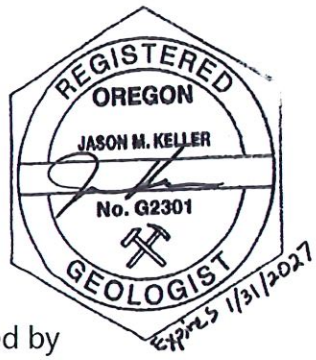
WALLA WALLA BASIN
WATERSHED COUNCIL

Artificial Groundwater Recharge Testing

Supporting Materials for Limited License Application LL-1970

Submitted September 2026

Walla Walla Basin Watershed Council (WWBWC)
Hudson Bay District Improvement Company (HBDIC)
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1.0 Introduction, Program Goal, and Objectives

This document was prepared to satisfy the requirements of OAR 690-350-0120(3)(c) (Purpose of Recharge) and OAR 690-350-0120(3)(g) (Project Description Report) in support of Limited License application LL-1970 for artificial groundwater recharge (AR) testing. The program will be administered and managed by the Walla Walla Basin Watershed Council (WWBWC) and the Hudson Bay District Improvement Company (HBDIC).

The proposed AR testing includes seven recharge sites in the Walla Walla Basin of northeastern Oregon, all served by the HBDIC canal system: Anspach, Barrett, Gallagher, Johnson, NW Umapine, Ringer Road, and Trumbull (Figure 1). All seven sites have been previously established and operated under Oregon limited license authorization. LL-1970 will authorize continued testing at these sites.

A separate Bypass Flow Monitoring Plan, approved by ODFW and OWRD, describes how WWBWC and HBDIC will monitor and manage diversions to protect instream flows in the Walla Walla River during AR testing.

1.1 Program Goal and Measurable Objective

The goal of artificial groundwater recharge testing under LL-1970 is to seasonally raise the alluvial aquifer water table in the vicinity of recharge sites within the Little Walla Walla alluvial fan. This is expected to provide seasonal benefits to alluvial aquifer users, including increased well yields and spring branch flow for rural domestic, irrigation, and other uses from the alluvial groundwater and spring branch system.

The measurable objective is to seasonally augment portions of the alluvial aquifer system, with the effect evaluated at 15 monitoring locations (13 wells and two springs). The monitoring approach and data analysis methods are described in Chapter 4.

1.2 Document Contents

This document includes the following:

- A summary of surface water hydrology, aquatic resources, and groundwater/surface-water interactions relevant to the AR program (Chapter 2)
- Descriptions of the AR sites included in LL-1970 (Chapter 3)
- The proposed monitoring plan (Chapter 4), including diversion monitoring, hydrologic response monitoring, and water quality monitoring. Following each recharge season, WWBWC will submit an annual report documenting diverted water volumes, observed

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water level and spring discharge changes relative to October baseline conditions, water quality results, and bypass flow compliance.

Site designs, construction records, and standard operating procedures for field sampling are available upon request.

2.0 Hydrologic Setting and Resource Context

2.1 Surface Hydrology

The Walla Walla River system is a bi-state watershed located in northeast Oregon and southeast Washington. At Milton Freewater, the Walla Walla River flows from the Blue Mountains and historically divided into a distributary stream system across a large alluvial fan (La Marche and Stratton Garvin, 2025). Today the river and its distributaries are controlled and channelized. Flow onto the upper alluvial fan is controlled by a gated diversion from the Walla Walla River into the Little Walla Walla River, which distributes water through an extensively modified network of distributary channels, irrigation ditches, and pipelines.

Annual diversions into the distributary system have declined from the 1930s, when they exceeded 90,000 acre-feet per year, to approximately 43,000 acre-feet per year under current conditions (La Marche and Stratton Garvin, 2025). The authors note that infrastructure changes, including canal piping, and reduced diversion volumes have both contributed to changes in the volume of channel seepage reaching the alluvial aquifer.

2.2 Hydrogeology and Groundwater/Surface-Water Interactions

Groundwater in the Walla Walla Basin occurs in two principal aquifer systems: (1) the unconfined to confined alluvial aquifer system, and (2) the underlying confined basalt aquifer system (Newcomb, 1965). The alluvial aquifer system is the focus of the AR program because of its high degree of hydraulic connection with streams on the valley floor.

Long-term OWRD and USGS observation well data from several locations in the alluvial aquifer system show October static groundwater levels have declined 4-19 feet since the 1940s (OWRD, LL-1970 application review, 2026). The WWBWC 2013 Aquifer Recharge Strategic Plan identifies four contributing factors to aquifer decline: changes in management of the valley's distributary channels, channelization of the Walla Walla River, lining and increased efficiency of irrigation

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canals, and development of groundwater resources (WWBWC, 2013). Groundwater flow modeling estimated net annual aquifer storage loss at approximately 5,000 acre-feet per year under conditions at the time of the study and estimated that infiltration rates exceeding 20,000 acre-feet per year may be necessary to reverse long-term storage declines (GeoSystems Analysis Inc., 2016).

La Marche and Stratton Garvin (2025) document that distributary channels upgradient of the spring arc currently lose approximately 5.2 percent of flow per mile to the alluvial aquifer, equating to approximately 8,400 acre-feet per year of groundwater recharge from channel losses under current diversion volumes, compared to an estimated 18,000 or more acre-feet per year under 1930s diversion volumes.

The Walla Walla River alluvial fan is characterized by a well-defined, curvilinear spring arc approximately four miles downstream of the Little Walla Walla River diversion, historically mapped as at least 50 individual spring vents (Piper et al., 1935; Newcomb, 1965). La Marche and Stratton Garvin (2025) measured average annual discharge from the spring arc at approximately 25.0 cfs (18,100 acre-feet per year) for 2021 through 2023, compared to estimates of 41,000 to 50,000 acre-feet per year from the alluvial fan in studies conducted between the 1930s and 1970s (Piper et al., 1935; Newcomb, 1965; Barker and MacNish, 1976). La Marche and Stratton Garvin (2025) identify managed aquifer recharge projects as one of several contributing sources of groundwater recharge upgradient of the spring arc, alongside channel losses from the Walla Walla River mainstem and on-farm irrigation losses.

