



Kaiser Mead Groundwater Remediation Interim Action

Monitoring Plan Wetlands/EC Treatment System and Groundwater Response

Final

November 2020

Kaiser Mead Custodial Trust



Kaiser Mead Groundwater Remediation Interim Action

Project No: KMCT2019.3300
Document Title: Wetlands/EC Treatment System and Groundwater Response
Monitoring Plan
Revision: Final
Date: November 2020
Client Name: Kaiser Mead Custodial Trust
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1. Introduction

This Monitoring Plan describes monitoring locations, frequencies, parameters, and reporting for the operation of a wetlands/EC treatment system to be implemented in support of the Interim Action (IA) for the Kaiser Mead Custodial Trust (KMCT) at the former National Priorities List (NPL) site in Mead, Washington (Figure 1). This plan is prepared to establish a monitoring approach to ensure proper system operation, compliance with the effluent limitations, and to provide data needed to optimize system performance with respect to IA goals. This monitoring plan follows the requirements of WAC 173-340-820 and addresses each of the following system components:

- Extraction system;
- Wetlands treatment unit;
- Electrocoagulation treatment unit (EC);
- Infiltration system; and,
- Groundwater/subsurface response

Ecology has determined that the wetland/EC treatment methods constitute AKART for the pollutants of concern in the groundwater at the site. This monitoring plan will provide data to demonstrate performance of the system and support ongoing refinement of the technology-based performance expectations for the treatment system.

Treated water effluent discharge to the infiltration basin is authorized through a Model Toxics Cleanup Act (MTCA) permit exception to the State Waste Discharge permit. Under WAC 173-340-710(9) this IA is exempt from the procedural requirements of the State Waste Discharge Permit program for discharge of treated water to ground. However, KMCT must comply with relevant substantive requirements of such a permit. This Effluent Compliance Monitoring plan provides the discharge effluent limits, monitoring, and reporting to Ecology for compliance with substantive requirements under the IA.

The monitoring plan is organized into the following sections to address the system components listed above. Section 2 is a summary of the Treatment process and sampling locations that will be used to demonstrate compliance with effluent limitations and system performance. Section 3 provides the monitoring specific to effluent limitation compliance, removal efficiencies, and mass removal for the groundwater pollutants. Section 4 describes the operational parameters and monitoring approaches used to ensure proper system operation and their use as surrogate parameters for effective effluent treatment. Section 5 is focused on the groundwater response to extraction and infiltration, understanding that groundwater conditions are less variable with longer time periods for pollutant concentrations responses in groundwater. Section 6 provides reporting requirements for each of these monitoring components and includes format for data collection and calculations for discharge monitoring reports and for summary reports of groundwater response monitoring. A start-up plan has been provided separately for initial and specific data needs during startup, which includes more frequent sampling and locations, which will be used to further refine operational parameters in the operations of the system.

2. Treatment Process Description

The remediation system consists of the following components, sequenced according to the flow of groundwater through the extraction, treatment, and discharge processes:

- Groundwater Extraction – A groundwater wellfield captures impacted groundwater from within the identified groundwater plume and delivers it to the treatment processes for removal of contaminants of concern, cyanide and fluoride, and nitrate

- Wetland Treatment – An Enhanced Treatment Wetland (ETW) system utilizing anaerobic and aerobic processes to remove cyanide and nitrogen
- Electrocoagulation (EC) Treatment – Treats wetland effluent through the development of iron and aluminum complexes with cyanide and fluoride using electrical reduction of iron and aluminum plate anodes
- Infiltration Basin – Discharge of treated effluent from the EC process occurs at the infiltration basin, located over the existing groundwater plume down-gradient from the extraction system and upgradient of the compliance monitoring wells

Figure 3 shows the process flow diagram for the remediation system and the monitoring locations for sampling collection and surrogate parameters during the treatment process. The sampling stations and ports allow for grab samples of water for field measurements and analytical testing across the treatment processes. Surrogate operation parameters are measured as part of the treatment process and used in control and ensuring the systems are running within the effective operational boundaries for effective treatment.

Groundwater is extracted through pumping from the individual extraction wells into an extraction force main. Each well has a sampling station for monitoring from each wellhead. Figure 4 shows the process sampling port locations for raw influent, wetlands effluent, and final effluent. The raw influent is from the extraction wells with the sampling port located from the force main, before it discharges into the wetlands. The wetland effluent sampling port is located on the discharge line from the wetland system prior to the equalization tank. The final effluent sampling port is located after the EC treatment, located on the line after the bag filters, upstream from valving to discharge to the infiltration basin, return to wetlands, or fire pond.

The raw influent can be routed either to the wetlands, cell 1, or directly to the equalization tank for treatment by the EC system. Wetlands effluent can be monitored from a sampling port located after the wetlands, cell 3, and before discharge into the equalization tank for treatment by the EC system. Individual ponds can be sampled through sumps and cleanouts should the need arise but these locations are not routine sampling points. Surrogate operation parameters pH and electrical conductance are monitored continuously in the equalization tank as part of treatment for feed to the EC reactors, Rx1 and Rx2. Surrogate operation parameters current and voltage are monitored continuously in each reactor as part of the treatment controls.

The surrogate operation parameter pH is monitored continuously after the EC reactors in the defoam tank. The defoaming process provides pH adjustment and buffering through the flocculation, clarification, and filtration process. A sampling port is located after final filtration for collection of system final effluent prior to discharge to the infiltration basin, fire pond, or recirculation to the wetlands ponds. The operation parameter flow is measured on the discharge main continuously measuring instantaneous flow and totalizer volume of water discharged to the infiltration basin.

3. Treated Water Effluent Monitoring

This section describes monitoring of conducted from the IA treatment system. This monitoring consists of flow and analytical parameters for extracted raw influent, wetlands effluent, and treated effluent to the infiltration basin. Figure 3 shows the process diagram for treatment system with flow monitoring and sampling locations. Monitoring sampling and analysis will be conducted as described in Attachment A, Sampling and Analysis Plan. Samples collected of the treated effluent discharged to the infiltration basin are used for compliance with the required effluent limitations listed in Table 1. The flow and analysis results the treated water monitoring will be used to calculated the performance for removal efficiency and mass removed from raw influent to discharged effluent of the system.

3.1 Monitoring Locations, Parameters, and Frequency

The flow monitoring and sampling locations for the treatment system are shown on Figure 3. An inline flow meter measuring continuous flow and totalizer is located on the extraction main in the EC building to record the flow and total volume of groundwater extracted. An inline flow meter is located on the discharge main to the infiltration basin. The instantaneous flow and totalizer readings are recorded continuously, however will be documented in the discharge reporting sheet (Attachment B) at the time of sampling to be used in the treatment performance calculations.

Water grab samples are collected from raw influent, wetlands effluent, and final effluent at the sampling ports shown on Figure 3. The grab samples be analyzed for the parameters and methods in Table 1, with detection and reporting limits in general accordance with those shown and in compliance with the sampling and analysis plan in Attachment A. The minimum sampling frequency for the treatment is weekly, with data collected recorded as shown in Attachment B, discharge data sheet. The analysis results from the discharge main sampling will be used to demonstrate compliance with the effluent limitations shown in Table 2. More frequent sampling and analysis if conducted will also be recorded in the discharge data sheet and included in the calculations of treatment performance and demonstrated compliance with effluent limits.

The effluent limitations are based on an averaging period as shown in Table 2 and are based on calendar months. If system operations are suspended for a calendar month, Ecology will be notified, and discharge effluent sampling will not be conducted for that week, or month, as no discharges to the infiltration basin will be occurring.

Table 1 – Analytical Parameters and Methods

Parameter	Methodology	Detection Limit	Reporting Limit
Total Cyanide	EPA 335.4	0.004 mg/L	0.01 mg/L
Free Cyanide	ASTM D7237	0.001 mg/L	0.01 mg/L
Fluoride	EPA 300.0	0.06 mg/L	0.1 mg/L
Nitrate-N	EPA 300.0	0.04 mg/L	0.1 mg/L
pH	SW-846 9045D	1 to 14 standard units	2 to 13 standard units
<p>Note: Sampling methods, containers, preservation, and analytical quality assurance/quality control are detailed the SAP included as an attachment to this plan</p>			

Table 2 – Sampling Parameter, Frequency, and Final Effluent Discharge Limits

Parameter	Limit	Units	Frequency	Averaging Period
Total Cyanide	NA	mg/L	Weekly ^(a)	Calendar month average ^(c)
Free Cyanide	0.2	mg/L	Weekly ^(a)	Calendar month average ^(c)
Fluoride	4	mg/L	Weekly ^(a)	Calendar month average ^(c)
Nitrate-N	10	mg/L	Weekly ^(a)	Rolling annual average ^(d)
pH	6 to 9	s.u.	Weekly	None ^(b)
Flow	NA	gpm	Continuously	None

NA – Not applicable. Parameter is included in the effluent compliance monitoring for reporting purposes but does not have an effluent limit.

(a) – Sampling will be conducted at least once per week, with a minimum of 4 samples used in the calendar month average.

(b) – The pH will be continuously monitored as an operational parameter in the defoaming tank.

(c) – Calendar month average shall be calculated as the arithmetic average of the values for all effluent samples collected for a calendar month.

(d) – Rolling annual average shall be calculated as the average of the preceding twelve calendar monthly averages. Compliance with the limit shall be evaluated monthly beginning at the end of the twelfth calendar month following system start-up.

Note that during startup, initial condition monitoring may be initiated later in the calendar month. During start up, the initial averaging period will for four weeks, followed by calendar month average on the follow first full month of operations.

Visual inspection of the infiltration basin, basin berms, and standing water, and free board depth, if standing water is observed will be conducted on a weekly basis to monitor infiltration basin performance and address adverse conditions if observed that would require maintenance or repair.

The monitoring will incorporate consistent parameters, analytical methodology, sampling protocols, and quality assurance/quality control procedures implemented through a sampling and analysis plan (SAP) provided as Attachment A to this plan. This will provide a consistent framework for water to be collected and demonstrate that discharge water is in compliance with the limitations. Analytical services will be provided by an Ecology certified testing laboratory. Weekly pH measurements will be provided by Ecology certified operators and technicians.

