS data to other state and federal agencies. For example, DOH regularly provided up-to-date source water protection area data to the state departments of Natural Resources, Ecology, Agriculture, Transportation, and local governments. They make permitting decisions for facilities, water quality, timber buffers, road construction, and pesticide management compliance advised by this information.

Technical Assistance

DOH continues to provide technical assistance to water systems through presentations at multiple conferences, site visits to the source protection areas, and one-on-one consultations. DOH engages and educates water systems and other partners on the principals of source water protection. DOH also emphasizes how efforts today can protect a system's source into the future.

In 2017 DOH determined the need to commit additional resources to review and provide advice on local governments' ground water protection ordinances. It is clear that ground water protection occurs at the local level through the permitting processes. Through these ordinances, we achieve substantial implementation of the source water protection program. As a result, we added an additional dedicated FTE to the program and have expanded our technical assistance to local governments.

DOH now regularly provides information to local governments about their role in source water protection, including evaluating and commenting on local land use ordinances and State Environmental Policy Act (SEPA) decisions that relate to ground water protection and CARA ordinances. DOH's goal is to provide direct and targeted technical assistance to local jurisdictions developing statutorily required updates to comprehensive plans and development regulations, focused on critical areas/critical aquifer recharge areas and related aspects; and occasionally related to local permitting issues.

Additional examples of local government source water protection related activities include:

- Provided formal written comments on approximately fifty-eight periodic notices of updates and amendments to local comprehensive plans and development regulations, with emphasis on critical areas/critical aquifer recharge areas, and the public water component of utilities and capital facilities elements.

- Provided formal written comments on over eighty-five notices of environmental determination under SEPA for source water protection implications. Most represent development projects statewide with relationships to established wellhead protection areas, or those established in conjunction with public water system requirements for the project. Upon local agency request, we provided follow-up technical assistance associated projects and comments.
- Participated in the Ruckleshaus workshop (legislative inquiry into comprehensive growth management reform), to understand potential impacts of changes to regulation of critical areas and critical aquifer recharge areas.

DOH continued to disseminate source water protection tools, resources, notices about funding availability, and training opportunities via our website and partners. DOH developed three new publications: *Wellhead Protection Areas: Protecting Drinking Water* 331-634; *Wellhead Protection Areas: Delineating Wellfields* 331-635; and *Assessment of Your Wellhead Protection Delineation Method* 331-636; and updated our *Source Water Protection Grant Guidelines* 331-552. You can find all of these documents on our webpage. We also regularly review and update other source protection related publications.

DOH, along with regional office staff, worked with various local governments to identify emerging source water protection issues and identify possible solutions (such as feasibility studies, facilitation, development of ordinances, and seeking additional funding).

Partnerships

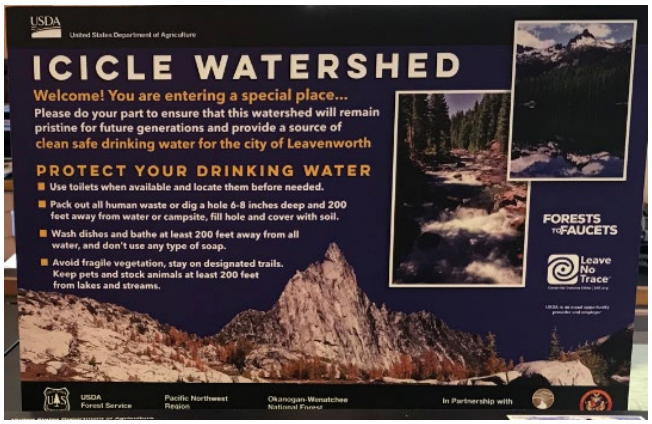
DOH strengthened partnerships with key state and federal agencies including the departments of Ecology (Clean Water Act lead agency), Agriculture, Natural Resources, and the U.S. Forest Service, to raise awareness about the Source Water Program and the need for, and importance of, protecting drinking water from contamination and loss of supply. We collaborated on projects with mutual benefits to drinking water and fish through the Drinking Water Providers Partnership. DOH staff actively serve on the Washington well-drilling technical advisory committee. DOH also worked with the Office of the Columbia River and Department of Commerce on long-term water supply challenges faced by mid-Columbia municipalities. DOH is an active member of the Lower Yakima Groundwater Management Area. We worked closely with Department of Ecology on Underground Injection Control program guidance for storm water.

Grant Funding

DOH has a Source Water Protection Grant Program, which uses DWSRF set-aside funds, available to Group A public water systems for projects that result in improved source water protection, or resolve water quantity and water quality issues. Typical grants are $30,000. In this reporting period, DOH issued fourteen grants for a total of $326,000 to fund a number of high-priority source water protection projects. Examples include:

- Prepare for Watershed acquisition.

- Identify critical aquifer recharge area.
- Identify shallow sources with declining groundwater quantity.
- Develop source protection planning documents.
- Public outreach and education campaigns.
- Alternate source feasibility studies.



2.3.9 *Legionella* and Building Water Systems

The incidence of Legionellosis, a respiratory infection caused by bacteria in the genus *Legionella*, has increased 550 percent since 2000 and is now the most commonly reported cause of drinking waterborne outbreaks (Benedict et al., 2017; CDC, 2019). The biggest threat of Legionnaires' disease appears to come from building plumbing systems when the organisms proliferate and become aerosolized. Outbreaks are associated with potable water within building plumbing systems, cooling towers, hot tubs, decorative fountains, and industrial waters (Garrison et al., 2016). The Centers for Medicare & Medicaid Services (CMS) issued a June 2017 letter (S&C 17-30 Medicare/Medicaid Legionella Requirement) requiring all Medicare certified healthcare facilities to have water management policies and procedures in place to reduce the risk of growth/spread of *Legionella* and other opportunistic pathogens in building water systems (CMS 2017). This directive and increased awareness by insurance companies has prompted many large institutions across the USA to install whole building treatment systems in order to minimize the risk of Legionellosis.

DOH responded to this increased Legionella awareness by increased participation in ASDWA building water system investigation and development efforts, with AWWA premise plumbing sub-committee participation including co-authoring a Legionella article in the AWWA OpFlow, and development of guidance for staff. The introduction to this guidance is provided below.

Existing buildings (primarily medical facilities) are installing treatment to their water supply that they receive as direct service customers from existing, regulated Group A public water systems. Installation of whole system treatment triggers regulation of the building water system under WAC 246-290-020 as a regulated public water system (PWS). These buildings can be quite large serving many people (thousands), have significant financial resources and operate and maintain varied complex systems like HVAC and medical instrumentation. Planning and engineering is required for these unique types of water systems under sections 105 and 110 of WAC 246-290. The scope and detail needed for planning and engineering for these situations is not adequately addressed by existing DOH guidance that relies primarily on the SWSMP explicitly developed for small water systems. The intent of this guidance is to achieve explicit planning and engineering intent of sections 105 and 110; and the monitoring and reporting intent under sections 300, 451, and 455 in a manner suitable to this setting. While the main driver behind this paper is microbial treatment surrounding *Legionella*, any building treatment system such as corrosion control, should be addressed in a similar manner.

2.3.10 Sanitary Survey Program

Sanitary surveys of public water systems are key to capacity development. Regular inspections of water systems provide opportunities for education and technical assistance for operators and other water system personnel.

The Sanitary Survey Program coordinates and administers inspections of all water systems in Washington. Inspections occur every three or five years, depending on system type, source, and performance. During an inspection, surveyors physically inspect the water system components, review the management and operations of the water system, identify significant deficiencies that would allow contaminants to enter the system, and provide other observations and recommendations for improvement. When DOH finds significant deficiencies, we explain how to correct them, set deadlines and follow up to make sure the system addresses the deficiencies. We also document our observations and recommendations associated with steps the water system can take for improved technical, managerial and financial capacity.

Some survey findings warrant further follow up by other specialists in the regional offices. These are called “internal referrals.” Examples include potential GWI (groundwater under the influence of surface water) and improper operation and monitoring of disinfection systems. In 2018, we began to use more formal procedures to ensure action is taken in response to internal referrals.

DOH continues to encourage water systems to find and fix deficiencies as part of their ongoing operations and maintenance activities, reducing the number of deficiencies found during surveys. We include information on how to conduct a self-inspection in our survey notification letters to water systems.

In 2018, we made enhancements to our data system that enables us to track the occurrence of significant deficiencies and other findings to measure trends that indicate success in building capacity to prevent future occurrences.

Our Local Health Jurisdiction (LHJ) partners survey the state’s numerous smaller public water systems on our behalf. (We also have a limited number of independent contractors who conduct surveys for DOH.) LHJ staff conduct more than half of the hundreds of (and sometimes more than one thousand) sanitary surveys performed each year. Without our local health partners, DOH could not meet our responsibilities to complete effective sanitary surveys within required timeframes.

Table 3

2017

Region/Surveyor	CWS	NTNC	TNC	Totals
ERO DOH Surveyors	127	15	31	173
ERO LHJ/3rd Party Surveyors	69	22	94	185
NWRO DOH Surveyors	143	3	32	178
NWRO LHJ/3rd Party Surveyors	110	6	44	160
SWRO DOH Surveyors	104	4	22	130
SWRO LHJ/3rd Party Surveyors	144	9	62	215
Totals	697	59	285	1041

2018

Region/Surveyor	CWS	NTNC	TNC	Totals
ERO DOH Surveyors	46	14	66	126
ERO LHJ/3rd Party Surveyors	25	8	98	131
NWRO DOH Surveyors	135	6	44	185
NWRO LHJ/3rd Party Surveyors	118	4	31	153
SWRO DOH Surveyors	169	4	19	192
SWRO LHJ/3rd Party Surveyors	106	16	69	191
Totals	599	52	327	978

2019

Region/Surveyor	CWS	NTNC	TNC	Totals
ERO DOH Surveyors	96	8	20	124
ERO LHJ/3rd Party Surveyors	51	5	62	118
NWRO DOH Surveyors	82	7	25	114
NWRO LHJ/3rd Party Surveyors	60	7	54	121
SWRO DOH Surveyors	54	7	23	84
SWRO LHJ/3rd Party Surveyors	57	20	93	170
Totals	400	54	277	731

Training is key to a competent sanitary survey workforce. During the period 2017-2019 DOH held two statewide trainings.

- The 2017 and 2018 statewide trainings included “Beginner” and “Experienced” tracks to better tailor training strategies to the needs of the participants. During this period we had many new LHJ staff joining the statewide sanitary survey workforce, and we created beginner curriculum comprised of learning modules related to the basics of public water systems and how they work, and how to conduct a sanitary survey. The Experienced Track offered advanced topics for continuing education and professional development of seasoned surveyors.
- In 2018 we included a field training for both the beginner and experienced LHJ staff. Field trainings are widely valued and requested by our LHJ partners. In previous years the field component was organized and instructed by an outside contractor. In 2018, we used in-house

resources to plan and implement the field training. Students in the experienced track were assigned to small groups and guided through stations set up at participating water systems in the Ellensburg area. Groups reported back the next day on what they learned and observed. Typical of the positive feedback we received is the following, "As anticipated, I learned a great deal and found the hands on-experience invaluable, plus connecting with LHJ drinking water staff from other counties and DOH staff from other regions."

Regional meetings

- In addition to the statewide trainings that, since 2018, occur every other year, each of our three regional offices generally also holds an annual regional meeting for additional training, mentoring, networking and professional development. Capacity development is an underlying theme of the regional trainings in that our emphasis is on helping water systems be successful.

Co-surveys and mentorship

- Regional engineers and other DOH staff periodically conduct co-surveys with the LHJ staff, and review the LHJ survey reports and provide feedback for continued growth in proficiency in conducting sanitary surveys.

Individual meetings with the LHJs

- Individual meetings with the LHJs, in which DOH staff meet with the LHJ staff to discuss the DOH-LHJ contract and address other issues, also serve to supplement training and provide clarification on DOH expectations.

LHJ Survey Tools

- In 2018, we updated the Field Guide for LHJ and third-party surveyors. The field guide helps ensure consistency in follow up to survey findings, and provides comprehensive information and guidance for helping water systems be successful.
- The third-party checklist covers not only technical issues but also many aspects of capacity. It is required that our LHJs use the checklist. Where capacity is lacking, standard language is inserted into correspondence to the water system to aid them in addressing the gap.

Technical assistance and other field work

- DOH contracts with the LHJs also allow for the provision of technical assistance outside of the regular survey activities. Technical assistance is provided to help the water system overcome barriers to success. Special Purpose Investigations (SPIs) in follow up to water quality issues are also performed on behalf of DOH within the terms of the DOH-LHJ contract. The SPI checklist is designed not only to determine the cause of current water quality problems, it also serves to prevent future water quality problems.

2.4 Managerial Assistance

2.4.1 Operator Certification

Our mission in the Office of Drinking Water is to work with others to protect the health of the people of Washington state by ensuring safe and reliable drinking water. The Waterworks Operator Certification ensures the success of this mission by coordinating, collaborating, and communicating with water systems, certified operators, governing bodies, and our training partners. Our program focuses on supporting our operators and certifying qualified and capable professionals. A waterworks operator's certification is more than just proof of an operator's knowledge; the certification shows the operator's integrity and commitment to protect public health and uphold our rules and standards.

The DOH program facilitates the certification, renewals, and professional growth of four thousand waterworks operators and fifteen hundred backflow assembly testers. We also ensure compliance with our operator rules. Over 99 percent of the 2,857 drinking water systems required to have a certified operator maintain that capacity.

DOH has seen significant changes to our Waterworks Operator Certification Program since 2016.

- As part of Governor Inslee's paperless initiative; we developed and implemented:
  - A new electronic content management system, streamlining our candidate application tracking and review process.
  - An on-line candidate application submittal and payment program.
  - Waterworks Operator on-line payments for certification renewal.
  - An on-line interface to allow certified waterworks operators to view their (up to the minute) professional growth reports, print validation cards, and update their contact information.
  - Operator email validation process, which is nearly 99 percent for both certified operators and backflow assembly testers.
  - On-line tool for third-party trainers to submit trainings for assignment of continuing education units (CEU).
- Ensuring DOH remains responsive to our public drinking water systems, operators, and stakeholders; we adopted some rule changes: we adopted revisions to our Operator Certification Rule (WAC 246-292) that:
  - Expanded the Operator in Training (OIT) designation to all levels of certification and addressing concerns from DOH stakeholders. This change allows certified operators who lack the required operating experience to move up to the next level to show potential hiring agents they have the knowledge to advance and just need an opportunity to work.
  - Changed the experience requirements for the Cross-Connection Control Specialist (CCS) certification to allow industrial water, wastewater treatment, engineering, or operations consultant experience to count toward certification requirements. This change allows

more portability of certifications because cross-connection control is universal in protecting high quality water supplies from lower quality uses.

- We worked with the Department of Ecology on the DOH operator certification and cross-connection control requirements in their "new" Reclaimed Water Rule. This rule requires operators certified as Distribution Managers and CCS to operate, maintain, and repair reclaimed water distribution systems. The rule includes extensive detail on protecting reclaimed water from lower quality water through cross-connections.

2.4.2 Workforce Development and Succession Planning

Utility infrastructure is the foundation of social, economic, and environmental health for every community in Washington. Waterworks operators are the most important asset within drinking water systems. Our existing infrastructure is aging concurrently with the workforce operating, maintaining, and repairing it. We are witnessing a mass of operator retirements while our infrastructure fails. DOH also sees new opportunities to organize, collaborate, and take action by ensuring a highly trained, dedicated, and experienced certified operator workforce is in place to protect public health.

A recent DOH survey highlights the urgent need to recruit and train the next generation of utility workers.

- 32 percent of existing certified waterworks operators will retire within the next five years.
- 50 percent of respondents that will retire in the next five years work in rural counties.
- 51 percent of existing certified waterworks operators will retire in the next ten years.
- 70 percent of respondents had over ten years of industry experience.
- 70 percent of respondents reported some level of college experience or a college degree.

Over the last three years DOH has seen a 34 percent increase in new operators while the total number of operators in the state remains at 4,000. DOH has seen a relatively constant number of certified operators over the last fifteen years while Washington state has seen a 21 percent increase in population over that time. Population increases represent more than an increase in the number of customers per operator, it coincides with an increase in:

- Media (and social media) demands.
- New and changing water quality requirements.
- Capacity demands for water resources.
- New or updated infrastructure systems with advanced technology.
- Evolving government regulations that require utilities to train and re-train operators.

It's common to hear that a water system posted a job and did not get any qualified candidates to apply. A certified operator must have experience working for a public drinking water system. The more complex the system, the more experience required. Generally, a community's constrained financial position limits ability to pay for OIT. Without the opportunity to gain the requisite experience, it is a significant challenge for systems to find certified operators. The barrier is that

communities cannot consistently pay competitive wages for certified operators or compensate OIT staff.

DOH needs to urge utilities to consider employee needs as much as water utility needs when recruiting and retaining millennials and a diverse workforce. DOH needs to focus attention on changing cultural thinking that jobs in these trades aren't "good" and model a marketing strategy similar to that advocated by Mike Rowe Works. The goals would be to change the perception that without a college degree an individual is less capable, and to highlight the value, stability, and vital work of the waterworks operator trade.

This poor perception even affects Washington's state agencies where the state compensation system does not offer a competitive salary to fill Certified Waterworks Operator positions for state-owned drinking water systems. For example, the state compensation system does not have a classification for a level 4 operator, despite the fact that level 4 operators are identified under the regulations for Waterworks Operator Certification (Chapter 246-292 WAC) and the Associated Boards of Certification national operator certification standards. The inability to fairly compensate and ensure high quality candidates extends to the Office of Drinking Water where we're challenged to fill our two Certified Water Operator positions with highly skilled and experience candidates and we're losing the ability to provide "boots-on-the-ground" experience and perspective to certified operators, water systems, and our staff.

DOH needs to elevate the importance of understanding workforce development as a pipeline. The key challenge for addressing workforce recruitment, retention, and retirement is understanding that the pipeline needs to stay full to be functional. Too many utilities are waiting until someone retires to think about filling a position.

Evergreen Rural Water of Washington (ERWOW) recently developed and implemented a new apprenticeship program to help water systems think proactively about succession planning. These two-year apprenticeships requires four thousand hours of on-the-job training and 288 hours of classroom instruction.

EPA announced the Water Workforce Initiative to help cities and communities across the country that are facing critical staffing shortages. The goal of this new initiative is to provide federal leadership, collaborate with partners, and increase public awareness to bolster interest in water sector careers. Other agencies currently engaged in recruitment efforts include:

a) National Water Sector Workforce Convening.
b) American Water Works Association.
c) Water Environment Federation.
d) Baywork.
e) Veterans' certification programs, such as From MOS to Job and Helmets to Hardhats.

Workforce development issues effect the economic, social, and environmental vitality of our communities. As a state, we must do more to change the perception of the utility operator for decision makers, customers, consultants, and even the operators' own self-image. We trust operators to deliver reliable water services to our families twenty-four hours per day, seven days a

week. This is a Washington state issue and requires more resources and influence than DOH is currently afforded.

The following ten opportunities could address some current and future workforce development concerns.

1. Invest in cultural change to encourage work in the trades similar to Mike Rowe Works Foundation.
2. Promote and offer scholarships to trade schools and community colleges focused on getting students into the workforce; as an alternative to four-year degree programs.
3. Create strategies that remove perceived barriers for increasing the number of required operators at a water system. This includes focusing on decision makers and regulatory agencies to educate and empower change.
4. Promote and fund regionalization efforts to combine public water systems, eliminate low quality water sources, and share experience and equipment between utilities.
5. Establish incentives, such as state supplemented pay for certified operators, or partial salary compensation for reducing recidivism of formerly incarcerated candidates.
6. Create a Rural Washington Public Works Corps program (similar to AmeriCorps). This program would fund experience and education in exchange for work in rural areas for a period.
7. Encourage, promote, and develop apprenticeship programs focused on getting new operators into the workforce. Evergreen Rural Water of Washington implemented a new operator apprenticeship program in 2019.
8. Value of water communications partnership and outreach with the Office of Student Public Instruction and with Boards of County Commissioners to highlight the online Associate of Arts program in Water and Wastewater Operations provided by Green River College.
9. Explore public private partnerships that can promote water sector workforce development.
10. Tie the investment of public dollars for capital infrastructure to promoting career experience for year eleven and twelve high school students. Expose them to the planning, design, construction, and operation of our public works projects as part of their STEM programs.

