

Quality Assurance Project Plan

Roza Irrigation District ASR Pilot Test

August 2026

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Each study funded by the U.S. Environmental Protection Agency (EPA) must have an approved Quality Assurance Project Plan (QAPP). This QAPP describes the objectives of the study and the procedures to be followed to achieve those objectives. This QAPP was prepared by a licensed hydrogeologist. A signed and stamped copy of the report is available upon request. This document is available on the Department of Ecology's website at: https://apps.ecology.wa.gov/publications/summarypages/2612018.html Data for this project are available in EPA's Water Quality Exchange (WQX) database (https://www.epa.gov/waterdata/water-quality-data-wqx). The QAPP is valid through August 2031.

Cover photo credit

- Roza Irrigation Canal near Stokely Well. (Geosyntec Consultants)

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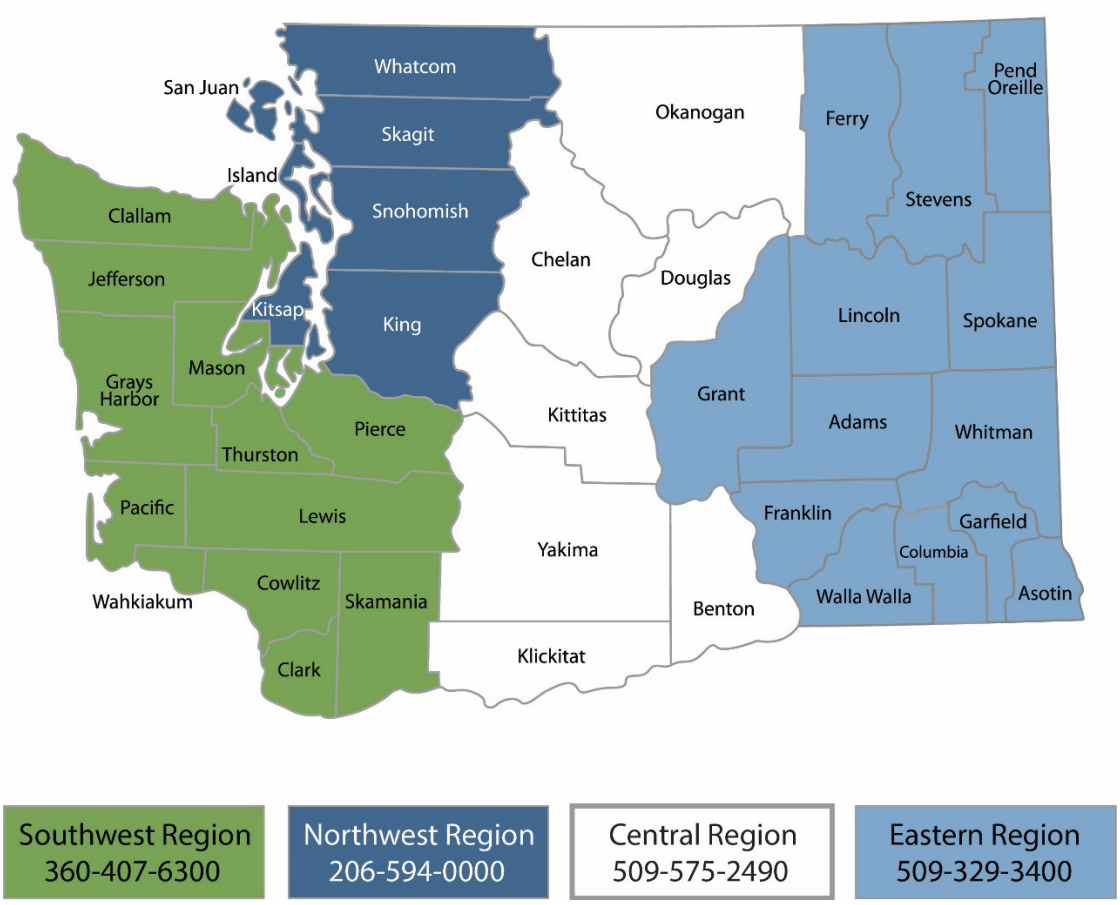
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2.0 Abstract

This Quality Assurance Project Plan (QAPP) was prepared by Geosyntec Consultants (Geosyntec) for the Roza Irrigation District (Roza) to outline the procedures for quality data collection and interpretation under the Aquifer Storage and Recovery (ASR) Pilot Test as described in the Pilot Test Plan (Geosyntec, 2026). The proposed ASR Pilot Test will treat available source water from the Roza Canal and inject it into the Wanapum Aquifer via a privately owned irrigation well near Grandview, Washington (the "Stokely Well").

In partnership with Roza, the well owner has agreed to allow access to the Stokely Well for pilot testing as part of a regional Roza-led ASR program. The goal of the regional ASR program is to stabilize and increase groundwater levels in the Wanapum Aquifer, to create a sustainable irrigation water supply for drought relief, and to improve baseflow to the Yakima River. Previous studies have been conducted within the Roza service area to characterize the hydrogeologic setting, existing well infrastructure, groundwater levels, groundwater quality, and surface water quality. Based on these findings, ASR has been demonstrated to be a viable concept on the regional scale, but no ASR pilot tests have been conducted.

The purpose of this QAPP is to establish a programmatic approach to assess data collected for the Pilot Test planned for the Stokely Well. The Pilot Test will provide data to support ASR in accordance with Chapter 173-157 Washington Administrative Code (WAC). Specifically, results from the Pilot Test will be used to evaluate well performance, groundwater level response to recharge and recovery, stored water quality changes, and treatment requirements (both pre-injection and post-recovery).

The Pilot Test will be conducted under a preliminary Reservoir Permit issued by the Washington State Department of Ecology (Ecology). The Pilot Test will be completed using existing infrastructure with some modification, such as retrofitting the Stokely Well with a new variable speed pump and downhole control valve. Source water will be treated using a direct, inline filtration system to meet the Groundwater Criteria listed in WAC 173-200-040. Use of the source water for the Pilot Test will be authorized under the existing Roza surface water right (S4-84351-J) and potentially supplemented with mainstream Yakima River instream flow/mitigation rights held by the owner of the Stokely Well.

The Pilot Test will consist of two cycles of injection, storage, and recovery. Cycle 1 will focus on establishing baseline well performance conditions by conducting a 1-day step-rate injection test, followed by one day of storage, and then 1 day of step-rate withdrawal (or recovery). Results from Cycle 1 will be used to determine the injection and pumping rates for Cycle 2, which will be conducted over several weeks. Source water will be treated prior to injection to ensure compliance with Ecology groundwater quality standards (Chapter 173-200 WAC).

Groundwater water levels in the Stokely Well will be monitored continuously to evaluate aquifer characteristics and response to injection, storage, and pumping. Two observations wells (Evans and Lewis wells) will be periodically monitored during the Pilot Test for water levels

using existing air lines. The water quality of the source water will be assessed prior to injection and groundwater quality will be monitored throughout injection, storage, and pumping to evaluate changes resulting from ASR operations.

If the results from Pilot Test are favorable, Roza will proceed with final ASR permitting, including development of an ASR Reservoir Permit. Final permitting of the ASR project will require designation of the long-term source water authorization(s) and final design of the water treatment system(s) to demonstrate compliance with the groundwater quality standards in Chapter 173-200 WAC.

3.0 Background

Roza provides irrigation water to customers in the Lower Yakima River Basin in south-central Washington. Regional groundwater declines, particularly exacerbated in the summer or times of low water supply or drought, have resulted in an investment into the feasibility of a regional ASR program.

3.1 Introduction and problem statement

A regional ASR program is designed to support agricultural water supply and reduce impacts to surface water and offset regional declining groundwater levels. ASR was originally proposed in the first groundwater storage assessment for the Yakima Basin, which was prepared in 2006 for the US Bureau of Reclamation (BOR) during the early stages of the Yakima Basin Integrated Plan (YBIP; Ecology 2008). The concept was re-visited in a 2022 study funded by the YBIP Groundwater Subcommittee (GWSC), with a specific focus on the Konnowac Pass area (Geosyntec and CWU, 2024). The 2022 study re-visited the hydrogeology of the Wanapum and surrounding aquifers, existing Roza well infrastructure, groundwater levels, and groundwater quality, as well as surface water quality in the Roza Canal. The 2022 study confirmed that a regional scale Roza ASR program was a viable concept.

Roza conducted a Feasibility Study (FS) to evaluate the usability of a privately owned well (Stokely Well) within the Roza service area to complete an ASR Pilot Test (Aspect, 2025). The goal of the ASR Pilot Test is to inform target-per-well injection rates, resulting groundwater levels, water treatment requirements, and post-injection water quality. Data from the Pilot Test will be used to update the regional groundwater model to refine predicted groundwater responses to long-term injection/recovery and update the cost analysis of regional ASR to better understand the return on investment from a regional Roza ASR program.

At full build-out, the Roza ASR Program is envisioned to deliver 20,000 acre-feet per year, or more, of surface water via the Roza Irrigation Canal to a series of injection wells completed in the Wanapum Aquifer. Surface water would be delivered via the Roza canal, primarily during the early spring months, and injected into the aquifer every year when source water is available. Roza's existing water right and, potentially, other project partner surface water rights, would be applied to the surface water delivery (Aspect 2025a).

Conceptually, this year-over-year injection of 20,000+ acre-feet/year would constitute a direct annual increase in recharge, which would, over time, begin to stabilize groundwater level declines in the Wanapum Aquifer. The stabilization of groundwater levels is also expected to contribute groundwater baseflow to the Yakima River by restoring upward gradients between the Wanapum Aquifer and overlying basalt and clastic aquifers that are in hydraulic connection to the Yakima River. A portion of the accumulated storage from injection would be made available for consumptive use to support both instream and out of stream uses, especially during periods of low water supply or drought.

The injected water would develop an ASR storage "pool" that would be managed by Roza in coordination with Ecology. While the delivery of injection water is expected to occur every year, recovery of the ASR storage pool would be managed for both drought resiliency and out-of-stream uses. Injection may occur initially over a period of years without any recovery so that the aquifer system achieves a new dynamic equilibrium from which withdrawals of aquifer storage can occur during dry or drought conditions.

In summary, the project envisions a regional ASR program that can provide additional consumptive irrigation delivery during dry years; restore groundwater storage in the Wanapum Aquifer; and improve baseflow to the Yakima River.

The Pilot Test at the Stokely Well is the next step in evaluating the feasibility of a regional Roza ASR program. The development of this QAPP for completion of the Pilot Test is funded under Ecology Office of Columbia River (OCR) Grant (Agreement No. WRYBIP-2325-RozID-00074) between the Roza and Ecology. Geosyntec is under contract with Roza to prepare this QAPP and complete the Pilot Test.

3.2 Study area and surroundings

The Stokely Well is located near Grandview, Washington within the area served by Roza (Figure 1). Roza serves an area of approximately 72,000 acres of land in the Lower Yakima River Basin in south-central Washington (Figure 1). The Lower Yakima River Basin lies within the western portion of the Columbia Plateau in a structural region known as the Yakima Fold and Thrust Belts, which is characterized by a series of predominantly east-to-west trending anticlinal ridges and synclinal basins and associated faults.

Regional geology of the Yakima River Basin is composed of shallow, unconsolidated sedimentary deposits that are underlain by multiple formations of the Columbia River Basalt Group (CRBG), a series of stacked basalt flows and sedimentary interbeds with significant structural discontinuities on the northern and southern boundaries that are likely to act as barriers to groundwater flow (Figure 2). Within the area served by Roza, surficial deposits are mapped as quaternary alluvial and outburst flood deposits composed of interbedded silts, sands, and gravels and range from absent to 100 feet thick. Underlying the young surficial deposits and occasionally exposed at the surface, bedrock geology is composed of the Miocene-aged Saddle Mountains Basalt Formation, which is composed of multiple basalt flows that are frequently interbedded with clay, silt, and sand beds of the Ellensburg Formation. Underlying the Saddle Mountains Basalt is the Wanapum Basalt, which is separated from the Saddle Mountains Basalt by the Mabton Interbed of Ellensburg Formation (Jones and Vaccaro, 2008).

The Wanapum Aquifer is laterally extensive in the Yakima River Basin, with an estimated area of 640 square miles, which is defined by the geologic structural complexes that make up the topographic features in the basin (i.e., Horse Heaven Hills, Toppenish Ridge, Rattlesnake Hills, etc.). The aquifer ranges from 600 to 1,000 feet thick and is typically encountered at depths of 475 to over 2,600 feet below ground surface. Additionally, the aquifer is hydraulically confined by dense basalt interiors and exhibits favorable conditions for ASR, including high transmissivity

and limited local direct connection to surface water bodies (Aspect 2025a). Groundwater levels in the Wanapum Aquifer have shown a long-term declining trend of approximately 2 to 3 feet per year since the 1970s, underscoring the need for sustainable groundwater management strategies. Based on the analysis of the existing information from the Wanapum Aquifer, the estimated storage potential for regional ASR is greater than 100,000 acre-feet.

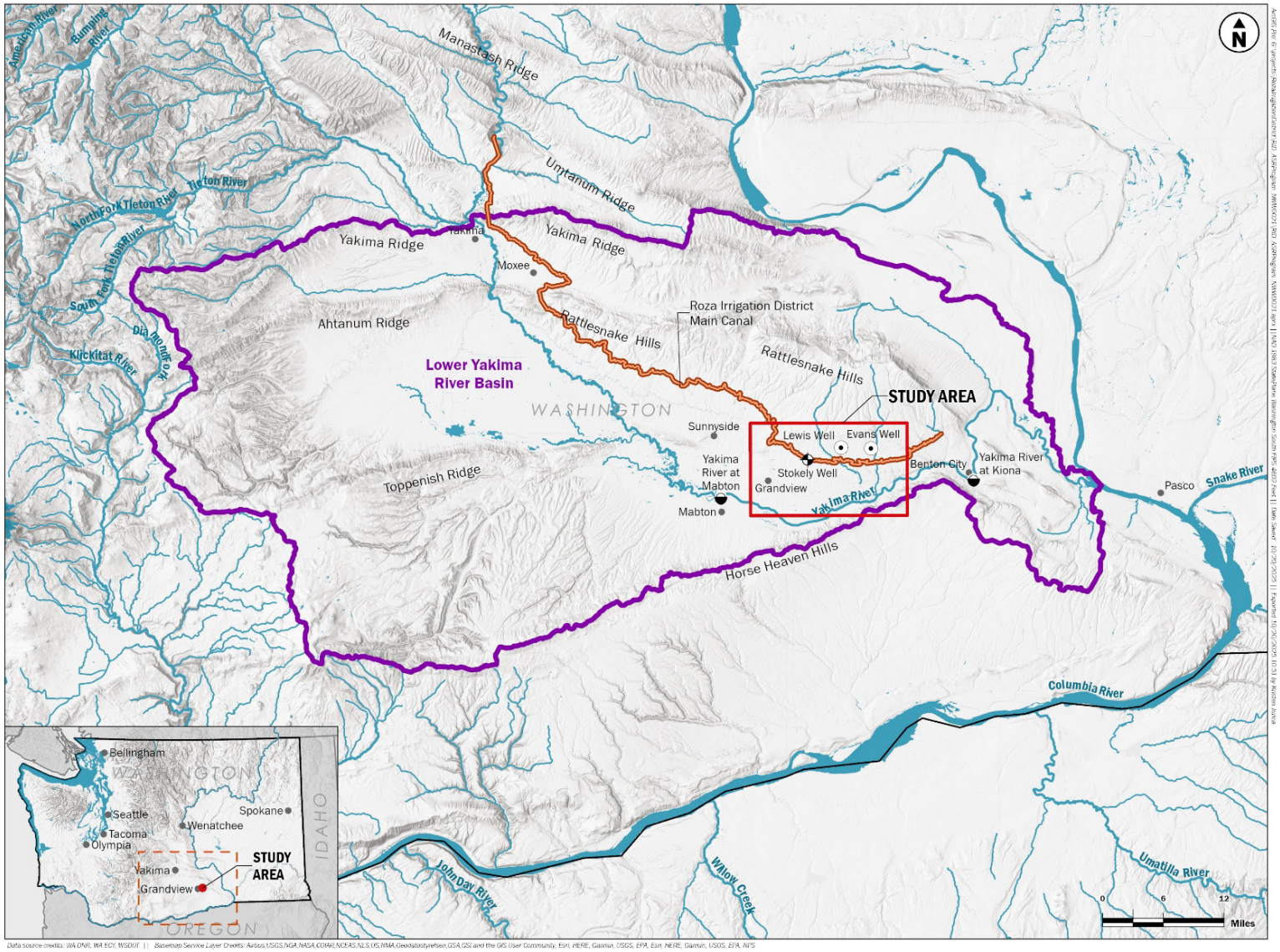


Figure 1. Map of larger study area.

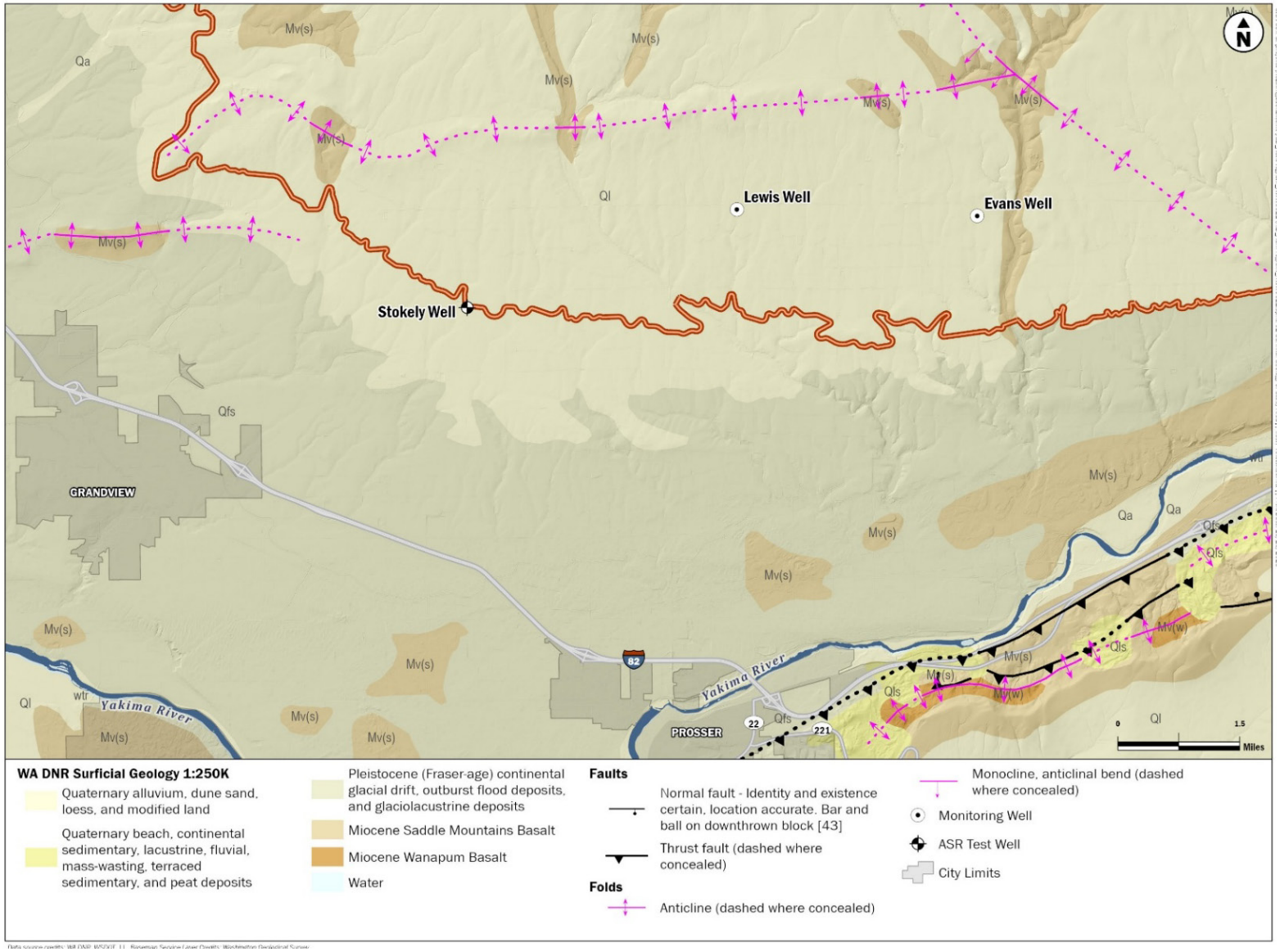


Figure 2. Surficial Geology of Study Area

Climatically, the Yakima region receives less than 8 inches of mean annual precipitation in the valleys to more than 40 inches in the upland areas in the foothills of the Cascade Range. In the Lower Yakima River Basin, precipitation ranges from less than 8 to about 15 inches in the surrounding hills and ridges (Vaccaro et al. 2015). The estimated mean annual recharge from precipitation over most of the Lower Yakima River Basin is less than 1 inch per year (in/yr) in the valleys where precipitation is typically less than 8 in/yr (Kahle et al. 2011). Much of the remaining water available from precipitation is either surface runoff to streams and rivers, diverted for irrigation use, or lost to evapotranspiration.