4. Surrogate Operational Parameter Monitoring

Key operations parameters have been identified and will be monitored as surrogate monitoring parameters during operation of the electrocoagulation process. The surrogate parameters are specific to operational processes as described in Section 2. The treatment process and surrogate parameters are listed in Table 3. The surrogate parameter initial operational setpoints and controls are listed in Table 4. A high or low alarm set point triggers system alarms that are reported to the operators before the operational parameters are out of range and allow for adjustment while continuing operations. A high high or low low set point shuts off the system before operational parameters are exceeded in the treatment process.

The equalization tank is used to add calcium chloride to the influent stream prior to feeding into the EC reactors. The pH and electrical conductance are monitored continuously and used to control the addition of calcium and effectiveness of the EC reactor process.

There are two EC reactors in series, with water flowing through EC reactor Rx-1 first, and then through EC reactor Rx-2. The operational performance of the EC reactors is measured through continuous measurement of the current and voltage across the reactor. The current has a low and low low set point to ensure that sufficient charge is applied across the reactor to interact with the water across the sacrificial metal plates. Continued operation with the continuously measured surrogate parameters ensures proper treatment within the EC reactors to meet discharge effluent limitations.

The defoaming tank provides pH stabilization after the EC reactors, to allow for efficient deflocculating and clarification of treatment precipitates and inhibit redissolution of precipitated materials. The operational set points are within the range of the discharge effluent limitations with will be verified with downstream water sampling and analytical results collected as part of the monitoring program. The continuous monitoring of pH in the defoam tank will be used as a surrogate parameter to confirm that final effluent pH is steady and within discharge limits in between formal compliance grab samples.

The initial operational setpoints will be validated with analytical final effluent sampling data with these parameters being refined through operations. A narrower range of setpoints will be defined as operations develop a better understanding of the system performance under the specific treatment conditions. Revised setpoints will be validated through the discharge analytical sampling and providing acceptable boundary conditions for meeting discharge limits. New validated surrogate set points will be documented in the Discharge Monitoring Reporting (Attachment B).

Operators will record surrogate parameters across the treatment process as shown in the Discharge Monitoring Report, surrogate parameter data sheet. Reporting includes triggering of alarm conditions and the maximum or minimum value measured that triggered the alarm. If alarm conditions result in EC treatment being discontinued, the time interval for the reactor downtime will be recorded as shown in the Discharge Monitoring Report, operator notes data sheet. Notes will be recorded for operational downtime and return to operation. The operator notes will be used to document process metering issues and analytical deviations with resolution to be reflected in the effluent limitations and treatment performance reporting and ensure consistent and accurate demonstration of the treatment process and discharge.

Table 3 – Surrogate Parameters

Process	Parameter	Units	Frequency
Equalization Tank pretreatment for feed to EC reactors	pH	Standard units (s.u.)	Inline continuously
Equalization Tank pretreatment for feed to EC reactors	Electrical Conductance	microSiemens (uS)	Inline continuously
EC reactors	Current	Ampere (A)	Inline continuously
EC reactors	Voltage	Volts (V)	Inline continuously
Defoaming Tank providing pH adjustment and buffering for precipitation and removal flocculation and clarification	pH	Standard units (s.u.)	Inline continuously

Table 4 – Initial Operational Setpoints, Alarm Points, and Shutdown Points

<u>Surrogate Parameter</u>	<u>High High</u>	<u>High</u>	<u>Low</u>	<u>Low Low</u>
EQ Tank pH (s.u.)	10.5	9.0	8.5	-
EQ Tank EC (uS)	-	3000	2800	-
Rx-1 Current (A)	-	-	800	300
Rx-2 Current (A)	-	-	800	300
Post EC Rx Defoam Tank pH (s.u.)	8.5	7.4	7.2	6.2

5. Groundwater Response Monitoring

Groundwater monitoring includes groundwater extraction quantity and quality, changes in groundwater elevations, and changes in downgradient groundwater concentrations of the contaminant parameters. Figure 2 shows the groundwater well network used to monitoring the groundwater and evaluate the remediation effectiveness on downgradient groundwater concentrations of contaminant parameters. Figure 2 also shows the well network used in a separate wetlands detection groundwater monitoring (*Wetlands Detection Groundwater Monitoring Plan, Kaiser Mead Custodial Trust, May 2020*). The wetlands detection monitoring is conducted to determine if leakage from the ponds is occurring, which has separate monitoring and reporting requirements. This groundwater well network uses monitoring points in the current and ongoing compliance monitoring being conducted for the KMCT groundwater remediation interim action.

The groundwater response monitoring consists of the five extraction wells, groundwater monitoring network, sampling methods and frequency, detection parameters and analytical methods, and statistical methods to develop background and determination of statistically significant changes in groundwater contaminant concentrations related to extraction and infiltration operations.

5.1 Groundwater Response Monitoring Network and Sampling Frequency

The groundwater response monitoring network consists of compliance monitoring wells KM-1, KM-2, KM-3, KM-4, KM-5, KM-6, KMCP-1B, KMCP-2B, KMCP-3B, KMCP-4B, and KM-5B, extraction wells TW-1B, TW-2B, TW-3B, TW-4B, and TW-5B, and monitoring wells KM-15, KM-16, KM-17, and KM-18 (Figure 2). Wells TW-1B, TW-2B, TW-3B, TW-4B, and TW-5B will provide the drawdown due to pumping and concentrations of contaminant parameters captured in the extraction wellfield area of influence. Wells KM-15, KM-16, KM-17, and KM-18 are observation wells providing groundwater elevations used to evaluation the lateral influence of the groundwater extraction and infiltration basin in the B-zone saturated interval.

Depth to groundwater will be collected more frequently in the first quarter of monitoring, weekly for the first month, monthly for the following two months, and then quarterly from the five extraction wells and four observations, coordinated to coincide with depth to groundwater measurements collect in the compliance monitoring wells (per the requirements of the SAP, Attachment A). The depth to groundwater measurements will be used to calculate groundwater elevations and displayed as a hydrograph and

potentiometric surface map for determining flow direction and estimates of capture zone in the saturated unit.

Groundwater samples will be collected quarterly from the five extraction wells (from sampling stations), coordinated to coincide with the sampling in the compliance monitoring wells (per the requirements of the SAP, Attachment A). The groundwater analytic results will be used with the compliance monitoring results to provide updated groundwater plume maps in the saturated B-zone and time-series plots of groundwater concentrations in extraction wells.

5.2 Groundwater Response Monitoring Sampling Parameters and Analytical Methods

The groundwater response monitoring will incorporate consistent groundwater monitoring parameters (Table 5), analytical methodology, sampling protocols, and quality assurance/quality control procedures as described in the SAP (Attachment A). This will provide a consistent framework for groundwater to be collected with other groundwater monitoring being performed at the site. Groundwater samples will be collected from sampling stations installed for representative samples collected during extraction well operation. Purge water from the monitoring wells will be temporarily containerized for discharge into the wetlands groundwater treatment system.

Analytical services will be provided by SVL Analytical Inc. (Kellogg, ID), the same laboratory that performs analytical services for the compliance monitoring. Use of the same analytical testing laboratory provides consistent and comparable data results for site wide evaluation.

Table 5 Groundwater Response Monitoring Parameters

Parameter	Methodology	Detection Limit	Reporting Limit
Total Cyanide	EPA 335.4	0.004 mg/L	0.01 mg/L
Free Cyanide	ASTM D7237	0.001 mg/L	0.01 mg/L
Fluoride	EPA 300.0	0.06 mg/L	0.1 mg/L
Nitrate-N	EPA 300.0	0.03 mg/L	0.1 mg/L

Field parameters will be measured during sample collection in accordance with Attachment A. These parameters, specifically pH and specific conductivity, will be evaluated ongoing correlation of field parameters with analytic results for fluoride and total cyanide.

6. Reporting

The section summarizes the reporting and reporting frequency for the monitoring program. Treatment monitoring and surrogate monitoring data will be submitted quarterly in the Discharge Monitoring Report sheets.

The discharge monitoring report sheets will be provided electronically in pdf format by email to Ecology project manager within 30 days after the calendar quarter for the monitoring period ends. The submittal will consist of the five discharge monitoring sheets as shown in Attachment B, and cover sheet (submittal coversheet tab in Attachment B) as formal transmittal and certification of the data submitted.

The groundwater monitoring and response report will be submitted in electronic pdf format by email to Ecology project manager within 60 days after the calendar quarter for the monitoring period ends.

Groundwater response monitoring will be submitted in data reports quarterly, and an annual report summarizing the quarterly data reports and providing interpretation of groundwater response data for evaluation of the interim action effectiveness.

The quarterly groundwater response data reports will include summary information, including:

- Summary tables documenting flow, pH, temperature recorded during the sampling events and analytical results.
- Sampling forms
- Laboratory analytical packages.
- Data validation of analytical results will include transport, chain-of-custody, laboratory data package, percent recovery, matrix spike and spike duplicate, and blank spike recovery, in accordance with the SAP and laboratory analytical methods.

An annual groundwater response report will be submitted that incorporates the fourth quarter data report and include historical data, hydrographs, quarterly potentiometric surface maps, time-series plots, statistical trend analysis for determination of increasing or decreasing trends in downgradient monitoring wells and quarterly groundwater plume maps for evaluation of groundwater response to the IA. Annual evaluation reporting is considered appropriate given the anticipated time for groundwater response to groundwater extraction and anticipated cleanup timeframe.

