DEPARTMENT OF ECOLOGY
State of Washington

Addendum to Quality Assurance Project Plan

City of West Richland Phase 2a Well No. 10

January 2023

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Addendum to Quality Assurance Project Plan: City of West Richland Phase 2a Well No. 10

by Phil Brown and Alicia Candelaria

January 2023

Approved by:

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1.0 Table of Contents

Note: The numbered headings in this document correspond to the headings in the original QAPP. Only relevant sections are included here; therefore, some numbered headings may be missing.

3.0 Background

The City of West Richland (City) is developing an Aquifer Storage and Recovery (ASR) facility at existing City Well No. 10 in conjunction with the Washington State Department of Ecology's (Ecology) Office of Columbia River (OCR). Phase 1a was completed with Ecology Grant No. WROCR-2018-WeRiPW-00004 between 2018 and 2019. The Phase 1a Well No. 10 condition assessment found limited biological activity and that the well is in relatively good condition. Phase 2a work is underway, with support from OCR with Ecology Grant No. WROCR-1921-WeRiPW-00016.

During the course of delivering Phase 2a of the project (aquifer testing, baseline sampling, and permit application), Ecology requested that the City conduct additional (not included in the original project implementation plan or Grant Agreement) groundwater sampling to develop a formal determination of background water quality in accordance with Ecology publication No. 17-10-035: Guidance for Aquifer Storage and Recovery AKART Analysis and Overriding Consideration of the Public Interest Demonstration (November 2017). This guidance document describes an evaluation of background that is based on eight samples. Because the baseline characterization sample already collected as part of Phase 2a can be used to support this analysis, an additional seven samples are planned as described in this QAPP addendum.

The original Phase 2a Quality Assurance Project Plan (QAPP) describes aquifer testing, water quality sampling, geochemical compatibility analysis, and development of information needed to conduct an **a**ll **k**nown, **a**vailable **a**nd **r**easonable methods of prevention, control and **t**reatment (AKART) analysis. This Phase 2a QAPP Addendum describes only the additional sampling, analytical program, and schedule associated with collecting seven groundwater samples to be used in establishing background groundwater quality at Well No. 10. Field methods and procedures and QA/QC procedures remain unchanged from the original QAPP except where specifically noted below in this addendum.

4.0 Project Description

In accordance with Ecology guidance documents, Guidance for Aquifer Storage and Recovery AKART Analysis and Overriding Consideration of the Public Interest Demonstration (November 2017) and Implementation Guidance for the Ground Water Quality Standards (October 2005),the Department of Ecology has requested that additional groundwater samples are collected to establish background groundwater quality at West Richland Well No. 10 in support of the Well No. 10 ASR project AKART analysis presented in the Draft Phase 2a Report.

The description of the work pertaining to this Addendum includes:

1. Collect an additional seven groundwater samples from Well No.10, at a monthly frequency; samples will be collected at a minimum 30-day interval. Combined with the sample collected as part of the baseline characterization sampling, this will result in a total of eight groundwater samples.
2. Conduct QA/QC of the results.
3. Enter the resulting compatible data into Ecology's EIM system.

4.1 Project goals

The goal of the work described in this addendum is to collect the water quality data necessary to conduct the background determination analysis that will be used to update the AKART to meet the original project goal of developing a complete Reservoir Permit application. The project goals remain unchanged.

4.2 Project objectives

The objective of the work described in this QAPP addendum is to collect seven additional groundwater samples (and one duplicate sample) from West Richland Well No.10 to comply with the above referenced guidance for establishing background. The project objectives remain unchanged.

4.3 Information needed

Eight total samples are needed to support the statistical analysis presented in the Ecology ASR/AKART guidance document referenced in Section 3. Seven additional samples will be collected under this QAPP, which with the existing sample collected during Phase 2a testing will meet this information need.

4.4 Tasks required

The tasks to be completed for the additional work described in this QAPP addendum are:

1. Collect an additional seven groundwater samples from Well No.10, at a monthly frequency; samples will be collected at a minimum 30-day interval. Combined with the sample collected as part of the baseline characterization sampling, this will result in a total of eight groundwater samples.
2. Conduct QA/QC of the results.
3. Enter the resulting compatible data into Ecology's EIM system.

Specific changes with respect to tasks listed in the original QAPP are listed below.

Task 3: Sampling

The sampling methodology remains largely unchanged from the procedures described in the original QAPP. The difference associated with this QAPP addendum is to remove reference to the sampling occurring as part of the aquifer test. For the additional seven samples, the well will be purged of a minimum three wellbore volumes and demonstrate stable field parameters prior to collecting the samples.

Task 5: AKART

The AKART as described in the original QAPP will be updated to include the data developed through the implementation of the work described in this QAPP addendum. This will include the analytical results of the original baseline characterization sample, the additional seven samples, and the analysis to establish background with respect to groundwater.

5.0 Organization and Schedule

5.1 Key individuals and their responsibilities

Table 3 shows the organization and responsibilities of those who will be involved in this project.