2.4.3 Cross-Connection Control Program

A cross-connection is as an actual or potential connection between a drinking water system and an unapproved water supply or other potential source of contamination. When the pressure of a potential contaminant source exceeds the potable source, the flow of water can reverse direction and pull the potential contaminant into the water system. According to an American Water Works Association (AWWA) article on waterborne disease outbreaks (AWWA Journal), 45 percent of all waterborne disease outbreaks since 1996 are because of chemical and microbial contamination from cross-connections.

The following are examples of backflow incidents that have occurred in Washington since our last report.

1. Contamination from a heating boiler. An unprotected bypass around an RPBA on the boiler make-up line was left open after maintenance. An unprotected bypass was found in a neighboring building also, which initiated a hazard survey program.
2. Water line was connected from a hose bib to the priming port for a sump/recycling pump on a granite cutting saw. The contents (~100 gallons) of the sump was pumped into the distribution system.
3. Homeowners pumped water from an irrigation ditch into the distribution system. A pump was installed in the irrigation ditch and piping was connected to the existing irrigation system without disconnecting from the potable water system. A backflow assembly was installed, but it was installed backward.
4. Sewage from an RV back pressured into the distribution system when a camper attempted to flush their holding tank. Hose bib vacuum breaker on a frost-free hydrant is not designed to prevent backpressure incidents.
5. Hydroseed company connected to a fire hydrant to fill their application tank. An error in connecting the machine resulted in injecting hydroseed into the public drinking water system.
6. Poor maintenance of an air-actuated water valve in a dentist office resulted in compressed air entering the building plumbing and the public drinking water system.
7. An air compressor was connected to the fire suppression system at a lumber mill. Intending to blow the water out of the fire lines before a winter storm, the company injected the contents of the fire lines and compressed air into the drinking water distribution system.
8. An “off taste” was reported at a school during a holiday closure. A boiler make-up line was found to be bypassed and boiler chemicals entered the building plumbing.
9. During routine distribution system flushing, the water utility exceeded the normal capacity and lowered the pressure in the higher elevation of the system. Customers reported hearing “sucking” noises in their fixtures. The contents of the plumbing in fifteen homes was pulled into the drinking water system.
10. A failed carbon dioxide regulator caused carbon dioxide to enter the drinking water system. The carbon dioxide passed through a carbonated beverage dispenser that was not properly installed with appropriate backflow protection.

With an aging water system infrastructure in the United States, having certified operators trained in cross-connection control is critical to protecting the public from potential waterborne illnesses. DOH has increased the focus on the certification of CCS and compliance tracking of cross-connection control.

In 2014, DOH began limited compliance activities; a strong technical assistance program, and increased training opportunities for our staff, certified operators, and decision makers. Since then, compliance with CCC rules continues to trend upward. More than one hundred new CCS were

certified, and DOH protection rates from system connections posing a high-hazard risk improved more than 10 percent.

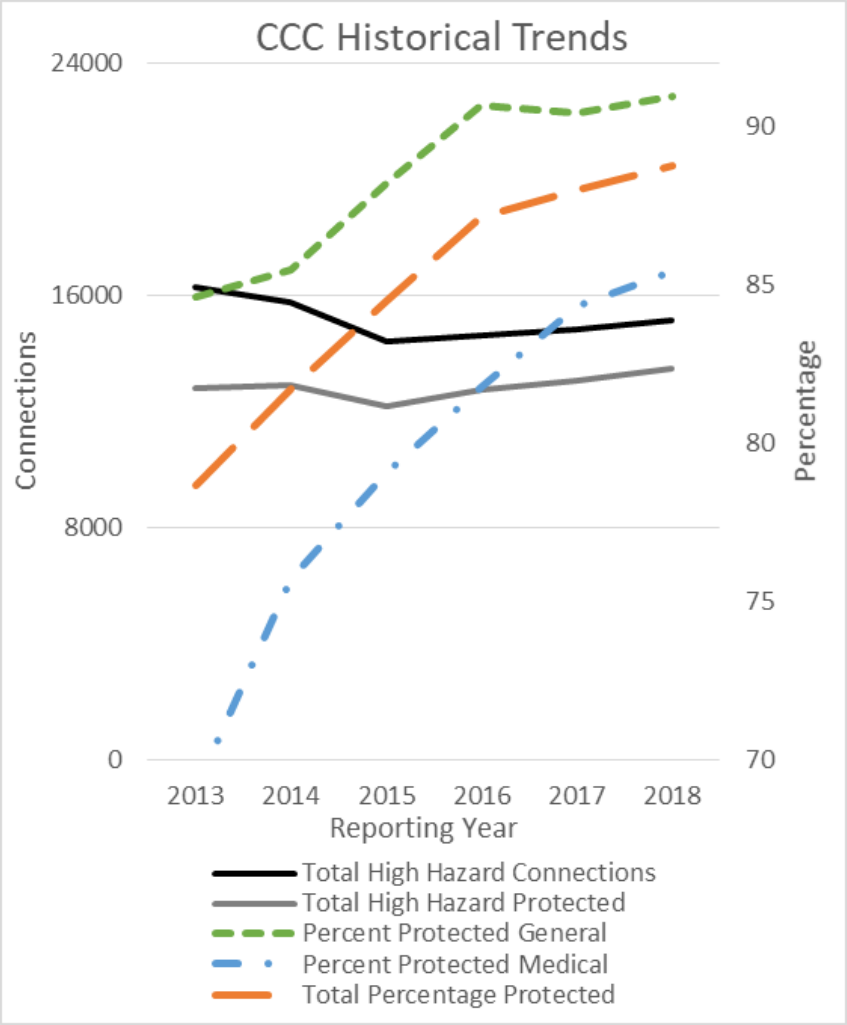


Figure 3: Cross-connection control coverage for high hazard locations in Washington state.

DOH's CCS position has remained vacant since the last report and we face challenges attracting and retaining an experienced CCS for this important program:

1. Long running budget issues in Office of Drinking Water.
2. Human resource policies prohibiting offering a competitive salary to certified operators (see Workforce Development section).
3. A shift in office priorities to focus more on water system engineering and planning.

2.4.4 Water System Planning Overview

While the entire Office of Drinking Water (ODW) is devoted to development of the Technical, Managerial, and Financial capacity of the state's 4,135 Group A water systems, the planning

program focuses on bringing all three concepts together in one document. The cornerstone of the planning program is working one-on-one with water systems and water system managers, helping them develop their Water System Plan (WSP), Small Water System Management Program (SWSMP), Coordinated Water System Plan, or Satellite Management Program, as outlined in following subsections.

ODW is comprised of a three regional offices (RO), Northwest (NWRO), Southwest (SWRO), and Eastern (ERO). Each office manages about the same number of water systems, but vastly different numbers of connections and counties. NWRO has only seven counties, but includes predominately large cities like Everett, Seattle, and Tacoma, and the highest population. ERO is more rural, predominantly agricultural and forest lands with a mixture of city sizes ranging from rural small towns to large cities like Spokane, with twenty counties and covering over half of the state's land mass. SWRO fits in the middle with twelve counties and a mix of medium sized cities and agricultural and forest lands.

Each RO has two planners. Each planner, accompanied by a Regional Engineer, conducts at least ten to twenty pre-planning conferences each year. The pre-plan is the opportunity for the purveyor and RO to discuss the WAC requirements for WSPs and SWSMPs and focus which WAC areas to emphasize. This is known as determining the appropriate level of planning (ALOP).

Usually the purveyor's consulting engineer will submit the WSP to the RO six to twelve months from the date of the pre-plan. The RO planner and engineer will review the WSP for consistency with the WAC and issue comments explaining any deficiencies found in the submittal. After an iterative process, the WSP will be approved and can receive up to a ten-year plan approval.

Other planner's duties include providing technical assistance to water systems, being a technical liaison with other state agencies, like the Department of Ecology regarding water rights and watershed planning, providing technical expertise to county and city planning efforts, working with county planners to process local government consistency for water system plans, and working internally to develop policies, procedures and standards to promote ODW's mission. This last category is exemplified by the planning team's efforts to develop a Water System Planning Guidebook, addressed below.

2.4.5 Water System Planning and Technical Assistance

Planners provide education in primarily managerial and financial capacity areas. We are a resource by phone, email, or in person; at conferences or meetings; or one-on-one. Planners lead and facilitate meetings preparing short and long range water system planning, and on a wide variety of topics: asset management, budgeting, funding, governance, rates, resiliency and preparedness, source water protection, regional collaboration and consolidation, receivership, and water use efficiency, etc.

NWRO: Between the two islands, DOH planners presented at and attended six bi-annual meetings on Camano and nine of the twelve quarterly meetings on Whidbey. Topics included: Asset Management, Board Responsibilities, Budgeting and Rates, Consolidation, Planning for

Infrastructure Replacement, Funding Options for Capital Projects, Restructuring, Regionalization, and Emergency Preparedness. The annual Sound Waters Conference provided a new opportunity to reach small water systems in 2017.

In the NWRO, staff collaborate with various organizations to promote safe and reliable drinking water. The Regional Cooperative of Pierce County has a monthly meeting where DOH staff are a part of their regular agenda of items and provide presentations on water quality changes such as the Revised Total Coliform Rule, the emerging PFAS issues, and Coordinated Water System Planning. In Island County, there is a non-profit called Whidbey Island Water System Associations with quarterly meetings, where DOH provides subject matter expertise. On Camano Island, there have been bi-annual meetings supported with volunteers, who are mentored by their DOH regional planner for agenda topics and presenters. These partner groups have done much to advance planning for water system infrastructure replacement, board member responsibilities, rate setting, budgeting, and even taken up emergency preparedness and response. In Skagit County, there is an annual meeting to discuss drinking water with the local environmental health staff and planning staff who administer the Coordinated Water System Plan for Skagit, and help review and comment on water system plans and service area boundaries.

2.4.5.1 Water System Planning Guidebook

The planning team is making the final edits to our updated *Water System Planning Guidebook*. The Guidebook includes up-to-date, and comprehensive guidance to help water system owners, operators, engineers and consultants prepare of WSPs. The Guidebook builds on the information included in our recently released fourth edition *Water System Design Manual* (WSDM).

We released the updated Guidebook to more than one thousand stakeholders and interested parties for a ninety-day review with comments closing December 11, 2019. We received more than one hundred comments from seventeen individuals. Now we're reviewing those comments and clarifying the Guidebook accordingly. DOH expects to release the completed Guidebook midyear 2020.

Revisions include updates driven by the Municipal Water Law and other regulatory changes.

Here is a summary of the elements and updates included in the *Water System Planning Guidebook*:

- Chapters 1–10 include a stated objective, a list of chapter topics, and a publications reference list. We included Planning Tip dialogue boxes throughout to highlight useful information.
- WSPs assist water systems in developing and demonstrating strong technical, managerial, and financial capacity. To that end, we included elements of technical capacity in Chapters 2, 3 and 6; managerial capacity in Chapters 1, 4, 5, 7 and 10; and financial capacity in Chapters 8 and 9.
- Where available, the *Water System Planning Guidebook* refers to or links to other publications, such as the WSDM and the *Water Use Efficiency Guidebook* rather than duplicating information contained in other documents.

2.4.5.2 Small Water System Management Programs

All community and noncommunity Group A water systems not required to submit a Water System Plan (WSP) must develop and implement a Small Water System Management Program (SWSMP).

The SWSMP has two guidebooks with fill-in templates to complete the program. One is for community systems and the other is for non-community systems. These templates are designed to guide the water systems through the planning process, with little-to-no need for the help of a hired consultant. The SWSMP benefit small water systems by providing:

- A central location for water system records and policies.
- A process to evaluate current and future water system needs and improvements needed for continued reliable system operations.
- A list of operation and maintenance duties that can be used, reviewed, and improved by system personnel so they have the information they need and can easily keep it current.

While all Group A systems without WSPs are required to have a SWSMP, only certain circumstances require a SWSMP to be submitted to the RO for review and approval:

- A new non-transient, non-community (NTNC) water system is created.
- A Group A water system without a WSP seeks to be eligible for Drinking Water State Revolving Fund (DWSRF) loan.
- A Group A water system with operational, managerial, and/or financial problems is directed by DOH to complete a SWSMP in order to address and correct the problems.
- An existing Group A water system is seeking "as-built" approval under WAC 246-290-140.

During the 2017-2019 timeframe, DOH increased emphasis on the importance and value of a complete and up-to-date SWSMP. One of the ways DOH has done this is by including the planning document on the sanitary survey checklist, allowing an opportunity to discuss the WSP or SWSMP in person with the water system and go over valuable sections for that particular system. Regional engineers have started to include improvements to SWSMP on their list of recommendations on the Sanitary Survey letters, referring the water system to contact the regional planner for assistance. The regional planners have also identified SWSMPs as an area of focus for the next ten years. They will continue to consider options for increasing the number of valid SWSMPs and ways to keep track of these numbers without the requirement for review and approval.

2.4.6 Coordination Act and Coordinated Water System Planning

The Coordination Act is a Washington state law that applies to all counties, or portions thereof, who chose to plan under the Act, and allows the county to analyze water availability, designate a lead purveyor for each service area, and evaluate planned growth. DOH has regulatory oversight; however, the law gives counties who chose this regional planning tool legal responsibility and authority to implement this program. Under this RCW and corresponding WAC, counties, or portions of counties, may designate a Critical Water Supply Service Area (CWSSA) and develop a Coordinated Water System Plan (CWSP) to regulate the CWSSA.

The CWSP identifies individual service areas for water systems within the CWSSA and the service agreements between these systems. CWSP service area maps benefit the CWSSA by clearly identifying the water purveyor for a piece of land to avoid the unnecessary creation of additional water systems or overlapping water systems. The water systems are required to provide water

service in a timely and reasonable manner with adequate pressures. Also, the CWSP designates which water purveyor has first right of refusal to own and operate new water systems that are developed within its designated service areas. This assures the water system that as their system expands to the full limits of its service area that it can seamlessly consolidate with new water systems on the way.

The Public Water System Coordination Act (PWSCA) provides statutory planning authority to evaluate public water systems in a defined geographical area and to identify and correct problems that affect the water utilities' ability to provide safe and reliable drinking water to their customers. The PWSCA identifies and corrects problems related to:

- Inadequate water quality.
- Unreliable water service (quantity and delivery issues).
- Uncoordinated planning (creation and proliferation of new small public water systems).
- Inadequate water quantity to serve projected population growth.

The PWSCA addresses and corrects the above highlighted issues by directing requests for new public water service to existing water utilities with demonstrated expertise and capacity (technical, managerial and financial). Water utilities demonstrate this capacity through preparation of comprehensive water system plans on a required, ongoing periodic schedule.

There are currently twenty-two PWSCA areas in Washington state.

In the NWRO, all seven counties have active CWSP plans with four counties very active in providing comments on those water systems' planning ten to twenty years ahead. The two NW planners coordinate, collaborate and provide guidance, structure and timelines for plan review, comments and in the end, issue the approval letter.

Island County's water resource advisory committee has discussed the CWSP and updating it in order to solve small water system issues for the last three years but funding and clarifying objectives are still needed. DOH planners have presented and educated about the philosophy, history and the provision of water service as intended by the CWSP.

Pierce County allocated $225,000 to fund their CWSP update, which began in late 2018 and will be finalized sometime in 2020. DOH planning staff have attended all meetings to provide guidance and contribute historical knowledge and context while giving recommendations to solve current issues like small failing water systems.

In the eastern region, there are only four CWSSAs and none of them cover entire counties. All four CWSPs are in need of updates. There are several areas in the region that could benefit from CWSSA designation; however, without requiring these areas to implement CWSPs, they are unlikely to do so on their own.

The SWRO has four of its twelve Counties planning under the CWSA, Jefferson, Kitsap, Thurston, and Clark. These CWSAs have not been updated recently but are still regularly consulted anytime an individual water purveyor submits a WSP.

2.4.7 Satellite Management Agency Program

In 1991 the Washington state Legislature developed a new program to develop a professional group of water managers, known as Satellite Management Agencies (SMA). The SMA program establishes minimum criteria that SMAs must meet in order to be granted and maintain this title. The SMA is required to submit a SMA Plan to DOH every five years. Upon approval of the SMA plan, the SMA will be listed in the Secretary of Health's list of SMAs. This list is an easy desktop reference for those systems and the Counties who need to identify qualified managers and owners of water systems.

In 1995 the legislature made having an SMA as either the owner or manager of new water system a prerequisite for approval of that water system.

The SMA fulfills the need for water systems to have technical and managerial capabilities to deliver safe and reliable drinking water.

The SMA program has changed over the decades since it was implemented. It has created huge successes in water quality compliance. However, as the entities involved in the beginning have changed business models, or aged out of the business, DOH has seen the list become smaller and smaller. Some who had been in the "operations and management" only business have realized they don't control the money, and have left the business to save their reputations and decrease their frustrations with volunteer revolving board members who don't understand how expensive it is to run water systems well.

Planners are available to help SMA's with their plan updates, review and approve their plans, hold pre-plan meetings, and provide technical assistance. Planners have been working with some of the SMAs to help with regionalization, restructuring and consolidation.

In the three-year time period, planners have held pre-plan meetings, reviewed SMA plans, assisted new SMA's to complete their plan, and approved SMA plans.

2.4.8 Water Use Efficiency Program

In 2003, the Washington state Legislature passed the Municipal Water Supply-Efficiency Requirements Act. This law, commonly known as the Municipal Water Law, provides flexibility for municipal water rights to serve growing communities by reducing the risk of relinquishment. In exchange for this water right flexibility, the law required new standards for water use efficiency (WUE).

Water is a precious, limited resource. In the Pacific Northwest, drinking water for our growing population competes with other users that include agriculture, industry, recreation, and maintaining adequate stream flow for fish. By working with public water systems to implement water-use efficiency programs, we strive to ensure safe and reliable drinking water supplies for current and future needs.

Water systems can help prevent potential health and sanitation risks to their customers by effectively planning and implementing Water Use Efficiency (WUE) measures. This means fewer

emergencies when water supplies are scarce, especially during summer months when it rains less and user demands are high.

Any Group A community water system that serves at least fifteen residential service connections is a designated "municipal water supplier" and must comply with the Water Use Efficiency Rule (whether publicly or privately owned). The rule says municipal water suppliers must:

- Publicly establish water-saving goals for their customers.
- Evaluate or implement specific water-saving measures to achieve customer-based goals.
- Develop a WUE planning program to support the established goals.
- Install meters on all customer connections.
- Achieve a standard of no more than 10 percent water loss.
- Submit a Water Loss Control Action Plan (WLCAP) if they exceed 10 percent water loss.
- Report annually on progress towards achieving these goals.

In 2018, we had 2,196 systems designated as municipal water suppliers. More than 97 percent of them submitted WUE annual reports. Along with improvements in reporting compliance, we've seen improved metering compliance and a reduction in apparent water losses. By using water efficiently, water systems help to protect against temporary water service interruptions during peak usage, long-term or repeated water disruptions due to limited water supply, and contamination of the water supply due to leaky pipes.

WUE also promotes good stewardship of the state's water resources, ensures efficient operation and management of water systems, reduces energy use, and saves money.

Table 4

WUE System Data

Year	Total Gallons Produced	Authorized Consumption	% Loss	Total Connects	Population Served
2016	349,565,203,973	316,401,635,597	9.49%	2,538,085	6,302,268
2017	355,680,452,235	322,000,933,363	9.47%	2,557,470	6,324,331
2018	364,858,043,534	333,816,653,669	8.51%	2,554,831	6,318,062

The WUE program manager position has remained vacant at DOH since the last report. This is attributed to long running budget issues in the drinking water program and a shift in office priorities to focus more on water system engineering and planning. As such, the six regional planners play a key role in educating water systems on all aspects of the WUE program.