Figures

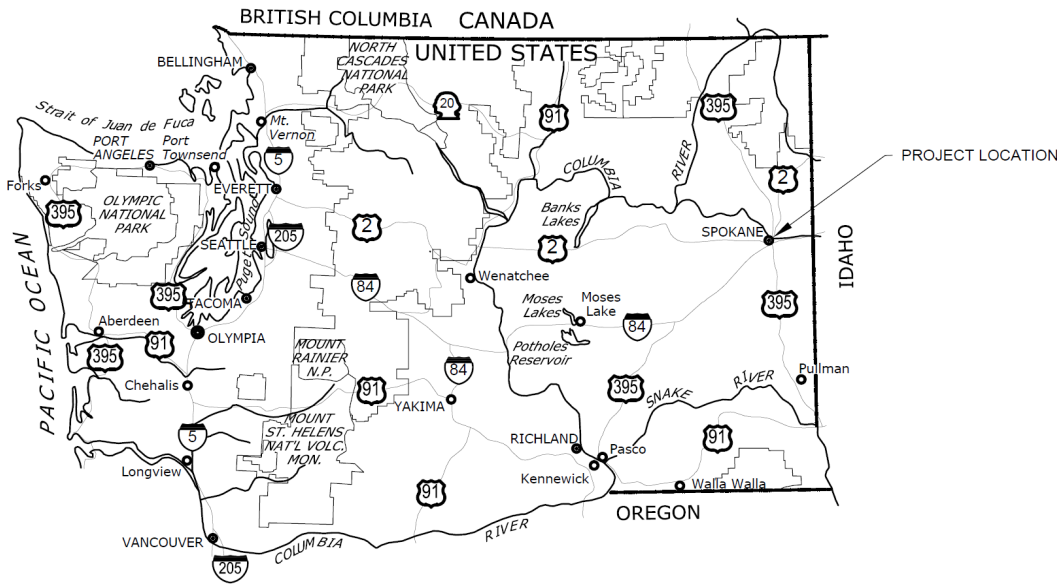


FIGURE 1
PROJECT LOCATION MAP
KAISER MEAD CUSTODIAL TRUST
SPOKANE, WASHINGTON



SITE AREA MAP




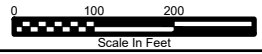

SITE ACCESS TO STAGING
AREA THROUGH SPOKANE
RECYCLING PROPERTY



LEGEND

- ⊕ EXTRACTION WELL
- ⊙ EXTRACTION WELLFIELD PERFORMANCE MONITORING LOCATIONS
- ⊗ WETLANDS DETECTION GROUNDWATER MONITORING LOCATION
- × CUSTODIAL SITE-WIDE GROUNDWATER MONITORING LOCATION

FIGURE 2
KMCT GROUNDWATER MONITORING LOCATIONS

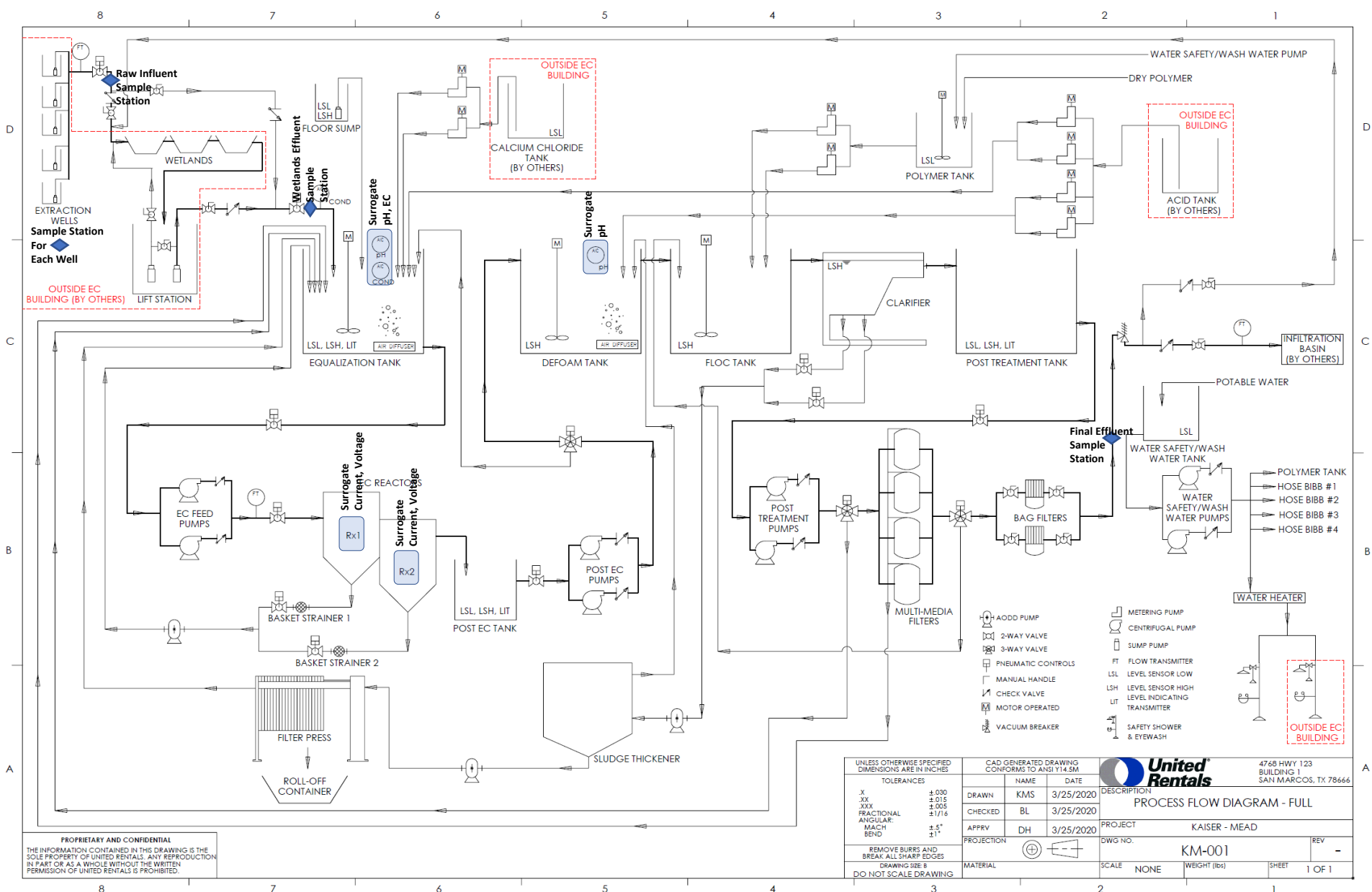


FIGURE 3
Process Flow Diagram
KAISER MEAD CUSTODIAL TRUST
SPOKANE, WASHINGTON



Raw Influent Sampling Station
Sampling located on the extraction force main from the well field, prior to valves to wetlands or EC system.

Wetlands Effluent Sampling Station
Sampling located on piping from wetlands prior to the equalization tank.



Final Effluent Sampling Station
Sampling located after bag filters, prior to valves controlling flow to infiltration basin, wetlands return, or fire pond.

FIGURE 4
Process Sampling Locations
KAISER MEAD CUSTODIAL TRUST
SPOKANE, WASHINGTON

Attachment A
Sampling and Analysis Plan



Kaiser Mead Groundwater Remediation Interim Action

Sampling and Analysis Plan

Final

November 2020

Kaiser Mead Custodial Trust



Kaiser Mead Groundwater Remediation Interim Action

Project No: KMCT2019.3600
Document Title: Sampling and Analysis Plan
Revision: FINAL
Date: November 2020
Client Name: Kaiser Mead Custodial Trust
Project Manager: Jay Dehner/SPK

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1. Introduction

This Sampling and Analysis Plan (hereinafter SAP) is for the Kaiser Mead Custodial Trust (KMCT) National Priorities List (NPL) site in Mead, Washington (Figure 1) and identifies monitoring requirements as part of the Kaiser Mead Groundwater Remediation Interim Action (IA). This SAP includes procedures that are designed to ensure monitoring results for the IA are representative. This SAP is intended for use by KMCT or its consultants and describes the sample collection, handling, and analysis procedures at the site, and under the requirements of WAC 173-340-0820. The site consists of the groundwater extraction wells, wetlands and electrocoagulation (EC) treatment system, infiltration basin for treated water, and network of groundwater monitoring wells (Figure 2). Groundwater monitoring wells are used for monitoring in situ groundwater elevations and contaminant concentrations in response to groundwater extraction and treatment IA. Figure 3 shows the process flow diagram for the extraction and treatment process with sampling station locations. Each extraction well has its own separate sampling station, the extraction main in the EC building has a sampling station for combined flow into the treatment system, and a sampling station is located after the bag filters prior to the discharge main to the infiltration basin.

1.1 Purpose

Groundwater at the former NPL site is contaminated with cyanide and fluoride, stemming from past waste and process wastewater management practices at the facility. The KMCT has been working with the Washington State Department of Ecology (Ecology) to address this contamination and contaminants of concern (COCs). In May 2019, Ecology approved an interim action to efficiently remove COCs from the groundwater plume, meet identified effluent limits, and to minimize operations and maintenance needs.

The purpose of this SAP is to support the sampling and analysis activities conducted at the site for the ongoing IA. The monitoring activities include, but are not limited to:

- **Site-wide Groundwater Compliance Monitoring Program (Site-wide Monitoring Program)** – The KMCT has been performing site-wide groundwater compliance monitoring of a select subset of site wells since at least 2006 as required by the Consent Decree. This monitoring currently consists of quarterly monitoring of 11 wells and water level monitoring at an additional 6 wells. The KMCT also conducts some limited surface water sampling to support overall compliance monitoring.
- **Wetlands/EC Treatment System Start-up Plan** – The KMCT start-up plan for initial startup of the groundwater extraction system and treatment system.
- **Monitoring Plan Wetlands/EC Groundwater Treatment System** – The KMCT monitoring plan to demonstrate the treatment system compliance with effluent limits for discharges into the infiltration basin. The infiltration basin receives the flow from the discharge force main after treatment of extracted groundwater. This plan provides the discharge effluent limits, monitoring, and reporting to Ecology for compliance with substantive requirements under the IA.
- **Wetlands Detection Groundwater Monitoring Plan** – The KMCT detection monitoring plan to evaluate groundwater downgradient of the lined wetlands pond system and detect leaks from the wetlands ponds. This wetlands detection groundwater monitoring plan will provide leak detection monitoring for the wetlands pond operations and will be coordinated with additional monitoring activities at the site described below.

1.2 Site History and Description

This section briefly summarizes the Kaiser Mead site history and current conditions. Please refer to Section 3.0 (*Site History, Description, and Previous Investigations*) of the *IAWP* for additional detail.