Table 3. Organization of project staff and responsibilities

Staff	Title	Responsibilities
Roscoe Slade III, PE City of West Richland Phone: 509-967-54354	City of West Richland Public Works Director	Clarifies scope of the project. Provides internal review of the QAPP and approves the final QAPP.
Julie West, PE City of West Richland Phone: 509-967-7019	City of West Richland Capitol Projects Manager	Coordinates City team and Consulting team
Phil Brown, LHg Northwest Groundwater Services, LLC Phone: 503-313-5195	Principal Hydrogeologist/Project Manager	Ensures the hydrogeologic team meets technical quality requirements, directs the field program, produces required project reports, and provides guidance and review of analytical interpretations, QA efforts, and reports.
Kevin Lindsey, LHg GeoEngineers Phone: 509-209-2840	Principal Hydrogeologist	Principal Hydrogeologist provides technical support, senior review, and reviews QAPP and Phase 2a report.
Jon Travis, LG GeoEngineers Phone:509-209-2839	Hydrogeologist	Supports field data collection, sampling, and transportation of samples to the laboratory.
Alicia Candelaria GeoEngineers Phone: 509-289-2840	Hydrogeologist, QA/QC manager	QA/QC laboratory data
Denell Warren GeoEngineers Phone: 253-722-2792	Database manager	Uploads data to EIM.
Alex Fazzari, PE J-U-B Engineers, Inc. Phone:509-783-2144	Senior Engineer	Drafts QAPP components related to the AKART. Conducts AKART analysis. Supports project with Engineering analysis as-needed.
Ingrid Ekstrom Office of the Columbia River Phone:509-454-4335	Ecology Office of Columbia River Project Manager	Reviews and comments on draft QAPP. Provides Ecology/OCR QAPP review. Updates project team on schedule, scope, and budget.
Scott Tarbutton Phone: 509-867-6534	Ecology Office of Columbia River Quality Assurance Coordinator	Reviews and approves the draft QAPP and the final QAPP Addenda.
Michael Callahan Phone: 509-454-4270	Ecology Office of Columbia River Former Quality Assurance Coordinator	Reviewed and approved the draft QAPP and the final QAPP -original version April 2021
Eurofins - Spokane 509.942.9200	Accredited Analytical Laboratory	Sample analysis and development of data packages.

Notes:
EIM: Environmental Information Management database
QAPP: Quality Assurance Project Plan

5.4 Proposed project schedule

Tables 4 and 5 list key activities, due dates, and lead staff for this project. This schedule assumes an addendum approval date of January 2023 (Table 2).

Table 4. Schedule for completing field and laboratory work.

Task	Due date	Lead staff
Ecology Phase 2a QAPP (Draft) approval	February 2021	Phil Brown
Ecology Review and Final QAPP	March 2021	Ecology
Establish final observation well network approved by Ecology	April 2021	Phil Brown
Collect source water sample	March/April 2021	Jon Travis
Fieldwork – aquifer testing and sampling	April/May 2021	Jon Travis
Laboratory analyses	April/May 2021	Phil Brown
Geochemical Compatibility Modeling	June/July 2021	Brad Bessinger
AKART Analysis	August/September 2021	Alex Fazzari
Draft Phase 2a Report	December 2021	Phil Brown
Ecology Approves Phase 2a QAPP Addendum **	***January 2023***	***Ecology***
Groundwater Sampling	***Jan.- July 2023***	***Jon Travis***
QA/QC, Finalize Database, EIM Upload	***September 2023***	***Alicia Candelaria***
Finalize AKART	***November 2023****	***Alex Fazzari***
Final Phase 2a Report	***December 2023***	***Phil Brown***

Notes:
* Assumes revision to geochemical model is not required
**Schedule elements prior to January 2023 are as presented in the original Phase 2a QAPP. Elements in bold/italics are new items related to this QAPP addendum

Table 5. Schedule for data entry

Task	Due date	Lead staff
EIM data loaded*	September 2023	Denell Warren
EIM QA	September 2023	Jon Travis/Denell Warren
EIM complete	September 2023	Denell Warren

Notes:
*EIM Project ID: WROCR-2018-004
EIM: Environmental Information Management database

6.0 Quality Objectives

6.2 Measurement quality objectives

The measurement quality objectives for the additional seven samples collected as part of this QAPP addendum are provided in Table 6a. There are changes in the CAS#, MDLs and PQLs, due to the necessity of using a different lab than what was used in the original Phase 2a. work.

Table 6a only contains the analytes relevant to the AKART evaluation. Bacteriological analyses, radiological analyses, VOCs, SVOCs, and SOCs are not included in this evaluation. They were included in the original sample to establish pre-recharge baseline conditions but are not included in the work associated with this addendum because either they were both not expected and undetected and/or because they are not relevant to updating the mixing models and the AKART with respect to background.

Bromate and Chlorite were added to the analytical list because they are included in the above-referenced AKART guidance document, even though DBPs are not anticipated to be encountered in native groundwater.