The goal setting, development of measures intended to achieve that goal, and development of the WLCAP are updated every six or ten years, dependent upon the applicable planning cycle for each water system, as part of the water system's WSP or SWSMP. Also the planners provide WUE technical assistance upon request by phone call, emails, attending meetings and giving presentations.

2.5 Financial Assistance

2.5.1 Drinking Water State Revolving Fund (DWSRF)

Congress established the DWSRF program when it reauthorized the Safe Drinking Water Act in 1996. EPA manages DWSRF funds at the federal level and DOH administers DWSRF at the state level. The DWSRF Loan Program provides low-interest loans to eligible public water systems to build, repair, and redesign their infrastructure. In some instances, up to 50 percent principal forgiveness is available, based on an affordability index and consolidation projects. Now twenty years old, the DWSRF Construction Loan Program has provided almost $1 billion in construction loan funds. These loan funds helped more than six hundred water systems improve their facilities and protect public health. Capital improvements to our public water systems are critical to the long-term health and economic vitality of Washington's communities. During this reporting period, the DWSRF program provided over $78 million in financing to fifty-six grant or loan projects to help improve public health and water system sustainability.

Since its inception in 1997, the Department of Commerce, Public Works Board (PWB) and DOH have jointly administered the DWSRF Program. To streamline the program, the 2016 Legislature passed Senate Bill 5251, transferring contract administration of the DWSRF Construction Loans from Commerce and PWB to DOH. This will bring Washington in line with the model used by most states. The transfer was completed and as of July 1, 2018, DOH oversees all aspects of the DWSRF loan program.

Due to lack of a capital budget in 2017, a number of projects were suspended and the DWSRF construction loan program had to reduce the amount of available funds due to a cash deficit issue. During the time period 2017 to 2019, forty-eight new construction loans were awarded for a total of $77.55 million. This volume of projects is much less than previous years. However, moving forward, the DWSRF program is more resilient and able to offer more funding for construction projects. The majority of construction loan projects funded between 2017 and 2019 benefited small water systems. The table below shows funded DWSRF construction projects, by system size, during the 2017–2019 reporting period.

Table 5

2017–2019 Funded DWSRF Construction Loan Projects by System Size

System Size	Population	Projects Funded
Large Systems	Greater than 100,000	1
Medium Systems	Between 10,000 and 100,000	8
Small Systems	Less than 10,000	39

In addition to the DWSRF Construction Loan Program, DOH continues to offer Emergency Loans, Preconstruction Loans (limited to existing construction loan recipients), and Consolidation Feasibility Study Grants.

- **Preconstruction Loan**: In the event a current DWSRF Construction Loan recipient is unable to make progress and proceed to construction within eighteen months, DOH is able to convert the construction loan to a preconstruction loan. The water system will be able to continue with preconstruction activities with the preconstruction loan and prepare for construction. This loan can provide up to $300,000 at the current construction loan interest rate for a term of six years. If the project is later funded with a DWSRF construction loan, the preconstruction loan can be incorporated into it.
- **Emergency Loan:** The Emergency Loan Program was modified to better align with the Clean Water State Revolving Fund Emergency Loan Program, per stakeholder requests. Emergency loans are available for up to $500,000 at 0 percent interest rate for a term of ten years. This program is limited to not-for-profit community water systems serving fewer than ten thousand people. One emergency funding agreement was issued in 2018 for the Pierce County-Kapowsin Water District receivership project to allow drilling of a new well.
- **Consolidation Feasibility Study Grant:** This grant provides funding to community water systems to study the feasibility of owning, maintaining, or serving smaller, struggling water systems serving ten thousand and fewer people. Up to $30,000 per consolidation project is available. This funding opportunity was suspended in 2017 and 2018 due to lack of a capital budget. However, the merits of the program warranted offering this program again and it is now funded from DWSRF construction loan origination fees. In 2019, these grants were made available with fourteen applications received and seven projects funded.

The following table provides a summary of each DWSRF funding cycle for the 2017–2019 period.

Table 6

2017-2019 DWSRF Applicants and Recipients by Funding Type

DWSRF Funding Cycle	Number of Applications Received	Amount of Funding Requested	Number of Projects Funded	Total Award Amount
Construction Loan	90	$135,000,000	48	$77,550,000
Emergency Loan	1	$500,000	1	$500,000
Consolidation Feasibility Study Grant	14	$470,000	7	$210,000

2.5.2 Sync

In 2017, the Washington state Legislature passed House Bill (HB) 1677. This legislation directed the Public Works Board to lead an interagency systems improvement team with the departments of Commerce, Ecology, and Health. The result of this directive is Sync, Washington's largest modern infrastructure program improvement effort. Sync's task is to identify, implement, and report to achieve efficiency, minimize costs, and maximize value across drinking water, wastewater, and

stormwater infrastructure programs. Sync developed a webpage where reports and meeting information can be found:

Since its inception, Sync has done extensive outreach to various stakeholders. Feedback received identified the following three priority areas.

1. Expand technical assistance capability.
2. Funding program process improvements.
3. System-wide infrastructure improvements.

Based on stakeholder feedback, Sync developed fourteen key activities to address these priority areas.

1. Tech Teams

Increase availability and frequency of Tech Teams to build local technical, financial, and managerial capacity and provide guidance on funding resources.

2. Value Planning

Promote the usage of value planning in infrastructure project planning and build local expertise in this best practice. Effective application of value planning increases stakeholder feedback and the development of the right project for the community. A Draft Introductory Guide to Value Planning is posted on the Sync webpage for review.

3. Asset Management

Build local capacity to utilize asset management effectively. Successful application of asset management reduces the overall cost of ownership, increases the lifespan of the system, and prioritizes capital improvements. A workgroup has been formed to address asset management.

4. Regional Governance and Resource Efficiency

Provide technical tools and technical expertise to facilitate explorations of regional governance. Tools include interlocal agreements that provide administrative and systems efficiencies, such as agreements to share operators or equipment. A pilot regionalization project is ongoing in Lincoln County.

5. Decision Package Requests for Coordinated Technical Assistance

Coordination will include alignment between agency budget requests for additional technical assistance staff and resources. Additional staff will focus on building local technical capacity across four areas: tech teams, value planning, asset management, and regional governance.

6. Electronic Resource Portal

Create a repository for technical resources. Sync will begin work to improve existing funding portals, such as Fund Finder, as the foundation of a program directory. This will assist stakeholders in accessing funding opportunities.

7. Affordability and Hardship

Sync will develop the process to share underwriting and explore the development of a universal hardship determination model. A workgroup has been formed to address this issue, specifically how to develop other metrics around affordability.

8. Applications

Simplify and streamline funding program applications to increase stakeholder efficiency. This will also make it easier on clients to understand program funding criteria and support applications to be more competitive.

9. Co-funding Process

This activity will seek to organize a consistent process for coordinating and packaging investments. This will assist Sync to leverage federal dollars and make projects whole, particularly if coordination between multiple infrastructure projects is needed.

10. Income Surveys

Update currently available income survey guidance and coordinate with organizations on alternative data and metrics.

11. Secure the Public Works Assistance Account

Request a phased return of all diverted Public Works Assistance Account tax revenues and loan repayments for local infrastructure projects by 2023.

12. Support to the Legislature

Become a resource that provides expertise and support to legislators in making infrastructure related funding decisions.

13. Alternative Finance

Create consistent state funding resources for stakeholders that don't have access to reasonable rates in the private credit market. Also, to access and leverage additional state and federal funding.

14. Workforce Development

Sync will explore options to raise visibility of infrastructure-related careers. This includes partnerships with institutions of higher learning, and studying gaps in the workforce.

DOH staff participate in both the monthly Sync meetings and Sync work groups for key activities, providing input and resources for Sync activities. Updates and reports are available on the Sync website.

3.0 Protecting Public Health and Keeping People Informed

3.1 *H2Ops* and *Water Tap* Newsletters

We published two editions of *H_2Ops* and two editions of *Water Tap* in 2019.

- *H_2Ops*, a publication targeted to water system owners and operators, provides in-depth coverage on a select technical topic of interest to water systems. The summer edition focused on drought. The winter edition focused on capacity in all of its forms.
- *Water Tap* goes to a more diverse audience of labs, engineers, and backflow assembly testers, as well as water system owners and operators. The spring edition covered Washington's infrastructure program, vandalism, lead in drinking water, and sampling. The fall edition covered drought, succession planning, and award winners for treatment optimization and Drinking Water Week.

3.2 Health Advisories

Emergency response in support of water systems has been listed as the number one priority for DOH staff. As such, we work to maintain our own capacity as well as that of water systems to respond to emergencies.

With more than four thousand public water systems in Washington state, it is almost inevitable that at least a few times a month we need to support water systems as they issue health advisories. Most of these health advisories are voluntary, issued by water systems due to main breaks and loss of pressure within distribution systems. In addition, we also work with water systems to issue health advisories due to microbial risks, chemical risks—nearly all due to high levels of nitrate, process upsets at water treatment plants, and malevolent actions affecting water system facilities. The vast majority of these health advisories are associated with very small water systems, who rely upon us heavily since it is rare, thankfully, that any individual system has to issue a health advisory.

To make sure we are **always** available to water systems and our public health partners at local health, other state, and federal agencies, a small group of senior managers within our Operations Section are available after-hours, on holidays and weekends 24/7/365. This group commonly handles "routine" health advisories. In addition, the people on this team handle more unusual situations that may not result in a drinking water health advisory, but are nonetheless an important part of the service we provide to the people of Washington state.

3.3 Water Quality Programs

3.3.1 Source Monitoring

DOH's source monitoring program performs the following activities to help assure that water systems are delivering safe and reliable water to their customers:

- Generate and maintain chemical water quality monitoring requirements for 5,385 sources associated with over 2,500 community and NTNC water systems.
- Implement a waiver model for water systems to grant federally allowable relief from monitoring when technically defensible while still protecting public health.
- Develop tools like the Water Quality Monitoring Schedule (WQMS) to communicate SDWA distribution and source monitoring requirements to water systems.
- Track compliance with required chemical water quality monitoring and respond to unmet requirements.
- Collect and assess water quality data to verify the safety of drinking water sources, obtain information about known contaminants, and confirm effectiveness of treatment.
- Provide technical assistance to water systems to help them comply with established water quality standards, resolve violations and communicate with their customers during health advisories.

3.3.1.1 WQMS

DOH developed monitoring schedules in 2000 to help water systems understand and meet their SDWA requirements. The general benefits are numerous:

- Clear communication of complex monitoring requirements and other deadlines while reducing demand on state resources.
- Simple for the water system to participate and to understand an otherwise complex set of requirements.
- Allows for long-term budgeting for sampling and greater focus on system asset management and infrastructure issues.
- Includes enhanced waiver process, which is simpler to implement and technically defensible.

In 2014, DOH moved the WQMS from the original annual paper mailings to an interactive online tool with increased capabilities. The WQMS recalculates in real time to show when samples are entered and sampling requirements are met; it is updated for the public weekly. In the last three years, we have greatly improved the accuracy of the WQMS and added programmatic calculations for radionuclide and most disinfection byproduct requirements, which were previously manually added each year.

DOH is now armed with resources and strategy to notify systems that do not meet monitoring requirements. We use reminder postcards and emails, especially for TNC systems that don't have a WQMS in our efforts to get to 100 percent compliance.

3.3.1.2 Waivers

In 1994 the Legislature directed DOH to develop a program to grant relief from a major increase in costly new and ongoing monitoring requirements while still protecting public health. This waiver program focuses on requiring monitoring where the risk of contamination is greatest and reducing or eliminating monitoring where the risk is least. DOH continues to base associated risk determination on information from water systems regarding the physical characteristics of the actual water source, water quality history from the source, and additional water quality information from our sister agencies. DOH is proud of the fact that we successfully reduced the burden of monitoring requirements to utilities while ensuring public health protection.

The original waiver model program was extremely complicated and difficult to implement, and the risk to water supplies may change over time. These were the impetus for DOH to reevaluate the waiver model between 2012 and 2013 and streamline it in 2014.

The waiver program continues to be:

- Simple for both the systems and the state.
- Technically defensible.
- Sustainable (for eighteen to twenty-seven years—two to three nine-year compliance cycles).
- Able to assign simple monitoring requirements that can be completed at the lowest frequency, while still be protective of health.

Reduced monitoring waivers are assessed by each analyte group, since different source characteristics can create different chemical risks. For example, an extremely deep and confined source may be a low risk for pesticides, but a higher risk for naturally occurring inorganic contaminants, such as arsenic. In the waiver model, systems/sources will fit in three groups.

- Those with sufficient data to know they are lower risk and considered for lower frequency sampling. The majority of water system sources are in this group.
- Those we know are at an increased risk due to water quality issues or system defects.
- Systems/sources that, due to lack of information, we do not know enough about. These are new systems/sources, or they have not sampled enough in the past and we cannot put them into one of the other groups.

Some assumptions made for the waivers include:

- Approximately 80 percent of system/sources are “stable” and we can assign baseline “core” monitoring requirements on a six- to nine-year compliance cycle versus the three-year compliance period. This can only be assessed after sufficient data from each source is analyzed.
- Approximately 10 percent of the systems/sources are be found at risk and will have assigned appropriate monitoring requirements based on the system/source specific situation.
- DOH will have insufficient information in some instances, such as new sources or emerging contaminants, to place them in the prior two groups and they will require monitoring and program resources.

State waivers: Some waivers are based on statewide and existing system specific historic information. This is completely appropriate for some of the contaminants that have never been found or were not used in the state.

3.3.2. Coliform Monitoring—RTCR

The Revised Total Coliform Rule (RTCR) is one of the few SDWA rules that applies to all 4,134 Group A water systems in Washington. The last three years established the foundation for the implementation of the RTCR and provides DOH with a baseline from which we can improve future outcomes. From 2016 to 2019, coliform incidents have remained consistent each year, with an overall compliance success rate of 98.4 percent.

Transient non-community (TNC) water systems have the highest potential to improve their Technical, Managerial, and Financial (TMF) capacities. As shown in the table below, this system type incurs the most monitoring violations by missing their monthly sample requirement or failing to collect repeat (follow-up) samples. Just over 30 percent of systems statewide are TNCs while they make up over 50 percent of the coliform incidents. DOH's Coliform Program spends most of its time providing technical assistance to these systems to explain the importance of monitoring, sample locations, sampling technique, troubleshooting contamination issues, and encouraging proactive use of best management practices.

Table 7

Annual Average Number of Incidents by Incident and System Type from 2016 through 2019

	Transient Non-Community	Non-Transient Non-Community	Community	All Systems
Monitoring	378	48	132	558
E. coli MCL	5	<1	7	13
Contamination Confirmed (TTTPS)	80	13	118	210
Follow-up Failure (TTTR)	23	1	7	31

Assessments Summary

The RTCR added assessment requirements. An assessment is a self-inspection, completed by the water system, to find the potential source of contamination detected in the distribution system. It consists of a written review of the system's maintenance and operations as well as an inspection of its facilities. The assessment also includes confirmation that any sanitary defects have been fixed or a timeline for making the corrections necessary to prevent future contamination. Part of the assessment is to determine gap areas in their TMF capacity. We find that assessments provide an insight in system functioning as shown below.

- Seven-hundred-fifty-five assessments have been required for 517 unique systems (some systems incurred multiple assessment requirements).
- Eighty-seven point five percent of systems have **not** been required to complete an assessment—or are in compliance with repeat sampling and did not confirm contamination in the distribution system.
- Two hundred and thirty-five assessments found sanitary defects; sanitary defects are pathways for contamination to enter the system. That is nearly one-third of the assessments. With less gaps in TMF capacities, we expect less assessments to review and higher quality assessments completed.
- Seventy-nine assessments included defects to *storage facilities* such as improperly constructed or protected vents and overflows, and improperly sealed hatches.
- Seventy-two assessments included defects at the *water source(s)* such as gaps at the conduit junction boxes.

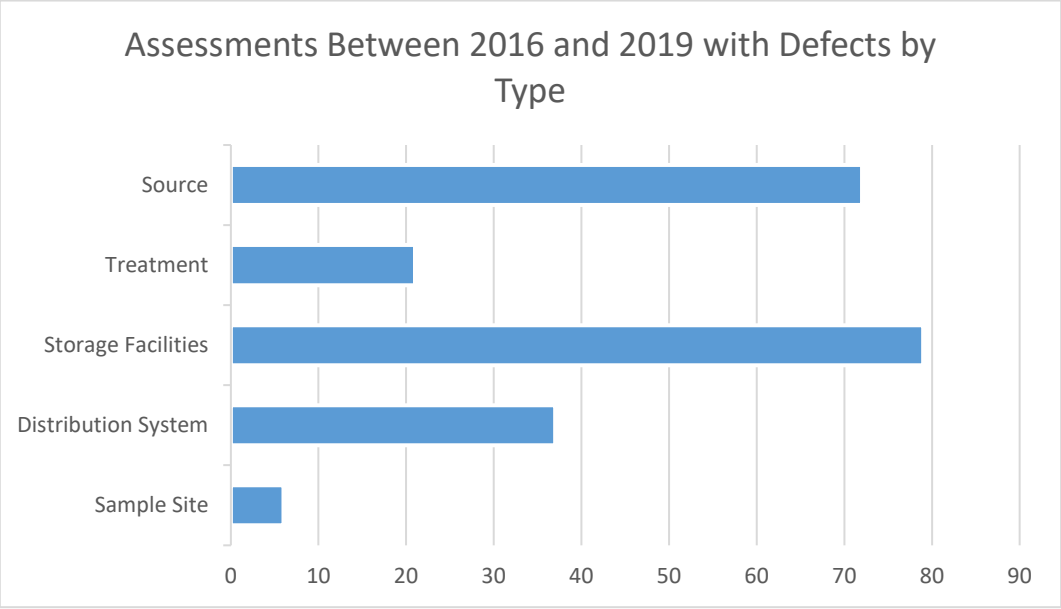


Figure 4: Summary of findings from assessments conducted under the RTCR.

By identifying pathways for contamination, the purveyor also has an opportunity to add preventative measures to protect the system from future contamination. By knowing when and where contamination is most likely to occur, purveyors can better focus their TMF capacity.

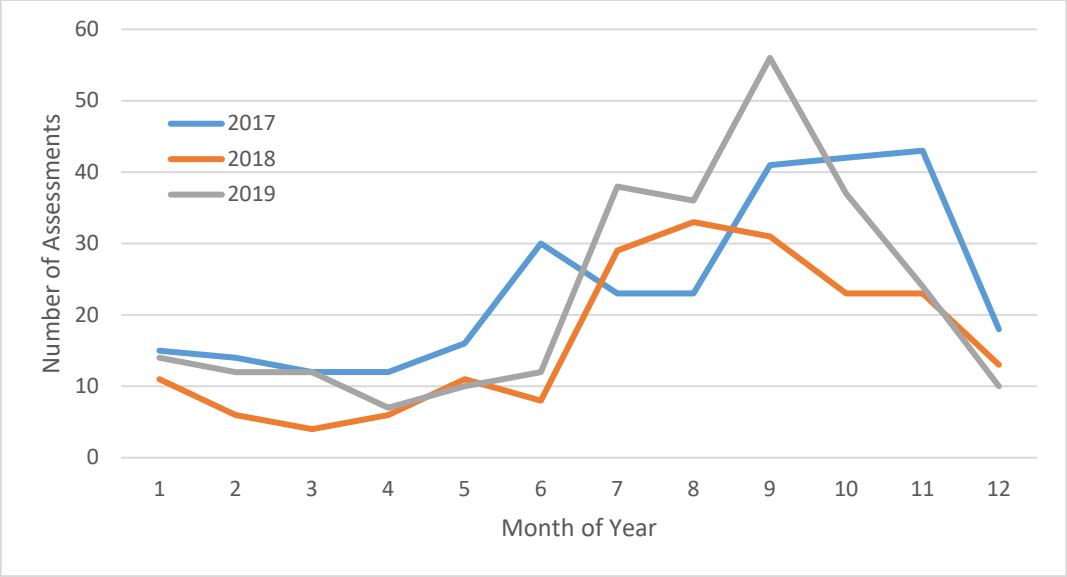


Figure 5: Seasonal trends in triggered assessments in Washington state.