3.2.1 History of study area

Roza was established on March 8, 1920, under the name of the Yakima-Benton Irrigation District. Water used by Roza is primarily sourced from the Yakima River. Presently, Roza operates approximately 95 miles of Main Canal with approximately 110 miles of earthen laterals and 270 miles of pipe laterals (Roza, 2025).

The Stokely Well is an existing private irrigation well located adjacent to the Roza Main Canal and is the candidate well for pilot testing. The well is completed in the Wanapum Aquifer from 665 to 1,135 feet below ground surface (bgs). The construction of the Stokely Well was confirmed with a video inspection in January 2025 (Aspect, 2025). The well is constructed with 12-inch diameter steel casing from ground surface to 420 feet bgs and 10-inch diameter steel casing from 412 to 665 feet bgs. An open hole is present from 655 to 1,135 ft bgs. A memorandum of understanding (MOU) has been established between Roza and the well owner to access the Stokely Well for the Pilot Test.

3.2.2 Summary of previous studies and existing data

3.2.2.1 Water Levels

Ecology maintains a database of monitored water levels of wells in the vicinity of Roza that are screened in the Wanapum Aquifer. The overall range in the groundwater elevations for the Wanapum Aquifer in the project vicinity from 1976 through 2024 was from about 510 to 905 feet elevation (NAVD88). The reported static water level in the Stokely Well at the time of construction in 1998 was 465 feet bgs. In February 2025, the static water level was 565 feet bgs, representing a decline of 100 feet over the past 28 years, or an average annual decline of 3.5 ft/yr.

3.2.2.2 Water Quality

As part of the Feasibility Study (Aspect 2025a), groundwater water quality, source water quality, and their compatibility were evaluated to identify potential constituents of concern listed in Chapter 173-200 WAC. This work built off the background water quality evaluation presented in the Konnowac Pass ASR feasibility study (Geosyntec, 2024). The discussion of water quality for groundwater and the source water in this section incorporates the results of both studies.

3.2.2.2.1 Groundwater

Groundwater quality within the Wanapum Basalt Aquifer has been characterized using data compiled as part of the Konnowac Pass ASR Feasibility Study, including regional datasets, site-specific sampling, and published literature. Native groundwater is generally described as geochemically evolved basalt water, transitioning from Ca-Mg-HCO_3 compositions associated with recharge to sodium-bicarbonate (Na-HCO_3) type water with increasing residence time. This evolution is attributed to water–rock interaction processes, including basalt dissolution, silicate hydrolysis, and ion exchange. Groundwater is characterized by elevated pH, increased dissolved silica, and higher total dissolved solids relative to surface water. Redox conditions vary within the aquifer and are commonly reduced in deeper zones, where iron and manganese may be present. Nitrate concentrations are generally low or not detected. These data establish baseline groundwater quality conditions for evaluation of changes associated with managed recharge and provide the basis for assessing compliance with Washington State anti-degradation requirements.

Groundwater quality samples were collected from February through June 2025 as part of the FS; these included two groundwater samples collected from the Stokely Well, and surrounding three samples from the Lewis well and three samples from the Evans Well. Samples were analyzed for metals, bacteriological constituents, volatile organic compounds (VOCs), synthetic/semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), disinfection by-products and residuals, haloacetic acids, radiological constituents, per-and poly-fluorinated hydrocarbons (PFAS), and benzene/toluene/ethylbenzene/xylene (BTEX). For the two groundwater samples collected from Stokely well only Total PAHs and N-Nitroso-di-n-propylamine (SVOC) exceeded Chapter 173-200-040 WAC Groundwater Quality Criteria.

Overall, groundwater quality data collected as part of the Stokely Well study (2025) are consistent with the regional characterization. Samples collected from the Stokely Well and nearby wells indicate pH values of approximately 8.8 to 9.1, total dissolved solids of approximately 300 to 360 mg/L, and elevated alkalinity relative to source water. Metals, organic compounds, and radionuclides were either not detected or present at low concentrations. Nitrate was not detected. Source water from the Roza Canal is less mineralized but of similar general composition. Evaluation of groundwater and source water data, including geochemical mixing analyses, indicates that introduction of source water is not expected to result in exceedances of groundwater quality criteria under Washington State anti-degradation standards. Available analyses indicate limited potential for mobilization of trace constituents or formation of precipitates that would adversely affect groundwater quality.

3.2.2.2.2 Source Water

Source water for the proposed ASR system is from the Roza Canal, which conveys Yakima River water diverted at Roza Dam. As described in the Konnowac Pass ASR Feasibility Study (Geosyntec, 2024), the canal water quality is generally representative of the Yakima River upstream of the diversion and is characterized as a calcium–magnesium–bicarbonate (Ca-Mg-HCO_3) type water. River monitoring data indicate moderate alkaline conditions (pH

commonly about 8.0 to 8.5), relatively high dissolved oxygen concentrations (generally 8 to 12 mg/L), and low turbidity (typically less than about 10 NTU), reflecting well-oxygenated surface water with relatively low mineralization (Geosyntec, 2024).

Water quality in the Roza Canal remains similar to the source river water but may be modified during conveyance through the irrigation system. Potential influences include sediment entrainment, biological activity (including algal growth), and minor inputs from groundwater seepage and irrigation return flows, although these effects are likely small relative to the large canal flow rates. Available monitoring data (2020–2022) indicate generally low nutrient concentrations (e.g., nitrate typically well below drinking water standards) and low to moderate turbidity and suspended solids, with occasional elevated sediment or microbial indicators. Canal management practices, including periodic herbicide applications for aquatic weed control, may also affect water quality and are documented by the irrigation district for operational coordination (Geosyntec, 2024).

Surface water quality samples were collected from two locations along the Roza Canal in April 2025: Roza Canal adjacent to the Stokely Well (Canal MP 74) and Roza canal at the Crosby Bridge crossing (MP 79.4) approximately 4 miles to the east. Samples were analyzed for metals, bacteriological constituents, VOCs, SVOCs, PAHs, PCBs, radiological constituents, PFAS, and BTEX. Because the ASR treatment system is not proposing to use chlorination, disinfection byproducts (trihalomethanes and haloacetic acids) were not measured. The surface water sample collected from the Roza Canal at Stokely did not exceed any Chapter 173-200-040 WAC Groundwater Quality Criteria. The surface water sample from the Roza Canal at Crosby, was estimated above the screening level of 0.05 ug/L for both total and dissolved arsenic (0.28 and 0.35 ug/L for total and dissolved arsenic, respectively) but was below the method-specific reporting level.

During the Pilot Test, source water will be treated to meet the Washington anti-degradation standards prior to recharge.

3.2.2.2.3 Source Water Compatibility

Water quality analyses and geochemical modeling indicate water from the Roza Canal generally exhibits good water quality and is geochemically compatible with the native groundwater in the Wanapum Aquifer. No adverse effects from mixing the source water with groundwater are expected to occur.

3.2.2.3 Well Performance

Step-rate and constant rate pumping tests were conducted at the Stokely Well as part of the FS in February 2025 (Aspect 2025). Results estimated transmissivity between 100,000 to 120,000 ft^2/day in the Wanapum Aquifer with estimated storage potential greater than 500,000 acre-feet (when accounting for current withdrawal). Based on analysis of well performance and aquifer testing data, injection rates up to 1,000 gpm are considered feasible during the pilot test for the current construction of the Stokely Well (primarily limited by the 10-inch-diameter liner).

3.2.3 Parameters of interest and potential sources

Water quality will be monitored during the Pilot Test to confirm background water quality, evaluate the quality of injection source water, collect groundwater quality data to use in modeling geochemical reactions that could potentially occur during storage of source water within the Wanapum Aquifer, and to monitor for compliance with Groundwater Quality Criteria listed in Chapter 173-200-040 WAC. Potential changes in well performance related to water quality will also be evaluated (e.g., total suspended solids). Prior to the Pilot Test, at least two samples will be collected from the Roza Canal to confirm background water quality of select analytes. The Pilot Test includes collection of one sample of treated source water prior to injection and up to 11 groundwater samples collected from the Stokely Well during Cycles 1 and 2 of the Pilot Test. The timing of the sampling will occur in conjunction with the phases of injection, storage, and pumping and is described below in Section 7.2.1.

The following sections describe the water quality analytes selected for the Pilot Test. As noted above, because chlorination is not proposed as part of the ASR treatment system, disinfection byproducts will not be monitored.

3.2.3.1 Field Parameters

Field parameters will be measured during each of the sampling events to analyze constituents that have short hold times and can be readily measured in the field. Field parameters are detailed in Section 7.2.2 and include:

- Temperature
- Dissolved oxygen
- Turbidity
- pH
- Specific conductance
- Oxidation-reduction potential (ORP)

3.2.3.2 Primary and Secondary Inorganic Compounds and Metals (General Chemistry)

Both groundwater and source water quality samples will be analyzed for a select suite of constituents in both the dissolved (field-filtered to 45 microns) and total recoverable fractions. This analytical suite will be used to confirm source treatment requirements in the context of Chapter 173-200 WAC (Groundwater Quality Standards) and select WAC 246-290-310 (Drinking Water Standards) using standard analytical methods.

Constituents will include:

- Alkalinity
- Aluminum
- Arsenic*
- Bicarbonate
- Calcium
- Chloride
- Dissolved Organic Carbon (DOC)
- Iron
- Magnesium
- Manganese
- Molybdenum
- Nitrates
- Potassium
- Silica
- Sodium
- Sulfate
- Titanium
- Total Organic Carbon (TOC)
- Zinc
- per- and poly-fluorinated hydrocarbons (PFAS)
- Naphthalene
- Nitroso-di-n-propyl-amine

*Arsenic will also be measured for speciation.

3.2.3.3 Herbicides

Herbicides will be analyzed for both source water supply. This will be used to confirm background water quality is met and will include the analytes specified in US EPA Method 515.

3.2.4 Regulatory criteria or standards

The purpose of the Pilot Test is to evaluate regulatory compliance of proposed ASR program operations, where the introduction of recharge water to the storage aquifer is subject to the Antidegradation Rule and numerical Groundwater Quality Criteria defined in Chapter 173-200-040 WAC. Because the injected and recovered water are not going to be used for drinking water, the ASR Pilot Test is not required to meet drinking water standard under Washington State Department of Health (DOH) requirements (Chapter 246-290 WAC). Table 1 provides the analytical parameters that were measured under the February 2025 Feasibility Study water quality Tests with groundwater quality standards and drinking water standards.

Table 1. Water Quality Analytes Measured during 2025 and Applicable Standards

Analytical Method	Analyte	Units	WAC 173-200-040 Groundwater Quality Criteria	WAC 246-290 Primary Drinking Water Standard
General Chemistry, Inorganics				
EPA 300.0	Chloride	mg/L	250	
EPA 353.2	Nitrates	mg/L	10	
SM 2540C	Total Dissolved Solids	mg/L	500	
EPA 300.0	Sulfate	mg/L	250	
Metals by ICP or ICP/MS				
EPA 200.8	Arsenic	ug/L	0.05	
EPA 200.7	Iron	mg/L	0.3	
EPA 200.8	Manganese	mg/L	0.05	
EPA 200.8	Zinc	mg/L	5	
PFAS				
EPA 537.1	HFPO-DA	mg/L		0.00001
EPA 537.1	PFBS	mg/L		
EPA 537.1	PFHxS	mg/L		0.00001
EPA 537.1	PFNA	mg/L		0.00001
EPA 537.1	PFOA	mg/L		0.000004
EPA 537.1	PFOS	mg/L		0.000004
Herbicides				
EPA 515.3	2,4,6-Trichlorophenol	ug/L	4	
EPA 515.3	Pentachlorophenol	mg/L		0.001
EPA 515.3	2,4,5-TP (Silvex)	mg/L	0.01	0.05
EPA 515.3	2,4-D	mg/L	0.1	0.07
EPA 515.3	Dalapon	mg/L		0.2
EPA 515.3	Dinoseb	mg/L		0.007
EPA 515.3	Picloram	mg/L		0.5

3.3 Water quality impairment studies

The continuing efforts to characterize and improve the water quality in the Yakima River watershed have generated multiple Total Maximum Daily Load studies that are documented in Ecology publications numbered: 01-10-062, 07-03-036, 10-03-018, and 20-10-030.

3.4 Effectiveness monitoring studies

Effectiveness monitoring to assess the progress of the TMDL implementation efforts are documented in Ecology publication number 06-03-014.

4.0 Project Description

The ASR Pilot Test is a component of a regional, long-term water supply strategy for Roza to stabilize groundwater levels and increase resiliency of the irrigation water supply. This Pilot Test will recharge the Wanapum Aquifer with water delivered via the Rosa Canal and injected through the Stokely Well. Data collected under the Pilot Test will be used to inform target-per-well injection rates, impacts of injection rates on groundwater levels, water treatment requirements, and post-injection water quality.

4.1 Project goals

The goal of the Pilot Test is to assess treatment efficacy and hydraulic performance of the Wanapum Aquifer during injection, storage, and pumping. To achieve this goal, treated source water and groundwater quality samples will be collected from different stages of the Pilot Test and analyzed for a select suite of parameters. The water quality data collected will be used in predicting whether ASR project operations will result in degraded groundwater quality and wellbore plugging or define "geochemically compatibility" between the injected source water and the aquifer. The process of injecting and storing surface water in an aquifer perturbs the groundwater conditions through a variety of geochemical processes, including: 1) changes to the oxidation and reduction potential (Eh activity), 2) sorption and ion exchange, 3) precipitation, 4) filtration, 5) acid-base reactions and 6) biologically mediated geochemical reactions and biofouling. The data collected will provide information with which to assess the potential for these processes to occur and the effects on groundwater quality if they do occur during project operations.

These data will be evaluated for evidence of any geochemical changes in Wanapum Aquifer geochemistry during injection, storage, and pumping.

4.2 Project objectives

The objectives of the Pilot Test are listed below.

Objective 1 – Determine if water quality injected into, stored within, and pumped out of the Wanapum Aquifer meets the state Groundwater Quality Criteria (Chapter 173-200-040 WAC) numerical groundwater quality standards throughout the duration of the Pilot Test.

Objective 2 – Evaluate performance of the Stokely Well during ASR cycles.

Objective 3 – Assess Wanapum Aquifer hydraulic response to injection, storage, and recovery of water during ASR cycles.

4.3 Information needed and sources

Groundwater quality data during the ASR Pilot Test are needed to evaluate the geochemical compatibility of the source water with native groundwater in the target aquifer. Groundwater levels and volumes will be monitored at the Stokely Well during injection and recovery cycles.

Water levels in the Lewis and Evans Wells will also be monitored to evaluate aquifer response during the ASR Pilot Test.

4.4 Tasks required

The following tasks are required to meet objectives of the ASR Pilot Test.

4.4.1 Task 1: Engineering and Treatment Design

Minor modifications to the existing Stokely Well and Roza Canal system are needed to allow for a successful Pilot Test. Planned modifications include:

- Installation of a downhole control valve and submersible pump with controls to control injection rates, prevent air entrainment, and facilitate water recovery;
- Installation of 20 to 40 feet of temporary piping from the existing irrigation turnout to the treatment system and wellhead, including installation of an injection flow meter and additional valving and water quality sampling port near the wellhead; and
- Installation of a portable in-line filtration treatment plant and supporting infrastructure (i.e., power).

Prior to the injection of source water into the Stokely Well, raw and treated water from the Roza canal will be sampled to confirm background water quality.

4.4.2 Task 2: Pilot Test

The Pilot Test includes a minimum of two cycles of injection, storage, and pumping at the Stokely Well. Water quality will be monitored throughout these ASR cycles to evaluate well performance and potential water quality changes. Based on analysis of well performance and aquifer testing data conducted as part of the Feasibility Study (Aspect 2025), injection and pumping rates of up to 1,000 gpm are considered feasible during the Pilot Test based on the current construction of the Stokely Well.

4.4.2.1 Task 2.1: Cycle 1

Cycle 1 will be completed over 3 days, starting with a step-rate injection test to determine the maximum sustainable injection rate during the recharge portion of Cycle 2. Injection will occur for approximately 24 hours, after which the water will be stored for 24 hours. Following storage, a step-rate drawdown test will be performed over the final 24 hours. Step-rate injection and step-rate drawdown results will be compared to evaluate changes in well efficiency that may occur during recharge, an indication of possible clogging from the introduction of sediment (e.g., distribution system scale).

Groundwater levels in the Stokely well will be measured using an automated pressure transducer with datalogger connected to a telemetry system. Water levels in the Lewis and Evans wells will be measured manually using existing air lines. Flow rates for water pumped into and out of the Stokely Well will also be monitored continuously. A total of five water quality samples will be collected during Cycle 1 as shown in Table 2.

Table 2. Water Quality Sampling Schedule for Cycle 1

Operational Period	Description	Number of Samples
Prior to Injection	Background groundwater sample prior to the start of Cycle 1 plus field blank	2
Injection Step-Rate	Surface water sample (post treatment) after 24 hours of injection.	1
Storage	Groundwater sample after 24 hours of storage (immediately collected upon recovery startup)	1
Pumping Step-Rate	Groundwater sample after 50% of recharge volume is recovered and after 100% of recharge volume is recovered*	3 (includes one duplicate)
	Total	**6**

* In the event that a 100% recovery is not achieved, the final water quality sample will be collected at the end of the 24-hour pumping period.

4.4.2.2 Task 2.2: Cycle 2

Cycle 2 is planned to simulate a typical ASR cycle. The injection phase is planned for 30 to 45 days at the maximum sustainable injection rate determined in Cycle 1. The actual duration of recharge may depend on time of year and availability of the source water. Water levels will be monitored continuously to determine injection pressure buildup that may be indicative of clogging. Injected water is planned to be stored for a period of time roughly equal to the injection phase, but adjustments may be necessary due to Roza operations and/or the end of irrigation season. Following storage, water will be recovered for an equal duration as the recharge phase to recover 100% of the stored water during Cycle 2. Based on the performance evaluation of the first year of ASR pilot testing, additional ASR pilot cycles may be completed in future years to collect additional data to address permitting requirements and/or storage of additional water to meet overall project goals.

A total of six water quality samples is planned for collection during Cycle 2 as shown in Table 3.

Table 3. Water Quality Sampling Schedule for Cycle 2

Operational Period	Description	Number of Samples
Prior to Injection	Background groundwater sample prior to the start of Cycle 2* plus field blank	2
Injection	Source water sample (post treatment) collected every 20 days after injection starts	3 (includes one duplicate)
Storage	Groundwater sample at the end of storage (sample collected immediately upon recovery startup)	1
Pumping Step-Rate	Groundwater sample after 50% of the recharge volume is recovered and 100% of recharge volume is recovered**	2
	Total	**7**

* If Cycle 2 commences immediately following Cycle 1, the background sample will not be collected.
** In the event that a 100% recovery is not achieved, the final water quality sample will be collected at the end of the 24-hour pumping period.