Table 6a. Amended Geotechnical Analytical Suite

Analyte	Units	CAS#	Drinking Water MCL/SMCL	Groundwater Criteria	MDL	RL	PQL	Method	Duplicate
INORGANICS									
Alkalinity	mg $CaCO_3$/L	STL00171			1	1	1	SM2320B	Duplicate
Ammonia	mg/L as N	7664-41-7			0.264	0.5	0.264	SM4500NH3G	Duplicate
Bicarbonate	mg/L as $CaCO_3$	STL00138			1	1	1	SM2320B	Duplicate
Carbonate	mg/L as $CaCO_3$	STL00154			1	1	1	SM2320B	Duplicate
Chloride	mg/L	16887-00-6	250 (SMCL)	250	0.42	0.8	0.42	EPA 300.0	Duplicate
Cyanide (HCN)	mg/L	57-12-5	0.2		0.0028	0.005	0.0028	EPA 335.4	Duplicate
Fluoride	mg/L	16984-48-8	4 (2 SMCL)	4	0.028	0.05	0.028	EPA 300.0	Duplicate
Total Hardness	mg $CaCO_3$/L	STL00009			0.660	0.660	0.660	EPA 200.8	Duplicate
Nitrate + Nitrite (total N)	mg/L as N		10		0.1	0.2	0.1	EPA 300.0	Duplicate
Nitrate (as N)	mg/L as N	14797-55-8	10	10	0.057	0.2	0.057	EPA 300.0	Duplicate
Nitrite-N	mg/L as N	14797-65-0	1		0.0689	0.2	0.0689	EPA 300.0	Duplicate
Orthophosphate as P	mg/L	14265-44-2			0.0460	0.0920	0.0460	EPA 300.0	Duplicate
Total Silica (as SiO2)	mg/L	14808-60-7			0.00940	0.0428	0.00940	EPA 200.7	Duplicate
Dissolved Silica (as SiO2)	mg/L	14808-60-7			0.00940	0.0428	0.00940	EPA 200.7	Duplicate
Sulfate	mg/L	14808-79-8	250 (SMCL)	250	0.128	0.5	0.128	EPA 300.0	Duplicate
Sulfide	mg/L	18496-25-8			0.0224	0.05	0.0280	SM4500S2F	Duplicate

Analyte	Units	CAS#	Drinking Water MCL/SMCL	Groundwater Criteria	MDL	RL	PQL	Method	Duplicate
TOTAL and DISSOLVED METALS									
Aluminum	mg/L	7429-90-5	0.05 to 0.2 (SMCL)		0.0015	0.002	0.0015	EPA 200.7	Total Only
Antimony	mg/L	7440-36-0	0.006		0.000057	0.001	0.000057	EPA 200.8	Total Only
Arsenic[1]	mg/L	7440-38-2	0.01	0.00005	0.00089	0.001	0.00089	EPA 200.8	Total Only
Barium	mg/L	7440-39-3	2	1	0.00014	0.002	0.00014	EPA 200.8	Total Only
Beryllium	mg/L	7440-41-7	0.004		0.0000830	0.0003	0.00000830	EPA 200.8	Total Only
Cadmium	mg/L	7440-43-9	0.005	0.01	0.00014	0.0005	0.00014	EPA 200.8	Total Only
Calcium	mg/L	7440-70-2			0.0210	0.1	0.0210	EPA 200.7	Total Only
Chromium	mg/L	7440-47-3	0.1	0.05	0.00031	0.0009	0.00031	EPA 200.8	Total Only
Cobalt	mg/L	7440-48-4	-- +		0.00013	0.002	0.00013	EPA 200.8	Total Only
Copper	mg/L	7440-50-8	1.3**	1	0.00055	0.001	0.00055	EPA 200.8	Total Only
Iron	mg/L	7439-89-6	0.3 (SMCL)	0.3	0.00460	0.01	0.0.00460	EPA 200.7	Total Only
Lead	mg/L	7439-92-1	0.015**	0.05	0.00008	0.0005	0.00008	EPA 200.8	Total Only
Magnesium	mg/L	7439-95-4			0.000510	0.001	0.00510	EPA 200.7	Total Only
Manganese	mg/L	7439-96-5	0.05 (SMCL)	0.05	0.00023	0.002	0.00023	EPA 200.8	Total Only
Mercury	mg/L	7439-97-6	0.002	0.002	0.0000056	0.0001	0.000056	EPA 245.7	Total Only
Molybdenum	mg/L	7439-98-7			0.00016	0.002	0.0.00016	EPA 200.8	Total Only
Nickel	mg/L	7440-02-0	0.1		0.00024	0.001	0.0.00024	EPA 200.8	Total Only
Potassium	mg/L	7440-09-7			0.0290	0.2	0.0290	EPA 200.7	Total Only
Selenium	mg/L	7782-49-2	0.05	0.01	0.0016	0.002	0.0016	EPA 200.8	Total Only
Silver	mg/L	7440-22-4	0.1 (SMCL)	0.05	0.00013	0.0005	0.00013	EPA 200.8	Total Only
Sodium	mg/L	7440-23-5	20**		0.0570	0.1	0.0570	EPA 200.7	Total Only
Strontium	mg/L	7440-24-6			0.000069	0.002	0.000069	EPA 200.8	Total Only
Thallium	mg/L	7440-28-0	0.002		0.00016	0.0003	0.00016	EPA 200.8	Total Only
Uranium	mg/L	7440-61-1	0.03		0.000052	0.001	0.000052	EPA 200.8	Total Only
Vanadium	mg/L	7440-62-2	-- +		0.0024	0.002	0.0024	EPA 200.8	Total Only
Zinc	mg/L	7440-66-6	5 (SMCL)	5	0.0023	0.005	0.0023	EPA 200.8	Total Only
DISINFECTION BY-PRODUCTS (DBPs) & RESIDUAL DISINFECTANTS									
Residual Chlorine	mg/L	STL00076	4		0.02	0.5	0.02	SM 4500CL-G	Duplicate
Dibromoacetic Acid (HAA)	µg/L	631-64-1	See Total HAAs		0.6	1	0.6	SM6251B	Duplicate
Dichloroacetic Acid (HAA) [2]	µg/L	79-43-6	0		0.6	1	0.6	SM6251B	Duplicate

