EMERGENCY DRINKING WATER FRAMEWORK

Prepared for:

RDPO
Regional Disaster Preparedness Organization
Unified. Prepared. Resilient.

Regional Water Providers Consortium

Salus Resilience

RH2

The Formation Lab

seft
Consulting Group

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LIST OF ACRONYMS AND ABBREVIATIONS

ADD	Average Daily Demand
ANSI	American National Standards Institute
AWIA	American Water Infrastructure Act
AWWA	American Water Works Association
CAL OES	California Office of Emergency Services
CCSF	City and County of San Francisco
CDC	Centers for Disease Control
CDPH	California Department of Public Health
CEMP	Comprehensive Emergency Management Plan
CERT	Community Emergency Response Team
City	City of Portland
CLACK	Clackamas County
COLUM	Columbia County
COOP	Continuity of Operations Plan
CRESA	Clark Regional Emergency Services Agency (Washington State)
CRW	Clackamas River Water
CRWP	Clackamas River Water Providers
CSZ	Cascadia Subduction Zone
DES	Department of Enterprise Services (Washington State)
DGS	Department of General Services (California State)
DHS	Department of Human Services (Oregon State)
DOC	Department Operations Center (County Level)
DOD	Department of Defense (Federal Level)
DOGAMI	Department of Geology and Mineral Industries (Oregon State)
DOH	Department of Health (Washington State)
DOT	Division or Department of Transportation
DSHS	Department of Social and Health Services (Washington State)
ECC	Emergency Coordination Center (Oregon State or Local Level)
EHD	Environmental Health Department (California State)
EMAC	Emergency Management Assistance Compact
EMD	Emergency Management Division (Washington State)
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
ERP	Emergency Response Plan
ESF	Emergency Support Function
EWEB	Eugene Water and Electric Board

EWTDP	Emergency Water Treatment and Distribution Plan
FEMA	Federal Emergency Management Agency
Framework	Emergency Drinking Water Framework
gal	gallons
GIS	Geographic Information System
GPCD	gallons per capita per day
gpm	gallons per minute
IC	Incident Commander
ICP	Incident Command Post (Multnomah County)
ICS	Incident Command System
Island(s)	Emergency Response Islands
IPAWS	Integrated Public Alert and Warning System
IPREM	Integrated Partnership for Regional Emergency Management (Vancouver, BC)
JIC	Joint Information Center
JWC	Joint Water Commission
LHD	Local Health Department
LPCD	liters per capita per day
M	million(s)
MAC	Multi-Agency Coordination
MACS	Multi-Agency Coordination System
MG	million gallons
MGD	million gallons per day
MULT	Multnomah County
MWTS	Mobile Water Treatment System
NCG	The Novak Consulting Group
NERT	Neighborhood Emergency Response Team
NET	Neighborhood Emergency Team
NGO	Non-governmental Organization
NIMS	National Incident Management System
NRF	National Response Framework
OA	Operational Area (California State)
OAR	Oregon Administrative Rule
ODHS	Oregon Department of Human Services
ODOT	Oregon Department of Transportation
OEM or ODEM	Oregon Office of Emergency Management; also called Oregon Department of Emergency Management
OHA	Oregon Health Authority
OR	Oregon State

ORP	Oregon Resilience Plan
ORWARN	Oregon Water/Wastewater Agency Response Network
OSSPAC	Oregon Seismic Safety Policy Advisory Commission
OWRD	Oregon Water Resources Department
PBEM	Portland Bureau of Emergency Management
PGE	Portland General Electric
PIO	Public Information Officer
POD(s)	Point(s) of Distribution
PTF	Project Task Force
PUD	Public Utility District
PWB	Portland Water Bureau
PWM	Public Works Management, Inc.
RCAP	Rural Community Assistance Partnership
RDPO	Regional Disaster Preparedness Organization
REAC	Regional Engineers Advisory Committee (Vancouver, BC)
Region	Five-County Portland-Vancouver Metropolitan Region
REOC	Regional Emergency Operations Center
RETR	Regional Emergency Transportation Route
RRA	Risk and Resilience Assessment
RSF	Recovery Support Function
RWPC	Regional Water Providers Consortium (Oregon State)
SCADA	Supervisory Control and Data Acquisition
SEMS	Standardized Emergency Management System (California State)
SOC	State Operations Center (California State)
TVWD	Tualatin Valley Water District
UASI	Urban Areas Security Initiative (Federal Level)
USACE	United States Army Corps of Engineers
USDHS	United States Department of Homeland Security
USEPA	United States Environmental Protection Agency
VHF	Very High Frequency
WA	Washington State
WADNR	Washington Department of Natural Resources
WARN	Waste/Wastewater Agency Response Network
WASH	Washington County
WAWARN	Washington Waste/Wastewater Agency Response Network
WEDC	Water Engineering and Development Centre
WHO	World Health Organization
WSDA	Washington State Department of Agriculture

WSDHS	Washington State Department of Human Services
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

The Provision of the Emergency Drinking Water Framework (Framework) was developed to enhance regional coordination and policymaking and provide guidelines for local planning for the provision of emergency potable water to the public following a disaster. The project is funded by a grant from the Department of Homeland Security's Urban Areas Security Initiative (UASI) program. Over the last decade, water providers in the region have been using UASI funds and local budgets to purchase emergency mobile water treatment and distribution systems. Before additional investments are made, there was recognition that the region needed a better understanding of what the emergency drinking water needs are, what resources are available, and what capability gaps exist, in addition to defining roles and responsibilities.

In 2020, the City of Portland (City)'s Bureau of Emergency Management (PBEM), in coordination with the Regional Disaster Preparedness Organization (RDPO) and the Regional Water Providers Consortium (RWPC), contracted with the Salus Resilience Consulting Team, consisting of Salus Resilience, a division of Haley & Aldrich, Inc.; The Formation Lab; SEFT Consulting Group; and RH2 Engineering to develop the Framework for the five-county Portland-Vancouver Metropolitan Region (Region). The area consists of Clackamas, Columbia, Multnomah, and Washington counties in Oregon, as well as Clark County in Washington. The study coverage area is shown in Section 1.

For this Framework, the consulting team assembled data, conducted a literature survey, and solicited feedback and participation from agencies across the Region, the state, and Federal Emergency Management Agency (FEMA), through interviews, surveys, and workshop participation. The analyses and information gathered were used to develop and recommend a Framework for use in future planning efforts by water providers and emergency response agencies to evaluate emergency water supply capacity and Regional needs; and to determine agency responsibilities to plan for distribution of emergency drinking water to the general public during Regional emergencies, including the expected Cascadia Subduction Zone (CSZ) earthquake; and to provide general guidance on future emergency water distribution discussions and related policy development. Note in the context of this report, emergency response agencies include any agencies (local, state, and/or federal) that are responsible for and provide emergency response and recovery services; these include organizations such as police, fire, and medical assistance.

RDPO and RWPC developed several goals for this Framework:

- To enhance emergency water distribution disaster planning, collaboration, and communication among water providers and emergency response agencies;
- To determine post-disaster emergency water supply needs and gaps throughout the region;
- To identify and recommend roles and responsibilities for distribution of emergency drinking water;
- To serve as a planning resource for water providers to evaluate their systems, incorporate needed improvements into planning, and support emergency response efforts to supply emergency drinking water;

- To provide guidance that assists the Regional network of emergency responders and water providers in their planning for emergency water distribution to underserved or vulnerable populations during and after a disaster;
- To develop strategies to close any gaps between available water resources and demand following a disaster; and
- To develop policies to address Regional emergency management and water distribution priorities.

Recommendations and potential policies addressing Region-wide emergency management and water distribution priorities are included.

This Framework will serve as a guide for water providers and emergency response agencies to prepare and develop their emergency water distribution plans, and to establish general water distribution procedures and processes ahead of emergencies. Future work will be necessary by the RDPO, RWPC, individual water providers, and emergency response agencies to implement this Framework collectively and in their individual jurisdictions. Three main elements are included in this Framework: 1) clarity in roles and responsibilities; 2) an effective regional Framework with room to evolve; and 3) equity considerations. Sections 3 through 5 discuss, in detail, how water providers and emergency response agencies can evaluate how much water is needed for their jurisdiction, how much water may be available, and provides guidance for determining emergency supplies needed and emergency planning efforts.

PROJECT METHODOLOGY

Stakeholder Engagement

The development of the Framework relied heavily on stakeholder input and participation. Stakeholders included federal, state, county, and local emergency response and public health agencies, and representatives from large and small water providers across the five-county Region.

A focused stakeholder engagement plan was developed to ensure the Framework would meet the needs of the Region. The engagement plan included select water provider interviews and a detailed on-line survey. The interviews and surveys are discussed in Section 2. In addition, three water provider and emergency response agency stakeholder workshops were held virtually to obtain feedback that drove the development of the Framework. A fourth workshop was held in September 2022 and solicited feedback on the draft Framework, specifically the recommendations for future work and policy development.

- Workshop 1, June 2021 – Roles and Responsibilities
- Workshop 2, October 2021 – Baseline Water Use, Results of Water Provider Survey, Geographic Assessments, and Preliminary Gap Analysis
- Workshop 3, March 2022 – Tabletop Exercise to test the draft Framework
- Workshop 4, September 2022 – Present regional recommendations based on Tabletop Exercise and Gap Analysis

Identification of Emergency Response Islands

During research for the project, it became clear that transportation failures after a large seismic event would hinder water distribution. Thus, we used publicly available state and local agency data to identify anticipated Regional divisions, described as Emergency Response Islands (Islands), that are expected to exist following a large disaster, such as an earthquake. Figure ES-1 shows the Islands in the study area. Figures 2.1 through 2.5 show islands in each county in more detail. These Islands represent geographic areas and associated water service populations that are expected to be isolated in the aftermath of a CSZ event due to transportation system damage and physical and natural barriers. These Islands will likely need to access drinking water without relying on outside help during the first few weeks after a CSZ event. Our evaluations included considerations of these Islands.

Figure ES-1: Emergency Response Islands

Emergency Scenarios

Representative emergency scenarios were developed to test the Framework. Due to the wide variety of potential hazards, we focused on the potential damage due to these hazards and developed three scenarios based on the type of damage and number of water providers affected.

The emergency scenarios for this Framework include:

- Scenario 1 – Small Event: One to five water providers are affected. The existing water distribution networks are functional, while supply/source or transmission is disrupted.
- Scenario 2 – Subregional Event: Source area and transmission affected; multiple water providers are affected (could be one or more providers affected; key is the difference in how the water system is impacted). Water distribution networks are functional, while supply/source and transmission are disrupted.
- Scenario 3 – Regional Event: Source area, transmission, and distribution networks are affected across the Region; most water providers are expected to be affected.

Under most variations of the Small and Subregional Event scenarios, it is assumed that the majority of the existing water distribution and transmission systems will remain largely intact and will continue to distribute water to most of the Region's service population through the existing pipe networks. These scenarios are categorized as "piped-water" scenarios. The Regional Event is typically considered by the project stakeholders to be a large, widespread catastrophic event, such as a CSZ event. Such a catastrophic event is expected to damage significant portions of the Region's water systems and will likely severely impact the ability of water providers to deliver drinking water through the existing piped distribution system. For purposes of this study, this scenario is considered a "distribution failure" scenario and is categorized as a "non-piped-water" scenario.

A previous study commissioned by the RWPC focused on "piped-water" scenarios. The Regional Water Interconnections Map and Evaluation project (Interconnections Study; Murray, Smith & Associates, 2010) identified water system interconnections among water providers and evaluated the ability to move water within individual, interconnected subregions of the Portland Metropolitan Area. The Interconnections Study demonstrates that the interconnectedness of the Region's water systems can facilitate some degree of water service in a "piped-water" scenario, where the distribution system remains sufficiently intact (e.g., during and after Small and Subregional Event scenarios) and pumping equipment and fuel are available. During the Regional Event, we anticipate that the distribution and interconnection systems will be unavailable. Further, due to widespread damage, mandatory curtailment to subsistence-level demands will be required throughout the whole region. Under subsistence conditions, it is reasonable to assume that the priority for potable emergency drinking water will be used for domestic purposes. Considerations for fire suppression, institutions, and other water uses were not included in this emergency drinking water study.

Survey and Interview Results

There are 72 water providers in the study area, each with their own governing body. Collectively, they serve over 2.3 million people. The 54 providers who met a minimum threshold of at least 150 connections were invited to answer the survey. Interviews were conducted, and 43 survey responses were received and informed the development of this Framework. Interview results are summarized in Section 2. Survey results provided information on levels of emergency preparedness, plans, training and planning status, communications, resilience of water systems, and emergency supplies and response equipment.

Roles and Responsibilities

Based on our gathered information, emergency water distribution is seen as a shared responsibility requiring collaboration and partnership among various levels of government emergency response agencies, water service providers, private sector companies, and non-governmental organizations (NGOs). Emergency response starts at the lowest possible level and is elevated to the next level when the resources and capabilities of the lower level are exceeded. For Small and Subregional Events, the emergencies are generally within the capabilities of the water providers with minimal assistance from emergency response agencies. For the Regional Event, we assume: 1) that the water system will be heavily damaged and water providers will be focused on repairing the water system; 2) that the distribution of emergency water will exceed the capabilities of the water providers; and 3) that the provision of emergency water will rest with the emergency response agencies.

To understand and properly define the roles and responsibilities of stakeholders at various levels (from local water service providers to the federal government) during an emergency event, a variety of sources of information, including interviews with FEMA, state and local personnel, state and local emergency drinking water planning guides, the Oregon Health Authority rules, and U.S. Environmental Protection Agency UUSEPA) guidance, and local water agencies' after-action reports, have been collected and reviewed. An extended discussion of this information is included in Section 3.

The Framework provides a discussion of current roles and responsibilities and best management practices (Section 3) as well as recommendations for additional responsibilities and practices (Section 7), based on the information collected and obtained during Workshop 1. This information is summarized into Table ES-1, below. Cities and counties are grouped together in the table to minimize duplication. Following their entries are roles and responsibilities unique to the counties.

Table ES-1: Combined Current and Proposed Roles and Responsibilities

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
Residents and Businesses	NA	NA	NA	• Sign up for the local emergency alert system for notifications.	• Maintain at least two weeks' supply of drinking water after an emergency. One gallon per person per day at a minimum. • Include additional water for pets and livestock. • Prepare clean, refillable containers to obtain water from distribution sites.
Water Providers (including public municipality, Special District, public utility district (PUD), or other)	Emergency Management (includes emergency operations center [EOC], Engineering, and Operations)	<u>Emergency Preparedness</u> • Develop an emergency response plan (ERP); maintain and update regularly. • Develop an emergency drinking water distribution plan (required in Oregon). • Develop rationing and curtailment plans.	• Coordinate with city and county EOCs to distribute emergency drinking water to identified points of distribution (PODs_ and islands. • Work with city/county EOC to develop demobilization plan for emergency water distribution as water infrastructure recovers.	• Obtain contracts or agreements with chemical suppliers for necessary emergency treatment chemicals and associated shipping services. • Obtain contracts or agreements with suppliers for pipes, valves, and materials, services, and deliveries, etc.	• Establish written mutual aid agreements (especially with ones east of the Cascade Mountains and out-of-state). • Provide guidance, technical assistance, and staff to set up the mobile treatment and emergency water distribution at PODs.

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
Water Providers (Continued)	Emergency Management (Continued)	<u>Emergency Response</u> • Repair water system and restore potable piped water supply. • Activate EOC when necessary. • Prepare information as needed for the local disaster declaration. • Consult Oregon Health Authority (OHA) / Washington Department of Health (DOH) for technical and regulatory advice and issue a health advisory, if necessary. • Notify the public of any water advisories.		• Develop an emergency drinking water distribution plan (suggested in Washington). • Prepare Continuity of Operations Plan (COOP) • Join and participate in Oregon or Washington Water/Wastewater Agency Response Network (ORWARN or WAWARN). • Obtain mutual aid agreements and request assistance. • Obtain shared worker agreements. • Complete resource typing of equipment, staffing, and materials. Promote organization and individual emergency preparedness.	• Contract with fuel vendors for emergency fuel supply. • Establish agreements and/or emergency contracts with vendors for critical supplies, long-lead-time items and unique parts and materials expected to be needed during emergencies to aid in recovery. • Contract with engineers and contractors for technical assistance, emergency repair contracts, post-event damage assessment, or other services needed. • Install two-way interconnections, where feasible, and prepare written agreements with those that share the interconnection for maintenance and emergency assistance. • Procure water-related equipment and materials needed to provide emergency water from

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
Water Providers (Continued)	Emergency Management (Continued)				tanks, reservoirs, wells, and the backbone pipe POD, as well as at treatment sites and distribution sites.
	Infrastructure Readiness (Engineering, Operations and Field Crews)	• Develop seismic risk assessment and mitigation plan. (Required for most providers in Oregon) • Implement seismic improvement projects needed to comply with American Water Infrastructure Act (AWIA), Oregon Resilience Plan (ORP), and states' resilience requirements and recommendations for water systems.	• No change	• In an emergency impacting delivery of potable water, notify water providers, local government, regulatory agencies, and critical customers. • Develop a seismic risk assessment and mitigation plans (suggested in Washington). • Procure backup power (permanent or portable generators) and adequate fuel storage for emergency power outages.	• Create a map overlaying where resilient water storage is available and where the vulnerable populations are and address any infrastructure gaps. • Collaborate with City/County Emergency Management to develop resilient communications.
	Public Information Officer (PIO) (or Communications Manager)	• Obtain approved language of a water advisory from OHA or WA DHS prior to its release and have translated for the public. • Disseminate information to the	• No change	• Communicate through city-wide alert, the Integrated Public Alert and Warning System (IPAWS), or media. • For small, rural water service providers, obtain assistance from OHA or DOH to	• Establish relationships with local communities, NGOs, school districts, emergency response committees, and media for their assistance in communicating to the public in multiple

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
Water Providers (Continued)	PIO (continued)	public • Coordinate press conferences and respond to questions.		communicate to the public.	languages and to those with disabilities. • Communicate the emergency response and emergency drinking water plans with stakeholders and the public.
City / County	Emergency Management	<u>Emergency Preparedness</u> • Develop an ERP that includes critical services and infrastructure and regularly refine the plan. • Identify locations with low risk in various emergency scenarios for PODs, including emergency water distribution. <u>Emergency Response</u> • Activate EOC or Emergency Coordination Center (ECC) • Prepare city/county disaster declaration. • Escalate to county/state level emergency management and	• Work with water providers to develop demobilization plan for emergency water distribution as water infrastructure recovers.	• Regularly refine the plan. • Exercise EOC regularly and include water providers. • Collaborate with water providers to identify available locations for emergency water distribution sites. • Coordinate the resources and response among water providers, mutual aid partners, volunteer organizations, and other stakeholders. • Develop a city/county map of vulnerable populations and PODs. • Aggregate resource gaps identified by water providers to estimate resource gaps	• Maintain a list of approved vendors for pre-packaged water supply. • Consider locations of vulnerable populations when identifying PODs, shortening required travel distances in areas with high concentrations of individuals with low mobility (e.g., seniors) or transportation access (e.g., low level of car ownership). • Further study to identify best practices for reaching vulnerable populations with water and other essential services.

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
City / County (Continued)	Emergency Management (Continued)	request assistance, if necessary. • Identify, arrange, manage, and coordinate distribution of food, water, shelter, and mass care including emergency drinking water to affected populations within city or county jurisdiction. • Lead emergency water distribution, including setup and management. • Notify the public of the anticipated locations of PODs for food, water, shelter, and mass care. • Procure materials and equipment needed for PODs.		and collaborate with water providers and various levels of government to identify potential options to address the gaps. • Include transportation of trucked water between where water is available and the PODs. • Represent member water providers to negotiate with fuel vendors to develop municipal standing offer agreements for liquid fuel.	• Include vulnerable populations in the ERP. • Develop collaborative resilient communications and structure with water providers. • Invest in a centralized data center/platform to show status of outages and repairs. • Develop process for communicating status for all utilities to avoid duplicating efforts.

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
City / County (Continued)	PIO	• Disseminate information to the public. • Coordinate press conferences and respond to questions	• No change	• Use city- or county-wide alert, IPAWS, or media.	• No change
	Department of Public Works (Division or Department of Transportation, [DOT])	• Remove debris from city-or county-maintained roads to facilitate recovery of critical services. • Repair damaged roads and bridges for emergency access.	• No change	• Include facilitating recovery of water services and other critical infrastructure.	• No change
	Law Enforcement	• Protect essential city/county and other agency facilities within jurisdiction.	• No change	• Protect water supplies, equipment, and staff repairing the water system, and maintain security at emergency water distribution sites.	• No change

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
County-specific (not listed above)	Emergency Management	• Facilitate coordination between the state and the city (if water service provider is a municipal department). • Collaborate with non-municipal water providers to identify distribution locations. • Request emergency declaration from Governor.	• No change	• Prioritize drinking water agencies for emergency fuel allotment/distribution including those in municipalities.	• No change
Oregon/ Washington State	State Governors	• Declare a State of Emergency	• No change	NA	NA
	State Emergency Manager, or Incident Commander	• Lead and coordinate state emergency response. • Responsible for coordinating all Emergency Support Functions (ESFs) with federal, state, and local agencies.	• No change	• Assist partners in providing a coordinated response. • Identify state staging areas for commodity PODs.	• Revisit ESFs to ensure appropriate state agencies are leading emergency water distribution and recovery.

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
Oregon / Washington State (Continued)	Oregon Department of Human Services (DHS)/ Washington Department of Social and Health Services (DSHS)	• Responsible for ESF #6 Mass Care, #8 Health and Medical, and ESF #11 Food and Water. • Collaborate with local emergency management agencies to identify and provide resources for mass care, food, water, and ice needs. • Coordinate with supporting state agencies to obtain requested resources. • Collaborate with supporting state agencies to coordinate transportation of food and water resources.	• No change	• Establish procedures to ensure water is safe for consumption.	• No change
	OHA or DOH:	• Support agency for ESF #6 and ESF #11. • Provide regulatory oversight of water systems repair and operations. • Provide consultation and approval of issuing drinking water health advisories.	• No change	• Provide technical assistance to water providers.	• Provide guidance on treatment of emergency water supplies.

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
Oregon / Washington State (Continued)	Oregon DOT (ODOT)	• ODOT – Lead agency for ESF #3 Public Works. • Remove debris from state highways and bridges and repair as needed to facilitate access and recovery.	• No change	• Focus on engineering, transportation, and infrastructure needs. • Include access and recovery to critical infrastructure and emergency services.	• No change
	National Guard	• Assist in emergency water distribution.	• No change	• Provide and staff water treatment units such as water purification systems that provide emergency water distribution, when requested.	• No change
Federal	FEMA	• Obtain bottled water and deliver water to state distribution sites. • Participate in a multi-agency coordination. • Coordinate federal resources. • Provide technical assistance.	• No change	• Mobilize federal response within 3 to 5 days (or as soon as practicable) after the event. • Include equipment, supplies, and materials for water treatment and/or distribution, when requested.	• No change
	U.S. Army Corps of Engineers (USACE)	• Assist in emergency water distribution. • Deliver water to distribution sites. • Provide technical assistance.	• No change	• If requested, set up emergency water treatment and distribution sites.	• No change

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
RWPC	NA	NA	NA	• Promote emergency preparedness to the public. • Apply for grants to fund planning tools and equipment for emergency water treatment and distribution. • Provide guidance on the use of the Region's emergency water treatment and distribution equipment. • Update and maintain a regional study on water system interconnections. • Promote mutual aid agreements. • Maintain and update water providers' emergency contact list. • Maintain inventory of emergency water treatment and distribution resources owned by local water providers.	• No change

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
ORWARN/ WAWARN	Water and wastewater mutual aid	NA	NA	• Maintain written mutual aid agreements among members. • Facilitate mutual aid assistance among members. • In Oregon, promote shared worker agreement	• Continue to promote shared worker agreement (OR)
Power Utilities (Portland General Electric [PGE], Pacific Power and Light (PP&L), Columbia River PUD, Clark Public Utilities, etc.)	NA	NA	NA	NA	• Prioritize requests from water providers for restoration of power. • Collaborate with water providers to prioritize pre- disaster mitigation so that power services can be restored quickly for water facilities.
Communication Providers	NA	NA	NA	NA	• Prioritize restoration of communications for water providers. • Collaborate with water providers to prioritize pre- disaster mitigation so that communication

Agency	Role in Agency	Current Roles and Responsibilities	Proposed Roles and Responsibilities	Current Best Practices	Proposed Best Practices
Communication Providers (Continued)					services can be restored quickly for water facilities.
Private Consultants and Contractors	NA	NA	NA	NA	• Provide technical assistance and post-event damage assessment. • Assist in preparing emergency contracts, plans and specification for repairs. • Assist in repairing the damages to water systems, as requested.
CERT/NET and other volunteers	NA	NA	NA	• Assist emergency responders	• Participate in the development of an emergency drinking water plan. • Assist emergency responders, including water providers, as requested.
*NA = Not applicable; **Blue Font** = Proposed Change; Blank Boxes or Regular Font = No Change*					

Base Emergency Water Need

For the purposes of this analysis, Base Emergency Water Need is defined as the minimum quantity of potable water needed to serve the domestic water needs of a population during a Regional Event scenario when potable water must be conserved and rationing of water at subsistence levels may be required. As discussed later in this section, the duration for which subsistence-level water provision will be required will vary depending on the type and magnitude of the event, and when assistance from organizations outside the Region may be able to respond at a level sufficient to restore normal water service. The following definitions are used in this Framework:

- **Base Daily Water Rate** – Volume of water required to support an individual's basic water needs at a subsistence level for one (1) day. Reported in units of gallons per capita per day (GPCD).
- **Base Water Duration** – Period of time during which a water provider is operating under emergency conditions and emergency water distribution is required. Reported in units of days.
- **Base Daily Water Demand** – Volume of water required to meet the base water needs of all populations within a defined area for one (1) day (for this project, we used service populations within Islands). Reported in units of millions of gallons per day (MGD).
- **Base Emergency Water Need** – Volume of water needed to serve all population within an Island at the base water rate and duration specified. Reported in units of gallons (gal) or million gallons (MG).

The calculation to determine the base water need for a water district or Island is shown in Figure ES-2. An example of how the Base Emergency Water Need is calculated is included in Section 4. For the purposes of this exercise, a duration of 45 days was assumed for Scenario 3 – Regional Planning Event.

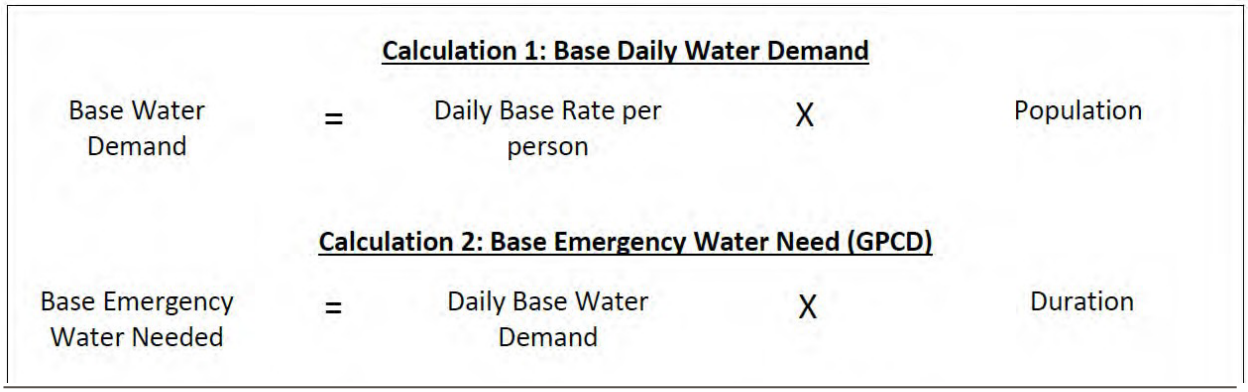
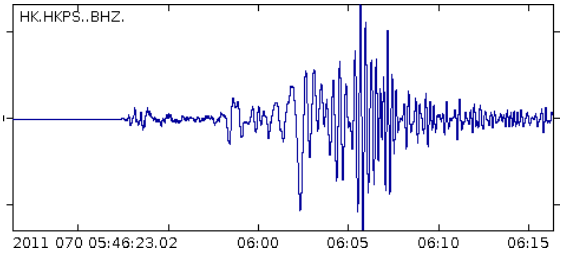


Figure ES-2: **Base Emergency Water Need Calculations**

Emergency Water Resources

A summary of the basic information gathered from the survey and resources available to water providers within the RDPO to support provision of emergency water during an emergency is included below and detailed in Section 5. Below is a quick summary of key questions and answers the overall region may need to access immediately after a Regional Event (Figure ES-3).



Waveform of the 2011 Great Tohoku Earthquake, Japan

- How much storage/source water is available?
- What supplies do we have?
- What emergency supplies do we need?
- Where do we need the supplies?
- How do we get water from here to there?

Figure ES-3: **What Happens When the Big One Hits**
(Seismograph Source: Incorporated Research Institutions for Seismology)

Based on the survey results, stakeholders indicated we can assume there may be as much as 380 MG (Table ES-2) of water in seismically-resilient storage throughout the Region. However, of the 380 MG, only about 80 MG (approximately 21 percent) is from resilient storage that also include seismic valves or an alternate approach to isolate and retain the storage. Further, wells and other sources may be available after a large event. Based on this and our calculations on the water needed in the Region, the Region may have an estimated 17- to 83-day supply of water available in reliable storage to meet its Base Emergency Water Need.

This water will require transportation to emergency response agencies' PODs so it can be distributed to the public. There are several ways water might be able to be moved, including through pipes that are either not damaged or have been repaired; through temporary overland pipes; through temporary or permanent connections at tanks, reservoirs, and backbone piping at specified PODs; trucked within Islands or from other Islands, water providers, or localities; water hauled in from out of the Region; and bottled water.

Table ES-2 also summarizes the Base Emergency Water Need, resilient water storage available, and the gap between the Base Emergency Water Need and the resilient storage with seismic valves.

Section 5 provides guidance for exercises to determine the emergency water needs within jurisdictions. Figures ES-4a and ES-4b (below) summarizes these key steps.

Table ES-2: Base Emergency Water Need and Seismically-Resilient Water Storage Available (assuming 45 days and 2 GPCD)

Emergency Response Island	Population (M)	Volume of Seismically-Resilient Storage		Base Emergency Water Need (MG)	Gap between Base Emergency Water Need and available storage with seismic valves (MG)
		Total (MG)	With seismic valves (MG)		
CLACK1	0.070	9.3	5.3	6.3	-1.0
CLACK11	0.010	NA	NA	0.9	-0.9
CLACK2	0.102	12.5	11.0	9.2	1.8
CLACK3	0.058	10.0	3.0	5.2	-2.2
CLACK5	0.050	15.8	1.3	4.5	-3.2
CLACK7	0.002	NA	NA	0.1	-0.1
CLACK9	0.004	0.3	NA	0.4	-0.4
Clackamas County	**0.296**	**47.8**	**20.5**	**26.6**	**-6.0**
CLARK1	0.415	33	2	37.4	-35.4
CLARK3	0.021	NA	NA	1.9	-1.9
Clark County	**0.436**	**33**	**2**	**39.3**	**-37.3**
COLUM2	0.002	1.0	1.0	0.2	0.8
COLUM4	0.017	0.5	NA	1.5	-1.5
COLUM5	0.008	2.0	NA	0.7	-0.7
Columbia County	**0.027**	**3.5**	**1.0**	**2.4**	**-1.7**
MULT1	0.115	14.2	4.4	10.4	-6.0
MULT2	0.740	132.4	31.4	66.6	-35.2
MULT3	0.003	1.0	NA	0.3	-0.3
Multnomah County[1]	**0.858**	**147.6**	**35.8**	**77.3**	**-41.4**
WASH1	0.002	1.2	NA	0.2	-0.2
WASH3	0.591	98.1	20.5	53.2	-32.7
WASH4	0.069	11.2	0.0	6.2	-6.2
WASH6	0.024	40	NA	2.2	-2.2
WASH7	0.005	0.0	0.0	0.4	-0.4
Washington County	**0.691**	**150.5**	**20.5**	**62.2**	**-41.7**
Total rounded	**2.31**	**382**	**80**	**208**	**-128**

Notes:

1. *Portland Water Bureau (PWB) has implemented a backbone reservoirs isolation plan using two cells that can operate independently instead of seismic isolation valves. The Bureau's related mid-range estimate for water retained through isolation is included in the seismic valve column.*
2. *Negative number in red denotes shortage*
3. *NA = Information not available*

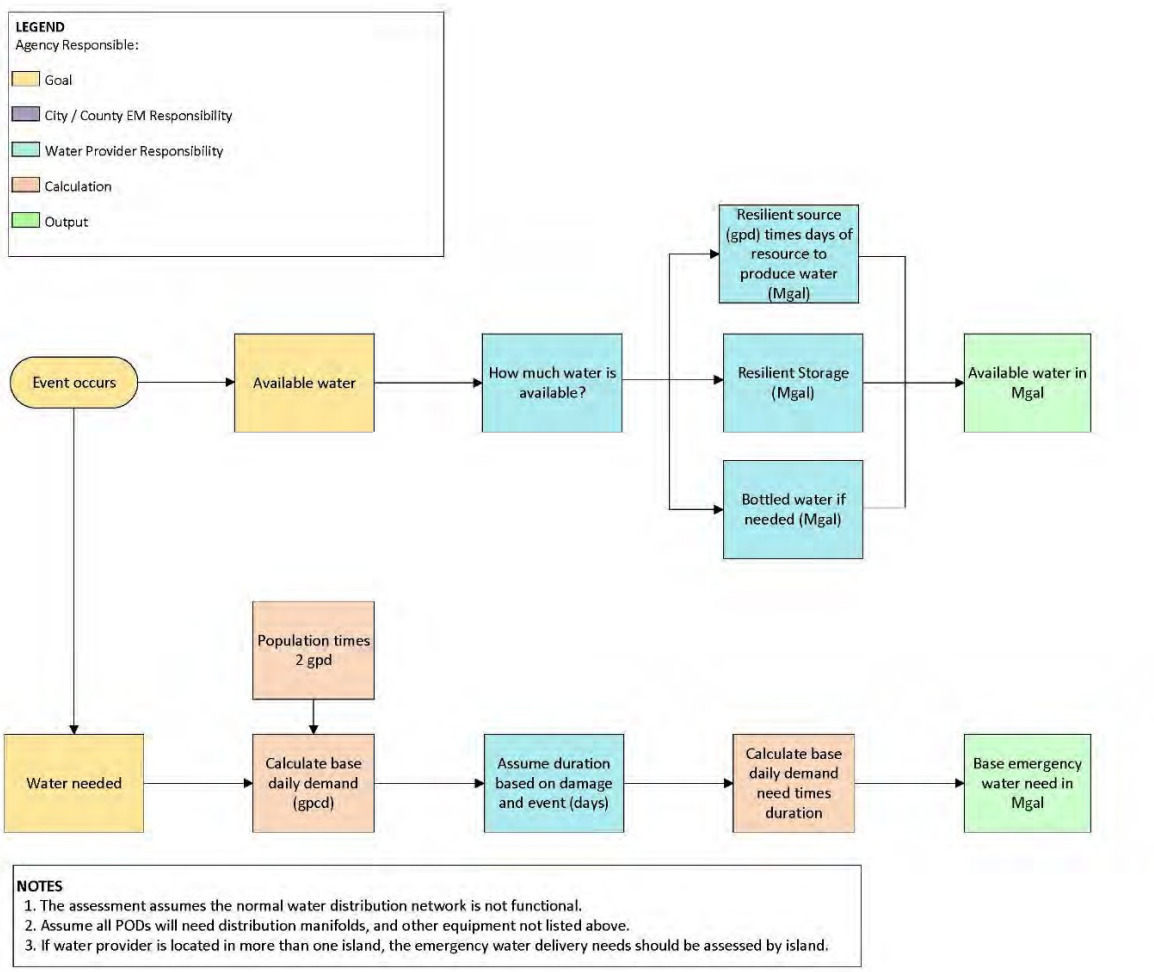


Figure ES-4a: Emergency Water Needs Assessment Summary – Part 1

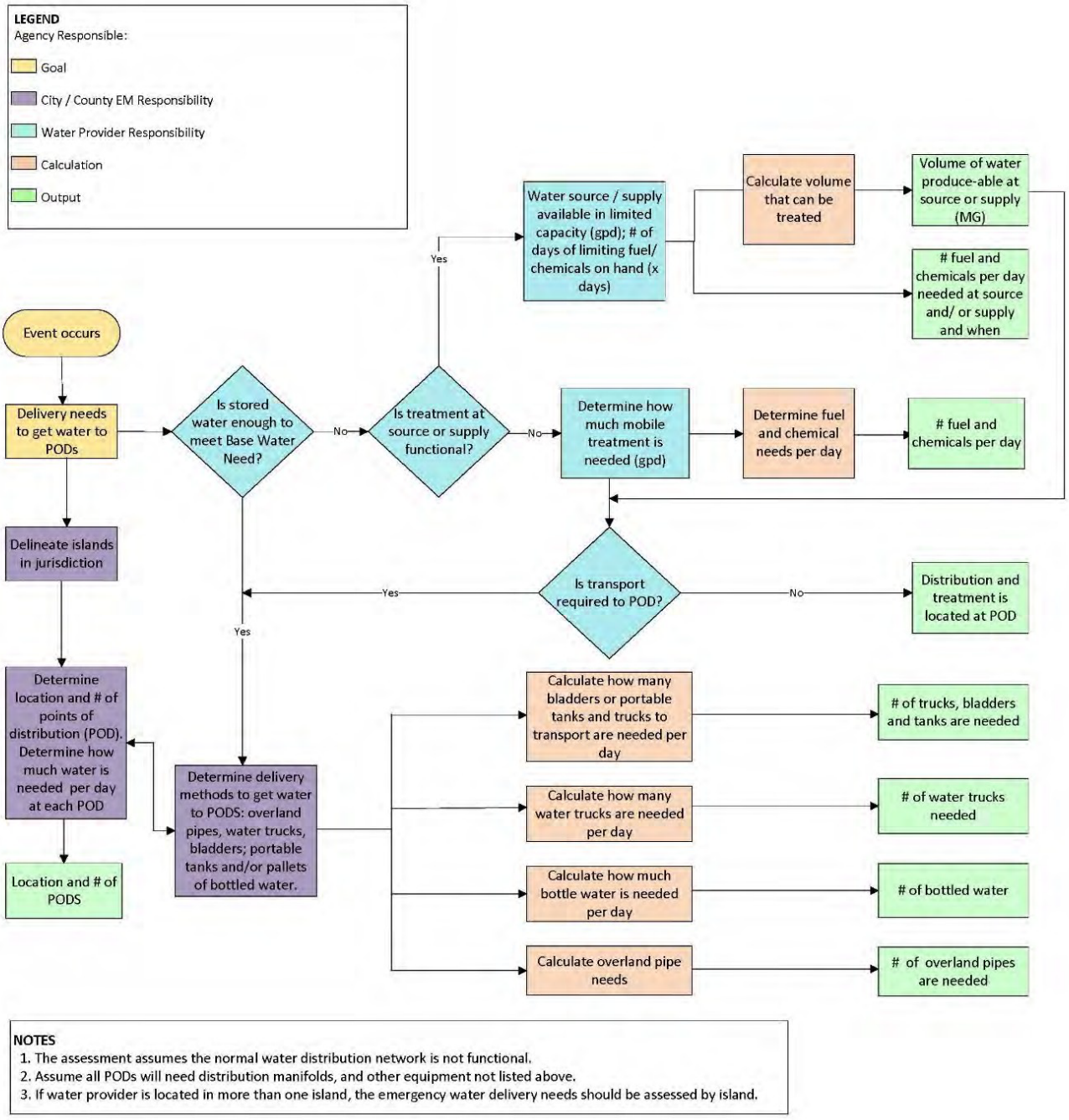


Figure ES-4b: **Emergency Water Needs Assessment Summary – Part 2**

The Regional distribution of seismically-resilient water sources is shown in Figure ES-5.

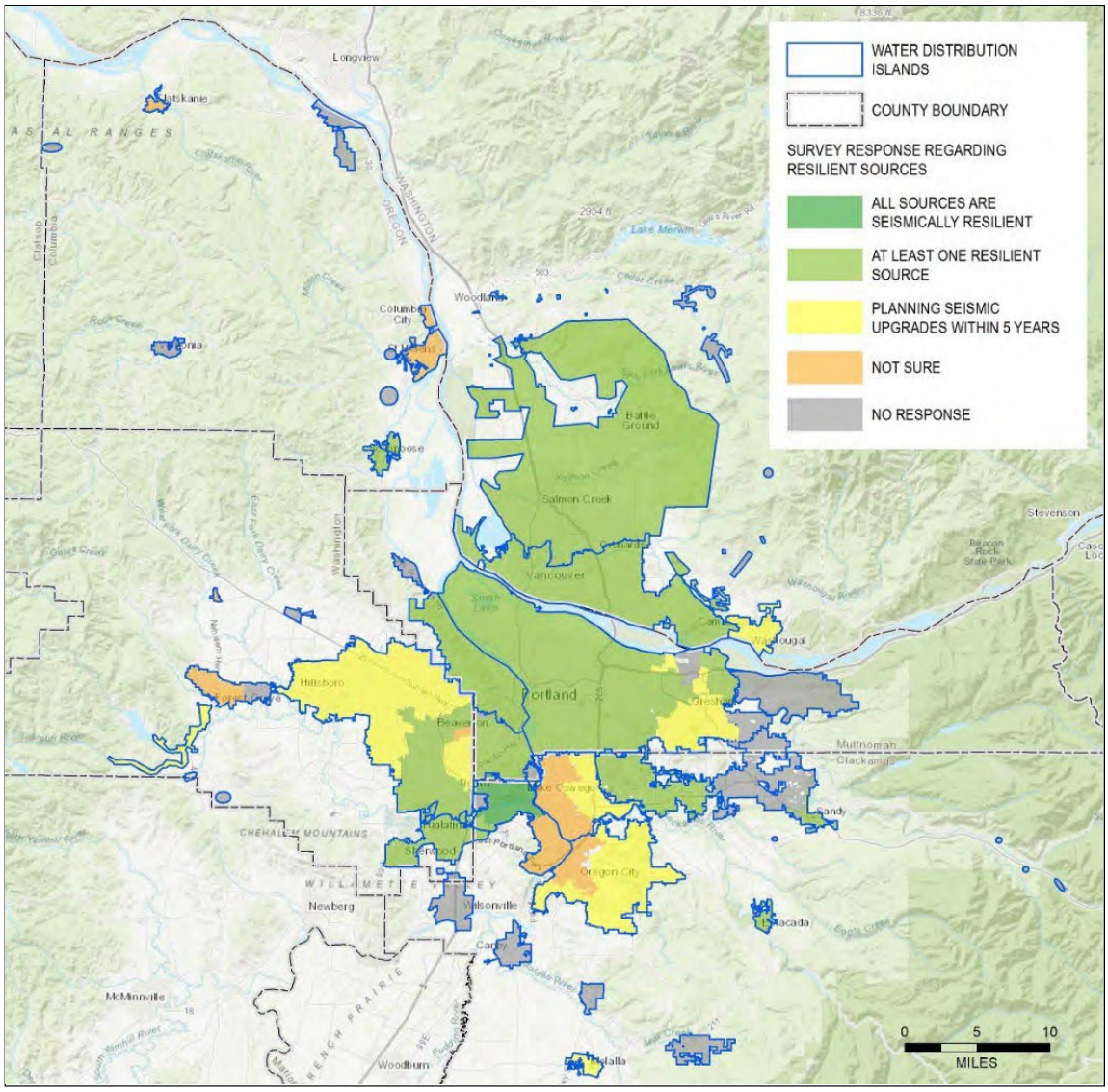


Figure ES-5: Regional Distribution of Resilient Sources by Emergency Response Island

Gap Analysis

Gaps in regional emergency drinking water distribution and planning are based on data self-reported by water providers, best practices, plans from other agencies, and technical expertise of the project team. Details are included in Section 6.

Recommendations

Successful implementation of the emergency water provision and distribution plans following a large disaster with broad and severe impacts (Regional Scenario 3) will require effective partnering and preparation at the federal, state, county, and local levels. Emergency response agencies bearing the primary responsibility of distributing emergency water tend to use standardized approaches that primarily include commercially-bottled water, and they may not have considered water providers or local water resources within their emergency response approaches or how to get emergency water during the interim period before outside aid arrives.

Water providers have made considerable progress in investing in resilient water supply and storage, as well as in other infrastructure improvements over the past couple of decades. This readiness on the water providers' behalf opens opportunities for emergency management agencies to expand their approaches to incorporate water providers and local water resources in their planning. However, a lack of consensus on or clear definition for roles and responsibilities of water providers has led few water providers or emergency response agencies to invest in the planning or supplies required to leverage that resilient infrastructure for the provision of emergency water. Our understanding of these current roles and responsibilities, as well as our recommendations for future changes, are included above in Table ES-1. In addition, Figure ES-6 (appended at the end of the report) is a flowchart of the proposed roles and responsibilities process, including recommendations such as using volunteers to deliver water to vulnerable customers or customers that cannot make it to the distribution site on their own; and increasing multi-language communications to the public.

Section 7 outlines the recommendations provided, including proposed tasks or actions that can be implemented to narrow or close identified gaps. Included are both operational and emergency management recommendations as well as policy recommendations developed to help emergency managers and water providers better prepare to distribute emergency water after a disaster, including to vulnerable populations. Recommendations are offered in the spirit of helping the agencies in the Region be more prepared and resilient regardless of the size and severity of the disaster.

1. Introduction and Background

1.1 INTRODUCTION AND PROJECT BACKGROUND

In 2020, the City of Portland (City)'s Bureau of Emergency Management (PBEM), in coordination with the Regional Disaster Preparedness Organization (RDPO) and the Regional Water Providers Consortium (RWPC), contracted the Salus Resilience Consulting Team, consisting of Salus Resilience, a division of Haley & Aldrich, Inc.; The Formation Lab; SEFT Consulting Group; and RH2 Engineering to develop an Emergency Drinking Water Framework (Framework) for the five-county Portland-Vancouver Metropolitan Region (Region). The approximately 4,440-square-mile study area consists of Clackamas, Columbia, Multnomah, and Washington counties in Oregon (OR) as well as Clark County in Washington (WA).

For this Framework, the consulting team assembled data, conducted a literature survey, and solicitated feedback and participation from agencies across the Region, the state, and Federal Emergency Management Agency (FEMA) through interviews, surveys, and workshop participation. The analyses and information gathered were used to develop an agreed-upon Framework for use in future planning efforts by individual water providers and emergency managers for providing emergency drinking water for the general public. The Framework provides general guidance and recommendations for future discussion and policy development including agency responsibilities and evaluation of and planning for emergency water needs and delivery for regional emergencies including a large earthquake such as the expected Cascadia Subduction Zone (CSZ) earthquake.

1.2 PROJECT GOALS

Emergency planning, and particularly water supply provision planning, is crucial not only to meet basic needs during the emergency response phase immediately after a disaster, but also to sustain our social and economic backbone after a disaster to support the long-term viability of our communities. There is an implicit commitment among water providers, as well as emergency response agencies, and the government at local, state, and federal levels to meet basic customer needs during and in the immediate aftermath of an earthquake, storm, terrorist attack, or other emergency. The PBEM, RDPO, and RWPC have been working for years and have invested millions of dollars to prepare the Region to effectively respond to disasters.

This effort draws on lessons learned from the RDPO's recent update to regional emergency transportation routes (RETRs) but is also mindful of the major differences in how water and transportation systems are planned and managed. Major transportation routes are organized on a city, county, or state level, while water systems are managed by cities (municipally-owned water providers) and special water districts at a very localized level. These water providers work together through multiple local, regional, and state-wide partnerships, such as the RWPC, recent emergency planning efforts with PWB's wholesale customers, and the Oregon- and Washington Water/Wastewater Agency Response Network (ORWARN and WAWARN); however, water system control and management remain with each individual water provider.

With the adoption of the 2013 Oregon Resilience Plan (ORP) and the 2018 American Water Infrastructure Act (AWIA), many water providers (at least those serving at least 3,300 people or more) have completed and/or updated resilience or emergency response plans (ERPs) for their systems. Those plans typically focus on making investments over a 50-year period to create a resilient water system that can recover relatively quickly to provide near-normal water services to their customers (i.e., functional recovery) after an event. Though important, these plans typically leave a gap; i.e., planning for provision of subsistence-level, emergency water in the period between an event and functional recovery of a water system. The goal of this project is to help fill that gap through the development of the Framework to guide water providers and emergency response agencies in planning for that time period.

Our regional water providers and emergency response agencies have significant resources they can commit to use to provide emergency drinking water. Many water providers have invested in seismic upgrades for their water tanks and reservoirs, and other improvements to increase system reliability and resilience. At a subsistence level (1 to 2 gallons [gal] per person per day), typical water systems may have a couple of weeks to over one month of storage already in place. This quantity of water needs to be considered and fully utilized as part of key supplies for emergency drinking water. If ignored, it would be impractical to replace that stored volume with bottled water or other approaches, especially when considering a catastrophic CSZ event affecting a broad geographic region. An approach that preserves and distributes this stored water (augmented with other available water resources) in those critical first weeks would be practical. This Framework is being offered as a guideline for how to address the provision of emergency drinking water before damaged water systems are restored to full functionality.

RDPO and RWPC developed several goals for this Framework:

- To enhance disaster planning and collaboration among water providers and emergency response agencies;
- To establish clear lines of communication and identify roles and responsibilities around emergency drinking water delivery;
- To develop a framework that will help water providers assess their current system, identify capability gaps, develop solutions to close gaps, and incorporate needed improvements into long-term planning;
- To serve as guidance to individual water providers and emergency response agencies for the provision and distribution of emergency water;
- To ensure water provision to underserved or vulnerable populations during and after a disaster, to the extent possible;
- To develop a strategy to close the gap between water resources and demand following a disaster;
- To develop policies to address regional emergency management and water distribution priorities; and
- To conduct workshops to test planning assumptions, guidelines, and recommendations.

Recommendations and potential policies addressing region-wide emergency management and water distribution priorities are included. These should be established in advance of an emergency to promote equitable and inclusive emergency water provision when disaster strikes and facilitate reimbursement of eligible disaster-related costs.

This Framework will serve as a guide for water providers and emergency response agencies to prepare and develop their emergency water distribution plans, establish general water distribution procedures and processes process, and identify and mitigate priorities ahead of emergencies. Future work will be necessary by the RDPO, RWPC, individual water providers, and emergency response agencies to implement this Framework collectively and within their individual jurisdictions.

1.3 PLANNING

Funding for this project is through the United States Department of Homeland Security's (USDHS') Urban Areas Security Initiative (UASI) Grant Program. The UASI Program's purpose is to provide funding to high-threat, high-density urban areas to focus efforts on building and sustaining the capabilities necessary to prevent, protect against, mitigate, respond to, and recover from acts of terrorism and natural disasters.

1.4 WHAT ARE THE RDPO AND RWPC

The RDPO is a partnership of government agencies, non-governmental organizations (NGOs), and private-sector stakeholders in the region working to increase the Region's resilience to disasters. Formed in 2012, the RDPO's mission is to build and maintain regional disaster preparedness capabilities across Clackamas, Columbia, Multnomah, and Washington Counties in Oregon as well as Clark County in Washington. The RDPO's vision is to create a secure and disaster-resilient Region where local agencies, organizations, and communities are coordinated and prepared to prevent, protect against, mitigate, respond to, and recover from threats and hazards to the Region.

Figure 1.1: Map of RDPO Boundaries

(*Source: www.rdpo.net*)

The RWPC is a collaborative and coordinating organization that works to improve the planning and management of municipal water supplies in the Portland, Oregon Metropolitan Region. The RWPC was formed in 1997 and works with its 25 members in emergency preparedness, water conservation, and regional coordination. The RWPC engages members in implementing regional programs and media campaigns to promote water conservation programs and strengthen emergency preparedness and resiliency. The RWPC's focus is to strengthen water providers' ability to plan for, respond to, and recover from extreme events, and to educate the public about the importance of having an emergency water supply. The RWPC consists of the Consortium Board, Executive Committee, Technical Committee, and working committees which provide opportunities for elected officials and staff to discuss and identify emerging issues, develop unified messaging, share materials, and support each other's work.