4.4.3 Task 3: Water Quality Evaluation

In this task, we will evaluate the water quality in the Wanapum Aquifer during injection, storage, and pumping in accordance with Ecology guidelines. Results from the treated source water sample will be compared to groundwater sample concentrations. Groundwater samples will be collected from the Stokely Well throughout Cycles 1 and 2 to determine temporal variability of the water quality. Field water quality parameters (i.e., pH, specific conductance, temperature, ORP, dissolved oxygen, and turbidity) and analytical parameters will be collected for all water quality samples.

The water quality evaluation will be used to ensure overall compliance with Ecology's groundwater antidegradation policy (Chapter 173-200-030 WAC) and Groundwater Quality Criteria (Chapter 173-200-040) and confirm that Pilot Test pre-treatment of the source water is sufficient.

4.4.4 Task 4: Pilot Test Analysis and Reporting

This task includes preparing a draft and final ASR Pilot Test report. Ecology will review and comment on the draft report and changes will be incorporated into the final ASR Pilot Test report. The final ASR Pilot Test report will be available for review by the YBIP Groundwater Storage Subcommittee. At the completion of the study, the findings will be presented to the YBIP Groundwater Storage Subcommittee. Data collected under this QAPP will be uploaded into the Ecology EIM system.

If the results of this Pilot Test are favorable, Roza will likely proceed with final ASR permitting, including development of an ASR Reservoir Permit.

4.5 Systematic planning process

This QAPP has been prepared to satisfy the systematic planning needs for this project.

5.0 Organization and Schedule

5.1 Key individuals and their responsibilities

Table 4 shows the responsibilities of those who will be involved in this project.

Table 4. Organization of project staff and responsibilities.

Staff	Title	Responsibilities
Jeff Dermond Department of Ecology, Office of Columbia River Phone: (509) 268-1784	Project Manager, OCR	Provides oversight of the Study and Ecology Grant. Clarifies scope of the project. Provides internal review of the QAPP and approves the final QAPP.
Llyn Doremus Department of Ecology, Office of Columbia River Phone: (509) 709-2830	Hydrogeologist	Provides review of the QAPP, reviews and approves water quality data.
McKenna Murray Department of Ecology, Office of Columbia River Phone: (509) 329-3539	Quality Assurance Coordinator	Provides review of all copies of the QAPP and approves the final QAPP.
Wayne Sonnichsen Roza Irrigation District Phone: (509) 836-4819	Project Manager	Reviews the draft and final QAPP and project deliverables, manages the project budget, and submits deliverables for the Ecology grant.
Tyson Carlson Geosyntec Consultants Phone: (509) 895-5923	Principal Investigator	Co-author of QAPP and Geosyntec Project Director. Oversees approach development, data analysis, and QA/QC. Reviews final ASR feasibility report.
Derek Holom Geosyntec Consultants Phone: (206) 496-1475	Senior Hydrogeologist	Co-author of QAPP and Geosyntec Project Manager. Conducts oversight of field program development and execution. Performs review of data, analyses, and hydrogeologic interpretations. Co-authors the draft and final ASR feasibility reports.
Logan Uselman Geosyntec Consultants Phone: (703) 350-5374	Senior Hydrogeologist	Co-author of QAPP. Conducts oversight of field program development and execution. Performs review of data, analyses, and hydrogeologic interpretations. Co-authors the draft and final ASR feasibility reports.
Ian Lauer Geosyntec Consultants Phone: (509) 774-7597	Project Hydrogeologist	Performs field work and water quality sampling. Performs data entry and field logging.
Lea Beard Geosyntec Consultants Phone: (206) 780-7749	Data Scientist	Reviews and uploads EIM data.

Staff	Title	Responsibilities
Randee Arrington Eurofins Phone: (509) 924-9200	Laboratory Business Unit Manager	Prepares laboratory reports for all analytes except for nitrates.
Nicole Irons Eurofins Phone: (509) 924-9200	Quality Assurance Manager	Conducts laboratory QA/QC

QAPP: Quality Assurance Project Plan
QA/QC: Quality Assurance Quality Control

5.2 Special training and certifications

A hydrogeologist licensed in the State of Washington will perform all analysis and interpretation of field data and provide oversight of hydrogeologic data collection. All field staff involved in this project will either have the relevant experience in the required standard operating procedures (SOPs) or will be trained by more senior field staff or the project manager who has the required experience. The experienced staff will then lead the field data collection and oversee/mentor less experienced staff.

5.3 Organization chart

See Table 4.

5.4 Proposed project schedule

Table 5 below provides the anticipated schedule proposed under this project based on the EAGL grant (WRYBIP-2325-RozID-00074). If opportunity allows, the schedule will be expedited with a target start date for the Pilot Test by Spring 2026.

Table 5. Schedule for completing field and laboratory work

Task	Target Completion Date	Notes
ASR Pilot Test Operations Plan	June 2026	For Ecology approval
Project QAPP (this document)	June 2026	For Ecology approval
Engineering and Treatment Design	February 2026	For Ecology approval
Procurement and Infrastructure Installation	July and August 2026	
ASR Pilot Test	August through November 2026	Cycle 1 and 2
Draft Report	March 2027	For Ecology review
Final Report	June 2027	For Ecology approval
Water Quality and Water Levels Database Upload	June 2027	Uploaded to EIM

5.5 Budget and funding

Roza has received a grant from Ecology OCR (Agreement No. WRYBIP-2325-RozID-00074) to complete all tasks described in Section 4.4.

6.0 Quality Objectives

6.1 Data quality objectives [2]

One of the primary data quality objectives (DQO) for the Pilot Test is to collect representative water quality data to use in evaluating the geochemical compatibility of treated source water with the native Wanapum Aquifer groundwater and to ensure the aquifer groundwater quality complies with the Groundwater Criteria in Chapter 173-200-040 WAC. One of the Pilot Test objectives listed in Section 4.4 lists is to evaluate water quality changes during the Pilot Test. List the data quality objectives used to ensure the data that is collected will meet this objective Additionally, a DQO for the Pilot Test is to collect sufficient water level and flow rate data during injection, storage, and pumping to evaluate well performance and determine aquifer response and aquifer parameters for upscaling to a regional Roza ASR program. Groundwater level measurements and barometric pressure data will be collected from the Stokely Well and two observation Wells (Lewis and Evans Wells), covering at a minimum pre-test static condition, injection, storage, pumping, and return to static groundwater condition. Injection and pumping test analysis will use appropriate methodologies to evaluate well performance and aquifer response based on observed groundwater level changes.

6.2 Measurement quality objectives

MQOs are statements of the precision, bias, and lower measurement limits necessary to meet the Pilot Test objectives listed in Section 4.1 and 4.2. Precision and bias together express data accuracy, whereas other considerations include the representativeness, completeness, and comparability of the data.

The Pilot Test will collect representative water samples for analyses, and measure water quality field parameters. The MQOs for the field investigation are based on the project objectives listed in Section 4.0, and the data quality objectives listed in Section 6.1, to ensure that the data collected is of sufficient accuracy and resolution to assess changes in groundwater quality resulting from pilot test operations. Also taken into account are the sample collection methods required for the chosen analytical methods, the accuracy and precision of the field equipment used to collect measurements, and the SOPs employed to make decisions in the field. The field data collection instrumentation accuracy, resolution and range for each of the parameters measured are listed in Table 6. Water quality samples will be analyzed using EPA methods listed in Table 7.

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[2] DQO can also refer to ***Decision*** Quality Objectives. The need to identify Decision Quality Objectives during the planning phase of a project is less common. For projects that do lead to important decisions, DQOs are often expressed as tolerable limits on the probability or chance (risk) of the collected data leading to an erroneous decision. And for projects that intend to estimate present or future conditions, DQOs are often expressed in terms of acceptable uncertainty (e.g., width of an uncertainty band or interval) associated with a point estimate at a desired level of statistical confidence.

The MQO for groundwater level monitoring for the Stokely Well is to obtain groundwater level measurements relative to the established measuring point or ground surface within a 0.1-foot accuracy. The accuracy of the water level measurements at the Lewis and Evans Wells is estimated to be +/-1 foot using existing airlines.

A description of the water level monitoring techniques that will be used to obtain the MQO for the water level measurements and well locations are provided in the Field Procedures section (Section 8.0). Water level monitoring during the Pilot Test will be conducted per Ecology's Aquifer Test Procedures and Depth to Water Measurement SOP (Ecology, 2023a; Ecology, 2023b).

Table 6. Field Equipment measurement accuracy and precision

Parameter	MQO	Equipment / Method	Equipment Information			Expected Range
			Accuracy	Resolution	Range	
Field Water Quality Parameters						
pH	±0.2 SU	In-Situ AquaTroll 600 (with flow-through cell)	+0.1 SU	0.01 SU	0 to 14 SU	6.5 to 8.5 SU
Specific Conductivity	±2% µS/cm		±0.5% + 1 µS/cm	0.1 µS/cm	0 to 350,000 µS/cm	150 to 500 µS/cm
Dissolved Oxygen	±0.5 mg/L		± 0.1 mg/L	0.01 mg/L	0 to 20 mg/L	0 to 10 mg/L
Oxidation Reduction Potential	±20 mV		±5 mV	0.1 mV	-1,400 to +1,400 mV	-300 to +300 mV
Temperature	±0.2 °C		±0.1°C	0.01°C	-5 to 50°C	1 to 25°C
Turbidity	±1 or ±10% NTU		±2% or 0.5 NTU	0.01 NTU	0 to 4,000 NTU	0 to 100 NTU
Air Monitoring						
Temperature	±0.5 °C	Van Essen Baro-Diver	±0.1 °C	0.01 °C	-10 to 50°C	-7 to 31 °C
Barometric Pressure	±0.1 ft-H2O	Van Essen Baro-Diver	±0.016 ft-H2O	0.003 ft-H2O	50 ft-H2O	33.5 to 34.4 ft-H2O
Groundwater Level Measurements						
Pressure	±0.5 ft-H2O	Seametrics PT2X 300 PSIG	±0.05% FSO	±0.3 ft-H2O FSO	Max 692 ft-H2O	10 to 30 ft-H2O
Temperature	±0.2 °C	Van Essen TD-Diver DI801	±0.1°C	0.01°C	0 to 50°C	1 to 25°C
Depth to Water	±0.1 ft	Waterline Envirotech 800-ft E-Tape	0.05 ft	0.01 ft	0.5 to 800 ft	50 to 300 ft

Parameter	MQO	Equipment / Method	Equipment Information			Expected Range
			Accuracy	Resolution	Range	
Depth to Water (airline)	±0.1 ft-H2O	Dickson PR325	±1% FSO	0.1 psi (0.231 ft-H2O)	0 to 300 psi	10 to 100 psi
Wellhead Position (GPS)	±0.3 ft	EOS Arrow 100+ GNSS Receiver (RTK)	0.1 ft	0.01 ft	--	--
Aquifer Testing Measurements						
Recharge / Pumping Rate	±15%	Soundwater Orcas T31-C7 Ultrasonic Flowmeter	± 2.0%	0.01 gpm	0 to >5,000 gpm in 6-inch dia. pipe	50 to 500 gpm

Table 7. Laboratory MQOs of Water Samples

Analytical Method	Analyte	Units	MQO	Method Detection Limit	Method Reporting Limit	Matrix Spike (% Rec.)	Matrix Spike (RPD)	Blank Spike (LCS % Rec.)	Blank Spike (RPD)	Regulatory Authority[1]
General Chemistry, Inorganics										
SM 2320B	Alkalinity	mg/L	5	5	20	80-120	20	90-110	20	
SM 2320B	Bicarbonate	mg/L	5	5	20	80-120	20	90-110	20	
EPA 300.0	Chloride	mg/L	0.2	0.01471	0.5	80-120	10	90-110	20	GW
SM 5310C	Dissolved Organic Carbon	mg/L	0.2	0.088	0.3	80-120	20	90-110	20	
EPA 353.2	Nitrate Nitrite as N	mg/L	0.05	0.05	0.2	90-110	10	90-110	10	GW
EPA 300.0	Sulfate	mg/L	0.2	0.128	0.5	80-120	10	90-110	20	GW
SM 2510B	Total Organic Carbon	mg/L	0.2	0.088	0.3	120-80	20	90-110	20	
Metals by ICP or ICP/MS										
EPA 200.8	Aluminum	ug/L	5	3.94	20	70-130	20	85-115	20	
EPA 200.8	Arsenic	ug/L	0.5	0.245	1	70-130	20	85-115	20	GW
EPA 200.7	Calcium	mg/L	0.1	0.0705	1	70-130	20	85-115	20	
EPA 200.7	Iron	mg/L	0.005	0.00217	0.01	70-130	20	85-115	20	GW
EPA 200.7	Magnesium	mg/L	0.05	0.00994	0.1	70-130	20	85-115	20	
EPA 200.8	Manganese	ug/L	1	0.41	2	70-130	20	85-115	20	GW
EPA 200.8	Molybdenum	ug/L	1	0.219	2	70-130	20	85-115	20	
EPA 200.7	Silica (as SiO2)	mg/L	0.5	0.0334	0.428	-		-		
EPA 200.7	Sodium	mg/L	0.1	0.1	1	70-130	20	85-115	20	
EPA 200.8	Titanium	ug/L	1	0.137	1	70-130	20	85-115	20	
EPA 200.8	Zinc	ug/L	5	4.28	20	70-130	20	85-115	20	GW
EPA 200.8	Aluminum (Dissolved)	ug/L	5	3.94	20	70-130	20	85-115	20	

Analytical Method	Analyte	Units	MQO	Method Detection Limit	Method Reporting Limit	Matrix Spike (% Rec.)	Matrix Spike (RPD)	Blank Spike (LCS % Rec.)	Blank Spike (RPD)	Regulatory Authority[1]
EPA 200.8	Arsenic (Dissolved)	ug/L	0.5	0.245	1	70-130	20	85-115	20	
EPA 200.7	Calcium (Dissolved)	mg/L	0.1	0.0705	1	70-130	20	85-115	20	
EPA 200.7	Iron (Dissolved)	mg/L	0.005	0.00217	0.01	70-130	20	85-115	20	
EPA 200.7	Magnesium (Dissolved)	mg/L	0.05	0.00994	0.1	70-130	20	85-115	20	
EPA 200.8	Manganese (Dissolved)	ug/L	1	0.41	2	70-130	20	85-115	20	
EPA 200.8	Molybdenum (Dissolved	ug/L	1	0.219	2	70-130	20	85-115	20	
EPA 200.7	Potassium (Dissolved)	mg/L	0.2	0.12	1	70-130	20	85-115	20	
EPA 200.7	Silica (as SiO2) (Dissolved)	mg/L	0.5	0.0334	0.428	-		-		
EPA 200.7	Sodium (Dissolved)	mg/L	0.1	0.1	1	70-130	20	85-115	20	
EPA 200.8	Titanium (Dissolved)	ug/L	1	0.137	1	70-130	20	85-115	20	
EPA 200.8	Zinc (Dissolved)	ug/L	5	4.28	20	70-130	20	85-115	20	
Volatile Organic Compounds										
EPA 524.2	Naphthalene	ug/L	0.5	0.48	0.5	70-130	20	80-120		
SM 8270E	N-Nitrosodi-n-propylamine	ug/L	4	0.059	4	48-120	32	48-120	32	GW
PFAS										
EPA 537.1	HFPO-DA	ng/L	2	1	2	70-130	30	70-130	30	DW
EPA 537.1	PFBS	ng/L	0.5	0.37	2	70-130	30	70-130	30	DW
EPA 537.1	PFHxS	ng/L	0.5	0.32	2	70-130	30	70-130	30	DW
EPA 537.1	PFNA	ng/L	0.5	0.4	2	70-130	30	70-130	30	DW
EPA 537.1	PFOA	ng/L	0.5	0.38	2	70-130	30	70-130	30	DW
EPA 537.1	PFOS	ng/L	0.5	0.43	2	70-130	30	70-130	30	DW
Herbicides										

Analytical Method	Analyte	Units	MQO	Method Detection Limit	Method Reporting Limit	Matrix Spike (% Rec.)	Matrix Spike (RPD)	Blank Spike (LCS % Rec.)	Blank Spike (RPD)	Regulatory Authority[1]
EPA 515.3	2,4,5-TP (Silvex)	ug/L	0.03	0.03	0.1	70-130	22	80-120		GW, DW
EPA 515.3	2,4,6-Trichlorophenol	ug/L	0.1	0.02	0.1	70-130	40	80-120		GW
EPA 515.3	2,4-D	ug/L	0.08	0.08	0.1	70-130	41	80-120		GW, DW
EPA 515.3	Dalapon	ug/L	0.5	0.5	1	70-130	40	80-120		DW
EPA 515.3	Dinoseb	ug/L	0.09	0.09	0.2	70-130	24	80-120		DW
EPA 515.3	Pentachlorophenol	ug/L	0.02	0.02	0.04	70-130	29	80-120		DW
EPA 515.3	Picloram	ug/L	0.04	0.04	0.1	70-130	43	80-120		DW
Metal Speciation										
EPA 1632A	Arsenic (III) / Arsenic (V)	ug/L	0.5	0.43	0.5					

Notes:
RPD = relative percent difference, LCS = laboratory control sample, %Rec = percent recovered, Surr. = Surrogate.
mg/L – milligrams per liter; ug/L = micrograms per liter; SU = standard units (pH); ng/L = nanograms per liter.
DW = Drinking Water standards per WAC 246-290-310; GW = Groundwater standards per Chapter 173-200-040 WAC

The MQOs for the water quality analyses are summarized above in Table 7. Water quality sampling will be performed using industry-standard procedures (Section 8.2) to minimize bias and maximize precision. All sampling equipment will be decontaminated before and after completion of sampling activities.

Eurofins is accredited by Ecology for all analytical procedures performed for this project, and by the National Environmental Laboratory Accreditation Program (NELAP) for a comprehensive analytical laboratory accreditation. The laboratory is responsible for ensuring that all procedures performed comply with all requirements specified in the accreditation programs, laboratory quality assurance (QA) manuals, individual analytical methods, and this QAPP. Copies of the laboratory accreditations for Eurofins are included in Appendix A.

6.2.1 Targets for precision, bias, and sensitivity

Table 7 outlines expected precision of sample duplicates and method reporting limits. The reporting limits of the methods listed in Table 7 are appropriate for the expected range of results and the required level of sensitivity to meet project objectives.

The quality and usability of data collected will be determined, based on the outcomes of data verification and validation, and expressed as the following MQOs: precision, accuracy (bias), representativeness, comparability, completeness, and sensitivity. The MQOs routinely obtained by the laboratory for the analytical procedures performed for this project are considered adequate. The definitions of the MQOs are presented in the following sections.

6.2.1.1 Precision

Precision is defined as the degree of agreement between or among independent, similar, or repeated measurements. Precision is a measure of variability due to random error in the results of replicate measurements. Precision is usually assessed by analyzing duplicate field measurements and random error is imparted by the variation in field procedures. Therefore, field sampling precision is addressed by collection of duplicate samples and measurements. One duplicate sample will be collected per ASR pilot testing cycle.

Bias will also be assessed using calibration standards and blank samples (e.g., method blanks). In cases where accuracy is determined from spiked samples, accuracy will be expressed as the percent recovery. The closer these values are to 100 percent, the more accurate the data.

Precision is also expressed in terms of analytical variability. For this investigation, analytical variability will be measured as the relative percent difference (RPD) or coefficient of variation between analytical laboratory duplicates and between the matrix spike (MS) and matrix spike duplicate (MSD) analyses.