The site is located within the former Kaiser Aluminum Chemical Corporation smelter complex constructed by the United States government in 1942. The complex covers approximately 240 acres (Figure 1). The area immediately adjacent to the smelter complex is zoned for industrial use. The nearest residential properties are located approximately 1,500 feet to the northwest of the smelter. The Custodial Trust owns approximately 50 acres within the complex. Approximately 25 of the 50 acres are in the western portion

where waste materials were traditionally disposed of and where a groundwater contamination plume containing elevated levels of cyanide and fluoride exists. The groundwater plume extends from the northwest corner of the plant for approximately two and one-half miles to the Little Spokane River.

The site overlies the western end of the Spokane Valley-Rathdrum Prairie aquifer near the northern end of the Hillyard Trough. Beneath the site, groundwater occurs at a depth of approximately 140 to 150 feet below ground surface (bgs) in an aquifer composed predominantly of fine- to coarse-grained sand with intervening layers of thin and discontinuous silt and clay. The aquifer system underlying the site has historically been subdivided into (from shallowest to deepest) the A-Zone, B-Zone, and C-Zone hydrostratigraphic units (HSUs) for the purposes of discussing contaminant. The silt/clay layer separating the A-Zone and B-Zone HSUs pinches out to the west/northwest (approximately 800 feet downgradient from the spent potliner pile); as such, the water-bearing units are vertically continuous beyond this point.

Ecology became aware of the cyanide and fluoride groundwater contamination found at the site in late 1978. Since then, a series of remedial actions have been completed, culminating in the final SFS (Hydrometrics, 2018), which evaluated potential groundwater remedial actions for the site. As part of the SFS, additional site characterization was performed, the conceptual site model was refined, groundwater treatability studies were conducted, and potential remedial technologies were pilot tested. The SFS considered a variety of remedial technologies and combined feasible technologies into eight remedial alternatives. Alternative C(50), Groundwater Pumping and Treatment by Wetland-Electrocoagulation plus Monitored Natural Attenuation at a nominal rate of 50 gallons per minute (gpm), was selected as the preferred interim action.

1.3 Sampling and Analysis Objectives

This SAP has been prepared to ensure that the field and laboratory procedures utilized during the implementation of the monitoring plans are consistent with standard, generally accepted methods. This SAP provides a description of the specific procedures, activities, and protocols to be followed to meet the data collection and evaluation objectives. Field work conducted on behalf of KMCT will be conducted in accordance with the SAP, which is intended to promote:

- Consistent field procedures
- Collection of representative samples
- Proper calibration of field equipment to obtain accurate field measurements
- Minimization of cross-contamination, or the introduction of contaminants
- Accurate documentation of field observations, sampling procedures, and decontamination procedures
- Collection of samples that are accurate, defensible, and are of adequate technical quality to meet the data quality objectives.

1.4 Data Quality Objectives

Data and information collected during the monitoring programs will be compared to the groundwater cleanup levels established in the IA and to effluent limits established by Ecology. The primary objectives are to collect data on water levels, flow, and quality to assess current site conditions, monitor the treatment process and discharge, and the progress toward meeting groundwater cleanup levels. Data generated during the monitoring will require standard levels of quality assurance. Data will be of sufficient quality and quantity to support the assessment of current groundwater conditions, document the concentration of indicator substances, and confirm the effectiveness of IA for the site. Field sampling and monitoring, laboratory analysis, and data validation will be designed to meet those needs.

Two types of data, with correspondingly different levels of data quality, will be generated as part of the monitoring:

- Validated laboratory analytical data and State certified pH measurements; and
- Non-validated field measurements.

Data needs and uses are summarized in Table 1. Data quality objectives are presented in Table 2.

Laboratory analyzed water samples, along with field and laboratory quality assurance (QA) samples, will be subject to data validation prior to its use in the monitoring. The overall QA objective for these samples is to provide analytical data of known quality in terms of precision, accuracy, completeness, representativeness, and comparability. The same data validation requirements will apply to sludge samples collected for laboratory analysis.

Field calibration data will be maintained in field notebooks to document that field meter-derived data are collected from functional and properly calibrated equipment. Field calibration and limits are presented in Table 3. As an additional validation step, field-collected data will also be compared to normally expected values or historical measurements. Treatment system inline continuous measurements of flow, pH, temperatures, and conductivity, and will be compared against field measurements collected at a minimum weekly in accordance with the manufacturer recommendations in the operations and maintenance manual.

1.5 Revisions

Data gaps may be identified from evaluation of the data collected during implementation of the IA. If the field activities or treatment system monitoring are expanded, the SAP will be revised, as needed, to document the procedures that will be followed. Revisions will be submitted to Ecology for concurrence. However, revision of the SAP will not require modification to the IA or the Consent Decree.

1.6 Monitoring Frequency and Schedule

The specific monitoring plans include specific schedules and frequencies to address the goals and objectives of each activity. The monitoring sample collection, handling, and analysis procedures will be conducted in compliance with the SAP. Frequency and scheduled sampling will be coordinated between KMCT and Ecology and approved within each specific monitoring plan.

2. Sampling Methods and Quality Control

Proposed methodology for the collection and analysis of samples are identified below. Details regarding the sampling locations are shown on Figure 2, Figure 3, and Figure 4. Sampling activities include water samples from sampling stations and groundwater samples from monitoring wells. Individual sampling stations are available for each extraction well, providing data from individual wells. Sampling stations are located on the force main in the EC building to provide data from the combined flow from the extraction well field as raw influent, from the wetland effluent, and on the discharge force main to provide data for the final effluent discharged to the infiltration basin (Figure 3). Groundwater samples will be collected from monitoring wells accessing groundwater underlying the site providing data about the groundwater flow, direction, and contaminant concentrations (Figure 2). These data will be used to assess ongoing IA effectiveness and for optimization of groundwater extraction operations.

2.1 Sampling Station, Well Inspection, Redevelopment, and Repair

At the beginning a sampling event, each sampling station or monitoring well that will be sampled will be inspected to determine its condition. Following inspection of monitoring wells for wells without dedicated pumps the total depth will be measured to determine if well screens are partially or fully blocked with

sediment. Depending on the nature of repairs needed, repairs may be performed before or after sampling, or if specialized equipment is needed, prior to the next scheduled sampling event.

2.2 Groundwater Measurements, Samples, and Parameters

Groundwater monitoring consists of measuring the static water level, purging each well sufficiently to obtain a representative groundwater sample, measuring field water quality parameters (pH, temperature, specific conductance (SC), dissolved oxygen [DO], and oxidation-reduction potential [ORP]), recording observations for the collected sample (e.g., odor, appearance), and collecting water quality samples for field or laboratory analysis. Specific groundwater purging and sampling procedures are presented in Section 3.0 of this SAP. If the field measurements deviate significantly from expected values (e.g., pH or SC) or data from recent groundwater sampling events, the measurement(s) in question will be repeated.

Groundwater measurements will be collected from monitoring wells, as described in the monitoring plan. Table 2 lists the analytical parameters to be collected, analytical methods, and laboratory reporting limits.

2.3 Sample Station Measurements, Samples, and Parameters

Sampling station monitoring consists of recording the flow measurement, initiating flow and purging the sample station, reducing the flow and measuring field water quality parameters (pH, temperature, specific conductance), recording observations for the collected sample (e.g., odor, appearance), and collecting water quality samples for field or laboratory analysis.

Sampling stations are equipped with a valve to allow for sampling directly from flow during pumping operations and does not require additional pumps to collect a sample. Samples can only be collected during flowing conditions and the flow measurement will be recorded for use in calculations related to remediation performance. The extraction well sample stations require the line to be pumped free of water after sampling (for frost-free protection).

2.4 Field Quality Assurance/Quality Control

Grab samples are collected from discrete sampling stations and will be submitted for laboratory analysis with laboratory quality assurance/quality control as described in Section 6. Samples collected from groundwater monitoring wells will follow field quality assurance/quality control procedures and described in this section.

Three types of samples will be submitted to the laboratory as part of the field QA/QC program: field duplicates (FD), equipment blanks (EB), and matrix spike/matrix spike duplicates (MS/MSDs). These QA samples are described in the following sections. One EB will be collected for each sampling event when non-dedicated purging equipment is used (submersible pumps). Laboratory QA/QC procedures are described in Section 6. In addition, temperature blanks will be provided by the contract laboratory in sample coolers shipped to site with sample containers. Field duplicates will be collected from wells that are expected to contain measurable concentrations of analysis parameters. The MS/MSD sample can be collected from any well and the laboratory will be requested to run the MS/MSD specific to the site sample batch.

2.4.1 Field Duplicates

One field duplicate sample will be collected for each groundwater sampling event. The field duplicate sample will consist of an extra set of sample bottles and will be analyzed for the same constituents as the original samples. The field duplicate sample location will be determined in the field from a well that has historically shown to have detectable concentrations of analytical parameters. The duplicate will be assigned a different sample identification (ID) than the original sample. The duplicate sample ID will be such that it does not alert the laboratory personnel which sample the duplicate derived from. Both the original sample ID number and the duplicate sample ID number should be entered in the field notebook

and field form at the time they are collected. Additionally, the sample time for the field duplicate will be fictitious to further disassociate it from its parent sample.

2.4.2 Equipment Blanks

Analysis of equipment blanks serves to check the effectiveness of decontamination procedures, if not using dedicated pumps. One equipment blank sample will be collected for each sampling event using a portable submersible pump that contacts groundwater samples from multiple sampling locations. After decontamination, deionized water will be used to rinse the equipment, and the rinsate will be collected into the appropriate sample bottles for analyses. The source of water used for equipment blank will be recorded in the field notebook. One equipment blank will be collected for each groundwater sampling event if dedicated pumps are not used. Equipment blanks will be analyzed for the entire suite of analytical parameters.

2.4.3 MS/MSD (Collected for Laboratory QA/QC)

One MS/MSD sample will be collected during each groundwater sampling event. Extra sample bottles will be provided by the laboratory for the MS/MSD samples, which will be analyzed for all parameters. MS/MSD samples are typically collected at a minimum frequency of five percent (i.e., one for every 20 groundwater samples collected). MS/MSD samples will be labeled and identified on the COC to alert the laboratory of this status. The appropriate sample volume necessary to perform the MS/MSD analyses will be confirmed with the specific laboratory performing the analyses.