The majority of systems that incur an assessment requirement are not disinfected. However, through the process of monitoring for coliform bacteria, many systems have realized the need and benefit of adding continuous chlorination to protect the water quality from microbial contamination. Permanent and effective disinfection treatment installed at a system provides an added barrier of protection against contamination.

3.3.3 Nitrate Program

The Nitrate Program is managed by regional and central DOH staff. Regional office staff oversee compliance with the water quality standards while central staff issue compliance documents pertaining to nitrate monitoring.

Of the 4,133 Group A waters systems in Washington state, fifty-one (1.2 percent) of those systems exceeded the nitrate MCL of 10.0 mg/L at least once between 2017 and 2019. These exceedances have resulted in 175 Health Advisories over the same period of time.

Regional water quality, compliance and engineering staff work with systems that are exceeding the nitrate MCL to communicate with their customers, develop a compliance solution, and implement it. Pathways to compliance include drilling a new well, consolidating with a neighboring water system, blending with a low nitrate source, or installing nitrate removal treatment. Currently, Washington has sixty-six water systems (1.5 percent of the total number of systems) treating to remove or blending to reduce nitrate.

During the 2017-2019 period, the nitrate team worked to create a new enforcement trigger for when a system is required to mitigate their nitrate problem. This new trigger received approval from management. The nitrate team is now working through the process of creating and updating policies and compliance strategies.

3.3.4 Lead and Copper Program

Over the last three years, Washington state re-evaluated its lead and copper program to ensure that consumers are protected and informed about the quality of water at their taps. Lead and copper is not found in source water but leaches from the metals used in a home's plumbing. Over the years, bans in lead plumbing, most recently in 2014, reduced the amount of lead allowed to be used in pipes, valves, and fixtures, but there is legacy of lead in Washington state plumbing.

Washington state conducted a lead service line and lead component survey of water systems in October 2016 in accordance with the Governor's Directive 16-06. Out of the 4,062 Group A water systems surveyed, 686 water systems responded, representing 2.2 million of 2.5 million connections statewide. Since the 2016 survey one large system has removed all their lead service lines. We estimate 300 lead service lines remaining in service at the time, but do know there may be additional unknown lead service lines in approximately five other systems. Approximately fifteen water systems report they have an estimated 4,841 lead goosenecks in service and twelve systems report that they have unknown numbers of lead goosenecks. DOH continues to provide technical assistance to water systems as they identify and replace their lead service lines and/or lead components.

Table 8

Lead component	% of connections
Lead service line in service	0.02
Unknown service line may be lead	1.2
Service line—definitely not lead	**98.8**
Lead goosenecks in service	0.21
Unknown gooseneck may be lead	7.6
Goosenecks—definitely no lead	**92.2**

All community and non-transient non-communities (2,532 systems) are required to test for lead and copper in their distribution systems at least every three years. Over the last three years, twenty-nine water systems have exceeded the lead action level and seventeen water systems have exceeded the copper action level. These action level exceedance are followed up by additional sampling and treatment adjustment or installation as necessary. Lead action level exceedance require public education and notification within sixty days and yearly until the system no longer exceeds the lead action level.

Two hundred eighty-three water systems, serving almost four million people in Washington, have some type of corrosion control treatment installed, including pH adjustment and corrosion inhibitors. DOH will continue working with these systems to ensure corrosion control treatment is optimized, with a focus on system monitoring over the next couple of years.

3.3.5 Disinfection Byproducts Formation Study

Water systems add chlorine to drinking water to kill or inactivate harmful organisms in a process called disinfection. During this process, chlorine also reacts with naturally occurring organic matter

that may be present in drinking water. Chlorine disinfection byproducts (DBPs) can form during this chemical reaction. The Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules require water systems that use a disinfectant to monitor for two groups of DBPs. EPA determined that regulating these two groups of DBPs would cause a general overall reduction in all DBPs.

In Washington, the majority of the systems that have experienced elevated DBPs (above the regulatory values) have been found in small groundwater systems. This was not expected, given that the organic matter that causes DBPs is more often associated with surface water. In 2015-2016 DOH staff partnered with the University of Washington Civil Engineering department to conduct a year-long study on what might cause so many small groundwater systems to have high levels of DBPs. The study report was completed in 2017 and DOH staff presented the results of the study at the 2017 AWWA Water Quality Technology Conference; a highly regarded conference that provides a practical forum for a wide range of water technology professionals from around the world to exchange the latest research and information.

Through the study, staff also identified some specific parameters that these small systems can easily measure to determine if their system may be susceptible to elevated DBPs. The findings were also incorporated into the WSDM. The full report is included in the appendices.

3.3.6 Known areas of PFAS contamination in drinking water aquifers in Washington State.

PFAS contamination has been found in groundwater used for drinking water supplies in five areas of the state (Figure 6), in some cases at levels that are above the lifetime health advisory level (LHAL) for PFOA and PFOS of 0.07 µg/L set by EPA in 2016. In all five areas, water systems and/or the military have taken action to meet the federal health advisory. The primary source suspected in these areas is a firefighting foam called AFFF that contained PFAS. Additional sources of PFAS may be uncovered by ongoing investigations. Available state data are presented below with a summary of actions taken in each area.

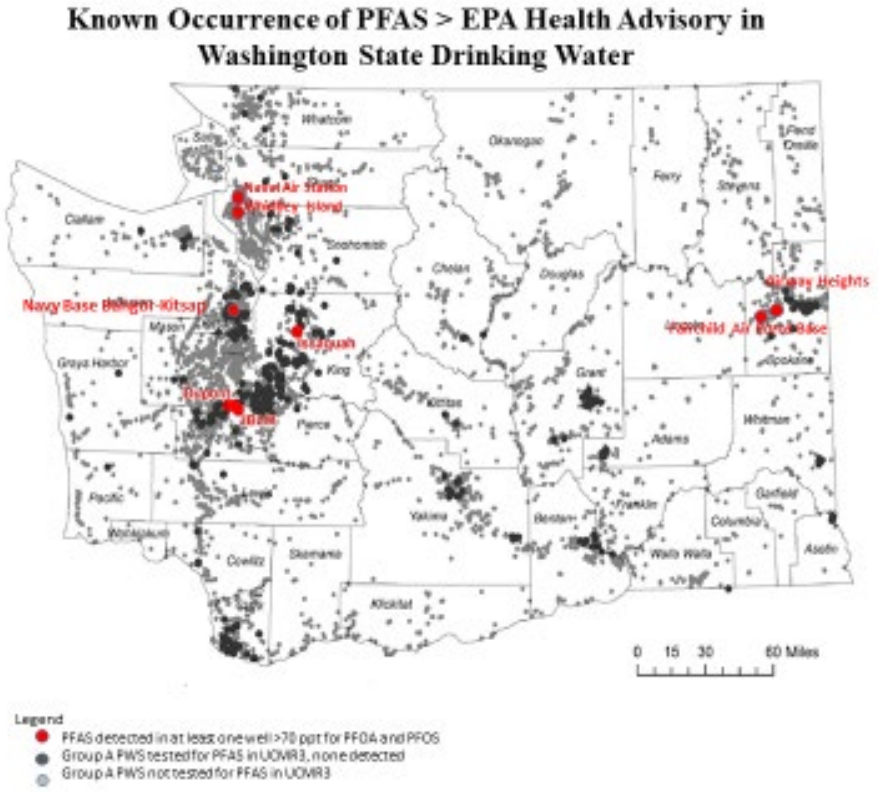


Figure 6: Known areas of PFAS contamination in groundwater supplies used for drinking water. The Unregulated Contaminant Monitoring Survey (UCMR3) tested for six PFAS in all public drinking water systems (PWS) that serve over 10,000 people and in a representative sample of smaller systems between 2013-15. Voluntary testing by the Navy, Airforce, and Army has discovered additional drinking water contamination in private and public wells on and/or around four military bases between 2016 and 2020.

City of Issaquah, 2015-16

As part of the EPA's UCMR3 testing, the City of Issaquah discovered PFOS, PFHxS, and smaller amounts of PFOA, PFNA, PFBS and PFHpA in one production well in their public water system. PFOS concentration in the affected well ranged from 0.4 to 0.6 µg/L and PFHxS ranged from 0.20 to 0.24 µg/L. Concentrations of other PFAS were less than 0.03 µg/L. Water from this well was blended in a ratio of 1:4 with a deeper adjacent well that was PFAS-free before it entered the distribution system. After blending, the water level did not exceed the 2009 provisional EPA health advisory, which was 0.4 µg/L for PFOA and 0.2 µg/L for PFOS (EPA, 2009). In November 2015, additional sampling across the Issaquah system detected PFOS at 0.106 µg/L at the entry point of the two blended wells, and levels ranging from 0.068 to 0.038 µg/L in more distant areas of the distribution system. At each site, PFHxS was present at about half the PFOS concentration. In January 2016, the city shut down the impacted well and eventually invested over $1 million in a granular activated carbon (GAC) treatment system installed in May 2016. Since June 2016, the treatment system has been effective at removing PFOA and PFOS, and is routinely tested for performance. The city

investigated the potential sources of contamination, and concluded that the likely source was the Eastside Fire and Rescue headquarters about a mile up gradient. Soil samples in a firefighting training area at the headquarters contained PFOA and PFOS from firefighting foam. One monitoring well and two drinking water production wells operated by nearby Sammamish Plateau Water system were also found to contain PFOA and PFOS at trace levels (Sammamish Plateau Water, 2016, 2018). These wells continue to be monitored.

Naval Air Station, Whidbey Island, 2016-19

In 2016, the Naval Air Station Whidbey Island began offering PFAS water testing in off-base drinking water wells located within one mile down gradient from potential or known release sites of Aqueous Film Forming Foam (AFFF) on the base. Water results were compared to the 2016 EPA LHAL for PFOA and PFOS. Subsequent sampling rounds have "stepped out" in a half-mile radius from exceedances of PFOS and/or PFOA in drinking water. In October 2018, the Navy identified PFAS in a storm water drain near Hangar 6 at Ault Field and in an associated storm water drainage system that empties into Clover Valley Stream and Dugualla Bay. As a result of this new information, the Navy conducted drinking water sampling near Clover Valley Stream and Dugualla Bay. No exceedance of the EPA health advisory was identified. The Navy has tested a total of 281 private drinking water wells as part of this investigation. PFOS and/or PFOA were detected in 24 wells (9 percent). Sixteen of these wells exceeded the EPA LHAL. Eight are near the Outlying Landing Field (OLF) southeast of the town of Coupeville, two are near Ault Field in Oak Harbor, and six are near a Navy disposal site used from the1960s to1990s for industrial and household wastes (referred to as Area 6). See Figure 7 for a map with these locations. While PFOS was the leading PFAS detected near Ault Field and Area 6, contamination near OLF was dominated by PFOA. The Navy continues to conduct biannual sampling of all drinking water wells with PFAS detections. It also monitors wells adjacent to properties with wells above the EPA health advisory. The Navy provides bottled water to residents whose results for PFOA and/or PFOS exceed the EPA health advisory until a long-term solution is developed and implemented. Long-term solutions may include extending a water main from the public water system, installing whole house filtration systems, and installing a new drinking water well.

Figure 7: Arial map of Naval Air Station on Whidbey Island.

In addition to private wells, two Group A public water systems in the area were found to have PFAS detections. The Town of Coupeville is located near OLF. Coupeville's water system blends water

from multiple wells, most which are not impacted, so tap water has remained below the EPA health advisory for PFOA and PFOS (Hinds, 2017). Water testing results from two specific wells in March 2019 showed PFOA concentrations ranged from 0.022- 0.061 µg/L. Detectable levels of PFHxS and PFHpA were also present. The Navy recently installed a granulated activated carbon treatment system to remove PFAS from one of Coupeville's wells near OLF. The treatment system is routinely tested to ensure that these PFAS are removed. The second Group A public water system with PFOA and PFOS combined above the EPA health advisory is a mobile home park near Area 6. The long-term solution being considered for this system is connection to the Oak Harbor Water System. At least twelve small public water systems on Whidbey Island have tested their wells for PFAS as of July 2018. None reported detections.

The Navy conducted a number of public meetings where they presented health information and answered people's questions about the potential health effects of PFAS. The Navy continues to work on its on-base source investigation and is implementing a policy regarding removal, disposal, and replacement of legacy AFFF [2]. No firefighting training is occurring on base with PFAS-containing foams.

Fairchild Air Force Base, 2017-19

Fairchild AFB detected PFAS in groundwater monitoring wells on the base, in monitoring directed by the Department of Defense. Drinking water on the base comes from wells several miles north of the base near the Spokane River, and a well located on the southern tip of the base. These wells are not contaminated with PFOS or PFOA. Based on groundwater monitoring results, Fairchild conducted off-base testing for PFAS in public and private drinking water wells in several phases. They detected PFAS in private wells east of the base, municipal wells for the City of Airway Heights northeast of the base, and other community and private wells to the north and northeast of the base.

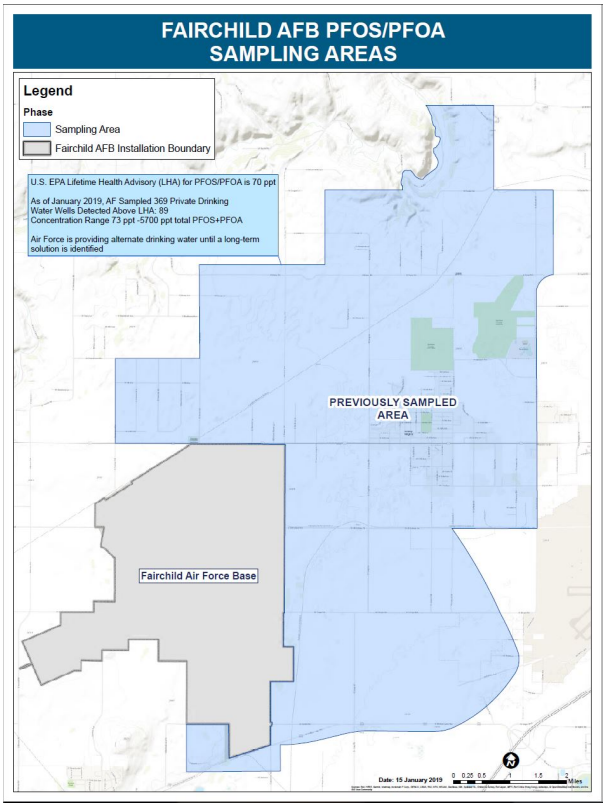


Figure 8: Sampling area for private wells around the Fairchild Air Force Base.

As of January 2020, the Air Force tested 372 private residential drinking water wells. One hundred and sixty nine (169) residential wells had detectable levels of PFAS and 91 of those wells exceeded the EPA LHAL for PFOA and PFOS (Mark Loucks, 2020). The maximum detected level of PFOA and PFOA combined was 5,700 ppt total in a private well. The Air Force policy is to immediately notify well owners and provide bottled water if levels for PFOS and PFOA in drinking water exceed the EPA LHAL. Bottled water is provided until a long-term solution is developed and implemented. According to a January 2020 progress report, the AFB has installed

78 residential granular activated carbon treatment systems on impacted residential wells. Where a GAC filtration system is not feasible, the Air Force is connecting private wells to the City of Airway Heights water system (Fairchild Air Force Base, 2018; Mark Loucks, 2020).

The Air Force sampled four municipal wells, two from the City of Medical Lake and two from the City of Airway Heights. Only the two Airway Heights wells had detectable levels of PFAS. The concentration of PFOS and PFOA in the Airway Heights wells were 1.1- 1.2 µg/L PFOS and 0.3 -0.32 µg/L PFOA in the affected wells. These levels are about 17 times higher than the EPA LHAL for PFOS and PFOA.

In response to PFAS detection in April 2017, the City of Airway Heights public water system closed their contaminated wells and used an emergency intertie with the City of Spokane to flush their system with clean water. Flushing included draining reservoirs and water towers. During the flushing, the city warned residents west of Hayford Road to not drink or cook with water from city pipes, and Fairchild AFB provided bottled water to city residents. After testing throughout the water system confirmed that PFAS were sufficiently flushed, the water system resumed delivery with City of Spokane water. The city added another connection to the City of Spokane to supply drinking water and the Air Force installed a treatment system on Municipal Well 9 to supplement the Airway Heights water supply during high-demand summer and fall months. This system was operational in the Fall of 2018 (Fairchild Air Force Base, 2018).

According to Fairchild AFB, the base has transitioned to a safer foam that is based on C6 fluorochemistry. Fairchild no longer uses AFFF during live fire training. Fire trucks on base are outfitted with a test system that prevents any foam discharge during equipment testing. AFFF use is limited to emergency responses with immediate containment requirements. The Strategic Environmental Research and Development Program (SERDP), Environmental Security Technology Certification Program (ESTCP) is funding research on new fluorine-free firefighting foam formulations that can meet the military's performance requirements (Mil-Spec), and are readily biodegradable (Ananth, 2018; Payne, 2018; Tsang, 2018).

Joint Base Lewis-McChord

The Army's Fort Lewis facility and the Air Force's McChord Field facility are currently operated as a joint military base, but have separate water systems.

Fort Lewis Water System

Fort Lewis monitored seven drinking water sources as part of the UCMR3 monitoring. PFOA was detected at 0.051 µg/L in one well and PFHpA at 0.013 µg/L in another. Subsequent testing in November 2016 confirmed the previous detections in those two wells and showed PFOA concentration in Fort Lewis' Well 17 at 0.071 µg/L which is just above the LHAL (Military.com Daily News, 2017). According to a Freedom of Information Act request, Army drinking water testing in 2018 detected 0.144 µg/L total PFAS concentration at Fort Lewis with seven PFAS detected—PFBS, PFHpA, PFHxS, PFHxA, PFNA, PFOS, PFOA (Environmental Working Group, 2020). Well 17 was taken offline and will likely be abandoned. The November 2016 testing also revealed additional wells with PFAS contamination. A well that serves the military golf course near DuPont had levels just above the LHAL. Bottled water was supplied at that facility, and point-of-use treatment devices are now

used to reduce exposure to PFAS. The primary source of drinking water (Sequalitchew Springs and infiltration gallery) for the vast majority of the main base generally has around 0.015 to 0.020 µg/L of PFOS plusPFOA combined.

McChord Field

McChord Field was not involved in UCMR3 monitoring because the population served by its water system at that time was below ten thousand. In the November 2016 monitoring, PFOS and small amounts of PFOA were reported in two drinking water wells serving McChord Field at combined concentrations of 0.250 and 0.216 µg/L (Military.com Daily News, 2017). According to a Freedom of Information Act request, Army testing in 2017 detected a total PFAS concentration of 0.303 µg/L with five PFAS detected (PFBS, PFHpA, PFHxS, PFOS, PFOA)(Environmental Working Group, 2020). Both wells that contained PFOS and PFOA above the advisory level were shut down in 2017. In early 2020 JBLM installed GAC filtration systems on these two wells and two to other wells with lower levels of PFAS that supply drinking water to McChord Field and the housing units for McChord.

JBLM staff believes contamination in both areas (Fort Lewis and McChord Field) came from firefighting foam used through the early 1990s for firefighter training at several locations associated with McChord Field's runway and Fort Lewis's Gray Army Airfield, as well as other potential sources such as landfills. According to JBLM staff, use of foams containing PFAS was discontinued more than twenty years ago.

Another military site managed by JBLM, the Yakima Training Center, tested drinking water for PFAS in November 2016, and there were no detections.