Precision will be calculated as the RPD as follows:

$$RPD\ (\%) = 100\ x\ \frac{|S - D|}{(S + D)/2}$$

where:

S = analyte concentration in a sample
D = analyte concentration in a duplicate sample

The resultant RPD will be compared with criteria established by this QAPP in Table 7, and deviations from these criteria will be reported. If the QAPP criteria are not met, the laboratory will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. The RPD will be evaluated during data review and validation. The data reviewer will note deviations from the specified limits and comment on the effect of the deviations on the reported data.

6.2.1.2 Bias

Bias is the difference between the sample population mean and the true value. Bias results from systematic errors in analytical equipment calibration or from sample matrix interferences in the analytical processes. It can also be introduced during the sample collection, transport and storage processes. Field blanks will be used during the sampling events to detect contamination introduced through sampling procedures, external field conditions, sample transportation, container preparation, sample storage, or bias in the analysis process.

Field blanks will be prepared in the field by the field sampling personnel. Field blanks will be exposed to the ambient atmosphere at the sampling location during sample collection and may determine the influence of external field conditions on sample integrity. One field blank per ASR pilot testing cycle will be collected.

Bias introduced during the calibration process will be evaluated using analyses results for 10 check standards and calculated using the equation that subtracts the true sample value from the mean of the 10 check sample analyses results , divided by the true sample value. The percent recoveries of Matrix Spikes and Matrix Spike Duplicate and the blank spike replicates analyses results.

Matrix Spike recovery percent calculation:

$$Recovery\ (\%) = \frac{MC}{SC}\ x\ 100$$

where:

SC = spiked concentration
MC = measured concentration

Duplicate Matrix Spike recovery will be calculated as follows:

$$Recovery\ (\%) = \frac{MC - USC}{SC}\ x\ 100$$

where:

SC = spiked concentration
MC = measured concentration
USC = unspiked sample concentration

Matrix Spike Duplicate percent recovery will be calculated as follows:

$$Recovery\ (\%) = \frac{MDC - USC}{SC}\ x\ 100$$

where:

SC = spiked concentration
MDC = measured duplicate spike concentration
USC = unspiked sample concentration

The resultant percentage recoveries will be compared with criteria established by this QAPP in Table 7, and deviations from these criteria will be reported in the final report (and in laboratory limits for RPD reported by the lab in individual reports). If the objective criteria are not met, the laboratory will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. Percent recoveries will be evaluated during data review and validation, and the data reviewer will comment on the effect of the deviation on the reported data.

Additionally, a likely source of bias in the proposed project tasks are sensor drift (accuracy loss) over time in automated monitoring equipment, including both pressure transducer and water level data, and lack of sufficient sampling rate to accurately resolve changes in measurement. All measurements will be performed at or greater than the frequency outlined in the SOP0074. Automated equipment will be calibrated and checked for accuracy by performing contemporaneous manual field measurements and comparing time-plots of both data sets based on the SOP.

Groundwater level measurements for the pressure transducer are barometrically corrected through the use of a vented tube and collection of atmospheric data in an independent barometric pressure transducer. Transducer submergence depths are plotted with manual measurements to assess if a bias is present. If sensor drift is observed, it will be corrected using appropriate method as outlined in EAP074 (Ecology, 2019a).

6.2.1.3 Sensitivity

Sensitivity will be determined by Method Reporting Limits (MRLs). MRLs will be set low enough to allow meaningful comparisons with screening criteria to the extent possible, considering matrix effects. The laboratory will be directed to report compounds detected above the Method Detection Limit (MDL) and positively identified below the MRL as estimated (J flag).

6.2.2 Targets for comparability, representativeness, and completeness

6.2.2.1 Comparability

Comparability is the degree to which the data can be compared to historical data, reference values (such as background), and reference materials. This will be achieved through the use of standard techniques to collect samples, EPA-approved methods to analyze samples, and consistent units to report analytical results. Ecology SOPs will be followed for the data collection supporting the aquifer test. The SOPs that will be followed for this project are listed in Section 8.2. Data comparability also depends on data quality; data of unknown quality cannot be compared.

6.2.2.2 Representativeness

Representativeness is the degree to which sample results represent the system under study. This component is generally considered during the design phase of a project. This project will use the results of all analyses to evaluate the data in terms of its intended use.

Representativeness of the sample will be ensured during the collection process by: (1) employing proper decontamination procedures and (2) thorough purging of the well and ensuring stability of field parameters prior to collecting groundwater samples (Section 8.2). The representativeness of analytical results will be determined by evaluating hold times, sample preservation, and blank contamination. Samples with expired hold times, improper preservation, or contamination may not be representative. Field conditions noted in project data sheets and notebooks that have the potential to affect the representativeness of measurements and samples analyses results will also be considered.

6.2.2.3 Completeness

Completeness will be calculated as follows:

$$Completene\ ss\ (\%) = \frac{V}{P}\ X\ 100$$

where:

V = number of valid measurements
P = number of planned measurements

Valid and invalid data (i.e., data qualified with the R flag [rejected]) will be identified during data validation. The completeness target for the study is 100 percent of water quality samples.

6.3 Acceptance criteria for quality of existing data

Existing data has been collected by Roza during the ASR feasibility study (Aspect 2025a), in accordance with a Work Plan that followed typical format of an Ecology-approved QAPP for ASR. The FS Work Plan (Aspect 2025b) was reviewed by Ecology and received no substantive comments or revisions. All water quality samples previously collected for analysis followed approved standards and procedures. Water quality analyses were conducted at accredited laboratory facilities. Acceptance of the results by Ecology is acceptable criteria under this study.

Acceptance criteria for existing data should consider whether conditions are comparable to those present during the planned ASR pilot testing) as the basis for incorporating the existing data into the project analyses. In this case, that might be represented by analyses results for groundwater samples collected during active pumping conditions (threshold amount and rate of aquifer pumping prior to sample collection), samples collected from similar geologic and hydrogeologic environments, samples collected using similar procedures or analyzed using similar measurement techniques.

Other relevant outside data may be used in the evaluation of the Pilot Testing results that meet the minimum requirements of the DQOs established in this QAPP.

6.4 Model quality objectives

The potential for physiochemical changes (mineral dissolution and/or precipitation) to occur because of recharge operations will be evaluated using the data collected during the Pilot Test with PHREEQC geochemical model simulations (Parkhurst et al., 1980) for the Wanapum Aquifer. The model will calculate Saturation Indices (SIs) for the primary minerals found in the storage aquifer.

A range of combinations for potential mineral assemblages will be evaluated by the model as part of a sensitivity analysis and quality evaluation. Mineral assemblage will include both the mineral phases considered during the Stokely Feasibility Study, as well as a screening review of any other geochemically credible oxide, carbonate, and sulfate minerals capable of precipitating in the aquifer during ASR activities.

The qualitative quality objective for the modeling is that the SIs calculated for water quality at various stages of testing shall agree with the water quality data collected during the pilot testing. The results of the model will be used to identify potential constituents and/or well performance trends to monitor during additional pilot testing or ASR scaling. Model results will be compared to water quality analytical results for samples collected during the pilot testing using graphical representation. Such visual comparisons are useful in evaluating model quality and uncertainty.

Geochemical modeling will be used to evaluate the effects of mineral precipitation and dilution, as well as the effects of changing redox and gas saturation on aquifer conditions. These reactions will be incorporated into the geochemical model in PHREEQC, and discussed conceptually in the model results. The model will calculate changes in constituent concentrations that may occur due to mineral dissolution and precipitation.

The rates of the predicted reactions will not be explicitly modeled (i.e., a kinetic geochemical model will not be developed for this project). Therefore, no quantitative quality objectives are set for a comparison of the geochemical modeling to observed water chemistry.

7.0 Study Design

A narrative of the overall study design is provided in Section 4. This section provides the details of the data collection and analysis.

7.1 Study boundaries

The approximate study area, Stokely Well, Lewis Well, and Evans Well are shown in Figure 1.

7.2 Field data collection

The following sections describe field data collection tasks and schedules.

7.2.1 Sampling locations and frequency

The Pilot Test includes the collection of at least 13 water quality samples plus required duplicates. A minimum of two surface water samples will be collected to confirm background water quality, one water quality sample is anticipated to be collected from the Roza Canal source water after treatment and before injection, five water quality samples are anticipated to be collected from the Stokely Well during Cycle 1 and six water quality samples are anticipated to be collected from the Stokely Well during Cycle 2. All samples will be compared to the Groundwater Quality Criteria in Chapter 173-200-040 WAC.

7.2.2 Field parameters and laboratory analytes to be measured

The analyte suite for water quality is described in Sections 3.2.3 and 6.2 and will be sampled according to the quality objectives described in Section 6. Following sampling, laboratory results will be evaluated to determine effectiveness of the chosen analyte lists. Select constituents which have been shown to be non-detect in two or more samples will be submitted to Ecology for approval to be removed from subsequent sampling events.

Field parameters will be measured using an AquaTroll 600 multimeter (as described in Section 8.2), including:

- Specific conductance
- Dissolved oxygen
- ORP
- pH
- Temperature
- Turbidity

Measurements of the above constituents will be collected until values are stable, as described in Section 8.2.

7.2.3 Groundwater Level Monitoring Locations and Frequency

Manual depth-to-water measurements will be collected during the aquifer testing program at the test well according to Ecology's Aquifer Test Procedures (Ecology, 2023a) using an electronic water level indicator as discussed in Section 8 and in accordance with EAP052 standard operating procedures (Ecology, 2023b). Manual water levels will be measured both during deployment and retrieval of dataloggers to provide depth-to-water, groundwater elevation, and sensor drift corrections to the pressure transducer data. Manual depth-to-water measurements will be collected at wells using an electronic water level indicator. Measurements will be performed twice at each well to verify depth to water and will be scheduled to avoid active injection or pumping conditions.

A datalogger will be installed in the Stokely Well at least one week prior to the start of the Pilot Test to collect background water levels and will remain in the well following test completion. During testing, a vented PT2X pressure transducer will be used to collect drawdown and recovery data in the test well and will record at a minimum interval of every 30 seconds. A barometric pressure transducer will be installed at the Stokely Well to collect continuous atmospheric pressure measurements prior to and after testing at a rate of one observation every ten minutes.

Given size and operational constraints present in the Lewis and Evans Wells, water level in each well will be monitored with previously installed airline water level indicators. The air line water level indicators use compressed air to measure the depth to water by monitoring the pressure in the air line that is submerged to a known depth.

Additional details on groundwater monitoring are provided in Section 8.2.1.

7.3 Modeling and analysis design

Aquifer properties and well performance will be estimated using appropriate analytical methods for the observed hydrogeologic conditions, available data, and governing analytical model assumptions. The published underlying assumptions for the analytical methods used will be verified as being met prior to selecting a specific analytical method. Water quality modeling will be conducted using the PHREEQC geochemical software developed by the U.S. Geological Survey (USGS).

The following sections detail the hydraulic and geochemical modeling procedures and analysis.

7.3.1 Analytical framework

Analytical methods for hydraulic analysis will be based on the pre-determined conditions of the Wanapum Aquifer: a confined, homogenous, isotropic, fault-bounded aquifer with potential leakage. The method will be adjusted if results from the Pilot Test change the hydrogeologic conceptual site model described in the Feasibility Study (Aspect, 2025).

The PHREEQC model simulations will evaluate the potential for common primary and secondary minerals to dissolve or precipitate based on the measured chemistry of mixed waters and calculated mineral saturation indices. The model simulations will incorporate water quality results for groundwater in Wanapum Aquifer and from the treated Roza Canal source water. The results of the model will be used to identify potential constituents and/or well performance trends to monitor during future ASR operations.

7.3.2 Model setup and data needs

Well efficiency testing will be conducted using published analytical methods for step-rate injection and pumping tests (e.g., the Hantush-Bierschenk method). Data needs for the model include time-series recharge/drawdown and injection/discharge data, water level measurements, well locations, and published geologic information. Data will be tabulated, compared with type recharge/pumping curves, and analyzed using a spreadsheet-based tool or third-party analytical software.

Mixed water chemistry will be predicted by the model based on water quality data collected for the Stokely Well and the source water. Geochemical modeling will begin by adding water from the source to groundwater at assumed mixing ratios of 50/50 and 80/20 (source water / groundwater). The stored water will also be modeled in equilibrium with common alluvial/outwash aquifer minerals (based on LLNL equilibrium and speciation data for aqueous and mineral compounds) to simulate potential water quality impacts from interaction with the Wanapum Aquifer. Following mixing, saturation indices (SIs) for common basalt minerals deemed to have potentially applicable reaction kinetics (i.e., with potential to react within the timeframe considered for storage) will be calculated to assess the potential for mineral precipitation or dissolution.

7.4 Assumptions of study design

The Pilot Test assumes that existing water quality and groundwater level data collected under the Feasibility Study (Aspect, 2025) are of sufficient quality to meet acceptance criteria of this QAPP.

There are also several assumptions around designing the Pilot Test and analyzing the results. These assumptions include:

- The equipment used in the injection and pumping tests (flow meters, pressure transducers, water level data loggers, water level indicators, etc.,) give accurate readings when installed, used, and calibrated properly.
- Discharge from the pumping test will not recharge the aquifer.
- Constant injection and pumping rates are maintained during the entirety of the injection and pumping tests under Cycle 2.
- An appropriate method will be used to analyze aquifer test data. Analytical methods have several built-in assumptions that are incorporated into the Pilot Test, including:
- The aquifer has infinite areal extent;

- The aquifer is homogeneous, isotropic and of uniform thickness;
- Flow to the pumping well is horizontal;
- The aquifer is nonleaky, confined or semi-confined;
- Water is released instantaneously from storage with decline in hydraulic head;
- Diameter of the pumping well is very small, so storage in the well can be neglected.
- Measured drawdown at the observation well data is representative of influence from the test well

7.5 Possible challenges and contingencies

Possible logistical problems, practical constraints, and schedule limitations are discussed below.

7.5.1 Logistical problems

Logistical problems that interfere with measurement collection may occur during fieldwork. Some of the probable challenges identified for this project include (but not limited to) the following:

Problem #1: Water quality samples meeting hold times and temperature criteria when shipping samples to laboratory for analysis

Potential contingencies:

- If a sample collected during the injection or recovery period does not meet criteria for laboratory acceptance, then a new sample will be collected.
- If a sample at the end of the injection or recovery period does not meet hold times, then the results will be qualified (J-flagged).

Problem #2: Insufficient water is available for either Cycle 1 or Cycle 2 injection during Fall 2026.

Potential contingencies:

- Planning and coordination between Roza, Ecology, and Geosyntec can help plan and mitigate for potential water availability limitations
- The pilot test may need be postponed to Spring 2027 or later when water is available.

Problem #3: Availability of testing equipment prescribed in the QAPP and engineering design

Potential contingencies:

- Alternative testing equipment of similar accuracy and precision may need to be deployed in cases where the availability of the primary listed equipment is limited
- In cases where critical components of the pilot testing system are delayed, the pilot testing program may need to adjust the start and or duration of the ASR cycles.

7.5.2 Practical constraints

Practical constraints that can interfere with a project include scheduling problems with personnel, equipment failure, or availability of adequate resources.

Operation of the pilot testing system will be led by Roza. In the event that Roza staff are unable to operate the system during a critical period or event (e.g., high turbidity spike detected by the sentinel turbidity station), then a competent staff member from Geosyntec or HLA will be available to assist as backup to Roza.

In the event of equipment failure, the pilot testing system may need to temporarily shut down for repairs or replacement. Depending on the timing of the potential failure, the system may either be restarted or discontinued until the next ASR cycle.

7.5.3 Schedule limitations

The primary potential limiting factors for the schedule, with a goal of starting the Pilot Test by Summer of 2026 include:

- Severe drought conditions that limit the total available quantity of water for injection during the Pilot Test
- Availability of testing equipment (i.e., lead times for specific, specialized components such as the electrical control panel)
- Construction progress

8.0 Field Procedures

8.1 Invasive species evaluation

Geosyntec field staff will follow Ecology's SOP EAP070 (publicly available in digital format on Ecology's website; Ecology, 2023a) for minimizing the spread of invasive species for areas of both moderate and extreme concern.

At the end of each field visit, field staff will minimize the spread of invasive species by:

- Inspecting and cleaning all equipment by removing any visible soil, vegetation, vertebrates, invertebrates, plants, algae, or sediment. If necessary, a scrub brush will be used and then rinsed with clear water either from the site or brought for that purpose. The process will be continued until all equipment is clean.
- Draining all water in samplers or other equipment that may harbor water from the site. This step will take place before leaving the sampling site or at an interim site. If cleaning after leaving the sampling site, field staff will take steps to prevent debris from leaving the equipment and potentially spreading invasive species during transit or cleaning.

Established Ecology procedures will be followed if an unexpected contamination incident occurs.

8.2 Measurement and sampling procedures

The procedures used in the Pilot Test are typical for any hydrogeologic investigations. SOPs to be followed are publicly available in digital format online and include the following:

- Ecology's Aquifer Test Procedures (Ecology, 2023a),
- SOP EAP052, Version 1.4 – *Manual Well-Depth and Depth-to-Water Measurements* (Ecology, 2023b),
- SOP EAP074, Version 1.2 – *Use of Submersible Pressure Transducers During Groundwater Studies* (Ecology, 2019a), and
- Standard Operating Procedure EAP070, Version 2.3 – *Minimize the Spread of Invasive Species* (Ecology, 2023c)
- Standard Operating Procedure EAP099, Version 1.2 – *Collecting Groundwater Samples: Purging and Sampling Monitoring Wells for General Chemistry Parameters* (Ecology, 2023b)
- Standard Operating Procedure EAP098, Version 1.1 – *Collecting Groundwater Samples for Metals Analysis from Water Supply Wells* (Ecology, 2019a)
- Standard Operating Procedure EAP015, Version 1.4 – *Manually Obtaining Surface Water Samples* (Ecology, 2019b)
- Washington State Department of Health General Sampling Procedure (DOH, 2003).

8.2.1 Groundwater Sampling

Groundwater quality samples from the Stokely Well will be collected in general accordance with Ecology (2019a; 2023b) and DOH (2023) standard procedures. Groundwater samples will be collected from a sample port installed near the wellhead of the Stokely Well. If no pumping has occurred for at least one hour prior to groundwater sampling, the well will be purged for a minimum of 10 minutes (or three well volumes) prior to the collection of any groundwater samples or until the water quality parameters stabilize, whichever is longer (note that SOP EAP098 does not include this provision for a minimum purge volume). During collection of groundwater sampling where pumping has been occurring for greater than one hour, a sample will be collected from the sampling port without additional purging.

Prior to collecting groundwater quality samples stable conditions will be defined using field water quality parameters (temperature, pH, specific conductivity, dissolved oxygen, ORP, and turbidity) monitored in the field with a multiprobe sensor using a closed flow-through cell. Stable conditions will be confirmed for each of these parameters when three successive measurements over a one-minute period do not vary by more than the quantity listed in "Value" column of Table 8. Once the water quality parameters have stabilized, the groundwater quality samples shall be collected from the respective sampling port.

Table 8. Field Parameter Stabilization Criteria

Parameter	Value	Units
pH	±0.1	SU
Specific Conductance	±10.0	uS/cm
Dissolved Oxygen	± 0.05 for values < 1 mg/L ± 0.2 for values > 1 mg/L	mg/L
Temperature	±0.1	Celsius
ORP	+10	millivolts

8.2.2 Surface Water Sampling

Surface water quality samples from the Roza Canal source water will be collected after treatment and in general accordance with Ecology Standard Operating Procedure EAP015 (2019b).

8.2.3 Groundwater Level Monitoring

Groundwater levels will be measured in the Stokely Well and observation wells. A vented PT2X pressure transducer will be installed in the Stokely Well for the Pilot Test to automatically record water levels. Water levels in the Lewis and Evans wells will be measured via submerged air lines.

During the Pilot Test, manual measurements will be performed in the Stokely Well at a frequency equal to or more frequent than outlined in Ecology's Aquifer Test Procedures

(Ecology, 2023a). Manual measurements in the Stokely Well will be made during deployment and recovery of pressure transducer to provide manual verification and conversion pressure to depth-to-water readings for the automated transducer data. Manual measurements in the Lewis and Evans wells will be collected during data retrieval and opportunistically as time permits.