2.3 Aquatic Species and Instream Water Needs

The Walla Walla River supports ESA-listed aquatic species including Middle Columbia River steelhead, bull trout, and reintroduced spring Chinook salmon. The Walla Walla Water 2050 Strategic Plan identifies low streamflows as a primary constraint on fish recovery in the basin, noting that improving instream flows is a prerequisite for recovering ESA-listed species (Walla Walla Watershed Management Partnership, 2021). In the Oregon portion of the basin, HBDIC, in collaboration with WWBWC and state and federal funders, has completed irrigation efficiency and canal piping projects that have resulted in 12.4 cfs of completed instream water rights under Oregon's conserved water program, contributing to improved instream flows for ESA-listed species (Walla Walla Watershed Management Partnership, 2021, p. 40). La Marche and Stratton Garvin (2025) document that reduced diversion volumes and infrastructure changes have affected the volume of passive groundwater recharge reaching the alluvial aquifer through distributary channel seepage, as described in Section 2.2.

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AR testing under LL-1970 is designed to supplement alluvial aquifer recharge using Walla Walla River water available above the minimum biologically necessary instream flow targets. Diversions for AR testing will be made only when Walla Walla River flows at Nursery Bridge Dam meet or exceed those flow targets, as established in the Walla Walla River Bi-State Flow Study and recommended by the Oregon Department of Fish and Wildlife (ODFW) in its review of the LL-1970 application.

3.0 Artificial Groundwater Recharge Testing Sites

The seven active AR sites included in LL-1970 are all served by the HBDIC canal system, with the point of diversion at the Little Walla Walla Diversion on the Walla Walla River (Figure 1). The sites are listed in Table 1. Estimated recharge volumes and conveyance losses are listed in Table 2.

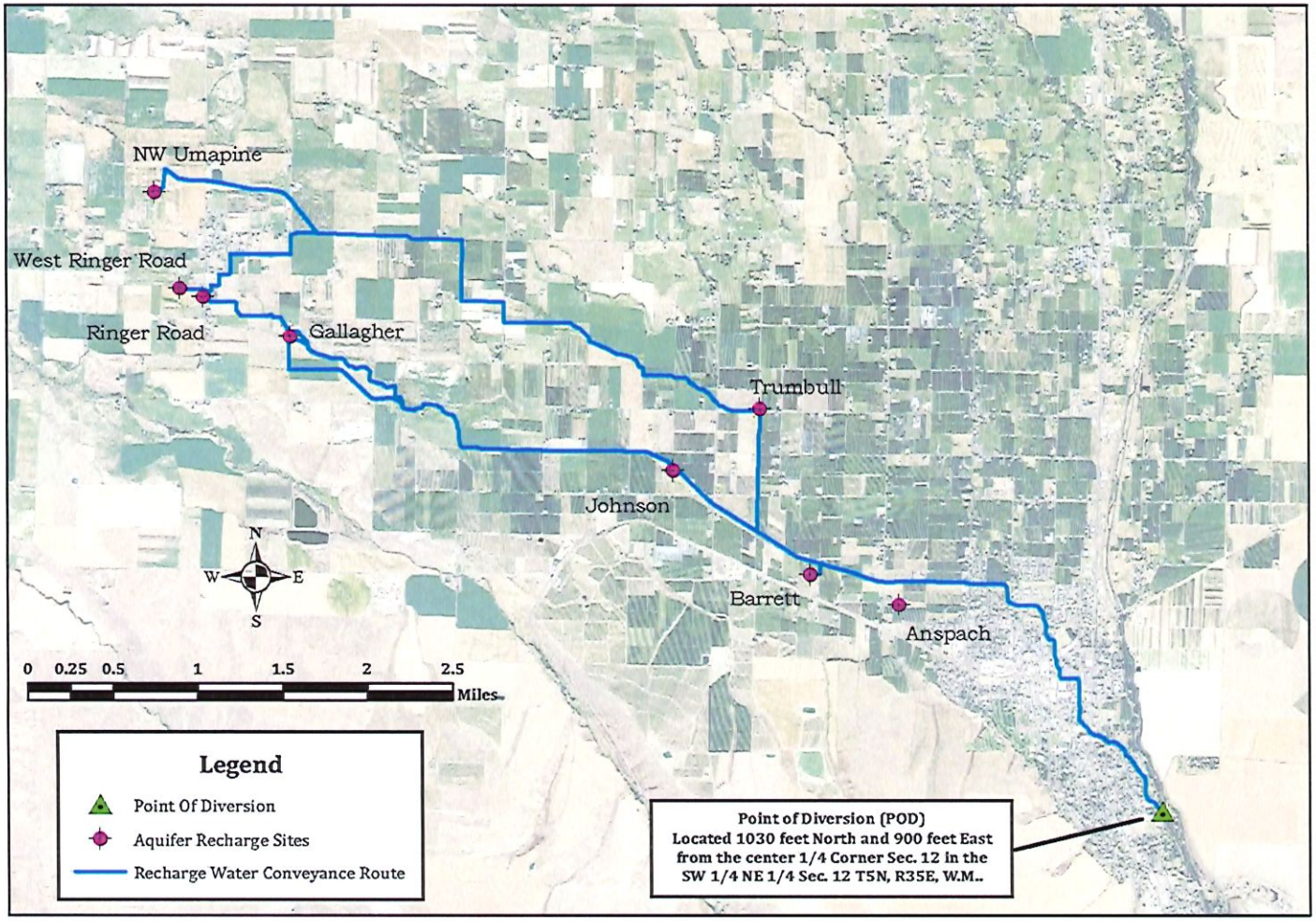
Table 1. Location and type of recharge testing sites.