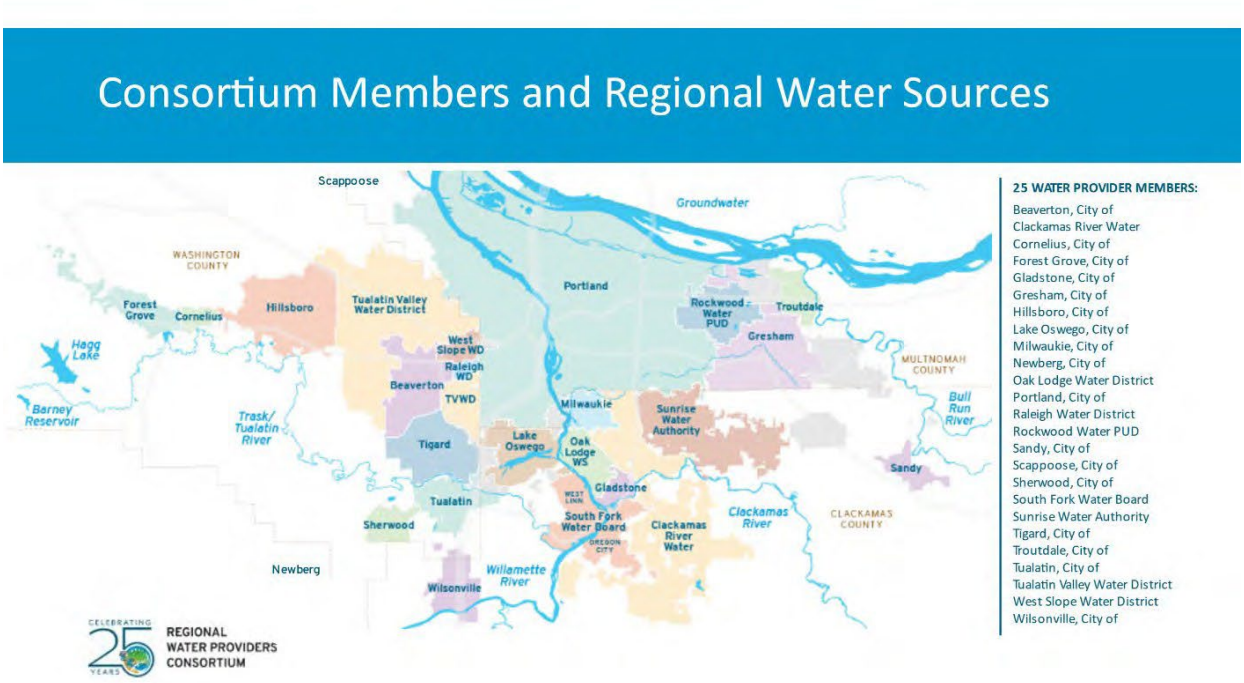


Figure 1.2: Map of RWPC Boundaries
(*Source:* *https://www.regionalh2o.org/or-regions-water*)

1.5 STUDY AREA

The study area for this project encompasses the five-county Region. The approximately 4,440-square-mile study area consists of Clackamas, Columbia, Multnomah, and Washington counties in Oregon, as well as Clark County in Washington (which are shown in Figure 1.1). This Framework focuses on water providers and governmental emergency response entities located within the study area only and does not include water providers or emergency response agencies in Yamhill County.

1.6 PROJECT APPROACH

For the Framework to be effective, it requires the three main elements discussed in the subsequent sections.

1.6.1 Clarity in Roles and Responsibilities among the RDPO, Individual Water Providers, and Emergency Response Agencies

It is sometimes unclear who is responsible for water provision in those first days and weeks following a disaster. Some water providers have prioritized recovering water system function while others (e.g., emergency responders, FEMA, the American Red Cross, etc.) deliver bottled or trucked-in water to the community. Other providers have detailed plans (e.g., treating or transporting water, specific distribution sites, and ongoing public education campaigns) without identifying who is responsible for providing the emergency drinking water or managing the distribution sites. In-between are water providers and emergency response agencies that have limited equipment or supplies and have promoted "Two Weeks Ready" or "Start with Water" or similar emergency preparedness messaging but have no specific plans for providing emergency water.

Our approach started by identifying the current state of readiness of water providers and emergency response agencies in the study area. We conducted stakeholder interviews with a representative set of water agencies to better understand the current state of planning and future needs. The interviews were followed by an on-line survey to a wider selection of water providers in the Region that more comprehensively evaluated their current state of preparedness (see Section 2).

Throughout this project, we conducted four interactive workshops targeted for specific sections of the Framework. The first of these four workshops brought together emergency response agencies at all levels and water providers to identify roles and responsibilities for the Framework. The resulting Roles and Responsibility Matrix (Table 3.2) formed the foundation of the remaining work. The second workshop presented the gap analysis findings described in Section 6 for stakeholder comment. The third workshop was a tabletop exercise with the stakeholders to review their readiness and to begin work on recommendations. The final workshop will solicit feedback on the draft Framework, specifically the recommendations for future work and policy development.

1.6.2 Effective Regional Framework with Room to Evolve

A regional framework is critical in coordinating efforts and clarifying and communicating roles and responsibilities. This Framework is not anticipated to be a complete, stand-alone guide at the end of this project, but will provide the overarching goals, recommendations, policies, and general approach with details that will be refined with time as a living document.

It is important that the Framework remain flexible and allow for individual providers and emergency response agencies to request differing levels of support that match their unique needs while still meeting the overall regional emergency water distribution provision goals. We have identified that Section 7 of the Framework will require ongoing coordination and updates after completion of this Framework.

Due to budgetary limitations, development of a comprehensive Geographic Information System (GIS) model based on data collected from various stakeholders was not feasible for this study. As an alternative, we developed project-specific layers based on data collected during our surveys and interviews to support the Framework development. With this data information, we created Emergency Response Islands

(Islands) that are expected to exist following each of our emergency scenarios (Sections 1.6.4 and 2.4). The Islands were evaluated to identify deficiencies and complete the gap analysis discussed in Section 6.

1.6.3 Social Equity

Past research on disasters has found disproportionate impacts on women, children, the elderly, those of low socioeconomic status, and other marginalized populations, including communities of color. The greater negative impact is mainly due to a lower level of preparedness and greater difficulty accessing aid. This Framework considers both the promotion of individual disaster preparedness and the ability to provide emergency drinking water following a disaster.

There have been Regional efforts to promote disaster preparedness (e.g., Two Weeks Ready or Start with Water) within vulnerable and non-English speaking populations. The RDPO and RWPC have been participating in the effort, but more can be done. This Framework expands on emergency preparedness efforts already being done by RDPO and PWCP by considering a regional approach to the emergency drinking water provision. By addressing this at a county and Regional level, it resolves conflicting assumptions and perception, and standardizes how the emergency drinking water provision can be best leveraged across the Region.

The provision of emergency drinking water following a disaster cannot be separated from providing other basic needs (food, shelter, sanitation, and medical care). Meeting and prioritizing these basic needs are the purview of emergency management, with a focus on points of distribution (POD singular and PODs for plural) where multiple resources and services are provided. Individuals who cannot reach the POD may be served by community volunteers, until they can be moved outside the disaster area or to shelters or locations where resources can be more easily provided. Direct distribution of water to vulnerable individuals will likely be beyond the combined capacity of both emergency response agencies and water providers following a major disaster.

If community-level distribution efforts fail, PODs cannot be established quickly, and/or if there is insufficient potable water, then it will be the most vulnerable who are disproportionately affected. With the current lack of clear responsibilities and high variation in levels of preparedness across the Region, the Framework focuses on being able to provide sufficient potable water at a community level. Those efforts are the most effective way for emergency response agencies and water providers to improve outcomes for vulnerable customers.

1.6.4 Project Methodology

1.6.4.1 Stakeholder Engagement

The development of the Framework relied heavily on stakeholder input and participation. Stakeholders included federal, state, county, and local emergency response and public health agencies, and representatives from large and small water providers across the five counties.

1.6.4.2 Stakeholder Selection

The Project Management Team, which is composed of RDPO and RWPC project managers, provided day-to-day oversight of the project and management of the consultant team. This oversight included monthly meetings with the consultant team to review project progress updates, problem solve any issues, and facilitate communications among the stakeholder group.

The Project Management Team recruited the Project Task Force (PTF), a team of six regional experts, to support the Framework development. The PTF, in coordination with the Project Management Team, provided input on project deliverables, technical review, and assistance with recruiting other project stakeholders. The PTF met regularly and was composed of representatives from the City of Beaverton, City of Gresham, City of Tualatin, Clackamas River Water Providers (CRWP), Clark Regional Emergency Services Agency (CRESA), and the Tualatin Valley Water District (TVWD).

The stakeholder group consisted of individuals representing water providers serving at least 501 customers (classed as a small water provider according to the United States Environmental Protection Agency (USEPA) across the full range of geographic, economic, and provider sizes to engage in development of the Framework. Additional stakeholders included local, regional, and state emergency managers, planners, engineers, and public works staff. In total, the full stakeholder group consisted of more than 130 members from across the Region, and state and federal government entities. Stakeholders provided feedback on the Framework as it was developed and during four interactive workshops.

1.6.4.3 Stakeholder Engagement Overview

A focused stakeholder engagement plan was developed as the project progressed, to ensure that the Framework would meet the needs of the Region. The plan included detailed water provider interviews with six representative water providers and a detailed on-line survey sent to all water providers in the region (with 150 connections or serving about 500 people or more). The interviews and surveys are discussed in Section 2. In addition to these measures, three water provider and emergency response agency stakeholder workshops were held virtually to obtain feedback that drove the development of the Framework. The final workshop was conducted in September 2022.

- Workshop 1, June 2021 – Roles and Responsibilities
- Workshop 2, October 2021 – Baseline Water Use, Results of Water Provider Survey, Geographic Assessments, and Preliminary Gap Analysis
- Workshop 3, March 2022 – Tabletop Exercise to test the draft Framework
- Workshop 4, September 2022 – Present Regional Recommendations based on Tabletop Exercise and Gap Analysis

1.6.5 Emergency Response Islands Approach

During our research for the project, it became clear that transportation failures after a large seismic event would hinder water distribution. Thus, we used publicly available state and local agency data to identify anticipated regional divisions, described as Islands, that are expected to exist following a large

disaster such as an earthquake. These Islands represent geographic areas and associated water service populations that are expected to be isolated in the aftermath of a CSZ event due to transportation system damage and physical and natural barriers. These Islands will need to access drinking water without relying on outside assistance during the first few weeks after a CSZ event. Our evaluations included considerations of these Islands. A detailed methodology for creating these Islands is provided in Section 2.4.

1.6.6 Emergency Scenarios

Representative emergency scenarios were developed to test the Framework. Due to the wide variety of potential hazards, we focused on the potential damage due to these hazards and developed three scenarios based on the type of damage and number of water providers affected.

The emergency scenarios for this Framework include:

- Scenario 1 – Small Event: One to five water providers are affected. The existing water distribution networks are functional while supply/source or transmission is disrupted.
- Scenario 2 – Subregional Event: Source area and transmission affected; multiple water providers affected (could be one or more providers affected; key is the difference in how the water system is impacted). Water distribution networks are functional while supply/source and transmission are disrupted.
- Scenario 3 – Regional Event: Source area, transmission, and distribution networks affected across the Region; most water providers are expected to be affected.

Under most variations of the Small Event and Subregional Event scenarios, it is assumed that most of the existing water distribution and transmission systems will remain largely intact and will continue to distribute water to most of the Region's service population through the existing piping networks. These scenarios are categorized as "piped-water" scenarios. The Regional Event is typically considered by the project stakeholders to be large, widespread catastrophic event, such as a CSZ event. Such a catastrophic event is expected to damage significant portions of the Region's water systems and will likely severely impact the ability of water providers to deliver drinking water through the existing piped distribution system. For purposes of this study, this scenario is considered a "distribution failure" scenario and is categorized as a "non-piped-water" scenario.

A previous study commissioned by the RWPC focused on "piped-water" scenarios. The Regional Water Interconnections Map and Evaluation project (Interconnections Study; Murray, Smith & Associates, 2010) identified water system interconnections among water providers and evaluated the ability to move water within individual, interconnected subregions of the Portland Metropolitan Area. This project included an evaluation of whether, in each intertied subregion, water from a single major source could meet the demands throughout the subregion. The study found that depending on water source, between 5 and 129 percent of the total average daily demand (ADD) could be supplied. The scope of the Interconnections Study was limited, and a detailed evaluation of intertie capacities and hydraulic analysis of the integrated water system throughout the Consortium service area was not performed. Therefore, while the percentage of total ADD supplied by the water source may be viewed as a relative and theoretical measure

of its capacity as a subregion water supply, further detailed quantitative analysis would require verification through hydraulic modeling.

The Interconnections Study demonstrates that the interconnectedness of the Region's water systems can facilitate some degree of water service in a "piped-water" scenario, where the distribution system remains sufficiently intact (e.g., Small and Subregional Event scenarios) and pumping equipment and fuel are available. However, it should also be recognized that even in these "piped-water" scenarios, at least some areas of the Region's water infrastructure could be compromised (e.g., contamination event) or damaged (e.g., earthquake event) to a level that would require the hauling and manual distribution of water to meet the basic emergency water needs of a community. This can be considered a distribution failure scenario for a limited area under Small Event and Subregional Event scenarios (Scenarios 1 and 2).

During a Regional Event scenario, the geographic breadth of the impacts would likely necessitate mandatory curtailment to subsistence-level daily water demands throughout the whole Region. Under subsistence conditions, it is reasonable to assume that the priority for potable emergency drinking water will be for domestic purposes. Other uses, such as fire protection, may be allowed to continue to utilize the distribution systems, if some of the Region's water systems can support that use or fire flows could be met using non-potable water. The Regional Event scenario captures both extremes (i.e., event duration and largest population affected) to result in the highest total volumes of Base Emergency Water Needs for individual Islands and the whole Region and will be used in this study to define Base Emergency Water Need.

1.6.7 Project Exclusions

Due to scope and budget constraints, this project has been completed with the following limitations and exclusions:

- The project does not include an interdependency analysis between utilities or other infrastructure systems outside of water systems. We have included some basic assumptions to help frame later sections (e.g., RDPO transportation plan results, no grid power for at least one to three months in a CSZ scenario, etc.).
- The project does not quantify resources from outside the region or evaluate how or when outside resources would be utilized.
- Quantification of bottled water resources from local, state, or federal resources or what would be commercially available is not included in the study.
- The project does not provide plans or guidance for response and recovery of individual water systems.
- The project does not identify or include emergency water distribution to critical facilities (e.g., hospitals, care facilities, or prisons) or approaches to specifically serve individual critical facilities.
- Identification and/or evaluation of firefighting methods or water sources is not included.
- The provided gap analysis was completed based on the information collected during stakeholder interviews and surveys and is limited to a high-level evaluation at the scale of the Islands.

1.7 OTHER DISCLAIMERS

- Quantities provided in this document are based on interviews and survey results and are for Regional-level planning purposes only. These quantities should be re-evaluated by each water provider as they complete their own planning exercises and may also be different after the Regional Scenario Event occurs.
- The number and location of Islands in the study are assumed for planning purposes only and are identified with considerations, including physical and natural barriers, access to transportation, and best practices based on populations. The actual number and location of Islands may be different during a major regional disaster such as a CSZ event.
- Not all water providers participated in the survey or stakeholder engagement. Where data is not available, assumptions have been made. These assumptions are documented throughout the Framework.
- Information about the water systems and the available water and storage needs included in the report is based on the interviews, surveys, and other information provided by the water providers. Verification of the information provided was not part of this scope of services. Information provided represents a snapshot in time and may be different from what is available at the time of the disaster.
- This study does not include evaluation of emergency water interconnections between water providers, as these have already been considered in prior studies.
- For an earthquake event, this study only considers the mainshock. There will likely be numerous and potentially large aftershocks, and compounding and cascading events. These events can make conditions worse – creating more isolation and increasing the need for emergency water, as well as lengthening the recovery time when emergency water distribution is needed.
- Tables and data provided in the report may not be accurate or complete at the time of the disaster; these are pre-disaster planning tools that need to be updated as information changes.

2. Existing Plans and Overview of Water Providers

The purpose of this section is to provide an overview of existing emergency water provision guidance and plans, as well as an overview of the information gathered during this project from the water providers in the Region.

2.1 EXISTING GUIDANCE PLANS AND REQUIREMENTS

Guidance documents and some existing ERPs exist for use by water providers and emergency management agencies. These range from general industry and national-level guidance to existing regional response plans. These documents provide some context for the Framework development and are included in the document library updated by the Salus team. Descriptions of the documents and some applicable highlights are noted in this section.

2.1.1 Community Lifelines Stabilization and Core Capabilities

National-level guidance and national and state requirements mostly relate to general ERPs for water providers and emergency response agencies. However, they provide some principles, reveal some gaps, and provide some criteria on emergency water provision, though they do not clearly identify or assign responsibility for distribution of the emergency drinking water. The National Response Framework (NRF), Emergency Support Functions (ESFs) and Core Capabilities are discussed in detail in Section 3.2. Below is a high-level view of other national guidance documents.

2.1.1.1 National-Level Guidance

Guidance – Emergency Response Planning Guide for Public Drinking Water Systems (Rural Community Assistance Partnership [RCAP], 2014): This document by the RCAP provides general response plan guidance. For review of its guidance on roles and responsibilities, refer to Appendix A. It is the basis for the later and more local ERP guidance by the State of Washington Department of Health (WA DOH; refer to Section 2.1.1.4).

Guidance – American Water Works Association (AWWA): AWWA has several applicable guidance documents that provide emergency response planning guidance. The following AWWA documents are most applicable to emergency water provision:

Guidance – Water Sector Resource Typing (AWWA, 2019): Requesting assistance from outside agencies and providing mutual aid is critical during emergency response. This guidance facilitates the development of resource types for water sector personnel, teams, and equipment, allowing for the development of mission-ready packages and expedited mutual aid requests and responses.

Guidance – AWWA Emergency Preparation/Planning Guidance (not included in the Resource Library due to copyright restrictions):

- American National Standards Institute (ANSI)/AWWA G440-17 – Emergency Preparation Practices: G440 is the water sector consensus voluntary standard for ERP development (AWWA, 2017).
- AWWA M19, Emergency Planning for Water and Wastewater Utilities: This manual provides detailed best practices to meet industry standards for such planning (AWWA, 2018).

2.1.1.2 Federal Resilience Requirements and Guidance

Requirement – American Water Infrastructure Act (AWIA of 2018): Section 2013 of AWIA requires water providers to perform an all-hazards risk assessment and develop a related ERP. This mandate is intended to facilitate response to catastrophic impacts from natural as well as malevolent hazards.

Guidance – Planning for an Emergency Drinking Water Supply (USEPA, 2011): This document emphasizes the importance of emergency drinking water plan development by water providers so that in an emergency event, the water providers can obtain assistance from others; and thus, retain their own resources to work on restoration of piped water service. This document is described in further detail in Section 3.4.1.

2.1.2 State Emergency Response Planning

The Washington State Emergency Management Division (EMD) is a division of the Washington Military Department. The Oregon Department of Emergency Management (OEM or ODEM) was an office within the Oregon Military Department and is now a stand-alone department, though the state's website still uses both the Office and Department designation. The mission of both agencies (OEM and EMD) is similar, and includes leading and coordinating efforts to protect, mitigate, prepare for, respond to, and recover from emergencies and disasters. The OEM and EMD maintain and update their state emergency response and operations plans as well as other specialty emergency plans regularly. Summaries of the states' respective plans are provided below.

2.1.2.1 Oregon Guidance and Requirements

OEM and Oregon Seismic Safety Policy Advisory Commission (OSSPAC)

Requirement and Guidance – ORP: was developed by OEM and OSSPAC for the Oregon Legislature in February 2013 by the volunteer stakeholders representing government agencies, emergency response, utilities, and the private sector to increase the state's readiness to respond to and recover from a magnitude 9.0 (M9) CSZ earthquake. The plan includes recommendations for target states of recovery for eight sectors within a 50-year time frame, including the water and wastewater sector following a M9 earthquake. The water and wastewater sector focus in the ORP is to harden/strengthen the essential backbone systems (the most critical infrastructure) necessary to deliver water and wastewater to the

communities. It also identifies the need for PODs on the backbone systems for potable water within two weeks following a CSZ event. The ORP is a guidance document; however, for the water providers, Oregon Health Authority (OHA) has adopted the ORP as a requirement for Oregon water providers in OAR 333-061-0060 and is discussed below.

Guidance – The State of Oregon Emergency Management Plan Volume III: Emergency Operations Plan (EOP; OEM 2017): This plan coordinates emergency operations planning across multiple levels of government including state, tribal, local, and federal to provide an effective response to emergency events in the state. The plan engages NGOs and private-sector businesses to provide services before, during, and after an event. The state Emergency Operations Plan (EOP) is designed with the tenet that disasters are managed at the lowest jurisdictional level possible for an effective response, with assistance coming only after local resources have been exhausted. The State EOP utilizes an all-hazards plan that promotes scalable, flexible, and adaptable responses following the initial incident. We understand that this plan is currently being updated in 2022. Some updated information provided by OEM has been incorporated into this project; however, additional changes may be required once the final updated document is available for review.

Guidance – Cascadia Playbook (OEM, 2018): This response guidance document provides an outline for response during the initial time frame. Response responsibility is organized by ESF. The Public Works and Food and Water ESFs provide guidance on expectations in emergency water provision.

Oregon Health Authority

Requirement – Emergency Response Plans (Oregon Administrative Rule [OAR] 333-061-0064): requires water providers to maintain an all-hazards ERP that is updated every five years. In addition, the rule language changed in January 2022 and added requirements for two additional emergency plans.
The ERP must: "Identify actions, procedures and equipment which can prevent or significantly lessen the impact of a malevolent act or natural hazard upon public health and safety and the supply of safe drinking water to communities and individuals, including the development of alternative source water options, relocation of water intakes and construction of flood protection barriers; and (i) Make provisions for an auxiliary power supply and provide for redundant equipment for critical components. OAR 333-061-0064 Page 275 of 345 Effective January 1, 2022 (ii) Identify and develop plans for utilizing alternative drinking water sources and supplies. (iii) Develop plans for water rationing. (iv) Develop a plan for emergency provision of water." (OAR 333-061-0064). pwsrules.pdf (oregon.gov)

Requirement – Seismic Risk Assessment and Mitigation Plans (OAR 333-061-0060): As part of a water system master plan, water providers with 300 or more connections in areas of moderate or higher expected intensity of shaking during a CSZ event are required to prepare a seismic risk assessment and mitigation plan. The majority of water providers included in this study are subject to this requirement due to their location.

- "Seismic risk assessment must identify critical facilities needed to supply key community needs,

including at a minimum fire suppression, essential health care and first aid, emergency response, and drinking water supply points. The result would be a list of infrastructure backbone components including supply, treatment, distribution, and storage elements that are needed to continue to supply water for essential community needs immediately after a CSZ earthquake."

- "Based on the critical facilities identified to form the backbone, the mitigation plan may consist of projects that will be completed over the next 50 years to upgrade, retrofit, or rebuild these facilities so that they will continue to provide water following a CSZ event. The mitigations would include planned capital improvement projects, upgrades to minimize water loss from each critical facility, or recommendations for further study or analysis. The mitigation plan must also include a schedule as to when these mitigation efforts will be completed, within the 50-year planning horizon."

2.1.2.2 Washington Guidance and Requirements

Guidance – Emergency Response Planning Guide for Public Drinking Water Systems (Washington DOH, 2017): This guidance document provides information on general emergency response principles and serves as a planning template. This facilitates compliance with the basic requirement for water providers to have an ERP [per Chapter 246-290-415 (2)(b) WAC]. Section 11 of this guidance discusses alternative water sources and restricts what can be connected to the water system: intertie with another Group A water system (community water systems with at least 15 connections or non-community water systems that serve at least 25 people per day for 60 or more days), or a well meeting several criteria. Guidance in WAC246-290-415 is very limited or non-existent in the following applicable areas: water use curtailment, emergency water distribution, and catastrophic earthquake response; however, additional requirements can be found in Chapter 246-290-131 for emergency source and emergency supplies that include some requirements for delivering emergency drinking water and Chapter 246-290-420 for rationing and curtailment.

Guidance – Washington State Comprehensive Emergency Management Plan (Washington Military Department, 2019): The purpose of this plan is to provide a structured framework for state-wide mitigation, preparedness, response, and recovery activities to be completed consistently throughout the state. The plan provides a whole-community approach to establish collaboration among local, state, tribal, federal, volunteer, private, and public sector organizations. The plan further defines the primary emergency management responsibilities of state agencies – to support local jurisdictions and to maintain a comprehensive internal process to ensure continuity of government.

2.1.3 Regional Emergency Response Planning

Multiple regional planning groups have completed regional emergency response planning, including some with a focus on emergency water provision. The following subsections describe related documents for the local Region and other regions.

2.1.3.1 The Region

The Region consists of Clackamas County, Columbia County, Multnomah County, and Washington County in Oregon, and Clark County in Washington, and is home to approximately 2.4 million people (U.S. Census Bureau, 2020). All of the counties, some of the major cities, and most of the water providers have emergency operations centers (EOCs) and have completed some emergency response planning. A brief summary of the plans for five counties and two of the largest cities are provided in Appendix A. The emergency response planning by the water providers is discussed in Sections 2.2 and 2.3.

2.1.3.2 RDPO Planning Efforts

Guidance – Regional Recovery Framework (RDPO, 2019): The Regional Recovery Framework was completed in 2019 to provide a guide for coordination of recovery across the five counties within the RDPO. The framework was developed using an all-hazards approach and provides a guide to rebuilding, redevelopment, and recovery efforts in the weeks, months, and years following a disaster. The framework incorporates seven Recovery Support Functions (RSFs) to support stakeholders in establishing resilient and equitable regional and local recovery operations. The RSFs support stakeholders by facilitating problem solving, improving access to resources, and fostering coordination among agencies, non-governmental partners, and community stakeholders.

Guidance – RETR Update, Phase 1 (RDPO, 2021): Phase 1 of the RETRs Update was completed in 2021 for Metro, the City of Portland, and the RDPO. Data and input from the five counties within the RDPO were used to create recommendations to regionally prioritize routes, which will assist stakeholders within the RDPO in obtaining route funding and provide considerations for resiliency and emergency recovery for future work. This emergency plan also includes seismic vulnerabilities and engineering resilience in transportation planning, assessing connectivity considering both public works and emergency management viewpoints, and developing a product that will facilitate future funding requests for local agencies in the region.

Guidance – Portland Metropolitan Region's Multi-Agency Coordination System (MACS), Concepts of Operations Plan: The Regional Multi-Agency Coordination System Concept of Operations Plan (Regional MACS ConOps; RDPO, 2017) established a framework for coordination and support during incidents within the RDPO region. The plan defines the Regional MACS and the elements that are part of the system, as well as identifies concepts and coordination processes necessary for the plan to be successfully implemented. The plan was finalized in 2016 with all five counties agreeing to maintain the plan, support and facilitate plan and system implementation, and conduct regional emergency coordination activities consistent with the plan.

Guidance – Regional Emergency Fuel Planning, RDPO Phase 1 and 2, (RDPO, 2021): Data collected during past assessment of public agencies have identified significant gaps in the availability of fuel supply following a catastrophic earthquake in the Region. The RDPO created emergency fuel plans for each of the

five counties to address these gaps. In 2019, the multi-phase project began to address the fueling gaps previously identified. The first phase, completed in March 2021, was an in-depth assessment of the region's fuel sourcing, access and distribution, fuel availability, and estimated fuel usage. The second phase, also completed in March 2021, was the development of the individual emergency fuel management plans for each county. The final phase will be completed during the fall of 2022, when a tabletop exercise is conducted to validate the fuel management plans.

2.1.3.3 Regional Water Providers Consortium Emergency Response Planning Efforts

RWPC has conducted studies and implements a regional outreach campaign on behalf of its 25 members.

Guidance – Regional Water Interconnections Map and Evaluation Project (RWPC, 2010 – 2013): This project included development of an interties map as discussed in Section 1.7.

Guidance – Emergency Water Treatment and Distribution Plan (EWTDP; RWPC, 2015): The plan identifies some resources and strategies that RWPC-area water providers can use to respond rapidly to a significant disruption in drinking water supplies. It outlines procedures for activating, deploying, and maintaining Regionally-located emergency water treatment and distribution equipment. Guidance includes response coordination, protocols, outreach, and training. It includes inventories of regional emergency treatment and distribution equipment, and equipment-specific literature. The plan is useful on multiple fronts, from confirming some known equipment locations to being a guidance document for specific equipment and procedures.

Guidance – Outreach: The RWPC has a multi-lingual public outreach campaign about the importance of having an emergency supply of drinking water.

2.1.4 Examples from Other Regions

As part of the study, examples from other regions were examined and are summarized in Appendix A. All are guidance documents; some mention the need for clarifying roles and responsibilities for the provision of emergency drinking water. The Los Angeles EOP Logistics Annex is the closest agency suggesting the water providers and other stakeholders work together to identify and procure equipment and supplies necessary for the provision of water. Most of the guidance documents were silent on emergency drinking provision and on identifying who bears the responsibility for the provision.

2.2 REGIONAL WATER PROVIDERS OVERVIEW AND STATUS

This section provides an overview of the Region's water providers, introduction of the Islands concept, analysis of their representation in the water provider survey, and an overview of the survey.

2.2.1 Overview of Water Providers

This study focused on community water systems with at least 150 service connections, equivalent to serving approximately 500 people. These community water systems are referred to as water providers or water utilities throughout this document. There are 72 such water providers within the Region, and they serve more than 95 percent of the total population receiving water from a public water system. Water providers are categorized by size per USEPA classifications as follows:

- Small systems serve from 501 to 3,300 people.
- Medium systems provide water to between 3,301 and 10,000 people.
- Large systems provide water to between 10,001 and 100,000 people.
- Very large systems serve communities of greater than 100,000 population.

There are also four shared/partnership wholesale water providers (with shared water sources) within this region that are co-owned by the water providers they serve and have few or no direct water service connections. Table 2.1 describes how these shared sources were included in the project.

Table 2.1: Shared Sources and Their Method of Inclusion in the Water Provider Survey

Region Shared Wholesale Water Source Provider	Method of Inclusion in the Water Provider Survey
Joint Water Commission (JWC) includes Hillsboro, Beaverton, Forest Grove, and the Tualatin Valley Water District	Included in survey due to its own large water reservoirs
Lake Oswego-Tigard Water Partnership	Not included in survey: assets covered by the City of Lake Oswego
North Clackamas County Water Commission (Gladstone, Oak Lodge Water Services District, and Sunrise Water Authority	Not included in survey: assets included in Oak Lodge Water Services District
South Fork Water Board (Oregon City and West Linn)	Included in survey due to its reservoir and stores of emergency response equipment

2.2.2 Individual Water Provider Planning Efforts

Some of the individual water providers have conducted water resilience studies and emergency response planning efforts for years. These efforts include having their own EOCs, trained emergency responders, vulnerability and risk assessments, including seismic risk assessments, participation in the respective Water/Wastewater Agency Response Networks (WARNs), and various mutual aid agreements; and participation in the RDPO, the RWPC, and their respective city or county emergency response planning. They are not detailed in this study though since the focus is at the regional level; however, some information is captured in the water provider survey described below.

2.2.3 Water Provider Interviews

Five water provider agencies were interviewed as part of this project. The purpose of the interviews was to

capture a range of approaches to resiliency and to inform the broader water provider survey questions and stakeholder workshops. The selected interviewees represented a cross-section of water providers within the RDPO. Table 2.2 below provides a list of the water providers interviewed for this effort.

Table 2.2: Stakeholder Interview Water Providers and Characteristics

Water Provider	Size Category*	County	Water Source Type
Portland Water Bureau (PWB)	Very Large	Multnomah	Surface/Groundwater
City of Hillsboro	Large (high-end)	Washington	Surface
Clackamas River Water Providers**	Large**	Clackamas	Surface
Clark Public Utility District (PUD)	Large (high-end)	Clark	Groundwater
City of Vernonia	Small	Columbia	Surface

Notes:
** Size Category per USEPA definition. See Section 2.2.*
*** A group of water providers who get their water from the Clackamas River, ranging in sizes. Those that participated included small, large (low end of range), and large (middle of range).*

Interviews were conducted in May 2021. Interviewees were asked a series of open-ended questions; those questions are provided in Appendix B. Overall themes that emerged from the interviews are summarized in Table 2.3. In addition, feedback from the interviewees was used to develop the water provider survey and to complete the gap analysis.

Table 2.3: Stakeholder Interview Summary

Subject	Summary
Training	Holding sufficient emergency preparedness training (mainly tabletop exercises) is a challenge for water providers who face infrequent real-world emergencies. Almost all water providers interviewed cited this as a challenge or deficiency.
Promoting Individual Preparedness Among Staff	Many water providers have promoted individual preparedness among their staff. However, these efforts do not appear to be consistent. For example, there may have been a push at some time in the past, but not a sustained effort.
Promoting Individual Preparedness in the Community	Many, but not all agencies interviewed, have promoted individual preparedness in their community. The most common approaches appear to be readiness fairs or booths/information distribution at major community events.
Emergency Power Generator Availability	Most water providers have at least some backup power generators—though in most cases, these generators are insufficient in number and capacity to provide significant water supply. Newer infrastructure is more likely to include permanent backup power generation.

Subject	Summary
Fuel	Many permanent backup power generators have hours to a couple of days of fuel on site only. Water providers generally do not have a uniform standard for fuel storage across different supply/pumping sites. In general, it appears newer sites may tend to have more fuel storage. Some water providers let fuel levels drop significantly before refilling, so actual fuel availability at any given time may be much less than capacity. Many water providers are relying on fueling contracts - prioritization of those contracts may be a challenge in a major disaster.
Treatment and Disinfection Chemicals	The water providers interviewed generally have around one to two weeks of treatment and disinfection chemicals on hand. Contracts with secondary chemical suppliers are helpful, as chemicals may be more readily available or at a lower cost from a secondary supplier during an emergency.
Infrastructure Upgrades	Water providers that are growing quickly have the advantage of new infrastructure being constructed to the new resilient structural standards. Water providers with older infrastructure and lack of growth struggle to make the needed investments.
Training/Following of National Incident Management System (NIMS)	All water providers have ERPs that follow the NIMS Incident Command Structure (ICS). However, the NIMS ICS may not have been followed during actual emergencies, due to lack of training and familiarity of all parties involved. In some cases, this resulted in confusion about who is coordinating with other emergency response agencies (e.g., fire).
Provision of Emergency Water	There is both a lack of clarity and widely divergent views on the role of water providers and other agencies in providing emergency water when the water system fails. In some cases, water providers assume they will bear primary responsibility. Other water providers assume they will play a supporting role or leave emergency water distribution to others while they focus on restoring the water system.
Emergency Water Distribution Sites	Many water providers have not considered identifying emergency water distribution sites and do not consider identifying sites as a water provider responsibility. For the water providers that do have sites identified, some have focused on emergency distribution sites convenient to water infrastructure (well sites, reservoir sites), whereas others have focused on County or City planned shelter sites and other PODs.
Extending the Geography of Mutual Aid Agreements	Almost all providers are members of ORWARN or WAWARN, as well as participating in numerous other mutual aid agreements and organizations. There is a need for mutual aid agreements with areas that will not be impacted by the CSZ – perhaps eastern Washington and Oregon, south of Redding California, or farther away locations.
Equity and Vulnerable Populations	Water distribution plans do not explicitly consider vulnerable populations or include plans to distribute water directly to individuals not able to access community distribution sites.

2.3 EMERGENCY RESPONSE ISLANDS

2.3.1 Introduction and Definitions

It is well documented that in a Regional Scenario such as the CSZ event, transportation connectivity will be severely hindered. This will greatly impact Regional response, including emergency drinking water distribution. Furthermore, in a CSZ event, the interconnections (piped distribution systems) will not be available to move water in many areas. Thus, emergency water distribution in this scenario will be reliant on the transportation system to move water throughout the Region. To adequately prepare for these disruptions, we have divided the Region into Islands that reflect the anticipated disruptions to the transportation system and isolation of the water providers. They were developed after the water provider interviews and survey were completed, and they are used to explain the results of the water provider survey in Section 2.5.

2.3.2 Division by Islands

The Islands were developed from a seismic event and emergency response perspective using Regional geography, expected damage to the transportation system from geologic hazards following a seismic event, and Oregon Department of Transportation (ODOT) bridge data. Bridge data from the Washington State Department of Transportation (WSDOT) was not available. The geographical analysis was conducted using maps of the individual counties to identify natural barriers in the study area. The primary geographical barriers were limited to water bodies such as rivers, lakes, streams, landslide areas, and areas of expected liquefaction and ground movement.

Expected damage from geologic hazards in the study area was developed using data collected from the Department of Geology and Mineral Industries (DOGAMI), the Washington State Department of Natural Resources (WADNR), ODOT, WSDOT, and RDPO (DOGAMI, 2018; DOGAMI, 2020; ODOT, 2012; and RDPO, 2006). The expected damage following a Regional Scenario, such as a CSZ event, was developed from landslide, liquefaction, tsunami, and ground deformation data developed in the DOGAMI Enhanced Earthquake Impact Analysis (DOGAMI, 2018 and DOGAMI, 2020). More recently, ODOT has evaluated the seismic risks along state-designated seismic lifeline routes located in Oregon, specifically expected bridge failures. Isolation of geographic areas and populations is most likely to result from transportation failures (e.g., road damage, bridge failures, landslides, utility failures in roadways, and debris blocking roadways).

The result of this effort was the creation of Islands for each county, as shown in Figures 2.1 through 2.5 (appended at end of report). While the Islands used in the study are in part defined by water service area boundaries, some cut water service areas, and some divide emergency response agencies and local government jurisdictional boundaries. Implementation using the Islands will likely cause some policy and governance issues that need to be resolved and may affect the usage of the Islands themselves during the emergency preparedness and emergency response. The Islands presented herein are anticipated based on expected damage; however, they may vary depending on damage realized during an actual emergency. Islands will need to be evaluated by counties, cities, and water providers after an event.

2.4 WATER PROVIDER SURVEY

2.4.1 Survey Organization

All water provider stakeholders were invited to complete a survey. The questions of the water provider survey (survey) were developed based on Framework goals, project planning, and the water provider interviews. Table 2.4 shows categories of questions and how the categories are addressed in different sections of this report.

Table 2.4: Water Provider Survey Summary

Survey Question Number(s)	Survey Questions Summary	Section Primarily Addressed
1 – 5	System basic characteristics	This Section (2.4)
17	Roles and Responsibility for emergency water distribution	Section 3
6 – 11	Physical infrastructure resilience	Section 5
21	Emergency response equipment	Section 5
12 – 16, 19 – 20	Planning and training status	Section 5
22 – 26	Communication & community resources	Section 5

Survey questions were structured to exclude in-process work from the current status responses. For instance, the Willamette Water Supply Program projects were under construction at the time of the survey, so they are not captured under the current status response but rather under the "planned in the next 5 years" responses.

Survey questions and responses are provided in Appendix C.

2.4.2 Surveyed Water Providers and Respondents

The survey was provided to 54 water providers within the Region as well as to the two shared sources noted in Table 2.1. Details on the surveyed water providers and the survey respondents' representation of the Region are summarized in this subsection. The survey was emailed to the list—both in an Adobe Acrobat PDF format of all the survey questions as well as an online survey tool link. The survey was sent to the water providers in June 2021; most survey results were collected by October 2021.

Of those surveyed, 45 participants responded, including two that share sources. To avoid duplication, the two responders that share sources were only counted once, so the total providers counted in the rest of the report is 43. These responders serve a population of 2.31 million; i.e., 97 percent of the total population (2.38 million) served by the 72 Region water providers.

In creating the Islands, it was determined that several water providers span more than one Island. Additional survey responses from those providers were used to divide their population and resources across the individual Islands.

Much analysis in this Framework is based on the Island. Table 2.5 provides analysis of representation for the 20 Islands with 43 responding providers. In almost all the Islands, respondents represented more than

80 percent of the total Island population. There are two exceptions, shown in bold in Table 2.5. Conclusions about these two Islands are more uncertain. Twelve Islands are not included in Table 2.5 since we received had no response from water providers. These Islands are small, having an average service population of 2,662, and combined, they represent around 3 percent of the service population of water providers in the Region.

Table 2.5: Summary of Respondent Representation by Island

Emergency Response Island	Number of Respondents	Population of Responding Utilities	Percent of Service Population Represented by Survey Respondents
CLACK1	3	70,000	>99
CLACK11	1	9,910	>99
CLACK2	4	102,014	>99
CLACK3	2	58,200	94
CLACK5	2	50,492	>99
CLACK7	**1**	***1,500***	**56**
CLACK9	1	4,035	>99
CLARK1	4	415,000	98
CLARK3	1	21,130	>99
COLUM2	1	*1,785*	>99
COLUM4	2	16,876	81
COLUM5	1	7,621	>99
MULT1	1	115,334	>99
MULT2	5	739,521	99
MULT3	1	*3,300*	>99
WASH1	1	*2,000*	>99
WASH3	7	591,094	>99
WASH4	3	69,257	>99
WASH6	**1**	**24,000**	**66**
WASH7	1	4,581	>99
Total	**43**	**2,307,650**	

Figure 2.6 shows survey representation of water providers by provider size (as defined in Section 2.2.1). Representation was high among medium to very large water providers. Representation was much lower (12 percent) among small water providers. This under-representation is acknowledged in the Table 2.2 discussion above and is considered as part of the gap analysis in Section 6. Figure 2.7 shows that survey representation across the five counties ranged from 44 to 54 percent representation of the water providers in each county.

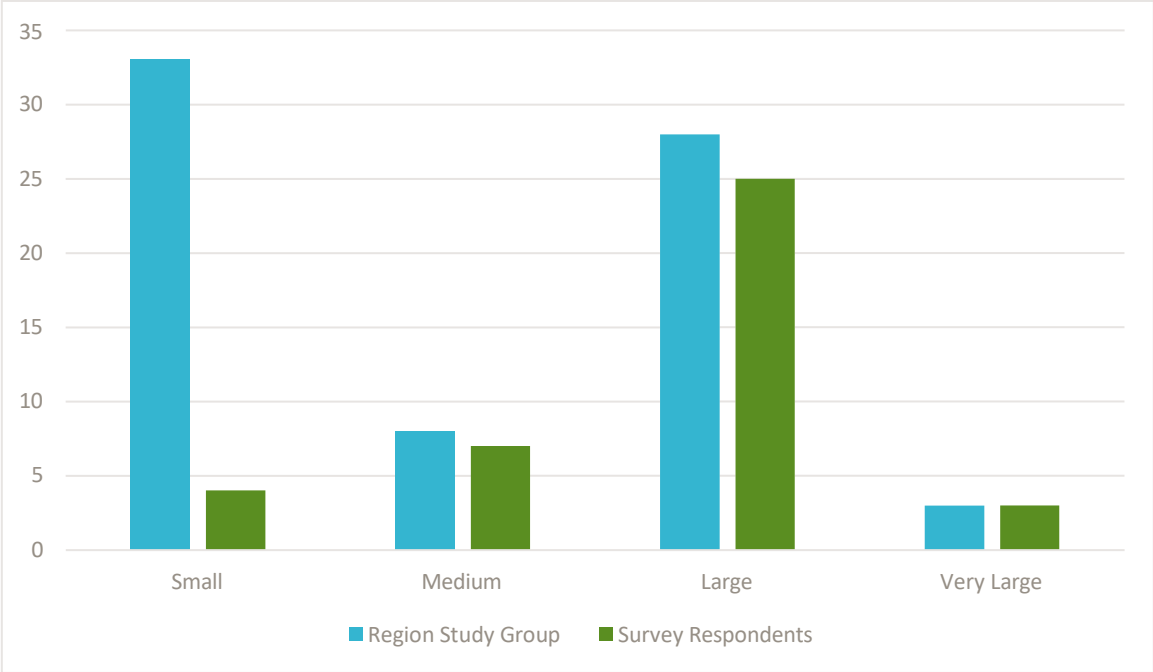


Figure 2.6: Representation of Survey Respondents Compared to Region Water Utilities – Size Category

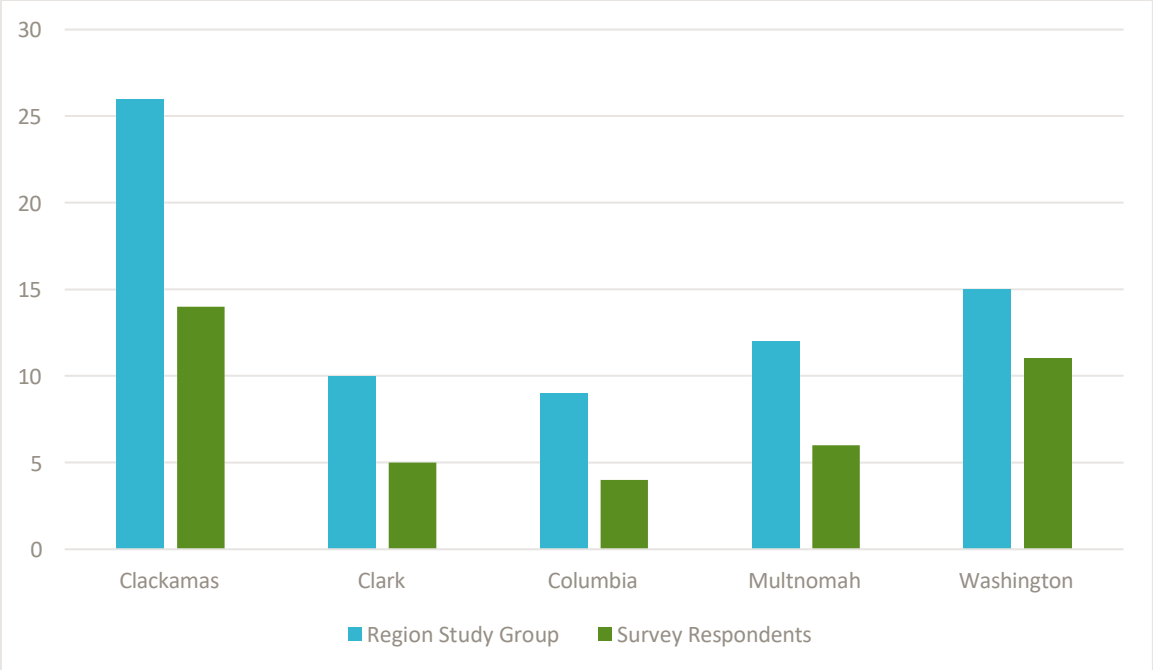


Figure 2.7: Representation of Survey Respondents Compared to Region Water Utilities – County

Table 2.6 provides metrics on the annual ADD of the survey respondents from within any one Island.

Table 2.6: Water Demand of the Survey Respondents

Metric	Survey Respondents ADD by Island, Million Gallons per Day (MGD)
Average	6.4
Median	2.4
Largest*	70.8
Smallest	0.2

**The largest water system actually has a higher total ADD, but its ADD is split across three Islands. The largest of the three is shown here.*

Due to the under-representation of small systems, demand numbers for the Region as a whole are slightly higher than those in Table 2.6. The total ADD for the respondents in the Region is 257 MGD.

The survey respondents draw from a variety of sources—many from more than one type of source. These are summarized by Island in Table 2.7. Roughly half the respondents use groundwater sources, and half use surface water sources.

Table 2.7: Summary of Water Sources

Emergency Response Island	Responding utilities represented in Island	Water Sources Available in Emergency Response Island				
		Groundwater	Aquifer storage and recovery well	Surface water treated at own facility	Surface water treated at a shared/regional facility	Water purchased from a wholesale provider
CLACK1	3	1		2	2	1
CLACK11	1			1		
CLACK2	4	1		1	1	1
CLACK3	2	2	1	2	1	2
CLACK5	2	1				1
CLACK7	1	1				1
CLACK9	1			1		
CLARK1	4	4		1		4
CLARK3	1	1				1
COLUM2	1			1		
COLUM4	2	1	1	1		1
COLUM5	1	1		1		1
MULT1	1	1		1		1
MULT2	5	4	1	1		4
MULT3	1			1		

Emergency Response Island	Responding utilities represented in Island	Water Sources Available in Emergency Response Island				
		Groundwater	Aquifer storage and recovery well	Surface water treated at own facility	Surface water treated at a shared/regional facility	Water purchased from a wholesale provider
WASH1	1	1		1		1
WASH3	7	3	3	3	4	3
WASH4	3	1	1	1	1	1
WASH6	1			1	1	
WASH7	1			1		
Total:	**43**	**23**	**7**	**22**	**2**	**10**
Percentage Using Source Type		**53 percent**	**16 percent**	**49 percent**	**23 percent**	**35 percent**

Note: Percentages add to more than 100 percent due to the use of multiple different water sources in individual Islands.

The above analyses of characteristics by Island provide context for understanding each of the 20 responding Islands. The earlier analyses of representation demonstrate the relevance of the data gathered from the survey respondents for understanding the whole Region, even though analysis in Sections 4 through 6 is limited to these 20 responding Islands.

3. Roles and Responsibilities

3.1 INTRODUCTION

Based on our gathered information, emergency water distribution is an emergency response activity, and it is seen as a shared responsibility requiring collaboration and partnership among various levels of government, water service providers, private sector companies, and NGOs. Emergency response starts at the lowest possible level and is elevated to the next level when the resources and capabilities of the lower level are exceeded. For Small and Subregional Events, the emergencies are generally within the capabilities of the water providers with minimal assistance from emergency response agencies. For the Regional Event, we assume that the water providers will be focused on repairing the water system; the provision of emergency water will exceed the capabilities of the water providers, and provision of water will rest with the emergency response agencies.

To understand and properly define the roles and responsibilities of stakeholders at various levels (from local water service providers to the federal government) during an emergency event, a variety of sources of information, including interviews with FEMA, state, and local personnel, state and local emergency drinking water planning guides, and local water agencies' after-action reports have been collected and reviewed.

The project team reviewed a number of emergency drinking water planning documents; these are mentioned in Section 2.1. The description of documents and examples from outside of the Region are included in Appendix A.

As part of the Framework development process, the consultant team collaborated with RDPO to convene Workshop 1 focusing on roles and responsibilities for emergency water provision on June 2, 2021. Representatives from water service providers, emergency managers of local governments within the Portland Metropolitan area, regional staff and representatives from FEMA, and consultants discussed how to facilitate regional collaboration and provided their perspectives on roles and responsibilities for the Framework during two hypothetical emergency scenarios (a severe windstorm and an earthquake). The input and guidance from the workshop have been incorporated, as much as possible, to recommend broad acceptance and implementation of this Framework in this Region. Because the number of actual workshop participants was fewer than invited by RDPO, the perspectives represented at the workshop may not be as comprehensive as desired. Additional input and perspectives received after the June 2021 workshop during the development of this document have been incorporated as appropriate to minimize any potential perspective gap.

3.2 OVERVIEW OF EMERGENCY RESPONSE CONCEPTS

Effective and efficient response requires collaboration and cooperation among a variety of organizations. The scale, scope, and complexity of an incident drives the number and variety of organizations that may respond. As an incident evolves, response efforts need to adapt to meet changing needs. The number, type, and sources of resources also may need to be adjusted to meet evolving conditions associated with

the incident and any cascading effects. In the United States, the Department of Homeland Security developed the National Response Framework (NRF) (USDHS, 2019) to support locally-executed, state-managed, and federally-supported disaster response operations with five guiding principles:

(a) engaged partnership;

(b) tiered response;

(c) scalable, flexible, and adaptable operational capabilities;

(d) unity of effort through unified command; and

(e) readiness to act.

Effective implementation of the NRF will allow a community to build an emergency management infrastructure that consists of a complex horizontal and vertical network of relationships to save lives and protect property.

3.2.1 Community Lifelines Stabilization and Core Capabilities

The primary effort during emergency response is to stabilize community lifelines to reduce the impact of threats and hazards on public health and safety and economic security. The NRF (2019) lists a total of seven community lifelines: (1) Safety and Security; (2) Food, Water, and Shelter; (3) Health and Medical; (4) Energy; (5) Communications; (6) Transportation; and (7) Hazardous Materials. These lifelines represent the most basic services a community relies on, and enable emergency response agencies, infrastructure owners and operators, and other partners to identify the root cause of an incident impact. They can then apply core capabilities (developed by engaging the community) throughout the emergency response to stabilize the lifelines and enable recovery.

National-level guidance and national and state requirements mostly relate to general ERPs for water providers and emergency response agencies. However, they provide some principles, reveal some gaps, and provide some criteria on emergency water provision, though they do not clearly identify or assign responsibility for distribution of emergency drinking water.

National guidance is dictated by Presidential Policy Directive-8: National Preparedness (The White House, 2011), which calls on federal departments and agencies to work with the whole community around six preparedness elements: (1) Goal; (2) Approach; (3) Frameworks; (4) Annual Report; (5) Federal Plans; and (6) Build and Sustain Preparedness. Of these six elements, the National Preparedness Goal is further defined by FEMA as what it means for the whole community to be prepared for all types of disasters and emergencies.

The National Preparedness Goal identifies five mission areas: Prevention, Protection, Mitigation, Response, and Recovery. There are 32 core capabilities – critical elements necessary to meet the National Preparedness Goal – that are divided among the five National Preparedness Goal mission areas. Providing emergency drinking water falls within the Response mission area, which is defined as: "*Respond quickly to*

save lives, protect property and the environment, and meet basic human needs in the aftermath of a catastrophic event (USDHS, 2019)."

To meet the goals of the Response mission area, the NRF was created to help jurisdictions develop plans needed in the Response mission area. The NRF identifies 15 core capabilities within the Response mission area:

- Planning;
- Public Information and Warning;
- Operational Coordination;
- Infrastructure Systems;
- Critical Transportation;
- Environmental Response/Health and Safety;
- Fatality Management Services;
- Fire Management Suppression;
- Logistics and Supply Chain Management;
- Mass Care Services;
- Mass Search and Rescue Operations;
- On-scene Security, Protection, and Law Enforcement;
- Operational Communications;
- Public Health, Healthcare, and Emergency Medical Services; and
- Situational Assessment.

The NRF also identifies 15 ESFs that provide the structure for coordinating federal interagency support for a federal response to an incident which supports the core capabilities of the Response mission area. Federal, state, and county governments typically use the ESFs as a coordinating structure to organize and manage their response resources and capabilities to build, sustain, and deliver core capabilities. These are listed below in Table 3.1. Each ESF consists of a group of organizations that work together to deliver core capabilities, with one department or agency being the ESF coordinator, and others as primary or supporting agencies. ESFs #3, #6, # 8, and #11 are directly related to the Emergency Drinking Water Framework and PODs.