2.4.4 Field Replicates

Field replicate (split) samples will be prepared only if the Ecology Project Manager indicates the agency wants to collect them. Analytical parameters for field replicates will be the same as for normal samples. No field replicates are planned at this time.

3. Sampling Procedures

Sampling procedures can be separated into four main activities: (1) static water level measurement or flow measurement; (2) purging; (3) measurement of field water quality parameters; and (4) sample collection. Each procedure is described in detail below.

3.1 Static Water Level Measurement or Flow Measurement

Water level data will be used to evaluate groundwater flow directions and gradients. Water level measurements also will be used to identify the mid-point within the well screened interval based on the height of the water column for non-dedicated low-flow sampling and will be the initial step in sampling each well. Water levels will be measured in all wells on the same day at the beginning of each sampling event, prior to any well purging or sampling. Prior to water level measurement, each well will be inspected for signs of damage, and the inspection results will be documented in the field note book or field record sheet.

Each well to be sampled will be measured for static water level and total depth to the bottom of the well (TD), for wells without dedicated pumps, prior to well purging. The depth to the static water level (DTW) is the distance between a reference point (a marked point on the top edge of the inner well casing) and the static water level. The measurement will be performed using an electronic water level meter. The meter's probe will be lowered into the well until it enters the water. The probe should be raised and lowered several times to ensure that the DTW is correct. The DTW and TD will be measured to the nearest 0.01 foot and recorded along with the date and time of measurement, in the field notebook or field sheet. The water level meter will be decontaminated prior to initial use, between each well, and after completion of the water level measurement event.

The lines equipped with sampling stations also have inline electronic flow measurement devices. Prior to purge and sampling, the flow rate on the digital readout will be recorded.

3.2 Low-Flow Purging and Sampling

Groundwater sampling from groundwater monitoring wells will be purged and sampled using low-flow techniques, in accordance with United States Environmental Protection Agency guidance document EPA/540/S-95/504 (Puls and Barcelona, 1996), modified for the site conditions using the methodology described in Attachment 3. Low-flow groundwater sampling is the process of purging and sampling wells at low flow rates from within the well screen zone to minimize purging and improve sample quality. Low-flow groundwater sampling has the advantage of producing a representative groundwater sample with far less purge water than is obtained from conventional sampling of monitoring wells, in which three well volumes are purged prior to sampling. Low-flow purging and sampling refers to the velocity with which water passes through the well screen, not necessarily to the flow rate of water discharged at the surface. Water-level drawdown provides the best indication of the stress imparted by a given flow rate for a given hydrological situation.

Groundwater sampling will be performed using a submersible pump and disposable polyethylene tubing set near the center of the water column within the well screen. Groundwater will typically be purged at a rate of 0.1 to 0.4 Liter per minute (L/min) but will be based on limitations of the formation and the purge flow-through cell. Continuous measurement of field water quality parameters will be used to assess when purged water has reached equilibrium. Stabilization of these parameters would indicate that the water is representative of in-situ groundwater conditions (the formation immediately surrounding the well screen near the pump intake).

3.3 Purging and Measurement of Field Water Quality Parameters

Sampling station purging will be conducted by opening the valve and allowing water to flow from the sampling port to remove the line volume of water and rinsing the internal workings of the sampling station, minimum of 500 ml. Once purged, the discharge flow will be decreased with field parameters measured prior to sampling collection for analytical analysis. The field parameters to be measured will include temperature (T), pH, and specific conductance (SC).

Prior to monitoring well sampling, groundwater will be purged from each well using a submersible pump and low-flow techniques. New or dedicated tubing connected to a portable submersible pump will be used to purge and sample each well. Field water quality parameters will be measured to determine when water removed from a well is representative of in-situ groundwater conditions. The field parameters to be measured will include temperature (T), pH, specific conductance (SC), dissolved oxygen (DO), and oxidation-reduction potential (ORP). The field parameters will be measured using a multi-parameter water quality meter. All field measurements will be recorded on a field sampling form or field notebook. The field parameters will be measured at initiation of discharge and thereafter at three to five-minute intervals, until parameters stabilize. Stabilization will be achieved when three consecutive readings, taken at consistent three to five-minute intervals, are within the following limits:

- Temperature (± 0.2 degrees C);
- pH (± 0.1 units);
- Specific conductance ($\pm 3\%$);
- DO (± 0.3 mg/L);
- ORP (± 10 millivolts).

Field parameters will be measured using multi-parameter meters, such as a Horiba U-52 water quality probe, or equivalent. The water quality probe will be calibrated prior to any use at the beginning of each day and subsequently, as needed, based on observations of the equipment performance and in

accordance with manufacturer's recommendations. At a minimum, field meters will be calibrated at least daily during each sampling event.

Non-dedicated equipment used in the measurement of field parameters, such as probes, beakers, or the submersible pump, will be decontaminated. Disposable cups may be utilized in place of beakers to avoid the need for decontamination.

3.4 Sample Collection

Samples will be collected immediately following completion of purging, and in well pumping, as determined by stabilization of the field water quality parameters. The same submersible pump and tubing used to purge a well will be used to collect the groundwater sample from that well. Field sampling personnel will don disposable nitrile gloves during purging and sampling activities, with new gloves worn at each sampling location. Water will be carefully collected from the sample port or tubing into laboratory-supplied sample containers. Table 4 lists the sampling containers, preservatives, and hold times for the analysis parameters.

Following collection, samples will be placed in an ice-filled cooler. Each sample will be listed on a chain-of-custody form, which will be placed inside the cooler and accompany the samples to the laboratory. After all samples are collected, samples will be either shipped via overnight courier service or will be hand delivered to the contracted laboratory.

4. Sample Identification and Documentation

4.1 Sample Identification

Each sample will be identified with a unique monitor well identification and sample date. Sample labels will be affixed to containers prior to sample collection. The following convention will be used to label the water samples:

yymmdd-MWXX-

Where: yymmdd – The year, month, and day of collection (e.g., 2103015 = March 15, 2021.

MWXX – sample location ID (e.g., MW 01).

Field duplicates will be labeled as a fictitious ID number (such as 210315-FD) and sample time will be assigned to all field duplicate samples collected. To avoid missing analysis holding times, the time assigned to field duplicate samples will be later than the collection time for the parent sample.

Equipment blank samples will be designated with "EB" followed by the day of sample collection. For example, an equipment blank sample collected on March 15, 2021, would be labeled: 210315-EB. If more than one trip blank (or equipment blank) is submitted on the same day, then these samples will be labeled in sequences as follows: 210315-EB01, 210315-EB02, and so on.

MS/MSD samples will be collected as replicate samples from a sampling location. Triple volume will be collected and labeled appropriately, as discussed above. Samples for MS/MSD analysis will be clearly identified on the chain-of-custody, along with the well ID.

4.2 Sample Documentation

The following information will be documented in the field notebook or on field sheets:

- Sampling team members;

- Equipment model number and calibration information for each meter used in the field;
- Monitoring well purging data (including purge times, incremental and total volume removed during well purging, and water levels at the beginning and end of the purging process);
- Field water quality parameters measured after each purge volume;
- Management of purge water (i.e., total volume collected from each well, collection method, and where discharged into the on-site treatment system);
- Sampling data including sample ID, types of bottles/jars filled and analyses to be performed on each sample, method of collection (e.g., submersible pump), odor and visual description of the water, and date and time samples were collected; and
- Miscellaneous observations regarding well integrity, other nearby field activities and equipment problems/troubleshooting measures.

5. Sample Handling, Shipping, and Laboratory Receipt

Specific procedures for sample packaging and shipping will be followed to assure sample quality and minimize breakage during transport to the laboratory. Table 4 summarizes sample containers, preservation, and holding times for each set of analyses.

5.1 Sample Preservation

Some samples require preservation to retard biological action, slow hydrolysis, and reduce sorption effects. Preservation methods generally consist of pH control through chemical addition (e.g., hydrochloric acid [HCl]), refrigeration (chill to 4 degrees Celsius), and protection from light (e.g., use of amber glass bottles). When a chemical preservative is needed for selected parameters, the laboratory will provide bottles with appropriate preservatives already added addition (e.g., HCl). Bottles prepared with preservative will be pre-labeled and identified as "preserved" in order to distinguish them from non-preserved bottles.

Samples will be placed in a cooler containing ice (refrigerated) immediately after collection and held under chain-of-custody until samples are ready for packaging and shipment. The ice will be in double-sealed plastic bags to contain the meltwater.

5.2 Sample Custody

Field personnel will maintain custody records for all samples collected as part of the monitoring. A chain-of-custody (COC) form will be completed for each shipping container, and the information will be consistent with the sample identification matrix.

The following information is to be included on the COC form:

- Client name and contact information;
- Name of sampler, company name, and contact information;
- Site name and location;
- Sample ID number;
- Date and time of collection;
- Type of sample;

- Type of container;
- Number of bottles per sample
- Analyses requested (if not submitted on a separate sample analysis request form);
- Inclusive dates of possession;
- Signature of sampler; and
- Signature of receiver(s).

In addition to the labels, seals, and COC form, other components of sample tracking include the field notebook and sample shipment receipt.

5.3 Sample Packaging

Samples to be shipped to the contract laboratory for analyses will be handled and packaged appropriately to prevent damage during transport, and to maintain complete COC records. Coolers will be provided by the contracted laboratory and will be used for shipping sample containers. Bubble wrap may be used to pack and cushion the sample containers in the cooler. The COC form will be sealed in a plastic bag and will be taped to the inside lid within the cooler. Two custody seals will be adhered on the cooler at the front and adjacent side of the container. The name and address of the receiving laboratory will be placed in a position clearly visible on the outside of the cooler, and the lid will be secured with strapping tape.

5.4 Sample Shipment

Samples will be shipped in accordance with Department of Transportation approved procedures. Samples will be transported to the laboratory by a member of the sampling team, or will be shipped via overnight courier (e.g., FedEx) to contracted Ecology-accredited laboratory.

5.5 Laboratory Receipt

When samples arrive at the laboratory, the personnel receiving the sample cooler will sign the COC and enter a laboratory number for the sample batch on the form. In addition, laboratory identification numbers are assigned to each sample and used by the laboratory for internal tracking of the samples. Samples will be assigned to particular analytical procedures either on the COC or on a sample analysis request form which may be submitted to the laboratory separate from the samples following review of the field data. The analytical methods which will be used are listed in Table 2 with the analytical parameters, analytical methods, and reporting limits. Both the laboratory batch number and sample numbers assigned in the field will be cited when analyses are requested. The laboratory will sign the COC and laboratory request forms and send a copy to the requestor for placement in the master job file.