Analyte	Units	CAS#	Drinking Water MCL/SMCL	Groundwater Criteria	MDL	RL	PQL	Method	Duplicate
Monobromoacetic Acid (Bromoacetic acid) (HAA)	µg/L	79-08-3	See Total HAAs		0.6	1	0.6	SM6251B	Duplicate
Monochloroacetic Acid (HAA) [2]	µg/L	79-11-8	70		1.2	2	1.2	SM6251B	Duplicate
Trichloroacetic Acid (HAA) [2]	µg/L	76-03-9	20		0.5	1	0.5	SM6251B	Duplicate
Total Haloacetic Acids (Total HAA's)	µg/L	STL01558	60		1.5	2	1.5	SM6251B	Duplicate
B Bromate	µg/L	15541-45-4	10		1.7	5	1.7	EPA 300.1	Duplicate
Chlorite	µg/L	14998-27-7	1000		5.9	10	5.9	EPA 300.1	Duplicate
Bromodichloromethane (THM) [2]	µg/L	75-27-4	0	0.3	0.1	0.5	0.1	EPA 524.3	Duplicate
Bromoform (THM)[2]	µg/L	75-25-2	0	5	0.2	0.5	0.2	EPA 524.3	Duplicate
Chloroform (THM)[2]	µg/L	67-66-3	70	7	0.2	0.5	0.2	EPA 524.3	Duplicate
Dibromochloromethane (THM) [2]	µg/L	124-48-1	60	0.5	0.5	0.5	0.5	EPA 524.3	Duplicate
Total Trihalomethane (TTHM)	µg/L		80		0.2	0.5	0.2	EPA 524.3	Duplicate
MISCELLANEOUS									
Chemical Oxygen Demand	mg/L	STL00070			8.68	20	20	EPA 410.4	NA
Color	Color units	STL01619	15	15	5	5	5	SM 2120B	NA
Corrosivity	Standard units	STL00247		Noncorrosive	NA	NA	NA	Langelier Index	NA
Dissolved Organic Carbon	mg/L	7440-44-0			0.29	0.5	0.29	SM 5310C	NA
Methane	mg/L	74-82-8			0.00626	0.05	0.01	RSK175	NA
Odor	T.O.N	STL00201	3 Threshold Nos. (SMCL)	3 Threshold Nos.	1	1	1	2150B	NA
Oxidation-Reduction Potential	millivolts	STL00289			10	10	10	SM2580B	NA
pH	pH units	STL00204	6.5 to 8.5 (SMCL)	6.5 to 8.5	0.01	0.01	0.01	EPA 150.1	NA
Specific Conductance	µS/cm	STL00244	700 (SMCL)		0.312	1	0.312	EPA 120.1	NA
Total Dissolved Solids	mg/L	STL00242	500 (SMCL)	500	13	25	13	SM 2540C	NA
Total Organic Carbon	mg/L	7440-44-0			0.29	0.5	0.29	SM5310C	NA
Total Suspended Solids	mg/L	STL00161			4	10	4	SM 2540D	NA
Turbidity	NTU	STL00189	1 (SMCL)		0.15	0.15	0.15	EPA 180.1	NA

Analyte	Units	CAS#	Drinking Water MCL/SMCL	Groundwater Criteria	MDL	RL	PQL	Method	Duplicate
FIELD PARAMETERS									
Dissolved oxygen	mg/L	NA	NA	NA	NA	NA	NA	YSI 556 or similar	NA
pH	S.U.	NA	NA	NA	NA	NA	NA	YSI 556 or similar	NA
Oxidation-Reduction Potential	millivolts	NA	NA	NA	NA	NA	NA	YSI 556 or similar	NA
Specific Conductance	µS/cm	NA	NA	NA	NA	NA	NA	YSI 556 or similar	NA
Temperature	° Celsius	NA	NA	NA	NA	NA	NA	YSI 556 or similar	NA
Turbidity	NTU	NA	NA	NA	NA	NA	NA	YSI 556 or similar	NA