Table 3.1: Essential Support Functions and Lead Agencies

ESF #	Coverage	Federal	Oregon	Washington
1	Transportation	NA	NA	NA
2	Communications	NA	NA	NA
3	Public Works and Engineering	Led by Department of Defense (DOD)/ United States Army Corps of Engineers (USACE). Coordinates resources and capabilities to facilitate infrastructure protection and emergency repair, restore critical infrastructure services, and provides technical assistance, engineering expertise, and construction management.	Coordinated and led by ODOT and focuses transportation, water, and sewer and on other state activities needing engineering.	Coordinated by Department of Enterprise Services (DES), with Department of Ecology, DOH, and DES as primary agencies.
4	Firefighting	NA	NA	NA
5	Information and Planning	NA	NA	NA
6	Mass Care, Emergency Assistance, Temporary Housing, and Human Services	Coordinates the human services needs of the communities such as distribution of food, water, and shelter.	Lead agency is Oregon Department of Human Services (DHS) with support from OHA. Focus is how Oregon will assess food, water, and ice needs after a disaster; identify and obtain these resources; and transport them to the impacted areas. As of 2020, ESF # 11 has been folded into this ESF under Oregon DHS.	Lead agency is Washington Department of Human Services (WSDHS).
7	Logistics	NA	NA	NA
8	Public Health and Medical Services	NA	Lead agency is Oregon DHS	Lead agency is WSDHS
9	Search and Rescue	NA	NA	NA

ESF #	Coverage	Federal	Oregon	Washington
10	Oil and Hazardous Materials Response	NA	NA	NA
11	Agriculture and Natural Resources Annex	Coordinated by U.S. Department of Agriculture, with its Food and Nutrition Service serving as primary agency for providing nutrition assistance and a variety of functions to protect the nation's food supply.	In Oregon, ESF # 11 is called Food and Water and has been folded into ESF #6 except for natural water bodies (lakes, rivers, and streams) which fall under Oregon Water Resources Department (OWRD).	Coordinated by the Washington State Department of Agriculture (WSDA). The primary Washington agency for providing nutrition assistance (including drinking water) is the Department of Social and Health Services (DSHS). It works with affected jurisdictions and state agency partners, including the WSDA Food Assistance Program to determine nutrition assistance needs, obtain food supplies, and arrange for delivery of the supplies.
12	Energy	NA	NA	NA
13	Public Safety and Security	NA	NA	NA
14	Cross-Sector Business and Infrastructure	NA	NA	NA
15	External Affairs	NA	NA	NA

Note: NA = Not applicable to emergency drinking water.

3.2.2 Engaged Partnership and Tiered Response

It is impossible for any government to do everything necessary to save lives and protect the property of the public. The community needs to be engaged to develop shared goals and align capabilities of individuals, families, communities, the private sector, NGOs, and government at all levels to maximize response efforts, and reduce the scope and duration of impacts of an incident.

Most emergency incidents start and end locally and are managed at the lowest jurisdictional level possible for the most effective response. For instance, typically emergency response starts at the city level as the lowest local level. Some incidents may overwhelm local resources and capabilities; and thus, they require additional resources or support from neighboring jurisdictions or are elevated to the next level of government (i.e., county or state level) as a conduit for assistance. For example, an incorporated municipality looks to their county as a conduit for assistance in an emergency; and their county, if their resources and capabilities are exhausted, looks to their state for capabilities and programs to support the county in fulfilling their response to disasters. In major disasters, the state may request assistance from other states through interstate mutual aid and assistance agreements (such as Emergency Management Assistance Compact [EMAC]). These EMAC agreements have been in place since 1996 for all 50 states and U.S. territories so that states may respond immediately across state boundaries; there are provisions in the EMAC that allow responding without waiting for a governor disaster declaration. Implementing the EMAC can be localized.

A smaller number of incidents may require federal support, often through the Stafford Act. Overall, national response processes are structured to provide tiered support and response when additional resources or support are needed. Figure 3.1 shows an overview of a response assistance request from the local level up to the federal government through their state EOC.

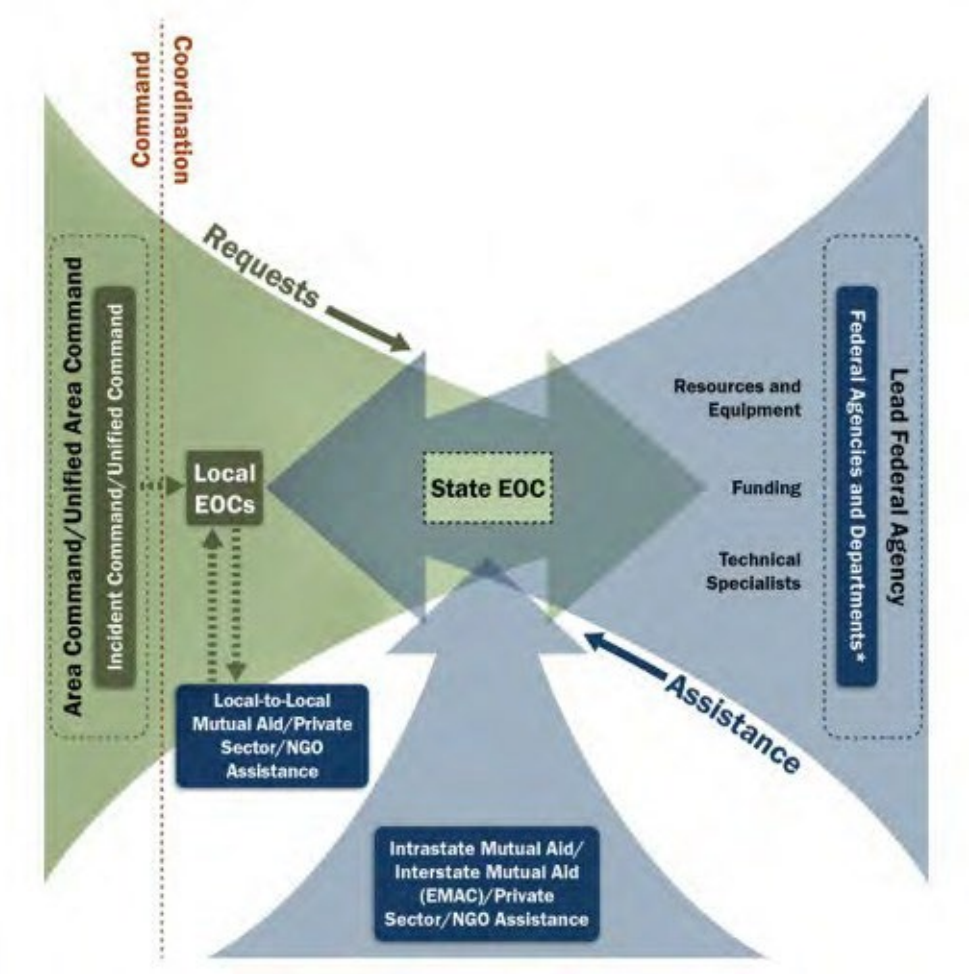


Figure 3.1: Response Assistance Request Overview
(Source: FEMA, 2017)

3.2.3 NIMS-ICS for Scalable, Flexible, and Adaptable Operational Capabilities

NIMS, consisting of resource management, command and coordination, and communications and information management, provides the template for incident management and support practices, regardless of size, scope, or complexity. The ICS, as prescribed in the command and coordination component of NIMS, is a standardized approach to emergency response command, control, and coordination of on-scene incident management or EOC. It ensures interoperability across multi-jurisdictional or multi-agency incident management activities.

Figure 3.2 shows an example of ICS organization with a single incident commander (IC) for a small situation where an incident occurs within a single jurisdiction and without jurisdictional or functional overlap. Incident management may also involve Multi-Agency Coordination Groups (MAC Groups). A MAC Group consists of senior officials who are authorized to commit their agency resources and funds to support incident management activities. A MAC Group acts as a policy-level or executive-level body during incidents, prioritizing resource allocation, and enabling decision-making among elected/appointed officials and the IC. Emergency responders at all levels of government use NIMS and ICS command as their

coordinating structure to manage and support response activities (if they want federal emergency preparedness and emergency response financial assistance).

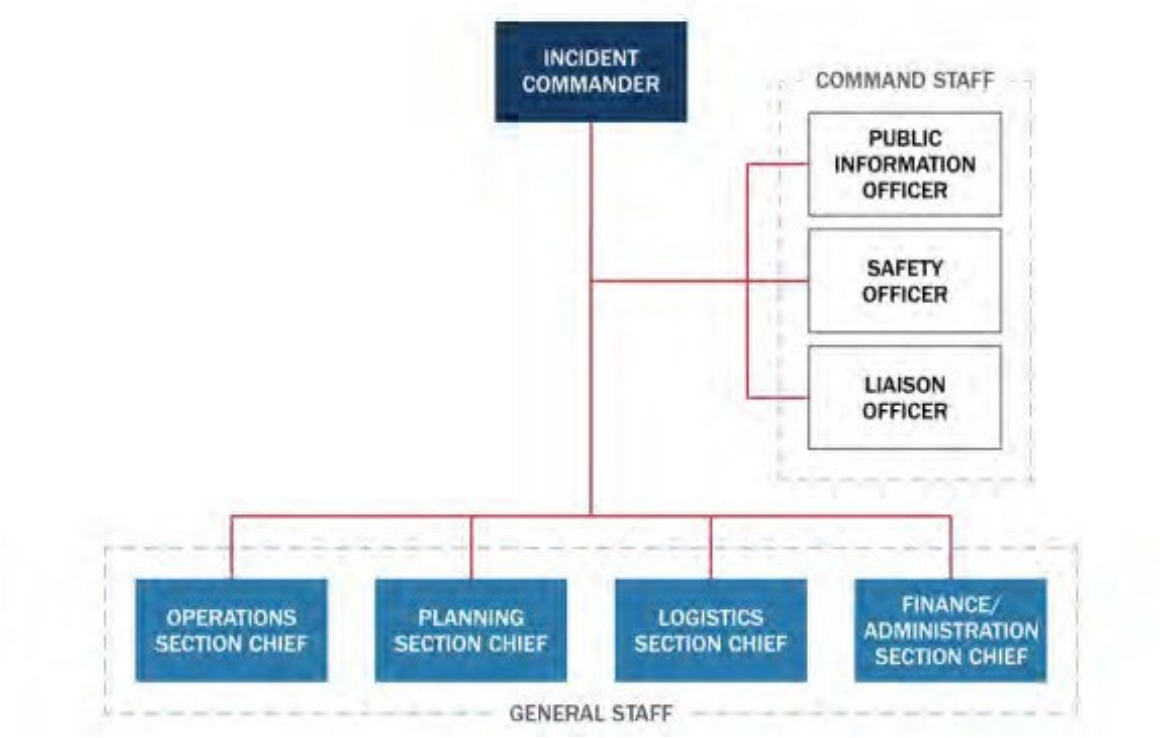


Figure 3.2: An ICS Organization with a Single IC
(Source: FEMA, 2017)

Figure 3.3 shows the coordinating structure of the Oregon State Emergency Coordination Center (ECC) within OEM. The Oregon State ECC (or Washington State EOC) serves as a centralized location during emergencies and disasters where state officials coordinate information, resources, and activities and implement direction from the Governor to provide an integrated and effective state response. The Oregon State ECC generally follows the ICS organizational structure (as shown in Figure 3.2), and an Executive Policy Group is created to provide direction and leadership during the incident. It operates following the principles and concepts of NIMS and ICS and includes appropriate state agencies filling ESFs based on the size, scope, and complexity of the incident.

In addition to all levels of government, ICS is widely used by many NGOs and private sector organizations that typically respond to emergencies. This enables ICs and emergency managers across disciplines and different sectors to collaborate seamlessly or at least more effectively. Overall, concepts provided in NIMS and ICS enable development of scalable, flexible, and adaptable operational capabilities during an emergency through: (a) aligning key roles and responsibilities of various governmental jurisdictions, NGOs, and private sector organizations; (b) integrating their capabilities and resources into a cohesive and seamless national infrastructure for emergency response; and (c) providing common terminology and defined roles.

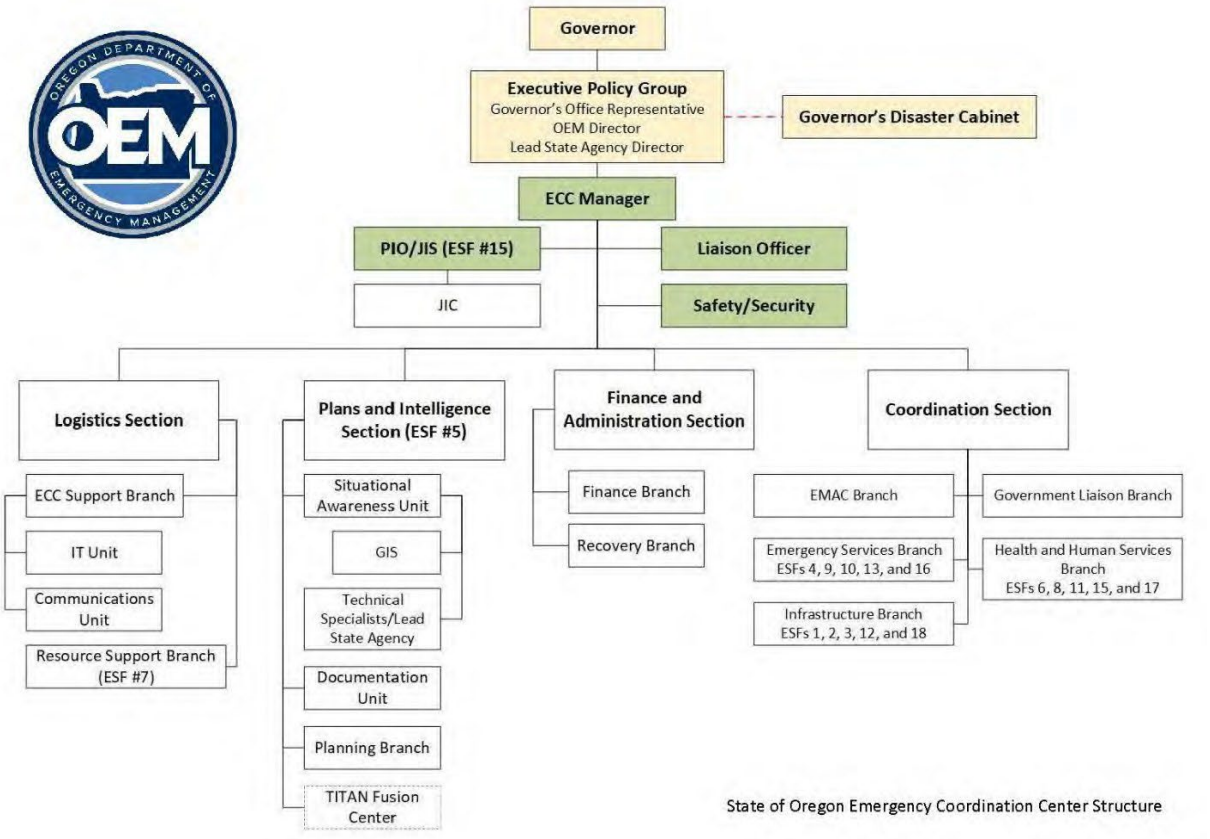


Figure 3.3: State of Oregon ECC Coordinating Structure
(Source: State of Oregon Department of Emergency Management, 2022)

3.2.4 Interfaces with County EOCs or ECCs

There is a general understanding on how to interact with City EOCs or ECCs depending on jurisdiction among water providers. To complement this understanding, this section provides a brief overview related to interfacing with a County EOC or ECC. When activated, a County EOC or ECC serves as a centralized location during emergencies and disasters where county officials coordinate information, resources, and activities and implement direction from the County Commissioners to provide an integrated and effective response.

Figure 3.4 provides various interfaces with a County EOC, including Incident Command to County EOC, City to County EOC, County Department Operations Center (DOC) to County EOC (or ECC), and Special Districts and/or Private Sector to County EOC (or ECC). Figure 3.4 is specific to Multnomah County and uses the term Incident Command Posts (ICPs) instead of the Planning, Operations, Finance, and Logistics Sections used by NIMS-ICS. Any IC operating within a county may request support from the County EOC. Some cities within a county may have their own emergency operations/coordination centers that provide resources and coordination for incidents that affect their jurisdictions. The City EOC (or ECC) takes the lead in supporting ICs within their jurisdiction. If their resources or capabilities are exceeded, the City may request additional resources and assistance from the County EOC (or ECC).

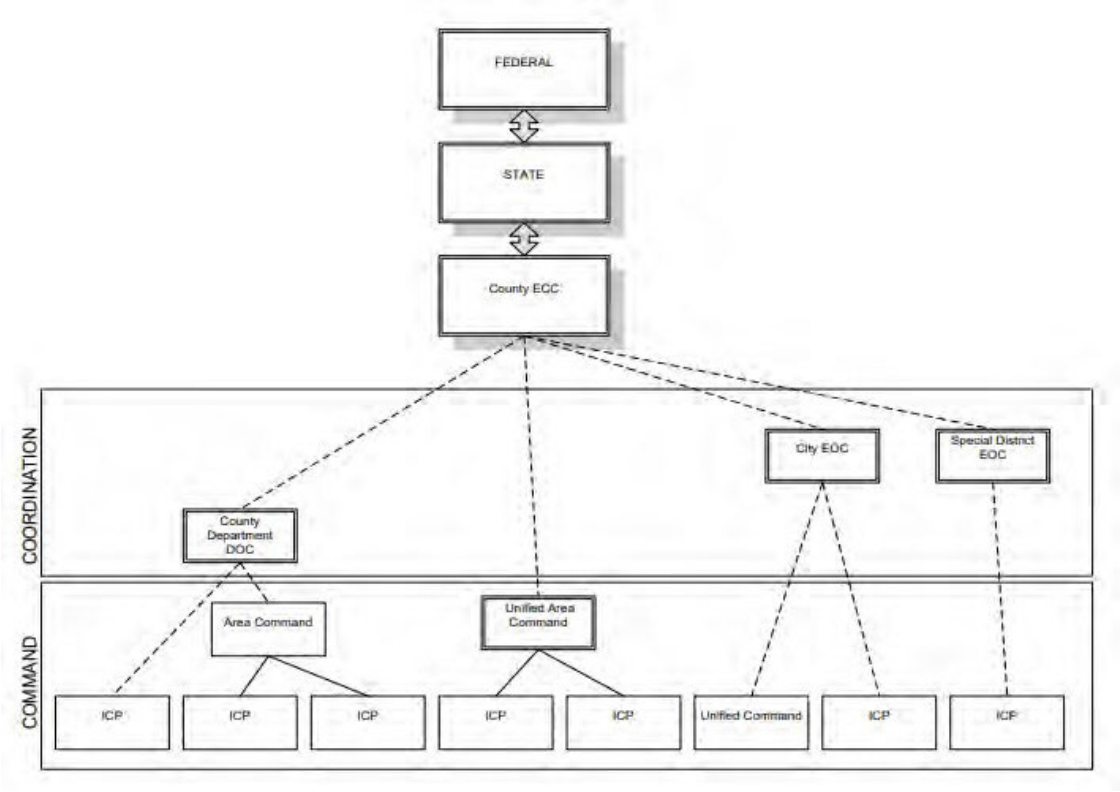


Figure 3.4: Interfaces with County EOC
(Source: Multnomah County EOP, 2017)

County departments may establish a DOC, EOC, or ECC depending on their reporting structure to support emergency operations by managing their agency resources, improving agency continuity of operations, and aiding their agency personnel assigned to the County EOC. When tasks are assigned by the County EOC, the individual at the EOC can serve as a conduit to the DOC and convey the tasks to the DOC for implementation.

Some water providers, including Cities and Special Districts, have their own EOCs that are activated for emergencies involving water systems using their own incident command structure. A water provider EOC may request aid and resources from the city or county EOC or ECC depending on their reporting structure and jurisdictional authority or may request mutual aid through the WARN. Participation in the WARN is optional and offers a way of providing and asking for emergency response assistance from other water (or wastewater) providers faster without waiting for approvals from the city, county, state, or federal government agencies.

3.3 CURRENT ROLES AND RESPONSIBILITIES FOR THE REGION

Based on the review of emergency drinking water planning guides, analyses of after-action reports for two water emergency events in or near the Portland-Vancouver Metropolitan Region, and input from the Roles and Responsibilities workshop, we have developed the following table and flow chart (Figure 3.5; appended at end of report). This table summarizes current roles and responsibilities for local, regional, state, and federal government agencies, NGOs, and private sector stakeholders to provide emergency drinking water in the event of an emergency.

A summary of our research conducted to define these current roles are listed in Table 3.2. We summarize current roles and responsibilities in federal, state, and regional guides; the two recent local emergency events (City of Salem and Clackamas River water providers); and the two emergency scenarios (windstorm and CSZ event) discussed in Workshop 1. Following these evaluations of roles and responsibilities, gaps are identified in Section 6, where there is no clear understanding of responsibilities, and some additional proposed recommendations are provided for improving collaboration in the Region. Proposed changes to Table 3.2 are listed as *recommended* roles and responsibilities in Table 7.2.

Table 3.2: Current Roles and Responsibilities for the Region

Agency	Role in Agency	Current Roles and Responsibilities	Current Best Practices
Residents and Businesses	NA	NA	• Sign up for the local emergency alert system for notifications.
Water Provider (including public municipality, Special District, public utility district (PUD), or other)	Emergency Management (includes EOC, Engineering and Operations)	<u>Emergency Preparedness</u> • Develop an ERP; maintain and update regularly. • Develop an emergency drinking water distribution plan. (Required in Oregon) • Develop rationing and curtailment plans. <u>Emergency Response</u> • Repair water system and restore potable piped water supply. • Activate EOC when necessary. • Prepare information as needed for the local disaster declaration. • Consult OHA / WA DOH for technical and regulatory advice and issue a health advisory, if necessary. • Notify the public of any water advisories.	• Obtain contractual agreements with chemical suppliers for necessary emergency treatment chemicals and associated shipping services. • Obtain contractual agreements with other suppliers for pipes, valves, and materials, services, and deliveries, especially hard to acquire items or items that need long lead time. • Develop emergency drinking water distribution plan (Suggested in Washington) • Prepare Continuity of Operations Plan (COOP). • Join and participate in ORWARN or WAWARN. • Obtain mutual aid agreements and request assistance. • Obtain shared worker agreements. • Complete resource typing of what equipment, staffing, and materials. • Promote organization and individual emergency preparedness. • In an emergency impacting delivery of potable water, notify partner water providers, local government, regulatory agencies, major industrial and wholesale customers, and critical customers.

Agency	Role in Agency	Current Roles and Responsibilities	Current Best Practices
Water Provider (continued)	Infrastructure Readiness (Engineering, Operations and Field Crews)	• Develop seismic risk assessment and mitigation plan. (Required for most water providers in Oregon) • Implement seismic improvement projects needed to comply with AWIA, ORP, and states' resilience requirements and recommendations for water systems.	• Develop seismic risk assessment and mitigation plans (Suggested in Washington). • Procure backup power (permanent or portable generators) and adequate fuel storage for emergency power outages.
	PIO (or Communication Manager)	• Obtain approved language of a water advisory from OHA or WA DHS prior to its release and have translated. • Disseminate information to the public. • Coordinate press conferences and respond to questions.	• Communicate through city-wide alert, IPAWS, or media. • For small water providers in rural areas, obtain assistance from OHA or DOH.
City / County EOC or ECC	Emergency Management or Incident Commander (IC)	<u>Emergency Preparedness</u> • Develop an ERP that includes critical services and infrastructure and regularly refine the plan. • Identify locations with low risk in various emergency scenarios for PODs including emergency water distribution. <u>Emergency Response</u> • Activate EOC or ECC. • Prepare city/county disaster declaration. • Escalate to county/state level emergency management and request assistance, if necessary. • Lead emergency water distribution including setup and management.	• Regularly refine the plan. • Exercise EOC regularly and include water providers. • Collaborate with water providers to identify available locations for emergency water distribution sites. • Coordinate the resources and response among water providers, mutual aid partners, local health department (LHD), volunteer organizations, and other stakeholders. • Develop a city/county map of vulnerable populations and PODs. • Aggregate resource gaps identified by water providers to estimate resource gaps and collaborate with water providers and various levels of government to identify potential options to address the gaps.

Agency	Role in Agency	Current Roles and Responsibilities	Current Best Practices
City / County EOC or ECC Continued	Emergency Management or IC (Continued)	• Identify, arrange, manage, and coordinate distribution of food, water, shelter, and mass care including emergency drinking water to affected population within city or county jurisdiction • Identify, arrange, and distribute emergency drinking water to affected populations within city or county jurisdiction. • Notify the public of the anticipated locations of the PODs for food, water, shelter, and mass care (including emergency water distribution sites). • Procure materials and equipment needed for PODs.	• Include transportation of trucked water between where water is available and the PODs. • Represent member water providers to negotiate with fuel vendors to develop municipal standing offer agreements for liquid fuel.
	PIO (or communication manager)	• Disseminate information to the public. Coordinate press conferences and respond to questions.	• Use city- or county-wide alert, Integrated Public Alert and Warning System (IPAWS), or media.
	Department of Public Works (Division or Department of Transportation, DOT)	• Remove debris from city-or county-maintained roads to facilitate recovery of critical services. • Repair damaged roads and bridges for emergency access.	• Include facilitating recovery of water services and other critical utility infrastructure.
	Law Enforcement	• Protect essential city/county and other agency facilities within jurisdiction.	• Protect water supplies, equipment, and staff repairing the water system, and maintain security at emergency water distribution sites.

Agency	Role in Agency	Current Roles and Responsibilities	Current Best Practices
County-specific (not listed above)	Emergency Management	• Facilitate coordination between the state and the city (if water service provider is a municipal department). • Collaborate with non-municipal water providers to identify distribution locations. • Request state emergency declaration.	• Prioritize drinking water agencies for emergency fuel allotment/distribution including those in municipalities.
Oregon / Washington State	State Governors	Declare a State of Emergency.	NA
	State Emergency Management or IC	• Lead and coordinate state emergency response. • Responsible for coordinating all ESFs with federal, state, and local agencies.	• Assist partners in providing a coordinated response. • Identify state staging areas for commodity PODs.
	Oregon DHS / Washington DSHS	• Responsible for ESF #6 Mass Care, #8 Health and Medical, and ESF #11 Food and Water. • Collaborate with local emergency management agencies to identify mass care, food, water, and ice needs. • Coordinate with supporting state agencies to obtain these requested resources, including monitoring the collection and sorting of all food and water supplies. • Collaborate with supporting state agencies to coordinate transportation of food and water resources to the impacted area EOC for distribution.	• Establish procedures to ensure water is safe for consumption.
Oregon / Washington State Continue	OHA or DOH	• Support agency for ESF #6 and ESF #11 • Provide oversight of water systems repair and operations. • Provide consultation in issuing drinking water health advisories.	• Provide technical assistance to water providers.

Agency	Role in Agency	Current Roles and Responsibilities	Current Best Practices
	Department of Transportation	• ODOT – Lead agency for ESF #3 Public Works Remove debris from state highways and bridges and repair as needed to facilitate access and recovery.	• Focus on engineering, transportation, and infrastructure needs. • Include access and recovery to critical infrastructure and emergency services.
	National Guard	• Assist in emergency water distribution.	• Provide and staff water treatment units such as water purification systems that provide emergency water distribution when requested.
Federal	FEMA	• Obtain bottled water and deliver water to state distribution sites. • Participate in a multi-agency coordination. • Coordinate federal resources • Provide technical assistance.	• Mobilize federal response within 3 to 5 days (or as soon as practicable) after the event. • Include equipment, supplies, and other materials for water treatment and/or distribution when requested.
	USACE	• Assist in emergency water distribution. • Deliver water to distribution sites. • Provide technical assistance.	• If requested, set up emergency water treatment and distribution sites.
RWPC	NA	NA	• Promote emergency preparedness to the public. • Apply for grants to fund planning tools and equipment for emergency water treatment and distribution. • Provide guidance on the use of the region's emergency water treatment and distribution equipment (RWPC, 2015). • Update and maintain a regional study on water system interconnections. • Promote mutual aid agreements. • Maintain and update water providers' emergency contact list.

Agency	Role in Agency	Current Roles and Responsibilities	Current Best Practices
RWPC Continued			• Maintain inventory of emergency water treatment and distribution resources owned by local water providers.
ORWARN / WAWARN	Water and wastewater mutual aid organizations	NA	• Maintain copies of written mutual aid agreements among members. • Facilitate mutual aid assistance among members. • In Oregon, promote shared worker agreement
CERT/NET and other volunteers	NA	NA	• Assist emergency responders

Notes:

NA = Not applicable

3.4 FEDERAL, STATE, AND REGIONAL PLANNING GUIDES – SUMMARY OF IDENTIFIED ROLES AND RESPONSIBILITIES

In the following sections, key findings and a matrix of roles and responsibilities from each of the emergency drinking water planning documents are summarized to provide users of this Framework with a general overview and understanding of roles and responsibilities of residents, water service providers, all levels of government, and other partners.

3.4.1 Planning for an Emergency Drinking Water Supply – USEPA (2011)

Developed through joint funding from the USEPA and the AWWA, the Planning for an Emergency Drinking Water Supply document emphasizes the importance of developing an emergency drinking water plan by a local water provider, recognizing that: (a) in the event of an emergency, a local water provider's primary mission is to restore piped water services; and (b) if a local water provider is overwhelmed during an emergency, it may rely on other partners to implement the plan to procure and distribute emergency water.

This document provides useful and practical guidance for a water service provider to prepare an emergency drinking water plan as a key component of its ERP. It recommends that the water service provider consider various types of emergency events, estimate the duration and extent of the events, and identify potential resource needs. The plan recommends including four key elements: (a) sourcing alternative drinking water supplies; (b) developing water treatment options; (c) identifying storage locations for packaged water, treated water, or other equipment; and (d) developing water distribution procedures. The emergency potable water supply plan potentially includes interconnection with neighboring water providers, bottled water supplied locally or regionally, and locally-produced water. Locally-produced water can be provided through: (a) packaging pre-treated water; (b) using mobile treatment in combination with water packaging and/or water tap distribution; and (c) trucked-in bulk water (including water bladders). The water provider may rely on its customer service personnel, neighborhood emergency response team volunteers, or assistance from outside agencies (such as the Red Cross) to staff the distribution sites.

It is recommended that each local water provider assess their capacity and identify resource gaps. Such resource gaps identified at local levels would be aggregated at a state level so that additional resources beyond the capacity of the local water provider can be properly planned for and addressed.

During an emergency, there is a time lag between the need for drinking water and the mobilization of resources to meet the need. Therefore, it is critical to educate the public and encourage personal preparedness at home; the USEPA's generic recommendation for most emergencies is to provide at least a three- to five-day supply of potable water for each home, based on usage of one (1) gallon per person per day.

As the Framework is a shared responsibility and requires collaboration among local water providers, all levels of government (federal, state, and local), and other partners, the USEPA documents provide a general description of roles and responsibilities of various agencies as summarized in Table 3.3.

Table 3.3: Summary of Roles and Responsibilities According to USEPA's Guidance Document (USEPA, 2011)

Stakeholder	Roles and Responsibilities
Residents	• Prepare a three- to five-day supply of potable water at home, based on usage of one (1) gal per person per day.
Local Water Provider	• Develop an emergency drinking water plan and communicate with all relevant partners (government agencies, NGOs, and stakeholders). • Take the lead in developing aid agreements and contracts for emergency supply and service. • Identify an EOC location for their agency (or DOC, as appropriate for the service provider's emergency management structure). • Prioritize restoring piped water service expeditiously.
WARN	• Provide emergency resources to affected water service providers, including personnel, equipment, materials, and other associated services.
State Governor	• Declare a State of Emergency, as appropriate. • Request federal assistance.
State Government	• Establish formal agreements with state partners or coordinating funding resources. • Assist in coordination of resources and communications.
State Drinking Water Primacy Agencies	• Regulate quality of alternative water supplies and public notification. • Provide consultants for a remediation and recovery plan. • Maintain a list of approved vendors for water packaging and hauling.
State Emergency Management	• Provide support. • Participate in consequence management planning as needed.
State Health Department	• Track data used to determine if there is a public health incident. • Alert healthcare providers as needed.
Environmental and Public Health Laboratories	• Provide analytical support. • Provide access to the Centers for Disease Controls (CDC's) Laboratory Response Network.
Local National Guard	• Assist in cordoning off quarantined or contaminated areas. • Assist in emergency water acquisition and distribution.
FEMA	• Provide technical assistance. • Participate in multi-agency coordination. • Coordinate water distribution sites. • Deliver water to distribution sites. • Procure equipment, supplies, and other materials for water treatment/purification. • Provide assistance, such as bottled water and public works engineering, per state requests.
Other Federal Agencies	• *ESF #3: Public Works and Engineering*, whose lead agency for the federal response is the USACE: • Coordinate with other federal agencies, including USEPA and the U.S. Public Health Service. • Provide services and supplies, including emergency generators, bottled or bulk water, ice, and emergency large-scale water treatment facilities.

Stakeholder	Roles and Responsibilities
	• *ESF #8: Health and Medical Services*, whose lead agency for the federal response is the U.S. Department of Health and Human Services.
The Red Cross, the Salvation Army, and other NGOs	• Participate in the development of an emergency drinking water plan. • Assist emergency responders, including water distribution.

3.4.2 Roles and Responsibilities Based on Local Water Emergency Events

To solicit input and guidance related to roles and responsibilities from water providers and emergency response agencies within the five-county Region, FEMA regional staff, the WARN representative, and the consultant team collaborated with RDPO to convene a workshop with approximately 40 participants (see Appendix D for list of attendees and their affiliations). As part of this workshop, attendees from water providers, local governments, and consultants were divided into six random groups to discuss the roles and responsibilities of water providers, emergency managers, and other stakeholders in two hypothetical emergency scenarios.

3.4.3 Hypothetical Windstorm Scenario

The first scenario assumed that a severe windstorm leading to power outage had affected several water providers in the Region. The storm had also affected other systems, including blocking some roadways and affecting deliveries. The discussion results related to addressing seven (7) dependency tasks in such an emergency scenario, including the following:

- **Task 1:** Sourcing water system repair materials

  All six groups agreed that water providers should take the leading role in sourcing water system repair materials. Some groups discussed that the city or county emergency management, ORWARN or WAWARN, and RWPC should provide support, if requested and able to assist, and if the scale of damage has exceeded the capacity limit of an individual water provider.

- **Task 2:** Sourcing generators for critical water facilities

  All six groups agreed that water providers should take the leading role in sourcing generators for critical water facilities, and that city or county emergency management should provide support as requested. Some groups discussed that ORWARN and power companies that may have generators should also provide support to source generators.

- **Task 3:** Sourcing fuel for generators at critical water facilities

  Five groups agreed that water service providers should play the leading role in sourcing fuel for generators at critical water facilities, and that city or county emergency management should provide assistance. One group thought this effort should be led by the city or county emergency managers because they have agreements in place. Two groups discussed that Portland General Electric (PGE) and WARN can provide support as well.

- **Task 4:** Clearing roads to critical water facilities

  There was not a clear trend in attendees' opinions of who should take the leading role in clearing roads to critical water facilities. Three groups agreed that city or county management should take the leading role and one group thought that the Transportation Division should play the leading role. One group stated that water providers and the Transportation Division should lead this effort equally. Water providers should be responsible for the local roads surrounding their facilities, and Transportation Division should be responsible for the city or county roads. One group thought that both water providers and city or county emergency response agencies should lead the effort in clearing roads.

- **Task 5:** Communicating with telecommunications companies to prioritize water providers' communications

  Five groups agreed that water providers should lead the effort in communicating with telecommunications companies to request their communications restoration be prioritized. Water providers should be responsible to prepare their own first responder network, radio backup, etc. One group thought that city or county emergency managers should lead this effort. Some groups agreed that city or county emergency managers and other communication providers should provide support.

- **Task 6:** Restoration of communications for water providers

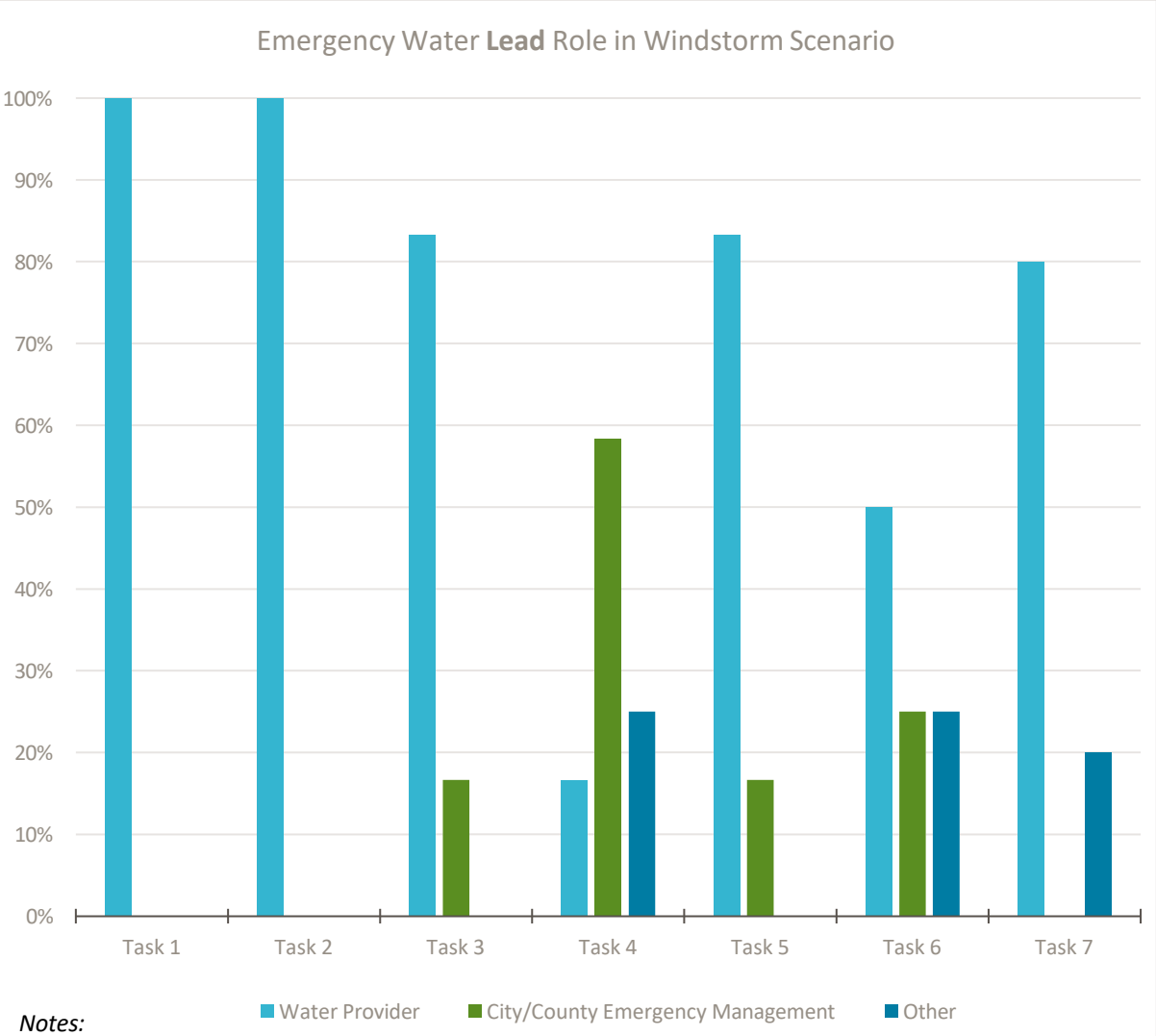
  There was not a clear trend in attendees' opinions of who should take the leading role in restoration of communications for water providers. One group thought that city or county emergency management should lead this effort because they are responsible for managing 800MHz and VHF radios. Two groups agreed that water providers should play the leading role, and city or county emergency managers and other communication providers or consultants should provide support. One group thought that the communication providers should lead this effort. Two groups did not provide an answer. One group also commented on issues with keeping devices charged.

- **Task 7:** Coordination among water providers

  Four groups agreed that water providers should lead the effort in coordinating among water providers. The reason includes that water providers know about their neighbors or can obtain assistance through existing mutual aid agreements. ORWARN, WAWARN, and emergency managers should provide support as needed and requested. One group thought that WARN or RWPC should play a leading role. One group did not provide an answer. One group thought that emergency managers should not play a role because they do not have the necessary expertise.

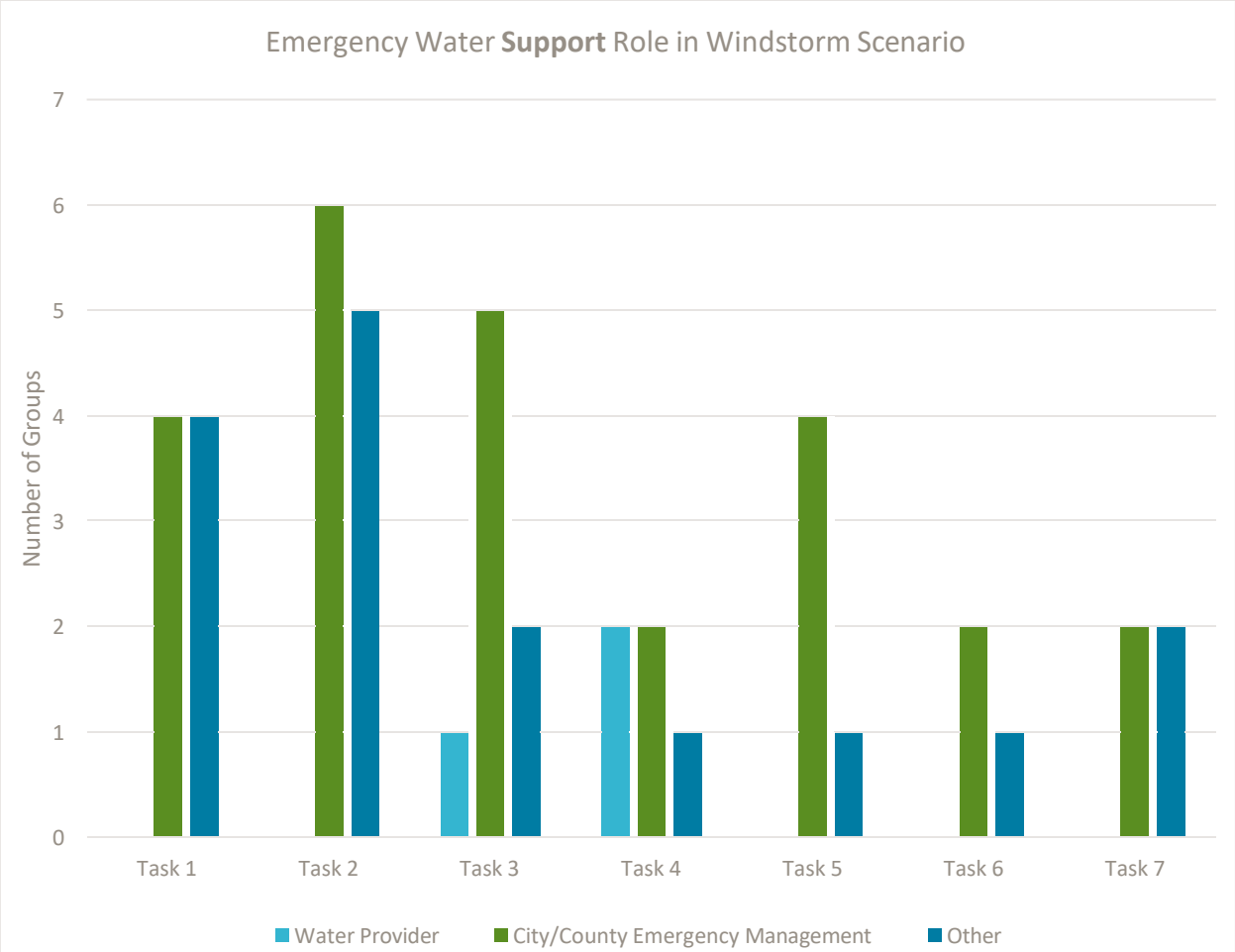
Figure 3.6 demonstrates the percentage of six groups' opinions of which entity should take the leading role for each task in the first scenario. Figure 3.7 shows the frequencies in which an entity was mentioned by six groups that should provide support for each task in the first scenario. Figure 3.8 demonstrates the frequencies with which detailed entities or organizations in the "Other" category were mentioned by attendees. If one group of attendees mentioned that two entities should both provide support for one task, two entities shared equal contribution in frequency. For example, four groups mentioned that city or county emergency management should assist in sourcing water system repair materials. Four groups mentioned that other entities or organizations should assist in sourcing water system repair materials, in

which one group mentioned both RWPC and WARN, two groups mentioned WARN, and one group did not provide detailed entities or organizations.



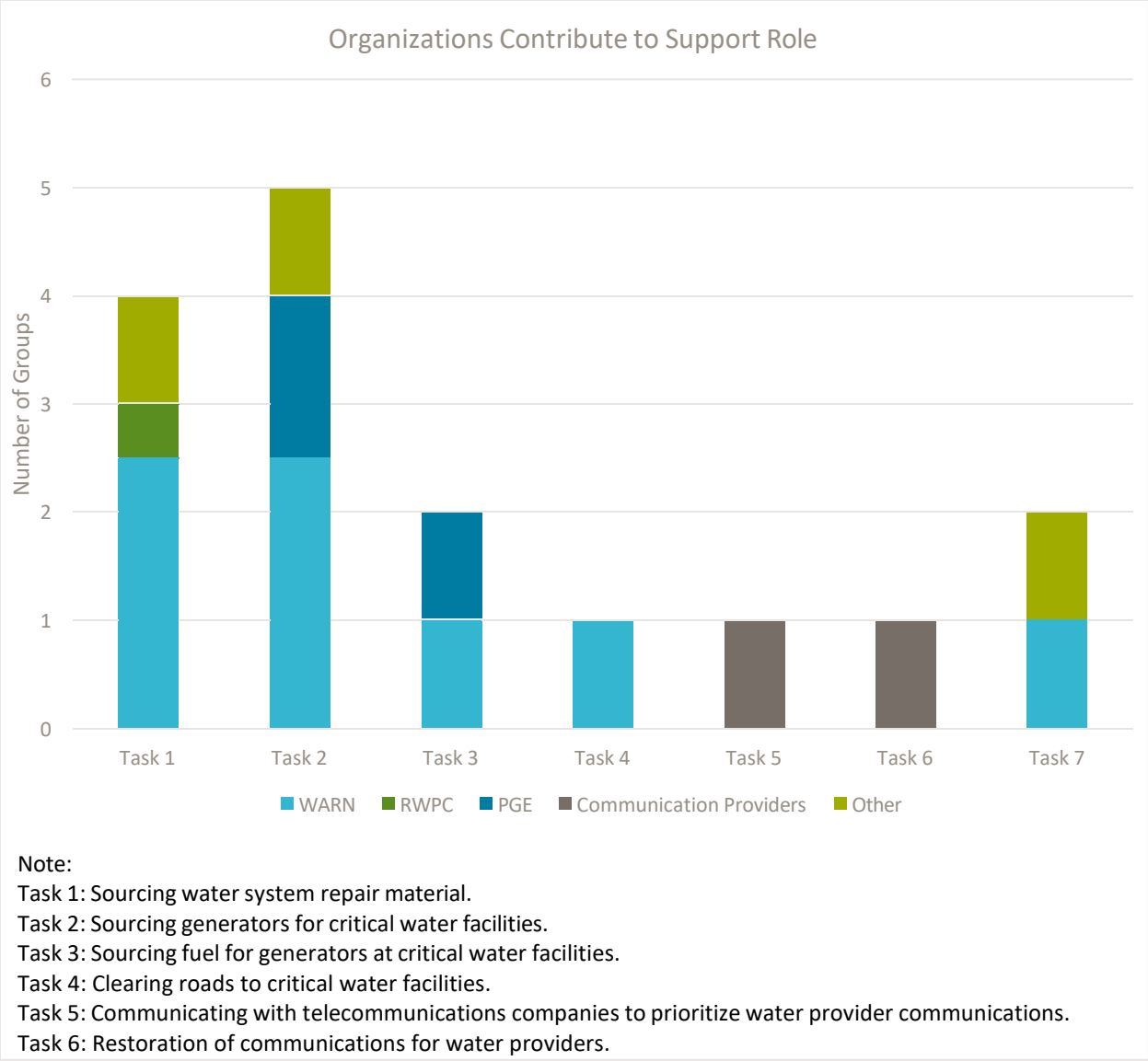
Notes:
Task 1: Sourcing water system repair material.
Task 2: Sourcing generators for critical water facilities.
Task 3: Sourcing fuel for generators at critical water facilities.
Task 4: Clearing roads to critical water facilities.
Task 5: Communicating with telecommunications companies to prioritize water provider communications.
Task 6: Restoration of communications for water providers.
Task 7: Coordination between water providers.

Figure 3.6: Attendees' Opinion on Leading Role for Emergency Water Tasks in a Windstorm Scenario



Notes:
Task 1: Sourcing water system repair material.
Task 2: Sourcing generators for critical water facilities.
Task 3: Sourcing fuel for generators at critical water facilities.
Task 4: Clearing roads to critical water facilities.
Task 5: Communicating with telecommunications companies to prioritize water provider communications.
Task 6: Restoration of communications for water providers.
Task 7: Coordination between water providers.

Figure 3.7: **Attendees' Opinion on Supporting Role for Emergency Water Tasks in a Windstorm Scenario**



Note:
Task 1: Sourcing water system repair material.
Task 2: Sourcing generators for critical water facilities.
Task 3: Sourcing fuel for generators at critical water facilities.
Task 4: Clearing roads to critical water facilities.
Task 5: Communicating with telecommunications companies to prioritize water provider communications.
Task 6: Restoration of communications for water providers.

Figure 3.8: Detailed Entities Mentioned in Other Classification

3.5 HYPOTHETICAL CSZ EARTHQUAKE SCENARIO

For the second scenario discussion, all the emergency managers were moved to one group, while the other attendees remaining were randomly assigned to five other groups. In this scenario, because of a large CSZ event, the water supply and water distribution system have been damaged and have been out of service. Attendees discussed the roles and responsibilities to source and distribute water to customers.

The discussion results related to addressing nine (9) tasks in such an emergency scenario include the following:

- **Task 1:** Developing a plan for emergency water distribution

  There was not a clear trend in attendees' opinions of who should take the leading role in developing a plan for emergency water distribution. Three groups agreed that service providers and emergency managers should lead the effort equally in developing a plan for emergency water distribution. Three groups agreed that water providers should lead this effort. The group of emergency managers thought that water providers should lead in smaller events, but that in large-scale events, it needs to be planned by city or county emergency managers. They also thought that it may need to be escalated to state and federal levels for large events and to plan for no water availability from local water providers in worst-case scenarios.

- **Task 2:** Identifying distribution sites

  There was not a clear trend in attendees' opinions of who should take the leading role in identifying distribution sites. Four groups agreed that water providers should lead the effort in identifying distribution sites because the providers are more familiar with their systems. Two groups, including the group of emergency managers, agreed that emergency managers should play the leading role because they need to coordinate with emergency transportation routes or other distribution. One group commented that water providers should play the leading role but should not be expected to provide complete coverage. They felt that the leadership should be transferred to FEMA once they arrive for a large-scale event.

- **Task 3:** Procure equipment needed to distribute water

  Five groups (including the group of emergency managers) agreed that water providers should lead the effort in procuring equipment needed to distribute water, while one group thought the emergency managers should play the leading role because they will know the barriers to other locations. One group thought that emergency response agencies should not play a role in procurement because they do not have expertise in specialized water distribution equipment. One group thought that water providers can purchase equipment with RDPO UASI funds.

- **Task 4:** Communicate distribution site locations to the public

  There was not a clear trend in attendees' opinions of who should take the leading role in communicating distribution site locations to the public. Four groups (including the group of emergency managers) agreed that emergency managers should lead the effort in communicating site locations to the public, while two groups thought this should be the water provider's responsibility. One group thought that water providers should be primarily responsible for their own communication and emergency managers should provide coordination support and broad messaging.

- **Task 5:** Coordinate with Community Emergency Response Team (CERT) or volunteer organization

  Five groups (including the group of emergency managers) agreed that city or county emergency management should lead the effort in coordinating with CERT or volunteer organizations. One group did not provide an answer.

- **Task 6:** Lead management of emergency distribution sites

  There was not a clear trend in attendees' opinions of who should take the leading role in managing emergency distribution sites. The group of emergency managers thought that emergency managers or CERT should lead the management and water providers should provide support by teaching the staff. Two other groups also agreed that emergency managers should lead this effort. Two groups thought that water providers should be responsible for site management. One group did not provide an answer.

- **Task 7:** Staff the emergency distribution sites

  There was not a clear trend in attendees' opinions of who should take the leading role in staffing the emergency distribution sites. Two groups (including the group of emergency managers) agreed that emergency managers should play the leading role and water providers should provide support by teaching the staff and ensuring potability of water if using emergency treatment equipment. These groups also thought that the National Guard should provide support. Two groups agreed that water providers should play the leading role and provide training for staff operating the emergency distribution sites. One group thought that both emergency managers and water providers should lead the effort equally. One group did not provide an answer.