Damaged sample containers, sample labeling discrepancies between sample container labels and COC forms, and analytical request discrepancies will be noted on the COC form or laboratory sample receipt checklist, and the QA/QC Manager will be notified for problem identification and resolution.

5.6 Calibration of Field Equipment

The following field equipment will be used to support the sampling program:

- Electronic water-level meter,
- Multi-parameter water quality meter (Horiba U-52, or equivalent meters) capable of measuring temperature, pH, specific conductance, DO, and ORP

Calibration will be performed prior to each sampling event per the manufacturer's specifications. Recalibration will be performed, as needed, if inconsistent readings or unexpected readings are obtained. Quality control specifications associated with field measurements are summarized in Table 3. This shows

control parameters to be assessed, control limits, and the corrective actions to be implemented if the control limits are exceeded.

Field equipment will be used to compare measurements to inline continuous meter measurements during each sampling event, and meters will be monitored and calibrated per the manufacturer's specifications.

5.7 Decontamination of Sampling Equipment

All non-dedicated field equipment that comes into contact with water (e.g., field meters, probes, and submersible pumps) will be washed in an Alconox or Liquinox cleaning solution, and double-rinsed with deionized water prior to use at each sampling location, and at the end of each sampling event. Water used for decontamination of non-dedicated equipment will be collected, containerized, and disposed of in the wetlands/EC treatment system. Equipment blanks will be collected to document the effectiveness of the decontamination process.

The sample containers for water samples are provided by the contract laboratory for each sampling event and are discarded after analysis.

5.8 Disposal of Investigation Derived Waste

Purge water and water used for decontamination of non-dedicated equipment will be placed temporarily into five-gallon buckets (for measurement purposes) and will be placed in the equalization tank located in the treatment building. With the use of low-flow sampling techniques, the estimated purge volume will be approximately 1 to 2 gallons per well, and less than that for sampling stations. Well re-development water, if performed, and water used to decontaminate the non-dedicated sampling equipment will be managed the same way.

Disposable personal protective equipment (PPE) will consist primarily of used nitrile gloves. Miscellaneous solid wastes generated during groundwater monitoring may consist of tubing, paper towels, plastic wrappers, plastic cups, and other similar materials. Total volume is expected to be one large plastic bag per day, which will be disposed of in wetlands/EC treatments system waste containers at the site for disposal as municipal waste.

If sediment is generated from monitor wells during redevelopment activities it will be containerized in 55-gallon steel drums and labeled with the name of the Site, monitoring well number, and date of collection. The drums will be temporarily staged on-site prior to disposal by the KMCT. Disposal of the sediment will be arranged by KMCT at an appropriate disposal location.

6. Laboratory Quality Assurance/Quality Control

6.1 Data Quality Objectives

Data quality may be evaluated relative to representativeness, comparability, precision, accuracy, and completeness. Procedures to evaluate these are detailed in *National Functional Guidelines for Inorganic/Organic Data Review* (EPA, 2002). Definitions of these parameters and methods in which to quantify accuracy, precision, and completeness are provided below. Table 1 lists the data needs and uses for the SAP. Table 2 lists the target detection levels and goals for accuracy, precision, and completeness.

6.1.1 Completeness

Completeness is the number of valid measurements compared with the total number of measurements generated. Completeness will be determined for each method, matrix, and analyte combination. The quantitative definition of completeness is given below. The target completeness objective will be

95 percent; the actual completeness may vary depending on the intrinsic nature of the samples. The completeness of the data will be assessed during quality control reviews.

Completeness is quantified as follows:

$$\%C = 100\% \times \left[\frac{V}{T} \right]$$

where:

%C = percent completeness

V = number of measurements judged valid

T = total number of measurements

(based on project-specific requirements)

Invalid data (i.e., data qualified as “R,” rejected) will be identified during the data quality review.

6.1.2 Precision

Precision is a measure of reproducibility of analytical results. It can be defined as the degree of mutual agreement among individual measurements obtained under similar conditions. Total precision is a function of the variability associated with both sampling and analysis. Precision will be evaluated as the relative percent difference (RPD) between field duplicate sample results or between the MS and MSD results. A quantitative definition of RPD is given below. Field duplicate samples will be collected to evaluate precision at a frequency of one per sampling event. Table 2 lists target quantitative precision objectives.

If calculated from duplicate measurements, precision may be quantified as follows:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2) / 2}$$

where:

RPD = relative percent difference

C₁ = larger of the two observed values

C₂ = smaller of the two observed values

6.1.3 Accuracy

Accuracy is the degree of agreement between a measured value and the “true” or expected value. It represents an estimate of total error from a single measurement, including both systematic error, or bias, and random error that may reflect variability due to imprecision. Accuracy is evaluated in terms of percent recovery (%R) determined from results of MS/MSD and laboratory control sample (LCS) analyses. The laboratory will use and report laboratory-generated accuracy control limits. MS/MSD samples will be collected to assess accuracy at a frequency of one set for each sampling event. Table 2 lists target quantitative accuracy objectives.

For measurements where matrix spikes are used, accuracy may be quantified as follows:

$$\%R = 100\% \times \left[\frac{S - U}{C_{sa}} \right]$$

where:

%R = percent recovery

S = measured concentration in spiked aliquot

U = measured concentration in unspiked aliquot

C_{sa} = actual concentration of spike added

6.1.4 Representativeness

Representativeness is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the samples. Sampling plan design, sampling techniques, and sample handling protocols (for example, storage, preservation, and transportation) have been developed to enhance representativeness. Documentation prescribed under this plan will establish that protocols have been followed and sample identification and integrity ensured. Field duplicate samples will be used to assess method variation. Laboratory sample retrieval, storage, and handling procedures have also been developed and are discussed in subsequent sections of this plan. Laboratory method blanks will be run at the minimum frequency of 5 percent or one per set to assess laboratory contamination.

6.1.5 Comparability

Comparability of the data will be evaluated by using standard laboratory methods and procedures, which have been defined or referenced in this document. Data comparability will be maintained through the use of consistent methods, consistent units, and well-defined detection limits. Table A-2 lists the specific analysis parameters and applicable methods. Table A-2 also presents detection limits, as applicable. The target detection limits for the project will be method reporting levels (MRLs) as provided by the contract laboratory. Method modifications to lower detection limits are cost-prohibitive and beyond the scope of this plan; thus, target detection limits for this study are laboratory MRLs. Detection limits are established using pure standards. During measurement of an actual sample, detection limits may be elevated because of interference from other components in the matrix. This cannot be predicted ahead of time but will be reported if it occurs.

6.2 Method Detection Limits, Reporting Limits, and Instrument Calibration Requirements

6.2.1 Method Detection Limits

The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. Each participating laboratory will determine the MDL for each method, matrix, and analyte for each instrument that will be used to analyze samples.

6.2.2 Reporting Limits

In general, reporting limits (RL) should be greater than two times the calculated MDL. RLs used by the laboratory should not be greater than the reporting limit objectives listed in Table 1. When calibrating instruments, a standard at a concentration equal to or less than the RL should be included.

6.2.3 Instrument Calibration

Laboratory instruments will be calibrated by qualified personnel prior to sample analysis according to the procedures specified for each method. Calibration will be verified at method-specified intervals throughout

the analysis sequence. The frequency and acceptance criteria for calibration are specified for each analytical method in Table 5.

6.3 Elements of Analytical Quality Control

Laboratory QC checks indicate the state of control that prevailed at the time of sample analysis. QC checks that involve field samples, such as matrix and surrogate spikes and field duplicates, also provide an indication of the presence of matrix effects.

A laboratory QC batch is defined as a method blank, LCS, MS/MSD, or a sample duplicate (depending upon the method) and 20 or fewer environmental samples of similar matrix that are extracted or analyzed together. Each preparation or analytical batch should be identified in a way that will associate environmental samples with the appropriate laboratory QC samples.

6.3.1 Method Blanks

A method blank (or laboratory reagent blank) is used to monitor each preparation or analytical batch for interference or contamination from glassware, reagents, and other potential contaminant sources in the laboratory. A method blank is an analyte-free matrix (laboratory reagent water) to which all reagents are added in the same amount or proportions as are added to samples. It is processed through the entire sample preparation and analytical procedures along with the samples in the batch. There should be at least one method blank per preparation or analytical batch. If a target analyte is found at a concentration that exceeds the RL, corrective action must be performed to identify and eliminate the contamination source. Associated samples must be re-prepared or reanalyzed, or both, after the contamination source has been eliminated if the compounds detected in the associated blank are also present in the field samples. No analytical data may be corrected for the concentration found in the blank (no blank correction).

6.3.2 Laboratory Control Sample

An LCS consists of an analyte-free matrix (laboratory reagent water) spiked with known amounts of analytes that come from a source different than that used for calibration standards. The spike levels should be less than or equal to the midpoint of the calibration range. If LCS results are outside the specified control limits, corrective action must be taken, including sample re-preparation or reanalysis, or both, if appropriate. Documentation of the re-preparation or reanalysis, or both, must be provided in the analytical report. If more than one LCS is analyzed in a preparation or analytical batch, the results for each of the LCSs analyzed must be reported. Any LCS recoveries that are above or below the QC limits affect the accuracy for the entire batch and require corrective action.

6.3.3 Matrix Spike/Matrix Spike Duplicate

An MS is a sample matrix fortified with known quantities of specific compounds; it is subjected to the same preparation and analytical procedures as the native sample. Target analytes are spiked into the sample. MS recoveries are used to evaluate the effect of the sample matrix on the recovery of the analytes of interest. An MSD is a second fortified sample matrix. The RPD between the results of duplicate MSs measures the precision of sample results. One MS/MSD (or laboratory duplicate, as required by the method) per 20 project-specific samples will be analyzed. The spike levels should be less than or equal to the midpoint of the calibration range. Exceedances of control limits should be flagged in the analytical report.