Water levels will be collected using an electrical water level meter with a precision of 0.01-ft and estimated accuracy of 0.05-ft. Water levels will be measured from the existing measurement point (MP) at each well to ensure data comparability.

If an MP does not exist, then we will establish one based on the following procedure:

1. MPs are normally established on the north side of the top rim of the actual well casing; this position is commonly referred to as “top of casing” (TOC). Locate the MP at a convenient place from which to measure the water level. If the TOC is level, collect the measurement from the north edge.

2. Clearly mark the MP. The MP must be as permanent as possible and be clearly visible and easily located. The MP may be marked using a permanent black marker, bright colored paint stick, or with a notch filed into the TOC.

3. Describe the position of the MP clearly in the field-data sheets.

4. The MP height is established in reference to a land surface datum (LSD). The LSD is generally chosen to be approximately equivalent to the average altitude of ground surface around the well.

5. Measure the height of the MP in feet relative to the LSD. Generally, MPs are established to the nearest 0.1-ft using a pocket tape to measure the distance from the MP to the LSD. Note that values for measuring points that lie below land surface should be preceded by a minus sign (-). Record the height of the MP and the date it was established.

6. MPs and the LSD may change over time, the distance between the two should be checked whenever there have been activities, such as land development that could have affected either the MP or LSD at the site. Such changes must be measured as accurately as possible, documented and dated in field-data sheets, and in any database(s) into which the water-level data are entered.

All subsequent water level measurements should be referenced to the established MP. The MP value will be used to convert measurements into values that are relative to land surface.

After a permanent MP is established for each well, continue sampling using the following process:

1. Open the top of the well and note any “popping” sounds that would indicate pressure buildup, any odors, and the condition of the well head.

2. If there is a pressure transducer attached to the well cap carefully note the initial position of the cap (mark cap position on casing with permanent marker). If the well was airtight, wait a few minutes for the water level to return to equilibrium with atmospheric pressure.

3. Turn the water level meter on and slowly lower the probe into the well until it makes a tone indicated contact with the water level. To confirm contact, slowly raise and lower the electric-tape probe in and out of the water column. If necessary, adjust the sensitivity setting of the meter to provide a "crisp" indication of the water surface. Measure the depth of water against the MP and mark the date and time the reading was made.

4. At the precise location the indicator shows contact with the water surface, pinch the tape between your fingernails at the MP. Read the depth-to-water.

5. Repeat the measurement to ensure that the water level is stable (not rising or falling over time).

6. When the probe is pulled back up, make a note of any mud, staining, or anything else on the tip. Before moving on to the next well, decontaminate the probe with a brush or paper towel, then rinse with distilled water and 10 percent bleach.

On occasion, condensation on the interior casing of the well can prematurely trigger the electric-tape indicator giving a false positive reading. In this situation, it can help to center the tape in the well casing above the water level and lightly shake the tape to remove the excess water on the probe.

8.2.3 Atmospheric Pressure Monitoring

A barometric pressure transducer and datalogger will be deployed near the Stokely Well. Data from this transducer will be used to correct barometric effects if observed in the Stokely Well and observation wells. Barometric efficiency can affect the representativeness of water level measurements from vented and unvented transducers (Spane, 2002). Corrections for barometric efficiency of wells will be made, as appropriate.

8.2.4 Aquifer and Well Testing

Step-rate injection and step-rate pumping tests will be performed in accordance with Ecology's *Aquifer Test Procedures* (Ecology, 2023a). A licensed hydrogeologist will oversee all testing activities by staff listed in Table 4 and ensure data collection is conducted in accordance with professional standards.

8.2.4.1 Step-Rate Injection and Step-Rate Pumping Test

A step-rate injection test and a step-rate pumping test will be conducted at the Stokely Well as part of Cycle 1 using best practices to evaluate well capacity and performance. The results of the step-rate tests will be analyzed to determine rates achievable in Cycle 2 as described in Section 4.4.

The anticipated rates for the step-rate injection test and pumping tests are summarized in Table 9. The duration of each step is anticipated to be 1 hour (4 hours total).

Table 9. Anticipated Step-rate Injection and Pumping Test Rates

Step No.	Pumping Rate (% sustainable production)	Anticipated Injection/Pumping Rate (gpm)
1	50	400
2	75	600
3	100	800
4	125	1,000

Based on analysis of well performance and aquifer testing data, injection and pumping rates up to 1,000 gpm are considered feasible during the pilot test for the current construction of the Stokely Well (primarily limited by the 10-inch-diameter liner). Higher injection and recovery rates are feasible at the location of the Stokely Well, if larger diameter wells are drilled in the future. Injection and pumping steps will be chosen to best match the anticipated total production of the well as shown in Table 9 and defined by Ecology's Aquifer Test Procedures (Ecology, 2023a). Actual pumping rates will be determined while conducting the test to ensure that four evenly spaced steps can be accommodated with the existing capabilities of the well and equipment, which may be affected by the minimum available pumping rate and maximum available drawdown at the time of testing.

The duration of each step will be a minimum of 1-hour, which is typically the minimum time required to reach a stable rate of drawdown and for conventional analysis of the test data to determine turbulent and laminar flow losses. The relative stability of the rate of drawdown will be confirmed on the first step and prior to advancing to the second step. If stable drawdown has not been reached within the first hour, the step will be extended until stable drawdown is observed. Each subsequent step will be equivalent in duration to the first step.

Discharge rates will be observed throughout testing to ensure constant discharge throughout each step. Discharge rates will be recorded at the same interval as manual depth to water readings and during any manual correction to discharge rate. Totalizer readings will be recorded prior to initializing the test and at the conclusion of each step.

8.3 Containers, preservation methods, holding times

The sample bottles and respective preservatives for each sample will be provided by the laboratory and filled according to analytical laboratory instructions. Latex or nitrile gloves will be worn at all times during collection of the water quality parameters and samples. Samples will be collected from the closed flow through cell. Samples for dissolved metal analyses shall be filtered with a 0.45-micron pore-size filter prior to collection in sample bottles. All bottles

will be clearly labeled with a unique sample name, date, time, and preservative. Samples will be stored in a cooler at 4 degrees Celsius (°C) and delivered to the laboratory under standard chain-of-custody protocols, within the hold times provided by the laboratory.

8.4 Equipment decontamination

Water samples are collected from dedicated sampling equipment or directly into laboratory provided containers to prevent cross-contamination. All sampling equipment will be decontaminated before and after completion of all sampling activities. Sampling equipment will be decontaminated with an industry standard, phosphorous-free detergent and brush or paper towel, then rinsed with distilled water.

8.5 Sample ID

All bottles shall be clearly labeled with a unique sample name, date, time, and preservative. Samples shall be stored in a cooler at 4°C and delivered to the laboratory under standard chain-of-custody protocols, within the hold times provided by the lab.

8.6 Chain of custody

After collection, samples will be maintained in Geosyntec custody until formally transferred to the analytical laboratory.

For purposes of this work, custody of the samples will be defined as follows:

- In plain view of the field representatives
- Inside a cooler that is in plain view of the field representative
- Inside any locked space, such as a cooler, locker, car, or truck to which the field representative has the only immediately available key(s)

A chain-of-custody record provided by the laboratory will be initiated at the time of sampling for all samples collected. The record will be signed by the field representative and others who subsequently take custody of the samples. Couriers or other professional shipping representatives are not required to sign the chain-of-custody form; however, shipping receipts will be collected and maintained as a part of custody documentation in the project files. A copy of the chain-of-custody form with appropriate signatures will be maintained in Geosyntec's files and included as an appendix to the project report.

8.7 Field log requirements

During the collection of any field samples, accompanying field documentation must be made that clearly states:

- Name and location of project
- Field personnel
- Sequence of events

- Any changes or deviations from the QAPP or SOPs
- Environmental conditions
- Date, time, location, ID, and description of each sample
- Field instrument calibration procedures
- Field measurement results
- Identity of QC samples collected
- Unusual circumstances that might affect interpretation of results

For the Pilot Test, data collected in the field will be contained in a field log (e.g., a binder backed by electronic scans of documents) that will consist of field notes (freehand notes) and Geosyntec field data sheets (Appendix B).

Field notes will be bound, waterproof notebooks with prenumbered pages (Rite in the Rain®). Permanent, waterproof ink should be used for all entries. Corrections will be made with single-line strikethroughs, initials, and date of correction. Use of white-out or correction fluid is not permitted.

While conducting field work, the field hydrogeologist or technician (Table 4) will document general, pertinent observations and events in a waterproof field notebook and, when warranted, provide photographic documentation of specific sampling efforts. Data collected during the sample collection procedures will be recorded on standard Geosyntec field data sheets (Appendix B). Field notes will include a description of each field activity, sample descriptions, and associated details, such as the date, time, and field conditions. The laboratory chain-of-custody forms will be filled out before leaving the site. Upon completion of a field task, the field personnel will then scan field notes and Geosyntec field data sheets into digital files and provide the original versions to the Geosyntec Project Manager. Copies of Geosyntec field data sheet and laboratory chain of custody are provided in Appendix B.

8.8 Other activities

Field procedures for the treatment of Roza Canal source water will be detailed in the Monitoring and Operations Plan that will be developed prior to the start of the Pilot Test.

9.0 Laboratory Procedures

9.1 Lab procedures table

Table 10 presents the laboratory procedures for each analyte, including the sample matrix, number of samples, expected range of results, reporting limit, and analytical method.

Table 10. Measurement methods (laboratory).

Analytical Method	Analyte	Sample Matrix	Number of Samples	Expected Range of Results	Method Reporting Limit	Units
General Chemistry, Inorganics						
SM 2320B	Alkalinity	Water	11	55 – 220	20	mg/L
SM 2320B	Bicarbonate	Water	11	55 – 220	20	mg/L
EPA 300.0	Chloride	Water	11	3.5 – 16	0.8	mg/L
SM 5310C	Dissolved Organic Carbon	Water	11	0.23 – 2.4	0.3	mg/L
EPA 353.2	Nitrates	Water	11	0.057 – 0.2	0.1	mg/L
EPA 300.0	Sulfate	Water	11	2.4 – 9.6	0.5	mg/L
SM 2510B	Total Organic Carbon	Water	11	0.3 – 2.4	0.3	mg/L
Metals by ICP or ICP/MS						
EPA 200.8	Aluminum	Water	11	4.6 – 130	20	ug/L
EPA 200.8	Arsenic	Water	11	0.28 – 1	1	ug/L
EPA 200.7	Calcium	Water	11	3.1 – 12	1	mg/L
EPA 200.7	Iron	Water	11	0.017 – 0.19	0.01	mg/L
EPA 200.7	Magnesium	Water	11	0.8 – 4.9	0.1	mg/L
EPA 200.8	Manganese	Water	11	1.5 – 8.2	2	ug/L
EPA 200.8	Molybdenum	Water	11	0.24 – 5.6	0.22	
EPA 200.7	Potassium	Water	11	0.84 – 12	1	mg/L
EPA 200.7	Silica (as SiO2)	Water	11	11 – 67	0.428	mg/L
EPA 200.7	Sodium	Water	11	4.2 – 100	1	mg/L
EPA 200.8	Titanium	Water	11	3.8 – 19	1	ug/L
EPA 200.8	Zinc	Water	11	2.1 - 20	20	ug/L
PFAS						
EPA 537.1	HFPO-DA	Water	2	<RL	2	ng/L
EPA 537.1	PFBS	Water	2	<RL	2	ng/L
EPA 537.1	PFHxS	Water	2	<RL	2	ng/L
EPA 537.1	PFNA	Water	2	<RL	2	ng/L

Analytical Method	Analyte	Sample Matrix	Number of Samples	Expected Range of Results	Method Reporting Limit	Units
EPA 537.1	PFOA	Water	2	<RL	2	ng/L
EPA 537.1	PFOS	Water	2	<RL	2	ng/L
Herbicides						
EPA 515.3	2,4,5-TP (Silvex)	Water	2	<RL	0.1	ug/L
EPA 515.3	2,4,6-Trichlorophenol	Water	2	<RL	0.1	ug/L
EPA 515.3	2,4-D	Water	2	<RL	0.1	ug/L
EPA 515.3	Dalapon	Water	2	<RL	1	ug/L
EPA 515.3	Dinoseb	Water	2	<RL	0.2	ug/L
EPA 515.3	Pentachlorophenol	Water	2	<RL	0.04	ug/L
EPA 515.3	Picloram	Water	2	<RL	0.1	ug/L
Metal Speciation						
EPA 1632	Arsenic (III)/Arsenic(V)	Water	11	Unknown		ug/L

9.2 Sample preparation method(s)

Samples will be prepared and extracted by an accredited lab in accordance with industry standards and analytical methods. The selected laboratory is discussed in Section 9.4.

9.3 Special method requirements

Not applicable.

9.4 Laboratories accredited for methods

Analysis of water quality samples will be performed by Eurofins at their Spokane, Washington laboratory. Eurofins is accredited by Ecology for analysis of parameters included in this project (see Appendix A).

Laboratory contact information is provided in Table 11.

Table 11. Laboratory Contacts

Laboratory	Address	Contact	Phone	Email
Eurofins Spokane	11922 East 1st Ave Spokane, WA 99206	Randee Arrington	(509) 924-9200	Randee.Arrington@et.eurofinsus.com

10.0 Quality Control Procedures

Field Quality Control (QC) procedures provide the information needed to assess the quality of the data that is collected. These procedures also help identify problems or issues associated with data collection or data analysis while the project is underway.

10.1 Table of field and laboratory quality control

Standard EPA Level II procedures will be followed by the laboratory for one standard check, method blank, analytical duplicate, and matrix spike per laboratory batch (typically 10 to 20, as accommodated by laboratory auto sampling equipment and sample backlog). Field procedures will follow standard guidelines and SOPs for the relevant field activity. As detailed below data validation samples will be collected at a minimum of every 10 samples collected.

10.1.1 Data Validation Samples

QC is accomplished through the analysis of controlled data validation (DV) samples that are introduced to the laboratory from the field. Field duplicates will be collected and submitted to the investigation laboratory to provide a means of assessing the quality of data resulting from the field sampling program.

10.1.2 Trip Blank

No trip blanks will be used.

10.1.3 Field Blanks

One field blank sample will be collected during each ASR Pilot Testing Cycle (two total) to evaluate sampling bias, as described in Section 6.2.

10.1.4 Field Duplicates

Field duplicate samples are used to check for sampling and analysis reproducibility. Field duplicate samples will be collected at a frequency of 10 percent of the field samples for every matrix and analytical method.

Two DV samples will be collected. The DV sample will include the following (see Section 6 for calculation of DV parameters and acceptance criteria and Section 9 for description of lab procedures):

- A MS/MSD
- A “blind” field duplicate (i.e., not indicated to the lab as a field duplicate)

The chemical analysis of DV samples will include the entire list of chemical analytes (Section 3.2.3). The blind field duplicate will be labeled in a manner that does not indicate its true sample location, and the MS/MSD will be labeled, as such, for laboratory processing.

10.2 Corrective action processes

Corrective action processes will be used if:

- Activities are inconsistent with the QAPP;
- Field instruments yield unusual results;
- Results do not meet MQOs or performance expectations; or
- If some other unforeseen problem arises.

Following identification of any of the above, the field personnel or Geosyntec Project Manager, as appropriate, will identify the likely cause of the error, document the error and corrective action, and collect a replacement measurement at the earliest convenience. If field methods are determined to be the cause of the deficiency, the method will be updated and documented. If field instruments are resulting in the deficiency, the field equipment will be recalibrated or replaced with an identical unit or another device which meets the QAPP specifications and MQOs. Following corrective action, the Geosyntec Project Manager will confirm that the corrective action had the intended resolution or will continue to address the problem as needed.

The laboratory will follow the analytical method for corrective action procedures when the sample results do not meet the QC acceptance criteria. The laboratory will notify the Geosyntec Hydrogeologist who submitted the samples and include a narrative in the laboratory report when following the analytical method corrective action procedures results in a sample result not meeting the QC acceptance criteria. Findings will be reviewed by the Geosyntec Project Manager. QC results may indicate problems with data during the course of the project. If QA/QC results in a sample not being acceptable for the study, the affected analytes will be resampled at the soonest convenience.

11.0 Data Management Procedures

11.1 Data recording and reporting requirements

Field technicians will record all field data in a water-resistant field notebook, electronic data forms, or Geosyntec's standard field data sheet. Before leaving each site, staff will check field notebooks, data sheets, or electronic data forms for missing or improbable measurements. Field technicians will enter field-generated data into spreadsheets or a project database as soon as practical after they return from the field. For data collected electronically, data will be backed up on servers when staff return from the field. Raw data files will be stored separately from processed data files. The Geosyntec field hydrogeologist and field technician will check data entry against the field notebook data for errors and omissions. The hydrogeologist will notify the Geosyntec Project Manager of missing or unusual data.

Data will be uploaded to Ecology's EIM database as described in Section 11.4.

11.2 Laboratory data package requirements

All continuous and laboratory data will be stored in a project database that includes station location information and data QA information. This database will facilitate summarization and graphical analysis of the data.

11.3 Electronic transfer requirements

The lab will provide an EPA Level II data package as a PDF and an electronic data deliverable (EDD), in the format of a csv or xls file (comma-separated value and Excel workbook). The data package will include the following sections: Case narrative; Chain-of-custody (COC) documentation; Summary of results for environmental samples; Summary of QA/QC results; and Raw data.

11.4 Data upload procedures

Following completion of the QC procedures described in Section 10 and the DV procedures described in Section 13, all quality assured data will be formatted and uploaded to Ecology's EIM database by a Geosyntec data scientist using Study ID: WRYBIP-2325-RozID-00074.

11.5 Model information management

Modeling will be completed using the PHREEQC code and existing peer-reviewed geochemical databases (Section 6.4). Geosyntec will maintain the final version of the model files, including input, output, and executables, for archiving at the completion of the task. Electronic copies of the data and supporting documentation will be made available upon request. Geosyntec will maintain copies in a task subdirectory, subject to regular system backups, for a minimum period of 3 years after task termination, unless otherwise directed. Maintenance of computer resources will be conducted by Geosyntec's in-house computer specialists.

12.0 Audits and Reports

12.1 Audits

Field technicians will be required to review this QAPP prior to each monitoring event and to maintain a copy of the QAPP and its appendices in the field. Field technicians may be audited at any time by the appropriate project manager or the Geosyntec data manager (Table 4) to check that field work is being completed according to this QAPP, work plan, and published SOPs.

12.2 Responsible personnel

Personnel responsible for the audits are as follows:

- Field audit: Geosyntec Project Manager
- Field consistency review: experienced (at least 3 years) staff (senior hydrogeologist or project manager)
- Data analysis: Geosyntec hydrogeologists (project, senior, and principal, as required for specific analysis)

Personnel assigned to these roles are listed in Table 4.

12.3 Frequency and distribution of reports

Results of the field data collection, data quality assessment, and any data analysis will be documented in a published report. The final report will be distributed to all other stakeholders involved or interested in the study as determined by Roza and Ecology.

Field and Laboratory Data will be entered into EIM when data collection is complete, and Quality Control assessment has been finished.

12.4 Responsibility for reports

The Geosyntec Project Manager is responsible for verifying data completeness and usability before the data are used in the technical report and entered into the EIM database. The Geosyntec Project Manager is also responsible for writing the final technical report or memo, unless an alternate author is agreed upon and documented prior to the start of the report.

The Geosyntec Project Manager is responsible for assigning a peer reviewer with the appropriate expertise to review technical report. A draft report will be prepared and submitted to Ecology, then a final report will be prepared that addresses Ecology's comments. The peer reviewer is responsible for working with the author to resolve or clarify any issues with the report.

13.0 Data Verification

Data verification is the process of evaluating the completeness, correctness, and conformance of a specific data set against the method, procedural, or contractual requirements.