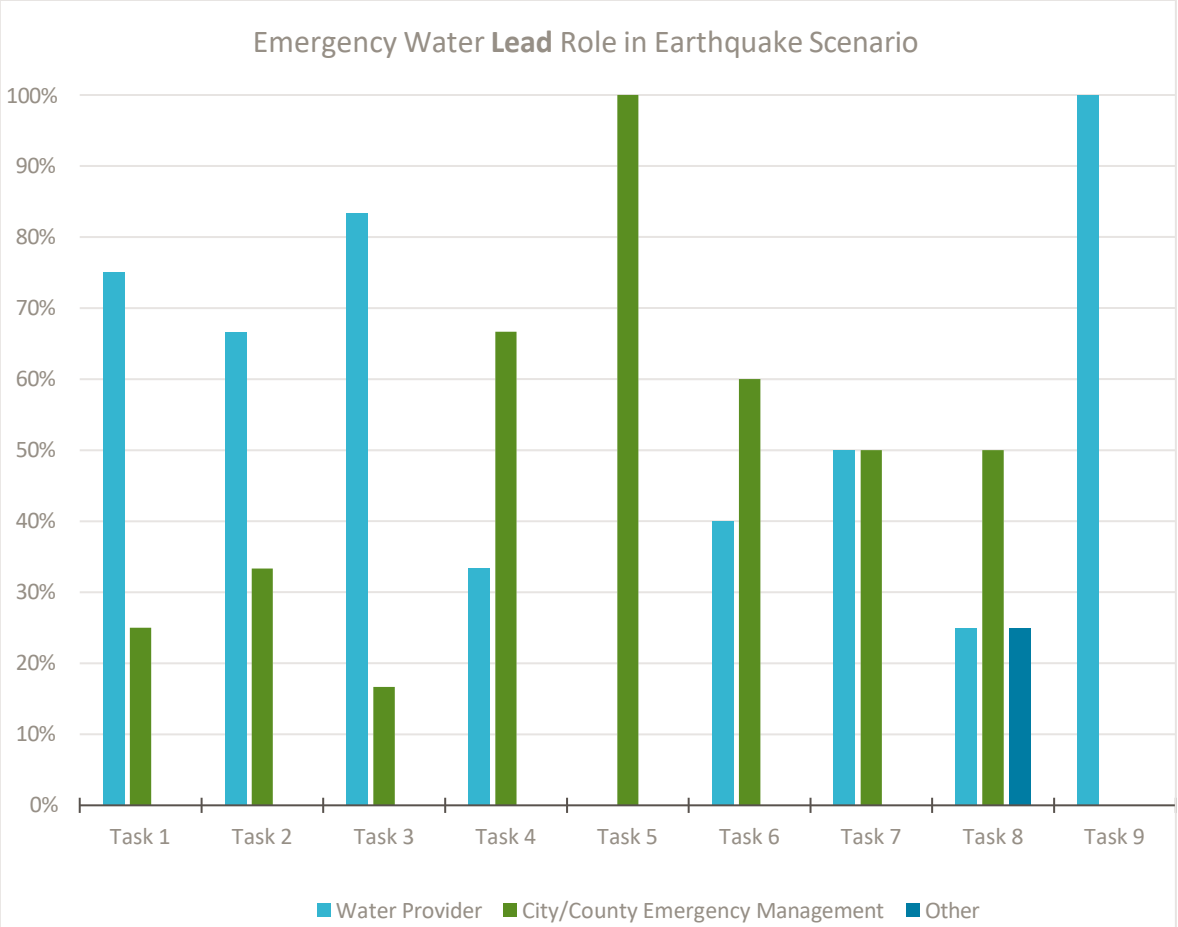
- **Task 8:** Get trucked or well water to the emergency water sites if pipes are offline

  There was not a clear trend in attendees' opinions of who should take the leading role in getting trucked-in or well water to the emergency water sites if pipes are offline. The group of emergency managers thought that emergency managers should be responsible for coordination if the water originates from somewhere else. Water providers should be responsible for coordination from source and water quality if the water comes from water agency. One group thought that emergency managers should play the leading role and water providers should be responsible for providing equipment. One group thought that water providers should lead this effort while one group thought that other stakeholders should lead the effort. Two groups did not provide an answer.

- **Task 9:** Repair the water system to get piped water to the emergency water distribution sites

  Four groups (including the group of emergency managers) agreed that water providers should be primarily responsible for repairing the water system to get piped water to the emergency water distribution sites. Two groups did not give an answer.

Figure 3.9 demonstrates the percentage of six groups' opinions of which entity should take the leading role for each task in the second scenario.



Notes:
Task 1: Developing a plan for emergency water distribution.
Task 2: Identifying emergency water distribution sites.
Task 3: Procuring equipment needed to distribute water.
Task 4: Communicating site locations to the public.
Task 5: Coordinating with CERT or volunteer organizations.
Task 6: Leading management of emergency distribution sites.
Task 7: Staffing the emergency distribution sites.
Task 8: Getting trucked or well water to the emergency water sites if pipes are offline.
Task 9: Repairing the water system to get piped water to the sites.

Figure 3.9: Attendees' Opinions on Leading Role for Emergency Water Tasks in Earthquake Scenario

4. Base Emergency Water Need

The purpose of this section is to define and determine basic emergency drinking water needs for each water provider as well as in the five-county Region during the emergency scenarios defined in this study. This section provides guidance for water providers to determine their own base need. In addition, this section determines a regional need, based on survey results, to support the gap analysis of Section 6.

Section 1.8 lists the three emergency scenarios and groups emergency events into “piped” and “non-piped-water" events. While the relative magnitude of the issues and challenges associated with distributing water under a “non-piped-water" event will vary by event, even in a limited area, the labor and logistics of water hauling would largely limit water use to a subsistence level (or Base Emergency Water Needs level) for at least a short time.

Examples of situations that could force subsistence-level water use include but are not limited to widespread system failure of the pipeline network due to an earthquake; system-wide contamination; or major flooding or wildfires resulting in widespread damage to existing distribution networks or source facilities. In these situations, transportation and distribution of emergency drinking water may be required. The magnitude and nature of the event will largely dictate the specifics for how and where water may need to be transported and distributed; but we assume that as access to water becomes more difficult (i.e., walk/drive to a fill station versus turn on the tap), individuals will moderate their water use. Because a Regional Event scenario such as a CSZ event would have the broadest and longest impacts compared to the others defined in Section 1.8, it is the controlling scenario that will be the focus of the analysis in this section.

4.1 DEFINITION OF BASE EMERGENCY WATER NEED

For the purposes of this analysis, Base Emergency Water Need will be defined as the minimum quantity of potable water needed to serve the domestic water needs of a population during a Regional Event scenario when potable water must be conserved and rationing of water at subsistence levels may be required. Alternative water sources may be required. As discussed later in this section, the duration for which subsistence-level water provision may be required will vary depending on the type and magnitude of the event, and when assistance from outside the Region may be able to respond at a level sufficient to restore normal water service.

Throughout this section, the following terms will be used:

- **Base Daily Water Rate** – Volume of water required to support an individual’s basic water needs at a subsistence level for one day. Reported in units of gallons per capita per day (GPCD).
- **Base Water Duration** – Period of time during which a water provider is operating under emergency conditions and emergency water distribution is required. Reported in units of days.

- **Base Daily Water Demand** – Volume of water required to meet the base water needs of all populations within a defined area for 1 day (for this project we used service populations within Islands). Reported in units of millions of gallons per day (MGD).
- **Base Emergency Water Need** – Volume of water needed to serve all population within an Island at the base water rate and duration specified. Reported in units of gallons (gal) or million gallons (MG).

The following subsections establish the base water rate and Base Water Duration for which subsistence-level emergency water is needed. These parameters are then used, along with estimated service population, to calculate the Base Emergency Water Need and base daily water demand for each Island, as well as the entire Region.

4.2 BASE DAILY WATER RATE

As previously discussed, the base water rate will be defined as the number of gallons of emergency potable water needed per day to support an individual's basic water needs at a subsistence level. In general, subsistence-level water distribution may be required in situations where the piped water distribution system has failed and/or cannot be relied on to deliver clean, safe drinking water.

Subsistence-level planning represents an extreme condition and is applicable in emergency planning, such as this study. Many other local, federal, and international emergency planning and aid agencies have estimated water use needs based on subsistence-level, domestic use. Table 4.1 summarizes these sources and provides commentary on applicability to the planning scenario of this project.

Table 4.1: **Subsistence Base Daily Water Rates – Various Sources**

Rate (GPCD)	Context and Source	Commentary
1 to 2.5	Vancouver, B.C. regional planning document promoting an initial base water rate for week one and then a higher base water rate one week after the disaster until the regular water supply is restored (Regional Engineers Advisory Committee [REAC], 2018).	Number is similar to the maximum end of the range provided by the World Health Organization (WHO) source below.
1.5 to 2	Eugene Water and Electric Board (EWEB) planning project with target to provide this level for 14 to 30 days following a catastrophic disaster (Public Works Management, Inc. [PWM], 2012)	Similar planning document and planning goal. The 2 GPCD end of the range was used in most of the planning.
1.3 to 2.6 (5 to 10 liters per capita per day [LPCD])	WHO technical brief on water in emergency response suggests a minimum of 5 LPCD for the first month of disaster response (WHO Water Engineering and Development Centre [WEDC], 2011).	Also noted an inverse relationship between water collection journey time and domestic consumption with collection times shorter than 40 minutes resulting in rate at 10 LPCD or higher.

Rate (GPCD)	Context and Source	Commentary
1	OEM's "Two Weeks Ready" and RWPC's "Start with Water" campaigns promoted this rate for individual preparedness, (1 gal per person per day for 14 days).	This is a common individual preparation recommendation echoed by other state and federal sources. Establishes the minimum end of range.
1+	USEPA source promoting public education and 3- to 5-days' supply of water (USEPA, 2011).	

A base water rate of 2 GPCD will be used in this study for emergency planning. While this base water rate is greater than the 1 GPCD that the RWPC has previously recommended for individual emergency preparedness (i.e., "Two Weeks Ready" campaign), the higher rate is consistent with the supply rate used by other agencies when planning for long-term, Regional water emergency response. Many persons may be hauling water for multiple family members and animals, so the 2 GPCD base water rate is a reasonable upper limit for planning purposes.

4.3 BASE WATER DURATION

The Base Water Duration is the period of time that the water provider is operating under emergency conditions and piped water distribution is not available. The Base Water Duration overlaps with emergency response and even the initial stage of recovery, though the emergency water provision duration may continue weeks and months after the base rate is met. Both time periods are described in emergency response planning and are dependent on the current conditions of the water provider's system. The ORP estimates the CSZ event recovery period in months and years (OSSPAC, 2013). The ORP estimates restoration to 90 percent operational levels in 3 to 6 months for water sources, and 6 to 12 months for the distribution systems. The Base Water Duration considered here occurs before this recovery level. During the emergency response period, where during the days and weeks after a catastrophic incident, the focus is on saving lives and meeting basic human needs. In the beginning of the response period, providing water will likely only come from resources within each individual Island. Outside resources will be very limited.

4.3.1 Establishing Base Water Duration

As defined below, the Base Water Duration will start shortly after an event and will end at some transition point during the response period.

4.3.1.1 Initial Response and Start of Base Water Duration

Within the days immediately following a major event, the focus will be on damage assessment, rescue and protection of human life, and conservation of resources to the extent dictated by the type and magnitude of the event. During this period, water service may be limited or non-existent. Based on the ORP (OSSPAC, 2013) Region water providers currently have capacity to make water available at community distribution centers within 1 to 2 weeks. However, the ORP recommends that water providers take actions and target a shorter time frame of within 3 to 7 days after a CSZ event. Therefore, the start of the Base Water Duration may need to occur within days of the emergency event.

4.3.1.2 Transition Out of Base Water Duration

After a catastrophic disaster such as the CSZ event, water providers will likely need to rely only on the resources within their individual Islands and later within the Region (as cataloged in Section 5) to meet the base water needs of the community. That provision could be from only stored water or some combination of stored water and new water production, depending on the nature of the event. Eventually, outside assistance will become available to water providers. This outside assistance could be the provision of water itself, hauled in from outside the Region or from one Island to another Island. The assistance could also be the input of outside resources needed to help with repair and/or operation of the water system, including chemicals, fuel, power, etc. Such assistance might not mean water beyond the base water rate is immediately available, but it will mark the point at which water providers have some assistance in providing water. This will reduce the stress on the local resources, and thus allow water providers to begin a positive transition in water provision to rates exceeding the base water rate. Estimating this transition time frame is very difficult, due to varying level of preparedness of water providers across the Region, but a general basis for assigning a time is described below.

This water provision transition can occur due to several types of triggers including the following:

- Provider's source and/or transmission repairs enable water provision from a source rather than just from storage.
- Outside assistance in providing water arrives in the form of water hauling, temporary water treatment, or water source repair.
- Energy (fuel, electrical power, or alternative power) from outside the Region arrives, which can help power water source facilities (e.g., wells, intakes, and treatment facilities).

Any one or combination of these triggers can accomplish a water provision transition. The team evaluated survey results, other emergency response planning documents, and recent transportation studies. Directly applicable estimates were not available but will likely fall between weeks and months. In the gap analysis for this project, we assume at least one or two triggers allowing a transition out of a base water period will occur near the middle of this range (1.5 months). Thus, the base water period duration is assumed to be around 1.5 months (45 days). This duration may differ for individual water providers and emergency management agencies depending on their preparation, outside resources, and the nature of the emergency event.

4.4 DETERMINING BASE EMERGENCY WATER NEED

Calculation 1: Base Daily Water Demand

Base Water Demand	=	Daily Base Rate per person	X	Population

Calculation 2: Base Emergency Water Need (GPCD)

Base Emergency Water Needed	=	Daily Base Water Demand	X	Duration

Example: Assumptions – population of 100,000, base water rate of 2 GPCD and a duration of 45 days

Calculation 1: Base Daily Water Demand

Base Daily Water Demand 200,000 gal per day (gpd; 0.2 MGD)

=

Base Rate per person 2 GPCD

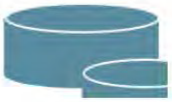
X

Population 100,000 people

Calculation 2: Base Emergency Water Need

Base Emergency Water Needed, 9 MG

=



Base Daily Water Demand, 200,000 gpd (0.2 MGD)

X

Duration, 45 days

Figure 4.1: **Base Emergency Water Need Calculations**

Table 4.2 provides a summary of the calculated base daily water demand using the assumed duration of 45 days for each Island. These calculations are based on Island population reported by each water provider as discussed in Section 2. These calculated Base Emergency Water Needs are used in the Gap Analysis described in Section 6.

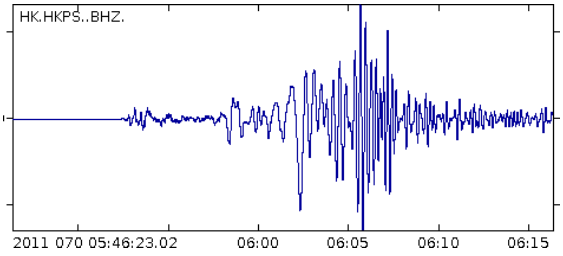
Table 4.2: Base Daily Water Demand and Base Emergency Water Need by Islands and Region, assuming 45 days and 2 GPCD

Emergency Response Island	Population of Responding Utilities, millions	Base Daily Water Demand, MGD	Base Emergency Water Need, MG
CLACK1	0.070	0.140	6.3
CLACK11	0.010	0.020	0.9
CLACK2	0.102	0.204	9.2
CLACK3	0.058	0.116	5.2
CLACK5	0.050	0.101	4.5
CLACK7	0.002	0.003	0.1
CLACK9	0.004	0.008	0.4
CLARK1	0.415	0.830	37.4
CLARK3	0.021	0.042	1.9
COLUM2	0.002	0.004	0.2
COLUM4	0.017	0.034	1.5
COLUM5	0.008	0.015	0.7
MULT1	0.115	0.231	10.4
MULT2	0.740	1.479	66.6
MULT3	0.003	0.007	0.3
WASH1	0.002	0.004	0.2
WASH3	0.591	1.182	53.2
WASH4	0.069	0.139	6.2
WASH6	0.024	0.048	2.2
WASH7	0.005	0.009	0.4
Total (Region)	**2.308**	**4.615**	**207.7**

5. Regional Emergency Water Resources

5.1 INTRODUCTION

The purpose of this section is to summarize the basic information gathered from the survey and resources available to water providers within the RDPO to support provision of emergency water during an emergency. This section focuses on resources that are owned and managed by regional water providers and does not include state or federal resources that are anticipated to have limited immediate availability following a catastrophic event. Below is a quick summary of key questions and answers the overall region may need immediately after the Regional Event.



Waveform of the 2011 Great Tohoku Earthquake, Japan

How much storage/source water is available?

What supplies do we have?

What emergency supplies do we need?

Where do we need the supplies?

How do we get water from here to there?

Figure 5.1: **What Happens When the Big One Hits**
(Seismograph Source: Incorporated Research Institutions for Seismology)

How much resilient water storage do we have?

- Based on the survey results, stakeholders indicated we can assume there may be as much as 380 MG (Table 5.3).
- However, of the 380 MG, only about 80 MG (approximately 21 percent) is from resilient sources with seismic valves or an alternate approach to isolate and retain the storage (Table 5.3).
- How much emergency water is needed?
- From Section 4, assuming 2 GPCD, duration of 45 days, population of 2.3 million, the Base Emergency Water Need for the region is approximately 210 MG (Table 4.2); the base daily water demand for the region is 4.6 MGD.
- Assuming all water is available from the resilient storage that was reported by stakeholders, this would indicate there could be anywhere from two weeks to three months of available storage. However, operational circumstances (storage off-line for maintenance or repairs, storage, or connections damaged in the earthquake, operationally only partially filling storage, etc.) could reduce the available storage.
- This means there could be between 40 and 200 percent of the Base Emergency Water Needs stored water in the Region.

Where is it needed?

- In Table 4.2 and Figures 2.1 through 2.5 (appended at end of report), we have identified the Islands in the Region, what their population is, and how much of that base emergency water is needed for those Islands.

How can we move the water around to where it is needed?

- There are several ways water might be able to be moved including through pipes that are either not damaged or have been repaired; temporary overland pipes; through temporary or permanent connections at tanks, reservoirs, and backbone piping at A specified POD; and trucked within Islands or from other Islands, water providers, or localities.

In Section 6, we discuss where the shortages may be, how we can move water around to cover the shortage, what happens if the shortage is less than expected or the duration is longer than estimated, and where reality might be different than the project assumptions or information reported.

The following templates from the Tabletop Exercise can be used to assess the emergency water need and where it is needed (Figures 5.2 through 5.5).

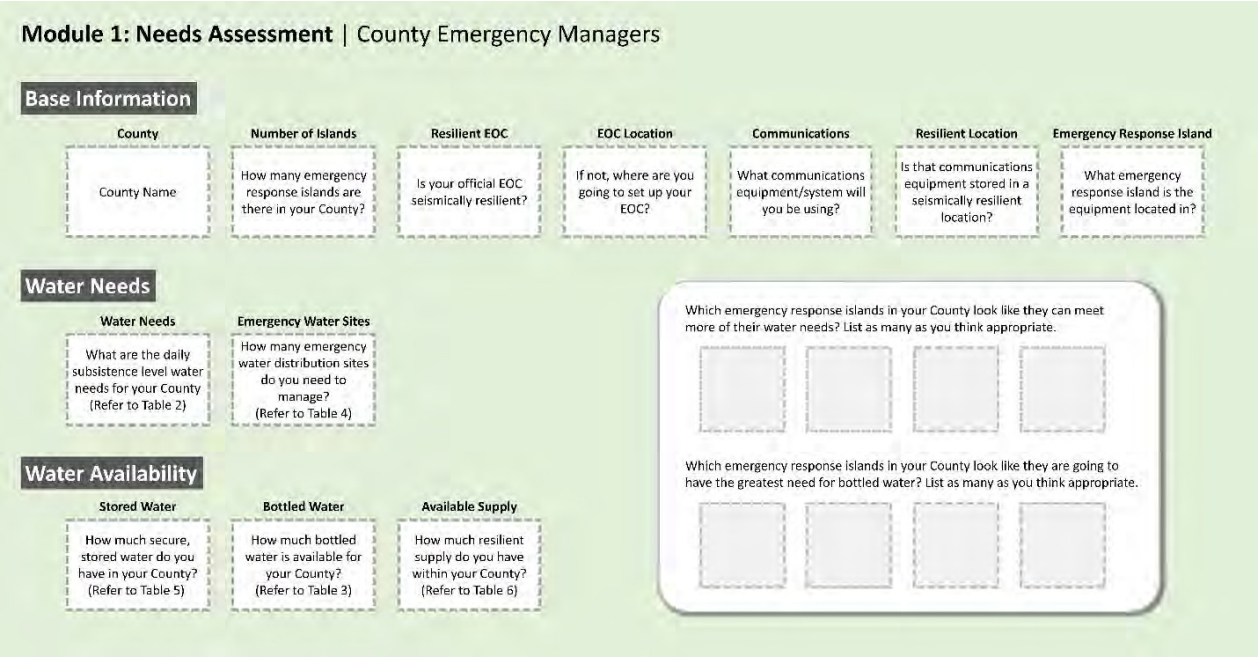


Figure 5.2: **Needs Assessment Chart for Emergency Management Agencies**

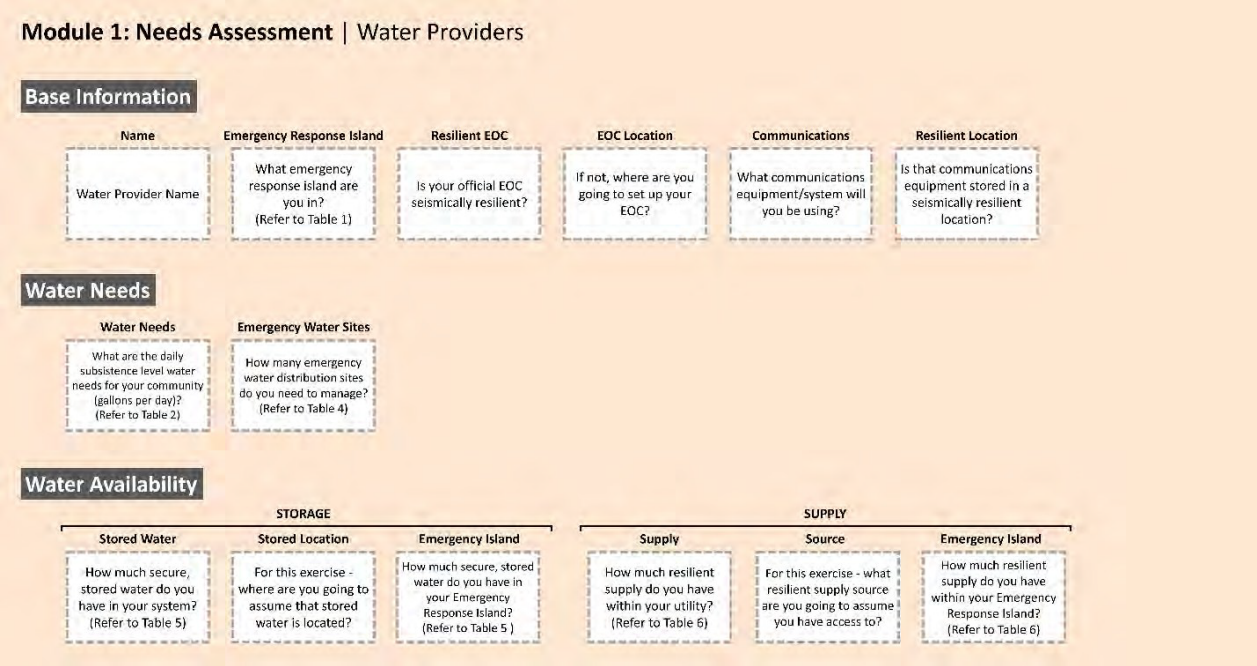


Figure 5.3: **Needs Assessment Chart for Water Providers**

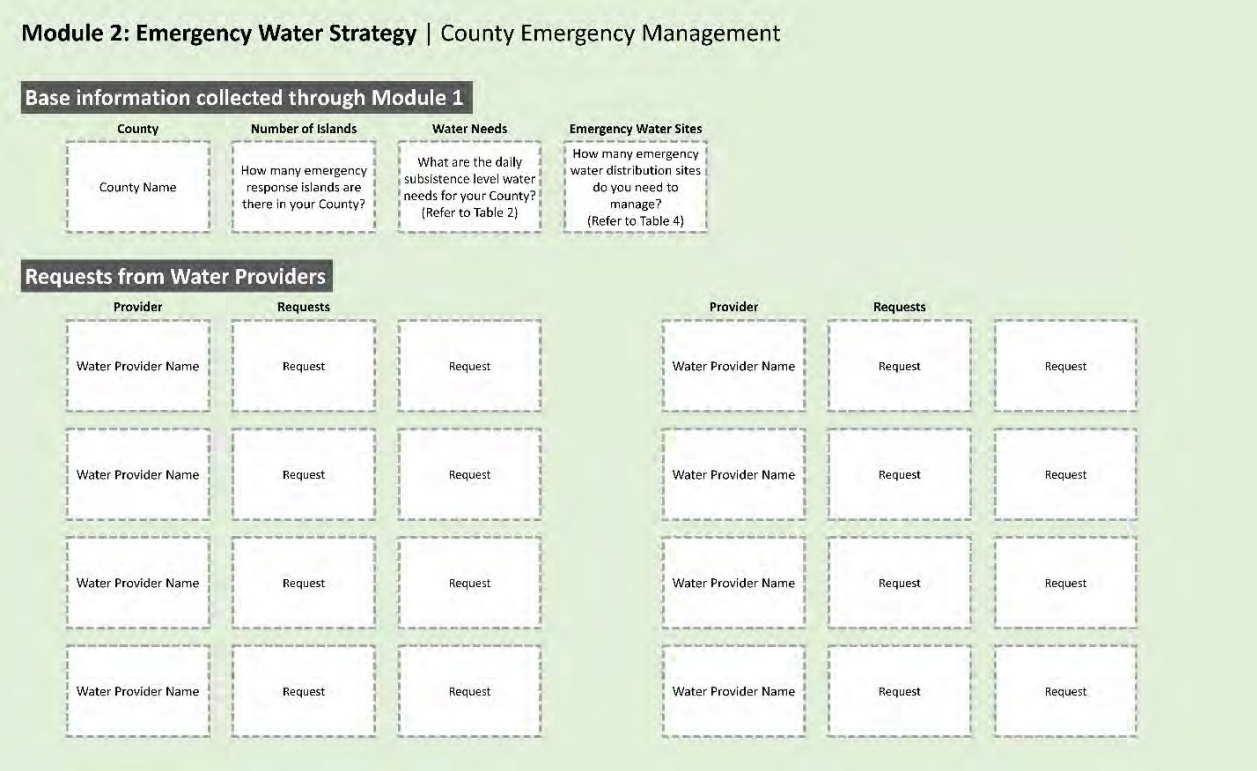


Figure 5.4: **Emergency Water Strategy Template for Emergency Response Agencies**

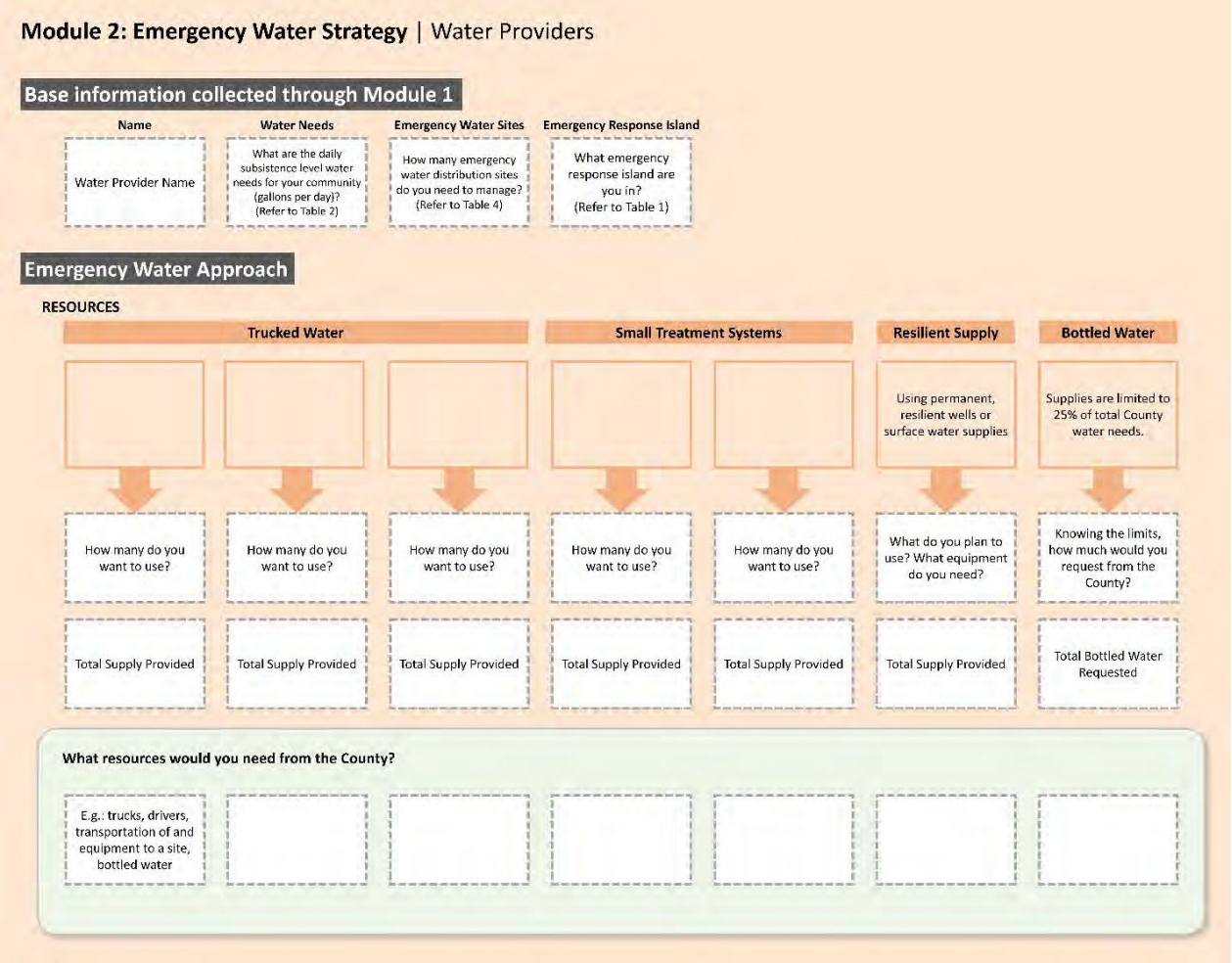


Figure 5.5: **Emergency Water Strategy Template for Water Providers**

Later in the section, the results from the water provider survey are summarized. The survey methodology and general information on survey respondents is provided above in Section 2.4. Results are generally reported by Island. Further analysis of the implications of these data is provided in Section 6 – Gap Analysis.

5.2 RESILIENT STORAGE

Resilient water infrastructure is important under both piped and non-piped emergency scenarios. Water providers were asked about their progress in developing resilient and seismically-resilient storage infrastructure – either through new construction or through retrofit of existing structures. Responses are tabulated herein by Island, then further summed by county and the overall RDPO area. Work under construction is not included.

For the seismically-resilient infrastructure, options ranged from “not sure/none” (least prepared) up to “all tanks and reservoirs are seismically-resilient” (most prepared); multiple responses were allowed. Table 5.1 shows the number of water providers in each Island responding in each category. The data show that most providers in the RDPO have at least one seismically-resilient tank; only six water providers have none or

are not sure. In addition, all Islands for which a response was received have at least one seismically-resilient tank or reservoir.

Table 5.1: **Seismically-Resilient Storage by Emergency Response Island**

Emergency Response Island	All tanks and reservoirs are seismically-resilient	At least one tank is seismically-resilient	We are planning seismic upgrades to tanks and reservoirs within the next 5 years	Not sure
CLACK1		3		
CLACK11			1	
CLACK2		3	1	2
CLACK3		2		
CLACK5		3	1	1
CLACK7		1		
CLACK9				1
Clackamas County	***0***	***12***	***3***	***4***
CLARK1	1	3	1	
CLARK3		1	1	
Clark County	***1***	***4***	***2***	
COLUM2	1			
COLUM4		1		1
COLUM5		1		
Columbia County	***1***	***2***		***1***
MULT1		1		
MULT2	1	2	4	1
MULT3		1		
Multnomah County	***1***	***4***	***4***	***1***
WASH1			1	
WASH3	1	6	2	
WASH4		3		
WASH6			1	
WASH7				
Washington County	***1***	***9***	***4***	***0***
OVERALL TOTAL (percent of overall responses)	**4 (9 percent)**	**31 (69 percent)**	**13 (29 percent)**	**6 (13 percent)**

Water providers were also asked about their use of seismic valves on their tanks and reservoirs—these are valves triggered by a seismic event to automatically close and retain the water in the tank. A seismic valve is important because it decreases the likelihood that stored water will be lost due to distribution system failures—even if the tank itself is seismically-resilient and survives. Options ranged from "not sure/none" (least prepared) up to "50 percent or more of our tanks and reservoirs have seismic valves" (most prepared); multiple responses were allowed. Table 5.2 shows the number of water providers in each Island responding in each category. The data show that most water providers in the RDPO do not yet have

seismic valves on their tanks and reservoirs. There are multiple Islands that lack any tanks and reservoirs protected by seismic valves. In particular, there are no water providers using seismic valves within Columbia County. PWB has made the choice to implement a backbone isolation plan and to use two cells in each large reservoir with one side programmed to fail open and one side programmed to fail closed, instead of seismic isolation valves. Their choice may be re-evaluated when ShakeAlert®, an earthquake early warning system, is implemented in Oregon and Washington. There may be other water providers that have also selected alternate approaches.

Table 5.2: **Water Providers with Seismic Valves Installed on Their Tanks and Reservoirs by Emergency Response Island**

Emergency Response Island	We have seismic valves on 50 percent or more of our tanks and reservoirs	We have installed seismic valves on at least one tank, (or use an alternative approach)	We are planning to install seismic valves within the next 5 years	Not sure
CLACK1		2		1
CLACK11			1	
CLACK2	1	2	1	2
CLACK3		1	1	
CLACK5		1	1	2
CLACK7				1
CLACK9				1
Clackamas County	***1***	***6***	***4***	***7***
CLARK1		1	1	1
CLARK3			1	
Clark County	***0***	***1***	***2***	***1***
COLUM2				1
COLUM4				2
COLUM5			1	
Columbia County	***0***		***1***	***3***
MULT1			1	
MULT2		2	4	1
MULT3		1		
Multnomah County[1]	***0***	***3***	***5***	***1***
WASH1				1
WASH3	1	3	3	1
WASH4			1	2
WASH6			1	
WASH7				
Washington County	***1***	***3***	***5***	***4***
OVERALL TOTAL (percent of overall responses)	**2 (4 percent)**	**13 (29 percent)**	**17 (38 percent)**	**16 (36 percent)**

Water providers were also asked about their overall volume of seismically-resilient storage in MG (both with and without seismic valves) and their ADD. Table 5.3 shows the reported storage volumes and average daily demand by Island. When looking at overall counties, all counties generally have close to one average day of seismically-resilient storage, with three counties exceeding that amount. Water providers have a much lower volume protected by seismic valves. Further analysis of this data is provided in the Gap Analysis in Section 6.

Table 5.3: Volume of Seismically-Resilient Storage by Emergency Response Island

Emergency Response Island	Total volume of seismically-resilient storage		Average Day Demand (MGD)
	With and without seismic valves (MG)	With seismic valves (MG)	
CLACK1	9.3	5.3	12.5
CLACK11			1.1
CLACK2	12.5	11.0	15.9
CLACK3	10.0	3.0	6.7
CLACK5	15.8	1.3	5.4
CLACK7			0.3
CLACK9	0.3		0.8
Clackamas County	***47.8***	***20.5***	***50.9***
CLARK1	33	2	44.3
CLARK3			1.5
Clark County	***33***	***2***	***45.8***
COLUM2	1.0	1.0	0.2
COLUM4	0.5		1.7
COLUM5	2.0		0.9
Columbia County	***3.5***	***1.0***	***2.8***
MULT1	14.2	4.4	14.0
MULT2	132.4	31.4	85.5
MULT3	1.0		0.8
Multnomah County[1]	***147.6***	***35.8***	***100.2***
WASH1	1.2		0.2
WASH3	98.1	20.5	68.2
WASH4	11.2	0.0	9.0
WASH6	40		3.0
WASH7	0.0	0.0	1.2
Washington County	***150.5***	***20.5***	***81.7***
OVERALL TOTAL	**382.3**	**79.8**	**273.1**

[1] *PWB has implemented a backbone reservoirs isolation plan using two cells that can operate independently instead of seismic isolation valves. The Bureau's related mid-range estimate for water retained through isolation is included in the seismic valve column.*

5.3 RESILIENT SUPPLY, BACKBONE, AND FACILITIES

Water providers were asked about their access to seismically-resilient water supply source in the survey. Options ranged from "not sure/none" (least prepared) up to "all of our water supply is seismically-resilient" (most prepared); multiple responses were allowed. Table 5.4 shows the number of water providers in each Island responding in each category. The data show that twelve of the Islands do not have access to any seismically-resilient supply, though at least some seismically-resilient supply (either surface or groundwater) is planned within four of these Islands within the next five years. The majority of providers do not currently have access to a seismically-resilient supply.

Table 5.4: Water Providers with Seismically-Resilient Supply by Emergency Response Island

Emergency Response Island	All of our supply is seismically-resilient	We have access to at least one resilient supply source (well or surface supply)	We are planning seismic upgrades to our supply within the next 5 years	Not sure
CLACK1	1	1		1
CLACK11			1	
CLACK2				4
CLACK3		2	1	
CLACK5			1	2
CLACK7		1		
CLACK9		1		
Clackamas County	***1***	***5***	***3***	***7***
CLARK1	1	3	1	
CLARK3			1	
Clark County	***1***	***3***	***2***	
COLUM2				1
COLUM4				2
COLUM5		1		
Columbia County	***0***	***1***		***3***
MULT1		1		
MULT2		3	2	1
MULT3			1	
Multnomah County	***0***	***4***	***3***	***1***
WASH1				1
WASH3		4	3	1
WASH4		3	2	1
WASH6				1
WASH7				1
Washington County		***7***	***5***	***5***
OVERALL TOTAL (percent of overall responses)	**2 (4 percent)**	**20 (44 percent)**	**13 (29 percent)**	**16 (36 percent)**

Water providers were asked about the connectivity of their water system to neighboring water providers, which could allow them to access resilient supply from others. Table 5.5 shows the number of water providers in each Island responding in each category. Options ranged from "not sure" (least prepared) up to "we have a connection to a redundant water supply or sufficient interties to meet our demands if we lost supply" (most prepared). The "not sure" response is not shown in Table 5.5 because it was not selected by any water providers in the survey. The data show Islands either have connected (all water providers in the Island indicated they have access to at least one intertie) or disconnected (all water providers in the Island indicated they are isolated)—no individual Islands had a mix of connected and disconnected water providers. However, all counties (other than Clark County) had both connected and disconnected Islands. It was assumed that water providers considered the water pressure of their own and neighboring water systems in responding to the survey.

Table 5.5: **Water System Connectivity by Emergency Response Island**

Emergency Response Island	We have a connection to a redundant water supply or sufficient interties to meet our demands if we lose supply	We have access to one or more local interties, but they could only meet a portion of our demands	Our system is isolated - we have no interties
CLACK1	1	2	
CLACK11			1
CLACK2	2	2	
CLACK3	1	1	
CLACK5	1	2	
CLACK7			1
CLACK9			1
Clackamas County	***5***	***7***	***3***
CLARK1		4	
CLARK3		1	
Clark County		***5***	
COLUM2			1
COLUM4		2	
COLUM5			1
Columbia County		***2***	***2***
MULT1			
MULT2	3		
MULT3			1
Multnomah County	***3***		***1***
WASH1			1
WASH3	5	1	

Emergency Response Island	We have a connection to a redundant water supply or sufficient interties to meet our demands if we lose supply	We have access to one or more local interties, but they could only meet a portion of our demands	Our system is isolated - we have no interties
WASH4		3	
WASH6	1		
WASH7			1
Washington County	***6***	***4***	***2***
OVERALL TOTAL (percent of overall responses)	**14 (31 percent)**	**18 (40 percent)**	**8 (18 percent)**

Water providers were also asked about progress in hardening their "backbone" transmission pipelines that connect critical facilities, storage, and supply. Options ranged from "not sure" (least prepared) up to "we have completed hardening our backbone" (most prepared); multiple responses were allowed. Table 5.6 shows the number of water providers in each Island responding in each category. The data show that most water providers have either started or have projects planned within the next five years. Only one water provider in the RDPO area has completed their backbone hardening.

Table 5.6: **Water Provider Progress in Backbone Hardening by Emergency Response Island**

Emergency Response Island	We have completed hardening our backbone	We have started work on hardening our backbone	We have backbone hardening projects planned within the next 5 years	Not sure
CLACK1	1		1	1
CLACK11			1	
CLACK2		1	1	3
CLACK3		1		
CLACK5		1	2	1
CLACK7		1	1	
CLACK9				1
Clackamas County	***1***	***4***	***6***	***6***
CLARK1		1	2	1
CLARK3			1	
Clark County	***0***	***1***	***3***	***1***
COLUM2		1		
COLUM4				2
COLUM5			1	

Emergency Response Island	We have completed hardening our backbone	We have started work on hardening our backbone	We have backbone hardening projects planned within the next 5 years	Not sure
Columbia County	***0***	***1***	***1***	***2***
MULT1		1	1	
MULT2		3	3	2
MULT3			1	
Multnomah County	***0***	***4***	***5***	***2***
WASH1				1
WASH3		4	5	1
WASH4		1	1	1
WASH6		1		
WASH7		1		
Washington County	***0***	***7***	***6***	***3***
OVERALL TOTAL (percent of overall responses)	**1 (2 percent)**	**17 (38 percent)**	**21 (47 percent)**	**14 (31 percent)**

Water providers were asked about seismic resilience of key facilities, such as District or City offices, operations centers, and operations buildings. Table 5.7 shows the number of water providers in each Island indicating their facilities are seismically-resilient. The data show that few water providers have invested in seismically-resilient office and operations facilities. Most concerning is the low number of water providers with a seismically-resilient EOC (12 of 42 respondents).

Table 5.7: **Resilient Facilities of Water Providers by Emergency Response Island**

Emergency Response Island	The following facilities are resilient at our water provider:			
	District Offices	Emergency Control/Operations Center	Operations Building	Not Sure
CLACK1			1	2
CLACK11			1	
CLACK2		1		1
CLACK3		1	1	
CLACK5	2	1	1	
CLACK7				1
CLACK9				1
Clackamas County	***2***	***3***	***4***	***5***
CLARK1	1	1	1	1
CLARK3				
Clark County	***1***	***1***	***1***	***1***

Emergency Response Island	The following facilities are resilient at our water provider:			
	District Offices	Emergency Control/Operations Center	Operations Building	Not Sure
COLUM2	1	1	1	
COLUM4		1		1
COLUM5		1	1	
Columbia County	***1***	***3***	***2***	***1***
MULT1				
MULT2	2	2	2	2
MULT3				1
Multnomah County	***2***	***2***	***2***	***3***
WASH1				1
WASH3	1	2	1	1
WASH4		1	1	
WASH6				1
WASH7				
Washington County	***1***	***3***	***2***	***3***
OVERALL TOTAL (percent of overall responses)	**7 (16 percent)**	**12 (27 percent)**	**11 (24 percent)**	**13 (29 percent)**

5.4 EMERGENCY POWER AND CHEMICALS

Power and access to treatment chemicals were identified as key dependencies within regional emergency response efforts and both were included in the water provider survey.

Water providers were first asked about whether they have emergency generators for their supply, pump stations, and EOC. Table 5.8 shows the number of water providers in each Island indicating the availability of emergency generators for these three types of facilities. The data show around three-quarters of the water providers have emergency generators at all three types of facilities.

Table 5.8: Emergency Generator Availability by Emergency Response Island

Emergency Response Island	We have emergency generators for the following facilities at our water provider:		
	Supply (well, or intake and water treatment plant)	Pump Stations	EOC
CLACK1	1	3	2
CLACK11	1		
CLACK2	2	2	4
CLACK3	2	2	2
CLACK5		2	2
CLACK7		1	
CLACK9	1	1	1
Clackamas County	***7***	***11***	***11***
CLARK1	3	4	3
CLARK3	1	1	1
Clark County	***4***	***5***	***4***
COLUM2	1		1
COLUM4	2	1	1
COLUM5	1	1	1
Columbia County	***4***	***2***	***3***
MULT1	1	1	1
MULT2	5	5	5
MULT3	1		1
Multnomah County	***7***	***6***	***7***
WASH1	1		
WASH3	5	5	6
WASH4	2	3	3
WASH6	1		
WASH7	1	1	
Washington County	***10***	***9***	***9***
OVERALL TOTAL (percent of overall responses)	**32 (71 percent)**	**33 (73 percent)**	**34 (76 percent)**

Water providers were further asked how long they would be able to operate their supply at ADD if they were on standby power. Available responses range from “we do not have standby power” (least prepared) to “more than 5 days” (most prepared). Table 5.9 summarizes provider responses by Island. The most common response was “1 to 3 days” with around three quarters of water providers having sufficient fuel to last 1 day or more.

Table 5.9: Standby Operation Duration for Supply by Emergency Response Island

Emergency Response Island	If you were on standby power, how long would you be able to operate your supply (well, or intake + water treatment plant) at ADD levels?				
	More than 5 days	3 to 5 days	1 to 3 days	Less than a day	We do not have standby power or not sure
CLACK1		1	1		1
CLACK11		1			
CLACK2		1	1		2
CLACK3	1		1		
CLACK5					3
CLACK7					1
CLACK9		1			
Clackamas County	***1***	***4***	***3***	***0***	***7***
CLARK1		1	3		
CLARK3	1				
Clark County	***1***	***1***	***3***	***0***	***0***
COLUM2	1				
COLUM4			2		
COLUM5		1			
Columbia County	***1***	***1***	***2***	***0***	***0***
MULT1	1				
MULT2	3		1	1	
MULT3		1			
Multnomah County	***4***	***1***	***1***	***1***	***0***
WASH1			1		
WASH3	1	1	4		1
WASH4	1		2		
WASH6			1		
WASH7				1	
Washington County	***2***	***1***	***8***	***1***	***1***
OVERALL TOTAL (percent of overall responses)	**9 (20 percent)**	**8 (18 percent)**	**17 (38 percent)**	**2 (5 percent)**	**8 (18 percent)**

Water providers were similarly asked how long they would be able to treat and disinfect their supply at ADD without chemical deliveries. Available responses range from "not sure" (least prepared) to "we do not require treatment or disinfection chemicals" (most resilient). Table 5.10 summarizes water provider responses by Island. The most common response was "more than 2 weeks"— most water providers would run out of fuel for standby generation before they would run out of treatment chemicals. This is reasonable, as standby generator fuel is used only during emergencies, while treatment chemicals are

generally used during both routine and emergency operations. In addition, there are land use restrictions on how much fuel can be stored in non-industrial areas which covers most of the Islands.

Table 5.10: **Treatment and Disinfection Chemical Availability by Emergency Response Island**

Emergency Response Island	How long would you be able to treat and disinfect your water without chemical deliveries (including chlorine) at average day demand levels? (Based on chemicals stores only, not power or other factors)				
	We do not require chemicals	More than 2 weeks	1 to 2 weeks	Less than 1 week	Not sure
CLACK1	2	1			
CLACK11			1		
CLACK2		2			2
CLACK3		1	1		
CLACK5		1		1	1
CLACK7	1				
CLACK9		1			
Clackamas County	***3***	***6***	***2***	***1***	***3***
CLARK1		2	2		
CLARK3		1			
Clark County	***0***	***3***	***2***	***0***	***0***
COLUM2		1			
COLUM4	1	1			
COLUM5		1			
Columbia County	***1***	***3***	***0***	***0***	***0***
MULT1		1			
MULT2	1	4			
MULT3			1		
Multnomah County	***1***	***5***	***1***	***0***	***0***
WASH1		1			
WASH3	1	4	1		1
WASH4		3			
WASH6			1		
WASH7		1			
Washington County	***1***	***9***	***2***	***0***	***1***
OVERALL TOTAL (percent of overall responses)	**6 (13 percent)**	**26 (58 percent)**	**7 (16 percent)**	**1 (2 percent)**	**4 (9 percent)**

5.5 EMERGENCY WATER DISTRIBUTION EQUIPMENT AND SUPPLIES

Water providers were asked about the emergency equipment and resources they have to provide as emergency water or to restore regular water service during an emergency. The results for physical equipment and supplies are shown in Table 5.11. The table indicates the total number of each item, not the number of water providers having at least one of the items. For example, the number "2" in the first cell could indicate either that two water providers in an individual Island each have a single emergency water treatment trailer, or that a single provider has two trailers. The exception is "bags or containers for water distribution to individuals" (numbers in this column represent the total number of water providers having these supplies). Overall, Clackamas County has the most of this emergency equipment; however, even within Clackamas County, there are four Islands with no emergency equipment. Clark County has the least equipment, with no water providers indicating they have any of the surveyed items.

Table 5.11: **Emergency Water Equipment by Emergency Response Island**

Emergency Response Island	Emergency water treatment trailer	Smaller portable treatment system (e.g., hurricane pump)	Spare filters for water treatment trailer or hurricane pumps	Manifold trailer for emergency water distribution	Reels of overland pipe	Potable water tanker trucks	Large truck bladders or portable tanks	Bags or containers for water distribution to individuals
CLACK1	2	2	1				2	1
CLACK11								
CLACK2	2	1	1	1	2		5	1
CLACK3								1
CLACK5	1	1	1			0	2	1
CLACK7								
CLACK9								
Clackamas County	***5***	***4***	***3***	***1***	***2***	***0***	***9***	***4***
CLARK1								
CLARK3								
Clark County	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
COLUM2	1							
COLUM4	1		1	1				
COLUM5								
Columbia County	***2***	***0***	***1***	***1***	***0***	***0***	***0***	***0***
MULT1				1				1
MULT2	3		1	3	1			3
MULT3								

Emergency Response Island	Emergency water treatment trailer	Smaller portable treatment system (e.g., hurricane pump)	Spare filters for water treatment trailer or hurricane pumps	Manifold trailer for emergency water distribution	Reels of overland pipe	Potable water tanker trucks	Large truck bladders or portable tanks	Bags or containers for water distribution to individuals
Multnomah County	***3***	***0***	***1***	***4***	***1***	***0***	***0***	***4***
WASH1								
WASH3	1	2		4	7		1	3
WASH4		1	1					2
WASH6								1
WASH7								
Washington County	***1***	***3***	***1***	***4***	***7***	***0***	***1***	***6***
OVERALL TOTAL	**11**	**7**	**7**	**10**	**10**	**0**	**9**	**15**

Water providers were also asked about non-equipment resources for emergency water distribution, including agreements and access to documents, as summarized in Table 5.12. The data shows that many water providers have thumb drives or paper copies of key information. Very few have contracts or mutual aid agreements in place with emergency fuel or other providers. These areas represent low-cost opportunities for improved resilience.

Table 5.12: **Non-Equipment Resources by Emergency Response Island**

Emergency Response Island	Disaster retainer agreement with consultants	Disaster retainer agreement with contractors	Emergency fuel agreements with emergency providers	Paper versions of ERPs	Paper or thumb drive version of GIS and/or system maps, drawings, and manuals
CLACK1			1	1	
CLACK11			1	1	1
CLACK2	1	1		4	3
CLACK3		1		1	1
CLACK5	1	1		1	
CLACK7				1	
CLACK9				1	
Clackamas County	***2***	***3***	***2***	***10***	***5***

Emergency Response Island	Disaster retainer agreement with consultants	Disaster retainer agreement with contractors	Emergency fuel agreements with emergency providers	Paper versions of ERPs	Paper or thumb drive version of GIS and/or system maps, drawings, and manuals
CLARK1			1	2	3
CLARK3			1	1	1
Clark County	***0***	***0***	***2***	***3***	***4***
COLUM2			1	1	1
COLUM4					
COLUM5					
Columbia County	***0***	***0***	***1***	***1***	***1***
MULT1				1	
MULT2			1	5	4
MULT3					
Multnomah County	***0***	***0***	***1***	***6***	***4***
WASH1					
WASH3		1	2	5	3
WASH4	1	1	1	3	2
WASH6					
WASH7					
Washington County	***1***	***2***	***3***	***8***	***5***
OVERALL TOTAL (percent of overall responses)	**3 (7 percent)**	**5 (11 percent)**	**9 (20 percent)**	**28 (62 percent)**	**19 (42 percent)**

5.6 PLANNING FOR EMERGENCY WATER DISTRIBUTION

Water providers were asked about steps they have taken to plan and prepare for emergency water distribution following a catastrophic emergency. Table 5.13 indicates the number of water providers that have taken a range of actions from developing an overall plan to coordinating with other agencies. The most common actions water providers have taken are identifying potential community distribution points and having equipment to support distribution of water. Even these most common actions have been taken by less than half of water providers. Notably, no water providers indicate they have an explicit plan for distribution of water to vulnerable customers.

Table 5.13: Emergency Water Distribution Preparation by Emergency Response Island

Emergency Response Island	Developed plan for distributing water	Identified community water distribution points	Identified vulnerable populations who may have difficulty reaching distribution points	Identified a way to get water to vulnerable populations	Have equipment (manifolds, distribution trailers) to help distribute water	Have planned how to staff water distribution sites	Have coordinated with CERT or other agencies about distributing water	Have not prepared to distribute emergency water
CLACK1					2			2
CLACK11								1
CLACK2		2			2	1		2
CLACK3								2
CLACK5	1				2	1		
CLACK7								1
CLACK9								1
Clackamas County	***1***	***2***	***0***	***0***	***6***	***2***	***0***	***9***
CLARK1	1	2					1	2
CLARK3						1		
Clark County	***1***	***2***	***0***	***0***		***1***	***1***	***2***
COLUM2		1						
COLUM4		1			1			1
COLUM5							1	
Columbia County	***0***	***2***	***0***	***0***	***1***		***1***	***1***
MULT1			1		1	1	1	
MULT2	1	1	1		3	1	2	1
MULT3								
Multnomah County	***1***	***1***	***2***	***0***	***4***	***2***	***3***	***1***
WASH1								
WASH3	2	5	2		5	2	2	
WASH4	1	3	1				1	
WASH6		1						1
WASH7					1			1
Washington County	***3***	***9***	***3***	***0***	***6***	***2***	***3***	***2***
OVERALL TOTAL (percent of overall responses)	**6 (13 percent)**	**16 (36 percent)**	**5 (11 percent)**	**0 (0 percent)**	**17 (38 percent)**	**7 (16 percent)**	**8 (18 percent)**	**15 (33 percent)**

Following a catastrophic disaster, individual preparedness will be important to fill emergency water needs while water providers and emergency responders are organizing emergency water distribution and system repairs. Water providers were asked about the efforts they have made to promote individual preparedness, such as "Two Weeks Ready." Table 5.14 indicates the number of water providers that have made specific efforts. Around half of water providers have not taken any actions to promote individual preparedness. For those water providers that have, the most common promotion has been via websites and newsletters or bill inserts.