Site Name	GPS Coordinates	Section, Township & Range	Taxlot	Site Type
Anspach	45.945540, -118.411043	NW ¼, NW ¼, Sec. 2, T5N, R35E	5N35020000200	2 Galleries
Barrett	45.948009, -118.421811	SW ¼, SE ¼, Sec. 34, T6N, R35E	5N3503A000400	Gallery
Gallagher	45.967832, -118.488055	NE ¼ & SW ¼ of Sec. 30, T6N, R35E	6N35300001800	Gallery & Basin
Johnson*	45.956758, -118.439294	SW ¼, NE ¼, Sec. 33, T6N, R35E*	6N3533A000900	Galleries & Basins
NW Umapine	45.979884, -118.503350	SW ¼, SE ¼, Sec. 24, T6N, R34E	6N34240000900	Basin
Ringer Road**	45.971370, -118.496996	SE ¼, NE ¼, Sec. 25, T6N, R34E	6N34250001801	2 Galleries
Trumbull	45.962171, -118.428849	SW ¼, SW ¼, Sec. 27, T6N, R35E	6N3527C001100	Gallery

**The Johnson site occupies both the SE and SW quarters of the NE ¼ of Section 33.*

*** Ringer and West Ringer Road sites are adjacent infiltration galleries operated as one site.*

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Point of Diversion, Aquifer Recharge Sites and Conveyance Routes

Figure 1. Map of the 7 aquifer recharge site locations, the point of diversion, and conveyance routes for proposed AR testing. Note: Ringer and West Ringer Road sites are adjacent infiltration galleries operated as one site.

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Table 2. Expected recharge rates, volumes, and conveyance losses.

Site Name	Expected Maximum Recharge Volume (ac-ft/year)	Expected Maximum Recharge Rate (cfs) (assumes a 120-day recharge season)	Calculated Conveyance Loss (assumes a 120-day recharge season)
Anspach	660	2.78	
Barrett	383	1.61	
Gallagher	16	0.1	
Johnson	4,500	19.1	
NW Umapine	499	2.09	
Ringer Road	111	0.46	
Trumbull	421	1.77	
Estimated Totals	6,590	27.91	1,179 ac-ft/120 days (5 cfs)
		Max Total Diversion	28+5=33 cfs

Anspach

The Anspach site consists of two infiltration galleries constructed in 2012 and 2015. Source water is diverted from the HBDIC White Ditch canal. HBDIC and WWBWC jointly manage the diversion. Monitoring wells GW_141 and GW_28 are associated with this site.

Barrett

The Barrett site is an infiltration gallery constructed in January 2014. Source water is delivered from the Barrett pipeline. HBDIC manages the diversion. Monitoring well GW_62 is associated with this site.

Gallagher

The Gallagher site has an infiltration gallery and basin. The site is connected to the HBDIC White Ditch. HBDIC and WWBWC jointly manage the diversion. Monitoring wells GW_66 and GW_119 are associated with this site.

Johnson

The Johnson site consists of 10 infiltration basins and three infiltration galleries, is the largest site in the program, and has run since 2004. Source water is delivered from the HBDIC White Ditch. HBDIC manages the basin operations, and WWBWC manages the galleries. Monitoring wells GW_40, GW_45, GW_46, GW_47, GW_48, GW_117, GW_118, GW_142, and GW_143 are

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associated with this site. Spring gage S-408 (Johnson Creek) monitors alluvial spring discharge downstream.

NW Umapine

The NW Umapine site is an infiltration basin constructed in 2013. Source water is diverted from the HBDIC Richartz pipeline. HBDIC manages the diversion. Monitoring wells GW_34 and GW_144 are associated with this site.

Ringer Road

The Ringer Road site consists of two infiltration galleries constructed in 2013 and 2018 (West Ringer Road and Ringer Road). Water is delivered via the HBDIC Richartz canal to Dugger Ditch. WWBWC manages diversion operations. Monitoring wells GW_66 and GW_119 are associated with this site.

Trumbull

The Trumbull site is an infiltration gallery constructed in late 2012 and operational since 2013. Source water is delivered via the HBDIC canal. HBDIC manages the diversion. Monitoring wells GW_142 and GW_143 are located down-gradient.

4.0 Monitoring Plan

Previous AR limited licenses in this program were evaluated primarily under a no-injury standard, with monitoring focused on confirming that recharge activities did not degrade groundwater quality and that diverted quantities were accurately measured and reported (OWRD, LL-1970 application review, 2026). Limited License LL-1970 adds a hydrologic response monitoring component designed to evaluate whether recharge operations produce measurable seasonal changes in groundwater levels and connected spring systems.

The monitoring plan is organized around three objectives:

- Diversion monitoring, which documents the volume of water delivered to each AR site and the total volume diverted from the Walla Walla River (Section 4.1)
- Hydrologic response monitoring, which uses groundwater level data and spring discharge measurements to evaluate whether recharge operations produce a detectable seasonal response in the alluvial aquifer (Section 4.2)

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- Water quality monitoring, which continues the program's established approach to confirming that recharge activities are not associated with degradation of native alluvial groundwater quality (Section 4.3)

4.1 Diversion Monitoring

Diversion monitoring documents the volume of water delivered to each AR site during recharge operations and the total volume diverted from the Walla Walla River at the Little Walla Walla Diversion. Each AR site will have either a rated intake structure or a flow meter installed at the diversion from the HBDIC canal. Water volumes delivered to each site will be recorded and maintained by WWBWC and reported to OWRD in annual written reports.

Conveyance losses between the Little Walla Walla Diversion and each AR site will be estimated by applying measured segment-specific seepage rates to the length of each canal segment and the duration of recharge operations, consistent with the approach documented in previous annual reports (WWBWC, 2014–2024). Total diversion volume from the Walla Walla River, in acre-feet, will be reported annually.

Diversion monitoring data will be collected in accordance with WWBWC's Sampling and Analysis Plan for Hydrological Trend Monitoring in the Walla Walla Basin (DEQ24-VOL-0014-SAP, Version 1.1, approved by ODEQ March 2026).