Notes:
MDL or RL is above the groundwater screening level criteria
Methods, MDLs, and RLs were provided by the analytical laboratory and are subject to change based on laboratory quality control/quality assurance.
--+ Indicates analyte is listed on the EPA Contaminant Candidate List (https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule)
** Indicates analytes not regulated by the Washington State Board of Health but acknowledged to have public health significance.
Levels shown are "action levels" set by the EPA and referenced in WAC 246-290-310.
[1] – The reported lab detection limit for arsenic is above the groundwater SL; however, arsenic was not detected above the SL in the two initial samples, nor was it detected in the source water sample.
[2] - Individual MCL goals (MCLGs) for individual contaminants set by EPA for National Primary Drinking Water Regulations. MCLGs allow for a margin of safety and are non-enforceable public health goals. Total HAAs and Total THMs are the target screen levels. (https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations)
MCL - Maximum Contaminant Level
mg/L - Milligrams per liter
SMCL - Secondary Maximum Contaminant Level
MDL - Method Detection Limit
MCL - Maximum Contaminant Level
MDL - Method Detection Limit
NA - Not available
NTU - Nephelometric Turbidity Units
PQL - Practical Quantitation Limit
RL - Reporting Limit
S.U. - Standard Units
pCi/L - Picocuries per liter
µg/L - Micrograms per liter
µS/cm - Micro-Siemens per centimeter

6.2.1 Targets for precision, bias, and sensitivity

The MQOs for the additional sampling described in this addendum are provided in Table 7a due to the use of a new lab, which has differing verification standards. In addition, two analytes (bromate and chlorite) were added. These were not included in the original baseline characterization sample, though are included here because they are listed in Ecology's guidance document. We anticipate that the absence of these two analytes will not affect the analysis because DBPs have not been detected nor are anticipated to be observed in native groundwater.

Table 7a. Measurement Quality Objectives Amended Geotechnical Analytical Suite Sample QA/QC

Parameter	Analytical Method	Field Duplicate Samples	Matrix Spike-Duplicates	Verification Standards			
				Lab Control Standard	Matrix Spikes	Internal Standard Recovery	Surrogate Standards
		Relative Percent Difference (% RPD)		Recovery Limits (%)			
INORGANICS							
Alkalinity	SM2320B	20	20	78-114	NA	NA	NA
Ammonia	SM4500NH3G	20	20	90-110	90-110	NA	NA
Bicarbonate	SM2320B	20	20	NA	NA	NA	NA
Carbonate	SM2320B	20	20	NA	NA	NA	NA
Chloride	EPA 300.0	20	10	90-110	80-120	NA	NA
Cyanide (HCN)	EPA 335.4	20	10	90-110	80-120	NA	NA
Fluoride	EPA 300.0	20	20	90-110	67-167	NA	NA
Hardness	EPA 200.8	20	20	90-110	90-110	NA	NA
Nitrate+Nitrite (total N)	EPA 300.0	20	20	90-110	80-120	NA	NA
Nitrate (as N)	EPA 300.0	20	20	90-110	80-120	NA	NA
Nitrite-N	EPA 300.0	20	10	90-110	80-120	NA	NA
Orthophosphate as P	EPA 300.0	20	20	90-110	90-110	NA	NA
Total Silica (as SiO2)	EPA 200.7	20	20	85-115	70-130	NA	NA
Dissolved Silica (as SiO2)	EPA 200.7	20	20	85-115	70-130	NA	NA
Sulfate	EPA 300.0	20	20	90-110	80-120	NA	NA
Sulfide	SM4500S2F	10	10	81-122	81-122	NA	NA
TOTAL and DISSOLVED METALS							
Aluminum	EPA 200.7	20	20	85-115	70-130	NA	NA
Antimony	EPA 200.8	20	20	85-115	70-130	60-125	NA
Arsenic	EPA 200.8	20	20	85-115	70-130	60-125	NA
Barium	EPA 200.8	20	20	85-115	70-130	60-125	NA
Beryllium	EPA 200.8	20	20	85-115	70-130	60-125	NA
Cadmium	EPA 200.8	20	20	85-115	70-130	60-125	NA
Calcium	EPA 200.7	20	20	85-115	70-130	NA	NA
Chromium	EPA 200.8	20	20	85-115	70-130	60-125	NA