Table 5.14: **Efforts to Promote Individual Preparedness by Emergency Response Island**

Emergency Response Island	Promoted on website	Newsletters or bill inserts	Preparedness or other community fairs	Tabling at community events	Working with CERT or other community organization	Participate in RWPC outreach campaign as member	Have not done significant general public preparedness promotion in the last several years
CLACK1			1	1		2	1
CLACK11	1						1
CLACK2	3	3	1			2	1
CLACK3	1	1				2	1
CLACK5	2	2	1	1	1	2	
CLACK7							1
CLACK9	1	1			1		
Clackamas County	***8***	***7***	***3***	***2***	***2***	***8***	***5***
CLARK1	1	1				1	2
CLARK3							
Clark County	***1***	***1***	***0***	***0***	***0***	***1***	***2***
COLUM2	1	1	1	1	1		
COLUM4							2
COLUM5					1		
Columbia County	***1***	***1***	***1***	***1***	***2***	***0***	***2***
MULT1							
MULT2	5	3	3	1	1	4	
MULT3							
Multnomah County	***5***	***3***	***3***	***1***	***1***	***4***	***0***
WASH1							

Emergency Response Island	Promoted on website	Newsletters or bill inserts	Preparedness or other community fairs	Tabling at community events	Working with CERT or other community organization	Participate in RWPC outreach campaign as member	Have not done significant general public preparedness promotion in the last several years
WASH3	4	4	3	3	1	6	1
WASH4	3	2	2	2	1	2	
WASH6						1	
WASH7	1	1		1		1	
Washington County	***8***	***7***	***5***	***6***	***2***	***10***	***1***
OVERALL TOTAL (percent of overall responses)	**23 (51 percent)**	**19 (42 percent)**	**12 (27 percent)**	**10 (22 percent)**	**7 (16 percent)**	**23 (51 percent)**	**10 (22 percent)**

6. Gap Analysis

6.1 OVERVIEW AND SCOPE OF GAP ANALYSIS

Gaps in regional emergency drinking water distribution and planning are based on data self-reported by water providers, best practices, plans from other agencies, and technical expertise of the project team. This gap analysis is organized into two general threads; i.e., organizational issues and infrastructure-related issues. Table 6.1 shows the structure for these two threads. The gap analysis for the organizational track is qualitative and based on comparing interviews and survey results with best practices and industry guidelines. For the infrastructure track, the gap analysis is more quantitative in nature, though not exclusively, and includes a comparison of infrastructure assets that the water providers have indicated having in the survey results versus what they might need to respond to a Regional Event.

Table 6.1: Gap Analysis Structure

Organizational issues
6.2 Roles and responsibilities
6.2.1 Lack of consensus on key responsibilities
6.2.2 Role of the CERT/Neighborhood Emergency Team (NET) and other volunteers
6.2.3 Lack of coordination between water providers and county/city emergency response planning
6.2.4 Inconsistent use of NIMS ICS in emergency response among water providers and emergency management agencies
6.3 Emergency response agencies gaps
6.3.1 FEMA's response gaps
6.3.2 States' response gaps
6.3.3 Conflicts with ESF reporting structures
6.4 Emergency response planning by water providers
6.4.1 Gap in emergency preparedness best practices
6.4.2 Planning and preparedness to reach vulnerable populations
6.4.3 Regional mutual aid efforts gap analysis
6.8 Policy and jurisdictional gaps

Infrastructure issues
6.5 Water system recovery and infrastructure investment
6.6 Water supply and distribution resources
6.6.1 Stored water gap analysis
6.6.2 Source, supply, and backbone gap analysis
6.6.3 Accessing and distributing supply for water distribution
6.6.4 Emergency drinking water distribution
6.7 Operational gaps

In the previous section, we identified gaps in emergency water distribution, discussed roles and responsibilities, and emergency resources. In Section 7, we will identify tasks that can be implemented to

close or narrow those gaps including some recommended policy changes for the county/city emergency response agencies and the water providers.

While we do not know exact location and extent of damages, we can make advance planning-level assessment of the water system's resilience. In some cases, the Islands may have sufficient stored water to cover their Base Emergency Water Need for the assumed 45 days as discussed in Section 4 or what duration is appropriate for each water provider. Other Islands will be short of stored water and need assistance sooner. In this section, we discuss where the shortages may be and what happens when the available storage is less than expected, the Base Water Duration is longer than assumed, or when reality differs from preparedness planning efforts.

6.2 GAPS IN ROLES AND RESPONSIBILITIES

Based on input received from workshops, interviews, and findings from the water providers survey, several potential gaps and/or barriers that would undermine the effective distribution of emergency water were identified.

6.2.1 Lack of Consensus on Key Responsibilities

It is well recognized that emergency water provision is a shared responsibility and requires collaboration among various levels of government, water service providers, and others. However, for many critical activities, there is lack of consensus among water providers and emergency response agencies on who should take the leading role. These gaps are summarized below:

- We have found that guidelines, legislation, and emergency management manuals identify those responsible for assisting in delivery of emergency drinking water; however, they fail to identify a leadership role.
- OHA Administrative Rule requires water providers (of all sizes) to develop an ERP, a plan for rationing and plan for the provision of emergency water while not specifying leadership responsibility (OAR 333-061-0064). We found through the survey and interviews that some water providers have not yet developed or finalized an emergency drinking water provision plan.
- Based on our research and understanding, identifying emergency water distribution sites is an emergency management function similar to the identification of mass shelters, mass casualty and care, and food distribution centers. However, the location of these sites in most cases have not been identified or shared with the water providers. Further, location of sites and proximity to a water source should consider how emergency water will be provided to optimize travel and production (for mobile treatment units), if applicable. Communication of the locations of these sites is also assumed to be an emergency management function but is not clearly defined in the documents reviewed.
- There is no agreement on which entity is responsible for setting up, managing, and staffing emergency drinking water distribution sites; especially during the interim before federal resources are deployed.

- It is unclear who is responsible for delivering trucked water (bladders or tanks from seismically-sound storage or sources) to the emergency water distribution sites if pipes are offline.

6.2.2 Role of the CERT / NET and Other Volunteers

Most of the counties and cities have volunteers such as the CERT and the Neighborhood Emergency Response Team (NERT) that can assist state and local emergency responders. Currently, less than 20 percent of water providers in the Region are engaging CERT/NERT or other volunteers to help with any areas of emergency response. This is an untapped resource that has not been considered in detail and can be coordinated through the emergency management agencies.

6.2.3 Lack of coordination between Water Providers and County / City Emergency Response Planning

Coordination between emergency response agencies and water providers could be improved. Areas where lack of coordination and planning is evident include:

- Consideration of water resources likely to be available in selecting distribution sites;
- Inclusion of transportation routes coinciding with where water is likely to be or where access is critically needed to get the water systems back in service quickly;
- Consideration of fuel needs of the water providers for backup generators, trucks, and equipment necessary for delivering water and repairing/operating the water systems;
- Joint participation in emergency exercises;
- Available transportation and transportation priorities might not match where water is available or where it is needed. Coordination between water providers, transportation agencies, and the county/city emergency management agencies is needed to plan for emergency water distribution; and
- Underdeveloped planning for providing water to vulnerable populations and those that cannot get to PODs.

6.2.4 Inconsistent Use of NIMS ICS in Emergency Response Among Water Providers and Emergency Management Agencies

- Generally, the use of NIMS ICS was inconsistent. Most water providers and emergency response agencies have been trained in the use of the NIMS ICS emergency response system; however, water providers do not consistently use it.
- Staff and volunteers likely to be asked to assist with emergency water distribution may not have experience, technical background, or adequate training.

6.3 EMERGENCY RESPONSE AGENCIES GAPS

6.3.1 FEMA's Response Gaps

Gaps identified are based on the project team's interview with FEMA staff in April 2022.

- FEMA provides emergency drinking water through commercially-bottled water, as well as trucked water in food-grade vehicles, and piped water from mobile treatment plants to various distribution sites. FEMA/USACE set up temporary treatment/distribution plants when they can, as soon as resources are available. However, in the CSZ event, they expect it will take a minimum of two weeks to deliver bulk water in any form to the Region. However, bottled water will arrive within days.
- FEMA Region 10 is based from Seattle, serving the west coast, including Hawaii and Alaska. They estimate their region covers over 9 million people in Oregon and Washington alone. More people will be impacted in northern California and if Hawaii and Alaska are hit with resulting tsunamis. FEMA intends to mobilize within days of the main earthquake and mobilize FEMA staff from other regions to assist. However, their staff will likely be caught in the earthquake and could find themselves needing assistance, as well as aiding others in the days, weeks, and months following the catastrophic earthquake.

6.3.2 State Response Gaps

There are significant deficiencies in detailed emergency water planning at the state level, and there is a need to quantify water needs for the state as well as regions within the expected damage zone for the CSZ event.

- Within state emergency management, there is an assumption that commercially-bottled water will be the emergency solution; however, it is unlikely that there will be enough to meet the state's need. There is not a plan to use stored water, nor a procedure for how to distribute it. Rules that govern the emergency drinking water need are detailed below:
- OHA new administrative rule 333-061-0064 calls for ERP and the seismic assessment plan, including a seismic implementation plan for capital improvements over next 50 years to align with the ORP with updates every five years and updates to the ERP every five years.
- The same administrative rule requires plans for rationing and for emergency water distribution and also implies shared responsibility with emergency management agencies for the provision of water but is not explicit about who has lead responsibility.

6.3.3 Conflicts with ESF Reporting Structures

The Framework falls under the three Oregon ESFs.

- ESF #3 (Public Works) is led by ODOT and is focused on engineering and infrastructure activities and supported by several other state agencies including OWRD. However, ODOT's experience and background in water infrastructure is extremely limited.

- ESF #6 (Mass Care) is led by the Oregon Department of Human Services (ODHS) and focuses on distribution of food and water to the public. However, it is a humanitarian focus, not infrastructure.
- ESF #11 (Agriculture) is led by Oregon Department of Agriculture and includes protection of natural resources, including water, and is supported by the OWRD.

The coordination between the ESFs and the agencies responsible for them is unclear. There are also incidences, where a function like drinking water is covered by multiple ESFs with multiple lead agencies. How the state coordinates between these different ESFs is unclear.

OHA is responsible for determining water quality requirements under normal condition, but indicates it has no water quality role in the provision of emergency water. These needs to be clearly defined based on the anticipated needs and sources after a large disaster so that water providers are clear on what is required before a disaster. Both states have some water quality guidance or requirements for bulk water transported or delivered to PODs.

6.4 EMERGENCY RESPONSE PLANNING BY WATER PROVIDERS

6.4.1 Gap in Emergency Preparedness Best Practices

The water providers and emergency response agencies interviewed or that responded to the survey are dedicated to preparing for emergencies (big and small) and are actively involved in those emergency response efforts. According to the interviews and survey results, we observed minor gaps in emergency preparedness best practices:

- Some water providers could improve their emergency response preparedness.
- Some water providers do not have a Continuity of Operations Plan (COOP).
- Some water providers indicated they are not members of ORWARN or WAWARN.
- Water providers and emergency response agencies are using different emergency communication equipment and may not be able to effectively communicate with each other during a large Regional Event.
- One-third of the water providers do not have a paper version of their ERP. While this seems like a minor detail, in the Regional Event, we cannot assume the power will be working and computers will be available to access the emergency plans.
- Some providers have not done resource typing, which is used to identify the resources they might need in an emergency, as well as those they might have which others can use.
- There is a lot of inconsistency in training staff in emergency preparedness on both the individual and organizational level.
- The water providers' staging areas, EOCs, and operations centers are not distributed throughout coverage area and there are Islands lacking these support functions.
- Cascading and compounding events were not typically considered in emergency response

planning. Aftershocks, loss of power, and loss of fuel will compound and worsen the impacts on water systems and lengthen the duration when emergency water distribution might be needed.

- In addition to emergency response activities, less than half of the water providers and emergency management agencies have a resilient emergency response center building or EOC.
- Survey results should be reviewed as each water provider plans and as regional planning progresses.

6.4.2 Regional Mutual Aid Efforts Gap Analysis

There are several opportunities for mutual aid – for water systems infrastructure and for the provision of emergency water. Both are discussed in this section.

6.4.2.1 Agreements with Commercial Providers

In many cases, pre-disaster agreements with commercial providers (trucking companies, fuel, and local bottled beverage companies) do not exist. Based on the survey results and interviews, only a few of the water providers and emergency management agencies have such agreements in place. There does not appear to be any advance provisions made to use these resources.

6.4.2.2 Mutual Aid Agreements

Mutual aid agreements through the ORWARN and WAWARN exist for many of the water providers, but many of the water providers are located and on the same side of the Cascades, which means the entities involved will be dealing with their own similar emergency response and may not be available to provide help. Further, many of the members of ORWARN and WAWARN are smaller agencies and might not be able to assist the larger agencies adequately during an event. Besides Oregon and Washington, there are no current interstate agreements between WARNs. ORWARN has a shared worker agreement; however, only a few entities have signed.

6.4.2.3 Emergency On-Call Agreements or Contracts with Engineering Consultants and Construction Contractors and Suppliers

There are few pre-arranged emergency on-call contracts with engineering consultants or construction contractors and suppliers. The nature of public contracting makes it difficult to have on-call or undefined contracts when there is no certainty that the Regional Event will occur during the life of the contract. Some agencies have existing on-call contracts that the scope of work might be modified after a disaster. Existing mutual aid agreements or emergency contracts in place based on the survey results are below:

- Three providers have agreements with consultants.
- Five providers have agreements with contractors.
- Nine providers have agreements with emergency fuel providers.

6.4.3 Planning and Preparedness to Reach Vulnerable Populations

- Survey results show few of the water providers have identified vulnerable populations, and none have planned for distribution of water to these populations in their plans. In conversations with participating emergency managers, they also have no plans that specifically identify getting water or any other emergency supplies to vulnerable populations.
- Water is a resource that will be needed and provided universally. Challenges related to vulnerable populations include a likely lower level of preparedness and resources in their homes and challenges reaching PODs for populations with limited mobility. These challenges will overlap in some populations (e.g., lower income seniors have fewer resources to prepare for an emergency, may have limited mobility and strength for transporting water on foot, and may also lack access to their own vehicle to drive to PODs). These vulnerabilities are relevant at all emergency scales if water is not available at the tap.
- Addressing the full needs of vulnerable populations (water, food, shelter, medical, and communication) and serving water to vulnerable populations should be the responsibility of emergency response agencies in combination with other needs and may include centralizing those individuals at shelters or locations where they can receive broad services. Delivering emergency water directly to individual vulnerable populations is beyond the abilities of water agencies and water is not the only need vulnerable populations will face.
- Since the responsibility for emergency water distribution is unclear, no one has invested in supplies or resources to reach vulnerable communities. This is generally believed by providers to be the responsibility of the county/city emergency response agencies.

6.5 WATER SYSTEM RECOVERY AND INFRASTRUCTURE INVESTMENT

The previous subsections have been focusing on organizational gaps. This subsection switches focus to the infrastructure side of the gap analysis. Many providers across the Region have been investing in resilient infrastructure. There has been the strongest investment in resilient storage, followed by seismic valves, supply, and backbone systems. However, even with these ongoing efforts, only a single provider currently has a resilient backbone. These investment patterns are consistent with the implied priorities recommended in the ORP, and they are now slowly being implemented. The first priority implied in the ORP is to focus on supply and backbone systems so they can be operational immediately after the CSZ event. Based on the ORP at the current level of resilience, restoration of distribution systems might require six months to one year or more for many water systems. The backbone systems alone are listed as weeks and months out for repair based on the ORP. Despite this projection, there is still a gap between the infrastructure capital improvement needs and the available funding for these improvements. Billions of dollars are needed on top of other infrastructure improvements required in the Region just to upgrade the water providers' supply and backbone systems to meet the target goals of recovery. Also, few providers have invested in emergency water distribution resources, and grant funds are limited.

6.6 WATER SUPPLY AND DISTRIBUTION RESOURCES

This analysis has evaluated the potential gap that water providers may experience between the water supply and distribution resources available following a planning-level catastrophic event and the base water needs of the Region.

For each water supply and distribution resource, gaps are identified, and discussion is provided in the sections below that consider the interdependencies and other factors affecting the sensitivity of the analysis. In general, gaps are evaluated at an Island level. In comparison to evaluation at the Regional level, evaluation at the Island level reveals more gaps.

6.6.1 Stored Water Resources Gap Analysis

Resilient water storage facilities (tanks, reservoirs, and clear wells) represent a key resource in meeting the Base Emergency Water Needs because of their wide distribution across the Region and because they have fewer resource dependencies in their necessity to provide water. Quantitative gaps are considered in terms of resilient storage volume compared to the base water needs identified in Section 5.

During normal operation, water tanks and reservoirs generally serve to establish the hydraulic grade (pressure) of the water system and work in concert with the supply sources and transmission pipes to provide storage and distribution of potable water to customers through the distribution system. Water tanks and reservoirs also provide emergency and standby storage for fire events and short-duration outages in the water supply.

During a Regional Scenario 3 (e.g., CSZ event), the importance and role of water tanks and reservoirs may change depending on the magnitude and type of event. In the most extreme conditions, where significant segments of the transmission and distribution systems are damaged to the point where supply sources cannot refill tanks and reservoirs and/or stored water cannot be distributed to customers through the piped network, water tanks and reservoirs may represent a water provider's only source of potable water for an extended duration. Since many of the water tanks and reservoirs in the Region are of varying ages and conditions which may or may not survive a CSZ event, this storage gap analysis will focus on storage resources that project stakeholders have identified as being seismically-resilient; and therefore, most likely to remain in-service following a catastrophic emergency scenario.

6.6.1.1 Region-Level Storage Gap Analysis

As previously discussed in Section 4, a minimum criterion of 2 GPCD for 45 days was established as the base water need for the Region following a catastrophic emergency event. Information provided by survey respondents and presented in Section 5 indicates that the Region's water providers have a total typical operational volume (not maximum design capacity volume) resilient storage capacity of 382 MG (Table 5.3) that would be available to serve the Region's approximately 2.3 million people. As illustrated in Figure 6.1, assuming that this capacity of resilient storage is available at the start of the base period (as defined in Section 4), the Region could have up to 3 months of water available to meet the Region's Base Emergency Water Needs, though the water may not be in the Islands where it is needed.

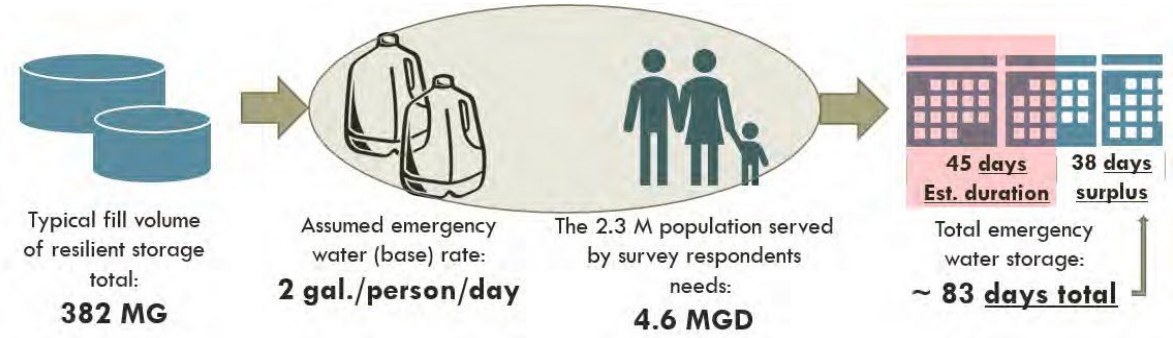


Figure 6.1: Region-Level Storage Gap Analysis

6.6.1.2 Impacts of Seismic Valves on Gap Analysis

In a Regional Event (e.g., CSZ) scenario, even resilient storage can be vulnerable to loss in the immediate earthquake aftermath. The elevation of most storage tanks means that major breaks in the distribution system can quickly drain the tanks. A tank or reservoir can be drained due to a break in the pipes either coming into or taking water from the storage container, high fire demand, or other demands in the aftermath of an earthquake. Seismic valves are a mitigation strategy to guard against some loss mechanisms. Using either an on-site seismic sensor or an earthquake early warning system such as ShakeAlert® to start a control strategy, a seismic valve can begin to isolate a tank or reservoir in the seconds or minutes between when an earthquake's p-wave and damaging s-waves reach a site.

Depending on a water system's needs, seismic valve isolation can be programmed to be completely or partially closed to balance the tank's abilities to meet some immediate needs in the aftermath of the earthquake against the goal of reducing storage loss.

As reported in Section 5, only 33 percent of respondents have installed seismic valves on at least one storage tank (Table 5.2), which accounts for approximately 80 MG (21 percent) of the total seismically-resilient storage capacity in the Region. While each water provider may employ a slightly different strategy; in general, it can be assumed that seismically-resilient storage tanks equipped with seismic valves are generally expected to be operated in a manner that will allow the provider to isolate and hold the majority of the tank capacity in reserve for use during the period after the event has occurred (i.e., the base period). Under this scenario, only about two to three weeks of base water use would be held in these seismically-resilient and isolated storage tanks and reservoirs.

6.6.1.3 Island-Level Storage Gap Analysis

While at a Regional level, the gap analysis suggests there may be sufficient resilient storage to meet the base water needs during an emergency event for a short period of time (around two weeks). Distribution of this water would be heavily reliant on a functioning piped water system and the intergovernmental agreements to support a wider sharing of water resources. As previously noted, under a Regional Event like the CSZ event, it is very likely that many water systems will be reliant on the resources solely available within their individual Island, and that Region-wide transmission and distribution may not be useable.

In Section 5, we calculated the total capacity of seismically-resilient storage, storage with seismic valves for each Island, and the number of days of base emergency water use that may be available following a catastrophic emergency event.

The resilient water storage (as identified in Table 5.2) with seismic valves might be available. The volume associated with seismic valves is the conservative value to consider in this gap analysis. From this information, we calculated the gap in water availability per Island. Shortages are shown as (red), and surpluses are shown as black. (Table 6.2). Only two Islands report a potential surplus. The remainder indicated shortages. Among the shortages, the Islands indicated with NA resilient water do not have seismic storage, much less seismic valves.

Table 6.2: Gap between Base Emergency Water Need and Resilient Water Available

(assuming 45 days and 2 GPCD) Emergency Response Island	Population of Responding Utilities, M	Resilient Water Storage Available with Seismic Valves, MG	Base Emergency Water Need, MG	Gap, MG
CLACK1	0.070	5.3	6.3	(1.0)
CLACK11	0.010	NA	0.9	(0.9)
CLACK2	0.102	11.0	9.2	1.8
CLACK3	0.058	3.0	5.2	(2.2)
CLACK5	0.050	1.3	4.5	(3.2)
CLACK7	0.002	NA	0.1	(0.1)
CLACK9	0.004	0.0	0.4	(0.4)
CLARK1	0.415	2	37.4	(35.4)
CLARK3	0.021	NA	1.9	(1.9)
COLUM2	0.002	1	0.2	0.8
COLUM4	0.017	0.0	1.5	(1.5)
COLUM5	0.008	0.0	0.7	(0.7)
MULT1	0.115	4.4	10.4	(6.0)
MULT2	0.740	31.4	66.6	(35.2)
MULT3	0.003	0.0	0.3	(0.3)
WASH1	0.002	0.0	0.2	(0.2)
WASH3	0.591	20.5	53.2	(32.7)
WASH4	0.069	0.0	6.2	(6.2)
WASH6	0.024	0.0	2.2	(2.2)
WASH7	0.005	NA	0.4	(0.4)
Total (Region), rounded	**2.31**	**80**	**208**	**(128)**

6.6.1.4 Storage Gap Analysis Considerations

The following are considerations or context related to this analysis based on discussion at project workshops, review of the sensitivity of the analysis, or review of potential implications of the analysis:

- Looking at all the resilient storage (part of Table 5.3), only seven Islands lack the storage needed to meet base daily water demands.
- Of the seven Islands which lack sufficient resilient storage to meet the base daily water demand, four have no resilient storage within their Island.
- The gap is more significant if we count only the resilient storage with seismic valves. Only two of the Islands have sufficient resilient storage that is equipped with seismic valves. These Islands represent only 10 percent of the Region's population, as reported by the water provider survey. This gap between the seismically-resilient storage with seismic valves and the Base Emergency Water Need is shown in Table 6.2. This means that if the only water available is from the resilient storage with seismic valves, most of the Islands are deficient and will run out of water between 2 weeks and 45 days.
- In at least one case, a large resilient reservoir is located in an Island that is not within its service area. In this gap analysis, that Island is shown as having a surplus of storage relative to base water need. While it is possible that that this resilient storage could be utilized to meet the needs of the Island, there is likely an operational gap that will require additional decision-making regarding the potential use of "surplus" water in the Island.
- One water provider serving the MULT1 and MULT2 Islands has implemented a backbone reservoir isolation plan. Other providers also might have isolation plans. Backbone and storage isolation plans are mitigating operational measures that could benefit from the resilience of water systems whether they have seismic valves or not.
- This study assumed potable water would not be used for firefighting; however, immediately following the large Regional Event, firefighting efforts to access the piped and stored water may be occurring before the tanks and reservoirs can be isolated and secured for emergency drinking water. Firefighting water use is excluded from water demands here but could quickly drain water from tanks in the aftermath of an earthquake. The use of seismic valve isolation can mitigate or re-direct this demand to other, non-resilient tanks and reservoirs so that the water in the resilient tanks and reservoirs can be saved for emergency drinking water to the extent possible.
- The storage gap analysis does not include aquifer storage and recovery systems. These systems and other groundwater sources are included as part of Section 6.7.2 Source Supply and Backbone Gap Analysis.
- The storage gap analysis assumes that there are no supply sources operating to replenish the storage tanks and reservoirs.

6.6.2 Source Supply and Backbone Gap Analysis

Having more resilient water sources and backbone piping could provide water to meet or exceed base water needs and replenish water in tanks and reservoirs. Source and backbone systems are analyzed together because operating a source without a functioning backbone piping (and/or terminal storage) may limit operation. Implications of water source type and other factors affecting source operation, such as emergency power generation and chemical stores, are also considered.

Although storage resources may provide water reserves for some portion of an emergency response period, source and backbone facilities are needed together to sustain subsistence-level water provision and restore higher levels of water service. This section of the gap analysis reviews these facilities and their dependencies.

During normal conditions, water providers use water supply sources to sustain storage facility levels and meet service area demands. Typical operations involve treatment and/or disinfection at the source with chemicals and transporting from the source through backbone piping. Some of this transportation is by gravity and some is pumped. Backbone piping is key transmission piping for water conveyance to tanks and reservoirs and to general water distribution piping.

During an emergency scenario, the importance and role of water source facilities may change depending on the condition of storage and backbone facilities and on the magnitude and type of the emergency. Sources might not be able to refill storage tanks and reservoirs in the usual manner in scenarios where any one of the following impacts have occurred: 1) source facilities are damaged; 2) backbone is damaged; 3) storage is damaged; or 4) sources are inoperable due to loss of power or lack of treatment or disinfection chemicals. During a catastrophic emergency scenario (e.g., CSZ event), at least one element is likely to be impacted. Therefore, source water may be unavailable or limited during initial emergency water provision, as the elements are often interdependent.

As discussed in Section 5, during a Regional catastrophic event scenario, it is assumed that significant portions of the water distribution system may be compromised and disrupted, and that water use may be restricted to subsistence levels. Sources are thus very sensitive to dependencies, but they are also very impactful to the potential of providing water during a sustained emergency response period.

6.6.2.1 Source Facilities Gap Analysis

This source facilities gap analysis provides a review of the presence or deficiency of resilient sources. An overview of resilient source locations illustrates the geographical spread of resilient sources in the Region.

Information from the water provider survey presented in Section 5 is represented in Figure 6.2 to show the distribution of resilient sources in the Region by Island. As shown in this figure, many Islands throughout the center of the Region have at least one resilient source of supply, while many of the Islands on the periphery have not reported a resilient water source.

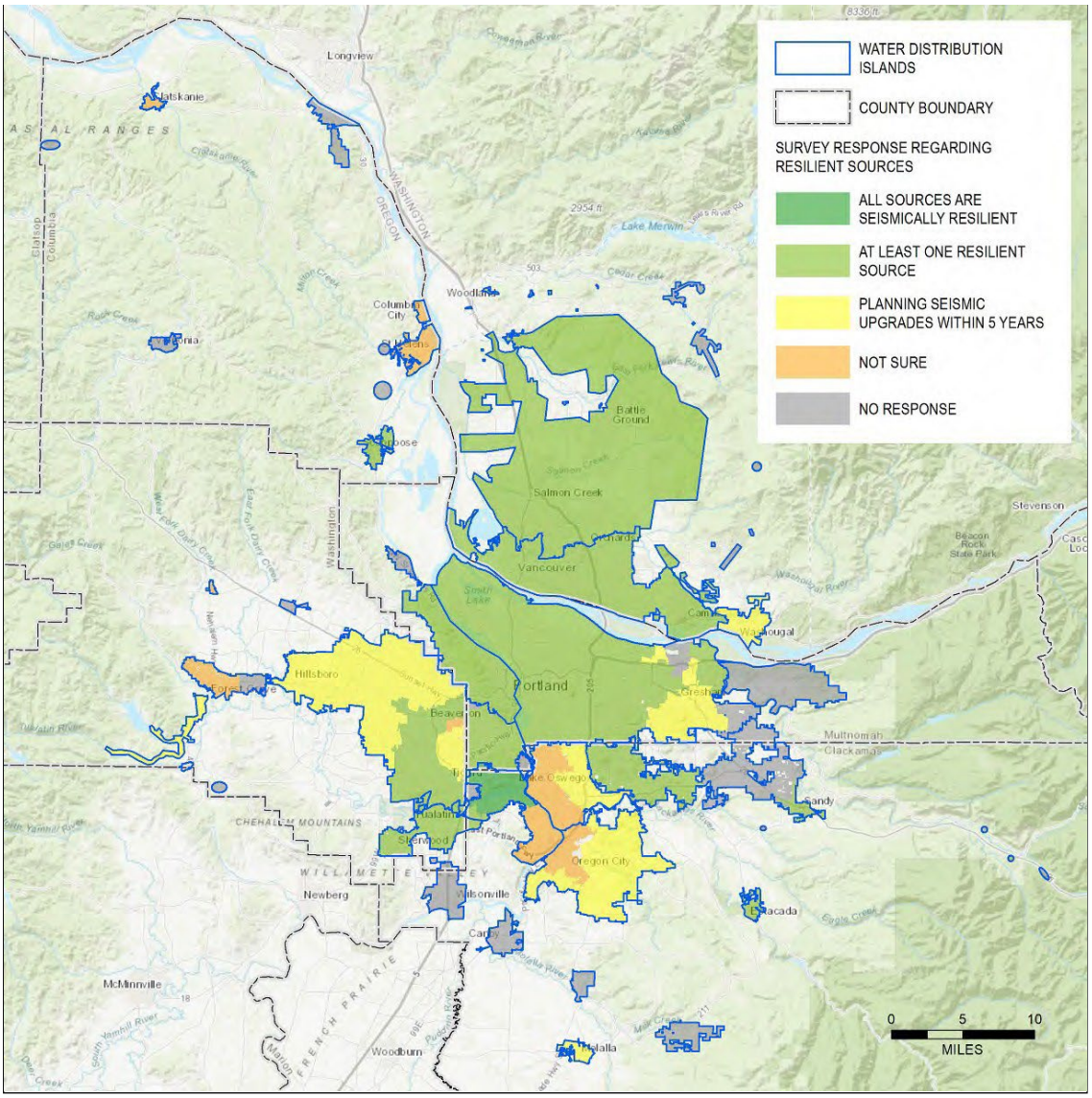


Figure 6.2: Regional Distribution of Resilient Sources by Emergency Response Island

Table 6.3 summarizes the number of utilities by Island that are deficient of a resilient supply and who have no plans for a resilient supply within the next five years. The table also provides the percentage of utilities in each Island that are deficient. Where 100 percent of the utilities in an Island are deficient, the Island is considered deficient.

Table 6.3: Emergency Response Islands Deficient of Seismically-Resilient Sources and/or Planning

Emergency Response Island	Number of Utilities Deficient of Seismically-Resilient Source, No 5-Year Plans for Resilient Source	Percent of Utilities Deficient in Island
CLACK1	1	33
CLACK2	4	100
CLACK5	2	67
COLUM2	1	100

Emergency Response Island	Number of Utilities Deficient of Seismically-Resilient Source, No 5-Year Plans for Resilient Source	Percent of Utilities Deficient in Island
COLUM4	2	**100**
WASH1	1	100
WASH3	1	14
WASH6	1	50
WASH7	1	100
Total Utilities	**14 (31 percent)**	

Notes:
1. *Deficient is defined as a water provider without resilient resource—whether current or planned*
2. *Rows with no entries = 0 (not deficient)*

Source Gap Analysis Discussion: The following points provide additional insights and context for consideration in the review of this source gap analysis:

- Of the five deficient Islands, one (COLUM4) has no resilient storage or supply.
- At least four of the deficient Islands have water providers with one or more groundwater sources. These include CLACK2, CLACK5, COLUM4, and WASH1. The groundwater sources, if upgraded, represent the potential to mitigate the deficiency.

6.6.2.2 Backbone Gap Analysis

This gap analysis provides a review of deficiencies in seismically-resilient backbone piping connecting the source and/or tanks and reservoirs within a distribution system. Analysis is focused on only the individual utilities in each affected Island since backbone piping, unlike sources, may provide limited benefit to the Island area which is beyond the individual water provider. We have assumed that the intertie system will not be functional during a Scenario 3 event.

Data from the water provider survey indicates that approximately half the responding water providers have some level of resilient backbone. Of those who do not have a resilient backbone, many have plans for a resilient supply within the next five years. The remainder, without any resilient backbone or plans, are deemed deficient.

In addition, due to the interdependencies described earlier, Islands with backbone deficiencies are also reviewed for the presence or deficiency of the other resources already analyzed: storage and source. The second column of Table 6.4 tabulates utilities deficient of resilient backbone but having either a current or planned seismically-resilient source. The final column summarizes deficiencies in backbone and/or source in acknowledgement that a deficiency in either can limit a water provider's ability to rely solely on storage in a catastrophic emergency scenario.

Table 6.4: Utilities Deficient of Seismically-Resilient Backbone and Related Coincident Deficiencies

Emergency Response Island	Number of Utilities		
	Deficient of Any Resilient Backbone (Current or Planned)	Deficient of Resilient Backbone but Having a Resilient Source (Current or Planned)	Deficient of Source and/or Backbone
CLACK1	1		2
CLACK11			**1**
CLACK2	3		4
CLACK3	1	1	1
CLACK5	1		3
CLACK9	**1**	**1**	**1**
CLARK1	**1**	**1**	**1**
CLARK3			**1**
COLUM2			1
COLUM4	**2**		**2**
MULT2	1		2
MULT3			1
WASH1	1		1
WASH3	1		3
WASH4	1	1	1
WASH6			2
WASH7			**1**
Total Utilities	**14 (31 percent)**	**4 (9 percent)**	**28 (62 percent)**

Notes:

1. *Deficient is defined as a water provider without resilient resource—whether current or planned*
2. *Rows with no entries = 0 (not deficient)*
3. *Bolding indicates Islands also deficient in storage.*

Backbone Gap Analysis Discussion: The following points provide additional insights and context for consideration in the review of this backbone gap analysis:

Fewer than one-third of reporting water providers are deficient of any resilient backbone (current or planned), but only one water provider reported that their backbone hardening was complete (Table 5.6). Therefore, while nearly two-thirds of water providers have backbones which are resilient in part or in planning, the incomplete status of most water providers means they may still experience significant gaps in emergency water response capability.

Deficiency in either backbone or source impacts nearly two-thirds of the water providers. This is significant because without resilience of both resources, water providers could struggle to refill dwindling tanks and reservoirs. This is especially significant for seven water providers which are also deficient in storage.

6.6.2.3 Other Factors Affecting Source and Backbone Gap Analysis

This gap analysis will look at other factors that are key inputs in the operation of source and backbone resources to determine whether their availability makes them limiting dependencies or just significant dependencies. As discussed in Section 5, standard electrical grid power is projected to be unavailable during the initial months after a Regional CSZ-type event. According to water provider survey respondents, 71 percent of water providers have backup power generation capability at their source (Table 5.8). In most cases, these backup power generators operate using diesel fuel, which must be stored on site and replenished. Other key inputs are dependencies related to treatment and/or disinfection chemicals. Eighty-seven (87) percent of reporting water providers require chemicals.

During power outage incidents, water providers rely on backup generators and fuel reserves to operate source, backbone, treatment, and pumping facilities; to operate remote controls and the Supervisory Control and Data Acquisition (SCADA) system for overall system control; and to keep pipes pressurized. Fuel for the emergency generators does not appear to be a limiting source dependency for emergency water provision if considered at an aggregate, Regional level. Most water providers indicated they have at least one day of fuel storage relative to water source operation at average daily demand levels. Operating a source even for one day at such a level could provide more than an Islands' base water need since water average daily demands in the Region were reported at an average of around 60 times greater than base daily demand.

Once fuel is depleted, it may take weeks before it can be replenished. The availability of fuel in the Region will be an additional barrier to restoring normal system operations. Also, this analysis also does not review the multiple uses of fuel beyond source water production. Such broader fuel analysis is outside the scope of this project. The RDPO is in process of other broader emergency fuel planning.

During a catastrophic Regional Event or other incident which cuts off chemical production or delivery, water providers will be reliant on their own stores of treatment and disinfection chemicals. However, storage levels for chemicals are typically much higher than for fuel. In the water provider survey, 39 water providers (89 percent) either do not require disinfection chemicals or have weeks of chemical supplies (Table 5.10). So, if days of fuel at average daily demand levels is more than sufficient for meeting weeks of base daily demand, then weeks of chemicals at average daily demand levels is also more than sufficient. Thus, chemical stores do not appear to be a limiting source dependency when considered at an aggregate, Regional level.

6.6.2.4 Source and Backbone Gap Analysis Considerations

- The following are considerations related to source and backbone gap analysis based on discussions at project workshops, review of the sensitivity of the analyses, or review of potential implications of the analysis.
- Some of the Region's primary water sources (such as Bull Run and Trask/Tualatin) are far from or outside their Island. Although not accounted for in this study, any absence of resilient backbone to connect such distant sources may limit the value of such sources in regional seismic and emergency planning.

- This analysis reviewed the availability, but not the seismic resilience of backup generators, their fuel supplies, and chemical stores.
- Some water providers rely only on an outside source; i.e., a shared source or a wholesale provider.
- Dependency risks related to interconnections, backbone, and prioritization of supply are potential gaps for providers reliant on outside sources. These dependency risks were not evaluated as part of this gap analysis.
- When an operable resilient source lacks a resilient backbone connection, it might be possible to discharge the source to trucks capable of hauling water. These trucks and other community distribution resources are addressed in the next subsection.

6.6.3 Emergency Drinking Water Distribution

Many water providers have invested in resilient storage, supply, and/or backbone piping, but emergency drinking water distribution (sometimes called community water distribution) resources are also needed. Even with resilient facilities, a catastrophic event will likely create challenges in water distribution. For instance, in a Regional Event (Scenario 3), it is assumed that large areas of the distribution networks will not be serviceable. Even in Scenarios 1 and 2, one water system may be reliant on the resources of their neighboring water system(s). Contamination can also render the distribution network unusable or prevent part of that network from being serviced. Under all these scenarios, resources will be needed to facilitate water distribution at sites throughout the community.

In this analysis, gaps are considered at the regional level by estimating the number of distribution sites needed and comparing them to potential packages of resources available to be assembled from the existing emergency water treatment trailers, manifold distribution trailers, reels of overland pipe, potable water tanker trucks, and large truck bladders/tanks.

Each county and city will likely need multiple distribution sites. In the Regional scenario, it is assumed the population is limited to manual water hauling on foot or bike. Such water hauling will necessitate the shorter hauling distances provided by multiple distribution sites. Even when distance is not a significant factor, the site logistics involved will limit the population which can be served at any one distribution site. In all scenarios, vulnerable populations may need additional or adapted distribution sites. Thus, multiple distribution sites and even multiple types of distribution sites are likely required in each county.

6.6.3.1 Past Emergency Drinking Water Distribution Resources Work

Anticipating the need for distribution sites, the RWPC has helped members apply for grant funding to purchase mobile water treatment and distribution systems. This is reported in the EWTDP (RWPC, 2015). These EWTDP resources help define resource types and are accounted for with the other emergency drinking water distribution resources reported in the water provider survey results of this project. Part of the purpose of this project was to identify needs for additional resources across the whole Region.

6.6.3.2 Types of Emergency Drinking Water Distribution Resources and Sites

This analysis uses two broad categories of emergency drinking water distribution sites and outlines which resource types are required at each category of site.

Proximity Sites and Resources: A limited number of sites are both suitable for the logistics of emergency drinking water distribution to the community and are proximate to storage, backbone, or raw water sources that could be more easily tapped. Such "proximity sites" are assumed to require the following basic emergency drinking water distribution resource package:

- Manifold(s) with spigots for water container filling; and
- An overland pipe or some other pipe or hose to connect the manifold(s) to the existing water facility.

Proximity sites are assumed to provide pressure to the manifold from the adjacent storage, backbone, or source facility.

Distant Sites and Resources: Where there is no existing water facility near a needed emergency drinking water distribution site, resources are needed to produce water at or transport water to the distribution site. Such "distant sites" are assumed to require the following resource package:

- The basic distribution resource package described above; and
- A way of producing or providing water at the site, such as either:
  - An emergency water treatment trailer (self-contained pumping, treatment, and pressure tank setup such as the Mobile Water Treatment System [MWTS]); or
  - A potable water tanker truck or truck hauling a bladder or tank. Also, a bladder or tank is needed to receive water at the site.

Support Resources: At both types of sites, support resources are required to facilitate equipment operation, staff operations, service population logistics, and sanitation.

6.6.3.3 Emergency Drinking Water Distribution Resources Gap Analysis

This analysis focuses on the availability of equipment and supplies needed for distribution of emergency water. The jurisdictional gap is covered under Section 6.8. The criteria for assessing the location and number of emergency water distribution sites are generally physical barriers caused by geologic barriers and damages, physical location of available water, capacity of emergency distribution equipment, location of other distribution supplies, and population limitations per site. The county and city emergency response agencies may also want to locate water distribution sites near other PODs to consolidate staff and supplies. It is unlikely that the water providers or emergency response agencies can provide water to all POD locations because of a lack of resources for transport and lack of available water.

This emergency drinking water distribution resources gap analysis compares Regional-level need and resources. Both proximity site and distant site resource requirements must first be estimated and then compared to the available resources. Estimation of needed resources is facilitated by aggregation of Island-level requirements, and these requirements are based on an assumed size of a community area, which could be served by a distribution site.

Such community areas are considered generically here to facilitate an approximation of the total count of such community areas in each Island and together in the Region. Since logistics limit the population which can be served at any one emergency drinking water distribution site, community areas are herein defined by population. Different distribution resource types are part of the logistical limitations. Populations which can be served by different distribution resources are presented in Table 6.5. These limits are calculated using the following equation and assumptions.

Population Limit Served Per Day = (Resource capacity in gallons per minute [gpm]) * (600 minutes) / (2 GPCD)

Assumptions:

- Distribution site hours of operation per day: 10 hours (600 minutes)
- Base rate water provision: 2 GPCD (per Section 4)

Table 6.5: Population Limit Served per Day Based on Distribution Resource Capacity

Distribution Resource Capacity	Population Limit Served Per Day	Notes
MWTS capacity = 18 gpm	6,000	There are nine MWTSs in the region (Source: RWPC)
Trucked water carrying 2,000-gallon bladder or tank. Assuming 10 deliveries per day (allowing 1 hour per round trip) = 20,000 gal = 33 gpm	10,000	2,000 gallons was selected since higher volumes begin to exceed the weight capacity of small dump trucks. Larger sizes and water (or other beverage or food-grade tanker) trucks are available. The EWTDP notes that bladders and portable tanks up to 5,000 gallons are available (RWPC, 2015).
Water supply through 2-inch hose at 5 feet per second; approximately 50 gpm	15,000	2 inches is the most common size of hose reel reported in the EWTDP (RWPC, 2015). It is also in-between common sizes of fire hoses.

A population of 12,000 is assumed in this analysis for setting the average emergency drinking water distribution area size. This size acknowledges that some proximity sites might be able to serve higher populations and some distant sites with their additional resource requirements might serve lower population numbers. On the other hand, distant site resources could be operated for more than the assumed 10 hours per day or with larger equipment to produce water for 12,000 (or more) people. Note, the Clark Regional Emergency Services Agency (CRESA) in Clark County uses 20,000 people per distribution site in their planning, and EWEB uses 25,000. However, for this study, the population of 12,000 is a mid-range assumption relative to the capacities estimated in Table 6.5. The actual number should be discussed and coordinated among the emergency response agencies and the water providers in their respective jurisdictions, and these numbers may need to be adjusted following the CSZ event to meet real

needs.

Table 6.6 estimates the number of each type of emergency drinking water distribution sites needed for the Region. Each Island is assumed to require at least one proximate site. For Islands with populations greater than 12,000 and for every additional 12,000 in population, additional sites are needed. Half of all such additional sites in an Island are assumed to be distant sites. The result of both assumptions is that just over one-half of the estimated sites are proximity sites. This is consistent with a characteristic of the Region's water providers which influences which site type is more likely. Larger water providers are likely to have larger facilities serving larger areas; therefore, they will need more distant sites than proximity sites. Smaller water providers cover small areas; therefore, more proximity sites are feasible. Smaller water providers sometimes represent smaller, isolated service populations, so each smaller provider drives up the number of sites required. Because of this sensitivity to smaller populations, this analysis (last two rows of Table 6.6) accounts for something that other gap analyses in this study have neglected: the 3 percent of the Region study population not represented in the responding utilities.

Table 6.6: Estimation of Needed Emergency Drinking Water Distribution Sites

Emergency Response Island	Service Population	Number of Sites Needed Assuming Site Serves Maximum of 12,000 People Per Day	
		Proximity Sites	Distant Sites
CLACK1	70,000	3	3
CLACK11	9,910	1	0
CLACK2	102,014	5	4
CLACK3	58,200	3	2
CLACK5	50,492	3	2
CLACK7	1,500	1	0
CLACK9	4,035	1	0
CLARK1	415,000	18	17
CLARK3	21,130	1	1
COLUM2	1,785	1	0
COLUM4	16,876	1	1
COLUM5	7,621	1	0
MULT1	115,334	5	5
MULT2	739,521	31	31
MULT3	3,300	1	0
WASH1	2,000	1	0
WASH3	591,094	25	25
WASH4	69,257	3	3
WASH6	24,000	1	1
WASH7	4,581	1	0
For the Islands above with non-responding water providers:	75,327	2	1
For the 10 non-responding Islands:		10	0

Emergency Response Island	Service Population	Number of Sites Needed Assuming Site Serves Maximum of 12,000 People Per Day	
		Proximity Sites	Distant Sites
Totals:	**2,382,977**	**119**	**96**

Table 6.7 estimates the number of emergency drinking water emergency distribution site resource packages required and then compares that to available Region resources. As previously discussed, each proximity and distant site will need the basic distribution package. For distant sites, distant site packages are also needed.

Resources reported in Section 5 are tabulated in combinations as available packages. Every basic distribution package requires paired elements. Distant site packages have options and thus are calculated with a combination of resources. Finally, these available packages are compared to the need.

Table 6.7: Estimation of Needed Emergency Drinking Water Distribution Resources vs. Availability in the Region

	Basic Distribution Package	Distant Site Packages
Total Estimated Need:	215	96
Current Available and Comparison:	10 (Pairs of overland pipe and Manifold trailers for distribution) 5 percent of Need	13 (9 Emergency water treatment trailers + 4 pairs of tanks/bladders) 14 percent of Need
Resource Gap:	(205)	(83)

Each mobile treatment unit only has the capacity to process enough water for 6,000 people per day. The Region has nine separate mobile treatment units and nine distribution trailers. Collectively, the city/county EOCs and water providers would need at least 96 treatment units and 215 distribution trailers for the Region. This represents a gap of 83 mobile treatment units and 205 distribution trailers. Note that the actual number may vary since newer treatment trailers may have distribution taps included, eliminating the need for a separate distribution trailer. Other factors that could improve the resource gap are changes in technology and increasing size (or capacity) of the distribution and treatment packages.

6.6.3.4 Emergency Drinking Water Distribution Resource Considerations

The following are considerations or context related to this gap analyses based on discussion at project workshops, review of the analysis sensitivity, or review of potential analysis implications.

- The hose reels and water distribution manifolds needed for any site are insufficient in number compared to the need, but some manifolds are also undersized. The size of the manifolds can be considered in terms of the number of spigots. A sufficient number of spigots is needed to serve the population within the assumed daily 10 hours of site operation. To serve the target population of 12,000, each manifold would need approximately forty spigots delivering 1 gpm

per spigot.[1] Some of the water distribution manifolds procured by the RWPC have only six spigots each. Larger and/or more manifolds are needed for serving the selected population of a single site.

- The assets procured by the RWPC represent a fraction of the emergency drinking water distribution resources available in the Region. The fact that the RWPC had to secure these resources with outside (grant) funding illustrates the difficulty individual water providers have in securing internal funding for such emergency equipment compared to funding infrastructure projects.
- This analysis is performed at a Regional level using only population to estimate the number of community areas, then the corresponding approximate number of sites needed. Detailed planning for emergency drinking water distribution will require consideration of both population and geographical analysis at an intra-water provider level.
- Although included in Section 5, "small portable treatment systems" are not counted as part of the available resources tabulated in Table 6.6. The company that made these systems is no longer in business, making replacement parts and filters impossible to obtain. The EWTDP indicates that because of their small capacity, they are "not intended for treating water for public distribution" (RWPC, 2015); though from our analysis, they could be redeployed to some of the smaller remote Islands. The EWTDP notes they can be used as a support resource for water staff. Some communities have made them available for use at low-population emergency drinking water distribution sites.
- The water provider survey did not collect data on the many other support resources that would be required at distribution sites. Again, intra-water provider-level planning is needed to determine support resource requirements.
- One critical support resource is fuel for trucks and generators. This is most critical for distant sites.
- Additional distant site resource packages beyond those tabulated in Table 6.7 are likely needed for some water providers that do not have a seismically-resilient backbone.

One workshop comment summarized the emergency drinking water distribution gap: "There is a disconnect between stored water and connecting it to people. Planning and assets are needed."

The templates provided in Figures 5.2 through 5.5 can be used by water providers and emergency management agencies to estimate their emergency water need and resources available during any of the three scenarios.

[1] Required spigots = (12,000 people per day) * (2 GPCD) / (600 minutes) / (1 gpm per spigot)

6.7 OPERATIONAL GAPS

Although basic intertie agreements exist between some water providers, project stakeholders identified that decision-making for resource sharing is typically not well defined for the Regional catastrophic event scenario. Some interties are unidirectional and only allow one direction of flow.

In some cases, one Island may have more than enough water for its basic emergency water need and may have a surplus. The surplus could either supply the Island longer or could potentially be used elsewhere. There could be an operational gap that will require additional decision-making regarding the potential use of "surplus" water in the Island.

The states have no clear requirements for monitoring water quality with emergency portable water systems other than hauling bulk water and who is allowed to operate the emergency treatment and distribution equipment in a non-conventional manner. OHA has indicated the mobile water treatment and distribution trailers are not "community water systems" according to OHA and OHA does not regulate emergency water standards. It is unclear if Washington has any regulatory requirements for the provision of emergency water distribution.

Another operational gap is that there is a lack of consistency in emergency communications among water providers and emergency response agencies. During the Regional Event, communications will be a major concern. Being able to connect with other water providers and the city/county emergency response agencies will be critical.

6.8 POLICY AND JURISDICTIONAL GAPS

Throughout the study, several gaps have been identified that have jurisdictional or policy implications. These include:

- Differences in governance structures of municipal water versus special districts for how water providers operate and what their authorities entail. These may create jurisdictional and oversight differences. Some municipal providers require jurisdictional approval to enter mutual aid agreements and expend money outside of their normal authority. Some are limited on what and when they can expend funds for emergency preparedness activities and would require special authority. Water districts may have more flexibility and take on responsibilities outside of their scope.
- Some water providers and emergency response agencies expect the states and FEMA to be responsible for the provision of water. According to the Oregon State OEM, the ESF function for the provision of water falls under the county and city EOCs as part of the mass shelter, food, and water distribution. Unfortunately, this issue is not consistently assumed or acknowledged, hence the need for this study to clarify where the responsibility rests.
- Many water providers or county/city EOCs do not understand that they are required by law to be responsible for the provision of water. Most of the guidance documents discussed in this study call for plans and call out assistance roles, but there is no agreement on a lead role. There is a gap between what the law requires versus the understanding of roles and responsibilities.

However, based on our outreach, most water providers believe they will be expected to provide emergency water to one extent or another by their community, the public, and their local political bodies regardless of who is legally responsible for it.