13.1 Field data verification, requirements, and responsibilities

Field notebooks, data sheets, and electronic information storage will be checked for missing or improbable measurements, and initial data will be verified before leaving each site. This process involves checking the data sheet (written or electronic) for omissions or outliers. If measurement data are missing or a measurement is determined to be an outlier, the measurement will be flagged on the data sheet and repeated if possible. The field hydrogeologist or field technician is responsible for in-field data verification.

Upon returning from the field, data are either manually entered (data recorded on paper) or downloaded from instruments and then uploaded into the appropriate database or project folder (see Section 11). Manually entered data will be verified/checked by a staff member who did not enter the data. Downloaded electronic data files will also be checked for completeness and appropriate metadata (such as file name and time code).

Following data entry verification, raw field measurement data will undergo a quality analysis verification process to evaluate the performance of the sensors. Field measurement data may be adjusted for bias or drift (increasing bias over time) based on the results of fouling, field, or standards checks following general USGS guidelines (Wagner, 2007) and the process described below.

13.1.1 Review Discrete Field QC Checks

Equipment calibration checks will be performed during each water quality sampling event. The field check of instrumentation will consist of a manual measurement for water levels, and measurement of water quality calibration standards in the field (checks with water quality standards will be completed separate from equipment calibration events). The post-check data from the field QC instrument check (water quality and water level) will be reviewed, and the result will be qualified, rejected, or accepted as appropriate.

13.1.2 Review/Adjust Time Series (Continuous) Data

1. Plot raw time series with field checks.
2. Reject data based on deployment/retrieval times, site visit disruption, blatant fouling events, and sensor/equipment failure.
3. Review sensor offsets for both recalibration and post-deployment buffer/standard checks. Flag any potential chronic drift or bias issues specific to the instrument.
4. If applicable, review fouling check and make drift adjustment, if necessary. In some situations, an event fouling adjustment may be warranted.

5. Review residuals from both field checks and post-checks, together referred to as QC checks. Adjust data, as appropriate, using a weight-of-evidence approach. Give the most weight to post-checks with National Institute of Standards and Technology standards (for pH, specific conductance, and ORP), then accept, reject, or qualify the field checks. Potential data adjustments include:

   Bias – Data are adjusted by the average difference between the QC checks and deployed instrument. The majority of QC checks must show bias to use this method.

   Regression – Data are adjusted using regression, typically linear, between QC checks and deployed instrument. This accounts for both a slope and bias adjustment. The regression must have at least five data points and an R^2 value of >0.95 to use for adjustment. Do not extrapolate regressions beyond the range of the QC checks.

   Calibration/Sensor Drift – Data are adjusted using linear regression with time from calibration or deployment to post-check or retrieval. The majority of QC checks, particularly post-checks, must confirm pattern of drift.

6. Typically, choose the adjustment that results in the smallest residuals and bias between the adjusted values and QC checks. Best professional judgement and visual review are necessary to confirm adjustment.
7. If the evidence is weak, or inconclusive, do not adjust the data.

It will be noted in the final report if any data is adjusted. Data adjustment must be performed or reviewed by the Geosyntec Project Manager or personnel with the appropriate training and experience in processing raw sensor data.

13.2 Laboratory data verification

The lab will provide an EPA Level II data package. Additional laboratory data validation (check batch QC) will be conducted by Geosyntec's project data scientist (Table 4). Laboratory validation results will be summarized in the laboratory reports, and Geosyntec's validation results will be summarized in the final report. An Geosyntec hydrogeologist will verify the validated laboratory results.

13.3 Validation requirements, if necessary

Not applicable

13.4 Model quality assessment

The geochemical model to be used in this project is a geochemical reactions simulations model developed by the USGS. The model uses an existing database of mineral phase equilibria (Section 6.4) to evaluate the potential for reactions to occur without consideration for reaction kinetics. The model is intended to be used to "bookend" potential water quality changes that may occur through ASR and will be used primarily to identify potential changes to monitor for during long-term ASR operations.

Quality assessment is defined as the process by which QC is implemented in the model development task. All modelers will conform to the following guidelines:

- All modeling activities including data interpretation are subject to audit or peer review. Thus, the modelers are instructed to maintain careful written and electronic records for all aspects of model development.
- If historical data are used in accordance with acceptance criteria (, a written record on where the data were obtained and any information on their quality will be documented in the final report. A written record on where this information is on a computer or backup media will be maintained in the task files.
- If new theory is incorporated into the model framework, references for the theory and how it is implemented in any computer code will be documented and peer reviewed.

Model results will be compared to water quality obtained from other ASR projects operating under very similar conditions (e.g., the City of Yakima ASR program).

A sensitivity analysis of input parameters and assumed mineral assemblages will be completed to assess the dependence of the geochemical model results on key input parameters and included in the Pilot Test report. The resulting changes in mineral SI's and predicted water quality parameter concentrations will be assessed and discussed in the Pilot Study Report.

14.0 Data Quality (Usability) Assessment

14.1 Process for determining project objectives were met

The Geosyntec Project Manager will assess all data (qualified and unqualified), results or verification, compliance with MQOs, and the overall quality of the data set to provide a final determination regarding usability in the context of the project-specific goals and objectives. The final report will document whether the final, acceptable-quality data set meets the needs of the project (allows desired conclusion/decisions to be made with the desired level of certainty).

14.2 Treatment of non-detects

Non-detects will be reported as the MRL for that analyte with the appropriate flag ("<") indicating it as a non-detect.

14.3 Data analysis and presentation methods

Data found to be of acceptable quality for project objectives will be analyzed before being summarized. Any relevant and interesting data analysis will be presented in the final report using a combination of tables and plots of various kinds, such as time-series plots, histograms, and box plots.

The report will contain a summary table of chemistry, figures of continuous data (water level hydrographs, potentiometric maps, etc.), discussion of results pertaining to each sample location (well), and a map of the study area.

14.4 Sampling design evaluation

The Geosyntec Project Manager will decide whether (1) the data package meets the MQOs, and criteria for completeness, representativeness, and comparability; and (2) meaningful conclusions (with enough statistical power) can be drawn from summary statistics. If so, the sampling design will be considered effective. If the sampling design is found ineffective, the approach will be modified in accordance with Ecology, and/or the study will be halted for redesign.

14.5 Documentation of assessment

In the final report, the Geosyntec Project Manager will include a summary and detailed description of the data quality assessment and model quality evaluation findings. This summary is usually included in the Data Quality section. The final report will also provide results of the data analysis, uncertainty analysis, and margin of safety.

15.0 References

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16.0 Appendices

Appendix A. Laboratory Accreditation

The State of Washington Department of Ecology

Eurofins Pomona

Pomona, CA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation.

This certificate is effective 3/14/2026 and shall expire 3/13/2027.

Witnessed under my hand on 3/11/2026.

Laboratory ID
C838

Rebecca Wood
Lab Accreditation Unit Supervisor

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

SCOPE OF ACCREDITATION

Eurofins Pomona

Pomona, CA

is accredited for the analytes listed below using the methods indicated. Full accreditation is granted unless stated otherwise in a note. EPA is the U.S. Environmental Protection Agency. SM is "Standard Methods for the Examination of Water and Wastewater." SM refers to EPA approved method versions. ASTM is the American Society for Testing and Materials. USGS is the U.S. Geological Survey. AOAC is the Association of Official Analytical Chemists. Other references are described in notes.

Matrix/ Analyte	Method	Note
Drinking Water		
Turbidity	EPA 180.1 2 1993	1
Chromium, Hexavalent	EPA 218.7 1 2011	1
Bromide	EPA 300.0 2.1 1993	1
Chlorate	EPA 300.0 2.1 1993	1
Chloride	EPA 300.0 2.1 1993	1
Chlorite	EPA 300.0 2.1 1993	1
Nitrate + Nitrite as N	EPA 300.0 2.1 1993	1
Nitrate as N	EPA 300.0 2.1 1993	1
Nitrite as N	EPA 300.0 2.1 1993	1
Orthophosphate as P	EPA 300.0 2.1 1993	1
Sulfate	EPA 300.0_2.1_1993	1
Bromate	EPA 300.1	1
Bromide	EPA 300.1	1
Chlorate	EPA 300.1	1
Bromate	EPA 317.0 2 2001	1
Perchlorate	EPA 331.0 1.0 2005	1
Cyanide, Total	EPA 335.4 1 1993	1
Color	SM 2120 B-2011	1
Odor	SM 2150 B-2011	1
Alkalinity	SM 2320 B-2011	1
Corrosivity	SM 2330 B-2011	1
Hardness, Calcium (as CaCO3)	SM 2340 B-2011	1
Hardness, Total (as CaCO3)	SM 2340 B-2011	1
Specific Conductance	SM 2510 B-2011	1
Solids, Total Dissolved	SM 2540 C-2015	1
Chlorine (Residual), Free	SM 4500-Cl G-2011	1,2
Chlorine (Residual), Total	SM 4500-Cl G-2011	1,2
Chlorine Dioxide	SM 4500-ClO2 D-93	1
Cyanide, Free	SM 4500-CN^- F-2011	1
Cyanides, Amenable to Chlorination	SM 4500-CN^- G-2011	1
Fluoride	SM 4500-F^- C-2011	1
pH	SM 4500-H+ B-2011	1,2
Orthophosphate as P	SM 4500-P E-2011	1
Dissolved Organic Carbon	SM 5310 C-2014	1
Total Organic Carbon	SM 5310 C-2014	1

Matrix/ Analyte	Method	Note
Drinking Water		
Anionic Surfactants (MBAS)	SM 5540 C-2011	1
UV Absorbing Organics	SM 5910 B-2011	1
Boron	EPA 200.7 4.4 1994	1
Calcium	EPA 200.7_4.4_1994	1
Hardness, Calcium (as CaCO3)	EPA 200.7 4.4 1994	1
Hardness, Total (as CaCO3)	EPA 200.7_4.4_1994	1
Iron	EPA 200.7_4.4_1994	1
Lithium	EPA 200.7 4.4 1994	1
Magnesium	EPA 200.7_4.4_1994	1
Manganese	EPA 200.7 4.4 1994	1
Potassium	EPA 200.7 4.4 1994	1
Silica	EPA 200.7_4.4_1994	1
Sodium	EPA 200.7 4.4 1994	1
Aluminum	EPA 200.8 5.4 1994	1
Antimony	EPA 200.8_5.4_1994	1
Arsenic	EPA 200.8 5.4 1994	1
Barium	EPA 200.8 5.4 1994	1
Beryllium	EPA 200.8_5.4_1994	1
Cadmium	EPA 200.8 5.4 1994	1
Chromium	EPA 200.8_5.4_1994	1
Copper	EPA 200.8 5.4 1994	1
Lead	EPA 200.8 5.4 1994	1
Manganese	EPA 200.8_5.4_1994	1
Mercury	EPA 200.8 5.4 1994	1
Molybdenum	EPA 200.8 5.4 1994	1
Nickel	EPA 200.8_5.4_1994	1
Selenium	EPA 200.8 5.4 1994	1
Silver	EPA 200.8 5.4 1994	1
Strontium	EPA 200.8_5.4_1994	1
Thallium	EPA 200.8 5.4 1994	1
Uranium	EPA 200.8_5.4_1994	1
Vanadium	EPA 200.8_5.4_1994	1
Zinc	EPA 200.8 5.4 1994	1
1,2,3-Trichloropropane	EPA 504.1_1.1_1995	1
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1 1.1 1995	1
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504.1 1.1 1995	1
Aroclor-1016 (PCB-1016)	EPA 505_2.1_1995	1
Aroclor-1221 (PCB-1221)	EPA 505 2.1 1995	1
Aroclor-1232 (PCB-1232)	EPA 505 2.1 1995	1
Aroclor-1242 (PCB-1242)	EPA 505_2.1_1995	1
Aroclor-1248 (PCB-1248)	EPA 505 2.1 1995	1
Aroclor-1254 (PCB-1254)	EPA 505 2.1 1995	1
Aroclor-1260 (PCB-1260)	EPA 505_2.1_1995	1
Chlordane (tech.)	EPA 505 2.1 1995	1
Toxaphene (Chlorinated camphene)	EPA 505_2.1_1995	1
2,4,5-T	EPA 515.4_1_2000	1
2,4-D	EPA 515.4 1 2000	1
2,4-DB	EPA 515.4_1_2000	1
3,5-Dichlorobenzoic acid	EPA 515.4 1 2000	1
Acifluorfen	EPA 515.4 1 2000	1

Matrix/ Analyte	Method	Note
Drinking Water		
Bentazon	EPA 515.4_1_2000	1
Dacthal Acid Metabolites	EPA 515.4 1 2000	1
Dalapon	EPA 515.4 1 2000	1
Dicamba	EPA 515.4_1_2000	1
Dichloroprop (Dichlorprop)	EPA 515.4 1 2000	1
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 515.4_1_2000	1
Pentachlorophenol	EPA 515.4_1_2000	1
Picloram	EPA 515.4 1 2000	1
Silvex (2,4,5-TP)	EPA 515.4_1_2000	1
3-Hydroxycarbofuran	EPA 531.2 1 2001	1
Aldicarb (Temik)	EPA 531.2 1 2001	1
Aldicarb sulfone	EPA 531.2_1_2001	1
Aldicarb sulfoxide	EPA 531.2 1 2001	1
Carbaryl (Sevin)	EPA 531.2 1 2001	1
Carbofuran (Furaden)	EPA 531.2_1_2001	1
Methiocarb (Mesurol)	EPA 531.2 1 2001	1
Methomyl (Lannate)	EPA 531.2 1 2001	1
Oxamyl	EPA 531.2_1_2001	1
Propoxur (Baygon)	EPA 531.2 1 2001	1
Glyphosate	EPA 547_1990	1
Diquat	EPA 549.2 1 1997	1
Paraquat	EPA 549.2 1 1997	1
Bromoacetic acid (MBAA, BAA)	EPA 552.2_1_1995	1
Bromochloroacetic acid (BCAA)	EPA 552.2 1 1995	1
Chloroacetic acid (MCAA, CAA)	EPA 552.2 1 1995	1
Dibromoacetic acid (DBAA)	EPA 552.2_1_1995	1
Dichloroacetic acid (DCAA)	EPA 552.2 1 1995	1
Total haloacetic acids (HAA5)	EPA 552.2 1 1995	1
Trichloroacetic acid (TCAA)	EPA 552.2_1_1995	1
Bromoacetic acid (MBAA, BAA)	SM 6251 B-05	1
Bromochloroacetic acid (BCAA)	SM 6251 B-05	1
Chloroacetic acid (MCAA, CAA)	SM 6251 B-05	1
Dibromoacetic acid (DBAA)	SM 6251 B-05	1
Dichloroacetic acid (DCAA)	SM 6251 B-05	1
Total haloacetic acids (HAA5)	SM 6251 B-05	1
Trichloroacetic acid (TCAA)	SM 6251 B-05	1
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	EPA 1613B_1994	1
1,4-Dioxane (1,4- Diethyleneoxide)	EPA 522 1 2008	1
1,1,1,2-Tetrachloroethane	EPA 524.2 4.1 1995	1
1,1,1-Trichloroethane	EPA 524.2_4.1_1995	1
1,1,2,2-Tetrachloroethane	EPA 524.2 4.1 1995	1
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 524.2 4.1 1995	1
1,1,2-Trichloroethane	EPA 524.2_4.1_1995	1
1,1-Dichloroethane	EPA 524.2 4.1 1995	1
1,1-Dichloroethylene	EPA 524.2_4.1_1995	1
1,1-Dichloropropene	EPA 524.2_4.1_1995	1
1,2,3-Trichlorobenzene	EPA 524.2 4.1 1995	1
1,2,3-Trichloropropane	EPA 524.2_4.1_1995	1
1,2,4-Trichlorobenzene	EPA 524.2 4.1 1995	1
1,2,4-Trimethylbenzene	EPA 524.2 4.1 1995	1

Matrix/ Analyte	Method	Note
Drinking Water		
1,2-Dichlorobenzene	EPA 524.2_4.1_1995	1
1,2-Dichloroethane (Ethylene dichloride)	EPA 524.2 4.1 1995	1
1,2-Dichloropropane	EPA 524.2 4.1 1995	1
1,3,5-Trimethylbenzene	EPA 524.2_4.1_1995	1
1,3-Dichlorobenzene	EPA 524.2 4.1 1995	1
1,3-Dichloropropane	EPA 524.2_4.1_1995	1
1,4-Dichlorobenzene	EPA 524.2_4.1_1995	1
2,2-Dichloropropane	EPA 524.2 4.1 1995	1
2-Chlorotoluene	EPA 524.2_4.1_1995	1
4-Chlorotoluene	EPA 524.2 4.1 1995	1
4-Isopropyltoluene (p-Cymene)	EPA 524.2 4.1 1995	1
4-Methyl-2-pentanone (MIBK)	EPA 524.2_4.1_1995	1
Benzene	EPA 524.2 4.1 1995	1
Bromobenzene	EPA 524.2 4.1 1995	1
Bromochloromethane	EPA 524.2_4.1_1995	1
Bromodichloromethane	EPA 524.2 4.1 1995	1
Bromoform	EPA 524.2 4.1 1995	1
Carbon disulfide	EPA 524.2_4.1_1995	1
Carbon tetrachloride	EPA 524.2 4.1 1995	1
Chlorobenzene	EPA 524.2_4.1_1995	1
Chlorodibromomethane	EPA 524.2 4.1 1995	1
Chloroethane (Ethyl chloride)	EPA 524.2 4.1 1995	1
Chloroform	EPA 524.2_4.1_1995	1
cis-1,2-Dichloroethylene	EPA 524.2 4.1 1995	1
cis-1,3-Dichloropropene	EPA 524.2 4.1 1995	1
Dibromomethane	EPA 524.2_4.1_1995	1
Dichlorodifluoromethane (Freon-12)	EPA 524.2 4.1 1995	1
Di-isopropylether (DIPE)	EPA 524.2 4.1 1995	1
Ethylbenzene	EPA 524.2_4.1_1995	1
Ethyl-t-butylether (ETBE) (2-Ethoxy-2-methylpropane)	EPA 524.2 4.1 1995	1
Hexachlorobutadiene	EPA 524.2_4.1_1995	1
Isopropylbenzene	EPA 524.2_4.1_1995	1
Methyl bromide (Bromomethane)	EPA 524.2 4.1 1995	1
Methyl chloride (Chloromethane)	EPA 524.2_4.1_1995	1
Methyl tert-butyl ether (MTBE)	EPA 524.2 4.1 1995	1
Methylene chloride (Dichloromethane)	EPA 524.2 4.1 1995	1
Naphthalene	EPA 524.2_4.1_1995	1
n-Butylbenzene	EPA 524.2 4.1 1995	1
n-Propylbenzene	EPA 524.2 4.1 1995	1
sec-Butylbenzene	EPA 524.2_4.1_1995	1
Styrene	EPA 524.2 4.1 1995	1
tert-amylmethylether (TAME)	EPA 524.2 4.1 1995	1
tert-Butylbenzene	EPA 524.2_4.1_1995	1
Tetrachloroethylene (Perchloroethylene)	EPA 524.2 4.1 1995	1
Toluene	EPA 524.2_4.1_1995	1
Total Trihalomethanes	EPA 524.2_4.1_1995	1
trans-1,2-Dichloroethylene	EPA 524.2 4.1 1995	1
trans-1,3-Dichloropropylene	EPA 524.2_4.1_1995	1
Trichloroethene (Trichloroethylene)	EPA 524.2 4.1 1995	1
Trichlorofluoromethane (Freon 11)	EPA 524.2 4.1 1995	1