City of Lakewood

As part of the UCMR3 monitoring, the Lakewood Water District tested five of its drinking water wells drawing from three different aquifers, and no PFAS were detected at that time. Because of detections in late 2016 at JBLM-McChord Field just east of Lakewood, the water district began proactively monitoring for PFAS in other wells in their water system starting in spring of 2017. Initially only trace levels were detected in the two wells at the Ponders well field. Since then the concentrations have gradually increased, and Lakewood removed these wells from service in summer 2018 and installed GAC treatment at the Ponders wellfield in late 2019. Lakewood continues to monitor and is evaluating options for reducing PFAS in another well field northwest of McChord Field. All six wells with detectable levels of PFAS tap shallow aquifers near JBLM—McChord Field. Wells in the deeper aquifers do not have measurable PFAS. Lakewood continues to monitor the thirty wells in its system and update its water customers about the issue (Lakewood Water District, 2019a, 2019b).

City of DuPont

As part of UCMR3 testing, the City of DuPont detected levels of PFOA (~ 0.03 µg/L) in two wells in the southwest area of its distribution system. PFOA and PFOS were not detected in the three wells serving the north and east areas of the distribution system. Between October 2018 and January 2020, DuPont was proactive in conducting follow-up monitoring for PFAS. January 2020 results show PFOA concentrations of 0.010 – 0.015 µg/L and PFOS concentrations of 0.005-0.009 µg/L at

two Bell Hill wells. October 2019 results at two Hoffman Hill wells show PFOA levels were 0.027 – 0.050 µg/L and PFOS levels were 0.010—0.013 µg/L. Because of blending, the combined concentration of PFOA and PFOS entering the water system from these well fields is lower: 0.014 µg/L for Bell Hill and 0.029 µg/L for Hoffman Hills. These levels are below the EPA LHAL. The City of Dupont has hired an engineering consulting firm to investigate the hydrology of the wells and options for next steps (City of Dupont, 2020).

City of Tacoma

Tacoma Public Utilities tested its South Tacoma Wellfield as part of the UCMR3 monitoring, and no PFAS were detected at that time. In late summer 2018, Tacoma Public Utilities tested for PFAS in some of the individual wells at the southern end of its South Tacoma Wellfield. This was a proactive effort to understand if PFAS existed in its water sources near JBLM. One of the wells sampled (Well 10C) draws from the shallow aquifer and was available only for customers who wanted to obtain untreated water in their own containers at the well site. It showed PFAS levels that exceeded the EPA LHAL. Tacoma notified customers and closed the well for additional testing and maintenance. Tacoma's Green River source, which serves all Tacoma Water customers with the vast majority of their drinking water, showed no detections of PFAS (Tacoma Public Utilities, 2018).

Parkland Light and Water Company

Parkland Light and Water Company tested its drinking water wells as part of the UCMR3 monitoring, and no PFAS were detected at that time. Because of detections in late 2016 at JBLM-McChord Field just west of Parkland, Parkland began proactively monitoring for PFAS starting in the spring of 2017. Levels of PFOS and PFOA well below EPA's LHAL have been detected in two of Parkland's wells located about three-fourths of a mile east of the middle of the runway at McCord Field. These two wells draw from a very shallow but extremely productive aquifer apparently flowing mostly from the southeast. Parkland continues to monitor these wells.

3.4 Emergency/Incident Response

3.4.1—Sallal, Snohomish

In October of 2018, the Sallal Water Association (Sallal) located in eastern King County received a photograph of a teenager fooling around at one of its storage tanks. When they went to the tank they discovered, among other things, that the tank's hatch cover was open and there were white pellets located on top of the tank. Sallal contacted DOH to report the incident and to discuss next steps. Although no threats had been made against the water utility it was decided that the best course of action was to immediately advise the eighty-two affected customers to not drink the water. Field tests conducted the next day by the King County Sheriff's office determined that the white pellets were biodegradable air soft pellets and did not pose a health threat.

In hopes of quickly lifting the health advisory, Sallal collected a number of water samples and had them analyzed for a variety of different substances. Unfortunately, the tests indicated that coliform bacteria were present in the distribution system. The health advisory remained in effect for several weeks until the storage tank could be drained and cleaned. The draining of the tank revealed a

number of foreign items in the tank suggesting that Sallal's tank inspection protocols required improvement.

The City of Snohomish had a similar vandalism event during the summer of 2019 when five teenagers decided to break into a tall storage reservoir owned by the city and go swimming on a warm summer day. The entire incident was captured on video by the teens and posted to the internet so that everyone could see what they had done. The city immediately took the tank out of service so that it could be drained and cleaned.

There were a number of lessons learned from these incidents. Both utilities have improved security at all of their tank sites. The episodes reinforced the need to incorporate redundant security measures into the design of a water system. Sallal's inability to isolate the storage tank from the distribution system status and its untreated status prevented it from lifting the health advisory and restoring normal service for almost two weeks. Snohomish had backup systems in place but was unable to drain the tank efficiently because the tank's design primarily relied upon the water to drain through the distribution system. The city was finally able to place the tank back into service approximately three weeks after the event occurred. Fortunately there are fixes available to both utilities that will allow them to reduce the amount of time they may be without full water service.

3.4.2 Drought Response

Due to below-normal snowpack and poor summer streamflow forecasts, Governor Inslee declared two drought emergencies covering twenty-four basins in Washington. These basins met the statutory requirement that the water supply forecast be below 75 percent of normal and that deficits were likely to cause undue hardships to water uses or users. Drought declaration areas are illustrated in Figure 9.

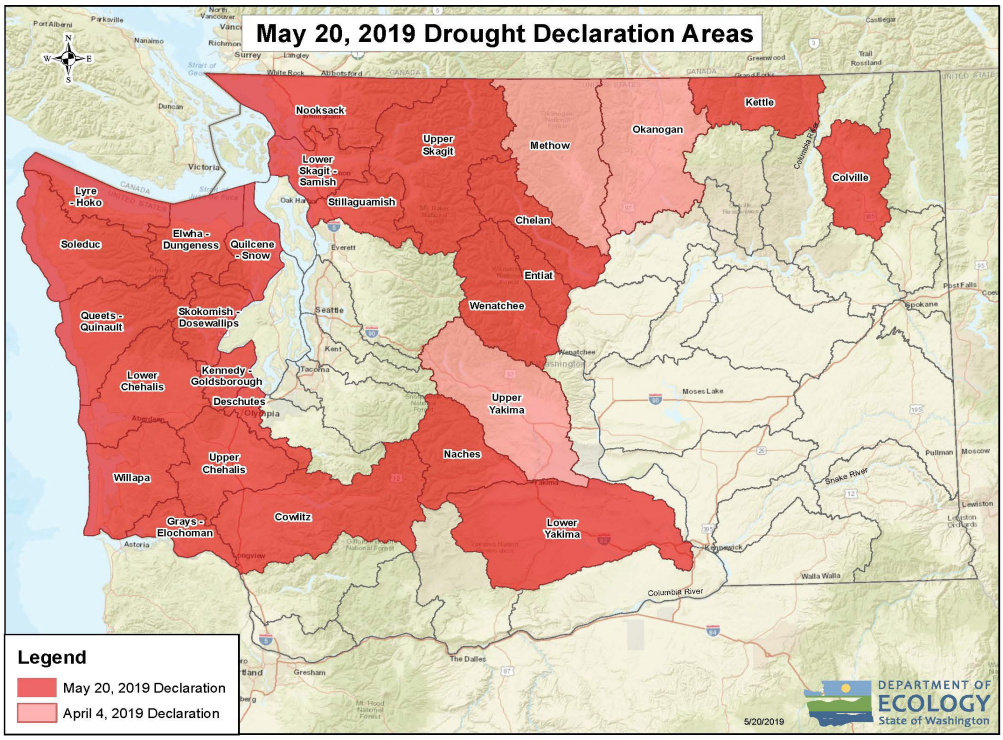


Figure 9: Drought Declaration Areas in May 2019.

The Washington State Drought Plan (plan) identifies public drinking water supplies as a high-risk sector and makes DOH responsible for completing several tasks described in the plan.

Actions completed by DOH during the 2019 drought and considered high value for reducing a water system's vulnerability to drought:

- Consult with Ecology and the Governor's Office on anticipated effects to public water systems.
- Survey large and medium water systems (>20,000) to assess existing conditions, drought preparedness, and response capability.
- Establish regional operations contacts to answer drought questions from water systems.
- Distribute drought-related technical assistance and publications targeted to size and level of risk.
- Coordinate with local health jurisdictions on Group B and private water system issues and concerns.
- Develop an action plan for DOH's response to water systems during the drought.
- Proactively communicate with utilities in drought-sensitive water sources or locations when a drought is declared, including filling raw water reservoirs, and monitoring groundwater withdrawal and drawdown.
- Provide technical assistance to Ecology by evaluating requests for relief from public water systems—including emergency grant applications, temporary water rights transfers, and action on new water rights.

During a declared drought emergency, DOH completed the following mandatory response actions:

- Map “at-risk” areas to enable targeted communications to water systems most vulnerable to drought.
- Respond to phone calls, emails, and requests for information from the public.
- Provide direct technical assistance to water systems dealing with immediate effects from drought conditions.
- Assist water systems with access to emergency funding and grant applications. Offer technical and financial assistance through Ecology’s emergency fund for infrastructure improvements, such as deepening an existing well, rehabilitating an inactive source, constructing an intertie with an adjacent utility and other appropriate projects.

Three systems in the southwest regional office struggled to meet demand in 2019 due to drought conditions. Specifically:

City of Forks. The city gets its water supply from five wells, each less than 100 feet deep. Water levels in the wells were dropping about one-foot per week through the months of May and June and there was concern the wells would fail. DOH and Ecology staff led a drought forum in Forks on June 24 to discuss options for the city and the surrounding communities. Potential options identified included trucking water to nearby communities and developing an additional source for the City of Forks. DOH staff helped with grant applications to Ecology for both options and conducted a site visit July 31 to evaluate an existing well as a possible emergency source for Forks. The well did not meet construction standards and a new well site was chosen and well drilled. DOH continues to work with city and Ecology staff to approve this well for use as a permanent drinking water source.

City of Ryderwood. The city gets its water supply from the East and West Forks of Campbell Creek, which drain from the Willapa Hills to the west. The Willapa Hills rise to 3,110 feet above sea level and are part of the Coast Range. These are low-elevation hills with varying amounts of snowpack each year. During years with low snowpack, the creek is more likely to dry up in the summer. This occurred in 2018, but the city was able to meet demand by filling its 500,000-gallon reservoir and aggressive conservation by its residents. Due to events last year and lower snowpack this year, Ecology and DOH staff were concerned Ryderwood would be unable to meet demand in late summer and early fall. Ryderwood implemented voluntary conservation July 3, and Ecology paid for and installed stream-flow gages on both forks of Campbell Creek August 14 to allow Cowlitz County to manage their resource better. Due to lower than anticipated summer temperatures and strong conservation by Ryderwood residents, the city reported no outages. DOH and Ecology staff met with and were in constant communication with Cowlitz County staff during the summer to monitor the situation and provide technical assistance. Ryderwood contracted with an engineering firm to identify long-term water supply options for the community due to the anticipated increased frequency of droughts in their area.

Island View Water District. This small system gets its water supply from Olsen Creek. In mid-August, flows in Olsen Creek dropped below the intake and the system began trucking water from another Clallam PUD system on August 20. Trucking continued for about six weeks until flows in Olsen Creek

were high enough to divert water. DOH staff provided technical assistance to ensure the trucked water met treatment standards.

DOH staff also provided support in their application to Ecology for drought funds to purchase another water truck. Ultimately, Clallam PUD decided not to submit the application to Ecology for a water truck nor seek reimbursement for the costs associated with water trucking.

Due to early drought declarations, active and ongoing communications and messaging, and cooler-than-anticipated summer temperatures, only one source on the Olympic Peninsula was known to be depleted. However, this system was able to begin trucking water immediately, which ensured a continued supply of potable water to its residents. In the eastern region, no Group A systems reported drought effects. However, water systems are not required to notify DOH if they activate a formal water shortage response strategy, which may lead to an under-awareness of effects in 2019.

In addition to technical and communications support, DOH assisted with applications for drought funds and Ecology awarded $668,000 to water systems and utility districts for drought response.

3.4.3 Wildfires 2017-2019

Following a previous period in Washington with major wild fires across several summers, DOH was equipped going into the 2017-2019 period with effective tracking tools that enabled us to conduct early outreach to at-risk water systems and offer assistance as needed. Assistance included guidance on assuring public notification should health advisories need to be issued, helping to coordinate assistance from other entities, and providing links to our publications and other communication products related to wildfire response. Compared to the previous period, Washington experienced relatively mild wildfire activity during 2017-2019. However, in 2017 and 2018, smoke from neighboring regions did cause air quality concerns, triggering response actions from other parts of the agency.

3.4.4 Building Water System Resiliency (The Forum)

Water utilities have been strengthening their facilities over the last several decades in hopes that the facilities can survive a variety of natural disasters. It has become clear, however, that the challenge goes beyond simply strengthening facilities. Utilities must ensure that their organizations can recover quickly from those same disasters, in other words they must build resiliency into every aspect of their business.

The central Puget Sound Water Supply Forum which consists of representatives from the region's largest water utilities and King, Pierce, and Snohomish counties challenged themselves over the past three years to address the resiliency of the region's water supply. The Forum on two previous occasions, came together to evaluate the capacity of the region's water supply to meet future demands for drinking water and was able to quickly come up with a scope of work and the funds to look at resiliency at the regional level. They considered a number of risks including climate change, earthquakes, water quality, and drought.

After evaluating each risk, the Forum agreed upon service levels they believed were appropriate following a major event and an appropriate timeline for restoring full service. This information was then used to develop an action plan that includes short-term and long-term actions for the Forum and individual water systems. The plan includes capital projects as well as additional studies regarding each risk. The study also emphasized the need to build strong relationships with local and state emergency managers and improve coordination with other lifeline sectors including transportation infrastructure, fuel supply, and electrical power.

The Forum's outreach efforts on resiliency prompts others to take action. The Department of Homeland Security recently launched its Regional Resiliency Assessment Program focusing on water supply in seven counties in Washington state from Pierce County north to Whatcom County and our two island counties. The work is expected to take two years and result in an assessment intended to guide strategic investments in equipment, planning, training, and resources to enhance the resilience and protection of facilities throughout the region.

The Forum's work on resiliency also prompted some of the small water systems in our Northwest Region to ask DOH how to move beyond water quality emergency response to focus on creating earthquake resiliency in their water systems. DOH saw this as an opportunity to increase all three areas of capacity: technical, managerial, and financial.

In 2018, a focus group was convened by DOH's Island County Engineer/Planner team to include Whidbey Island Water System Association's (WIWSA) board members, two local engineering firms, retired professionals serving as small water system home owner association Board Members, a Red Cross volunteer, and staff from Island County Emergency Management and Public Health. A checklist was the meeting product (see attached). It was designed to focus efforts on low-cost/high value, pre and post EQ actions, in order to improve operational and managerial resiliency in small water systems. On a qualitative level, it provided peace of mind, and more reasons for Boards to connect and communicate to their customers about level of service discussions.

Emergency Preparedness trainings were held in Island County in 2017, in Skagit in 2018, and Pierce in 2019 reaching over 130 water systems. DOH has heard anecdotally about dozens of water systems making the types of improvements recommended in the checklist. Even a few water system board members from Pierce County travelled to Island County to meet each other to discuss this important topic.

3.5 Operating Permits—A Simple Capacity Snapshot

Every year, DOH issues all Group A public water systems an operating permit. The operating permit system allows us to assess the capacity of waste systems to provide safe and reliable drinking water. The permit provides useable information about a water system's adequacy to serve existing services or to grow. Water system owners and operators, consumers, permitting authorities, and lending institutions use the operating permit category to make decisions that are based upon the capacity of the water system to serve existing and potential customers.

The color-coded operating permit system provides an easy method for water consumers to understand the status of the system providing their drinking water. In the year, 2019, the vast majority of water systems had green (3,092) or blue (912) operating permits with only a limited number having yellow (9) or red (11) operating permits.

Table 9

Category	System is	We view this system as
Green	Substantially **in compliance** with regulations.	**Adequate** for existing uses and for additional service connections up to the number of approved connections.
Yellow	Substantially **in compliance** with all requirements. But it: • Was notified to submit a legally compliant water system plan and has not satisfied this planning requirement. • Is under a compliance agreement to address the system's status as a state significant non-complier and is also acting in accordance with that agreement.	**Adequate** for existing uses and for additional service connections up to the number approved by the Department in a water system plan or modified by the Department in a compliance document.
Blue	Substantially **in compliance** with requirements. However, the system does not have a Department-approved water system design or is no longer operating consistently with that design, or the system has exceeded the number of Department-approved connections.	**Adequate** for existing uses, but not adequate for adding new connections.
Red	Substantially **out of compliance** with requirements.	**Inadequate** for existing uses and no additional connections are allowed. This may result in denial of home loans, building permits, on-site sewage disposal permits, food service permits, liquor licenses, and other permits or licenses for properties the system serves.

3.6 Enforcement/compliance program

DOH's mission is to ensure safe and reliable drinking water. When water systems and certified operators are unwilling or unable to achieve timely compliance, we use escalating formal enforcement tools to ensure that public health priorities are met.

DOH's enforcement philosophy is to:

1. Remain focused on protecting public health.
2. Educate and inform water consumers.
3. Ensure water system purveyors and operators understand their legal requirements.
4. Allow a fair opportunity to attain compliance.
5. Support water system regulatory compliance in every reasonable way.
6. Hold purveyors and operators accountable for compliance.
7. Follow through with enforcement actions in a consistent, fair, and timely manner.

DOH views its compliance program broadly to encompass both "soft" and "hard" enforcement tools.

DOH works to motivate and assist water systems with their return to compliance before those systems reach DOH's Formal Enforcement Trigger (FE trigger) and formal enforcement becomes necessary. These actions and activities are typically identified within DOH programmatic plans as compliance-enforcement strategies. When DOH undertakes hard enforcement for non-compliant water systems—such as issuing formal orders under Washington Administrative Procedures Act (APA), turning a system's operating permit red, issuing civil penalties, seeking court-ordered water system receivership, or seeking court-ordered specific performance of DOH's orders—DOH continues to use soft enforcement tools, where appropriate.

While DOH is concerned about, and takes enforcement action for, any drinking water violation, it calibrates its program to prioritize situations that present the highest public health risks. By focusing, first, on acute contaminants and, next, on chronic contaminants, the program functions consistently with national drinking water regulations and EPA's Enforcement Response Policy (ERP),[1] which EPA implements through its Enforcement Targeting Tool (ETT).

Through routine reporting, DOH notifies EPA when Group A public water system violate the national drinking water regulations. Quarterly and annually, EPA tracks DOH's efforts to return systems to compliance. DOH and EPA use the ETT to track water system violations and DOH's efforts to bring systems back into compliance. EPA can "over file," or pursue direct federal enforcement against a water system, if it finds doing so is necessary to gain compliance or at the state's request.

In December of 2009, EPA began implementing a new approach to enforcement targeting under the Safe Drinking Water Act (SDWA). EPA adopted its new approach through its ERP and ETT.