4.2 Hydrologic Response Monitoring

Groundwater level and spring discharge monitoring are the primary tools for evaluating the seasonal hydrologic response to AR operations. Monitoring will be conducted in accordance with WWBWC's Sampling and Analysis Plan for Hydrological Trend Monitoring in the Walla Walla Basin (DEQ24-VOL-0014-SAP, Version 1.1, approved by ODEQ March 2026), which describes equipment specifications, data collection procedures, QA/QC requirements, and data management protocols for pressure transducer-based water level monitoring and continuous streamflow monitoring.

4.2.1 Groundwater Level Monitoring

Data will be collected from 16 monitoring wells (Table 3) distributed across the Milton-Freewater alluvial fan in the vicinity of and downgradient of active recharge sites (Figure 2). All monitoring well survey points have been established using survey-grade GPS equipment. Pressure transducers will log water level data at 15-minute intervals throughout the license period, supplemented with quarterly manual measurements using an e-tape.

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Table 3. Alluvial aquifer monitoring wells for LL-1970. (See Figure 2 for map of locations)

Monitoring ID	Well ID Tag #	Well Log #	GPS Coordinates	Surface Elevation (Ft AMSL)	Depth	Parameters
GW_28	N/A	UMAT 7853	45.95838, -118.41848	900.803	111'	Water Level
GW_34	N/A	UMAT 4135	45.984507, -118.506733	661.855	50'	Water Level
GW_40	N/A	UMAT 58326	45.954077, -118.434295	875.913	75'	Water Level
GW_45	63871	UMAT 55115	45.956028, -118.438109	861.394	71'	Water Level
GW_46	63869	UMAT 55114	45.957821, -118.441180	850.123	67'	Water Level & Water Quality
GW_47	63870	UMAT 55116	45.957464, -118.440980	851.400	60'	Water Level
GW_48	63872	UMAT 55117	45.958222, -118.439737	851.732	61'	Water Level
GW_62	N/A	UMAT 58327	45.946135, -118.421334	929.478	40'	Water Level
GW_66	N/A	UMAT 4156	45.969092, -118.496930	688.485	70'	Water Level
GW_117	91062	UMAT 56444	45.962511, -118.421880	880.607	70'	Water Level
GW_118	91064	UMAT 56445	45.962173, -118.449890	820.898	70'	Water Level
GW_119	91065	UMAT 56447	45.972883, -118.485125	712.508	40'	Water Level
GW_141	97758	UMAT 57169	45.945663, -118.408360	962.874	55'	Water Level & Water Quality
GW_142	97760	UMAT 57171	45.965550, -118.433400	848.822	36'	Water Level
GW_143	97759	UMAT 57170	45.969233, -118.440530	830.039	25'	Water Level
GW_144	97761	UMAT 57172	45.980159, -118.506767	656.506	36'	Water Level & Water Quality

Water level data will be analyzed and presented in each annual report as follows. For each monitoring well, the October pre-season static water level will serve as the annual baseline, consistent with OWRD's recommendation that October represents the most static aquifer conditions of the year, before recharge operations begin and when large-scale groundwater pumping is decreasing or complete (OWRD, LL-1970 application review, 2026).

Hydrographs will be presented for the 16 monitoring wells, with recharge season start and stop dates annotated. This format, illustrated by the example in Figure 3, which combines data from GW_047, GW_118, and spring gage S-408 (Johnson Creek), allows visual assessment of whether water levels rise above the October baseline during the recharge season and decline following

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the end of recharge operations. Wells that show water level increases above the October baseline during the recharge season will be identified and the magnitude of the increase described.

Groundwater level data will be reported in feet above mean sea level (ft AMSL) as positive values. Raw pressure transducer data will be corrected for barometric pressure using data from nearby barometric transducers prior to conversion to ft AMSL. Data will include both WWBWC well names and OWRD log IDs (UMAT numbers) as listed in Table 3.

Because groundwater levels in the alluvial aquifer reflect a combination of influences including regional ditch operations, groundwater withdrawals, and seasonal precipitation in addition to AR operations, this analysis does not attempt to isolate the contribution of individual recharge sites to observed water level changes. Each annual report will describe which monitoring wells show a seasonal pattern of water level rise above October baseline conditions during the recharge season and decline following the end of operations and will report the magnitude of observed changes at each well.

4.2.2 Spring Discharge Monitoring

Spring discharge monitoring complements well water level data by providing a spatially integrated indicator of aquifer conditions across a broader area than individual wells can capture. Pressure transducers will record water levels at two alluvial spring monitoring gages (Table 4) at 15-minute intervals throughout the license period. WWBWC has established site-specific stage-discharge relationships for these sites and will produce a continuous discharge dataset for the license period. WWBWC staff will take quarterly flow measurements and will shift rating equations as needed to account for scour or depositional changes, using the rating tools in AQUARIUS Time-Series software. All data collection and processing will follow the ODEQ-approved sampling and analysis plan for hydrological trend monitoring in the Walla Walla Basin (WWBWC, 2026).

Table 4. Spring discharge monitoring gages

Spring Name	WWBWC Monitoring ID	GPS Coordinates	Elevation (ft AMSL)	Parameters
Little Mud Creek	S405	45.972762, -118.4512192	792.165	Stage/Discharge
Johnson Creek	S408	45.9729221, -118.4801381	722.267	Stage/Discharge

Spring discharge data will be analyzed in combination with well water level data in each annual report. Spring hydrographs will be presented alongside monitoring well hydrographs with

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recharge season start and stop dates annotated, as illustrated in Figure 3 for Water Year 2024. This format allows visual assessment of whether spring discharge changes are coincident with the timing of recharge operations.

Where a spring shows a measurable increase in discharge during the recharge season relative to the immediately preceding period, and where that increase is coincident with active recharge operations, it will be reported as corroborating evidence of a seasonal hydrologic response. Pre-season (October) discharge values will be reported as the annual baseline. Reports will note whether spring discharge returns toward pre-season levels following the end of recharge operations and will describe any multi-year trends in baseline spring flows.