Matrix/ Analyte	Method	Note
Drinking Water		
Vinyl chloride	EPA 524.2_4.1_1995	1
Xylene (total)	EPA 524.2 4.1 1995	1
2,4-Dinitrotoluene (2,4-DNT)	EPA 525.2 2 1995	1
2,6-Dinitrotoluene (2,6-DNT)	EPA 525.2_2_1995	1
4,4'-DDD	EPA 525.2 2 1995	1
4,4'-DDE	EPA 525.2_2_1995	1
4,4'-DDT	EPA 525.2_2_1995	1
Acenaphthylene	EPA 525.2 2 1995	1
Alachlor	EPA 525.2_2_1995	1
Aldrin	EPA 525.2 2 1995	1
Anthracene	EPA 525.2 2 1995	1
Atrazine	EPA 525.2_2_1995	1
Benzo(a)anthracene	EPA 525.2 2 1995	1
Benzo(a)pyrene	EPA 525.2 2 1995	1
Benzo(g,h,i)perylene	EPA 525.2_2_1995	1
Benzo(k)fluoranthene	EPA 525.2 2 1995	1
Benzo[b]fluoranthene	EPA 525.2 2 1995	1
Bromacil	EPA 525.2_2_1995	1
Butachlor	EPA 525.2 2 1995	1
Butyl benzyl phthalate	EPA 525.2_2_1995	1
Chlordane (tech.)	EPA 525.2 2 1995	1
Chrysene	EPA 525.2 2 1995	1
Di(2-ethylhexyl)adipate	EPA 525.2_2_1995	1
Di(2-ethylhexyl)phthalate, [Bis(2-ethylhexyl) phthalate], [DEHP]	EPA 525.2_2_1995	1
Diazinon	EPA 525.2 2 1995	1
Dibenz(a,h) anthracene	EPA 525.2_2_1995	1
Dieldrin	EPA 525.2 2 1995	1
Diethyl phthalate	EPA 525.2 2 1995	1
Dimethyl phthalate	EPA 525.2_2_1995	1
Di-n-butyl phthalate	EPA 525.2 2 1995	1
Di-n-octyl phthalate	EPA 525.2 2 1995	1
Endrin	EPA 525.2_2_1995	1
EPTC (Eptam, s-ethyl-dipropyl thio carbamate)	EPA 525.2 2 1995	1
Fluoranthene	EPA 525.2_2_1995	1
Fluorene	EPA 525.2 2 1995	1
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 525.2 2 1995	1
Heptachlor	EPA 525.2_2_1995	1
Heptachlor epoxide	EPA 525.2 2 1995	1
Hexachlorobenzene	EPA 525.2 2 1995	1
Hexachlorocyclopentadiene	EPA 525.2_2_1995	1
Indeno(1,2,3-cd) pyrene	EPA 525.2 2 1995	1
Methoxychlor	EPA 525.2 2 1995	1
Metolachlor	EPA 525.2_2_1995	1
Metribuzin	EPA 525.2 2 1995	1
Molinate	EPA 525.2_2_1995	1
Napropamide	EPA 525.2_2_1995	1
Phenanthrene	EPA 525.2 2 1995	1
Propachlor (Ramrod)	EPA 525.2_2_1995	1
Pyrene	EPA 525.2 2 1995	1

Matrix/ Analyte	Method	Note
Drinking Water		
Simazine	EPA 525.2_2_1995	1
Terbacil	EPA 525.2 2 1995	1
Thiobencarb	EPA 525.2 2 1995	1
Trifluralin (Treflan)	EPA 525.2_2_1995	1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)	EPA 533	1
1H,1H,2H,2H,-Perfluorodecanesulfonic acid (8:2 FTS)	EPA 533	1
1H,1H,2H,2H,-Perfluorooctanesulfonic acid (6:2 FTS)	EPA 533	1
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 FTS)	EPA 533	1
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	EPA 533	1
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS)	EPA 533	1
Hexafluoropropylene oxide dimer acid (HFPO-DA)	EPA 533	1
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	EPA 533	1
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	EPA 533	1
Perfluoro-3-methoxypropanoic acid (PFMPA)	EPA 533	1
Perfluoro-4-methoxybutanoic acid (PFMBA)	EPA 533	1
Perfluorobutane sulfonic acid (PFBS)	EPA 533	1
Perfluorobutanoic acid (PFBA)	EPA 533	1
Perfluorodecanoic acid (PFDA)	EPA 533	1
Perfluorododecanoic acid (PFDoA)	EPA 533	1
Perfluoroheptane sulfonic acid (PFHpS)	EPA 533	1
Perfluoroheptanoic acid (PFHpA)	EPA 533	1
Perfluorohexane sulfonic acid (PFHxS)	EPA 533	1
Perfluorohexanoic acid (PFHxA)	EPA 533	1
Perfluorononanoic acid (PFNA)	EPA 533	1
Perfluorooctane sulfonic acid (PFOS)	EPA 533	1
Perfluorooctanoic acid (PFOA)	EPA 533	1
Perfluoropentane sulfonic acid (PFPeS)	EPA 533	1
Perfluoropentanoic acid (PFPeA)	EPA 533	1
Perfluoroundecanoic acid (PFUnA)	EPA 533	1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)	EPA 537.1 revision 2 (3/20)	1
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	EPA 537.1 revision 2 (3/20)	1
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS)	EPA 537.1 revision 2 (3/20)	1
Hexafluoropropylene oxide dimer acid (HFPO-DA)	EPA 537.1 revision 2 (3/20)	1
N-Ethylperfluorooctane sulfonamido acetic acid (NEtFOSAA)	EPA 537.1 revision 2 (3/20)	1
N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)	EPA 537.1 revision 2 (3/20)	1
Perfluorobutane sulfonic acid (PFBS)	EPA 537.1 revision 2 (3/20)	1
Perfluorodecanoic acid (PFDA)	EPA 537.1 revision 2 (3/20)	1
Perfluorododecanoic acid (PFDoA)	EPA 537.1 revision 2 (3/20)	1
Perfluoroheptanoic acid (PFHpA)	EPA 537.1 revision 2 (3/20)	1
Perfluorohexane sulfonic acid (PFHxS)	EPA 537.1 revision 2 (3/20)	1
Perfluorohexanoic acid (PFHxA)	EPA 537.1 revision 2 (3/20)	1
Perfluorononanoic acid (PFNA)	EPA 537.1 revision 2 (3/20)	1
Perfluorooctane sulfonic acid (PFOS)	EPA 537.1 revision 2 (3/20)	1
Perfluorooctanoic acid (PFOA)	EPA 537.1 revision 2 (3/20)	1
Perfluorotetradecanoic acid (PFTeDA)	EPA 537.1 revision 2 (3/20)	1

Matrix/ Analyte	Method	Note
Drinking Water		
Perfluorotridecanoic acid (PFTrDA)	EPA 537.1 revision 2 (3/20)	1
Perfluoroundecanoic acid (PFUnA)	EPA 537.1 revision 2 (3/20)	1
Anatoxin-a	EPA 545	1
Cylindrospermopsin	EPA 545	1
Endothall	EPA 548.1 1 1992	1
Heterotrophic Bacteria	SM 9215 B (PCA)	1
Total coliforms-count	SM 9221 B	1
E.coli-count	SM 9221 B+F (LTB/EC Mug)	1
E.coli-count	SM 9221 B+F+C (LTB/BGB/EC Mug-MPN)	1
Fecal coliform-count	SM 9221 E1 (EC)	1
Total coli/E.coli - detect	SM 9223 B Colilert 18® (PA)	1
E.coli-count	SM 9223 B Colilert 18® QTray®	1
Total coliforms-count	SM 9223 B Colilert 18® QTray®	1
Total coli/E.coli - detect	SM 9223 B Colilert® 24 (PA)	1
E.coli-count	SM 9223 B Colilert® 24 QTray®	1
Total coliforms-count	SM 9223 B Colilert® 24 QTray®	1
Total coli/E.coli - detect	SM 9223 B Colisure® (PA)	1
Enterococci	SM 9230 D Enterolert®	1
Microcystins	EPA 546	1

Accredited Parameter Note Detail

(1) Accreditation based in part on recognition of Utah Department of Health NELAP accreditation. (2) Not to be used for regulatory purposes due to short holding time. (3) Provisional accreditation pending submittal of acceptable Proficiency Testing (PT) results (WAC 173-50-110).



Authentication Signature
Rebecca Wood, Lab Accreditation Unit Supervisor

03/17/2026

Date

Parameters Not Accredited

Eurofins Pomona

Pomona, CA

Analyte	Method	Notes	Matrix
Silica	SM 4500-SiO2 C-2011	a	D
Total/Fecal coli - detect	SM 9221 B (LTB) + E1 (EC)	a	D
Total coli/E.coli - detect	SM 9221 B+F (LTB/BGB/EC MUG-PA)	a	D

Denied Parameter Accreditation Footnotes

a) Withdrawn at laboratory request.

Matrix Definitions

A = Air
D = Drinking Water
N = Non-Potable Water
S = Solid and Chemical Materials

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 488 • Manchester, WA 98353-0488 • (360) 871-8840

March 17, 2026

Kathryn Chang
Eurofins Pomona
941 Corporate Center Drive
Pomona, CA 91768

Dear Kathryn Chang:

Thank you for your request to update your Washington Accreditation. Attached is an updated Scope of Accreditation effective 3/17/2026.

Accreditation for SM 4500-CN^- F-2011 in Drinking Water has been updated from Cyanide to Free Cyanide at your request supported by your current Utah NELAP accreditation. In recognition of the acceptable PTs for Total Cyanide this method in the past year, the parameter's Provisional status was also lifted. Please ensure your PTs for this method cite Free Cyanide going forward.

Accreditation for Silica by SM 4500-SiO2 C-201, in Drinking Water was Withdrawn at your request

No other changes have been made to your scope of accreditation at this time.

Based on your laboratory's most recent PT Study results, full accreditation is warranted for all applicable parameters. As a reminder, continued participation in the Ecology Lab Accreditation Program requires the lab to:

- Submit a renewal application and fees annually
- Report significant changes in facility, personnel, analytical methods, equipment, the lab's quality assurance (QA) manual or QA procedures as they occur
- **Participate in proficiency testing studies semi-annually, with the following exception**: **For each parameter where all PT results were satisfactory, you are required to submit only one PT result over this next year, and in subsequent years, as long as the results are satisfactory.**
- Submit copies of current third-party Scopes of Accreditation when they are available.

If you have any questions concerning the accreditation of your lab, please contact Ryan Zboralski at 360-764-9364, fax (360) 871-8849, or by e-mail at rzbo461@ecy.wa.gov.

Sincerely,

Rebecca Wood
Lab Accreditation Unit Supervisor

The State of Washington Department of Ecology

Eurofins Spokane

Spokane Valley, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation.

This certificate is effective 1/7/2026 and shall expire 1/6/2027.

Witnessed under my hand on 2/4/2026.

Rebecca Wood
Lab Accreditation Unit Supervisor

Laboratory ID
C569

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

SCOPE OF ACCREDITATION

Eurofins Spokane

Spokane Valley, WA

is accredited for the analytes listed below using the methods indicated. Full accreditation is granted unless stated otherwise in a note. EPA is the U.S. Environmental Protection Agency. SM is "Standard Methods for the Examination of Water and Wastewater." SM refers to EPA approved method versions. ASTM is the American Society for Testing and Materials. USGS is the U.S. Geological Survey. AOAC is the Association of Official Analytical Chemists. Other references are described in notes.

Matrix/ Analyte	Method	Note
Drinking Water		
Turbidity	EPA 180.1 2 1993	
Chloride	EPA 300.0 2.1 1993	
Fluoride	EPA 300.0 2.1 1993	
Nitrate as N	EPA 300.0 2.1 1993	
Nitrite as N	EPA 300.0 2.1 1993	
Sulfate	EPA 300.0 2.1 1993	
Color	SM 2120 B-2011	
Specific Conductance	SM 2510 B-2011	
Solids, Total Dissolved	SM 2540 C-2015	
Total coli/E.coli - detect	SM 9223 B Colilert® 24 (PA)	
Non-Potable Water		
Specific Conductance	EPA 120.1 1982	1
non-Polar Extractable Material (TPH)	EPA 1664B (SGT-HEM)	1
n-Hexane Extractable Material (O&G)	EPA 1664B -10 (HEM)	1
Turbidity	EPA 180.1 2 1993	1
Phosphorus, Total	EPA 200.7 4.4 1994	1
Chloride	EPA 300.0 2.1 1993	1
Fluoride	EPA 300.0 2.1 1993	1
Nitrate as N	EPA 300.0 2.1 1993	1
Nitrite as N	EPA 300.0 2.1 1993	1
Sulfate	EPA 300.0 2.1 1993	1
Orthophosphate as P	EPA 365.1 2 1993	1
Color	SM 2120 B-2011	1
Alkalinity	SM 2320 B-2011	1
Hardness (calc.)	SM 2340 B-2011	1
Specific Conductance	SM 2510 B-2011	1
Solids, Total Dissolved	SM 2540 C-2015	1
Solids, Total Suspended	SM 2540 D-2015	1
pH	SM 4500-H+ B-2011	1
Dissolved Oxygen	SM 4500-O G-2016	1
Phosphorus, total	SM 4500-P E-2011	1
Biochemical Oxygen Demand (BOD)	SM 5210 B-2016	1
Carbonaceous BOD (CBOD)	SM 5210 B-2016	1
Aluminum	EPA 200.7 4.4 1994	1,2

Matrix/ Analyte	Method	Note
Non-Potable Water		
Antimony	EPA 200.7 4.4 1994	1
Arsenic	EPA 200.7 4.4 1994	1
Barium	EPA 200.7 4.4 1994	1
Beryllium	EPA 200.7 4.4 1994	1
Boron	EPA 200.7 4.4 1994	1
Cadmium	EPA 200.7 4.4 1994	1
Calcium	EPA 200.7 4.4 1994	1
Chromium	EPA 200.7 4.4 1994	1
Cobalt	EPA 200.7 4.4 1994	1
Copper	EPA 200.7 4.4 1994	1
Iron	EPA 200.7 4.4 1994	1,2
Lead	EPA 200.7 4.4 1994	1
Magnesium	EPA 200.7 4.4 1994	1
Manganese	EPA 200.7 4.4 1994	1
Molybdenum	EPA 200.7 4.4 1994	1
Nickel	EPA 200.7 4.4 1994	1
Potassium	EPA 200.7 4.4 1994	1
Selenium	EPA 200.7 4.4 1994	1
Silver	EPA 200.7 4.4 1994	1
Sodium	EPA 200.7 4.4 1994	1
Thallium	EPA 200.7 4.4 1994	1
Tin	EPA 200.7 4.4 1994	1
Vanadium	EPA 200.7 4.4 1994	1
Zinc	EPA 200.7 4.4 1994	1
Mercury	EPA 245.1 3 1994	1
Gasoline range organics (GRO)	NWTPH-Gx (GC/MS)	1
Diesel range organics (DRO)	WDOE NWTPH-Dx (1997)	1
Solid and Chemical Materials		
pH	EPA 9045D 2002	1
Aluminum	EPA 6010D (7/14)	1
Antimony	EPA 6010D (7/14)	1
Arsenic	EPA 6010D (7/14)	1
Barium	EPA 6010D (7/14)	1
Beryllium	EPA 6010D (7/14)	1
Boron	EPA 6010D (7/14)	1
Cadmium	EPA 6010D (7/14)	1
Calcium	EPA 6010D (7/14)	1
Chromium	EPA 6010D (7/14)	1
Cobalt	EPA 6010D (7/14)	1
Copper	EPA 6010D (7/14)	1
Iron	EPA 6010D (7/14)	1
Lead	EPA 6010D (7/14)	1
Magnesium	EPA 6010D (7/14)	1
Manganese	EPA 6010D (7/14)	1
Molybdenum	EPA 6010D (7/14)	1
Nickel	EPA 6010D (7/14)	1
Potassium	EPA 6010D (7/14)	1
Selenium	EPA 6010D (7/14)	1
Silver	EPA 6010D (7/14)	1

Matrix/ Analyte	Method	Note
Solid and Chemical Materials		
Sodium	EPA 6010D (7/14)	1
Thallium	EPA 6010D (7/14)	1
Tin	EPA 6010D (7/14)	1
Vanadium	EPA 6010D (7/14)	1
Zinc	EPA 6010D (7/14)	1
Mercury	EPA 7470A 1 1994	1
Mercury	EPA 7471B (1/98)	1
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011-92	1
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8011-92	1
Aroclor-1016 (PCB-1016)	EPA 8082A (2/07)	1
Aroclor-1221 (PCB-1221)	EPA 8082A (2/07)	1
Aroclor-1232 (PCB-1232)	EPA 8082A (2/07)	1
Aroclor-1242 (PCB-1242)	EPA 8082A (2/07)	1
Aroclor-1248 (PCB-1248)	EPA 8082A (2/07)	1
Aroclor-1254 (PCB-1254)	EPA 8082A (2/07)	1
Aroclor-1260 (PCB-1260)	EPA 8082A (2/07)	1
Diesel range organics (DRO)	WDOE NWTPH-Dx (1997)	1
Motor Oil	WDOE NWTPH-Dx (1997)	1
1,1,1,2-Tetrachloroethane	EPA 8260D 4 (6/18)	1
1,1,1-Trichloroethane	EPA 8260D 4 (6/18)	1
1,1,2,2-Tetrachloroethane	EPA 8260D 4 (6/18)	1
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260D 4 (6/18)	1
1,1,2-Trichloroethane	EPA 8260D 4 (6/18)	1
1,1-Dichloroethane	EPA 8260D 4 (6/18)	1
1,1-Dichloroethylene	EPA 8260D 4 (6/18)	1
1,1-Dichloropropene	EPA 8260D 4 (6/18)	1
1,2,3-Trichlorobenzene	EPA 8260D 4 (6/18)	1
1,2,3-Trichloropropane	EPA 8260D 4 (6/18)	1
1,2,4-Trichlorobenzene	EPA 8260D 4 (6/18)	1
1,2,4-Trimethylbenzene	EPA 8260D 4 (6/18)	1
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260D 4 (6/18)	1
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260D 4 (6/18)	1
1,2-Dichlorobenzene	EPA 8260D 4 (6/18)	1
1,2-Dichloroethane (Ethylene dichloride)	EPA 8260D 4 (6/18)	1
1,2-Dichloropropane	EPA 8260D 4 (6/18)	1
1,3,5-Trimethylbenzene	EPA 8260D 4 (6/18)	1
1,3-Butadiene	EPA 8260D 4 (6/18)	1
1,3-Dichlorobenzene	EPA 8260D 4 (6/18)	1
1,3-Dichloropropane	EPA 8260D 4 (6/18)	1
1,4-Dichlorobenzene	EPA 8260D 4 (6/18)	1
2,2-Dichloropropane	EPA 8260D 4 (6/18)	1
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260D 4 (6/18)	1
2-Chlorotoluene	EPA 8260D 4 (6/18)	1
2-Hexanone	EPA 8260D 4 (6/18)	1
4-Chlorotoluene	EPA 8260D 4 (6/18)	1
4-Isopropyltoluene (p-Cymene)	EPA 8260D 4 (6/18)	1
4-Methyl-2-pentanone (MIBK)	EPA 8260D 4 (6/18)	1
Acetone	EPA 8260D 4 (6/18)	1
Allyl chloride (3-Chloropropene)	EPA 8260D 4 (6/18)	1
Benzene	EPA 8260D 4 (6/18)	1