Parameter	Analytical Method	Field Duplicate Samples	Matrix Spike-Duplicates	Verification Standards			
				Lab Control Standard	Matrix Spikes	Internal Standard Recovery	Surrogate Standards
		Relative Percent Difference (% RPD)		Recovery Limits (%)			
INORGANICS							
Cobalt	EPA 200.8	20	20	85-115	70-130	60-125	NA
Copper	EPA 200.8	20	20	85-115	70-130	60-125	NA
Iron	EPA 200.7	20	20	85-115	70-130	NA	NA
Lead	EPA 200.8	20	20	85-115	70-130	60-125	NA
Magnesium	EPA 200.7	20	20	85-115	70-130	NA	NA
Manganese	EPA 200.8	20	20	85-115	70-130	60-125	NA
Mercury	EPA 245.7	20	24	78-108	71-125	NA	NA
Molybdenum	EPA 200.8	20	20	85-115	70-130	60-125	NA
Nickel	EPA 200.8	20	20	85-115	70-130	60-125	NA
Potassium	EPA 200.7	20	20	85-115	70-130	NA	NA
Selenium	EPA 200.8	20	20	85-115	70-130	60-125	NA
Silver	EPA 200.8	20	20	85-115	70-130	60-125	NA
Sodium	EPA 200.7	20	20	85-115	70-130	NA	NA
Strontium	EPA 200.8	20	20	85-115	70-130	60-125	NA
Thallium	EPA 200.8	20	20	85-115	70-130	60-125	NA
Uranium	EPA 200.8	20	20	85-115	70-130	60-125	NA
Vanadium	EPA 200.8	20	20	85-115	70-130	60-125	NA
Zinc	EPA 200.8	20	20	85-115	70-130	60-125	NA
DISINFECTION BY-PRODUCTS (DBPs) & RESIDUAL DISINFECTANTS							
Residual Chlorine	SM 4500CL-G	--	NA	87-109	NA	NA	NA
Dibromoacetic Acid (HAA)	SM6251B	--	34	70-130	70-130	80-120	70-130
Dichloroacetic Acid (HAA)	SM6251B	--	27	70-130	70-130	80-120	70-130
Monobromoacetic Acid (Bromoacetic acid) (HAA)	SM6251B	--	50	70-130	70-130	80-120	70-130
Monochloroacetic Acid (HAA)	SM6251B	--	49	70-130	70-130	80-120	70-130
Trichloroacetic Acid (HAA)	SM6251B	--	30	70-130	70-130	80-120	70-130
Total Haloacetic Acids (Total HAA's)	SM6251B	--	See individual HAAs				
B Bromate	EPA 300.1	--	20	75-125	75-125	NA	NA
Chlorite	EPA 300.1		20	90-110	90-110	NA	NA
Bromodichloromethane (THM)	EPA 524.3	--	30	70-130	70-130	70-130	70-130
Bromoform (THM)	EPA 524.3	--	30	70-130	70-130	70-130	70-130
Chloroform (THM)	EPA 524.3	--	30	70-130	70-130	70-130	70-130
Dibromochloromethane (THM)	EPA 524.3	--	30	70-130	70-130	70-130	70-130
Total Trihalomethane (TTHM)	EPA 524.3	--	30	70-130	70-130	70-130	70-130

Parameter	Analytical Method	Field Duplicate Samples	Matrix Spike-Duplicates	Verification Standards			
				Lab Control Standard	Matrix Spikes	Internal Standard Recovery	Surrogate Standards
		Relative Percent Difference (% RPD)		Recovery Limits (%)			
INORGANICS							
MISCELLANEOUS							
Chemical Oxygen Demand	EPA 410.4	NA	NA	10% CCV	+/- 15% of expected concentration	NA	NA
Color	SM 2120B	NA					
Corrosivity	Langelier Index	NA					
Dissolved Organic Carbon	SM 5310C	--	20	20	NA	NA	NA
Foaming Agents (MBAs)	SM5540C	NA					
Methane	RSK175	NA					
Odor	2150B	NA					
Oxidation-Reduction Potential	SM2580B	NA					
pH	EPA 150.1	NA					
Specific Conductance	EPA 120.1	NA					
Total Dissolved Solids	SM 2540C	NA					
Total Organic Carbon	SM5310C		20	80-120	70-130	NA	NA
Total Suspended Solids	SM 2540D	NA					
Turbidity	EPA 180.1	NA					

Notes:
EPA - Environmental Protection Agency
Laboratory Control Sample (LCS) is synonymous with laboratory fortified blank.
MS/MSD - Matrix Spike/Matrix Spike Duplicate
CCV = Calibration Verification Standards
SOC = Synthetic organic compounds
SVOC = Semi-volatile organic compounds
VOC = Volatile organic compounds

7.0 Study Design

Groundwater samples will be collected monthly for seven months from Well No.10 beginning in the January 2023 or beginning the month after the QAPP addendum is approved. Field procedures for collecting water quality samples and field parameter measurements remain the same for the work described in this addendum. Differences are described below:

7.2.1. Water Level Monitoring

Prior to the start of groundwater quality sample collection water level monitoring will done by collecting manual measurements, air-line measurements and recording the digital readout for the City's pressure transducer. Once the pump has started groundwater level data will be collected approximately every 10 minutes using air-line until to termination of pumping.

7.2.2 Flow Rate Data and Field Water Quality Parameter Collection

Flow rate monitoring will be conducted when the well is pumping to the water supply system during sampling. The following protocol will be followed:

1. If the well has been pumping to the supply system for more than an hour prior to sampling, the instantaneous flow rate will be noted in the field notebook prior to and after the sample is collected.