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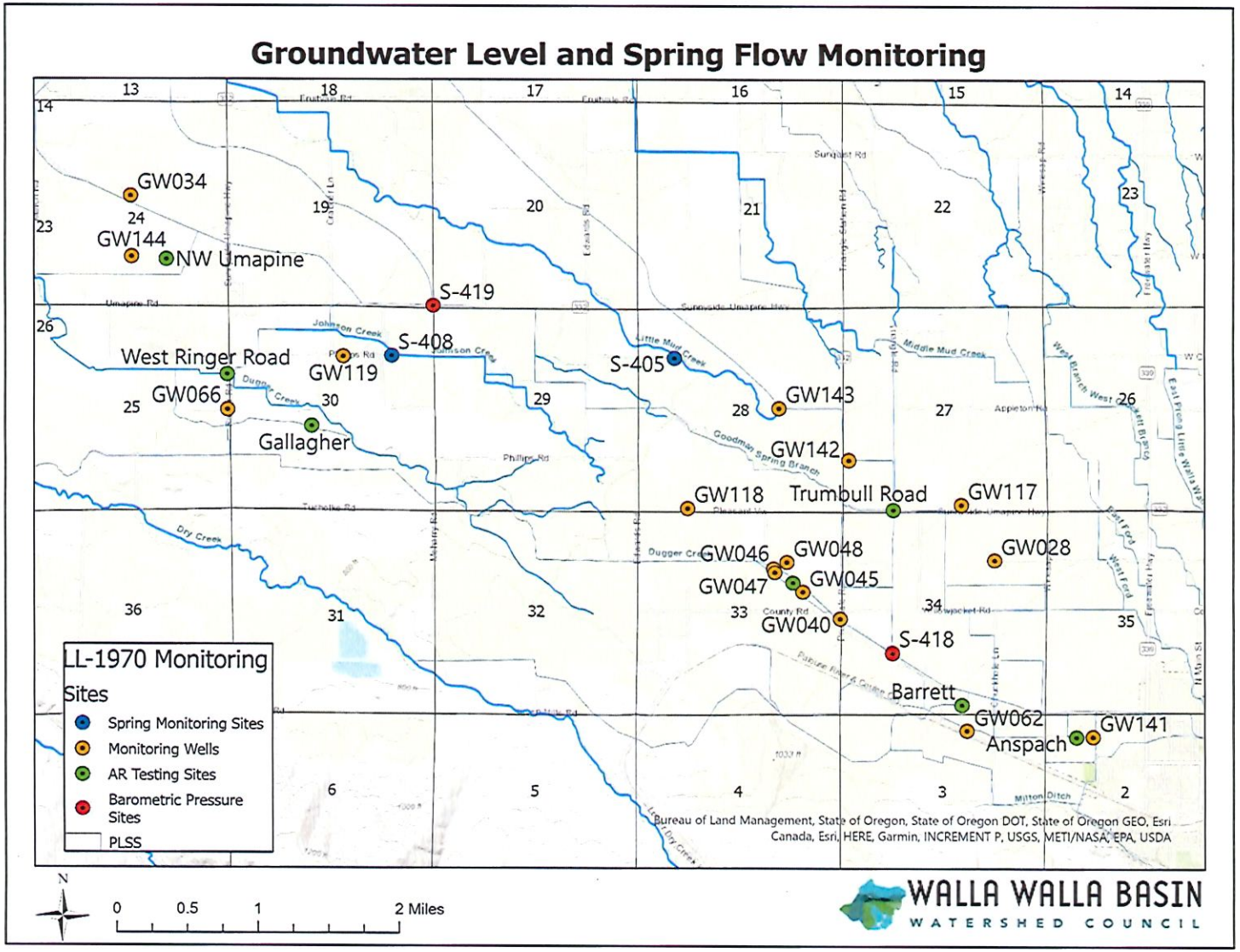


Figure 2. Map of alluvial aquifer wells, barometric pressure, and spring flow monitoring sites.

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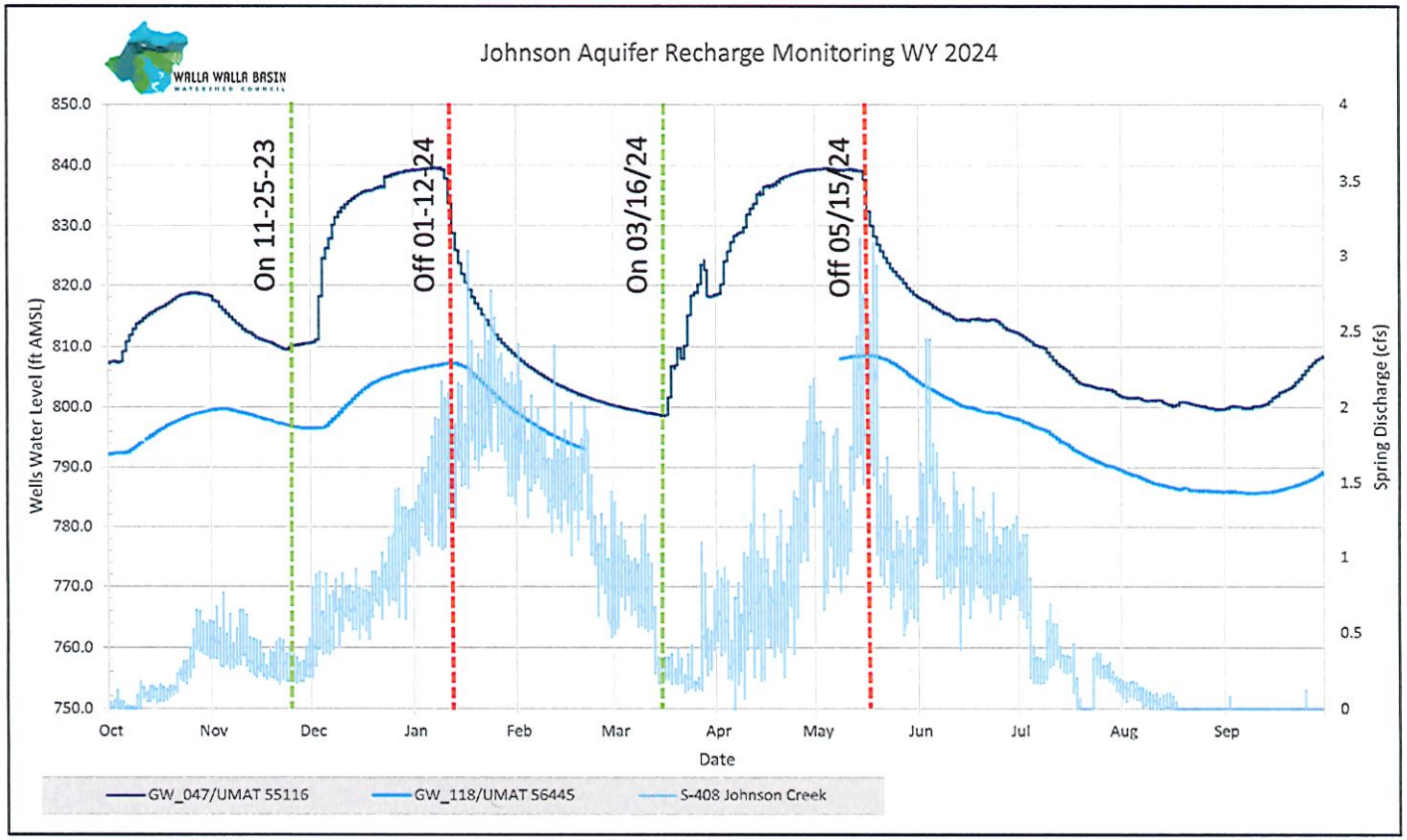