The approach focusses enforcement attention on public water systems with the most serious or repeated violations—**prioritizing systems with violations that pose health risk or violations across**

[1] EPA's ERP is available at: https://www.epa.gov/sites/production/files/documents/drinking_water_erp_2009.pdf.

multiple programs that could indicate the system is failing due to poor operations and management. **EPA's strategy brings these system to the top of the priority list so that EPA and states can RTC those systems as quickly as possible.**

The ERP and ETT's goal is to allow EPA and states to:

- Align violations with a prioritization that is more protective of public health.
- Comprehensively view public water system compliance.
- Ensure drinking water violations are resolved.
- Recognize that informal enforcement response are valid while ensuring that timely enforcement is taken when these efforts prove to be ineffective.
- Ensure enforcement efforts are escalated based on EPA's ETT prioritization.
- Provide a tool to calculate comprehensive non-compliance status for all systems and identify those not meeting national expectations.
- Provide another resource to identify systems that may need assistance in capacity development and sustainability.[2]

The ERP and ETT rank water system violations based on a formula that identifies systems having the highest total non-compliance across all rules within a designated period of time. Higher violation scores are given for violations that pose the greatest risk to human health. The formula calculates scores based on open ended violations and violations that have occurred over the past five years. ETT scores **do not include violations that RTC or are on the path to compliance through a specified enforcement action – an enforcement action where enforceable consequences result if the milestones in the enforcement action are not met.** Any water system with a score greater or equal to 11 is considered an ETT EPA designated priority system for enforcement response.[3]

The ERP sets forth a model for escalating response to violations. This model begins with the primacy agency—DOH—responding to each violation, and escalating in enforcement formality as the violation continues or recurs. For violations that pose a very serious and imminent risk to public health, proceeding directly to a formal enforcement action is appropriate.[4]

EPA recognizes that states carry out both formal and informal enforcement activities. These activities are effective tools for achieving compliance. Nevertheless, **systems specifically identified by the targeting tool as priorities must RTC or EPA will expect formal, enforceable mechanisms to RTC such systems. States will be expected to escalate their response to ensure that RTC is accomplished. Systems that are unable to sustain compliance should receive additional scrutiny**.[5]

Regarding the timeframes in which states must act to address violations, the ERP states the following.

[2] See ERP p. 2.
[3] See ERP pp. 3-5.
[4] See ERP p. 4.
[5] See ERP p. 6.

For the state's action to be considered timely enforcement, once a system is an ETT EPA designated priority system, the state must conduct an appropriate formal enforcement action, or the system must RTC, within two calendar quarters. For example, if a system becomes an ETT EPA designated priority system on the January ETT for enforcement priority, the state has until June to RTC the system or taking adequate enforcement action by issuing ERP formal enforcement documents, also referred to by EPA as "addressing documents."

An adequate enforcement action has the intent and effect of bringing the non-compliant system back into compliance by a certain time with an enforceable consequence if the schedule is not met. An adequate enforcement document, also known as the ERP addressing document, must describe the non-compliant violation, state the law being violated, state what is required to RTC, provide a schedule for returning to compliance, and provide the state with authority to impose penalties for violation of the enforcement document.[6]

In 2019, after consultation with its legal counsel and EPA, DOH's Compliance-Enforcement Team completed an update of DOH's escalated enforcement policies and procedures and its boilerplate enforcement documents to ensure that DOH is meeting the above criteria. This helps DOH staff properly administer drinking water laws and regulations and carry out DOH's federally delegated responsibilities, including those set forth in EPA's Enforcement Response Policy (ERP) and implemented through EPA's Enforcement Targeting Tool (ETT).

DOH formal enforcement actions are now designed to meet EPA's ERP expectation that states undertake adequate ERP formal enforcement actions within certain timeframes. As of 2019, EPA classifies DOH's boilerplate Notice to Correct Violation (NCV), Order to Correct Violation (OCV), and Formal Compliance Agreement (FCA) as ERP formal enforcement documents/actions because they describe the non-compliant violation, state the law being violated, state what is required to RTC, provide a schedule for returning to compliance, and provide the state with authority to impose penalties for violation of the enforcement document.

DOH reports violations to EPA on a quarterly basis by uploading Sentry data to the federal database (SDWIS). When entering enforcement documents into Sentry, staff normally attach existing violations for which the document is being issued. The ETT process now in effect provides an additional tool in evaluating DOH enforcement efforts by providing a way to look at overall water system compliance with Safe Drinking Water Act programs.

[6] See ERP pp. 7-8.

4.0 Conclusion

DOH partners with people at the local, state and federal level to support and sustain the capacity of water systems to provide safe and reliable drinking water. Our technical, managerial, and financial (TMF) capacity development efforts are diverse and designed to meet the unique needs of water systems, especially small water systems serving financially disadvantaged communities. These investments in the human, institutional, and physical infrastructure are essential to protecting public health and the economy. We are proud of the relationships and partnerships we have developed and sustained over the course of the three-year period covered in this report.

Appendices

Appendix A—Drinking Water State Revolving Fund (DWSRF) Success Stories

City of College Place

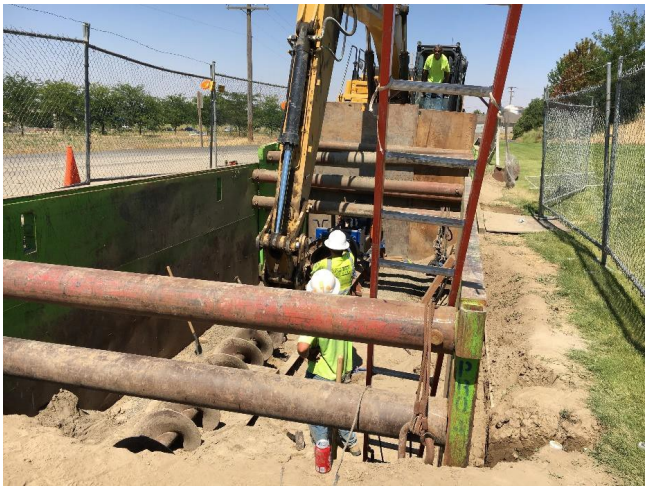
Christ Community Fellowship Consolidation Project

Christ Community Fellowship serves the College Place community as both a place of worship and school with a population of one hundred students. Christ Community Fellowship's well was impacted by nitrates almost twice the maximum contaminant level. The initial compliance proposal was for Christ Community Fellowship to drill a new well, but City of College Place became involved and offered to connect the church and school to its municipal water system. In order to facilitate this connection, a new water main and well were needed. Given the large scope of work, the City phased the project over the course of three years. The City agreed to install the new transmission main first to allow connection of the Christ Community Fellowship, which happened in August 2019 in time to provide safe drinking water to the students for the 2019 school year. In addition, this project will provide City of College Place with a new well to better serve Christ Community Fellowship and improves the resiliency of College Place's water system in response to the declining aquifer in this area.

College Place received three DWSRF loans for a total of $5.9 million and each loan included 50 percent principal forgiveness since the project consolidated a troubled water system.

Public health and environmental benefits

Christ Community Fellowship church and school now receive safe and reliable drinking water from City of College Place. The new well results in College Place becoming more resilient.



Directional drilling of new water main.

Liberty Lake Sewer and Water District

Eastside Liberty Lake Improvement Club Consolidation Project

East Side Liberty Lake Improvement Club (ESLLIC) was incorporated in 1945 and provides water service for 327 customers. The ESLLIC service area resides within the sewer service area boundary of Liberty Lake Sewer and Water District (LLSWD). In addition, LLSWD operates and maintains ESLLIC water system under contract, including meter reading and billing. An intertie exists between ESLLIC and LLSWD water systems as a back-up to the existing wells serving ESLLIC. In 2014, ESLLIC applied for and received a DWSRF loan for improvements to their water system. Improvements included replacement of fifty-plus-year-old well pumps, booster pumps, and reservoir. The loan was awarded for $905,465 with 1.5 percent annual interest rate.

In 2016, LLSWD general manager contacted the DWSRF program about converting the loan to a consolidation project. The proposal was to transfer ownership of ESLLIC water system to LLSWD, abandon the existing wells serving ESLLIC, utilize the existing intertie as the main water source to ESLLIC, and conduct needed improvements to ESLLIC distribution system. This proposal had merit given LLSWD's current relationship and service provided to ESLLIC. All stakeholders worked together and the ESLLIC loan was transferred to LLSWD, with the project becoming a consolidation. As a consolidation project, the loan terms were modified accordingly with 50 percent principal forgiveness granted and interest rate lowered from 1.5 percent to 1.0 percent. The loan award of $905,465 remained the same. LLSWD received another loan for $2,660,500 for continued improvements of ESLLIC old and undersized distribution lines with over 50 percent principal forgiveness. This project received an Aquarius Award from EPA for being an outstanding project.

Public health and environmental benefits

The revised project resulted in the following benefits.

- ESLLIC is out of the water business.
- ESLLIC will have updated distribution mains and a reliable water source from LLSWD.
- ESLLIC will have reduced water rates. Under ESLLIC ownership, the base water rate was
    - $50.76, which included the surcharge for the DWSRF loan. Upon consolidation with LLSWD, ESLLIC customer's base rate was reduced to $18.52.
- ESLLIC saved nearly $1 million by not investing in the well and pump station upgrades.

Installation of new water main.

City of Spokane

Central Wells 1 and 2 Rehabilitation Project

The City of Spokane is served by a number of groundwater sources. The Central Wells 1 and 2 provide approximately 15 percent of Spokane's total water supply. These wells are equipped with older, inefficient pumps. In addition, the existing pumps are very expensive to maintain. The City decided to replace the existing pumps and motors to improve reliability and efficiency. The project included new controls, pumps, and motors. The project was financed with a DWSRF loan for

$1,221,090 at 1.0 percent interest rate for twenty years.

Public health and environmental benefits

The new pumps and motors are more energy efficient, resulting in decreased energy consumption and costs. In addition, these wells improve Spokane's resiliency and ability to provide safe and reliable drinking water.

New pump motor at Central Well 2.

Appendix B—EPA Reporting Criteria

A. New Systems Program: Annual Reporting Criteria

1. *Has the state's legal authority (statutes and regulations) to implement the New Systems Program[7] changed in the previous reporting year? If so, please explain and identify how this has affected or impacted the implementation of the New Systems Program. If not, no additional information on legal authority is necessary.*

   No.

2. *Have there been any modifications to the state's control points (its implementing authorities to review and verify a newly proposed water system has satisfied all three aspects of capacity before it may be approved)? If so, describe the modifications and any impacts these modifications have had on implementation of the New Systems Program. If not, no additional information on control points is necessary.*

   No.

3. *List new systems[1] in the state within the past three years and indicate whether those systems have, at any point during the first three years of operation, had unaddressed violations that incurred an Enforcement Targeting Tool (ETT) score of greater than or equal to 11 (ETT scores are generated quarterly by EPA's Office of Enforcement and Compliance Assurance).*

   We now use EPA's ETT Tracker, which shows ETT trends over consecutive quarters. We appreciate the tool's ability to show trends and filter in various ways, including "by new system." We used the ETT Tracker to identify new systems and determine whether they appeared as priority systems on any previous ETT lists.

   During the last three years, we added 141 new systems to the state's inventory. Of those, twenty-three are community water systems and sixteen are nontransient noncommunity water systems. One of the new systems, a transient noncommunity water system, had a score of eleven or higher on a quarterly ETT lists during the tri-annual period at issue. However, it returned to compliance (see table B1 below).

[7] EPA's definition of a new system "includes both community or non-transient noncommunity (NTNC) water systems being newly constructed as well as systems that do not currently meet the definition of a public water system but that expand their infrastructure and thereby grow to become community water systems or NTNC systems."

Table B1

	Community Water Systems	Nontransient Noncommunity Systems	Total
New in 2014–16	23	16	39
On ETT list with score ≥ 11	0	0	0
Addressed compliance issue	N/A	N/A	N/A
Unaddressed compliance issue	N/A	N/A	N/A

4. *What is DOH doing to correct, or what have we done, to keep these numbers low?*

   DOH incorporated the Enforcement Response Policy and ETT into our compliance process. The ETT allows us to "quality check" our compliance process. When systems reach ETT priority status, we want them to return to compliance as soon as possible.

   To ensure a comprehensive approach in bringing systems into compliance, we explore how to use ETT data through the Capacity Development, DWSRF, and Operator Certification Programs.

   DOH also provides considerable training and outreach to struggling systems before resorting to formal compliance tools. We identify problems and help them find appropriate solutions. Often, systems have performance issues because of improper management. We start by examining their staffing, policies, rates, record keeping, and communication. This gives systems the opportunity to self-correct and thereby avoid formal enforcement action.

   When systems are not able to get on track, we employ a compliance strategy that directs us to:

   - Make protection of public health our top priority.
   - Enforce requirements by holding system owners and operators accountable for compliance.
   - Provide education to consumers and notify system owners of requirements, including the consequences of not meeting the requirements.
   - Follow-through in a consistent, fair, and timely manner with compliance actions that are appropriate for the particular violation.

B. Existing System Strategy

1. *In referencing the state's approved existing system strategy, which programs, tools, and/or activities were used, and how did each assist existing federally regulated public water systems (PWS) in acquiring and maintaining technical, managerial and financial (TMF) capacity?*

DOH's strategy for ensuring adequate water system capacity uses a multi-component approach for the more than four thousand federally regulated public water systems in Washington. It includes:

Annual Operating Permits

DOH provides a color-coded permit to each water system. The color indicates how well the system is meeting the regulatory requirements. It is also a way for us to share water system performance information with customers, lenders, local jurisdictions, and other stakeholders.

Prioritized Compliance Strategy

DOH's compliance strategy ensures that compliance efforts address the highest public health risks first. We notify water systems when they violate a regulation, and inform them of actions to correct the violation and return to compliance. We provide training and outreach to help systems find appropriate solutions, which often include strengthening aspects of their managerial capacity. DOH uses formal enforcement tools for systems that are unwilling or unable to work with us to return to compliance.

Comprehensive Planning

DOH requires that all public water systems plan. We gear these plans to the appropriate level of system need, so that each system gets the most out of its planning process. We look at the water system's plan as the foundation. The water system takes a comprehensive look at all of its goals, challenges, and statutory requirements and charts a course for achieving them. We use the planning documents as a means of ensuring water systems are working to build capacity in accordance with the expectations of the 1996 amendments to the federal Safe Drinking Water Act.

Operator Certification

In the effort to assist water systems with pending workforce issues and retirements, the Operator Certification Program continues to provide assistance in many service area.

Operator In-Training (OIT) Certifications

The OIT certifications now applies to all certification levels. The OIT certifications assist water operators with planning a career path and help water systems expand their applicant pool to find qualified applicants to address workforce concerns and vacancies due to retirements. For more information on OIT certifications, please check out the OIT webpage

Basic Treatment Operators (BTO): Granted Treatment Experience

BTO operators were given the opportunity to apply for a free upgrade to Water Treatment Plant Operator 1 (WTPO1) using the treatment experience they gained while working on the very small treatment plants. These small treatment plants were included in the treatment classification as a Level 1 treatment plant. Over eighty small treatment plants and their certified BTOs were upgraded to Level 1 classification and certifications.

Cross-Connection Control

DOH worked with Ecology on our operator certification and cross-connection control requirements in their updated Reclaimed Water Rule. This rule requires operators certified as Distribution Managers and Cross-Connection Control Specialists to operate, maintain, and repair the reclaimed water distribution system. The rule includes extensive detail on protecting reclaimed water from lower quality water through cross-connections. We also changed the experience requirements for the Cross-Connection Control Specialist (CCS) certification to allow industrial water, wastewater treatment, engineering, or operations consultant experience to count toward certification requirements. This change allows more portability of certifications because cross-connection control is universal in protecting high water quality supplies from lower water quality uses.

Mobile-Friendly Webpages

Technological advances in the water industry have led to increasingly smaller devices used to access webpages. Operators were using their cell phones and tablets to access information on the internet, so the Operator Certification Program applied some of the criteria to re-evaluate and update our webpages.

With the new format, viewers find what they are looking for more quickly. We strive to have the most current information available on our pages, and we are working toward having more mobile-friendly webpages.

Sanitary Surveys

DOH collaborates with local health jurisdiction staff and private consultants to help us inspect all water systems every three to five years, depending on system type, source, and performance. During a sanitary survey, our inspectors review the management and operations of the water system, identify areas for improvement, and identify resources to help them improve. When we find deficiencies, we explain how to correct them. We then set deadlines and follow-up with water systems to make sure they address deficiencies.

Data Management and Communication

DOH tracks, stores, and shares public water system data with systems and the public on our website, which provides customers with information about their water system, such as water quality history, operating permit, and compliance status. Our website and annual consumer confidence reports (CCRs) help keep customers informed about the overall performance of their system. Systems have the option of providing their customers copies of their CCRs electronically. DOH developed guidance for water systems that wish to provide their customers electronic access to their CCRs.

Security and Emergency Response Program

DOH works with water systems and others to plan, prevent, and prepare for security breaches and all hazard emergency response. We coordinate with our Agency Coordination Center (ACC) and State Emergency Operations Center (SEOC), which are central location for information gathering, analysis, and response coordination during an emergency. Our local

health agencies represent us at local emergency operations centers during emergencies. Our mutual aid network, Washington Water/Wastewater Agency Resource Network (WAWARN), has 168 participating water systems and 161 signed mutual aid agreements within the network.

In 2016, DOH hired a full-time Emergency Response and Legislative Liaison position. This position helps DOH better serve our systems during emergencies and provides needed expertise in emergency preparedness to our public water systems. Some highlights of current work in this program:

- Work on Infrastructure Nexus between water/utilities/energy/transportation and help maintain DOH drinking water priorities in planning discussions and efforts regarding the recovery of the region after a catastrophic disaster.
- Form and train a Field-Staff-Level Emergency Response Preparedness Team, composed of regional office staff (EPH strike team).
- Represent DOH in the Infrastructure Resilience Sub-Committee (IRSC) of the Emergency Management Council (EMC), which continues to be an active community concerned with improved coordination, planning, and response among public and private sector lifeline operators.
- Represent DOH on the State Catastrophic Incident Planning Team (SCIPT) at the Emergency Management Division (EMD) to facilitate the strategic restoration of water storage, water treatment capacity and conveyance systems and infrastructure for affected population, critical services, and critical infrastructure.
- Represent DOH on the Emergency Management Department (EMD) Hazard Mitigation Work Group to conduct interagency coordination and planning for strategic deployment of technical and financial assistance during an all hazards emergency response. Also conduct all hazards assessment and mitigation strategies.
- Provide content revisions for the Washington State Comprehensive Emergency Management Plan (CEMP), Catastrophic Incident Annex.
- Establish a technical foundation and create consistent understanding of the core technical concepts relevant to DOH emergency response operations.
- Represent DOH in Regional Infrastructure Security Group (RISG). Current focus is to identify and document critical assets, assess risk and interdependencies, and cybersecurity.
- Outreach and education to water utilities regarding all hazards emergency response planning.

DWSRF

Historically, the DWSRF program has been overseen by DOH, Department of Commerce, and the Public Works Board until July 1, 2018. Legislation passed in 2017 directed DOH to oversee the entire program, transferring contract administration duties from Commerce to DOH. DWSRF provides an intended use plan to EPA to allow release of the capitalization grant each year and then an annual report at close of each fiscal year that reports how capitalization funds were spent. DWSRF provides funds through the construction loan, emergency loan, and consolidation feasibility study grant programs to water systems to

make improvements for the protection of public health. For the period covered by this report, DWSRF funded fifty-six projects. DOH continues to promote system consolidations and we grant up to 50 percent subsidies to construction projects that include consolidations.

To date, the consolidation efforts have resulted in the elimination of over sixty water systems now served and/or owned by another viable entity.

Small Communities Initiative (SCI)

We use part of our local assistance set-aside for an agreement with Commerce that helps local elected officials, city staff, and citizens define, prioritize, and identify links between public health, environmental protection, and local development issues. Last year, SCI provided assistance to fifteen drinking water jurisdictions to secure funding for improvements and coordinating efforts in planning, rate setting, asset management, and source water protection, and an additional seventeen water systems with more limited SCI assistance. SCI efforts result in safe drinking water, improved environmental protection, and infrastructure that can help with community and economic development activities.

Rural Community Assistance Corporation

DOH uses part of our local assistance set-aside in an agreement with The Rural Community Assistance Corporation (RCAC) to provide technical assistance to small communities across the state. RCAC assists systems with financial and managerial capacity building projects such as rate studies, board training, and water system plan development. In 2019, RCAC assisted twenty-three public water systems to improve their capacity to provide safe and reliable drinking water into the future or review the feasibility of consolidating water systems.

Training

DOH provides training to complement the work of our technical assistance providers. This includes one-on-one training for water systems, speaking at conferences and public meetings, offering regulatory insight at various venues, and facilitating comprehensive performance evaluations and performance-based training.