- PODs are/will be assigned by counties/cities and have not considered restrictions that may not allow transportation of water between Islands that span divided city/county boundaries. This could raise jurisdictional and reporting issues; for example, West PWB is covered by Washington County, but is governed by Multnomah County emergency response. Washington County has no authority to operate in Multnomah County, and PWB reports through the City to Multnomah County.
- There is a financial gap depending on who provides the equipment and materials for the distribution of water. If it can be capitalized, it might be absorbed by water providers under their organizational rules and regulations. If it is base-funded (non-capitalized), it is more expensive and may exceed the water provider's authority to finance. This is especially true if the provision of water is accepted as the responsibility of the county and city, and is not that of the water provider.
- We assume everyone will have the necessary storage containers for their daily water allotment. There are few provisions for supplying storage containers at the distribution sites.

7. Recommendations

7.1 INTRODUCTION

Successful implementation of the emergency water provision and distribution plans following a large disaster with broad and severe impacts (i.e., Regional Event) will require effective partnering and preparation at the federal, state, county, and local levels. Emergency response agencies bearing the primary responsibility of distributing emergency water tend to use standardized approaches that primarily include commercially-bottled water and may not have considered water providers or local water resources within their emergency response approaches. Water providers have made considerable progress in investing in resilient water supply and storage, as well as other infrastructure improvements over the past couple of decades. This readiness on the water providers' behalf opens opportunities for emergency management agencies to expand their approaches to incorporate water providers and local water resources in their planning. However, a lack of consensus on or clear definition for roles and responsibilities of water providers has led few water providers or emergency response agencies to invest in the planning or supplies required to leverage that resilient infrastructure for the support provision of emergency water.

An effective emergency response could leverage local water resources in concert with traditional commercially-bottled water resources both from within and beyond the state. That response requires additional deliberate planning and partnering at all levels, paired with investments in equipment and improvements specific to treating, storing, and distributing emergency drinking water. These investments also improve emergency response during localized or less impactful disasters (Scenarios 1 and 2, respectively).

As part of this study, recommendations have been proposed to help address potential gaps and/or barriers identified in Section 6 that would undermine the response capabilities for an effective and efficient Framework.

In this section, we identify proposed tasks or actions that can be implemented to close, and in some cases, only narrow those gaps. Table 7.1 is a cross-reference between those gaps, and the recommendations discussed in this section. The table is organized numerically in the order the recommendations are discussed. Everything in this section, which is not already assigned, is a recommendation and can be adjusted or changed as needed.

The following recommendations are offered in the spirit of helping the agencies in the region be more prepared and resilient regardless of the size and severity of the disaster.

Table 7.1: Recommendations Cross-Reference with Gaps

Recommendations	Gap
7.1 Establish realistic expectations for timing and scale of help from the state and beyond the Region.	6.2 Roles and responsibilities
7.2 Establish clear roles and responsibilities for emergency response, water providers, and emergency water provision.	
7.3 Include water providers and local water resources in city- and county-level disaster planning efforts	6.2.3 Lack of coordination between water providers and county/city emergency response planning 6.3 Emergency response agencies gap
7.4 Improve collaboration across Portland-Vancouver Metropolitan Region	6.2.3 Lack of coordination between water providers and county/city emergency response planning 6.3 Emergency response agencies gap
7.4.3 Develop and maintain a regional map of vulnerable populations. Use this map to develop plans using the emergency response routes necessary to access neighborhoods with vulnerable populations to target messaging and education to vulnerable populations	6.4.3 Planning and preparedness to reach vulnerable populations
7.5 Enhance emergency planning and emergency response for water providers	6.4 Emergency response planning by water providers
7.6 Water providers should complete planning and preparation for restoration of normal service following a disaster	6.6 Water supply and distribution resources
7.7 Water providers should complete planning and preparation for supporting emergency water provision following a disaster	6.6.4 Emergency water distribution
7.7.3 Invest in at least one resilient water storage facility within each emergency response Island	6.5 Water system recovery and infrastructure investment
7.8 Drive regional efforts to secure grants, procure equipment and supplies, and establish mutual aid agreements, and share information through RDPO	6.4.2 Regional mutual aid efforts gap
7.9 Improve outcomes for vulnerable populations	6.4.3 Planning and preparedness to reach vulnerable populations
7.10 Operational recommendations for water providers	6.7 Operational gaps
7.11 Policy and jurisdictional recommendations	6.8 Policy and jurisdictional gaps

7.2 ESTABLISH REALISTIC EXPECTATIONS FOR TIMING AND SCALE OF HELP FROM THE STATE AND BEYOND THE REGION

7.2.1 Planning

Regional and local planning is currently inhibited by a lack of clear understanding about emergency drinking water resources that can be expected from FEMA and the states of Oregon and Washington following a CSZ event. FEMA expects to respond immediately or at least within days after the CSZ event. Realistically, it may take time to reach the Region and start assembling the resources needed. FEMA's 2022 CSZ event planning efforts account for the impact on their staff and local resources, and they plan to mobilize staff and resources from other FEMA regions. FEMA indicated they plan to stage from the airports in Portland, Eugene, and Redmond. Realistic plans and resource estimates should be developed to better estimate resources. Further, local emergency management and water providers should plan to provide water until FEMA resources are available.

7.2.2 State Response

The states of Oregon and Washington expect to respond immediately following the CSZ earthquake. However, like FEMA, they will be responding themselves to the emergency and preparing responses to the communities they serve. Roads and bridges throughout the states will be damaged and transportation will be hampered and slow. Regional planning should prepare for delays in state help and drinking water resources.

7.2.3 Regional and Local Response

Regional and local emergency response agencies and water providers should expect to be on their own for a period of time and adjust their ERPs and plans for rationing and emergency water distribution to include emergency drinking water provision and distribution during their planning. Plans should include strategies for providing emergency water within the Region from a variety of sources and types – including water piped from available tanks and reservoirs that are intact; installing temporary overland hoses to undamaged pipes, tanks, or reservoirs; using any and all available beverage and food-grade trucks capable of hauling water from undamaged tanks and reservoirs to distribution sites; and using commercially-bottled water when nothing else is available in the quantities needed.

7.2.4 Recovery

Timelines on expected recovery of other interconnected and interdependent lifeline infrastructure systems are needed to facilitate water-specific planning. This is work outside the scope of this project. However, understanding the expected outages for power, transportation, sewer, and communications will help the Region plan better.

7.3 ESTABLISH CLEAR ROLES AND RESPONSIBILITIES FOR REGIONAL EMERGENCY RESPONSE, WATER PROVIDERS, AND THE EMERGENCY WATER PROVISION

7.3.1 County/City

We recommend county/city emergency response agencies take an active role in establishing, setting up, operating, and managing the emergency drinking water distribution sites with assistance from the water providers. The county and city EOC would be responsible for procuring any additional resources needed to manage sites, including chairs, tables, sanitation facilities for staff, etc.

A further recommendation is for county/city emergency response agencies to participate in practice exercises and take a more active role in learning about their local drinking water sources and critical infrastructure.

County/city emergency response agencies are recommended to work with water providers to establish emergency drinking water distribution sites in locations that can readily access available water sources (e.g., tanks, reservoirs, backbone piping, etc.) that the water providers expect to be intact following a Regional Event. County/city emergency response agencies should consider adding a water provider liaison in the EOC to improve coordination and communication between water providers and the city/county emergency response.

7.3.2 Water Providers

Water providers need to coordinate with their county/city emergency response agencies on where emergency water will likely be available, and where and how connections can be made. Water providers should identify and procure water materials and equipment necessary for each water distribution site.

OEM considers water treatment to be an emergency management activity and assumes that emergency response agencies will take the lead role with the water providers supporting the activity. However, at the tabletop exercise level, water providers indicated they thought they should lead, oversee, and manage the water treatment aspects for the emergency water distribution sites. Water providers should set up the mobile treatment equipment and operate it. The state regulators have indicated they will not oversee the mobile treatment and distribution; therefore, we recommend this activity remain in the water providers' purview and that they coordinate with the emergency response agencies for the overall provision of water.

Water providers would train county/city EOC-assigned field staff on operation of the distribution equipment, as needed. Water providers should work with county/city EOCs to transport/deliver water from source to PODs (i.e., tanks, reservoirs, backbone piping, etc.). Based on the information gathered, if the transportation is via overland piping, then water providers should install the temporary piping and equipment. If transportation is via trucks, the county/city EOCs should be responsible for managing that activity.

7.3.3 Roles and Responsibilities Summary

Based on the review of emergency drinking water planning guides, analyses of after-action reports for two water emergency events in or near the Region, and input from the Roles and Responsibilities workshop, we developed Figure 7.1 (appended at end of report), which is a flowchart for proposed responsibilities, and Table 7.2 summarizes the proposed roles and responsibilities for local, regional, state, and federal government agencies, NGOs, and private sector stakeholders with the emphasis on the Framework distribution. The proposed flowchart focuses on the provision of water activities and does not cover the myriad of other activities that will be transpiring during a disaster. Key points are that the water providers have expressed a strong desire to participate in the planning and executing of emergency drinking water provision plans and have made suggestions on how they can help. The water providers will benefit by getting the emergency management agencies to consider alternative ways to provide water besides commercially-bottled water; and they can work with the counties and cities on where and how many water distribution sites are feasible.

These organizations and stakeholders have their own jurisdictional authorities and are not obligated to follow these recommendations, particularly the state and federal agencies, and NGOs may not change how they operate or respond. Stakeholders need to understand how they operate and how the regional and local agencies work with them.

Table 7.2: Proposed Roles and Responsibilities for the Region

Agency	Role in Agency	Proposed Roles and Responsibilities	Proposed Best Practices
Residents and Businesses	NA	NA	• Maintain at least two weeks supply of drinking water after an emergency (one gallon per person per day at a minimum). • Include additional water for pets and livestock. • Prepare clean, refillable containers to obtain water from distribution sites.
Water Providers (including public municipality, Special District, PUD, or other)	Emergency Management (includes EOC, Engineering and Operations)	<u>Emergency Response</u> • Coordinate with city or county EOC to deliver emergency drinking water to identified PODs and islands. • Work with city/county EOC to develop demobilization plan for emergency water distribution as water infrastructure recovers. • Reach out to city/county emergency response whenever resources and/or capabilities are exceeded, and outside assistance is needed.	• Establish written mutual aid agreements (especially with agencies east of the Cascade Mountains and out-of-state). • Provide guidance, technical assistance, and staff to set up the mobile treatment and emergency distribution and PODs. • Contract with fuel vendors to ensure adequate and timely emergency fuel supply. • Establish agreements and/or emergency contracts with vendors for critical supplies, long lead-time items, and unique parts and materials expected to be needed during emergencies to aid in recovery. • Contract with engineers and contractors for technical assistance, emergency repair contracts, post-event damage assessment, or other services needed. • Install two-way interconnections, where feasible, with neighboring water providers and prepare written agreements with those that share the interconnection for maintenance and emergency assistance. • Procure water-related equipment and materials needed to provide emergency water from tanks, reservoirs, wells, and backbone piping PODs, as well as at treatment sites and distribution sites.

Agency	Role in Agency	Proposed Roles and Responsibilities	Proposed Best Practices
Water Providers (Continued)	Infrastructure Readiness	No change	• Create a map overlaying where resilient water storage is available and where the vulnerable populations are and address any infrastructure gaps. • Collaborate with city/county emergency management to develop resilient communication.
	Public Information Officer (PIO; or Communication Manager)	No change	• Establish relationships with local communities, NGOs, school districts, emergency response committees, and media for their assistance in communicating to the public in multiple languages and to those with disabilities. • Communicate the emergency response and emergency drinking water plans with all relevant government officials, NGOs, staff, other stakeholders, and the public.
City / County	Emergency Management	• Work with water providers to develop demobilization plan for emergency water distribution as water infrastructure recovers.	• Maintain a list of approved vendors for pre-packaged water supply. • Consider locations of vulnerable populations when identifying PODs and shortening required travel distances in areas with high concentrations of individuals with low mobility (e.g., seniors) or transportation access (e.g., low level of car ownership). • Further study to identify best practices for reaching vulnerable populations with water and other essential services. • Include vulnerable populations in the ERP. • Develop collaborative resilient communications and structure with water providers. • Invest in a centralized data center/platform to show status about outages and the status of repairs. • Develop process for communicating status for all utilities to avoid duplicating efforts.

Agency	Role in Agency	Proposed Roles and Responsibilities	Proposed Best Practices
City / County (Continued)	PIO	No change	No change
	Department of Public Works (Division or DOT)	No change	No change
	Law Enforcement	No change	No change
County-specific (not listed above)		No change	No change

Agency	Role in Agency	Proposed Roles and Responsibilities	Proposed Best Practices
Oregon / Washington State	State Governors	No change	No change
	State Emergency Manager or Incident Commander	No change	• Revisit ESFs to ensure appropriate state agencies are leading emergency water distribution and recovery.
	Oregon DHS / Washington DSHS	No change	No change
	OHA or DOH	No change	• Provide guidance on treatment of emergency water supplies.
	Department of Transportation	No change	No change
	National Guard	No change	No change
Federal	FEMA	No change	No change
	USACE	No change	No change
RWPC	NA	NA	No change
ORWARN/ WAWARN	NA	NA	• Continue to promote shared worker agreement (OR).
Power Utilities (Portland General Electric [PGE], Pacific Power,	NA	NA	• Prioritize requests from water providers for restoration of power. • Collaborate with water providers to prioritize pre-disaster mitigation so that power services can be restored quickly for water facilities.

Agency	Role in Agency	Proposed Roles and Responsibilities	Proposed Best Practices
Columbia River PUD, Clark Public Utilities, etc.)			
Communication Providers	NA	NA	• Prioritize restoration of communications for water providers. • Collaborate with water providers to prioritize pre-disaster mitigation so that communication services can be restored quickly for water facilities.
Private Consultants and Contractors	NA	NA	• Provide technical assistance and post-event damage assessment. • Assist in preparing emergency plans and specification for repairs. • Assist in repairing the damages to water systems, as requested.
CERT/NET and other volunteers	NA	NA	• Participate in the development of an emergency drinking water plan. • Assist federal, state, and local emergency responders, including water providers, as requested. • Help staff and support the operation of PODs and including delivering water to vulnerable customers unable to access the distribution sites on their own.

*Notes: NA = Not Applicable; **Blue Font** = Proposed Change; Blank Boxes or Regular Font = No Change*

7.4 INCLUDE WATER PROVIDERS AND LOCAL WATER RESOURCES IN CITY- AND COUNTY-LEVEL EMERGENCY RESPONSE PLANNING EFFORTS

Another recommendation and request from the water providers was that they be included in city/county emergency planning, especially where water resources are involved. It is highly likely that during a large event, water providers and even local emergency management agencies will not have the resources they need to handle the disaster alone and will seek assistance from others, whether it is escalating needs to the state or federal level, using one or more of the WARN networks, use of emergency contracts or agreements, using volunteers, emergency or on-call contractors, engineering, or other outside help. It is possible to arrange for agreements or contracts with these other agencies during pre-disaster planning or after the disaster during emergency response and recovery. The more that are in-place prior to a disaster, the quicker the responses can be. The following recommendations are offered as further explanation.

7.4.1 Points of Distribution

Consider local water resources and Islands in identifying location of PODs from either tanks, reservoirs, or backbone pipes based on where water providers expect water to be available. Locate PODs in areas that reach vulnerable populations and diverse communities especially those that cannot physically reach the PODs. Consider a further study to address how better to reach these vulnerable populations. Water providers are concentrating their infrastructure investments on making their storage and backbone transmission/supply mains and critical distribution sites resilient as their first priority. It is anticipated that, during and after a major event, water systems would experience significant damage throughout the Region, and water services would be disrupted. Coordination with the water providers is essential for advanced planning and for verifying actual locations after the disaster. Understanding the location of resilient water storage and supply, especially tanks with seismic valves or some alternative way of isolation, within the county/city is important. These are likely to be the only ones that survive a regional scenario (such as the CSZ event).

7.4.2 Emergency Transportation Routes

Include emergency transportation routes to key water facilities and equipment needed for response and recovery of the water system in county and city transportation planning.

7.4.3 Fuel

Include fuel required for emergency water provision, and for restoration of regular water service in emergency fuel planning.

7.4.4 Communication

Establish emergency communication systems (including equipment and standardized procedures) between county/city EOCs and water providers. Develop collaborative resilient communications and structure between emergency management and water providers. Invest in a centralized data center/platform to show status about outages and the status of repairs. Develop processes for

communicating status for all utilities to avoid duplicating efforts. Water providers need to coordinate public messaging regarding status of drinking water and water system infrastructure with emergency response joint information centers.

7.4.5 Fuel Agreements and Contracts

Establish agreements with potential vehicle and fuel providers required to support emergency water distribution.

7.4.6 Commercial Agreements and Contracts

Include agreements with commercial providers of bottled water and other beverage or food-grade tanker trucks, and potable water distribution trucks and equipment in planning efforts. No one solution will satisfy all the needs for emergency water distribution. It will take a combination of strategies and options to provide emergency drinking water while the water systems are restored.

Establish agreements and/or emergency contracts with vendors for critical supplies, long lead-time items, and unique parts and materials expected to be needed during emergencies to aid in recovery. Consider contracts and agreements needed for each Island and stage materials, supplies, and equipment for each Island.

7.4.7 Engineering Consultants, Contractors, and Emergency Providers

Maintain a list of approved consultants, contractors, and emergency support for water system recovery and emergency water provision and distribution. This could be performed with emergency contracts that are regularly updated, and/or emergency provisions could be added into existing on-call contracts to cover emergency response.

7.4.8 Mutual Aid Agreements

Explore and consider use of other cooperative agreements that might exist with other public agencies such as ODOT, WSDOT, California Department of Transportation, etc. If there is an existing agreement, theoretically any public agency can piggy-back onto it. FEMA.gov has list of existing contracts that can be used as well as examples of mutual aid agreements available. Two such links are listed below.

Advance Contracts of Goods and Services | FEMA.gov

https://www.fema.gov/sites/default/files/2020-07/fema_nims_mutual_aid_guideline_20171105.pdf

Coordinate with the water providers on what mutual aid agreements are needed to minimize duplication of efforts.

ORWARN, WAWARN, and FEMA all have samples of mutual aid agreements.

7.4.9 Staff Planning

Water providers and emergency response agencies will more than likely call on non-technical staff (i.e., not the operators, distribution maintenance staff, engineers, and emergency response staff) and volunteers to assist in emergency water distribution site management. There should be a plan for how to utilize such staff with appropriate instructions for management and operation of the distribution sites.

7.4.10 Exercises

Conduct regular tabletop exercises between county/city EOCs and water providers. Expand on the coordination in planning and exercises that the RWPC has been doing with the county/city EOCs.

7.4.11 Available Resources

County/city EOCs should become familiar with available water supplies and resources within their jurisdiction. Water providers should work with emergency managers to identify strategies for sharing critical water system infrastructure geographic information system (GIS) datasets (where possible without violating confidentiality requirements). County/city EOCs should work with the water providers to protect and maintain the water provider information and infrastructure confidentiality.

7.5 IMPROVE COLLABORATION ACROSS THE REGION

Before any of these recommendations can be implemented, RDPO, the regional water providers, and city and county representatives should convene to refine and prioritize the proposed recommendations and complete associated feasibility studies as appropriate to determine leading and supporting agencies for implementing each recommendation, required staff and financial resources, and potential sources of required funding. This set of recommendations is intended to be accomplished at a regional and local levels (regional agency to be determined).

7.5.1 Education and Training

Educate, train, and encourage local water providers to develop an emergency drinking water plan, including identifying resource gaps to meet population needs in the event of an emergency.

7.5.2 Resource Gap Planning

Aggregate available resource gaps identified at local levels to estimate resource gaps at the regional level and collaborate with local water providers and various levels of government to identify potential options to address the gaps.

7.5.3 Vulnerable Population Mapping

Develop and maintain a Region-wide catalog and map of vulnerable populations. Metro has started this work already. Local government/water service providers can use this map with the emergency water

distribution plans and the emergency response routes to access neighborhoods with vulnerable populations. This map can also be used to target messaging and education to vulnerable populations.

7.5.4 Vendors

Maintain a list of approved vendors for the pre-packaged water supply. Develop municipal standing offer agreements or contracts with bottled water and other beverage bottling companies and commercial water hauling companies. This will ensure quicker and less expensive emergency water supply and delivery.

7.5.5 Mutual Aid Agreements

Promote mutual aid agreements or Memoranda of Understanding among water providers and emergency management agencies within the five-county Region to share emergency resources under pre-defined liability and insurance provisions. With pre-defined and executed mutual aid agreements, water providers in the Region can directly work with each other, and coordinate emergency response operations and resources without activating state-level EOCs to request assistance across the state border. Without the advance mutual aid agreements, a state disaster declaration is needed to request and provide aid across state boundaries.

7.5.6 Inventory Updates

Promote a standing work item within the RDPO annual work plan to update the inventory of emergency water treatment and distribution resources owned by local water providers and local governments. The information of the resource inventory will help the local water providers and local governments to refine their ERPs accordingly. The local water providers and local governments can also use this information to strategically target their grant applications for purchasing resources and equipment that can benefit both an individual water provider and the Region.

7.5.7 Fuel Agreements

Represent member water providers to negotiate with liquid fuel vendors to develop municipal standing offer agreements for fuel.

7.5.8 Communication

Promote a more reliable and resilient telecommunication technology among member water providers and local governments. Loss of communication is very common in an emergency. A compatible communication system would allow affected water providers to directly communicate and coordinate resources with EOCs more efficiently and effectively. Also, supporting redundant technology could extend communications capabilities during disaster response. Conduct an assessment of water providers' communications capabilities and identify methods of interagency communication and opportunities to improve interoperability.

7.5.9 Plan Updates

Continue to update and refine the Regional MACS ConOps Plan (RDPO, 2017). Provide ongoing orientation to the Regional MACS for regional stakeholders and oversee implementation of this Regional plan to ensure proper allocation of scarce resources at the Regional level.

7.5.10 Trucking Resources

Trucks to haul the water bladders/tanks or tanker trucks were not considered in this project but represent a real resource need for the distant sites to receive hauled water. A follow-up activity would be to inventory companies and agencies with these resources within the Region.

7.5.11 Contracted Resources

Contracted resources such as water hauling services and private wells have potential to meet some of the additional resource needs of distant sites. These options should be evaluated as additional regional resources.

7.5.12 Prioritizing Infrastructure Resilience Improvements

Organized regional support for prioritizing infrastructure resilience improvements would be helpful for jurisdictions that govern the water providers, especially when it comes to approving and supporting funding needs.

7.5.13 Distribution Policies

Regional water distribution policies that involve both regional collaboration and jurisdictional recommendations that would help in emergency response should be developed.

7.5.14 Plan Updates

Develop regular Framework updates to coincide with USEPA- and state-required water system ERP updates.

7.5.15 Mitigation Studies

Support additional studies to mitigate limitations to water supply from interdependent systems, considering fuel storage, access, and communications. Many of the water supply facilities use backup generators with on-site fuel for operation during power outages. However, these fuel supplies may only last for a few days. A collaborative fuel storage approach may be a solution to the presumed failed fuel supply during a catastrophic event.

7.5.16 Individual Preparedness

RDPO, emergency management agencies, and water providers should continue to promote individual preparedness such as the "Two Weeks Ready," "Start with Water," or similar campaigns.

https://www.oregon.gov/oem/hazardsprep/Pages/2-Weeks-Ready.aspx

https://www.regionalh2o.org/emergency-preparedness/start-water

Supplement with messaging on the value of minimal preparedness with goal of residents having at least 3 days of water and container(s) for individual water transport.

7.5.17 Grants

Consider a grant to provide every household with at least one water container (2 gallons or two 1-gallon containers per person supplied by water providers or emergency response agencies or even RDPO). Actively seek more grants to fund emergency treatment and drinking water treatment and distribution trailers and equipment needed for providing emergency drinking water.

7.6 ENHANCE EMERGENCY PLANNING AND EMERGENCY RESPONSE FOR WATER PROVIDERS

Emergency preparedness planning and response are important to keeping the Region livable and viable following a major disaster. We found in this study that levels of preparedness and advance planning were inconsistent across the Region. To address this, we propose the following:

- Participate in emergency planning efforts at the county, city, regional, and state level.
- Join ORWARN/WAWARN.
- Complete resource typing following the approach laid out in ORWARN/WAWARN.
- Develop a COOP. This is usually considered an annex or supplement to the ERP and is a tool for how the organization will operate during the disaster to recover as quickly as possible.
- Maintain paper copies of basic water system and critical organizational information and response plans. This is good practice to have paper copies in addition to whatever electronic media agencies have, since power and electronic equipment may not be available initially.
- Conduct regular emergency response trainings (at least annually) within the organization on the ERP and NIMS ICS process.
- Practice using NIMS in "everyday" emergencies. Examples could include main breaks, boil water notices, and water quality upsets.
- Identify and ensure that each water provider has a seismically-resilient EOC building if they do not already have one.
- Develop a plan of how water will be provided within each Island, including consideration of mobile water treatment, temporary overland piping, bottled water on site, locally stored water and supply, and commercial resources. Be open to other resources that can help accomplish the

same objective, such as using other beverage bottling companies, contractors with water trucks, or food-grade tanker trucks.

- Engage in emergency on-call agreements or contracts with engineering and construction contractors and other vendors.
- Engage in mutual aid agreements and contracts.
- There are minimal pre-arranged emergency on-call contracts with engineering consultants or construction contractors, service providers, deliveries, and suppliers. We suggest water providers and emergency response agencies assess what contracts and agreements they already have, and what they can prepare in advance. Where possible, consider adding emergency response to the scope of work for upcoming contracts.
- Extend mutual aid agreements and contracts further east of the Cascades and south of Cape Mendocino, California.

See Figure 7.2 below for additional guidance for individual water providers.

Recommended Utility Preparedness Guidance for Individual Water Providers

1. *Adopt or Integrate Regional Framework into ERPs (Roles/Responsibilities, Level of Service Goals, etc.)*
2. *Identify Emergency Distribution Service Gaps*
3. *Evaluate Supply Resilience*
4. *Evaluate Distribution Infrastructure Resilience (Rely on Seismic Plans and Risk and Resilience Assessments [RRAs])*
5. *Identify Gaps Where Customers Lack Water (Review RRAs and ERPs) and Update Water Supply Support Maps*
6. *Update ERPs to Fill Service Gaps*
7. *Prioritize Isolation of Stored Water*
8. *Valve Closure Plan to Reduce Leaks and Maintain Pressure*
9. *Backbone System Restoration*
10. *Full System Restoration*
11. *Incorporate Administrative Actions*
12. *Regular Coordination with Emergency Planning*
13. *Stockpiling*
14. *Retainer Agreements*
15. *ShakeAlert® Earthquake Early Warning*
16. *"Two Weeks Ready" and Other Public Campaigns*

Figure 7.2: Recommended Water Provider Preparedness Guidance for Individual Water Providers

7.7 WATER PROVIDERS SHOULD COMPLETE PLANNING AND PREPARATION FOR RESTORATION OF NORMAL SERVICE FOLLOWING A DISASTER

While many of the water providers are diligently working to make their water systems resilient in the long run, there is work that could be done in the near-term to enhance their readiness. The following are ideas to be considered and implemented where appropriate.

- Create and maintain a backbone isolation plan. Implement necessary capital improvements to facilitate backbone isolation during a major emergency.
- Improve current water curtailment plans if they are missing a catastrophic emergency-level plan. Such a catastrophic plan may resemble or include a backbone isolation plan. The goal is two-fold: keep the backbone pressurized and prevent loss/demand from draining the system.
- Invest in at least one resilient water storage facility or well within each Island. Include the infrastructure/equipment required to access the source, tanks, and reservoirs through emergency connections (aboveground). Include flexible connections to the buried piping, test ports, spigots, etc.
- Install or retrofit storage facilities with seismically-activated valves or ShakeAlert®-triggered isolation valves. Or consider at least as an interim alternative, program some tanks and reservoirs (or the cells inside them) to fail open and others to fail closed so that some water is retained in the tanks and reservoirs for emergency drinking water.
- Managing firefighting expectations will be necessary. Fire flow will be limited or non-existent following a CSZ earthquake. It will be difficult for fire trucks to reach fires and the normal infrastructure (hydrants and pipes) they use will not be available. Firefighting efforts will need to rely on other non-potable sources for firefighting purposes – such as drafting water from rivers, streams, lakes, pools, and other bodies of water.

7.8 WATER PROVIDERS SHOULD COMPLETE PLANNING AND PREPARATION FOR SUPPORTING EMERGENCY WATER PROVISION

7.8.1 Planning

All water providers with over 500 connections (small systems and larger) should have an emergency water distribution plan. Things to consider in the development include: 1) coordination and participation with the county/city emergency response agencies in development of the plan; 2) identification of PODs; 3) number of distribution sites; 4) involvement of all the providers in a single Island; 5) consider that people will be walking or riding bikes to the distribution sites; and 6) people may not have suitable containers for hauling their water allotment. Ideally, the plan should identify an approach to providing emergency drinking water through existing storage or sources or the backbone piping. The plan should identify all required resources (e.g., equipment, trucks, tanks, and fuel), as well as infrastructure improvements (e.g., water access points at reservoirs) for each site, considering local commercial resources.

Consider planning for those that arrive at distribution sites without a container. Consider providing containers as a contingency. Also, in the plan, consider how and who trains staff and volunteers to support the mobile treatment and emergency distribution sites.

Look at the water system, particularly map the resilient water storage that is expected to be available and overlay that with a map of known vulnerable populations to address any infrastructure gaps. Then use this information to identify infrastructure projects to help better serve these areas.

7.8.2 Investments

In addition, in coordination with the county/city EOCs, we recommend the water providers invest in and procure equipment and materials (e.g., trailer, pipes, manifold, fittings, nozzles, hoses, mobile treatment plant, overland temporary piping, etc.) required for the emergency drinking water treatment and distribution sites once the quantity and locations are mutually agreed upon with both parties.

7.9 DRIVE REGIONAL EFFORTS TO SECURE GRANTS, PROCURE EQUIPMENT AND SUPPLIES, ESTABLISH MUTUAL AID AGREEMENTS, AND SHARE INFORMATION THROUGH RDPO

- Coordinate and drive mutual aid agreements and emergency contracts with agencies and vendors outside the CSZ Event zone on a Regional level. Look beyond existing in-state water provider mutual aid agreement through ORWARN/WAWARN and extend agreements toward southern California, Nevada, Idaho, and Utah.
- Emergency contracts and agreements can be done at the individual agency level or grouped with other agencies. Also contracts and agreements by one agency may be usable by other agencies through cooperative agreements. Regionally this would benefit everyone and accelerate emergency response and recovery.
- Share information on best practices and lessons learned.
- Share information on water quality regulations during emergencies.
- Secure grants or help organizations such as RWPC secure grants to purchase, store, and maintain water distribution equipment and supplies.

7.10 IMPROVE OUTCOMES FOR VULNERABLE POPULATIONS

7.10.1 Increase Preparedness of Vulnerable Populations

Increase preparedness of vulnerable populations by promoting disaster preparedness and directly providing resources (e.g., sanitation buckets and information, bleach, water containers, disinfection information, and instructions for accessing a water heater) to vulnerable community members. Develop a Regional grant program to distribute grants to community organizations that serve vulnerable populations (e.g., seniors, immigrants). Many of those organizations operate on a county or regional level, spanning numerous cities and water providers. Organizations do not need an existing emergency focus; they just need connection to the community and willingness to be involved in emergency preparedness.

7.10.2 Develop Plans to Reach Vulnerable Populations Following a Disaster

Identify best practices for reaching vulnerable populations, especially individuals that cannot access distribution centers. Provide the information to emergency management agencies and water providers for incorporation into their ERPs, emergency water distribution planning, and coordination with CERT/NET organizations.

7.10.3 Community Emergency Response Teams

Share information with CERT/NET on emergency water provision plans, including planned or potential POD and volunteer needs. Leverage volunteer resources to further promote emergency preparedness and to support services to vulnerable populations following a disaster.

7.10.4 Volunteer Organization

Include volunteer organizations in intra-Island-level emergency water planning.

7.10.5 Communication

Basic Earthquake Emergency Communication Nodes are sites in Portland set up in advance for the community to request assistance or to report severe damage or injuries. These sites may be utilized to become distribution sites as well.

7.11 OPERATIONAL RECOMMENDATIONS FOR WATER PROVIDERS

- Continue looking for opportunities to install seismically-resilient interties where feasible to allow for potential transfer of water from one Island to another. Such transfers could level out the disparities between some interconnected Islands. Interties would need to be tested, disinfected, and maintained to assure readiness.
- Expand staging areas for staff, equipment, and materials so they are not centralized in only a few areas. Make them more accessible to the Islands and PODs.

7.12 POLICY AND JURISDICTIONAL RECOMMENDATIONS

7.12.1 Funding

Encourage funding of equipment and resources needed in advance of an event.

7.12.2 Jurisdictional Roles

Water providers are offering and requesting to take an active role in assisting in the provision of water. This may require developing interagency agreements to implement.

7.12.3 Authorizations

Encourage and develop any political authorizations needed to provide the funding, resources, and equipment for the provision of water.

7.12.4 Interagency Agreements

Interagency agreements (if needed) to address Island-level and inter-agency coordination should be developed. Examples include the following:

- Where an Island stretches across two counties, confirm with county emergency management where all entities in the Island can report, and when it would be more appropriate for water providers in the other county to just report to their home county.
- In many instances, when an Island contains multiple water providers, agreements on decision-making structures and methods are needed. WARNs only provide a platform to facilitate sharing resources. That is foundational, but how decisions will be made about sharing limited resources between multiple cities and districts is also needed. This was noted in more than one workshop.

7.12.5 Standardizations

Promotion of standardization that facilitates a coordinated and compatible response. Examples include at least the following:

- Standardization of radio systems or other backup communication methods; and
- Standardization of distribution point water distribution equipment.

7.12.6 Coordination with Fire Districts

Coordination with fire departments/districts is necessary to align expectations and to mitigate and prioritize water use for firefighting. Address alternate water sources and use expectations for urban wildfires. Encourage policies which would help limit draw-down of potable water tanks in scenarios (e.g., a major earthquake where they could be difficult to refill). Strategies could include switching to non-potable sources and preference for non-water fire suppression/containment solutions. Setting priorities in advance can help preserve water for both drinking as well as select firefighting needs.

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FIGURES

Figure ES-6
Emergency Drinking Water Framework
Proposed Flowchart Roles and Responsibilities

Disaster Occurs

WP:
Is drinking water available?

Yes

WP:
Proceed with provision.

No

WP:
Assess internal resources, equipment, and staff to handle.

WP:
Can it be handled internally?

Yes

No

No

WP:
Is County/City EOC aid needed?

WP:
Is WARN aid needed?

WP:
Follow WARN mutual request process.

WARN Members:
Aid found, negotiated
Gathered, sent to WP.

WP:
Elevate to County/City EOC

County/City EOC:
- Declare disaster;
- Assess resource needs;
- Assess status; and
- Coordinate response.

County/City EOC:
Assess and establish POD resources
- Where it is needed;
- How much;
- what equipment;
- In what form – bottled, tankers, trucks; and
- Staff resources needed.

WP:
Send <u>available</u> resources to help County/City EOC as requested.
Including:
- **Develop emergency water plan in coordination with County/City EOC;**
- **Set up PODs at tanks, reservoirs and backbone pipe locations where feasible;**
- **Assess specific POD needs with County/City EOC;**
- **Procure water-related equipment materials for emergency water treatment and distribution sites <u>as agreed to locations and quantities</u>; and**
- **Provide technical assistance and training in locating sites, setup and operating water equipment.**

Do County/City EOC have ability, resources to provide emergency drinking water?

Yes

No

County/City EOC:
Set up PODs; staff, operate and manage emergency drinking water distribution sites **including:**

- **Coordinate with Water Providers;**
- **Procure tankers, trucks, blivits to transport water from available tanks, reservoirs and pipe POD to emergency water distribution sites;**
- **Procure materials, equipment and supplies needed at the distribution sites needed to manage, staff and operate sites that are not obtained by water provider.**

County/City EOC:
Request aid from State EOC.

County/City EOC: Request and obtain assistance through mutual aid agreements or EMAC.
Coordinate with Water Providers to identify mutual aid needs to assist at distribution sites.

County/City EOC:
Receive resources from mutual aid and/or other states.

State EOC:
Is FEMA or EMAC assistance needed?

No

Yes

State EOC:
Send resources to County/City EOC **including temp treatment and distribution facilities.**

Other states send requested resources to State EOC.

State EOC:
Request aid through EMAC and/or from FEMA **including temporary treatment and distribution facilities.**

FEMA tasks USACE to assist state emergency water provisions.

USACE sends pallets of water to state EOC.

USACE sends resources to set up temporary treatment and distribution sites if requested.

LEGEND
Agency Responsible:

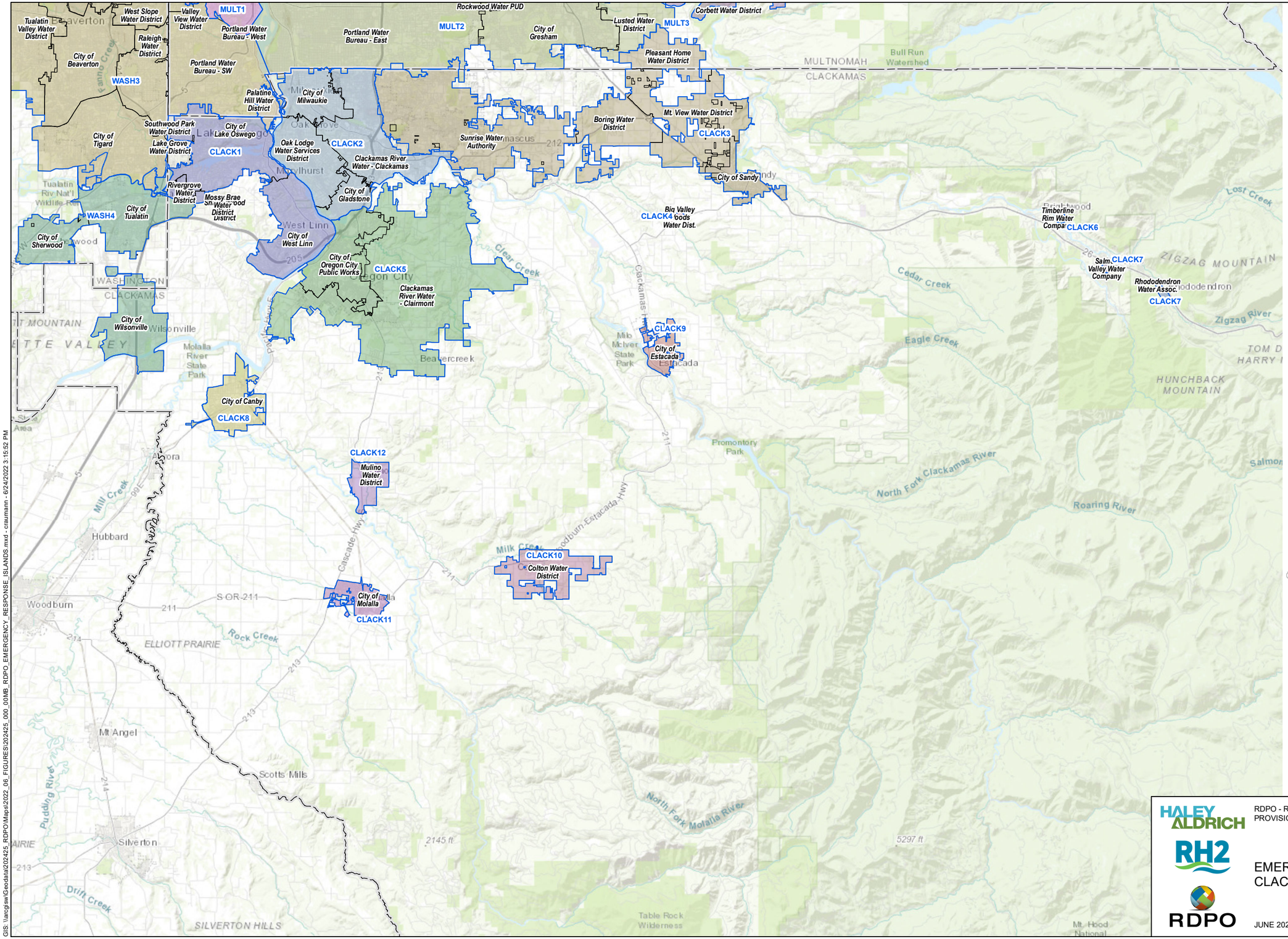
- Water Provider
- County/City Emergency Management
- State Emergency Management
- FEMA / USACE

ACRONYMS
Bold denotes proposed change.
EMAC = Emergency Management Assistance Compact
EOC = Emergency Operations Center
FEMA = Federal Emergency Management Agency
POD = Point of Distribution
USACE = United States Army Corps of Engineers
WARN = Wastewater Agency Response Network
WP = Water Provider

RDPO Regional Disaster Preparedness Organization
Unified. Prepared. Resilient.

REGIONAL WATER PROVIDERS CONSORTIUM

HALEY ALDRICH



LEGEND

- WATER DISTRIBUTION ISLANDS (VARIOUS COLORS)
- WATER DISTRICT SERVICE AREA
- COUNTY BOUNDARY

ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

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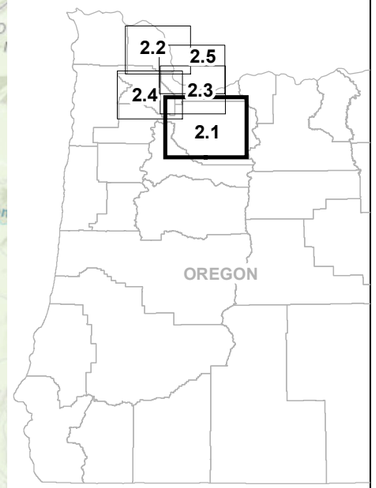
BASE MAP SOURCE: ESRI

FIGURE INDEX MAP



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RDPO - REGIONAL DISASTER PREPAREDNESS ORGANIZATION
PROVISION OF EMERGENCY DRINKING WATER FRAMEWORK

EMERGENCY RESPONSE ISLANDS CLACKAMAS COUNTY

JUNE 2022

FIGURE 2.1

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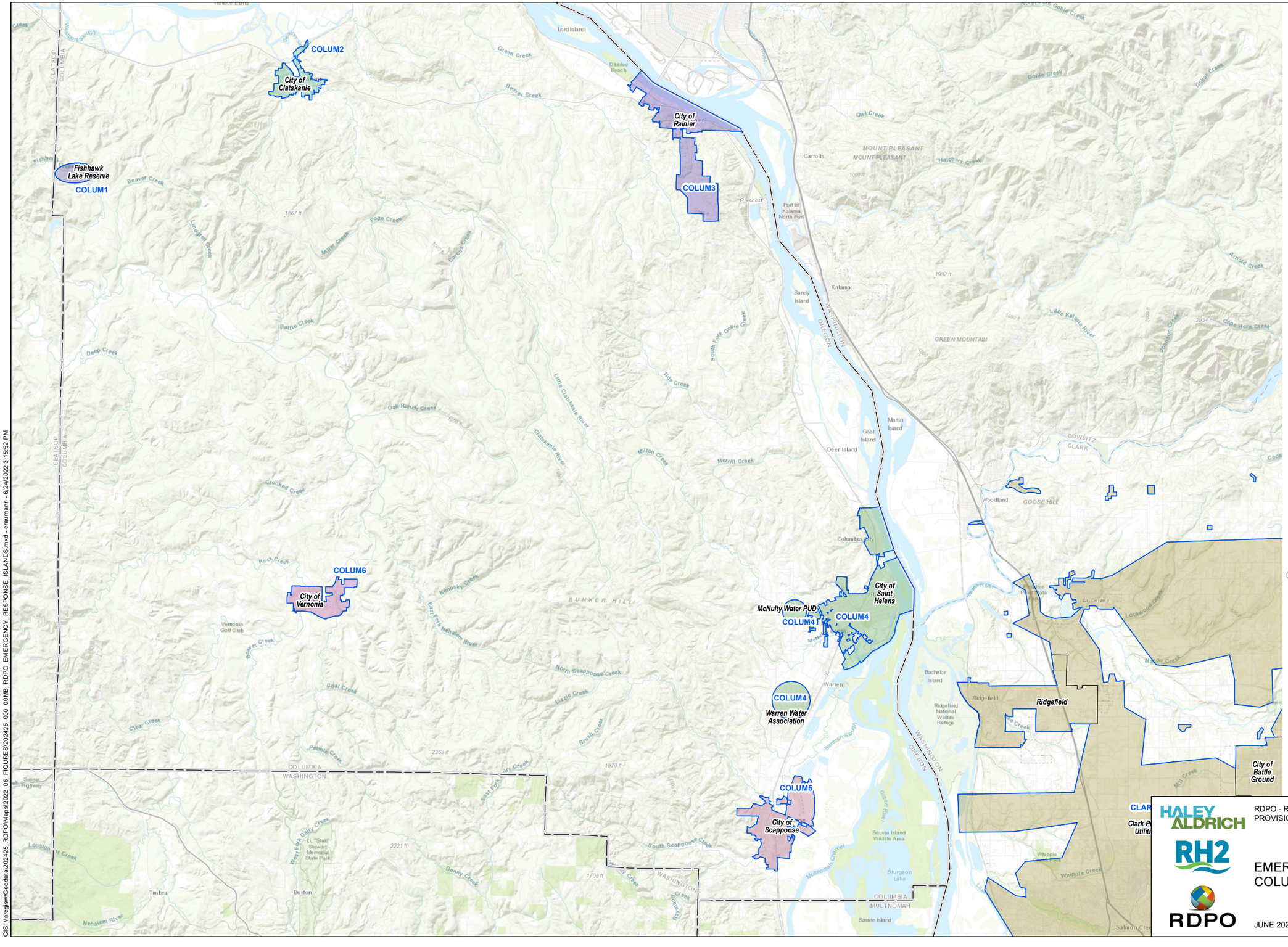

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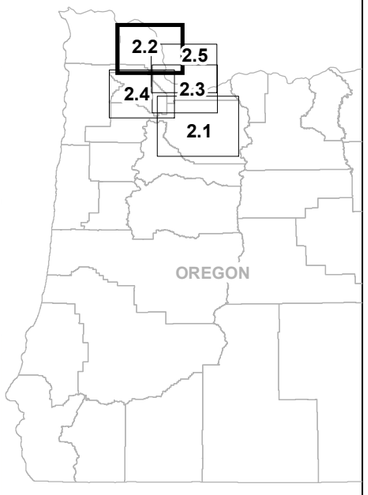

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RDPO - REGIONAL DISASTER PREPAREDNESS ORGANIZATION
PROVISION OF EMERGENCY DRINKING WATER FRAMEWORK

EMERGENCY RESPONSE ISLANDS COLUMBIA COUNTY

JUNE 2022

FIGURE 2.2

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COLUM5
City of Scappoose
City of Battle Ground
CLARK1
Clark Public Utilities
Larch Corrections Center
CLARK2
CLARK1
Burlington Water District
MULT1
Portland Water Bureau - East
MULT2
Portland Water Bureau - West
Tualatin Valley Water District
West Slope Water District
Valley View Water District
WASH3
Raleigh Water District
City of Beaverton
Portland Water Bureau - SW
City of Hillsboro
City of Vancouver
City of Camas
City of Washougal
CLARK3
MULT3
City of Fairview
City of Wood Village
City of Troutdale
Rockwood Water PUD
Corbett Water District
City of Gresham
Lusted Water District
Pleasant Home Water District
City of Milwaukie
Palatine Hill Water District
Sunrise Water Authority
Boring Water District
CLACK3
Southwood Park Water District
City of Tigard
Lake Grove Water District
City of Lake Oswego
CLACK1
Clackamas River Water - Clackamas
Oak Lodge Water Services District
CLACK2
Mt. View Water District
City of Sandy
Rivergrove Water District
Mossy Brae Water District
Shadowood Water District
City of Tualatin
WASH4
City of Gladstone
City of West Linn
City of Oregon City Public Works
CLACK5
Clackamas River Water - Clairmont
Big Valley Woods Water Dist.
CLACK4
City of Sherwood

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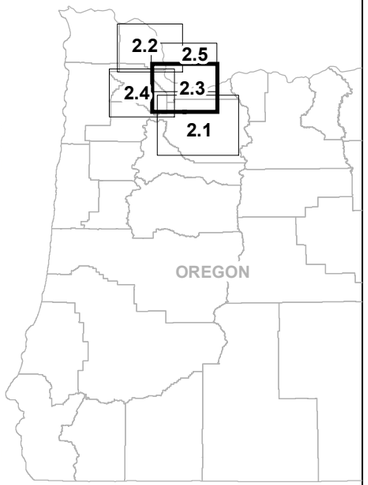

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RDPO - REGIONAL DISASTER PREPAREDNESS ORGANIZATION
PROVISION OF EMERGENCY DRINKING WATER FRAMEWORK

EMERGENCY RESPONSE ISLANDS MULTNOMAH COUNTY

JUNE 2022

FIGURE 2.3

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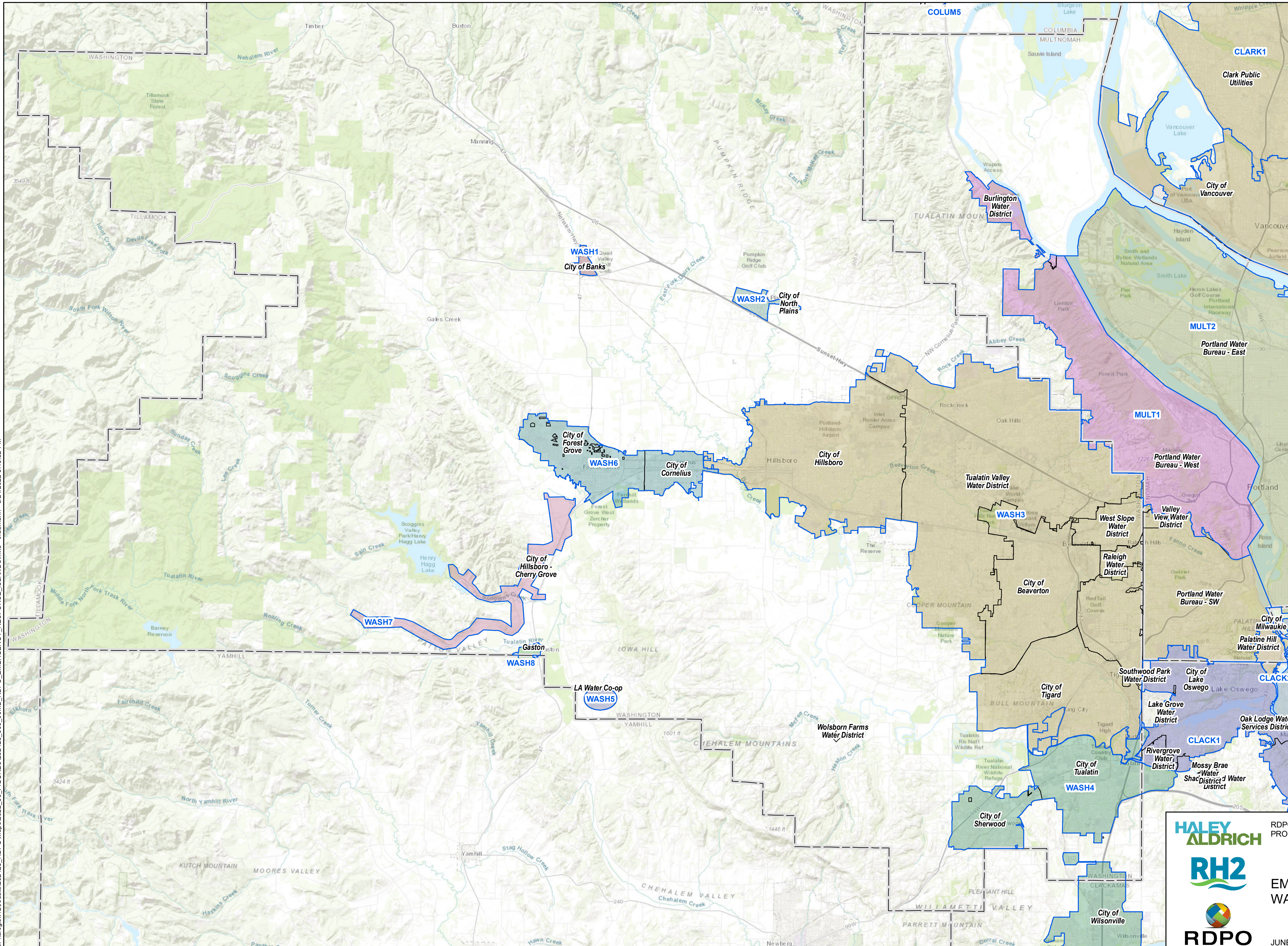

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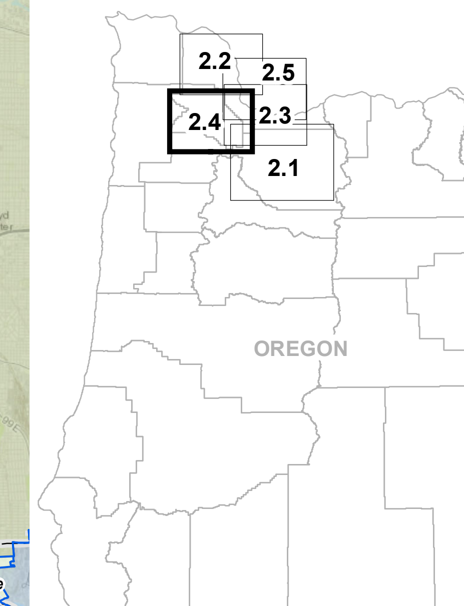