2. If the well has not been running and the City wishes to add water to the supply system, the totalizer reading will be recorded prior to startup and the well will be purged to the infiltration basin until acceptably clear, per City protocol prior to directing water into the supply system. Once the City redirects water to the supply system, the flow rate will be monitored at 5-minute intervals until the well is purged of a minimum of three wellbore volumes and the field water quality parameters have stabilized. The totalizer reading will be recorded just prior to sample collection.

3. If the well has not been in-use prior to sampling, and the City does not wish to add the water to the supply system, the water will be directed to the infiltration basin and flow rate will not be monitored because no flow meter is present on the waste discharge piping. The well is estimated to produce 1,200 gpm when pumping to atmospheric pressure. With a volume of approximately 250,000 gallons, the infiltration basin can receive water for a minimum of three hours. This pumping period is likely to exceed the time needed for water quality parameters to stabilize prior to sample collection. The duration of pumping and an estimate of the volume purged prior to sampling will be recorded in the field logbook.

Field water quality parameters will be collected using a YSI556 multi-probe meter and flow-through cell. The parameters will include temperature, pH, DO, ORP, turbidity, and specific conductance. Field measurements will be used to evaluate whether water quality is stable for three successive measurements (and therefore representative) prior to sampling. Field measurements will be collected as follows:

1. If the well has been pumping to the supply system for more than one hour prior to sampling, the field parameters will be measured three times (minimum) at 5-minute intervals to assess stability prior to sampling. If measurements do not meet stability criteria, additional measurements will be collected.

2. If the well has not been running prior to sampling, field parameter measurements will be collected at 5-minute intervals until parameters are stable prior to sample collection.

7.2.3 Groundwater Water Quality Sample Collection

Groundwater quality samples will be collected for the water quality characterization suite shown in Table 6a. The groundwater sampling program under this addendum is designed to collect 7 monthly samples.

8.0 Field Procedures

This addendum modifies portions of Sections 8.2 and 8.3 of the original Phase 2a QAPP (NWGS 2021).

8.2.1.1 Water Level Monitoring

Manual water level readings will be collected Well No. 10 using the air-line. Prior to the first sample, the City's pressure transducer will be removed and air-line accuracy will be confirmed by comparing airline readings to a manual measurement using an e-tape. Subsequent sampling events will rely on air-line measurements only. The digital readout from the City's pressure transducer will also be recorded in the field log book.

8.2.1.3 Field Parameter Water Quality Parameters

Field water quality parameter measurements will be recorded with a calibrated field instrument as the well is purged prior to sample collection. These will include temperature, pH, conductivity, dissolved oxygen (DO), oxidation/reduction potential (ORP), turbidity, and specific conductance. A YSI 556 (or similar) will be calibrated daily according to the instrument user's manual. Calibration information will be recorded in the field logbook to document instrument performance. Field parameters recorded during the test will have an accurate date/time stamp to ensure accurate correlations with other test measurements.

- Temperature will be reported to the nearest 0.01°C
- pH will be measured and reported to the nearest 0.01
- DO will be measured and reported to the nearest 0.01 milligram per liter (mg/L)
- ORP will be measured and reported to the nearest 0.01millivolt (mV)
- Turbidity will be measured with a Lamont 20/20 WE, or similar capable of report to the nearest 0.05 Nephelometric Turbidity Unit (NTU).

If a field parameter measurement appears anomalous, the field hydrogeologist will repeat the measurement. If the result remains suspect, the instrument will be recalibrated. If the measurement remains consistent after recalibration, the measurement will be documented, and the results communicated to the Project Manager.

8.2.1.4 Groundwater and Source Water Quality Sample Collection

No source water samples will be collected as part of the work described in this QAPP addendum. Seven groundwater samples will be collected at a minimum 30-day interval and analyzed for the list of constituents in Table 6a. One duplicate sample will be collected during one of the first four of the seven events.

This data and information will be compiled as the results are received from the laboratory and evaluated by the project team. If exceedances of water quality criteria are observed Ecology will be notified.

8.3 Containers, preservations methods, and holding times

Water sample containers, preservatives, trip blank, and sample coolers will be provided by the analytical laboratory. Sample container type, volume requirements, preservation requirements, and hold times are listed by analytical category in Table 12a.

Water quality samples will be shipped on ice and coolers secured with a custody seal on the outside, with signature and date provided by the attending field hydrogeologist.

Table 12a. Sample Container, Preservation, and Holding Times

Analytical Group or Specific Analyte	Container Type and Size[1]	Preservative	Holding Time (minimum for analytical group)
Disinfection By-Products	9-40 mL VOA vials	3 NH_4Cl, 3 MA/AA, 4ºC	14 days
Inorganics	1L HDPE, 125 mL HDPE	1 L none, NaOH in 125 mL, 4ºC	48 hours
Metals (total and dissolved)	1L HDPE	4ºC	28 days
Dissolved organic carbon	2x 40ml VOA vials, filtered	HCl to pH <2, 4ºC	28 days
Total Organic Carbon	2x 40 mL VOA vials	HCl to pH <2, 4ºC	28 days
Hardness	1L HDPE	4ºC	6 months
Carbonate and/or Bicarbonate			14 days
Chloride			28 days
pH			**
Specific conductance			28 days
Sulfate			28 days
Turbidity			48 hours
Methane	40mL Amber	HCl, 4ºC	14 days

Notes:

[1] - If a bottle count is not included, it is assumed to be one bottle.
HCl = Hydrochloric acid
HNO_3 = Nitric acid
HDPE = High-density polyethylene
NaOH = Sodium hydroxide
L = Liter
mL = Milliliter
** = analyze immediately

9.0 Laboratory Procedures

9.1 Laboratory procedures table

The sample count is listed in Table 13a. Tables 6a presents anticipated water quality analyte list, analytical method, MDLs, and RLs for the amended geochemical suite and field water quality parameters.