Matrix/ Analyte	Method	Note
Solid and Chemical Materials		
Bromobenzene	EPA 8260D 4 (6/18)	1
Bromochloromethane	EPA 8260D 4 (6/18)	1
Bromodichloromethane	EPA 8260D 4 (6/18)	1
Bromoform	EPA 8260D 4 (6/18)	1
Carbon disulfide	EPA 8260D 4 (6/18)	1
Carbon tetrachloride	EPA 8260D 4 (6/18)	1
Chlorobenzene	EPA 8260D 4 (6/18)	1
Chlorodibromomethane	EPA 8260D 4 (6/18)	1
Chloroethane (Ethyl chloride)	EPA 8260D 4 (6/18)	1
Chloroform	EPA 8260D 4 (6/18)	1
cis-1,2-Dichloroethylene	EPA 8260D 4 (6/18)	1
cis-1,3-Dichloropropene	EPA 8260D 4 (6/18)	1
Cyclohexane	EPA 8260D 4 (6/18)	1
Dibromomethane	EPA 8260D 4 (6/18)	1
Dichlorodifluoromethane (Freon-12)	EPA 8260D 4 (6/18)	1
Dichlorofluoromethane (Freon 21)	EPA 8260D 4 (6/18)	1
Diethyl ether	EPA 8260D 4 (6/18)	1
Ethyl methacrylate	EPA 8260D 4 (6/18)	1
Ethylbenzene	EPA 8260D 4 (6/18)	1
Hexachlorobutadiene	EPA 8260D 4 (6/18)	1
Iodomethane (Methyl iodide)	EPA 8260D 4 (6/18)	1
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260D 4 (6/18)	1
Isopropylbenzene	EPA 8260D 4 (6/18)	1
m+p-xylene	EPA 8260D 4 (6/18)	1
Methyl acetate	EPA 8260D 4 (6/18)	1
Methyl bromide (Bromomethane)	EPA 8260D 4 (6/18)	1
Methyl chloride (Chloromethane)	EPA 8260D 4 (6/18)	1
Methyl tert-butyl ether (MTBE)	EPA 8260D 4 (6/18)	1
Methylcyclohexane	EPA 8260D 4 (6/18)	1
Methylene chloride (Dichloromethane)	EPA 8260D 4 (6/18)	1
Naphthalene	EPA 8260D 4 (6/18)	1
n-Butylbenzene	EPA 8260D 4 (6/18)	1
n-Heptane	EPA 8260D 4 (6/18)	1
n-Hexane	EPA 8260D 4 (6/18)	1
n-Propylbenzene	EPA 8260D 4 (6/18)	1
o-Xylene	EPA 8260D 4 (6/18)	1
sec-Butylbenzene	EPA 8260D 4 (6/18)	1
Styrene	EPA 8260D 4 (6/18)	1
tert-Butyl alcohol	EPA 8260D 4 (6/18)	1
tert-Butylbenzene	EPA 8260D 4 (6/18)	1
Tetrachloroethylene (Perchloroethylene)	EPA 8260D 4 (6/18)	1
Tetrahydrofuran (THF)	EPA 8260D 4 (6/18)	1
Toluene	EPA 8260D 4 (6/18)	1
trans-1,2-Dichloroethylene	EPA 8260D 4 (6/18)	1
trans-1,3-Dichloropropylene	EPA 8260D 4 (6/18)	1
trans-1,4-Dichloro-2-butene	EPA 8260D 4 (6/18)	1
Trichloroethene (Trichloroethylene)	EPA 8260D 4 (6/18)	1
Trichlorofluoromethane (Freon 11)	EPA 8260D 4 (6/18)	1
Vinyl chloride	EPA 8260D 4 (6/18)	1
Xylene (total)	EPA 8260D 4 (6/18)	1

Matrix/ Analyte	Method	Note
Solid and Chemical Materials		
1-Methylnaphthalene	EPA 8270E 6 (6/18)	1
2-Methylnaphthalene	EPA 8270E 6 (6/18)	1
Acenaphthene	EPA 8270E 6 (6/18)	1
Acenaphthylene	EPA 8270E 6 (6/18)	1
Anthracene	EPA 8270E 6 (6/18)	1
Benzo(a)anthracene	EPA 8270E 6 (6/18)	1
Benzo(a)pyrene	EPA 8270E 6 (6/18)	1
Benzo(g,h,i)perylene	EPA 8270E 6 (6/18)	1
Benzo(k)fluoranthene	EPA 8270E 6 (6/18)	1
Benzo[b]fluoranthene	EPA 8270E 6 (6/18)	1
Chrysene	EPA 8270E 6 (6/18)	1
Dibenz(a,h) anthracene	EPA 8270E 6 (6/18)	1
Fluoranthene	EPA 8270E 6 (6/18)	1
Fluorene	EPA 8270E 6 (6/18)	1
Indeno(1,2,3-cd) pyrene	EPA 8270E 6 (6/18)	1
Naphthalene	EPA 8270E 6 (6/18)	1
Phenanthrene	EPA 8270E 6 (6/18)	1
Pyrene	EPA 8270E 6 (6/18)	1
Gasoline range organics (GRO)	WDOE NWTPH-Gx (1997)	1

Accredited Parameter Note Detail

(1) Accreditation based in part on recognition of the Lab ORELAP accreditation.(2) Provisional accreditation pending submittal of acceptable Proficiency Testing (PT) results (WAC 173-50-110). (4) Provisional accreditation pending submittal of acceptable corrective action report.

Rebecca Wood

Authentication Signature
Rebecca Wood, Lab Accreditation Unit Supervisor

02/04/2026

Date

Appendix B. Geosyntec Field Data Sheets

PUMPING TEST DATA FORM - PUMPING WELL

Well ID: _____ **Project Number:** _____
Test Date: _____ **Project Name:** _____
Start Time: _____ **Type of Test:** _____
Flow Measurement: _____ **Contractor:** _____
Static Water Level: _____ **Observer:** _____
Measurement Point: _____
M.P. Length: _____ *(positive value = above ground; negative values = below ground)*

Date	Time	Totalizer Reading (gallons)	Instantaneous Reading (gpm)	Depth to Water (feet bmp)	Notes

PUMPING TEST DATA FORM - OBSERVATION WELL

Observation Well ID: _____ **Project Number:** _____
Test Date: _____ **Project Name:** _____
Start Time: _____ **Contractor:** _____
Static Water Level: _____ **Observer:** _____
Measurement Point: _____
M.P. Length: _____ *(positive value = above ground; negative values = below ground)*
Pumping Well ID: _____

Date	Time	Depth to Water (feet bmp)	Notes

WATER QUALITY FIELD PARAMETERS

Well ID: _____ **Project Number:** _____

Observer: _____ **Project Name:** _____

Measurement Point: _____ **Date:** _____

Static Water Level: _____ **Weather:** _____

Measuring Device(s): _____

Time	Depth to Water (ft bmp)	Temp. (deg C)	pH (s.u.)	Specific Conductance (uS/cm)	Turbidity (NTU)	ORP (mV)	Dissolved Oxygen (mg/L)	Notes

Appendix C. Glossaries, Acronyms, and Abbreviations

Glossary of General Terms

Ambient: Background or away from point sources of contamination. Surrounding environmental condition.

Baseflow: The component of total streamflow that originates from direct groundwater discharges to a stream.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Dissolved oxygen (DO): A measure of the amount of oxygen dissolved in water.

Margin of safety: Required component of TMDLs that accounts for uncertainty about the relationship between pollutant loads and quality of the receiving water body.

pH: A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Sediment: Soil and organic matter that is covered with water (for example, river or lake bottom).

Total suspended solids (TSS): Portion of solids retained by a filter.

Turbidity: A measure of water clarity. High levels of turbidity can have a negative impact on aquatic life.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Acronyms and Abbreviations

DO	Dissolved oxygen
DOC	Dissolved organic carbon
e.g.	For example
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency

et al.	And others
FC	Fecal coliform
FSO	Full scale output
GIS	Geographic Information System software
GPS	Global Positioning System
i.e.	In other words
MEL	Manchester Environmental Laboratory
MQO	Measurement quality objective
NAF	New Approximation Flow
NPDES	National Pollutant Discharge Elimination System
NSDZ	Near-stream disturbance zones
NTR	National Toxics Rule
PBDE	Polybrominated diphenyl ethers
PBT	Persistent, bioaccumulative, and toxic substance
PCB	Polychlorinated biphenyls
QA	Quality assurance
QC	Quality control
RM	River mile
RPD	Relative percent difference
RSD	Relative standard deviation
SOP	Standard operating procedures
SRM	Standard reference materials
TIR	Thermal infrared radiation
TMDL	Total Maximum Daily Load

TOC	Total organic carbon
TSS	Total suspended solids
USFS	United States Forest Service
USGS	United States Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQA	Water Quality Assessment
WRIA	Water Resource Inventory Area
WSTMP	Washington State Toxics Monitoring Program
WWTP	Wastewater treatment plant

Acronyms and Abbreviations specific to this document

ASR	Aquifer Storage and Recovery
Bgs	below ground surface
BTEX	benzene/toluene/ethylbenzene/xylene
CRBG	Columbia River Basalt Group
CBOD	Carbonaceous Biochemical Oxygen Demand
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
GPS	Global Positioning System
GW	Groundwater
GWSC	Groundwater Subcommittee
MDL	Method Detection Limit
MOU	Memorandum of Understanding
MSDS	Material Safety Data Sheet
N	Nitrogen

NTU	nephelometric turbidity unit
NPDES	National Pollutant Discharge Elimination System
OCR	Office of Columbia River
ORP	Oxidation-reduction potential
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PFAS	per-and poly-fluorinated hydrocarbons
RL	Reporting Limit
Roza	Roza Irrigation District
RPD	Relative Percent Difference
SD	Standard Deviation
SOP	Standard Operating Procedure
S.u.	standard units
SVOCs	synthetic/semivolatile organic compounds
SW	Surface Water
TP	Total Phosphorus
TSS	Total Suspended Solids
USGS	United States Geological Survey
VOCs	volatile organic compounds

Units of Measurement

°C	degrees centigrade
cfs	cubic feet per second
cfu	colony forming units

cms	cubic meters per second, a unit of flow
dw	dry weight
ft	feet
g	gram, a unit of mass
kcfs	1000 cubic feet per second
kg	kilograms, a unit of mass equal to 1,000 grams
kg/d	kilograms per day
km	kilometer, a unit of length equal to 1,000 meters
L/s	liters per second (0.03531 cubic foot per second)
m	meter
mm	millimeter
mg	milligram
mgd	million gallons per day
mg/d	milligrams per day
mg/kg	milligrams per kilogram (parts per million)
mg/L	milligrams per liter (parts per million)
mg/L/hr	milligrams per liter per hour
mL	milliliter
mmol	millimole or one-thousandth of a mole
mole	an International System of Units (IS) unit of matter
ng/g	nanograms per gram (parts per billion)
ng/kg	nanograms per kilogram (parts per trillion)
ng/L	nanograms per liter (parts per trillion)
NTU	nephelometric turbidity units

pg/g picograms per gram (parts per trillion)

pg/L picograms per liter (parts per quadrillion)

psu practical salinity units

s.u. standard units

µg/g micrograms per gram (parts per million)

µg/kg micrograms per kilogram (parts per billion)

µg/L micrograms per liter (parts per billion)

µm micrometer

µM micromolar (a chemistry unit)

µmhos/cm micromhos per centimeter

µS/cm microsiemens per centimeter, a unit of conductivity

ww wet weight

Quality Assurance Glossary

Accreditation: A certification process for laboratories, designed to evaluate and document a lab's ability to perform analytical methods and produce acceptable data (Kammin, 2010). For Ecology, it is defined according to WAC 173-50-040: "Formal recognition by [Ecology] that an environmental laboratory is capable of producing accurate and defensible analytical data."

Accuracy: The degree to which a measured value agrees with the true value of the measured property. USEPA recommends that this term not be used, and that the terms *precision* and *bias* be used to convey the information associated with the term *accuracy* (USEPA, 2014).

Analyte: An element, ion, compound, or chemical moiety (pH, alkalinity) which is to be determined. The definition can be expanded to include organisms, e.g., fecal coliform, Klebsiella (Kammin, 2010).

Bias: Discrepancy between the expected value of an estimator and the population parameter being estimated (Gilbert, 1987; USEPA, 2014).

Blank: A synthetic sample, free of the analyte(s) of interest. For example, in water analysis, pure water is used for the blank. In chemical analysis, a blank is used to estimate the analytical response to all factors other than the analyte in the sample. In general, blanks are used to assess possible contamination or inadvertent introduction of analyte during various stages of the sampling and analytical process (USGS, 1998).

Calibration: The process of establishing the relationship between the response of a measurement system and the concentration of the parameter being measured (Ecology, 2004).

Check standard: A substance or reference material obtained from a source independent from the source of the calibration standard; used to assess bias for an analytical method. This is an obsolete term, and its use is highly discouraged. See Calibration Verification Standards, Lab Control Samples (LCS), Certified Reference Materials (CRM), and/or spiked blanks. These are all check standards but should be referred to by their actual designator, e.g., CRM, LCS (Kammin, 2010; Ecology, 2004).

Comparability: The degree to which different methods, data sets and/or decisions agree or can be represented as similar; a data quality indicator (USEPA, 2014; USEPA, 2020).

Completeness: The amount of valid data obtained from a project compared to the planned amount. Usually expressed as a percentage. A data quality indicator (USEPA, 2014; USEPA 2020).

Continuing Calibration Verification Standard (CCV): A quality control (QC) sample analyzed with samples to check for acceptable bias in the measurement system. The CCV is usually a midpoint calibration standard that is re-run at an established frequency during the course of an analytical run (Kammin, 2010).

Control chart: A graphical representation of quality control results demonstrating the performance of an aspect of a measurement system (Kammin, 2010; Ecology 2004).

Control limits: Statistical warning and action limits calculated based on control charts. Warning limits are generally set at +/- 2 standard deviations from the mean, action limits at +/- 3 standard deviations from the mean (Kammin, 2010).

Data integrity: A qualitative DQI that evaluates the extent to which a data set contains data that is misrepresented, falsified, or deliberately misleading (Kammin, 2010).

Data quality indicators (DQI): Commonly used measures of acceptability for environmental data. The principal DQIs are precision, bias, representativeness, comparability, completeness, sensitivity, and integrity (USEPA, 2006).

Data quality objectives (DQO): Qualitative and quantitative statements derived from systematic planning processes that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions (USEPA, 2006).

Data set: A grouping of samples organized by date, time, analyte, etc. (Kammin, 2010).

Data validation: The process of determining that the data satisfy the requirements as defined by the data user (USEPA, 2020). There are various levels of data validation (USEPA, 2009).

Data verification: Examination of a data set for errors or omissions, and assessment of the Data Quality Indicators related to that data set for compliance with acceptance criteria (MQOs). Verification is a detailed quality review of a data set (Ecology, 2004).

Detection limit (limit of detection)**:** The concentration or amount of an analyte which can be determined to a specified level of certainty to be greater than zero (Ecology, 2004).

Duplicate samples: Two samples taken from and representative of the same population, and carried through and steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variability of all method activities including sampling and analysis (USEPA, 2014).

Field blank: A blank used to obtain information on contamination introduced during sample collection, storage, and transport (Ecology, 2004).

Initial Calibration Verification Standard (ICV): A QC sample prepared independently of calibration standards and analyzed along with the samples to check for acceptable bias in the measurement system. The ICV is analyzed prior to the analysis of any samples (Kammin, 2010).

Laboratory Control Sample (LCS)/LCS duplicate: A sample of known composition prepared using contaminant-free water or an inert solid that is spiked with analytes of interest at the midpoint of the calibration curve or at the level of concern. It is prepared and analyzed in the same batch of regular samples using the same sample preparation method, reagents, and analytical methods employed for regular samples. Monitors a lab's performance for bias and precision (USEPA, 2014).

Matrix spike/Matrix spike duplicate: A QC sample prepared by adding a known amount of the target analyte(s) to an aliquot of a sample to check for bias and precision errors due to interference or matrix effects (Ecology, 2004).

Measurement Quality Objectives (MQOs)**:** Performance or acceptance criteria for individual data quality indicators, usually including precision, bias, sensitivity, completeness, comparability, and representativeness (USEPA, 2006).

Measurement result: A value obtained by performing the procedure described in a method (Ecology, 2004).

Method: A formalized group of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, data analysis), systematically presented in the order in which they are to be executed (USEPA, 2001).

Method blank: A blank prepared to represent the sample matrix, prepared and analyzed with a batch of samples. A method blank will contain all reagents used in the preparation of a sample, and the same preparation process is used for the method blank and samples (Ecology, 2004; Kammin, 2010).

Method Detection Limit (MDL): The minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results (USEPA, 2016). MDL is a measure of the capability of an analytical method of distinguished samples that do not contain a specific analyte from a sample that contains a low concentration of the analyte (USEPA, 2020).

Minimum level: Either the sample concentration equivalent to the lowest calibration point in a method or a multiple of the method detection limit (MDL), whichever is higher. For the purposes of NPDES compliance monitoring, EPA considers the following terms to be synonymous: "quantitation limit," "reporting limit," and "minimum level" (40 CFR 136).

Parameter: A specified characteristic of a population or sample. Also, an analyte or grouping of analytes. Benzene and nitrate + nitrite are all parameters (Kammin, 2010; Ecology, 2004).

Population: The hypothetical set of all possible observations of the type being investigated (Ecology, 2004).

Precision: The extent of random variability among replicate measurements of the same property; a data quality indicator (USGS, 1998).

Quality assurance (QA): A set of activities designed to establish and document the reliability and usability of measurement data (Kammin, 2010).

Quality Assurance Project Plan (QAPP): A document that describes the objectives of a project, and the processes and activities necessary to develop data that will support those objectives (Kammin, 2010; Ecology, 2004).

Quality control (QC): The routine application of measurement and statistical procedures to assess the accuracy of measurement data (Ecology, 2004).

Relative Percent Difference (RPD): RPD is commonly used to evaluate precision. The following formula is used:

$$RPD = \frac{Abs(a-b)}{(a+b)/2} * 100\%$$

where "Abs()" is absolute value and a and b are results for the two replicate samples. RPD can be used only with 2 values. Percent Relative Standard Deviation is (%RSD) is used if there are results for more than 2 replicate samples (Ecology, 2004).

Relative Standard Deviation (RSD): A statistic used to evaluate precision in environmental analysis. It is determined in the following manner:

$$RSD = 100\% * s/x$$

where s is the sample standard deviation and x is the mean of results from more than two replicate samples (Kammin, 2010).

Replicate samples: Two or more samples taken from the environment at the same time and place, using the same protocols. Replicates are used to estimate the random variability of the material sampled (USGS, 1998).

Reporting level: Unless specified otherwise by a regulatory authority or in a discharge permit, results for analytes that meet the identification criteria (i.e., rules for determining qualitative presence/absence of an analyte) are reported down to the concentration of the minimum level established by the laboratory through calibration of the instrument. EPA considers the terms "reporting limit," "quantitation limit," and "minimum level" to be synonymous (40 CFR 136).

Representativeness: The degree to which a sample reflects the population from which it is taken; a data quality indicator (USGS, 1998).

Sample (field): A portion of a population (environmental entity) that is measured and assumed to represent the entire population (USGS, 1998).

Sample (statistical): A finite part or subset of a statistical population (USEPA, 1992).

Sensitivity: In general, denotes the rate at which the analytical response (e.g., absorbance, volume, meter reading) varies with the concentration of the parameter being determined. In a specialized sense, it has the same meaning as the detection limit (Ecology, 2004).

Spiked blank: A specified amount of reagent blank fortified with a known mass of the target analyte(s); usually used to assess the recovery efficiency of the method (USEPA, 2014).

Spiked sample: A sample prepared by adding a known mass of target analyte(s) to a specified amount of matrix sample for which an independent estimate of target analyte(s) concentration is available. Spiked samples can be used to determine the effect of the matrix on a method's recovery efficiency (USEPA, 2014).

Split sample: A discrete sample subdivided into portions, usually duplicates (Kammin, 2010).

Standard Operating Procedure (SOP): A document which describes in detail a reproducible and repeatable organized activity (Kammin, 2010).

Surrogate: For environmental chemistry, a surrogate is a substance with properties similar to those of the target analyte(s). Surrogates are unlikely to be native to environmental samples. They are added to environmental samples for quality control purposes, to track extraction efficiency and/or measure analyte recovery. Deuterated organic compounds are examples of surrogates commonly used in organic compound analysis (Kammin, 2010).

Systematic planning: A step-wise process which develops a clear description of the goals and objectives of a project, and produces decisions on the type, quantity, and quality of data that

will be needed to meet those goals and objectives. The DQO process is a specialized type of systematic planning (USEPA, 2006).

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QAPP_RozaPilotTest

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