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PROVISION OF EMERGENCY DRINKING WATER FRAMEWORK

EMERGENCY RESPONSE ISLANDS WASHINGTON COUNTY

JUNE 2022

FIGURE 2.4

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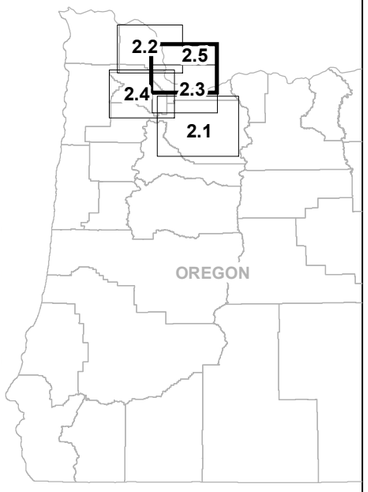

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RDPO - REGIONAL DISASTER PREPAREDNESS ORGANIZATION
PROVISION OF EMERGENCY DRINKING WATER FRAMEWORK

EMERGENCY RESPONSE ISLANDS CLARK COUNTY

JUNE 2022

FIGURE 2.5

Figure 3.5
Emergency Drinking Water Framework:
Roles and Responsibilities Flowchart – Current Process

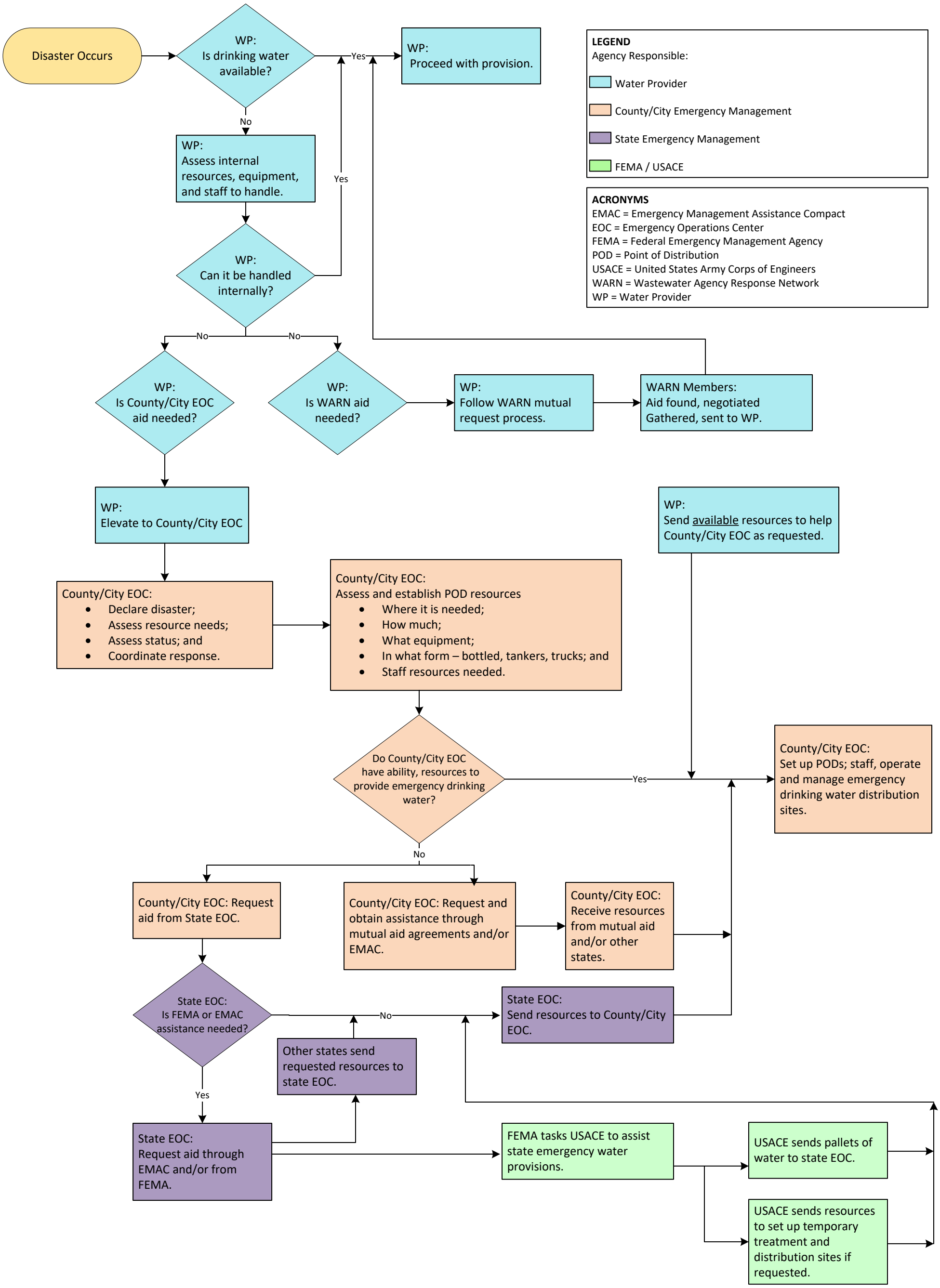

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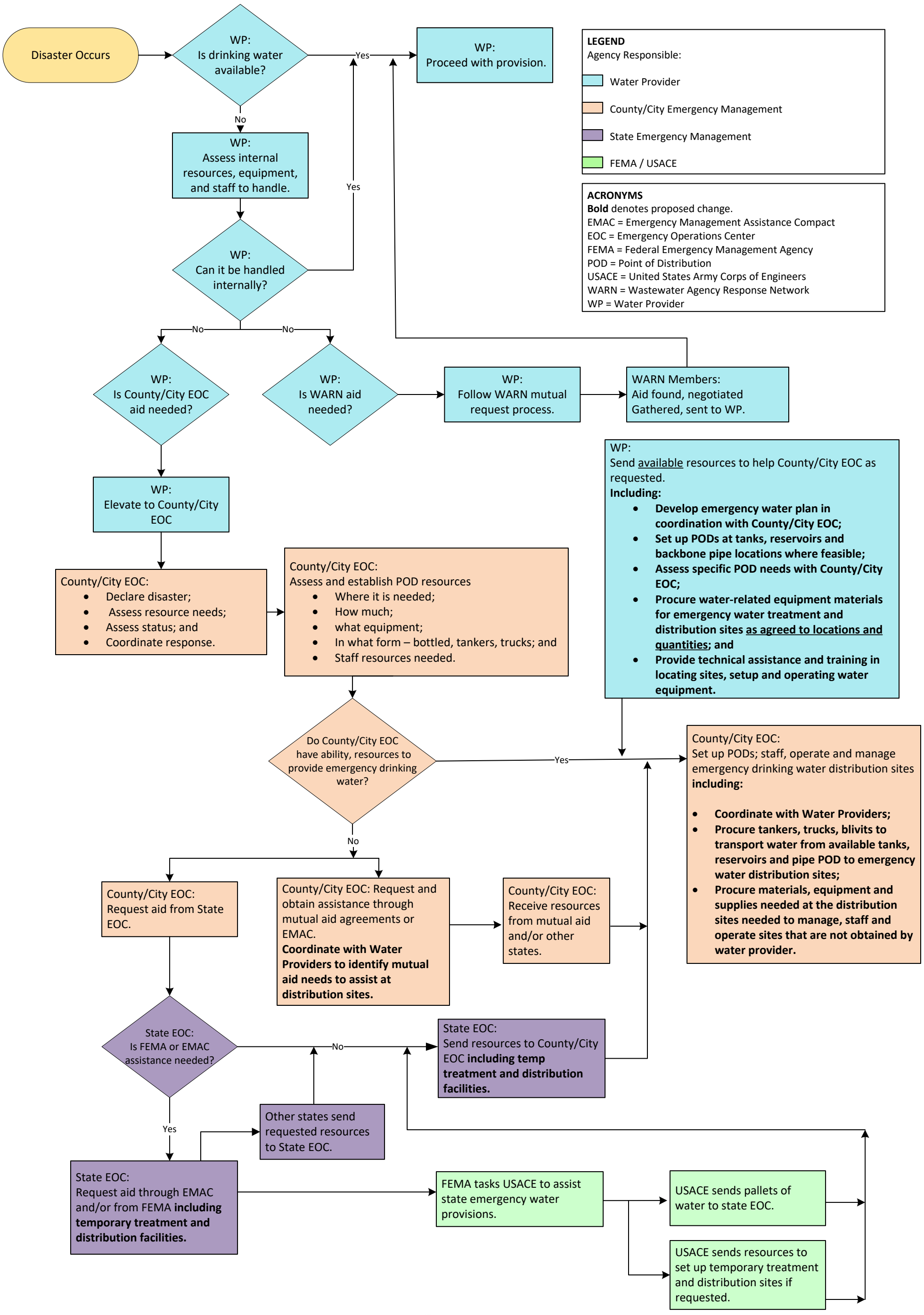
Figure 7.1
Emergency Drinking Water Framework:
Roles and Responsibilities Flowchart – Proposed Process



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APPENDIX A
Examples from Other Regions

As one stakeholder said: “we are informed by what we’ve learned from others.” This appendix includes descriptions of local emergency response plans; and examples of how other local, out-of-state and out-of-country entities address the provision of emergency water. Examples from California and Canada include the State of California, Los Angeles, San Francisco, and Vancouver, BC. Local examples of how the emergency water provision was treated by the City of Salem Water Advisory and the Clackamas River Water Providers are discussed. One of the take-aways from these examples is that other regions treat emergency drinking water provision similar to what the Portland-Vancouver Region is considering. The lack of clarity of lead and support responsibilities is prevalent across-the-board. Also following the same process used in Section 2, resources are denoted with either Requirement or Guidance where appropriate. As noted, the majority of the resources reviewed are guidance documents. There are very few resources that are actually requirements.

1.0 Local Emergency Response Plans

Individual Plans from RDPO Counties and Cities: All five counties and major cities in the Portland-Vancouver Metropolitan Region have emergency operations plans.

1.1 Clackamas County Emergency Operations Plan (Clackamas County Disaster Management, 2017)

The Clackamas County Emergency Operations Plan (EOP) provides an all-hazard approach to describe how the county will organize and respond to emergencies and disasters. The plan utilizes Emergency Support Functions (ESFs) to conduct a response in the most organized, efficient, and effective way possible.

1.2 Clark County Comprehensive Emergency Management Plan (CEMP); Clark Regional Emergency Services Agency [CRESA], (2018)

The Clark County CEMP provides the framework for mitigation, preparedness, response, and recovery activities across the region. CRESA’s role is to coordinate and facilitate interrelationships to ensure the plan is used consistently throughout the region by participating jurisdictions.

1.3 Columbia County Emergency Operations Plan (EOP) (Columbia County Department of Emergency Management, 2018)

The Columbia County EOP provides a description of the roles and responsibilities of the departments, and certain other agencies during emergencies and disasters. The plan is organized using the National Incident Management System (NIMS) and National Response Framework (NRF) for managing the response and recovery activities across the county.

1.4 2017 Multnomah County EOP (Multnomah County Office of Emergency Management, 2017)

The Multnomah County EOP is part of the larger CEMP that is designed to guide the county in conducting emergency management activities for mitigation, prevention, protection, response, and recovery. The EOP is focused on response and short-term recovery activities and provides a framework for how the county will conduct their emergency operations following an emergency or disaster.

1.5 2017 Washington County EOP (Washington County Emergency Management, 2017)

The Washington County EOP utilizes an all-hazards approach to describe how the county will organize and respond to emergencies and disasters in the community. The plan is compatible with the NRF and State of Oregon EOP. The goal of the plan is to maximize public safety and minimize property damage in the most organized, efficient, and effective manner possible.

1.6 Portland Basic EOP 2016 (PBEM, 2016)

The Portland Basic EOP creates a framework for city-wide coordination in emergencies and disasters, and to ensure that all PBEM emergency responders have shared expectations, mutual accountability, and good communication throughout the incident. The plan follows the NIMS and NRF federal guidance and is a companion document to the citywide Continuity of Operations Plan (COOP).

1.7 City of Vancouver EOP (City of Vancouver, 2018)

The City of Vancouver EOP was written to describe how the city plans to operate during major emergencies or disasters. The EOP was meant to be a guide for collaboration and coordination of operations to protect public safety and welfare. The plan includes an agreement with CRESA to augment emergency support services.

2.0 Guidance Resources from Other Regions

2.1 Guidance - Vancouver, British Columbia (B.C.): Regional Temporary Provision of Drinking Water Guideline (Regional Engineers Advisory Committee [REAC] Water Subcommittee, 2018)

This document was developed for local governments in Metro Vancouver, BC, Canada, to prepare an emergency drinking water plan at a regional level. It explores roles and responsibilities for health authorities, federal, provincial, regional, and local governments, Integrated Partnership for Regional Emergency Management (IPREM) in Metro Vancouver, First Nation, and mutual aid organizations. It also provides 17 recommendations to help local government to be more prepared in emergency response. See Section 3.4.3 for general recommendations of the document and discussion of roles and responsibilities addressed in the document.

2.2 Guidance - California: Emergency Drinking Water Procurement & Distribution Planning Guidance (California Governor's Office of Emergency Services [Cal OES], 2014)

This document was developed to clarify the roles and responsibilities of the stakeholders from different levels in California's Standardized Emergency Management System (SEMS). It is rooted in the lessons

learned by emergency managers from the 1994 Northridge earthquake and has been refined over time to ensure that potable drinking water will be provided to the general public after major natural disasters, including earthquakes. It also includes activities to be considered by the water providers to evaluate the emergency situation, identify alternative drinking water sources, and procure resources to distribute water. Some state level programs and resources that can assist in emergency response are also outlined in this document.

2.3 Guidance - Los Angeles: EOP, Logistics Annex, Food and Potable Water Appendix (City of Los Angeles, 2018)

This plan is a Functional Support Appendix to the City of Los Angeles' EOP and can serve as a stand-alone plan or as part of the EOP. This plan was developed in cooperation with the City and non-City agencies identified as responsible for the acquisition of food and potable water. The purpose of the plan was for it to be used by each department and/or agency to develop their own standard operation procedures to direct their procedures and assigned responsibilities for the logistical coordination of food and water assets following an emergency or disaster.

2.4 Guidance - San Francisco: City and County of San Francisco (CCSF) ERP, ESF #12: Water and Utilities Annex (CCSF, 2017)

This plan was included in the larger CCSF ERP to provide guidance on local assistance and resources to enable the restoration of water systems and utilities following a large-scale emergency or disaster. The purpose of the ESF is to identify water system and water provider shortfalls, assist providers with requests for emergency response assistance, and coordinate private and public sector response efforts.

2.5 Guidance - Emergency Drinking Water Procurement & Distribution Planning Guidance – Cal OES (2014)

This guidance document was developed by Cal OES to clarify the roles and responsibilities of the stakeholders from different levels in California's SEMS. It is rooted in the lessons learned by emergency managers from the 1994 Northridge earthquake and has been refined over time to ensure that potable drinking water will be provided to the general public after major natural disasters, including earthquakes. It also includes activities to be considered by the water providers to evaluate the emergency situation, identify alternative drinking water sources, and procure resources to distribute water. Some state-level programs and resources that can assist in emergency response are also outlined in this document.

2.5.1 Key Findings from CAL OES

There are five SEMS organization levels:

- Field: carry out decisions and activities in direct response to an incident.
- Local government: includes cities, counties, and special districts.

- Operational Area (OA): intermediate level of the state's emergency management organization. Serve as the coordination and communication link between the local government level and the regional level.
- Regional: manage and coordinate information and resources among OAs within the mutual aid region. Also coordinate between the OA and the state level. California is divided into three Cal OES Administrative Regions (Inland, Coastal, and Southern) and six mutual aid regions.
- State: prioritize tasks and coordinate state resources in response to the requests from the regional level. Coordinate mutual aid among the mutual aid regions and between the regional level and state level.
- Water providers vary in sizes, so they do not fit in the five SEMS levels neatly.
- MAC Group may be convened by an EOC director to involve participation of agencies and disciplines at any SEMS level to facilitate decisions for emergency response activities.

The operational goals and strategies for the five SEMS levels are:

- Field Level (local water provider): The first priority of the local water providers is to procure and distribute drinking water to their customers while they repair and restore the water system. The water providers should seek assistance from appropriate SEMS level EOC when they cannot fulfill the demand.
- Local Government Level (City, County, and Special Districts): The first priority of the City, County, or Special District water providers is to procure and distribute drinking water to their customers when the water provider is part of the local government while they repair and restore the water system. They also need to coordinate assistance for privately owned water systems in their jurisdictions. The local government should contact the OA EOC for assistance when they cannot fulfill the demand.
- OA Level: Assist the local water providers or local governments in procuring and distributing emergency drinking water as needed. The OA EOC should contact the Regional EOC (REOC) for assistance when they cannot fulfill the demand.
- Regional Level: The REOC should contact the State Operations Center (SOC) for assistance when they cannot fulfill the demand.
- State Level: Coordinate with unaffected REOCs and provide support to field-level operations. Cal OES may request resources from FEMA, EMAC, public/private partnerships, or other sources.
- Water providers disseminate emergency public information to their customers. Cal OES coordinates the state's emergency public information efforts and makes sure that the state government issues a timely and concise message.
- The California Department of General Services (DGS) has developed the State Bottled Water Contract and the State Bulk Water Contract to ensure local governments a quicker and simpler purchase of bottled or bulk water supplies.
- The California Department of Public Health (CDPH): Food and Drug Branch maintains a list of licensed water haulers, bottlers, and distributors.

Table A.1 summarizes the roles and responsibilities of various levels of California agencies mentioned in this document. In addition to those stakeholders discussed above, the table also includes many other government agencies at various levels and non-governmental organizations that provide critical supporting functions for procurement and distribution of emergency drinking water.

Table A.1: Summary of Roles and Responsibilities in California (Cal OES, 2014)

Stakeholder	Roles and Responsibilities
Water Provider	• Procure and distribute emergency drinking water. • Assess damages to their system and make repairs as needed. • Identify the distribution sites and negotiate agreements for location use. • Notify local and state regulatory agencies, local health department (LHD)/local environmental health department (EHD), and other agencies. • Issue notices to the public. • Request local governments, OA or regional EOC to coordinate the distribution of emergency drinking water if needed.
Local Primacy Agency/EHD	• Oversee smaller systems in accordance with regulatory requirements. • Provide technical assistance.
City/County/Special District	• Operate local EOCs to coordinate resources within the jurisdiction. • Identify the distribution sites and negotiate agreements for location use. • Assist the local water providers in procuring and distributing emergency drinking water. • Provide situational assessment to an OA EOC. • Request OA to establish a Task Force to facilitate emergency water requests.
OA EOC	• Coordinate the emergency response activities within the county jurisdiction. • Coordinate resources within the OA. • Assist cities, special districts, and water providers in procuring and distributing emergency drinking water. • Request REOC to establish a Task Force to facilitate emergency water requests.
Medical and Health OA Coordination Program	• Assure drinking water safety. • Support OA EOC. • Prepare situation reports. • Coordinate emergency response activities among different levels. • Coordinate resources within OA or by utilizing existing agreements.
Regional Emergency Operations Center (REOC)	• Coordinate operations and resources among the OAs within the mutual aid region. • Coordinate state agency support.
State Drinking Water Program	• Collect drinking water system situational status information. • Contact and/or send representative to affected Public Water System to provide technical assistance.

Stakeholder	Roles and Responsibilities
	• Provide consultants for emergency drinking water supply plan. • Approve water source and treatment units.
SOC	• Coordinate mutual aid and resources among mutual aid regions.
DGS	• Develop the State Bottled Water Contract and the State Bulk Water Contract.
CDPH	• Monitor drinking water situational information. • Maintain a list of approved water haulers, bottlers, and distributors. • Determine if State resources are needed and fill resource requests.
California National Guard	• Assist in providing drinking water treatment and storage equipment.
California Highway Patrol	• Provide security.
California Conservation Corps	• Provide assistance and assets.
FEMA	• Provide bottled water distribution.
Indian Health Service	• Support Tribal Governments.
Cal WARN	• Provide drinking water resources among members.
California Utilities Emergency Association	• Provide drinking water resources and state mutual aid.

2.6 Regional Temporary Provision of Drinking Water Guideline – REAC Water Subcommittee (2018)

The Metro Vancouver REAC Water Subcommittee developed this document for local governments in Metro Vancouver, B.C., Canada to prepare an emergency drinking water plan at a regional level. It outlines roles and responsibilities for health authorities, federal, provincial, regional, and local governments, IPREM in Metro Vancouver, First Nation, and mutual aid organization. It provides 17 recommendations to help local government to be more prepared in emergency response.

2.6.1 Key Findings from REAC

- IPREM is an inter-governmental entity and partnership between the Province of British Columbia and the Metro Vancouver Regional District. It helps to develop regional emergency plans on priority emergency management activities.
- It is recommended for local government to provide a minimum 4 liters (approximately 1 gal) of portable water per person per day right after a disaster, increasing to 10 liters (approximately 2.5 gal) per person per day in the week following a disaster until the regular water supply is restored.
- It is recommended for IPREM to facilitate a multi-jurisdictional and multi-disciplinary workshop to develop a regional map of critical facilities and vulnerable populations.
- It is recommended for residents to prepare a drinking water supply for a minimum of 72 hours and prepare refillable containers in which to store and ration drinking water.

- It is recommended for local government to consider key dependencies of water distribution efforts. Local government should implement emergency debris removal plans and source fuel for vehicles to distribute water.
- It is recommended for the REAC Water Subcommittee, the IPREM, and the Province to develop municipal standing offer agreements with local bottled water companies and commercial water hauling companies.
- It is recommended for REAC Water Subcommittee to approve a standing work item to the annual work plan to update the inventory of local government-owned emergency water treatment and distribution resources.

Table A.2 summarizes the roles and recommended responsibilities of various levels of agencies mentioned in this document.

Table A.2: Roles and Responsibilities for Metro Vancouver, B.C. (REAC, 2018)

Stakeholder	Roles and Responsibilities
Residents	• Prepare a drinking water supply for a minimum of 72 hours after an emergency. • Prepare clean refillable containers to store and ration drinking water.
• Local Government	• Develop emergency plans. • Follow the plans to source, prioritize, and provide resources from the supporting area to the affected area. • Prepare for the collection, receipt, transport, storage, and delivery of drinking water to their communities.
Health Authorities	• Inspect drinking water systems, protect water from chemical and microbiological contamination. • Approve, inspect, and monitor drinking water supplies in accordance with regulatory requirements. • Provide oversight to water systems.
REAC Water Subcommittee	• Approve a standing work item to the annual work plan to update the inventory of local government-owned emergency water treatment and distribution resources. • Work with IPREM and the Province to develop municipal Standing Offer Agreements with local bottled water companies and commercial water hauling companies.
IPREM in Metro Vancouver	• Support regional and local emergency management planning and make recommendations to the Province on issues of importance to local government. • Facilitate a multi-jurisdictional and multi-disciplinary workshop to develop a regional map of critical facilities and vulnerable populations.

Stakeholder	Roles and Responsibilities
Regional Government	• Collect, store, treat, and reliably supply safe potable water in a cost-effective manner to member Municipalities, Electoral Area, and Treaty First Nation. • Provide water supply to an affected local government from the undamaged part of the system. • Ensure that there are sufficient resources, systems, policies, and procedures in place. • Provide communications and coordination with stakeholders. • Develop a list of points in their transmission network in each local government that is most likely to survive a seismic event to allow local governments to plan for the logistics of bulk water extraction, delivery, and storage.
Provincial Government	• Declare a State of Emergency to engage emergency response efforts to the impacted area. • Provincial support is expected to be directed through local government EOCs.
Federal Government	• Support provincial emergency response activities.

2.7 Emergency Response Planning Guide for Public Drinking Water Systems – RCAP (2014)

This RCAP document was developed for public water systems serving a population of 3,300 individuals or fewer to develop an ERP for drinking water. It helps staff from rural water providers to identify vulnerabilities in their water systems and improve preparedness for emergencies. This document mainly focuses on the important emergency response planning elements for rural water providers, and it provides ERP templates to help the rural communities to create their own plans.

Table A.3 summarizes some key roles and responsibilities for rural water providers and local primacy agencies. Local primacy agencies are responsible for implementing the requirements of the Safe Drinking Water Act for small public water systems.

Table A.3: Summary of Roles and Responsibilities for Rural Communities (RCAP, 2014)

Stakeholder	Roles and Responsibilities
Water Provider	• Have basic information and technical data available for both external agencies and internal personnel. (For small rural systems, the technical data and system specific information may be known by only a few people and may be based on historic knowledge. Small water systems should document the information as much as possible.) • Prepare a detailed map of the distribution system. • List out each responsibility for people who are in the chain of command. (Small water providers may only have one or two staff members in the chain of command.) • Prepare a plan for emergency notification. Assign responsibilities to oversee and send out notification. Assemble a comprehensive call-up

Stakeholder	Roles and Responsibilities
	lists with names and contact numbers. Prepare a plan for disseminating information. • Form partnerships with local community groups, school districts, emergency planning committees, local media, and scout troops for their support in disseminating information. • Poll the customers to determine the best method to deliver emergency messages. • Lead the effort in issuing a health advisory if necessary. • Develop a plan for notifying customers, drinking water officials, local health officials, local law enforcement, and water testing laboratories. • Develop partnerships with local emergency response network. • Lead the effort in sourcing alternative water supply and testing sources. Working with local primacy agency or tribal authority to obtain approval if necessary.
Local Primacy Agency	• Provide consultation in making a decision on whether to issue a health advisory. • Assist in developing and communicating messages to the public if the water service providers have limited staff. • Provide approval of alternate source to water providers.

3.0 Roles and Responsibilities Based on Local Water Emergency Events

Additionally, we reviewed and analyzed after-action reports from two different recent local drinking water emergency events that took place in or near the Portland Metro region – the City of Salem Water Advisory After Action Assessment Report (The Novak Consulting Group [NCG], 2018) and Clackamas River Water Providers (CRWP) Winter Storm 2021 After Action Report (CRWP, 2021). Each emergency involved different root causes (algal toxin for Salem and power outage for CRWP); and thus, required a local water service provider to respond to their emergency event by engaging different sets of stakeholders. The two case studies offer a useful opportunity to examine roles and responsibilities of stakeholders participating in the actual response in comparison to those proposed in the planning guides. Insightful knowledge gained from these local events has improved the relevance and applicability of roles and responsibilities proposed for this Framework. Key findings from each of the emergency events are summarized to provide users of this Framework with a general sense of roles and responsibilities of stakeholders participating in the actual response.

3.1 City of Salem Water Advisory (NCG, 2018)

The source of drinking water for the City of Salem, Oregon, is Detroit Lake, which experienced regular blooms of blue-green algae during the summer of 2018. The City Public Works Department worked with the OHA to prepare for and issue two rounds of drinking water advisories The sequence of events is listed below.

- On 23 May 2018, the OHA issued a recreation advisory for the Lake due to levels of harmful cyanotoxins in the water.

- On 25 May 2018, Salem Public Works Department was notified with a test result showing levels of harmful cyanotoxins in the drinking water exceeds USEPA thresholds for vulnerable populations.
- On 29 May 2018, the first "Do Not Drink the Water" Advisory was issued.
- On 31 May 2018, Governor declared a State of Emergency and dispatched National Guard to assist the City of Salem to distribute water.
- The water advisory was lifted on 2 June 2018, after levels of cyanotoxins test results dropped below the threshold.
- A second advisory was issued on 6 June 2018, when test results again showed that the levels of cyanotoxins were above the thresholds. The second advisory was lifted on 3 July 2018. During the second advisory, the City responded well and effectively managed public outreach. The National Guard troops withdrew on 19 June 2018.

To ensure everyone in the City's service area had access to safe drinking water, officials, and staff members at multiple governmental levels, from the State to the City, cooperated to test the water quality, communicated to the public, distributed alternative drinking water, and mitigated the water quality issue.

3.2 Key Findings for Salem

- The City of Salem directly alerted OHA when City staff received the alarming test results and discussed with them on whether to issue a drinking water advisory. Although the City has tested levels of cyanotoxins for years, there was no emergency management plan in place for how to respond if or when the test results exceed the USEPA threshold. There were no state or federal rules on how to address what happens when the threshold is exceeded.
- Marion County worked closely with the City of Salem in coordinating its response and distributing water to residents within its jurisdiction. The County EOC facilitated coordination between the State and the City.
- Both public and internal communications are critical. During the first advisory, there was no efficient communication to the public. Only 15 percent of the population had signed up for the City-wide alert system. Neither the City nor the County was able to send out an IPAWS notice, so they had to request OEM to send out the message, which took four hours to send out the correct alert to the public. The City did not designate a PIO and staff were unprepared for questions at a press conference. The internal communication should also be prioritized in such an event. The internal staff and the City Council would have liked to have been informed earlier so that they could have more time to process the information and prepare to participate in the response to the advisory.

Based on review and analyses of the after-action report, Table A.4 summarizes the roles and responsibilities of the State, the County, the City, and other stakeholders in the response to the Water Advisory.

Table A.4: Summary of Roles and Responsibilities During the 2018 City of Salem Water Advisory

Stakeholder	Roles and Responsibilities

Residents	• Prepare emergency drinking water. • Sign up for the City-wide alert system to receive information.
Stakeholder	**Roles and Responsibilities**
Salem Department of Public Works (Water Provider)	• Responsible for maintaining safe drinking water and testing the water. • Activate a DOC for coordinating incident response. • Coordinate water distribution. • Reach out for mutual aid and the National Guard for its water distribution tanks. • Contract with engineering staff to develop a solution to reduce cyanotoxins in the water and prevent the situation from reoccurring.
Salem Emergency Manager	• Request Marion County to issue an IPAWS message to the public.
City Communications Manager	• Approve the language of the Advisory. • Coordinate a press conference.
City Manager's Office	• Participate in discussion to issue the Advisory. • Participate in press interviews. • Authorize the steps taken in response to the Advisory, including purchase of the Enzyme-Linked Immunosorbent Assay testing system. • Coordinate the City-wide response and authorize staff to be removed from their normal duties to conduct emergency response related activities.
City Finance Staff	• Work on making quick vital emergency response purchases. • Work with Human Resources to authorize overtime pay for staff.
Deputy City Manager	• Supervise the Communications Manager. • Assist in setting up the Joint Information Center (JIC). • Serve on the JIC as a liaison to the City Council.
Mayor and City Council	• Get updated regularly by the City Manager and Deputy City Manager. • Convene a Special Council Meeting to discuss the response.
Marion County DOH	• Conduct outreach and triage requests for assistance in the EOC. • Reach out to large retail stores to ensure water supplies. • Approve the emergency water distribution setups on site.
Marion County Emergency Management	• Activate EOC and facilitate coordination between the State and the City. • Help distribute water by staffing water distribution points, delivering packaged water to non-mobile residents, and assisting the Oregon Department of Corrections in providing water to inmates.
County PIO	• Assist in sending messages to the public.

OHA	• Administer and enforce water quality standards across the state. • Provide consulting on whether to issue an Advisory. • Review the Advisory language prior to its release. • Activate the Incident Management Team and JIC. • Assist in providing information to the public. • Issue temporary rules on testing the cyanotoxin levels in drinking water, bridging the gap in current regulation. • Plan to issue permanent testing rules and apply statewide.
Stakeholder	**Roles and Responsibilities**
Oregon OEM	• Assist all partners in providing a coordinated response. • Send out an IPAWS notice to affected residents.
Oregon Governor	• Declare a State of Emergency.
National Guard	• Assist in distributing water.

3.3 CRWP Winter Storm (CRWP, 2021)

The Portland Metropolitan Area experienced a winter storm event in February 2021, causing widespread power and telecommunication outage in water treatment plants and water distribution systems, particularly in Clackamas County. The CRWP Winter Storm 2021 after-action report outlines the emergency response activities taken by affected water providers and mitigation strategies for future emergency preparation. The affected water providers include the City of Lake Oswego, City of Tigard, City of Oregon City, South Fork Water Board, North Clackamas County Water Commission, City of Gladstone, Oak Lodge Water Services, and Clackamas River Water (CRW).

3.3.1 Key Findings according to CRWP after action

- The City of Lake Oswego has existing relationship with EC Electric, who provided two emergency generators and liquid fuel for the City's intake and the water treatment plant. The City declared an emergency so that they could make an emergency procurement with EC Electric. The battery backup for the supervisory control and data acquisition (SCADA) system ran out, resulting in loss of communication for the water system. They considered options ranging from just preparing for "plug-in" for generators to installing a permanent generator at the pump stations and the treatment plant.
- Interties among water providers worked. The City of Lake Oswego was able to receive water from the City of Tigard, which reached out to the City of Beaverton and the JWC for emergency water supply through interconnections.
- The City of Oregon City lost communications and power for several days. The SCADA system was out of service due to lack of power. Reservoir levels had to be inspected manually. They relied on very high frequency (VHF) radio systems and a police satellite phone for communication. They initiated an emergency contract for debris removal from roadways. They also contacted ORWARN for emergency generators, but available generators through ORWARN were not large enough for their needs.
- Portland General Electric (PGE) prioritized South Fork Water Board's request and restored power in the pump station and the water intake very quickly. South Fork Water Board relied on

North Clackamas County Water Commission for emergency water supply through interconnection. They provided an emergency distribution trailer for residents of a West Linn neighborhood to obtain water in portable containers.

- North Clackamas County Water Commission lost power at the water treatment plant. Although the plant was equipped with an onsite PGE generator, PGE was overwhelmed and unable to provide fuel for the generator. They contacted another fuel provider to get fuel. The Clackamas County Roads Department responded quickly to maintain the road condition on Clackamas River Drive so that the water treatment plant could be reached. The mitigation strategies include

identification of more fuel sources for PGE generators, getting a better generator refueling plan with PGE, preparing emergency power source for pump stations, and reviewing regional transportation route plan.

- The City of Gladstone got water from Oak Lodge Water Services through an interconnection.
- Oak Lodge Water Services had a difficult time getting fuel. They had to work with several companies for fuel supply. They will look at emergency procurement agreements for fuel.
- Clackamas River Water (CRW) lost power in their treatment plant. Although CRW was equipped with an on-site PGE generator, they had to find fuel from a local vendor, and were required to clear the road so that fuel could be delivered to the treatment plant. They hung door hangers to notify customers of a boil water notice in the affected area.

APPENDIX B
RDPO Water Provider Interview Questions

RDPO
Emergency Water Provision Plan - Utility Interview Questions

Utility Info

1. Name of your organization
2. What county are you located in?
3. How many people does your utility serve?
4. What is your water source?
5. How connected are you to neighboring water systems or water supplies?

Overall

1. What do you think your utility has done best in preparing for a major disaster?
2. What do you think are your utility's greatest gaps in preparing for a major disaster?
3. Are there any specific gaps either locally or regionally that you have identified during previous disasters?
4. How long to you expect to go after a large disaster (ex CSZ) before you have outside help.

Infrastructure

1. What investments has your utility made in seismic resilience? What further investments are you planning?
2. What's your approach to backup power? Do you cover a certain portion of your capacity? How much fuel do you have on hand?

Emergency Preparedness Planning

1. Do you have a plan for how to recover water system operations after a major disaster?
2. How do you see your role in getting emergency water to your community if the water system fails?
3. Do you have an Emergency Operations Plan (EOP) or Continuity of Operations Plan (COOP)?
    a. How have you coordinated with other agencies in developing EOP/COOP and other emergency plans? Do you have any MOUs in place?

    b. What hazards (scale of hazards) are included in your EOP/COOP?

4. Have you ever activated your Emergency Operations Plan (EOP) or Continuity of Operations Plan (COOP)? What went well? What didn't go well?

5. Has your utility adopted a National Incident Management System (NIMS) Incident Command Structure? How has it been implemented in your agency? Where is your Emergency Operations Center (EOC)?

6. Have your staff been trained or participated in exercises with your the EOP and for individual preparedness?

7. What approach has your utility or City taken to promote individual disaster preparedness (e.g., two weeks ready)?
8. Have you used the FEMA Resource Typing Library Tool? If so, was it useful? How complete is the information in the system?

Communicating During a Disaster

1. How do you plan to communicate with staff and emergency responders during an emergency?
2. How do you plan to communicate with customers?
3. If you needed additional resources to keep your water system running or to restore operations who would you contact?

Additional Questions

1. Do you have other information that is important for our team to know that we didn't ask?
2. Do you have any advice for our team as we develop the Emergency Water Response Framework?

APPENDIX C
Survey Results Analysis

Island ID	GIS Water District Name	1. Name of your organization	2. What county are you located in? (select one)					3. What is your service population? (not connections)			4. What is your average daily demand? (millions of gallons per day: MG)		Gal/Capita
		Open-Ended Response	Clackamas	Clark	Columbia	Multnomah	Washington	People	Population From OHA Data Online (no survey response)	Comment (if needed)	ADD (MG)	Comment (if needed)	
WASH1	City of Banks	City of Banks					1	2000			0.226		113
CLARK1	City of Battleground	City of Battleground		1				22,000			1.8		82
WASH3	City of Beaverton	City of Beaverton					1	90,000		Our total population is 100,000. 10% of our pop is served by three other water utilities	9		100
CLARK1	City of Camas	City of Camas, WA		1				24000			4		167
COLUM2	City of Clatskanie	City of Clatskanie			1			1,785			0.187	187,000	105
CLACK9	City of Estacada	City of Estacada	1					4035		growing rapidly	0.75	.7 to .8 MGD	186
WASH6	City of Forest Grove	City of Forest Grove					1	24000			3		125
CLACK2	City of Gladstone	City of Gladstone	1					12000		roughly	2		167
MULT2	City of Gresham	City of Gresham				1		70000			6.1		87
WASH3	City of Hillsboro	City of Hillsboro					1	83419			15.05	Number from 2020	180
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro					1	4581			1.18	Number from 2020	258
CLACK1	City of Lake Oswego	City of Lake Oswego	1					40000			7		175
CLACK2	City of Milwaukie	City of Milwaukie	1					21014		2018	2.4	from 2010 master plan	114
CLACK11	City of Molalla	City of Molalla	1					9910			1.11		112
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work	1					36492		2019 PSU population survey	4		110
COLUM4	City of Saint Helens	City of Saint Helens			1			14,000			1.5		107
CLACK3	City of Sandy	City of Sandy	1					12000			1.25		104
COLUM5	City of Scappoose	City of Scappoose			1			7621		The population includes 87 out-of-city water	0.901		118
WASH4	City of Sherwood	City of Sherwood					1	19,000			1.89		99
WASH3	City of Tigard	City of Tigard					1	62000			6		97
MULT2	City of Troutdale	City of Troutdale				1		16,180			1.6		99
WASH4	City of Tualatin	City of Tualatin					1	27527			4.34		158
CLARK1	City of Vancouver	City of Vancouver		1				270000			26		96
CLACK1	City of West Linn	City of West Linn	1					26000			5		192
MULT2	City of Wood Village	City of Wood Village				1		4000			0.5	14,000,000 Monthly	125
CLARK3	City of Washougal	City of Washougal		1				21,130			1.507		71
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water	1					41000			8.4	8.4mg North (CRW) 1.4 South (South Fork Water)	205
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water	1					14000			1.4	8.4mg North (CRW) 1.4 South (South Fork Water)	100
CLARK1	Clark Public Utilities	Clark Public Utilities		1				99000			12.5		126
MULT3	Corbett Water District	Corbett Water District				1		3,300			0.75		227
WASH6	Joint Water Commission	Joint Water Commission					1					Number from 2019	
COLUM4	McNulty Water PUD	McNulty			1			2876			0.236		82
MULT2	Portland Water Bureau - East	Portland Water Bureau				1		583,348		1 Million retail and wholesale, 186,800 retail accounts	71		121
MULT1	Portland Water Bureau - West	Portland Water Bureau				1		115,334			14		121
WASH3	Raleigh Water District	Raleigh Water District					1	4,250			0.505	2020 data	119
CLACK1	Rivergrove Water District	Rivergrove Water District	1					4000			0.489	489192 MG	122
MULT2	Rockwood Water PUD	Rockwood Water PUD				1		65993		Based on PSU study for 2020	6.43	3 year average of ADD	97
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company	1					1,500		approximate	0.3	During the summer	200
CLACK5	South Fork Water Board	South Fork Water Board	1										
CLACK3	Sunrise Water Authority	Sunrise Water Authority	1					46200			5.4	(2020 Calendar year)	117
WASH3	Tualatin Valley Water District	Tualatin Valley Water District					1	216200		Estimate is from 2020	21.4	FY 2020	99
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.	1					28000			3.07		110
WASH3	West Slope Water District	West Slope Water District					1	10500			1.12	Average annual daily demand	107
WASH4	City of Wilsonville		1				1	22730			2.8		123
WASH3	Portland Water Bureau - SW	Portland Water Bureau				1		124,725			15		121

Island ID	GIS Water District Name	1. Name of your organization	5. What is your water source? (select all that apply)						6. How connected are you to neighboring water systems or water supplies (source)? (select one)				
		Open-Ended Response	Groundwater	Aquifer storage and recovery well	Surface water treated at our own facility	Surface water treated at a shared/regional facility	Water purchased from a wholesale provider, if so who?	Who wholesale water is purchased from	Our system is isolated - we have no interties	We have one or more local interties, but they could only meet a portion of our demands	We have a connection to a redundant water supply or sufficient interties to meet our minimum demands if we lost supply	Not sure	Other (please specify)
WASH1	City of Banks	City of Banks	1		1				1				
CLARK1	City of Battleground	City of Battleground	1				1	CPU		1			
WASH3	City of Beaverton	City of Beaverton	1	1	1	1	1	City has a wheeling agreement with a neighboring water district or small			1		
CLARK1	City of Camas	City of Camas, WA	1		1					1			
COLUM2	City of Clatskanie	City of Clatskanie			1				1				
CLACK9	City of Estacada	City of Estacada			1				1				
WASH6	City of Forest Grove	City of Forest Grove			1	1					1		
CLACK2	City of Gladstone	City of Gladstone				1	1				1		
MULT2	City of Gresham	City of Gresham	1				1	PWB			1		
WASH3	City of Hillsboro	City of Hillsboro				1				1			
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro			1				1				
CLACK1	City of Lake Oswego	City of Lake Oswego			1	1				1			
CLACK2	City of Milwaukie	City of Milwaukie	1							1			
CLACK11	City of Molalla	City of Molalla			1				1				
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work					1	SFWB		1			
COLUM4	City of Saint Helens	City of Saint Helens			1					1			
CLACK3	City of Sandy	City of Sandy	1		1		1	PWB			1		
COLUM5	City of Scappoose	City of Scappoose	1		1				1				
WASH4	City of Sherwood	City of Sherwood	1			1				1			We have groundwater as a
WASH3	City of Tigard	City of Tigard	1	1		1					1		
MULT2	City of Troutdale	City of Troutdale	1										3 interties, but I am curious if they could meet the demands considering they may be in a similar emergency situation
WASH4	City of Tualatin	City of Tualatin		1			1	PWB		1			
CLARK1	City of Vancouver	City of Vancouver	1							1			
CLACK1	City of West Linn	City of West Linn			1	1	1	SFWB		1			
MULT2	City of Wood Village	City of Wood Village		1							1		
CLARK3	City of Washougal	City of Washougal	1							1			
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water			1						1		
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water	1				1				1		
CLARK1	Clark Public Utilities	Clark Public Utilities	1							1			
MULT3	Corbett Water District	Corbett Water District			1				1				
WASH6	Joint Water Commission	Joint Water Commission			1				1				
COLUM4	McNulty Water PUD	McNulty	1	1						1			
MULT2	Portland Water Bureau - East	Portland Water Bureau	1		1								We supply water to other utilities
MULT1	Portland Water Bureau - West	Portland Water Bureau	1		1								We supply water to other utilities
WASH3	Raleigh Water District	Raleigh Water District					1	PWB			1		
CLACK1	Rivergrove Water District	Rivergrove Water District	1								1		
MULT2	Rockwood Water PUD	Rockwood Water PUD	1				1	PWB			1		
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company	1						1				
CLACK5	South Fork Water Board	South Fork Water Board			1					1			
CLACK3	Sunrise Water Authority	Sunrise Water Authority	1	1	1	1	1	Clackamas River Water (Also South Fork Water Board		1			
WASH3	Tualatin Valley Water District	Tualatin Valley Water District		1	1	1	1	PWB			1		
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.					1	NCCWC		1			
WASH3	West Slope Water District	West Slope Water District					1	PWB			1		
WASH4	City of Wilsonville				1					1			
WASH3	Portland Water Bureau - SW	Portland Water Bureau	1		1								We supply water to other utilities

Island ID	GIS Water District Name	1. Name of your organization	7. Which of these seismic improvements have you cor													
			a. Tanks and finished water storage						b. Seismic valves on tanks (select all that apply)					c. Supply (wells or surface supply)		
		Open-Ended Response	We have at least one seismically resilient tank	All of our tanks are seismically resilient	We are planning seismic upgrades to tanks within the next 5 years	Not sure	Sum to find duplicates	Deficient (neither done nor planned)	We have installed seismic valves on at least one tank	We have seismic valves on 50% or more of our tanks	We plan to install seismic valves within the next 5 years	Not sure	Deficient (neither done nor planned)	We have access to at least one resilient supply source (well or surface supply)	All of our supply is seismically resilient	We are planning seismic upgrades to our supply within the next 5 years
WASH1	City of Banks	City of Banks			1		1	0				1				
CLARK1	City of Battleground	City of Battleground		1			1	0				1			1	
WASH3	City of Beaverton	City of Beaverton	1				1	0	1					1		
CLARK1	City of Camas	City of Camas, WA	1				1	0	1					1		
COLUM2	City of Clatskanie	City of Clatskanie		1			1	0				1				
CLACK9	City of Estacada	City of Estacada				1	1	1				1		1		
WASH6	City of Forest Grove	City of Forest Grove			1		1	0			1					
CLACK2	City of Gladstone	City of Gladstone				1	1	1				1				
MULT2	City of Gresham	City of Gresham	1		1		2	0	1							1
WASH3	City of Hillsboro	City of Hillsboro		1			1	0								1
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro						1								
CLACK1	City of Lake Oswego	City of Lake Oswego	1				1	0	1						1	
CLACK2	City of Milwaukie	City of Milwaukie	1		1		2	0	1		1					
CLACK11	City of Molalla	City of Molalla			1		1	0			1					1
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work	1		1		2	0				1				
COLUM4	City of Saint Helens	City of Saint Helens	1				1	0				1				
CLACK3	City of Sandy	City of Sandy	1				1	0						1		
COLUM5	City of Scappoose	City of Scappoose	1				1	0			1			1		
WASH4	City of Sherwood	City of Sherwood	1				1	0				1		1		1
WASH3	City of Tigard	City of Tigard	1				1	0	1		1			1		
MULT2	City of Troutdale	City of Troutdale			1	1	2	0			1	1		1		
WASH4	City of Tualatin	City of Tualatin	1				1	0			1			1		1
CLARK1	City of Vancouver	City of Vancouver	1		1		2	0					1	1		
CLACK1	City of West Linn	City of West Linn	1				1	0				1	1			
MULT2	City of Wood Village	City of Wood Village			1		1	0			1		0			1
CLARK3	City of Washougal	City of Washougal	1		1		2	0			1		0			1
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water	1			1	2	0	1			1	0			
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water	1			1	2	0	1			1	0			
CLARK1	Clark Public Utilities	Clark Public Utilities	1				1	0			1		0	1		1
MULT3	Corbett Water District	Corbett Water District	1				1	0	1				0			1
WASH6	Joint Water Commission	Joint Water Commission		1			1	0			1		0			1
COLUM4	McNulty Water PUD	McNulty				1	1	1				1	1			
MULT2	Portland Water Bureau - East	Portland Water Bureau	1		1		2	0			1		0	1		
MULT1	Portland Water Bureau - West	Portland Water Bureau	1				1				1			1		
WASH3	Raleigh Water District	Raleigh Water District	1				1	0				1	1			
CLACK1	Rivergrove Water District	Rivergrove Water District	1				1	0	1				0	1		
MULT2	Rockwood Water PUD	Rockwood Water PUD		1			1	0	1		1		0	1		
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company	1				1	0				1	1	1		
CLACK5	South Fork Water Board	South Fork Water Board	1				1	0			1		0			1
CLACK3	Sunrise Water Authority	Sunrise Water Authority	1				1	0	1		1		0	1		1
WASH3	Tualatin Valley Water District	Tualatin Valley Water District	1		1		2	0	1		1		0			1
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.	1				1	0		1			0			
WASH3	West Slope Water District	West Slope Water District	1				1	0		1			0	1		
WASH4	City of Wilsonville		1				1	0				1	1	1		
WASH3	Portland Water Bureau - SW	Portland Water Bureau	1		1		2				1			1		1

Island ID	GIS Water District Name	1. Name of your organization	pleted (include infrastructure originally built to a sufficient seismic standar)? (select all that apply)													
			(select all that apply)			d. "Backbone" transmission pipelines connecting critical facilities, storage, and supply (select all that apply)					e. Key facilities and supplies (select all that apply)					
		Open-Ended Response	Not sure	Deficient source (neither have nor planned)	Deficient and Groundwater	We have started work on hardening our backbone	We have completed hardening our backbone	We have backbone hardening projects planned within the next 5 years	Not sure	Deficient (neither done nor planned)	Our District or City offices are seismically resilient	Our emergency control/operations center is seismically resilient	Our operations building is seismically resilient	We have emergency water for staff	We have emergency food for staff	Any above listed food/water supplies will last less than 1 week
WASH1	City of Banks	City of Banks	1	1	1				1	1						
CLARK1	City of Battleground	City of Battleground		0	0				1	1	1			1	1	
WASH3	City of Beaverton	City of Beaverton		0	0	1		1		0		1		1	1	1
CLARK1	City of Camas	City of Camas, WA		0	0			1		0						
COLUM2	City of Clatskanie	City of Clatskanie	1	1	0	1				0	1	1	1			
CLACK9	City of Estacada	City of Estacada		0	0				1	1				1		
WASH6	City of Forest Grove	City of Forest Grove	1	1	0	1				0						
CLACK2	City of Gladstone	City of Gladstone	1	1	0				1	1						
MULT2	City of Gresham	City of Gresham		0	0	1				0						
WASH3	City of Hillsboro	City of Hillsboro		0	0			1		0	1	1	1	1	1	1
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro	1	1	0	1				0				1	1	1
CLACK1	City of Lake Oswego	City of Lake Oswego		0	0		1			0			1		1	
CLACK2	City of Milwaukie	City of Milwaukie	1	1	1				1	1		1			1	
CLACK11	City of Molalla	City of Molalla		0	0			1		0			1			
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work	1	1	0				1	1	1	1	1			
COLUM4	City of Saint Helens	City of Saint Helens	1	1	0				1	1		1				
CLACK3	City of Sandy	City of Sandy		0	0					1		1	1	1	1	1
COLUM5	City of Scappoose	City of Scappoose		0	0			1		0		1	1			
WASH4	City of Sherwood	City of Sherwood		0	0	1				0				1	1	
WASH3	City of Tigard	City of Tigard		0	0			1		0				1	1	1
MULT2	City of Troutdale	City of Troutdale	1	0	0			1	1	0	1	1	1	1	1	1
WASH4	City of Tualatin	City of Tualatin	1	0	0			1		0		1	1		1	
CLARK1	City of Vancouver	City of Vancouver		0	0	1				0						
CLACK1	City of West Linn	City of West Linn	1	1	0				1	1						
MULT2	City of Wood Village	City of Wood Village		0	0				1	1						
CLARK3	City of Washougal	City of Washougal		0	0			1		0				1		1
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water	1	1	0	1		1		0				1	1	
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water	1	1	1	1		1		0						
CLARK1	Clark Public Utilities	Clark Public Utilities		0	0			1		0		1	1	1	1	1
MULT3	Corbett Water District	Corbett Water District		0	0			1		0						
WASH6	Joint Water Commission	Joint Water Commission		0	0			1		0	1	1	1	1	1	1
COLUM4	McNulty Water PUD	McNulty	1	1	1				1	1						
MULT2	Portland Water Bureau - East	Portland Water Bureau		0	0	1		1		0	1	1	1	1	1	
MULT1	Portland Water Bureau - West	Portland Water Bureau		0	0	1		1		0				1	1	
WASH3	Raleigh Water District	Raleigh Water District	1	1	0				1	1						
CLACK1	Rivergrove Water District	Rivergrove Water District		0	0			1		0						
MULT2	Rockwood Water PUD	Rockwood Water PUD		0	0	1		1		0						
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company		0	0	1		1		0						
CLACK5	South Fork Water Board	South Fork Water Board		0	0			1		0	1			1	1	
CLACK3	Sunrise Water Authority	Sunrise Water Authority		0	0	1				0						
WASH3	Tualatin Valley Water District	Tualatin Valley Water District		0	0	1				0				1	1	
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist	1	1	0				1	1				1	1	1
WASH3	West Slope Water District	West Slope Water District		0	0	1		1		0				1	1	1
WASH4	City of Wilsonville			0	0				1	1				1	1	1
WASH3	Portland Water Bureau - SW	Portland Water Bureau		0	0	1		1		0				1	1	