2. *Based on the existing system strategy, how has the state continued to identify systems in need of capacity development assistance?*

DOH continues to use compliance data, sanitary surveys, and planning documents to identify systems that are in need of capacity development assistance. DOH created a capacity development workgroup to guide our capacity development program. We continue to work with our regional offices to identify systems in need of technical assistance through sanitary surveys, special purpose investigations, routine contact, and emergency response work. We target assistance to these systems through our technical assistance providers.

DOH is researching the ability of our available data management systems to identify and track system capacity. We are considering creating a small capacity development team to create a

ranking and tracking program for targeting our technical assistance activities to those systems most in need.

3. *During the reporting period, if the state has identified any PWS capacity concerns or capacity development needs (Technical, Managerial, or Financial), what was the state's approach in offering and/or providing assistance?*

   Local Assistance Set-Aside Funds
   DOH uses local assistance set-aside funds from our annual capitalization grant to help address the capacity development needs we identify. Over the past year, we provided:
   - Sanitary surveys and related technical assistance to help fix problems identified during the survey.
   - Training to third-party sanitary surveyors.
   - Support during coliform and health advisory situations, including developing action plans with water systems and communicating with labs, local health jurisdictions, and the media.
   - Technical assistance to small water systems on water quality, source water protection, cross-connection control, and engineering issues.
   - Source water protection technical assistance through conference training sessions, direct assistance from our Source Water Protection Program Manager, and a contract with Evergreen Rural Water of Washington.
   - A wellhead protection interactive GIS website.
   - Managerial and financial capacity assistance through contracts with Rural Community Assistance Corporation and Small Communities Initiative.
   - Targeted financial technical assistance to improve small systems' financial capacity and position them to apply successfully for funding opportunities.
   - Capacity information to water systems through our website, publications, including *Water Tap* and *H_2Ops* newsletters, and other media channels.
   - Partnership support with other state agencies to help local officials, city staff, and residents define, identify, and prioritize issues related to public health and environmental protection.
   - Feasibility studies for restructuring and consolidation projects.

4. *If the state performed a review of implementation of the existing system strategy during the previous year, discuss the review and how findings have been or may be addressed.*
   The state did not perform a review of the existing system strategy in 2016.

5. *Did the state make any modifications to the existing system strategy?*
   No.

Appendix C—DBP Formation Study in Washington State

DBP Formation in Coastal Groundwater Study (Washington State)

Steve Deem, P.E.; Jolyn Leslie, P.E.; Virpi Salo-Zieman, P.E.
NW Regional Office—Office of Drinking Water
Washington State Department of Health
In partnership with

Michael Dodd, PhD; Tessora Young; Huan He

Department of Civil and Environmental Engineering
University of Washington

In Washington state thirty-five groundwater systems have exceeded the maximum contaminant level (MCL) for Disinfection Byproducts (DBPs), compared to twelve surface water systems. These groundwater systems are concentrated in San Juan, Island, and Whatcom counties (see figure C1) and tend to have higher levels of total trihalomethanes (TTHMs) versus haloacetic acids (HAAs). Unlike most surface water systems with DBPs these groundwater systems have higher percentages of brominated trihalomethanes (THMs) that are more harmful to human health and are more difficult to remove from the water. The occurrence of such significant numbers of groundwater systems exceeding the DBP MCLs was unexpected and limited information exists on what specific groundwater characteristics lead to DBP formation in the presence of chlorine disinfection.

EPA guidance documents and research to date have focused mostly on surface water systems. Because standard groundwater source water quality monitoring does not include water quality parameters that may influence DBP formation, little information exists on why DPBs form in one water system and not in an adjacent system. Naturally occurring organic matter (NOM), bromide, ammonia, and other parameter concentrations that may influence DBPs are unknown by both affected water utilities and by DOH.

DOH efforts focused on monitoring results from the distribution system (as required by regulation) and on treatment of the DBPs after they have already formed. Since DOH does not know the specific water quality parameters that are controlling DPB formation, source monitoring guidance cannot be given to water systems, and possible source mitigation actions to reduce DBP formation in the first place cannot be undertaken.

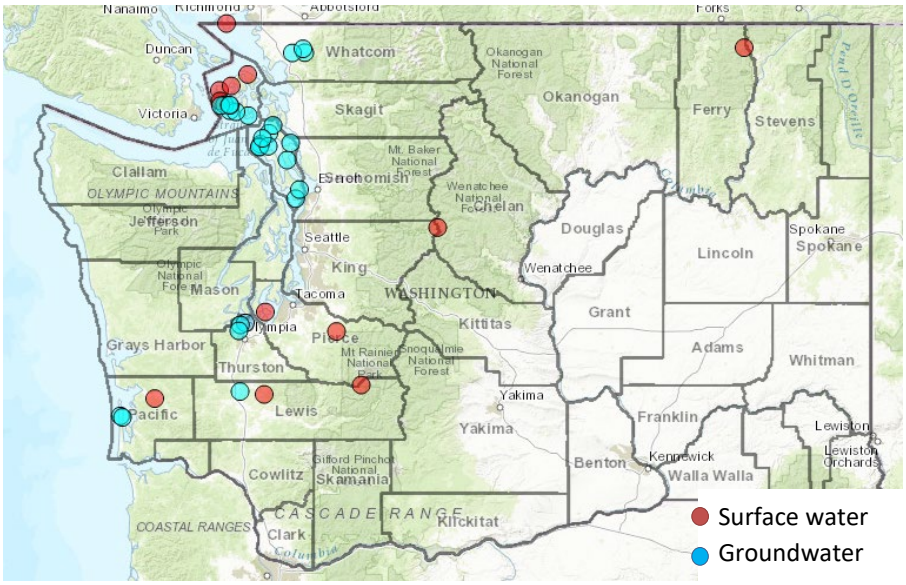


Figure C1: Location of the public water systems in WA that have exceeded DBP MCL.

In order to better understand if there are specific source water quality parameters that are important for groundwater systems, DOH developed this DBP Formation Study. Our proposal was to collect water quality samples from a selected group of Group A water systems, which included collecting and evaluating relevant water system operating parameters over a one-year period. In order to cover any seasonal impacts, we established a quarterly sampling schedule with the first set of samples collected in September 2015 and the last set collected in June 2016. The water systems selected for the study all practice continuous chlorination treatment and are located in San Juan and Island Counties. This included eighteen groundwater sources representing fifteen Group A water systems; all of whom exceed or have exceeded the MCL for TTHMs with six of these have primarily brominated byproducts. We also selected a few nearby systems that have not exceeded the MCL for TTHMs or HAAs as controls.

The key questions for this study were:

- What water quality parameters lead to DBP formation in disinfected water systems using groundwater sources of supply in San Juan and Island Counties? (Why do adjacent water systems with similar well settings exhibit very different DBP compliance results?)
- What are the limiting factors for creation of brominated byproducts?
- Are there certain water quality indicators that could be used to evaluate DBP formation potential in other groundwater systems?
- Do these parameters vary by season, pumping rate, seawater influence, or some other yet unidentified reason?
- What can systems do to minimize DBP formation, or to treat for DBPs.

The study was funded by DWSRF set aside money and led by DOH Northwest Regional Office (NWRO) staff in collaboration with the University of Washington Civil Engineering Department.

AmTest Laboratories was used for analytical services. The contracts are included in the APPENDIX—Contracts. We also conducted on-site field testing for certain water quality parameters.

Sampling Equipment, Analytical Services and Contracts

The total cost proposal of the study was $49,787. The contract was managed by Derek Pell, NWRO. Krista Chavez, NWRO assisted with the four quarters of field-testing.

Civil and Environmental Engineering, University of Washington, Seattle

Dr. Michael Dodd is an Associate Professor in the Department of Civil and Environmental Engineering and an Adjunct Associate Professor in the Department of Environmental and Occupational Health Sciences at the University of Washington (UW). His research addresses the characterization of chemical and photochemical redox processes in engineered and natural aquatic systems, particularly with regard to their application in optimizing pollutant and pathogen elimination during water and wastewater treatment. Focus areas include elucidating and modeling the behavior of chemical and microbiological contaminants during chemical oxidation and disinfection processes, developing assays to quantify the impacts of such processes on contaminants' chemical and biological properties and effects, and engineering novel approaches to centralized and decentralized water treatment. Mr. Dodd provided consultation on the study structure including sampling parameters and performed data analysis of the study results. He is the primary author of the March 2017 Final Report that serves as the basis for this project summary document.

Two of his PhD graduate students Tessora Young and Huan He conducted the lab analysis, provided sampling protocols and QA/QC, assisted in one round of sampling in Island County and conducted data analysis.

The total contract amount for the UW contract was $28,998 and provided analytical data and limited data analysis support for this study. The analytical work covered by this contract included TOC, DOC, DBP-Formation potential tests, ATP analyses, and the organic characterization work. The methods are detailed in the UW Final Report that is included in this binder.

AmTest Laboratories, Kirkland

Am Test Inc. is a Washington State Department of Ecology accredited, analytical laboratory including drinking water testing. The total contract was $13,000. The analytical services included testing of 18 samples per quarter as listed in Table C1.

Table C1

Laboratory Methods for Water Quality Parameters

Parameter	Chloride	Bromide	Iodide	Ammonia	TDS	Conductivity	HPC
Method(s)	EPA 300.0[5]	EPA 300.0[5]	EPA 200.7[6]	EPA 350.1[7]	SM 2540C[4]	SM 2510B[4]	SM 9215B/9215D[4]

Field Testing

The on-site field testing included free and total chlorine, temperature, and pH. Samples were collected from raw and filtered water locations and at the entry point to the system. Free and total chlorine measurements in the field were done with Hach Pocket Colorimeter II and DPD Reagents in accordance with the manufacturers' instructions. A HACH sensION + pH1 meter with SensION+ pH Probe 5050T was used to measure pH and temperature. These analytical equipment (as well as DI water, kim wipes, pH buffers and such needed to perform these analyses in the field) were also purchased with the study funds.

Selection of participating systems

DOH initially selected five water systems that had previous high TTHM results from each county. We then selected two other water systems that were located nearby, but had no historically high DBP results, from each county. We were mostly interested in the TTHMs, because almost all of the DBP MCL exceedances have been TTHMs. We also evaluated the regulatory DBP sample results to see if the system had a tendency to form more or less brominated compounds. Based on this evaluation, the exceeding systems could be grouped into three categories: mostly bromoform, mostly chloroform, and mixture of TTHMs. The fourth group of systems was the control systems that have not had DBP MCL exceedances. Figure C2 below shows the average percentages of sample results. In general, the less blue and red in the figure, the less chlorine-dominated TTHMs have formed in the system. The selection of control systems was also based on the systems geographic location to better understand why certain systems in a specific area have tendency to form DBPs while others do not.

The selected systems were invited to participate to the study and only one, Penn Cove Water and Sewer District, did not want to participate. This system was replaced with Rolling Hills—Glencairn (results also included in the figure below), which was initially excluded due to the high number of sources in use.

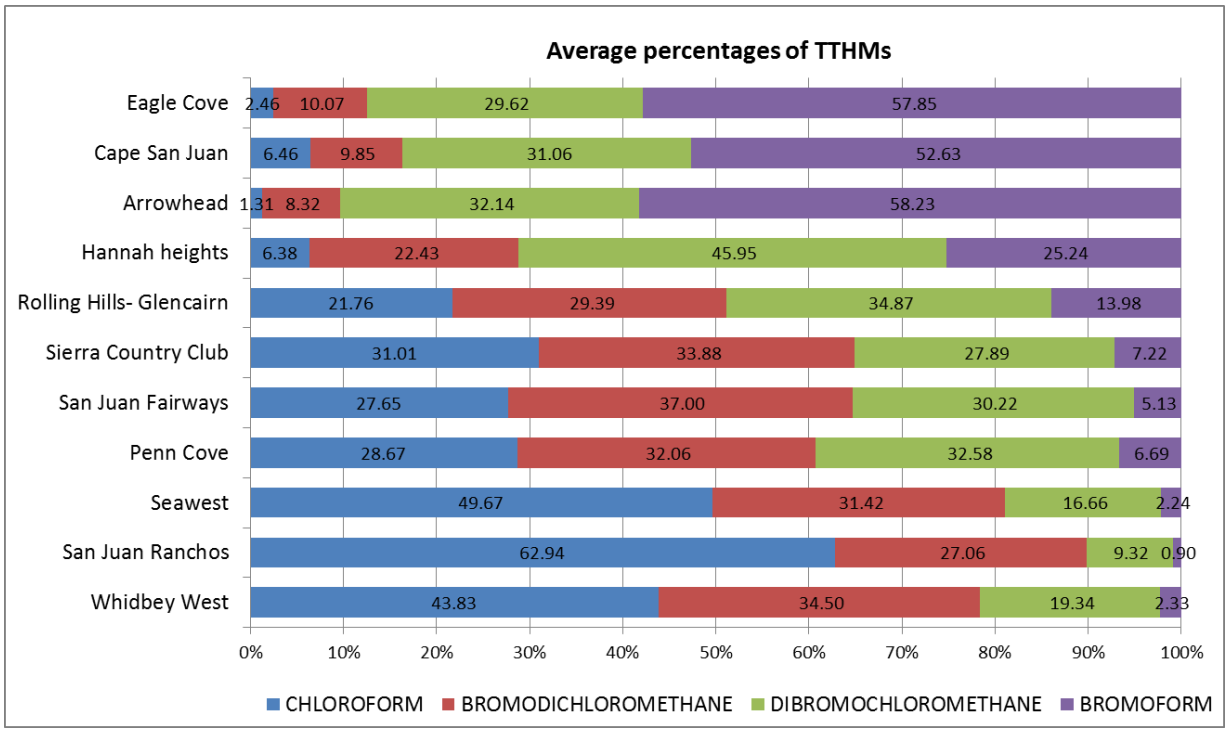


***Figure C2**. The average percentages of different TTHM compounds in regulatory compliance samples over the past several years in the selected water systems.*

Table C2

Public Water Systems Invited to Participate in the Study				
	San Juan		Island	
Study Group	ID#	Name	ID#	Name
Mostly bromoform	20803	Eagle Cove	03000	Arrowhead Beach
	11065	Cape San Juan		
Mixture of TTHMs	30850	Hannah Heights	78975	Sierra Country Club
	75765	San Juan Fairways	37544	Seawest
			74000	Rolling Hills—Glencaird
			66950	Penn Cove Water & Sewer District
Mostly chloroform	75795	San Juan Ranchos	36314	Whidbey West
Background	87780	Oaks MHP	76520	Scenic Heights
	69008	Portland Fair	08324	Briarwood
			67187	Pheasant Farm Acres (added after 2 quarters)

An example invitation letter is included in the binder. Arrowhead was invited by an email. Pheasant Farm Acres was added after two quarters after the initial sampling results indicated that one of the systems was not a representative control system.

Three of the Island County Systems, namely Seawest, Sierra Country Club and Rolling Hills – Glencairn have iron and manganese treatment installed. Additionally, during the study Whidbey West installed reservoir aeration for TTHM control. Information about the systems, their sources, treatments, and operating schemes are summarized in Table C3. Figures C3 and C4 show the study systems' geographical locations.

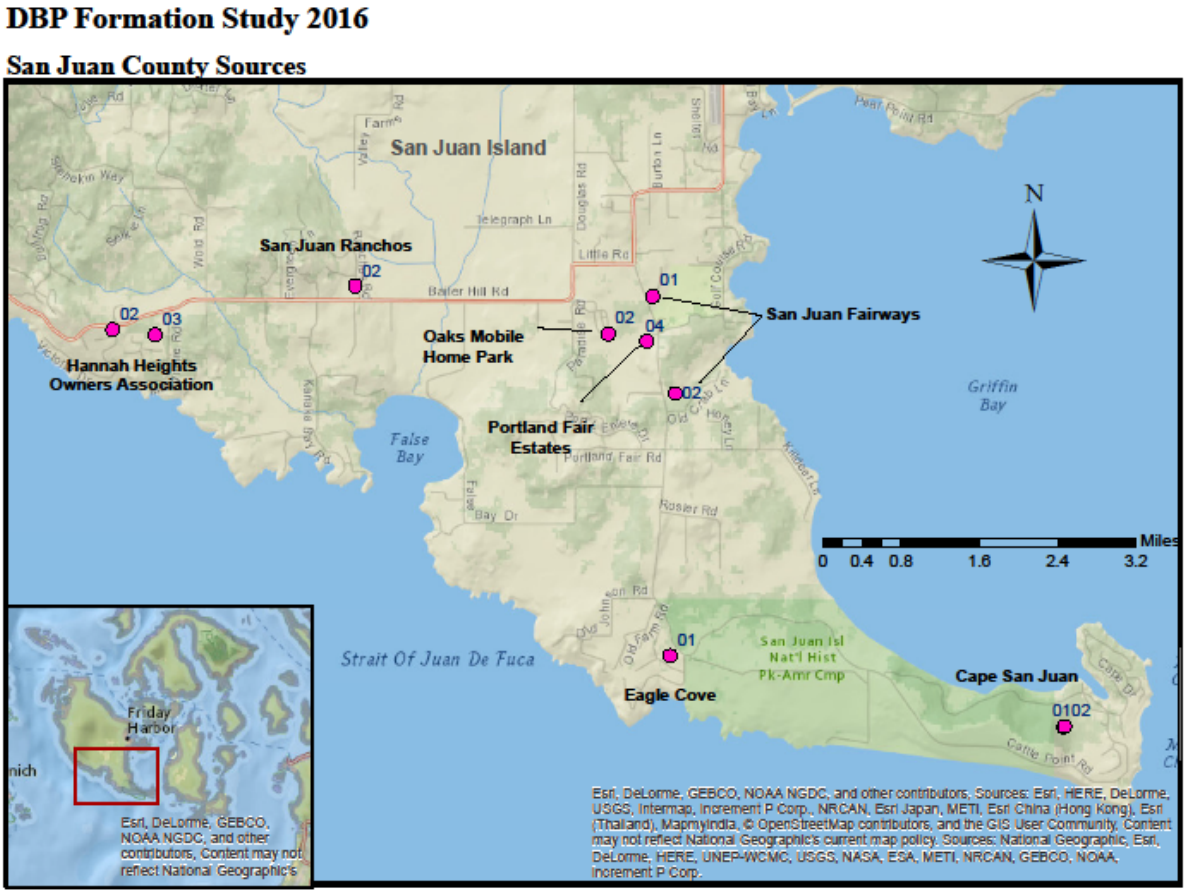


Figure C3: Location of the participating San Juan Island water systems.