Figure 3. Groundwater level and spring discharge data from two monitoring wells and spring gage S-408 (Johnson Creek) in the vicinity of the Johnson aquifer recharge site, Water Year 2024. Well water levels are reported in feet above mean sea level (ft AMSL) on the left axis, Johnson Creek discharge in cubic feet per second (cfs) on the right axis. Green and red dashed lines indicate recharge operation start and shutoff dates. GW_47/UMAT 55116 is located at the Johnson recharge site; GW_118/UMAT 56445 is located approximately 0.5 mile downgradient; S-408 (Johnson Creek) is a spring-fed creek approximately 2 miles downgradient. All three monitoring locations show water level or discharge increases above pre-recharge season conditions following each recharge start date. GW_047 shows an immediate, high-magnitude response; GW_118 shows a more gradual response of lower magnitude, consistent with its greater distance from the recharge site; and Johnson Creek discharge shows elevated flow during recharge periods that declines following shutoff. October water levels at both wells represent pre-season baseline conditions prior to the start of recharge operations.

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4.3 Water Quality Monitoring

Water quality monitoring for the WWBWC AR program has evaluated source water quality and groundwater quality before and after recharge operations since 2009. Results are documented in a series of annual reports (GSI 2012; WWBWC 2014–2024), reviewed and approved by ODEQ, and show no pattern of groundwater quality degradation coincident with AR operations. The monitoring approach described in this section is consistent with the approach implemented under the previous limited license from 2020 through 2024, with monitoring locations reduced to reflect the scope of LL-1970, which covers only sites within the HBDIC service area.

The water quality monitoring approach compares source water quality with groundwater quality at up-gradient, mid-gradient, and down-gradient locations before and after AR testing each year to evaluate whether recharge operations are associated with any changes in groundwater quality across the program area. Water quality will be evaluated through field parameter measurements and grab samples for laboratory analysis of inorganic and metal constituents and selected synthetic organic compounds (SOCs).

4.3.1 Water Quality Sampling Locations

Groundwater quality monitoring will be conducted at three wells distributed across the HBDIC program area: GW_141, GW_46, and GW_144 (Table 5, Figure 4).

Table 5. Groundwater quality sampling locations

Monitoring ID	Well ID Tag #	Well Log #	GPS Coordinates	Location Relative to AR Testing
GW_141	97758	UMAT 57169	45.945663, -118.408360	Up-gradient
GW_46	63869	UMAT 55114	45.957821, -118.441180	Mid-gradient
GW_144	97761	UMAT 57172	45.980159, -118.506767	Down-gradient