Island ID	GIS Water District Name	1. Name of your organization	f. Other (please specify)					8. How much seismically-resilient storage to you have in your system? Please fill in numeric responses in millions of gallons (MG)					
								a. Total average (not design) volume of all reservoirs/tanks likely to be intact after a Cascadia Subduction Zone earthquake:			b. Of the above resilient volume, how much of it has a seismic valve (triggered by ShakeAlert or on-site sensor) that would prevent it from being drained:		
		Open-Ended Response	We have emergency sleeping areas and supplies for staff	Not sure	Open-Ended Response	Have both a source and at least a start in backbone hardening	Have or are planning both a source and a backbone	Difficulty using resilient source (source but deficient backbone)	Ave. Seismic Volume (MG)	Comments (transferred out of numeric column)	Not sure	Seismic Volume w/ Seismic Valve (MG)	Comments (transferred out of numeric column)	Not Sure
WASH1	City of Banks	City of Banks		1		0	0	0	1.2					
CLARK1	City of Battleground	City of Battleground				0	0	1	7				None	
WASH3	City of Beaverton	City of Beaverton				1	1	0	5	(cooper mtn reservoir no.2); some of our ASR wells (up to 1 billion gallons)		5	(Cooper Mtn Reservoir No.2)	
CLARK1	City of Camas	City of Camas, WA		1	None of the above applies to our city	0	1	0	2			2		
COLUM2	City of Clatskanie	City of Clatskanie				0	0	0	1.026			1.026		
CLACK9	City of Estacada	City of Estacada		1		0	0	1	0.25					
WASH6	City of Forest Grove	City of Forest Grove		1		0	0	0						
CLACK2	City of Gladstone	City of Gladstone		1		0	0	0			1			
MULT2	City of Gresham	City of Gresham				0	0	0	10			10		
WASH3	City of Hillsboro	City of Hillsboro				0	0	0	31			0		
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro				0	0	0	0			0		
CLACK1	City of Lake Oswego	City of Lake Oswego				1	0	0	4			4		
CLACK2	City of Milwaukie	City of Milwaukie				0	0	0	1.5					1
CLACK11	City of Molalla	City of Molalla				0	0	0			1			1
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work				0	0	0	12.5					1
COLUM4	City of Saint Helens	City of Saint Helens				0	0	0	0.455					
CLACK3	City of Sandy	City of Sandy	1			0	0	1	3					
COLUM5	City of Scappoose	City of Scappoose				0	1	0	1.984					
WASH4	City of Sherwood	City of Sherwood	1			1	1	0			1			
WASH3	City of Tigard	City of Tigard				0	1	0	6					
MULT2	City of Troutdale	City of Troutdale	1			0	1	0						
WASH4	City of Tualatin	City of Tualatin				0	1	0	6					
CLARK1	City of Vancouver	City of Vancouver				1	1	0	18					
CLACK1	City of West Linn	City of West Linn		1		0	0	0	4					
MULT2	City of Wood Village	City of Wood Village		1		0	0	0						
CLARK3	City of Washougal	City of Washougal	1			0	0	0			1			1
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water	1		Our water treatment plant has life/safety improvements but will	0	0	0	6			6		
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water				0	0	0	1.25			1.25		
CLARK1	Clark Public Utilities	Clark Public Utilities	1			0	1	0	6					1
MULT3	Corbett Water District	Corbett Water District		1		0	0	0	1					1
WASH6	Joint Water Commission	Joint Water Commission	1			0	0	0	40					
COLUM4	McNulty Water PUD	McNulty		1		0	0	0			1			
MULT2	Portland Water Bureau - East	Portland Water Bureau	0			1	1	0	112.4			13	We do not have seismic valves at this time (but do have an isolation plan)	
MULT1	Portland Water Bureau - West	Portland Water Bureau	0			1	1	0	14.2			4.4	We do not have seismic valves at	
WASH3	Raleigh Water District	Raleigh Water District		1		0	0	0	0.5					
CLACK1	Rivergrove Water District	Rivergrove Water District		1	N/A	0	1	0	1.25			1.25		
MULT2	Rockwood Water PUD	Rockwood Water PUD		1	Our District office is not seismically upgraded and was constructed in the 1970's.	1	1	0	10			8.4		
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company		1	3 Employees, 1 small office, few supplies	1	1	0		.5 all the way to 0	1			0
CLACK5	South Fork Water Board	South Fork Water Board	1			0	0	0	2					
CLACK3	Sunrise Water Authority	Sunrise Water Authority			Current administration and operations facilities are not seismically resilient. New	1	1	0	7			3		
WASH3	Tualatin Valley Water District	Tualatin Valley Water District			Seismic upgrades in the ne1t 5 years include some but not all	0	0	0	46	Assumed 57 MG with minor		11.8	Assumed 14.75 MG 80% full	
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.	1			0	0	0	5			5		
WASH3	West Slope Water District	West Slope Water District				1	1	0	3.7			3.7		
WASH4	City of Wilsonville		1			0	0	1	5.2			0		
WASH3	Portland Water Bureau - SW	Portland Water Bureau	0			1	1	0	5.9			0	We do not have seismic valves at	

Island ID	GIS Water District Name	1. Name of your organization	9. Do you have emergency generators for these facilities? (select all that apply)				10. If you were on standby power, how long would you be able to operate your supply (well, or intake + water treatment plant) at average day demand levels? (select one)						11. How long would you be able to treat and disinfect your water without chemical deliveries (including chlorine) at average day demand levels? (based on chemical stores only, not power or other factors)					12. Beyond the Emerg following plans or docu
		Open-Ended Response	Supply (well, or intake and water treatment plant)	Pump stations	Emergency Operations Center	Not sure	We don't have standby power	Less than a day	One to three days	Three to five days	More than five days	Not sure	We don't require treatment or disinfection chemicals	Less than one week	One to two weeks	More than two weeks	Not sure	Continuity of Operations Plan or other plan with a strategic focus on the functional survival of your organization in an emergency
WASH1	City of Banks	City of Banks	1						2							1		
CLARK1	City of Battleground	City of Battleground	1	1	1				2						1			1
WASH3	City of Beaverton	City of Beaverton	1	1	1				2						1			1
CLARK1	City of Camas	City of Camas, WA	1	1					2						1			1
COLUM2	City of Clatskanie	City of Clatskanie	1		1						6					1		1
CLACK9	City of Estacada	City of Estacada	1	1	1					4						1		
WASH6	City of Forest Grove	City of Forest Grove	1						2						1			
CLACK2	City of Gladstone	City of Gladstone			1		0										1	
MULT2	City of Gresham	City of Gresham	1	1	1						6		1					1
WASH3	City of Hillsboro	City of Hillsboro	1	1	1				2							1		1
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro	1	1				0.5								1		1
CLACK1	City of Lake Oswego	City of Lake Oswego		1	1		0									1		
CLACK2	City of Milwaukie	City of Milwaukie	1	1	1					4						1		
CLACK11	City of Molalla	City of Molalla	1							4					1			
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work		1	1							1					1	1
COLUM4	City of Saint Helens	City of Saint Helens	1	1	1				2							1		1
CLACK3	City of Sandy	City of Sandy	1	1	1						6					1		1
COLUM5	City of Scappoose	City of Scappoose	1	1	1					4						1		1
WASH4	City of Sherwood	City of Sherwood	1	1	1				2							1		1
WASH3	City of Tigard	City of Tigard	1	1	1				2							1		1
MULT2	City of Troutdale	City of Troutdale	1	1	1			0.5								1		1
WASH4	City of Tualatin	City of Tualatin		1	1						6					1		1
CLARK1	City of Vancouver	City of Vancouver	1	1	1					4						1		
CLACK1	City of West Linn	City of West Linn		1	1					4			1					
MULT2	City of Wood Village	City of Wood Village	1	1	1						6					1		1
CLARK3	City of Washougal	City of Washougal	1	1	1						6					1		1
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water	1	1	1				2							1		1
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water		1			0							1				1
CLARK1	Clark Public Utilities	Clark Public Utilities		1	1				2							1		1
MULT3	Corbett Water District	Corbett Water District	1		1					4					1			
WASH6	Joint Water Commission	Joint Water Commission	1	1	1				2							1		
COLUM4	McNulty Water PUD	McNulty	1						2				1					
MULT2	Portland Water Bureau - East	Portland Water Bureau	1	1	1						6					1		1
MULT1	Portland Water Bureau - West	Portland Water Bureau	1	1	1						6					1		1
WASH3	Raleigh Water District	Raleigh Water District				1						1					1	
CLACK1	Rivergrove Water District	Rivergrove Water District	1	1					2				1					1
MULT2	Rockwood Water PUD	Rockwood Water PUD	1	1	1				2							1		
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company		1			0						1					1
CLACK5	South Fork Water Board	South Fork Water Board			1							1				1		
CLACK3	Sunrise Water Authority	Sunrise Water Authority	1	1	1				2						1			
WASH3	Tualatin Valley Water District	Tualatin Valley Water District	1	1	1				2							1		
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.			1							1					1	
WASH3	West Slope Water District	West Slope Water District			1					4			1					1
WASH4	City of Wilsonville		1	1	1				2							1		1
WASH3	Portland Water Bureau - SW	Portland Water Bureau	1	1	1						6					1		1

Island ID	GIS Water District Name	1. Name of your organization	Emergency Response Plan required for America's Water Infrastructure Act (AWIA), which have/will be complete/updated between 2015 and end of 2021? (select all that apply)					13. How often do you train your staff on your Emergency Response Plan, Emergency Operations Plan or Continuity of Operations Plan? (select one)					14. To what level has your utility adopted an Emergency Management System (NIMS) including (ICS)? (select all I tha apply		
		Open-Ended Response	Catastrophic Emergency Operations Plan or other tactical plan to recover water system operations after a catastrophic disaster (such as a Cascadia Subduction Zone earthquake)	Seismic risk assessment (likelihood and consequence of damage to critical assets)	Seismic risk mitigation plan (specialized capital improvement plan to reduce risk over the next decades)	FEMA/AWWA-compliant resource typing (internal and needed resource identification in a universal language)	Not sure	We have never done training	We have done at least one training in the past	We do training at least once a year	We do more than one training per year	Not sure	Have officially adopted the NIMS ICS system	Have designed ICS command roles within your water utility	Have trained ICS command staff within your water utility on NIMS
WASH1	City of Banks	City of Banks					1	1							
CLARK1	City of Battleground	City of Battleground							1				1		
WASH3	City of Beaverton	City of Beaverton		1	1					1			1	1	1
CLARK1	City of Camas	City of Camas, WA						1							
COLUM2	City of Clatskanie	City of Clatskanie	1									1	1		
CLACK9	City of Estacada	City of Estacada					1		1				1		
WASH6	City of Forest Grove	City of Forest Grove	1	1	1				1				1		
CLACK2	City of Gladstone	City of Gladstone							1						
MULT2	City of Gresham	City of Gresham		1	1					1			1	1	1
WASH3	City of Hillsboro	City of Hillsboro		1	1				1					1	1
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro		1	1				1					1	1
CLACK1	City of Lake Oswego	City of Lake Oswego					1	1							
CLACK2	City of Milwaukie	City of Milwaukie					1		1				1	1	1
CLACK11	City of Molalla	City of Molalla					1		1					1	1
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work	1		1				1				1		
COLUM4	City of Saint Helens	City of Saint Helens							1						
CLACK3	City of Sandy	City of Sandy		1	1				1						
COLUM5	City of Scappoose	City of Scappoose		1	1					1				1	
WASH4	City of Sherwood	City of Sherwood		1	1					1			1	1	1
WASH3	City of Tigard	City of Tigard								1			1	1	1
MULT2	City of Troutdale	City of Troutdale	1	1	1	1			1						1
WASH4	City of Tualatin	City of Tualatin	1	1					1				1	1	1
CLARK1	City of Vancouver	City of Vancouver						1						1	
CLACK1	City of West Linn	City of West Linn					1		1						1
MULT2	City of Wood Village	City of Wood Village	1			1				1				1	1
CLARK3	City of Washougal	City of Washougal		1	1					1			1		
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water		1	1					1			1	1	1
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water		1	1					1			1	1	1
CLARK1	Clark Public Utilities	Clark Public Utilities				1		1					1		
MULT3	Corbett Water District	Corbett Water District					1			1					
WASH6	Joint Water Commission	Joint Water Commission		1	1				1					1	1
COLUM4	McNulty Water PUD	McNulty		1				1							
MULT2	Portland Water Bureau - East	Portland Water Bureau	1	1	1	1			1				1	1	1
MULT1	Portland Water Bureau - West	Portland Water Bureau	1	1	1	1			1				1	1	1
WASH3	Raleigh Water District	Raleigh Water District		1						1					
CLACK1	Rivergrove Water District	Rivergrove Water District		1	1			1							
MULT2	Rockwood Water PUD	Rockwood Water PUD		1					1						1
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company			1			1							
CLACK5	South Fork Water Board	South Fork Water Board		1	1	1				1			1	1	1
CLACK3	Sunrise Water Authority	Sunrise Water Authority		1					1				1	1	1
WASH3	Tualatin Valley Water District	Tualatin Valley Water District		1	1				1				1	1	1
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.					1		1						1
WASH3	West Slope Water District	West Slope Water District		1					1						1
WASH4	City of Wilsonville					1				1					1
WASH3	Portland Water Bureau - SW	Portland Water Bureau	1	1	1	1			1				1	1	1

Island ID	GIS Water District Name	1. Name of your organization	opted the National Incident dent Command Structure one of the last two)			15. When we have activated or exercised our Emergency Response or Operations Plan, how well has it worked? (Select one)					16. How confident are you that your Emergency Response and Operations Plans are adequate for a catastrophic disaster such as the Cascadia Subduction Zone earthquake? (scaled response, range from 1 to 7, not at all confident, very confident)							17. In the immediate aftermath of a di incident, who do you consider responsible for distributing emergency water directly (e.g. bottled water or filling station op	
		Open-Ended Response	Have trained general staff within your water utility on NIMS	None of the above	Not sure	It worked well	It worked okay, but there were some deficiencies	It had major deficiencies / could not be followed	It had deficiencies but those have been corrected or will be by the end of 2021	Not Sure	1 not at all confident	2	3	4	5	6	7 very confident	Our utility is responsible for providing and distributing emergency water	We are responsible to provide support (such as providing water), but another agency is responsible for leading distribution of emergency water
WASH1	City of Banks	City of Banks			1		1				1								
CLARK1	City of Battleground	City of Battleground	1			1									1			1	
WASH3	City of Beaverton	City of Beaverton					1						1					1	
CLARK1	City of Camas	City of Camas, WA		1						1			1						
COLUM2	City of Clatskanie	City of Clatskanie					1							1					1
CLACK9	City of Estacada	City of Estacada				1									1			1	
WASH6	City of Forest Grove	City of Forest Grove					1					1	1						1
CLACK2	City of Gladstone	City of Gladstone		1			1						1					1	
MULT2	City of Gresham	City of Gresham	1				1						1					1	
WASH3	City of Hillsboro	City of Hillsboro	1				1							1				1	
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro	1				1							1				1	
CLACK1	City of Lake Oswego	City of Lake Oswego	1				1						1					1	
CLACK2	City of Milwaukie	City of Milwaukie	1				1								1			1	
CLACK11	City of Molalla	City of Molalla	1			1							1					1	
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work								1					1				1
COLUM4	City of Saint Helens	City of Saint Helens	1				1							1					1
CLACK3	City of Sandy	City of Sandy	1				1								1			1	
COLUM5	City of Scappoose	City of Scappoose					1							1				1	
WASH4	City of Sherwood	City of Sherwood	1				1						1					1	
WASH3	City of Tigard	City of Tigard	1				1						1					1	
MULT2	City of Troutdale	City of Troutdale					1						1						1
WASH4	City of Tualatin	City of Tualatin	1				1						1						1
CLARK1	City of Vancouver	City of Vancouver					1						1					1	
CLACK1	City of West Linn	City of West Linn					1						1						
MULT2	City of Wood Village	City of Wood Village	1				1								1			1	
CLARK3	City of Washougal	City of Washougal				1							1					1	
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water	1							1			1						1
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water	1							1			1						1
CLARK1	Clark Public Utilities	Clark Public Utilities								1				1					1
MULT3	Corbett Water District	Corbett Water District			1					1		1							
WASH6	Joint Water Commission	Joint Water Commission	1				1							1				1	
COLUM4	McNulty Water PUD	McNulty		1						1	1							1	
MULT2	Portland Water Bureau - East	Portland Water Bureau	1				1								1				
MULT1	Portland Water Bureau - West	Portland Water Bureau	1				1								1				
WASH3	Raleigh Water District	Raleigh Water District		1						1				1					1
CLACK1	Rivergrove Water District	Rivergrove Water District		1						1		1							
MULT2	Rockwood Water PUD	Rockwood Water PUD					1						1					1	
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company		1						1		1							1
CLACK5	South Fork Water Board	South Fork Water Board	1			1						1							1
CLACK3	Sunrise Water Authority	Sunrise Water Authority								1		1							
WASH3	Tualatin Valley Water District	Tualatin Valley Water District	1			1									1				
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.								1				1					1
WASH3	West Slope Water District	West Slope Water District								1				1					1
WASH4	City of Wilsonville		1				1								1			1	
WASH3	Portland Water Bureau - SW	Portland Water Bureau	1				1								1				

Island ID	GIS Water District Name	1. Name of your organization	Distribution system responsible for providing emergency water, community members)? (select one)		18. If your distribution system fails, what actions have you taken to prepare to get emergency water directly to people in your community? (select all that apply)									19. After a majo such as the Cas Zone event, how l expect to be on outside (state/ federal (selec t one)		
		Open-Ended Response	Not sure	Other agencies are responsible for providing and distributing emergency water	We have developed a plan for distributing water	We have identified community water distribution points	We have identified vulnerable populations who may have difficulty reaching distribution	We have identified a way to get water to vulnerable populations	We have equipment (manifolds, treatment and/or distribution trailers) to help deliver water	We have planned how to staff water distribution sites	We have not prepared to distribute emergency water	Coordinated with CERT or other agencies about distributing water	Not sure	Less than a day	One to two days	Two days to a week
WASH1	City of Banks	City of Banks											1			
CLARK1	City of Battleground	City of Battleground			1	1										1
WASH3	City of Beaverton	City of Beaverton							1							
CLARK1	City of Camas	City of Camas, WA		FEMA							1					
COLUM2	City of Clatskanie	City of Clatskanie				1										
CLACK9	City of Estacada	City of Estacada									1					
WASH6	City of Forest Grove	City of Forest Grove				1					1					1
CLACK2	City of Gladstone	City of Gladstone		Police & Fire Departments							1					
MULT2	City of Gresham	City of Gresham							1							
WASH3	City of Hillsboro	City of Hillsboro			1	1			1							
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro							1		1					
CLACK1	City of Lake Oswego	City of Lake Oswego							1		1					1
CLACK2	City of Milwaukie	City of Milwaukie				1			1							
CLACK11	City of Molalla	City of Molalla									1					
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work			1				1							
COLUM4	City of Saint Helens	City of Saint Helens							1							
CLACK3	City of Sandy	City of Sandy									1					
COLUM5	City of Scappoose	City of Scappoose										1				
WASH4	City of Sherwood	City of Sherwood				1										1
WASH3	City of Tigard	City of Tigard				1			1			1				
MULT2	City of Troutdale	City of Troutdale									1					
WASH4	City of Tualatin	City of Tualatin			1	1						1				
CLARK1	City of Vancouver	City of Vancouver									1					1
CLACK1	City of West Linn	City of West Linn	1						1							
MULT2	City of Wood Village	City of Wood Village										1				1
CLARK3	City of Washougal	City of Washougal								1						
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water				1			1	1						
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water														
CLARK1	Clark Public Utilities	Clark Public Utilities				1						1				
MULT3	Corbett Water District	Corbett Water District	1										1			
WASH6	Joint Water Commission	Joint Water Commission				1										
COLUM4	McNulty Water PUD	McNulty				1					1					
MULT2	Portland Water Bureau - East	Portland Water Bureau	1	FEMA and US Army Corps of Engineers have stated that they will provide emergency water following disasters			1		1	1		1				
MULT1	Portland Water Bureau - West	Portland Water Bureau	1	FEMA and US Army Corps of			1		1	1		1				
WASH3	Raleigh Water District	Raleigh Water District				1										
CLACK1	Rivergrove Water District	Rivergrove Water District	1								1		1			1
MULT2	Rockwood Water PUD	Rockwood Water PUD			1	1			1							
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company									1					
CLACK5	South Fork Water Board	South Fork Water Board							1	1						
CLACK3	Sunrise Water Authority	Sunrise Water Authority		Other agencies (FEMA, OEM, Clackamas							1					
WASH3	Tualatin Valley Water District	Tualatin Valley Water District		Our utility is responsible for	1	1			1	1						
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.									1					
WASH3	West Slope Water District	West Slope Water District				1	1									
WASH4	City of Wilsonville					1	1									
WASH3	Portland Water Bureau - SW	Portland Water Bureau	1	FEMA and US Army Corps of			1		1	1		1				

Island ID	GIS Water District Name	1. Name of your organization	seismic disaster Cascadia Subduction ng does your utility our own before al) help arrives? one)			20. What actions have you taken to promote general public individual preparedness, such as 2-weeks ready? (Select all that apply)									
		Open-Ended Response	One to two weeks	More than two weeks	Not sure	Promoted on website	Newsletters or bill inserts	Preparedness or other community fairs	Tabling at community events	Working with our Community Emergency Response Team (CERT) or other community organization	Participate in Regional Water Providers Consortium's outreach campaign as a member	We have not done significant general public preparedness promotion in the last several years	Not sure	Other (please specify)	Emergency water treatment trailer*
WASH1	City of Banks	City of Banks		1									1		
CLARK1	City of Battleground	City of Battleground									1				
WASH3	City of Beaverton	City of Beaverton		1							1	1			1
CLARK1	City of Camas	City of Camas, WA		1								1			
COLUM2	City of Clatskanie	City of Clatskanie	1			1	1	1	1	1					1
CLACK9	City of Estacada	City of Estacada		1		1	1			1					
WASH6	City of Forest Grove	City of Forest Grove									1				
CLACK2	City of Gladstone	City of Gladstone			1							1	1		
MULT2	City of Gresham	City of Gresham		1		1	1				1				1
WASH3	City of Hillsboro	City of Hillsboro	1			1	1		1		1			SOCIAL MEDIA	
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro	1			1	1		1		1			SOCIAL MEDIA	
CLACK1	City of Lake Oswego	City of Lake Oswego						1	1		1				1
CLACK2	City of Milwaukie	City of Milwaukie	1			1	1				1				1
CLACK11	City of Molalla	City of Molalla		1		1						1			
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work		1		1	1				1				1
COLUM4	City of Saint Helens	City of Saint Helens	1									1			1
CLACK3	City of Sandy	City of Sandy		1		1	1				1				
COLUM5	City of Scappoose	City of Scappoose			1					1					
WASH4	City of Sherwood	City of Sherwood				1					1				
WASH3	City of Tigard	City of Tigard	1			1	1	1		1	1				
MULT2	City of Troutdale	City of Troutdale	1			1					1				
WASH4	City of Tualatin	City of Tualatin			1	1	1	1	1	1	1			Social media campaigns, engaged community	
CLARK1	City of Vancouver	City of Vancouver										1			
CLACK1	City of West Linn	City of West Linn		1							1				1
MULT2	City of Wood Village	City of Wood Village				1	1	1							
CLARK3	City of Washougal	City of Washougal		1									1		
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water		1		1	1	1			1				1
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water		1			1	1			1				
CLARK1	Clark Public Utilities	Clark Public Utilities		1		1	1								
MULT3	Corbett Water District	Corbett Water District		1									1		
WASH6	Joint Water Commission	Joint Water Commission		1		1	1		1		1			SOCIAL MEDIA	
COLUM4	McNulty Water PUD	McNulty		1								1		NONE	
MULT2	Portland Water Bureau - East	Portland Water Bureau		1		1	1	1	1	1	1				1
MULT1	Portland Water Bureau - West	Portland Water Bureau		1		1	1	1	1	1	1				
WASH3	Raleigh Water District	Raleigh Water District	1								1				
CLACK1	Rivergrove Water District	Rivergrove Water District										1			
MULT2	Rockwood Water PUD	Rockwood Water PUD	1			1		1			1				
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company	1									1			
CLACK5	South Fork Water Board	South Fork Water Board		1		1	1	1	1	1	1				1
CLACK3	Sunrise Water Authority	Sunrise Water Authority		1							1	1		Facebook posts	
WASH3	Tualatin Valley Water District	Tualatin Valley Water District	1			1	1	1	1		1				
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist	1			1	1								
WASH3	West Slope Water District	West Slope Water District	1			1	1	1	1		1				
WASH4	City of Wilsonville			1		1	1	1	1						
WASH3	Portland Water Bureau - SW	Portland Water Bureau		1		1	1	1	1	1	1				

Island ID	GIS Water District Name	1. Name of your organization	21. Which of the following emergency equipment/resources do you have? (Select all that apply. *Indicate number of each selected)													21a. If you with an
		Open-Ended Response	Smaller portable treatment system (e.g. "hurricane" system)*	Spare filters for water treatment trailer or hurricane system	Manifold trailer for emergency water distribution*	Reels of overland pipe*	Potable water tanker trucks*	Large truck bladders and/or portable tanks*	Bags or containers for water distribution to individuals	Disaster retainer agreement with consultants	Disaster retainer agreement with contractors	Emergency fuel agreement with local provider	Paper versions of emergency response plans	Paper or thumb drive version of GIS and/or system maps, drawings and manuals	Not sure	Emergency water treatment trailer
WASH1	City of Banks	City of Banks													1	
CLARK1	City of Battleground	City of Battleground										1				
WASH3	City of Beaverton	City of Beaverton			1	1						1			1	1
CLARK1	City of Camas	City of Camas, WA												1		
COLUM2	City of Clatskanie	City of Clatskanie										1	1	1		1
CLACK9	City of Estacada	City of Estacada											1			
WASH6	City of Forest Grove	City of Forest Grove							1						1	
CLACK2	City of Gladstone	City of Gladstone											1			
MULT2	City of Gresham	City of Gresham		1	1	1			1			1	1			1
WASH3	City of Hillsboro	City of Hillsboro			1	1		1	1				1	1		
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro														
CLACK1	City of Lake Oswego	City of Lake Oswego		1				1	1							1
CLACK2	City of Milwaukie	City of Milwaukie											1	1		1
CLACK11	City of Molalla	City of Molalla					1					1	1	1		
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work	1	1				1					1			1
COLUM4	City of Saint Helens	City of Saint Helens		1	1											1
CLACK3	City of Sandy	City of Sandy							1							
COLUM5	City of Scappoose	City of Scappoose	1													
WASH4	City of Sherwood	City of Sherwood	1	1					1				1	1		
WASH3	City of Tigard	City of Tigard	1						1			1	1	1		
MULT2	City of Troutdale	City of Troutdale							1				1	1		
WASH4	City of Tualatin	City of Tualatin	1						1				1			
CLARK1	City of Vancouver	City of Vancouver											1	1		
CLACK1	City of West Linn	City of West Linn											1			1
MULT2	City of Wood Village	City of Wood Village											1	1		
CLARK3	City of Washougal	City of Washougal										1	1	1		
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water	1	1	1	1		1	1	1	1		1	1		1
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water								1	1					
CLARK1	Clark Public Utilities	Clark Public Utilities											1	1		
MULT3	Corbett Water District	Corbett Water District													1	
WASH6	Joint Water Commission	Joint Water Commission	1	1	1	1		1	1				1	1		
COLUM4	McNulty Water PUD	McNulty													1	
MULT2	Portland Water Bureau - East	Portland Water Bureau			1				1				1	1		2
MULT1	Portland Water Bureau - West	Portland Water Bureau			1				1				1			0
WASH3	Raleigh Water District	Raleigh Water District													1	
CLACK1	Rivergrove Water District	Rivergrove Water District	1									1				
MULT2	Rockwood Water PUD	Rockwood Water PUD			1								1	1		
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company											1			
CLACK5	South Fork Water Board	South Fork Water Board					1		1							2
CLACK3	Sunrise Water Authority	Sunrise Water Authority									1		1	1		
WASH3	Tualatin Valley Water District	Tualatin Valley Water District			1	1		1	1		1		1	1		
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.											1	1		
WASH3	West Slope Water District	West Slope Water District											1			
WASH4	City of Wilsonville									1	1	1	1	1		
WASH3	Portland Water Bureau - SW	Portland Water Bureau											1			0

Island ID	GIS Water District Name	1. Name of your organization	selected any of the following emergency equipment/resources asterisk from Question 21 above, please indicate quantity available.					22. What communication devices and approaches do you plan to use in an emergency to communicate with staff and other agencies? (select all that apply)								23.	
		Open-Ended Response	Smaller portable treatment system	Manifold trailer for emergency water distribution	Reels of overland pipe	Potable water tanker trucks	Large truck bladders and/or portable tanks	Cell phones - standard network	Cell phones - first-responder network	Satellite phones	CB Radios	Walkie talkies or cell phones with radio function	Ham radio	Not sure	Other (please specify)	Social media	Notification systems (e.g. Everbridge/ Nixle)
WASH1	City of Banks	City of Banks						1				1				1	
CLARK1	City of Battleground	City of Battleground									1	1				1	
WASH3	City of Beaverton	City of Beaverton	1	1	2	0	0	1			1						
CLARK1	City of Camas	City of Camas, WA						1								1	
COLUM2	City of Clatskanie	City of Clatskanie						1				1	1			1	1
CLACK9	City of Estacada	City of Estacada						1					1			1	1
WASH6	City of Forest Grove	City of Forest Grove						1			1	1	1		OMMERCIAL REPEATER/TR	1	
CLACK2	City of Gladstone	City of Gladstone						1								1	
MULT2	City of Gresham	City of Gresham		1	1			1					1			1	
WASH3	City of Hillsboro	City of Hillsboro		1	3		1	1	1	1	1	1	1			1	1
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro						1	1	1	1	1	1			1	1
CLACK1	City of Lake Oswego	City of Lake Oswego					1	1				1				1	
CLACK2	City of Milwaukie	City of Milwaukie							1		1		1			1	
CLACK11	City of Molalla	City of Molalla						1	1						Verbal & Runners	1	
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work	1	1			2	1		1	1	1	1			1	1
COLUM4	City of Saint Helens	City of Saint Helens		1				1			1	1				1	1
CLACK3	City of Sandy	City of Sandy						1								1	
COLUM5	City of Scappoose	City of Scappoose						1	1	1		1	1			1	
WASH4	City of Sherwood	City of Sherwood							1				1		800 MHZ RADIO	1	1
WASH3	City of Tigard	City of Tigard	1					1	1			1	1			1	1
MULT2	City of Troutdale	City of Troutdale						1	1		1	1				1	
WASH4	City of Tualatin	City of Tualatin	1					1	1		1					1	1
CLARK1	City of Vancouver	City of Vancouver						1			1					1	
CLACK1	City of West Linn	City of West Linn						1							900mhz radios	1	
MULT2	City of Wood Village	City of Wood Village						1			1					1	
CLARK3	City of Washougal	City of Washougal										1				1	
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water	1	1	2		5	1		1					Fully deployed VHF radio system	1	1
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water						1		1					Fully deployed VHF radio system	1	1
CLARK1	Clark Public Utilities	Clark Public Utilities							1	1					COMPANY RADIO SYST	1	1
MULT3	Corbett Water District	Corbett Water District						1			1					1	1
WASH6	Joint Water Commission	Joint Water Commission						1	1	1	1	1	1			1	1
COLUM4	McNulty Water PUD	McNulty						1									
MULT2	Portland Water Bureau - East	Portland Water Bureau		1				1		1					800Mhz Radios, GETS/WPS priority calling	1	1
MULT1	Portland Water Bureau - West	Portland Water Bureau		1				1		1					0	1	1
WASH3	Raleigh Water District	Raleigh Water District						1				1				1	
CLACK1	Rivergrove Water District	Rivergrove Water District	2					1								1	
MULT2	Rockwood Water PUD	Rockwood Water PUD		1				1				1				1	
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company						1							redundant cell provider relay for		
CLACK5	South Fork Water Board	South Fork Water Board				2		1						1			
CLACK3	Sunrise Water Authority	Sunrise Water Authority						1			1				C-800 RADIOS	1	1
WASH3	Tualatin Valley Water District	Tualatin Valley Water District		2	2				1	1					District radio network	1	1
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist						1				1				1	
WASH3	West Slope Water District	West Slope Water District						1				1		1		1	1
WASH4	City of Wilsonville							1		1	1	1	1			1	1
WASH3	Portland Water Bureau - SW	Portland Water Bureau		0				1		1					0	1	1

Island ID	GIS Water District Name	1. Name of your organization	How do you plan to reach customers during an emergency? (select all that apply)								24. How easily could your employees report for duty? (select one)					25. Do you Team (CE with
		Open-Ended Response	Community volunteer connections	Radio and/or TV stations	Community organizations	Roadside signs	Door hangers	Have a specific plan to reach non-English speakers	Not sure	Other (please specify)	Most of our employees lives within or close to our service area	Around half of our employees live within or close to our service area	Less than half of our employees live within or close to our service area	Not sure	Other	Yes, they are active and we have coordinated with them
WASH1	City of Banks	City of Banks		1			1						1			
CLARK1	City of Battleground	City of Battleground		1		1	1					1				
WASH3	City of Beaverton	City of Beaverton		1						Broadcast to cellphones			1			
CLARK1	City of Camas	City of Camas, WA											1			
COLUM2	City of Clatskanie	City of Clatskanie		1							1					1
CLACK9	City of Estacada	City of Estacada			1	1					1					1
WASH6	City of Forest Grove	City of Forest Grove		1	1	1	1				1					
CLACK2	City of Gladstone	City of Gladstone		1		1	1					1				
MULT2	City of Gresham	City of Gresham		1			1					1				
WASH3	City of Hillsboro	City of Hillsboro	1	1		1	1	1				1				
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro	1	1		1	1	1				1				
CLACK1	City of Lake Oswego	City of Lake Oswego											1			
CLACK2	City of Milwaukie	City of Milwaukie		1	1								1			
CLACK11	City of Molalla	City of Molalla			1		1				1					
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work	1	1	1	1	1					1				
COLUM4	City of Saint Helens	City of Saint Helens		1		1					1					1
CLACK3	City of Sandy	City of Sandy		1							1					
COLUM5	City of Scappoose	City of Scappoose		1			1				1					1
WASH4	City of Sherwood	City of Sherwood		1									1			
WASH3	City of Tigard	City of Tigard	1	1	1	1							1			1
MULT2	City of Troutdale	City of Troutdale		1			1			reverse 911	1					
WASH4	City of Tualatin	City of Tualatin	1		1	1							1			1
CLARK1	City of Vancouver	City of Vancouver		1	1	1						1				
CLACK1	City of West Linn	City of West Linn											1			
MULT2	City of Wood Village	City of Wood Village				1	1	1			1					
CLARK3	City of Washougal	City of Washougal		1		1	1	1			1					
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water		1									1			
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water		1									1			
CLARK1	Clark Public Utilities	Clark Public Utilities		1		1	1				1					
MULT3	Corbett Water District	Corbett Water District		1			1				1					
WASH6	Joint Water Commission	Joint Water Commission		1			1	1				1				
COLUM4	McNulty Water PUD	McNulty			1						1					
MULT2	Portland Water Bureau - East	Portland Water Bureau		1	1			1		Emails, webpage updates, emergency phone #	1					1
MULT1	Portland Water Bureau - West	Portland Water Bureau		1	1			1		0	1					1
WASH3	Raleigh Water District	Raleigh Water District	1	1							1					
CLACK1	Rivergrove Water District	Rivergrove Water District		1		1	1						1			
MULT2	Rockwood Water PUD	Rockwood Water PUD		1		1	1					1				
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company		1		1	1				1					
CLACK5	South Fork Water Board	South Fork Water Board		1							1					
CLACK3	Sunrise Water Authority	Sunrise Water Authority		1	1	1	1			WEBSITE, REVERSE 911 DIALING AND TE1TS			1		I am defining “close” as	
WASH3	Tualatin Valley Water District	Tualatin Valley Water District	1	1	1	1						1				
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.		1		1										
WASH3	West Slope Water District	West Slope Water District		1									1			
WASH4	City of Wilsonville			1	1	1	1						1			
WASH3	Portland Water Bureau - SW	Portland Water Bureau		1	1			1		0	1					1

Island ID	GIS Water District Name	1. Name of your organization	have a Community Emergency Response T) or equivalent community organization in your service area? (select one)				26. If you needed additional resources to keep your water system running or to restore operations aft that apply)							
		Open-Ended Response	Yes, they are active but we have not coordinated with them	Yes, but they are not very active	No	Not sure	Rural water agency (OAWU)	Regional Water Providers Consortium	ORWARN or WAWARN	County Emergency Center	AWWA Subsection	Portland Water Bureau	Neighboring utilities through informal relationships	Not sure
WASH1	City of Banks	City of Banks			1									1
CLARK1	City of Battleground	City of Battleground			1			1						
WASH3	City of Beaverton	City of Beaverton	1					1	1	1	1	1	1	
CLARK1	City of Camas	City of Camas, WA	1							1			1	
COLUM2	City of Clatskanie	City of Clatskanie							1		1		1	
CLACK9	City of Estacada	City of Estacada								1			1	
WASH6	City of Forest Grove	City of Forest Grove		1				1		1			1	
CLACK2	City of Gladstone	City of Gladstone			1		1	1	1	1	1		1	
MULT2	City of Gresham	City of Gresham				1		1	1	1		1	1	
WASH3	City of Hillsboro	City of Hillsboro	1				1	1	1	1	1	1	1	
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro	1				1	1	1	1	1	1	1	
CLACK1	City of Lake Oswego	City of Lake Oswego				1		1	1	1			1	
CLACK2	City of Milwaukie	City of Milwaukie		1				1				1		
CLACK11	City of Molalla	City of Molalla				1				1			1	
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work		1				1	1	1			1	
COLUM4	City of Saint Helens	City of Saint Helens					1				1		1	
CLACK3	City of Sandy	City of Sandy				1		1	1					
COLUM5	City of Scappoose	City of Scappoose					1	1	1	1	1		1	
WASH4	City of Sherwood	City of Sherwood			1		1	1	1	1			1	
WASH3	City of Tigard	City of Tigard							1	1			1	
MULT2	City of Troutdale	City of Troutdale				1	1	1	1	1	1	1	1	
WASH4	City of Tualatin	City of Tualatin						1	1	1	1	1	1	
CLARK1	City of Vancouver	City of Vancouver	1						1	1			1	
CLACK1	City of West Linn	City of West Linn			1		1	1	1				1	
MULT2	City of Wood Village	City of Wood Village			1				1	1	1		1	
CLARK3	City of Washougal	City of Washougal			1			1						
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water				1		1	1	1		1	1	
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water				1		1	1	1		1	1	
CLARK1	Clark Public Utilities	Clark Public Utilities				1			1	1			1	
MULT3	Corbett Water District	Corbett Water District				1	1		1	1	1		1	
WASH6	Joint Water Commission	Joint Water Commission	1				1	1	1	1	1	1	1	
COLUM4	McNulty Water PUD	McNulty	1							1				
MULT2	Portland Water Bureau - East	Portland Water Bureau											1	
MULT1	Portland Water Bureau - West	Portland Water Bureau											1	
WASH3	Raleigh Water District	Raleigh Water District			1			1	1	1		1		
CLACK1	Rivergrove Water District	Rivergrove Water District	1										1	
MULT2	Rockwood Water PUD	Rockwood Water PUD				1			1			1	1	
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company			1					1			1	
CLACK5	South Fork Water Board	South Fork Water Board				1		1	1	1	1	1	1	
CLACK3	Sunrise Water Authority	Sunrise Water Authority	1					1	1	1		1	1	
WASH3	Tualatin Valley Water District	Tualatin Valley Water District	1					1	1	1		1	1	
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.												
WASH3	West Slope Water District	West Slope Water District				1	1	1	1	1		1		
WASH4	City of Wilsonville		1				1	1	1	1			1	
WASH3	Portland Water Bureau - SW	Portland Water Bureau											1	

Island ID	GIS Water District Name	1. Name of your organization	er a major earthquake event who would you contact? (select all
		Open-EndecResponse	Other (please specify)
WASH1	City of Banks	City of Banks	
CLARK1	City of Battleground	City of Battleground	CPU
WASH3	City of Beaverton	City of Beaverton	
CLARK1	City of Camas	City of Camas, WA	
COLUM2	City of Clatskanie	City of Clatskanie	
CLACK9	City of Estacada	City of Estacada	
WASH6	City of Forest Grove	City of Forest Grove	JOINT WATER COMMISSION
CLACK2	City of Gladstone	City of Gladstone	
MULT2	City of Gresham	City of Gresham	
WASH3	City of Hillsboro	City of Hillsboro	The City is part of Washington County's Emergency Fuel Plan. The agreements we have are, like everyone else, with Bretthauer. The Plan allows for coordination and distribution of fuel and includes Bretthauer. It's governed by the EMC board, which Chief Downey sits on for the City.
WASH7	City of Hillsboro Cherry Grove	City of Hillsboro	The City is part of Washington County's Emergency Fuel Plan. The agreements we have are, like everyone else, with Bretthauer. The Plan allows for coordination and distribution of fuel and includes Bretthauer. It's governed by the EMC board, which Chief Downey sits on for the City.
CLACK1	City of Lake Oswego	City of Lake Oswego	
CLACK2	City of Milwaukie	City of Milwaukie	
CLACK11	City of Molalla	City of Molalla	
CLACK5	City of Oregon City Public Works	City of Oregon City Public Work	
COLUM4	City of Saint Helens	City of Saint Helens	
CLACK3	City of Sandy	City of Sandy	
COLUM5	City of Scappoose	City of Scappoose	
WASH4	City of Sherwood	City of Sherwood	VENDORS, SUPPLY HOUSES, CONTRACTORS
WASH3	City of Tigard	City of Tigard	
MULT2	City of Troutdale	City of Troutdale	anyone who can help!
WASH4	City of Tualatin	City of Tualatin	
CLARK1	City of Vancouver	City of Vancouver	
CLACK1	City of West Linn	City of West Linn	
MULT2	City of Wood Village	City of Wood Village	
CLARK3	City of Washougal	City of Washougal	
CLACK2	Clackamas River Water - Clackamas	Clackamas River Water	On Call Contractors and Engineers
CLACK5	Clackamas River Water - Clairmont	Clackamas River Water	On Call Contractors and Engineers
CLARK1	Clark Public Utilities	Clark Public Utilities	
MULT3	Corbett Water District	Corbett Water District	
WASH6	Joint Water Commission	Joint Water Commission	
COLUM4	McNulty Water PUD	McNulty	
MULT2	Portland Water Bureau - East	Portland Water Bureau	Eugene EWEB, TVWD
MULT1	Portland Water Bureau - West	Portland Water Bureau	Eugene EWEB, TVWD
WASH3	Raleigh Water District	Raleigh Water District	
CLACK1	Rivergrove Water District	Rivergrove Water District	
MULT2	Rockwood Water PUD	Rockwood Water PUD	Gresham through Water Supply IGA-Partnership
CLACK7	Salmon Valley Water Company	Salmon Valley Water Company	
CLACK5	South Fork Water Board	South Fork Water Board	
CLACK3	Sunrise Water Authority	Sunrise Water Authority	CPAWC (COOPERATIVE PUBLIC AGENCIES OF WASHINGTON COUNTY)
WASH3	Tualatin Valley Water District	Tualatin Valley Water District	
CLACK2	Oak Lodge Water Services District	Oak Lodge Water Services Dist.	
WASH3	West Slope Water District	West Slope Water District	
WASH4	City of Wilsonville		
WASH3	Portland Water Bureau - SW	Portland Water Bureau	Eugene EWEB, TVWD

APPENDIX D
Workshop Participants

Workshop Attendees

WORKSHOP 1
JUNE 2, 2021

- Sam Adams, *City of Camas*
- Danny Allison, *Portland Water Bureau*
- Kim Anderson, *Portland Water Bureau*
- Denise Barrett, *Regional Disaster Preparedness Organization (RDPO)*
- Shaun Brown, *Columbia County Emergency Management*
- Donn Bunyard, *Clackamas River Water Providers*
- Tyler Clary, *City of Vancouver*
- Justin Craven, *Federal Emergency Management Agency (FEMA) Region 10*
- Andrew Degner, *City of Gresham*
- Rob Drank, *City of Cornelius*
- Kari Duncan, *Rockwood Water Public Utility District (PUD)*
- Gerald Fischer, *City of Molalla*
- Dan Fraijo, *Pleasant Home Water District*
- Rebecca Geisen, *Regional Water Providers Consortium (RWPC)*
- Della Graham, *Salus Resilience*
- Michael Grimm, *West Slope Water District*
- Jeremiah Hunt, *Oregon Water/Wastewater Agency Response Network (OWARN)*
- Niki Iverson, *City of Hillsboro*
- Bryan Kast, *City of Ridgefield*
- Russ Knutson, *Clark Public Utilities*
- Mark D. McKay, *United States Army Corps of Engineers (USACOE)*
- Allen Nelson, *City of Camas*
- Jeff Page, *Oak Lodge Water Services*
- Carrie Pak, *Tualatin Valley Water District*
- Wyatt Parno, *South Fork Water Board*
- Courtney Patterson, *Metro*
- Robin Pederson, *City of Gresham, RDPO Public Works Work Group Chair*
- Justin Poyser, *City of Gladstone*
- Nicki Pozos, *The Formation Lab*
- Allison Pyrch, *Salus Resilience*
- Silas Richardson, *City of Gresham*
- David Schaffer, *City of Troutdale*
- Taylor Stockton, *RH2*
- Kim Swan, *Clackamas River Water Providers*
- Shannon Tice, *McNulty Water PUD*
- Anthony Vendetti, *Clark Regional Emergency Services Agency (CRESA)*
- Vance Walker, *City of Oregon City*
- John Water, *Clark Public Utilities*
- John Wheeler, *Washington County Emergency Management*
- Priya Dhanapal, *City of Beaverton*
- Bob Willis, *RH2*
- Kent Yu, *SEFT Consulting Group*

WORKSHOP 2
OCTOBER 4, 2021

- Kim Anderson, *Portland Water Bureau*
- Denise Barrett, *RDPO*
- Pete Boone, *Tualatin Valley Water District*
- Jason Branstetter, *City of Gresham*
- Janine Casey, *River Grove Water District*
- Sarah Jo A. Chaplen, *Oak Lodge Water Services*
- Andrew Chapman, *City of Sherwood*
- Tyler Clary, *City of Vancouver*
- Brenna Cruz, *City of West Linn Emergency Management*
- Melissa Dixon, *Haley & Aldrich*
- Kari Duncan, *Rockwood Water Public Utility District (PUD)*
- Dave Evonuk, *Portland Water Bureau*
- Hannah Farris, *RH2*
- Gerald Fischer, *City of Molalla*
- Dan Fraijo, *Pleasant Home Water District*
- Rebecca Geisen, *RWPC*
- Michael Grimm, *West Slope Water District*
- Sophia Hobet, *City of Hillsboro*
- Mike Jacobs, *Tualatin Valley Water District*
- Scott Johnson, *CRESA*
- Matt Kaatz, *City of West Linn*
- Bryan Kast, *City of Ridgefield*
- Delora Kerber, *City of Wilsonville*
- Russ Knutson, *Clark Public Utilities*
- Sue Lawrence, *City of Rainier*
- Terrance Leahy, *City of Tualatin*
- Beth McGinnis, *Clackamas River Water*
- Katelynn Niece, *South Fork Water Board*
- John Niiyama, *City of Wood Village*
- Carrie Pak, *Tualatin Valley Water District*
- Robin Pederson, *City of Gresham*
- Justin Poyser, *City of Gladstone*
- Nicki Pozos, *The Formation Lab*
- Allison Pyrch, *Salus Resilience*
- Greg Robertson, *City of Forest Grove*
- Erica Rooney, C*ity of Lake Oswego*
- Richard Sattler, *City of Sherwood*
- Taylor Stockton, *RH2*
- Kim Swan, *Clackamas River Water Providers*
- Shannon Tice, *McNulty Water PUD*
- Vance Walker, *City of Oregon City*
- Nic Westendorf, *City of Tualatin*
- Chantal Wikstrom, *Oregon Health Authority, Drinking Water*
- Brian Wilson, *City of Vancouver*
- David Winship, *City of Beaverton*
- Kent Yu, *SEFT Consulting Group*

- Dan Allison, *Portland Water Bureau*
- Kim Anderson, *Portland Water Bureau*
- Nick Augustus, *Tualatin Valley Water District*
- Brion Barnett, *Washington County*
- Shaun Brown, *Columbia County Department of Emergency Management*
- Tyler Clary, *City of Vancouver*
- Andrew Chapman, *City of Sherwood*
- Beth Crane, *RDPO*
- Rob Cummings, *Clackamas River Water Providers* Andrew Degner, *City of Gresham*
- Jessica Dorsey, *City of Hillsboro*
- Dave Evonuk, *Portland Water Bureau*
- Rebecca Geisen, *RWPC*
- Jeff Gilbert, *ODHS Emergency Management*
- Michael Grimm, *West Slope Water District*
- Della Graham, *Salus Resilience*
- Todd Heidgerken, *Clackamas River Water Providers*
- Ben Henderson, *City of Beaverton*
- Jeremy Hudson, *Rockwood Water PUD*
- Tim Jannsen, *Sunrise Water Authority*
- Scott Johnson, *CRESA*
- Delora Kerber, *City of Wilsonville*
- Russel Knutson, *Clark Public Utilities* Edwin Krieger, City of Beaverton
- Terrance Leahy, *City of Tualatin*
- John Lewis, *City of Oregon City*
- Jessie Maran, *The Formation Lab*
- Beth McGinnis, *Clackamas River Water Providers*
- Daniel Nibouar, *Clackamas Disaster Management*
- John Niiyama, *City of Wood Village*
- Rhonda Nyseth, *ODHS Emergency Management*
- Matt Oglesby, *Tualatin Valley Water District*
- Jonna Papefthimiou, *Portland Bureau of Emergency Management*
- Wyatt Parno, *South Fork Water Board*
- Robin Pederson, *City of Gresham*
- Steve Pegram, *ODHS Emergency Management*
- Justin Poyser, *City of Gladstone*
- Nicki Pozos, *The Formation Lab*
- Allison Pyrch, *Salus Resilience*
- Brian Rager, *City of Tigard*
- Haley Riach, *ODHS Emergency Management*
- Erica Rooney, *City of Lake Oswego*
- Rich Sattler, *City of Sherwood*
- Taylor Stockton, *RH2*
- Carol Sullivan, *City of Canby*
- Kevin Sutherland, *Tualatin Valley Water District*
- Darryl Sykes, *City of Scappoose*
- Kimberly Swan, *Clackamas River Water Providers*
- Vance Walker, *City of Oregon City*
- Nic Westendorf, *City of Tualatin*
- John Wheeler, *Washington County Emergency Management*
- David Windship, City of Beaverton
- Ryan Wood, *City of Sandy*
- Kent Yu, *SEFT*

WORKSHOP 4
SEPTEMBER 13, 2022

- Dan Allison, *Portland Water Bureau*
- Andy Anderson, *Washington State Department of Health*
- Kim Anderson, *Portland Water Bureau*
- Aaron Beattie, *City of Tigard*
- Stacy Bernash, FEMA Region 10
- Pete Boone, *Tualatin Valley Water District*
- Tyler Clary, *City of Vancouver*
- Sarah Jo A. Chaplen, *Oak Lodge Water Services*
- Andrew Chapman, *City of Sherwood*
- Beth Crane, *RDPO*
- Bonny Cushman, RWPC
- Andrew Degner, *City of Gresham*
- Melissa Dixon, *Haley & Aldrich, Inc.*
- Jessica Dorsey, *City of Hillsboro*
- Kari Duncan, *Rockwood Water Public Utility District (PUD)*
- Teresa Elliott, *Haley & Aldrich, Inc.*
- Dave Evonuk, *Portland Water Bureau*
- Rebecca Geisen, *RWPC*
- Jeff Gilbert, *ODHS Emergency Management*
- Della Graham, *Salus Resilience*
- Jeremy Hanson, *Rockwood Water PUD*
- Todd Heidgerken, *Clackamas River Water Providers*
- Napoleon Hogers, *The National Association for Black Veterans, Portland Chapter*
- Travis Hultin, *City of Troutdale*
- Jennifer Joe, *City of Tigard*
- Scott Johnson, *CRESA*
- Chrystal Jones, *Clark Public Utilities*
- Delora Kerber, *City of Wilsonville*
- Heather Knapp, *City of Hillsboro Water*
- Russel Knutson, *Clark Public Utilities*
- Cory M. Jones, *Oregon Department of Human Services*
- Sue Lawrence, *City of Rainier*
- Martin Montalvo, *City of Wilsonville*
- Beth McGinnis, *Clackamas River Water Providers*
- J.J. Olson, *City of Banks*
- Jonna Papefthimiou, *Portland Bureau of Emergency Management*
- Wyatt Parno, *South Fork Water Board*
- Robin Pederson, *City of Gresham*
- Steve Pegram, *ODHS Emergency Management*
- Trish Postma, *Tualatin Valley Water District*
- Justin Poyser, *City of Gladstone*
- Allison Pyrch, *Salus Resilience*
- Erica Rooney, *City of Lake Oswego*
- David Schaffer, *City of Troutdale*
- Craig Sheldon, *City of Sherwood*
- Daniele Spirandelli, *Haley & Aldrich, Inc.*
- Matthew Steidler, *Raleigh Water District*
- Taylor Stockton, *RH2*
- Carol Sullivan, *City of Canby*
- Kevin Sutherland, *Tualatin Valley Water District*
- Kimberly Swan, *Clackamas River Water Providers*
- *Kate Trudeau, Oregon Office of Emergency Management*
- Cole Trusty, *City of Lake Oswego*
- Troy VanRoekel, *Tualatin Valley Water District*
- Vance Walker, *City of Oregon City*
- Nic Westendorf, *City of Tualatin*
- John Wheeler, *Washington County Emergency Management*
- Brian Wilson, *City of Vancouver*
- Jesse Wilson, *City of Beaverton*
- David Windship, *City of Beaverton*
- Kent Yu, *SEFT*
- Gail Zuro, *Multnomah County*