DBP Formation Study 2016

Island County Sources

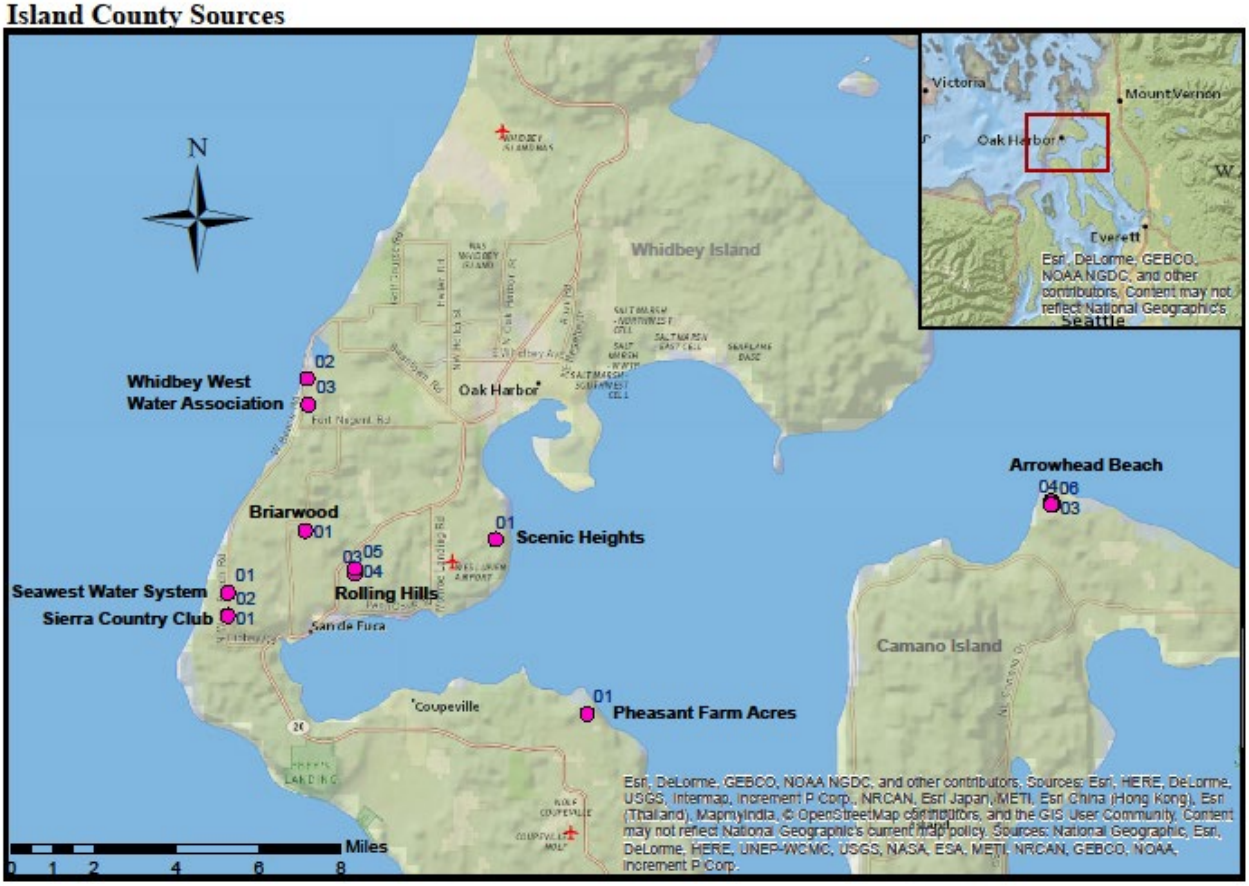


Figure C4: Location of the participating Island County water systems.

Table C3

Summary information on participating systems

System name	Source Description	Additional Treatment (all chlorinate)	Theoretical detention time (days)	S#	Well tag	Well depth (ft)	Land surface elevation above mean sea level (ft)	Aquifer characteristics	SWI risk rating
Arrowhead Beach	5 sources, one wellfield (S05), 3 wells (B-S01,C-S02,D-S03) in active use, all combine before treatment		13.7-15.5 days	01	AGA769	137	123	Unconsolidated sand and gravel	very high
				02	AGA768	148	?	Unconsolidated sand, clay and gravel	very high
				03	AGA767	147	130	Unconsolidated sand, clay and gravel	very high
Whidbey West	Two sources at different locations and pump to separate reservoirs, two entry points		1.1-10.3 days	02	AGA869	206	Well log?		high
				03	AGA888	334	122	Unconsolidated sand and gravel	low
Seawest	Single source	Fe/Mn removal: chlorine oxidation followed by greensand filtration.	6-10.7 days	01	AGA981	283	230	Unconsolidated sand and clay	very high
Briarwood	Single source		5.8-13.4 days	01	AGA877	171	Well log?	Unconsolidated sand and clay	low
Rolling hills—Glencairn	3 sources, two wells on together, one treatment plant and one entry point	Fe/Mn removal & corrosion control: Chlorine oxidation, Greensand filtration, Aeration at reservoir inlets.	2.3-3.4 days	03	ALA614	271	?	Unconsolidated clay, gravel, sand and silt	low
				04	AHB760	178	?	Unconsolidated gravel, clay, sand and wood	low
				05	?	265	well log?		low
Sierra Country Club	Two sources pump together, one entry point	Fe/Mn removal & softening: pot.perm. and hypochlorite oxidation, Greensand filtration, ion exchange, post filtration chlorination.	6.7-9.8 days	01	AGA973	315	?	Unconsolidated clay and sand	very high
				02	AGA972	282	?	Unconsolidated clay and sand	very high
Scenic Heights	Single source		3.6-6.2 days	01	AGA971	290	214	Unconsolidated clay, sand and gravel	very high
Pheasant Farm Acres	Single source		4.3-9.5 days	01	AGA921	295	?	Unconsolidated sand and gravel	medium
Cape San Juan	Wellfield of 2 sources		7.9-13.4 days	01	AFL641	103	well log?		
				02	AFL642	93	80		
Eagle Cove	Single source	Aeration tower for TTHM removal	5.1-9.3 days	01	AFL634	250	100		

Hannah Heights	Two sources at different locations, two entry points		1.2-11.2 days	02	AFL658	183	200		
				03	AFL672	385	?		
Oaks Mobile Home Park	Single source		4.9-7.6 days	02	AFL682	285	110		
Portland Fair	Single source		4.3-6.1 days	04	AFL646	145	well log?		
San Juan Fairways	Two sources at different locations, two entry points		8.4-16.8 days	01	AFL650	148	115		
				02	AGA037	225	100		
San Juan Ranchos	Single source		7.0-10.9 days	02	AFL628	174	?		

Theoretical detention calculated by dividing total storage volume by monthly daily average water treated (gpd) for each month that field samples were collected (September, December, March and June)

Sampling

Sample collection

At each system, samples were collected from the raw water before any treatment and after at least one well volume had been pumped from the well casing. If the individual wells were part of a wellfield, a single raw water sample was collected from a tap representing the wellfield (Arrowhead and Cape San Juan). In Rolling Hill's case, raw water samples were collected form each active source separately for the inorganics analyses, and the UW combined the samples based on the current pumping ratio for their analyses (there was no common tap available before chlorine injection at this system). Sierra Country Club has two sources that are operated at the same time and combine in a reservoir before the chemical additions. In that case, samples were collected after the raw water mixing tank, one sample representing both sources.

For systems with iron and manganese filtration, filtered water samples were collected as close after the filter as possible.

Timing

- Study Quarter 1—September 2015—fall/late summer—dry season
- Study Quarter 2—December 2015—winter—beginning of wet season
- Study Quarter 3—March 2016—spring—wet season
- Study Quarter 4—June 2016—summer—beginning of dry season/end of wet season

Sampling summary

Microbial

Microbial activity from raw source water samples before any treatment was measured by heterotrophic plate count (HPCs) and adenosine triphosphate (ATP). ATP measurements were also done after filtration for those systems with treatment.

HPC is a common method for evaluating microbial activity in drinking water distribution systems. HPC measures culturable heterotrophic bacteria with a detection limit of 1/ml. We used two standard methods: HPC standard agar and HPC R2A agar methods in our study. HPC R2A agar is a nutrient poor agar that better mimics the groundwater conditions than the more nutrient rich standard agar. The purpose was to see if there are significant differences as reported by others with the different agars.

ATP was analyzed using commercially available kits because no standard method exists. In our study, UW selected luminescence assay kit from Promega called BacTiter-Glo™. ATP measures the overall microbial activity in the water. The assay is a semi-quantitative indicator of metabolically active microbial cells and we included total, extracellular, and intracellular ATP concentrations.

Inorganics

All the inorganic analyses were done only from the raw water. We selected compounds that are not tested as part of a regulatory required IOC and/or that could have a role in DBP formation. Chloride (Cl^-), Bromide (Br^-), Iodide (I^-), total dissolved solids (TDS), conductivity, ammonia nitrogen (NH_3-N) were analyzed.

Organics

The organics were evaluated from raw and filtered water samples. The samples were collected following the protocol from UW and included total and dissolved organic carbon levels and UV absorbance at 254nm. The dissolved organic matter (DOM) in each water sample was also characterized by (a) fluorescence spectroscopy—to obtain fluorescence excitation-emission matrixes (EEMs) for subsequent processing by parallel factor analysis (PARAFAC), as a means of identifying characteristic signatures of fluorescent components present in the DOM, and (b) HPLC/size exclusion chromatography with online UV/visible, fluorescence, and dissolved organic carbon (DOC) detection (HPLC/SEC-UV/fluorescence/DOC)—to characterize and quantify the distribution of various size fractions of DOM present in the samples. The methods are detailed in the UW final study report. These methods aim at understanding the type and chemical structures and properties of the organic matter in the samples. This information can then be used to compare with other known sources of organic matter and their origin. The standards for EEMs evaluation are published by International Humic Substances Society (humic-substances.org).

DBP Formation potentials and Free Available Chlorine Demand

TTHM, HAA5, and HAA9 maximum formation potentials (seven-day) were determined for all raw and filtered water samples. HAA9 includes more of the brominated HAAs than the HAA5 panel and will be included in the next unregulated contaminant monitoring cycle as a potential compound group to be regulated. Formation potentials were chosen as a more standardized approach to compare DBP formation between the different water samples; we wanted to try to remove some of the system specific factors, like residence time, chlorine doses, etc. The details of the test and how it was carried out are in the UW final report.

The associated seven-day free available chlorine (FAC) demand for each sample was also determined as part of the maximum demand test.

Seven-day maximum formation potentials and their associated free chlorine demand measurements for each sample are presented in the UW report Chapter 4.2. and 4.3. In general, the results were very high. Due to the testing conditions, the DBP formation potentials tend to skew toward chlorinated compounds (more chlorine than bromine present to compete over the reactive sites). Bromine substitution factors were calculated for each result which provides a measure of the molar proportion of bromine relative to overall halogen content of the formed DBP.

Table C4

Groupings of DBP Compounds Measured in this Study

Analyte	Abbreviation	Group	
Chloroform	CF		
Dichlorobromomethane	DCBM	TTHM	
Dibromochloromethane	DBCM		
Bromoform	BF		
Chloroacetic acid	CAA		
Dichloroacetic acid	DCAA	HAA5	
Trichloroacetic acid	TCAA		
Bromoacetic acid	BAA		
Dibromoacetic acid	DBAA		HAA9
Bromodichloroacetic acid	BDCAA		
Bromochloroacetic acid	BCAA		
Dibromochloroacetic acid	DBCAA		
Tribromoacetic acid	TBAA		

Field analyses

DOH measured pH, temperature and total chlorine in the raw water at each source. Free and total chlorine were measured in filtered water samples for those systems that had iron/manganese treatment. Free and total chlorine were also measured at the entry point to the distribution system. The protocols are included in this binder. All the measurements were recorded in field data sheets developed for each system. These are included in binders two and three of this study project.

Summary results and conclusions

1. Dissolved organic carbon (DOC) in the source water is the primary factor affecting DBP formation. This is consistent with surface water, though the levels of DOC are relatively low compared to surface water. Other parameters including microbial activity and inorganics do not appear to affect total formations with exception of bromide that plays a role in the proportion of brominated DBPs that a system forms.
2. Total organic carbon (TOC) is almost all dissolved in this setting. (TOC = DOC).
3. Quarterly source water testing revealed significant variability in some source water quality parameters. (Example: San Juan Ranchos DOC varied from low of 1.3 mg/L to a high of 7.8 mg/L). This observed seasonal variability has implications for DOH source monitoring and treatment design approaches. (i.e. Reliance on a single sample as representing ground water quality may be wrong).
4. Accurate knowledge of DOC concentrations in source water can be used to anticipate water systems that may be likely to have HAA and THM compliance issues associated with chlorination. This study indicates that sources with **less than 1.2 mg/L DOC would be unlikely to exceed TTHM** MCLs. Sources with less than 2.1 mg/L DOC would be

unlikely to exceed HAA5 MCLs. The DOC concentrations in source water correlated linearly with DBP formation potentials. DOC should be considered a critical design parameter for treatment processes that include chlorine addition (currently not required or even anticipated by the reviewers or design engineers). Currently, DOC or TOC are not part of any regulatory monitoring.

5. Speciation of DOC revealed organics originating primarily from decayed vegetation (terrestrial origin—not coming from algae, wastewater, surface water, etc.). The organic matter was dominated by moderate to high molecular weight aromatic compounds commonly related to humic substances and their building blocks. Biopolymers and high MW hydrophilic compounds that often indicate recent biological origin were not observed in any of the samples. The chromatographic analysis of the compounds also showed the highest peaks corresponding to fractions B and C which are humic substances building blocks and although the exact quantities varied, once normalized to DOC concentration, the samples showed fairly uniform composition across the seasons and study area. The fluorescence EEM and component modelling further enforced the finding that dissolved organic matter (DOM) in the samples was dominantly humic substances of terrestrial origin. The smaller protein and amino acid compounds were present at much lower quantities.
6. UV_{254} Absorbance correlates very well with DOC concentrations (in raw water samples). (UV_{254} Abs could serve as an inexpensive surrogate parameter for DOC). The UV_{254} absorbance provides a measure of the abundance of aromatic DOM constituents and is often correlated with DOC concentration at a particular site. However, this approach did not work well for the treated water samples because of other absorbing compounds than DOC were present in the sample.
7. DOH field-testing and review of WTP operating and reporting practices suggests that water system chlorination facilities are operating inconsistently. (Some systems do not maintain a stable chorine residual in the water system. We observed variations from 0.0 to 3.5 mg/L FAC in the same month). Utility monitoring practices appear to be inconsistent and not representative of distribution conditions. Additionally, utilities are not routinely monitoring for total available chlorine (TAC).
8. Total formation potential tests for THMs and HAA5 do not correlate with regulatory TTHM and HAA5 testing results. The implications are significant. Results suggest that some systems may not exceed regulatory TTHM levels (when their source water DOC is higher than 1.2 mg/L) because of inconsistent disinfection treatment practices and the limited DBP distribution monitoring (annual or quarterly single sample) that does not detect/account for this variability. The testing conditions do not alone explain the difference. For instance, Briarwood regulatory results have been less than half the MCLs and the formation potentials reached 244ug/L for TTHM and 69ug/L for HAA5s. Similarly, Portland Fair regulatory samples have been very low, yet the formation potentials were 245ug/L for TTHM and 105ug/L for HAA5s. The formation potential tests in these systems resulted in similar values than the neighboring systems that have historically

exceeded the MCLs in their regulatory samples (for instance Rolling Hills—Glencairn in Whidbey Island and San Juan Fairway in San Juan County).

9. Island County iron and manganese treatment facilities did not remove any significant amount of DOC. (They have no impact on DBP formation).
10. Bromide (Br^-) is a key parameter concerning formation of the brominated DBPs. The formation of brominated DBPs correlated poorly with bromide alone, but appears to depend most strongly on the ratios of $[Br^-]/[DOC]$ in each sample, with higher $[Br^-]/[DOC]$ values generally leading to a higher tendency to form brominated HAAs and THMs. The highest **proportions** of brominated HAA and THM formation can be expected for sites exhibiting relatively low DOC concentrations and higher $[Br^-]$ levels (i.e., high $[Br^-]/[DOC]$ ratios).
11. Measurements of Chloride (Cl^-) and Br^- concentrations identified Cl^- concentrations in excess of 100 mg/L, and $[Br^-]/[Cl^-]$ ratios in excess of or approaching the natural seawater $[Br^-]/[Cl^-]$ ratio (1.54×10^{-3}) in several sources. This suggests that multiple sites may be at risk of or already under the influence of seawater intrusion, which could have important consequences for managing DBP formation and speciation in the future (primarily due to consequent increases in $[Br^-]$ under such circumstances).
12. The HAA9 results indicate that the additional non-regulated and more brominated DBPs are also formed at high levels in these systems. The four additional HAA compounds (in the HAA9 test panel) are included in the next UCMR. The DBP rule is currently under the 6-year review process and the regulatory framework may change in the future and impact more systems in coastal areas. (Very high results were seen in Whidbey West, Rolling Hills, Seawest, and Sierra County Club systems).
13. Microbial testing of HPC, HPC R2A and ATP revealed very low levels in most of the study water system sources. The results were less than 2 CFU/100mL at most systems. These results are consistent with DOC speciation noted in five above. (The DOC speciation showed no sign of biopolymers or high molecular weight hydrophilic compounds that are related to organic compounds of recent biological origin).
14. The initial sample collection effort in September 2016 revealed a number of source sample collection sites that were poorly constructed and/or not properly located. Several of these sampling sites would not be adequate for RTCR source sampling.
15. Ammonia is present in some sources! An ammonia level of as high as 3.2 mg/L as NH_3-N was measured. The highest levels were measured at Seawest and Sierra Country Club. Ammonia also showed some fluctuation in between the quarters being highest during the fall 2015, the end of the dry season. The presence of ammonia was also indicated by the high total chlorine results during field testing at some of the treated sites. Very little ammonia was present in Arrowhead and Pheasant Farm Acres sources and in the tested San Juan wells. These water systems with ammonia present are/may be actually employing chloramines. (Related to seven above; if systems are not measuring total available chlorine, they may not be aware that they have chloramines). Ammonia will exert high chlorine demand and consequently, systems may not be applying adequate oxidant doses for filtration treatment to work correctly, or may not be reaching

breakpoint chlorination leading to uncontrolled chloramination, nitrification, or high total chlorine levels in the distribution system. During the study, we measured total chlorine above the MRDL of 4 mg/L at two systems. Ammonia is a regulated drinking water contaminant in other countries (i.e. U.K. and Denmark). We do not require ammonia measurements during source approval or as part of regular monitoring. Breakpoint chlorination may promote DBPs. Alternative or additional treatments may be needed to address the presence of ammonia.

Table C5

Range of Chlorine and Ammonia Detected in Island County Systems

System	Monthly Report Free Chlorine mg/L	Free Chlorine mg/L	Total Chlorine mg/L	Ammonia mg/L NH_3-N
Arrowhead	0.18-0.62	0.17-0.3	0.23-0.37	ND-0.006
Briarwood	0.04-0.42	ND-0.09	0.01-0.83	0.32-0.40
Scenic Heights	Nd-0.14	0.06-0.16	1.7-2.6	0.64-0.77
Whidbey West S02	0.01-0.18	0.03-0.23	0.47-1.22	0.33-0.39
Whidbey West S03		ND-0.1	0.19-0.23	0.24-0.92
Rolling Hills	ND – 0.33	Filtered 0.01-4.8 Entry Point 0.08-0.77	Filtered 0.02-5.0 Entry Point 0.14-0.94	0.06-1.0
Sierra Country Club	0.06-0.35	Filtered 0.09-4.9 Entry Point 0.03-0.09	Filtered 4.7-10.8 Entry point 0.3-1.8	2.6-3.2
Seawest	ND—0.11	Filtered 0.02-1.5 Entry Point 0.03-0.10	Filtered 0.05-11.2 Entry point 0.4-1.0	0.9-2.3
Pheasant Farms Acres	ND-0.25	0.33-0.34	0.37-0.39	ND

1. Sampling protocols by some utilities are clearly not best practices! There is lack of consistency, lack of written standard operating procedures, and inappropriate monitoring equipment.
2. SUVA254 (UV254nm/DOC) was fairly uniform across the sample set with an average value of 2.86 $(mg/l/m)^{-1}$ and did not show a seasonal trend. This means that the organic matter is of similar character year round across the study area and indicates that the diagenetic processing of the aquifers were similar. This average is also within the range of typical $SUVA_{254}$ values for groundwater. It excludes the Island County treated water samples.
3. Systems in Island County yielded higher DBP FPs than San Juan systems with exception of the Pheasant Farm Acres and Arrowhead.

Next Steps/Action Items

1. Disseminate findings/conclusions to state, Utilities, EPA Region 10 and nationally as appropriate.
2. Brief DBP and disinfection workgroups—evaluate possible changes in implementation. (Issues include compliance samples collected when chlorine residuals at zero and sporadic chlorine WTP operation).
3. Repair source-monitoring guidance for GW system chlorination design (DOC/UV_{254}, Br^-). (Water System Design Manual addition)
4. Review DOH chlorination reporting practices and follow up. Develop and provide direct/explicit expectations for water system monitoring and reporting. Include residual monitoring equipment guidance. Develop guidance on SOPs for chlorination treatment plants. (RO managers/Disinfection workgroup)
5. Evaluate including ammonia (NH_3-N) sampling in source water sampling requirement for all ground water systems/systems chlorinating. And add requirement for TAC monitoring after chlorination. (DBP Workgroup/RO managers/Disinfection workgroup)


Washington State Department of
Health