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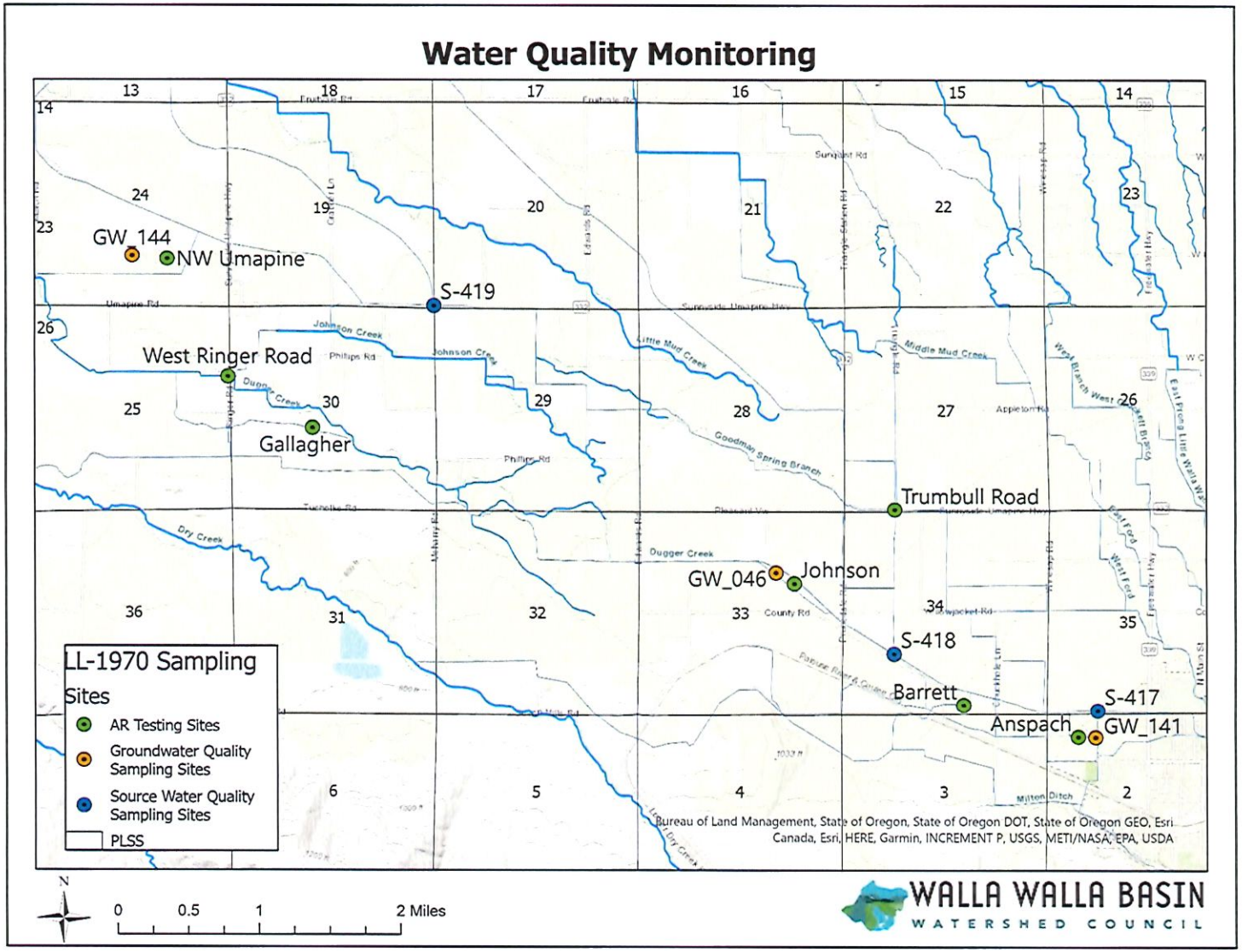


Figure 4. Groundwater quality and source water quality sampling sites

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Source water quality sampling will be conducted at three locations within the HBDIC canal and pipeline system (Figure 4, Table 6). S-417 (Zerba Weir) is located on the White Ditch canal upstream of the diversion to the Anspach site and represents source water conditions for the Anspach and Barrett sites. S-418 (Duff Weir) is located upstream of diversions to the Johnson, Trumbull, Gallagher, and Ringer Road sites. S-419 (Huffman-Richartz Weir) is located upstream of the NW Umapine site.

Table 6. Source water quality sampling locations and the relevant downgradient AR testing sites for each.

Monitoring ID	GPS Coordinates	Downgradient AR Testing Sites
S-417	45.947580, -118.408015	Anspach, Barrett
S-418	45.951665, -118.428920	Johnson, Trumbull, Gallagher, Ringer Rd
S-419	45.976577, -118.475888	NW Umapine

4.3.2 Water Quality Parameters, Sampling Methods, and Procedures

Water quality will be evaluated through field parameter measurements and laboratory analysis of inorganic and metal constituents and selected synthetic organic compounds (SOCs). All groundwater and source water locations will be sampled twice per recharge season: once before or within one week of the start of recharge operations (typically early November) and once within one week of the end of recharge operations (typically mid-May).

Field parameters (water temperature, specific conductance, pH, and dissolved oxygen) will be measured at all groundwater and source water locations using calibrated field meters at the time of each sampling event. Field parameter measurements follow the procedures described in WWBWC SOP V1.3 (2018, pages 50–51), available at https://wwbwc.org/images/Monitoring/SOP/WWBWC_SOP.pdf.

Parameters, analytical methods, and sampling frequency are summarized in Tables 7 and 8.

Inorganic and metal constituents will be analyzed using the Unibest Eco-Tracker passive sampling method. Eco-Trackers are ion-exchange resin capsules that are submerged in the water to be sampled and left in place for a defined deployment period. During deployment, dissolved ions diffuse into and are captured by the resin. After retrieval, capsules are sent to Unibest International for laboratory analysis using the Ag Manager analytical platform. The Eco-Tracker method was selected because it is a low-cost alternative to conventional methods. The method was approved by ODEQ for use in this monitoring program under previous limited licenses and has been used consistently since 2009. Ammonia is not included in the inorganic parameter list because the resin capsule used in the Eco-Tracker method contains ammonia,

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which biases sample results high and renders ammonia data unreliable using this method (WWBWC, 2019).

Nitrate-N will be analyzed by conventional laboratory method (EPA 300.0) in addition to the Eco-Tracker method, as nitrate has an established drinking water standard and warrants confirmation by a conventionally validated analytical method. SOC sampling will be conducted at down-gradient monitoring well GW_144 only, during the post-season sampling event, using conventional grab sample methods following WWBWC SOP V1.3 (2018, pages 16–17).

Groundwater and surface water sampling procedures follow WWBWC SOP V1.3 (2018, Section 4, pages 13–19). Parameters, analytical methods, quantitation limits, preservation requirements, and holding times are summarized in Table 9.

Table 7. Field water quality parameters

Parameter	Sample Matrix	Analytical Method	Frequency
Water Temperature	Surface Water & Groundwater	YSI 30 / Orion 5-Star	2x Annually: Before and after AR testing
Specific Conductance	Surface Water & Groundwater	YSI 30 / Orion 5-Star	2x Annually: Before and after AR testing
pH	Surface Water & Groundwater	Orion 5-Star	2x Annually: Before and after AR testing
Dissolved Oxygen	Surface Water & Groundwater	Orion 5-Star	2x Annually: Before and after AR testing

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Table 8. Surface water and groundwater quality parameters, analytical methods, and frequency.