6.3.4 Laboratory Sample Duplicate

For some methods, a laboratory duplicate is performed instead of a matrix spike duplicate. A laboratory sample duplicate is a sample duplicate selected by the laboratory. It is subjected to the same preparation and analytical procedures as the native sample. The RPD between the results of the native sample and laboratory sample duplicate measures the precision of sample results. The data collected may also yield information regarding whether the sample matrix is homogenous or heterogeneous.

6.4 Additional Quality Control Requirements

6.4.1 Holding Time

The holding time requirements specified in Table 4 must be met. For methods requiring both sample preparation and analysis, the preparation holding time will be calculated from the time of sampling to the completion of preparation. The analysis holding time will be calculated from the time of completion of preparation to the time of completion of the analysis, including required dilutions, confirmation analysis, and reanalysis. For methods requiring analysis only, the holding time is calculated from the time of sampling to completion of the analysis, including required dilutions, confirmation analysis, and reanalysis.

6.4.2 Sample Dilution

Dilution of a sample results in elevated RLs and ultimately affects the usability of the data related to potential actions at the sampling site. It is important to minimize dilutions and maintain the lowest possible RLs. When dilutions are necessary because of high concentrations of target analytes, lesser dilutions should also be reported to fully characterize the sample for each analyte. The level of the lesser dilution should be such that it will provide the lowest possible RLs without having a lasting deleterious effect on the analytical instrumentation.

6.4.3 Standard Materials and Other Supplies and Consumables

Standard materials must be of known high purity and traceable to an approved source. Pure standards must not exceed the manufacturer's expiration date or 1 year after receipt if no expiration date is provided. Solutions prepared by the laboratory from the pure standards must be used within the expiration date specified in the laboratory's standard operating procedure (SOP).

All other supplies and consumables must be inspected prior to use to ensure that the supplies meet the requirements specified in the appropriate SOP. The laboratory's inventory and storage system should ensure their use within the manufacturer's expiration date and storage under proper conditions.

6.4.4 Laboratory QA Program

The laboratory will maintain a quality assurance manual or equivalent document. The manual must include all of the requirements provided in the National Environmental Laboratory Accreditation Program. The manual will define the laboratory's internal procedures for QA/QC as follows:

- QA policies, objectives, and requirements
- Organization and personnel
- Document control
- SOPs (analytical methodology and administrative)
- Data generation
- Software verification
- Quality assurance
- Quality control
- Nonconformance/corrective action procedures
- Data review

6.4.4.1 Laboratory SOPs

The laboratory will maintain SOPs for all analytical methods and laboratory operations. The format for SOPs will conform to the following:

- *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, SW-846, Third Edition, Update III, Section 1* (EPA, 1996)
- "Good Laboratory Practices" in *Principles and Guidance to Regulations for Ensuring Data Integrity in Automated Laboratory Operations* (EPA, 1995)

All SOPs must have a unique identification number that is traceable to previous revisions of the same document.

6.4.4.2 Demonstration of Capability

Laboratory QA department personnel will maintain records documenting the ability of each analyst to perform applicable method protocols. Documentation will include annual checks for each method and analyst. In addition, internal, blind performance evaluation samples for each method and matrix demonstrating overall laboratory performance must be submitted annually. The laboratory may receive additional blind performance evaluation samples in conjunction with this program.

6.5 Data Quality Review and Validation

6.5.1 Data Review and Verification by Laboratory

Data reduction will be performed manually or by using appropriate application software. Quantitation procedures specified for each method must be followed. If data reduction is performed manually, the documentation must include the formulas used. Any application software used for data reduction must have been verified previously by the laboratory for accuracy. Documentation of the software's verification must be maintained on file in the laboratory. All documentation of data reduction must allow re-creation of the calculations.

All data will undergo a minimum of three levels of review at the laboratory prior to release. The analyst performing the tests will initially review 100 percent of the data. After the analyst's review has been completed, 100 percent of the data will be reviewed independently by a senior analyst or by the section supervisor for accuracy; compliance with calibration, QC requirements, and holding times; and completeness. Analyte identification and quantitation must be verified. Calibration and QC results will be compared to the applicable control limits. Reporting limits will be reviewed to make sure they meet the project objectives. Results of multiple dilutions will be reviewed for consistency. Any discrepancies must be resolved and corrected. Laboratory qualifiers will be applied when there are non-conformances that could potentially affect data usability. These qualifiers must be properly defined as part of the deliverables. All issues that are relevant to the quality of the data must be addressed in a case narrative. The laboratory quality control manager should review a minimum of 10 percent of data or deliverables generated for this program against the project-specific requirements. A final data review will be conducted by the Laboratory Manager or Client Service Representative to ensure that all required analyses were performed on all samples and that all documentation is complete.

Electronic laboratory reports for all samples and analyses will contain the information necessary to perform data evaluation.

The report will include:

- Cover letter complete with:
 - Title of report and laboratory unique report identification (Sample Delivery Group Number)
 - Project name and location
 - Name and location of laboratory and second-site or subcontracted laboratory
 - Client name and address
 - Statement of authenticity and official signature and title of person authorizing report release
- Table of Contents
- Summary of samples received that correlates field sample IDs with the laboratory IDs
- Laboratory qualifier flags and definitions
- Field identification number
- Date received
- Date prepared

- Date analyzed (and time of analysis if the holding time is less than or equal to 48 hours)
- Preparation and analytical methods.
- Result for each analyte
- Dilution factor
- Sample-specific reporting limit adjusted for sample size, dilution/concentration
- Sample-specific MDL adjusted for sample size, dilution/concentration
- Units
- MS/MSD and LCS spike concentrations, native sample results, spiked sample results, percent recoveries, and RPDs between the MS and MSD results. Associated QC limits must also be provided.
- Method blank results
- Analytical batch reference number that cross references samples to QC sample analyses
- Executed CoC and sample receipt checklist
- Case narrative that addresses the following information, at a minimum:
 - Sample receipt discrepancies, such as temperature exceedances
 - Descriptions of all non-conformances in the sample receipt, handling, preparation, analytical and reporting processes and the corrective action taken in each occurrence
 - Identification and justification for sample dilution is optional

6.5.2 Electronic Deliverables

Within the timeframe specified in the laboratory statement of work from sample receipt, the laboratory will deliver hardcopy reports and the electronic data in WADOE EIM format. All electronic data files will match the final hardcopy results.

All raw data will be maintained on file in the laboratory and will be available on request by project management. Complete documentation of sample preparation and analysis and associated QC information will be maintained in a manner that allows easy retrieval in the event that additional validation or information is required. All documentation must be retained for a minimum of 10 years after data acquisition.

The primary responsibility for the implementation of these procedures within the laboratory will reside with the Laboratory Manager or equivalent. The Laboratory Manager will approve laboratory reports before transferring the information to the client.

6.5.3 Data Review and Validation

The purpose of the data quality review and validation is to eliminate unacceptable analytical data and to apply data qualifiers to any data affected by quality issues. The data quality review will include a review of laboratory performance criteria and sample-specific criteria. The reviewer will determine whether the measurement quality objectives have been met and will calculate the data completeness for the project.

The data will be reviewed in accordance with the criteria contained in the National Functional Guidelines (NFGs) for *Inorganic Superfund Data Review* (EPA, 2014), and laboratory QC criteria (as applicable for each analytical method used). All reports will be reviewed for:

- Chain-of-custody records
- Case Narrative
- Proper sample collection and handling procedures

Electronic data will be loaded into an Access database that includes quality control limits and flagging criteria. An automated validation of the data will be performed using this database. Automated validation will result in review of:

- Holding times
- Field QC results
- Laboratory blank analysis
- MDLs and RLs
- Laboratory duplicate precision
- MS/MSD recoveries
- LCS recoveries
- Data completeness

Additionally, a manual 10 percent review of hardcopy versus electronic data will be performed.

Qualifiers will be added to data during the review as necessary. Qualifiers applied to the data as a result of the review will be limited to:

- U The analyte was analyzed for but was not detected above the detection limit.
- J The analyte was detected, but the associated numerical value is considered an estimated quantity.
- UJ The analyte was not detected above the detection limit. However, the detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified. No associated value is reported.

The corrective action and flagging criteria as listed in the NFGs will be used as guidance for applying the above flags to the samples results.

6.5.4 Data Quality Reports

A summary of the data quality review and validation will be included in Data Quality Reports (DQR) following each sampling event. The DQR will provide an interpretation of the data quality, identify which sample results were flagged and why (if needed), as well as evaluate the need for corrective actions. The report will include an evaluation of overall laboratory data precision, accuracy, completeness, representativeness, and comparability; an assessment of the overall data usability; and a discussion of any data use limitations.

7. References

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Washington State Department of Ecology (Ecology). 2019. "Model Toxics Control Act." <https://ecology.wa.gov/Spills-Cleanup/Contamination-cleanup/Rules-directing-our-cleanup-work/Model-Toxics-Control-Act>.