Table 13a. Laboratory Methods Summary

Analytes	Sample Matrix	Samples	Methods and Details
Water Quality Characterization Analytical Suite	Source Water	1	Table 6
	Pre-recharge Groundwater Quality	1	Table 6
Geochemical Suite	Groundwater	1	Tables 6 and11
Duplicate Geochemical Suite	Groundwater	1	Tables 6 and 11
Amended Geochemical Suite	Groundwater	7	Table 6a
Duplicate Amended Geochemical Suite	Groundwater	1	Table 6a

9.2 Sample preparation method(s)

Water quality samples will be collected as described in Section 8.0. The sample preparation will be conducted in accordance with applicable method requirements by an accredited lab. Methods are listed in Table 6a.

9.4 Laboratories accredited for methods

An environmental laboratory accredited for drinking water analysis by Ecology Lab Accreditation Program will be used as the primary laboratory. Eurofins-Spokane, Ecology Laboratory No. C569-22a, EPA Lab ID: WA01220 is anticipated to be the prime laboratory for the Phase 2a geochemical and full water quality analytical program. Their address is:

- Eurofins – 11922 E. 1st Avenue Spokane Valley, WA 99206-5302

The primary laboratory will provide most of the proposed analytical testing; however, the primary laboratory may subcontract analytical work to other accredited laboratories as needed to complete the analytical program list. No single customarily utilized Washington Drinking Water-certified laboratory can complete the analytical program listed in WAC 173-200. In this case, we will coordinate with the lab to aid in meeting hold times. For example, samples could be shipped directly to the subcontracting laboratory. The primary laboratory will provide all groundwater and injection water sample containers, container preparation, preservatives, trip blank(s), and coolers to ship samples.

10.0 Quality Control Procedures

This section is discussed in detail in Section 10.0 of the Phase 2a QAPP (NWGS, 2021). The analyte list, analytical methods, MDLs, RLs, and PQLs for the samples collected under this QAPP Amendment are provided in Table 6a. The MQOs for the analyte list for the samples collected under this Amendment are provided in Table 7a.

10.2 Laboratory Quality Control

At the laboratory, data quality indicators will be evaluated by the proper handling of the samples, the use of standard procedures for sample analyses. Tables 6a and 7a references the analytes of interest for this investigation to the standard reference methods. MDLs for analytes in water samples are provided and shall be established as contractual requirements between NWGS/GeoEngineers and the subcontracted analytical laboratory. The subcontracted laboratory is responsible for implementing the analytical methods selected, documenting through Standard Operating Procedures modifications (if any) to the methods and providing these documents for review upon request. Any changes to the method number selected for analysis and identified in Tables 6a and 7a must first be brought to the attention of the Project Manager in writing before analysis can begin. These requirements will vary by method but generally include:

- Method blanks.
- Internal standards.
- Calibrations.
- MS/matrix spike duplicates (MSD).
- Lab Control Standards (LCS).
- Laboratory duplicates.
- Surrogate spikes.

Laboratories will be responsible for their respective laboratory QA plans and procedures. Calibration of analytical laboratory equipment shall be in accordance with the laboratory's internal procedures. Appendix A presents Eurofins' Quality Assurance Statement and Plan.

12.0 Audits and Reports

A data summary table, laboratory deliverables, and QA/QC summary will be provided to the client and J-U-B for use in updating the AKART analysis for the West Richland Well No. 10 Phase 2a Draft Report (NWGS 2022). The updated AKART will follow Ecology guidance in Publication no. 17-10-035 (Ecology 2017). A draft updated AKART Analysis will be submitted to the client December 2023 (Table 2).

12.4 Responsibility for Reports

- Phil Brown, Northwest Groundwater Services
- Brad Bessinger, SSPA

- Alex Fazzari, J-U-B Engineers, Inc.
- Kevin Lindsey, GeoEngineers, Inc.
- Alicia Candeleria, GeoEngineers, Inc.
- Laura Hanna no longer works for GeoEngineers, Inc. or any other team member. She has been replaced by Jon Travis from GeoEngineers, Inc.

15.0 References

NWGS, 2021. Quality Assurance Project Plan: City of Richland Phase 2a Well No.10. Publication 21-12-007 Approved April 2021.

NWGS, 2022. DRAFT- Well No. 10 Aquifer Storage and Recovery Project Phase 2a Report, City of West Richland. February.