Analyte	Analytical Methods	Sampling Occurrence
Calcium	UNIBEST Eco Tracker	2x Annually: Before and after AR testing
Iron	UNIBEST Eco Tracker	
Magnesium	UNIBEST Eco Tracker	
Nitrate-N	EPA 300.0	
Phosphorus	UNIBEST Eco Tracker	
Potassium	UNIBEST Eco Tracker	
Sodium	UNIBEST Eco Tracker	
Sulfur	UNIBEST Eco Tracker	
Synthetic Organic Analytes (Groundwater well GW_144/UMAT 57172)		
Azinphos-methyl	EPA Method 8141B	1x Annually in May: After AR testing
Chlorpyrifos	EPA Method 8141B	
Diuron	EPA Method 532	
Malathion	EPA Method 8141B	

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Table 9. Sample containers, quantitation or detection limits, and holding times.

Analyte	Method	Sample Containers	Quantitation or Detection Limits	Preservation	Holding Times
Calcium	Eco-tracker	Unibest capsule	0.31 mg/L	Refrigerate	~3 days
Iron	Eco-tracker	Unibest capsule	0.05 mg/L	Refrigerate	~3 days
Magnesium	Eco-tracker	Unibest capsule	0.27 mg/L	Refrigerate	~3 days
Nitrate-N	EPA 300.0	HDPE	0.1 mg/L	Cool to 4°C	48 hours
Phosphorus	Eco-tracker	Unibest capsule	0.02 mg/L	Refrigerate	~3 days
Potassium	Eco-tracker	Unibest capsule	0.18 mg/L	Refrigerate	~3 days
Sodium	Eco-tracker	Unibest capsule	0.17 mg/L	Refrigerate	~3 days
Sulfur	Eco-tracker	Unibest capsule	0.02 mg/L	Refrigerate	~3 days
Azinphos-methyl	EPA 8141B	Amber glass	0.3 µg/L	Cool to 4°C	7 days
Chlorpyrifos	EPA 8141B	Amber glass	0.3 µg/L	Cool to 4°C	7 days
Diuron	EPA 532	Amber or clear glass	0.06 µg/L	Cool to 6°C; cupric sulfate; Tris buffer	14 days
Malathion	EPA 8141B	Amber glass	0.3 µg/L	Cool to 4°C	7 days

4.3.3 Water Quality Data Analysis

Water quality data will be analyzed in each annual report using the approach applied under previous limited licenses (WWBWC 2014–2024). For each monitoring well, groundwater constituent concentrations measured before the recharge season will be compared to concentrations measured after the recharge season. Groundwater concentrations will also be compared to concentrations measured at the relevant source water location for that well (Table 10) during the same sampling event.

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Table 10. Relevant source water sampling site for each groundwater sampling site.

Groundwater Monitoring Site ID	Well ID Tag #	Well Log #	Relevant Source Water Sampling Site
GW_141	97758	UMAT 57169	S-417, Zerba Weir
GW_46	63869	UMAT 55114	S-418, Duff Weir
GW_144	97761	UMAT 57172	S-419, Huffman Richartz Weir

The analysis will evaluate two questions for each constituent at each well:

- Did groundwater concentrations increase between the pre- and post-recharge sampling events?
- If concentrations increased, were source water concentrations higher than pre-recharge groundwater concentrations, which would indicate recharge water as a potential source of the increase?

Where post-recharge groundwater concentrations are higher than pre-recharge concentrations but source water concentrations are lower than groundwater concentrations, the source water is not considered the cause of the observed increase and no degradation attributable to AR activities will be reported. Where constituents with established drinking water standards, specifically nitrate-N, are detected at concentrations above those standards, the source water concentrations will be examined to determine whether the recharge water could be the cause. Results will be presented in tabular form comparing pre- and post-recharge concentrations at each well alongside the relevant source water concentrations for the same sampling events. Field parameter data will be reported in a separate table.

A comprehensive review of SOC data collected at AR sites in the Walla Walla Basin between 2006 and 2012 found that detections were sporadic, low concentration, and not attributable to AR activities (GSI, 2012). Based on those findings, SOC sampling was refined to a targeted list of four agricultural chemicals representative of pesticides used in the basin: azinphos-methyl, chlorpyrifos, diuron, and malathion. No SOCs have been detected in groundwater samples collected under the current programmatic monitoring approach (WWBWC annual reports, WY2014–WY2024). Any detection above the quantitation limit will be reported.

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4.4 Quality Assurance and Quality Control (QA/QC)

Quality assurance and quality control procedures for hydrologic response monitoring, including pressure transducer data collection, manual water level measurements, spring stage and discharge measurements, and data management, follow WWBWC's Sampling and Analysis Plan for Hydrological Trend Monitoring in the Walla Walla Basin (DEQ24-VOL-0014-SAP, Version 1.1, approved by ODEQ March 2026), available at https://wwbwc.org/images/Monitoring/SOP/DEQ24-VOL-0014-SAP_FINAL.pdf.

Water quality sampling QA/QC procedures follow WWBWC SOP V1.3 (2018). At minimum, one field duplicate and one field blank will be collected once per recharge season. Field duplicates are two samples collected at the same time and location and analyzed in the same batch. Field blanks are transfer blanks created using deionized water with sample bottles filled at the monitoring site. Data validation will be performed using a checklist that addresses completeness of field data sheets and observations, completeness of chain of custody forms, holding times for all constituents, and completeness of laboratory quality controls. All field notes, chain of custody forms, and analytical results will be retained by WWBWC for a minimum of five years and made available to OWRD and ODEQ upon request.

4.5 Reporting

Primary reporting for this monitoring plan will consist of annual reports completed following the end of each recharge season. The goals of annual reports are to: (1) report the quantity of water diverted and delivered to each recharge site, (2) describe observed water level changes and spring discharge patterns relative to October pre-season baseline conditions and recharge operation timing, and (3) report water quality results and assess whether any changes in groundwater quality are coincident with recharge operations.

Annual reports will include multi-well hydrograph figures presenting water level data from monitoring wells alongside spring discharge data, with recharge season start and stop dates annotated. Well data will be reported in feet above mean sea level as positive values, and WWBWC well names will be cross-referenced to OWRD UMAT log IDs as listed in Table 3.

Annual reports will be sealed and signed by a professional registered or allowed under Oregon law to practice geology, consistent with conditions imposed under previous limited licenses for this program.

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