Tables

Table 1. Data Needs and Uses

KMCT IA Sampling and Analysis Plan

Constituent	Data Needs & Rationale	Data User	Method	Units	Reporting Limit	Effluent Limit ¹
Field Parameters						
Flow	Field Parameter, operation and treatment volume/mass calculation	Hydrogeologist, regulators, operators	inline meter	gpm	--	--
Temperature	Field Parameter	Field samplers, hydrogeologist	Field Probe	Celsius	--	--
pH	Field Parameter, low-flow sampling criteria, effluent limit	Field samplers, hydrogeologist	Field Probe	Unitless	--	6 - 9
Specific Conductance (SEC)	Field Parameter, low-flow sampling criteria	Field samplers, hydrogeologist	Field Probe	µS/cm	--	--
Dissolved Oxygen (DO)	Field Parameter, low-flow sampling criteria	Field samplers, hydrogeologist	Field Probe	mg/L	--	--
Oxygen Reduction Potential (ORP)	Field Parameter, low-flow sampling criteria	Field samplers, hydrogeologist	Field Probe	mV	--	--
Static depth to groundwater	Needed for low-flow sampling & groundwater flow direction	Hydrogeologist, regulators, operators	Field Probe	feet	--	--
Analytical Parameters						
Cyanide (total)	Groundwater monitoring, remediation performance	Hydrogeologist, regulators, operators	EPA 335.4	mg/L	0.01	--
Cyanide (free)	Groundwater monitoring, remediation performance, effluent limit	Hydrogeologist, regulators, operators	ASTM D7237	mg/L	0.01	0.2
Fluoride	Groundwater monitoring, remediation performance, effluent limit	Hydrogeologist, regulators, operators	EPA 300.0	mg/L	0.1	4
Nitrate (as N)	Groundwater monitoring, remediation performance, effluent limit	Hydrogeologist, regulators, operators	EPA 300.0	mg/L	0.1	10
pH	Remediation performance, effluent limit	Hydrogeologist, regulators, operators	SW-846 9045D	mg/L	0.1	10

Acronyms/units:

µS/cm - microSiemens per centimeter EPA = Environmental Protection Agency
 mg/L = milligrams per liter ASTM = American Society for Testing and Materials
 mV = millivolts "--" = Not applicable
 gpm = gallons per minute SW = EPA SW-846 methods

Column Header Footnote:

1. Effluent limits listed in Kaiser Mead Interim Action Workplan, proposed substantive permit requirements for discharge of treated water to ground (Ecology, January 10, 2019)

Table 2. Data Quality Objectives

KMCT IA Sampling and Analysis Plan

Constituent	Method	Units	Reporting Limit	Effluent Limit	Matrix Spike Precision (RPD)	Matrix Spike Accuracy (%R)	Laboratory Control Sample Accuracy (%R)	Completeness (Percent)
Field Parameters								
Flow	inline meter	gpm	--	--	NA	NA	NA	NA
Temperature	Field Probe	Celcius	--	--	NA	NA	NA	NA
pH	Field Probe	Unitless	2 - 12	6 - 9	NA	NA	NA	NA
Specific Conductance (SEC)	Field Probe	µS/cm	--	--	NA	NA	NA	NA
Dissolved Oxygen (DO)	Field Probe	mg/L	--	--	NA	NA	NA	NA
Oxygen Reduction Potential (ORP)	Field Probe	mV	--	--	NA	NA	NA	NA
Static depth to groundwater	Field Probe	feet	--	--	NA	NA	NA	NA
Analytical Parameters								
Cyanide (total)	EPA 335.4	mg/L	0.01	--	20	90 - 110	90-110	95
Cyanide (free)	ASTM D7237	mg/L	0.01	0.2	20	79 - 121	90-110	95
Fluoride	EPA 300.0	mg/L	0.1	4	20	90 - 110	90-110	95
Nitrate (as N)	EPA 300.0	mg/L	0.1	10	20	90 - 110	90-110	95
pH	SW-846 9045D	mg/L	2 - 12	6 - 9	NA	NA	NA	NA

Acronyms/units:

µS/cm - microSiemens per centimeter
 mg/L = milligrams per liter
 mV = millivolts
 SW = EPA SW-846 methods

EPA = Environmental Protection Agency
 ASTM = American Society for Testing and Materials
 RPD = Relative percent difference
 %R = Percent recovery
 "--" = Not applicable

Table 3. Measurement Performance Criteria (onsite field measurements)

KMCT IA Sampling and Analysis Plan

Matrix	Parameter	Method	Units	Stabilization Criteria ¹	Calibration	Accuracy/Calibration Limit	Detection Limits
Water	pH	Hand-held multi-parameter probe (Horiba U-22 or equivalent)	standard units	+/- 0.1	At least daily with two buffer solutions (pH 4.0, 7.0, and/or 10.0)	+/- 0.1	1 to 14
Water	Temperature	Hand-held multi-parameter probe (Horiba U-22 or equivalent)	Degree C	None	None	+/- 0.4	-30.0 to 130.0
Water	Conductivity	Hand-held multi-parameter probe (Horiba U-22 or equivalent)	µS/cm	+/- 3%	At least daily calibration check of one or more standard (KCL) selected based on expected range	+/- 3%	0 to 9,999 µS/cm
Water	Oxidation-Reduction-Potential (ORP)	Hand-held multi-parameter probe (Horiba U-22 or equivalent)	mV	+/- 10 mV	Calibrate at least daily. ORP varies greatly with temperature; calibrate using standard solution, and use chart of solution values per temperature.	+/- 15 mV	+/- 1999 mV
Water	Dissolved Oxygen (DO)	Hand-held multi-parameter probe (Horiba U-22 or equivalent)	mg/L	+/- 0.3 mg/L	Calibrate at least daily to assess variability, which is based on elevation and temperature. In summer, keep instrument in a cooler to prevent high range temperature variations. Range is 0 to 20 mg/L; ±0.3 mg/L.	+/- 0.2 mg/L	0 to 19.99 mg/L

Notes:

1. Stabilization criteria for 'low-flow' sampling method.

Table 4. Sample Containers, Preservatives, and Hold Times

KMCT IA Sampling and Analysis Plan

Matrix	Parameters	Method	Container	Preservation	Analytical Holding Time
Water	Cyanide (total)	EPA 335.4	500 mL amber poly	NaOH to pH>12, 0-6°C	14 days
Water	Cyanide (free)	ASTM D7237	500 mL amber poly	NaOH to pH>10, 0-6°C	14 days
Water	Fluoride	EPA 300.0	500 mL poly	4C	28 days
Water	Nitrate (as N)	EPA 300.0	500 mL poly	4C	48 hours
Water	pH	SW-846 9045D	250 mL poly	None	Immediately

Acronyms/units:

EPA = Environmental Protection Agency

ASTM = American Society for Testing and Materials

mL = milliliter

poly = polyethylene

NaOH = sodium hydroxide

°C = degrees Celcius

Table 5. Laboratory Calibration and Quality Control Requirements for General Chemistry and Other Parameters in Water

KMCT IA Sampling and Analysis Plan

Quality Control Check	Frequency	Criteria	Corrective Action
Multipoint ICAL (a Blank and at Least Five Standards); Does Not Apply to Titrimetric Method	Before initial sample analysis, every 24 hours, when modifications are made to the analytical system, or when continuing calibration verification fails	Correlation coefficient of linear regression is ≥ 0.995 .	Correct the problem and repeat the ICAL.
Second-source Calibration Verification	Immediately following each ICAL	Analytes are within $\pm 15\%$ of expected value	Correct the problem and repeat ICAL.
Calibration Blank; Does not Apply to Titrimetric Method	After every second-source or continuing calibration verification analysis	No analytes were detected at or above the RL.	Correct the problem, then reanalyze previous 10 samples.
Continuing Calibration Verification	After every 10 samples and at the end of the analysis sequence	Analytes are within $\pm 15\%$ of expected value.	Recalibrate and reanalyze all samples since the last acceptable continuing calibration verification.
Method Blank	At least one per analytical batch	No analytes were detected at or above the RL.	Correct the problem, re-prepare, and reanalyze all associated samples.
MS/MSD	One set per 20 project-specific samples; MSD is optional if a laboratory sample duplicate is performed	All analytes are within limits specified in Table A-2 (or within laboratory-specified control limits).	None.
Laboratory Sample Duplicate	Once per analytical batch if MSD not performed	Concentration of reported analytes are >5 times the RL in either sample or relative percent difference is $>20\%$. One sample result is $<RL$ and has a difference of ± 2 times the RL.	None.
LCS	At least one per analytical batch	All analytes are within limits specified in Table A-2 (or within laboratory-specified control limits).	Correct the problem, re-prepare, and reanalyze the LCS and all samples in the analytical batch.

Acronyms/units:

Unless calibration and QC requirements are specified for an individual method.

ICAL = initial calibration

LCS = laboratory control sample

MS/MSD = matrix spike/matrix spike duplicate

Figures

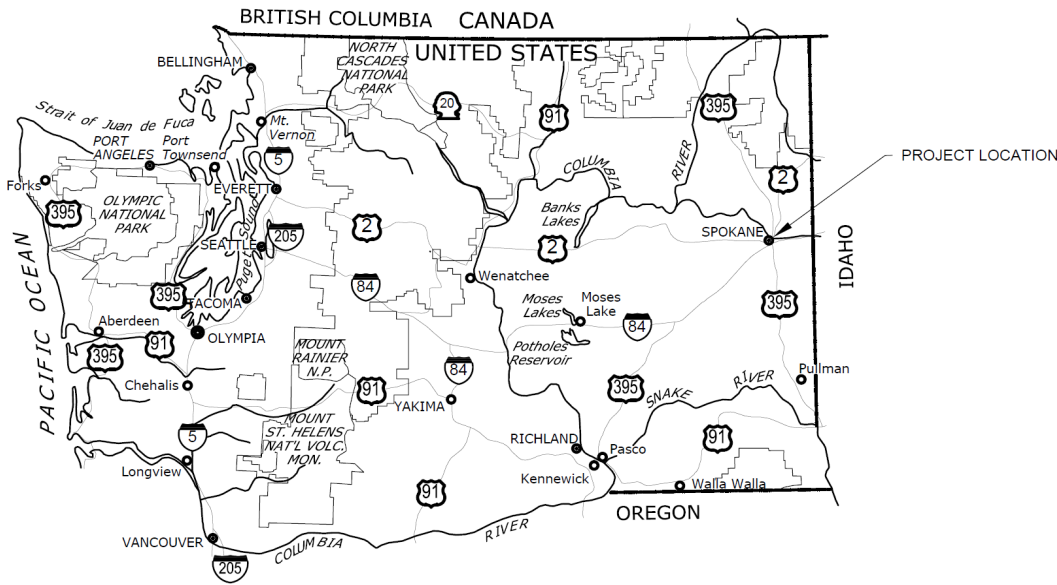


FIGURE 1
 PROJECT LOCATION MAP
 KAISER MEAD CUSTODIAL TRUST
 SPOKANE, WASHINGTON



SITE AREA MAP





LEGEND

- ⊕ EXTRACTION WELL
- ⊙ EXTRACTION WELLFIELD PERFORMANCE MONITORING LOCATIONS
- ⊗ WETLANDS DETECTION GROUNDWATER MONITORING LOCATION
- × CUSTODIAL SITE-WIDE GROUNDWATER MONITORING LOCATION

FIGURE 2
KMCT GROUNDWATER
MONITORING LOCATIONS

Scale in Feet: 0, 100, 200

JACOBS

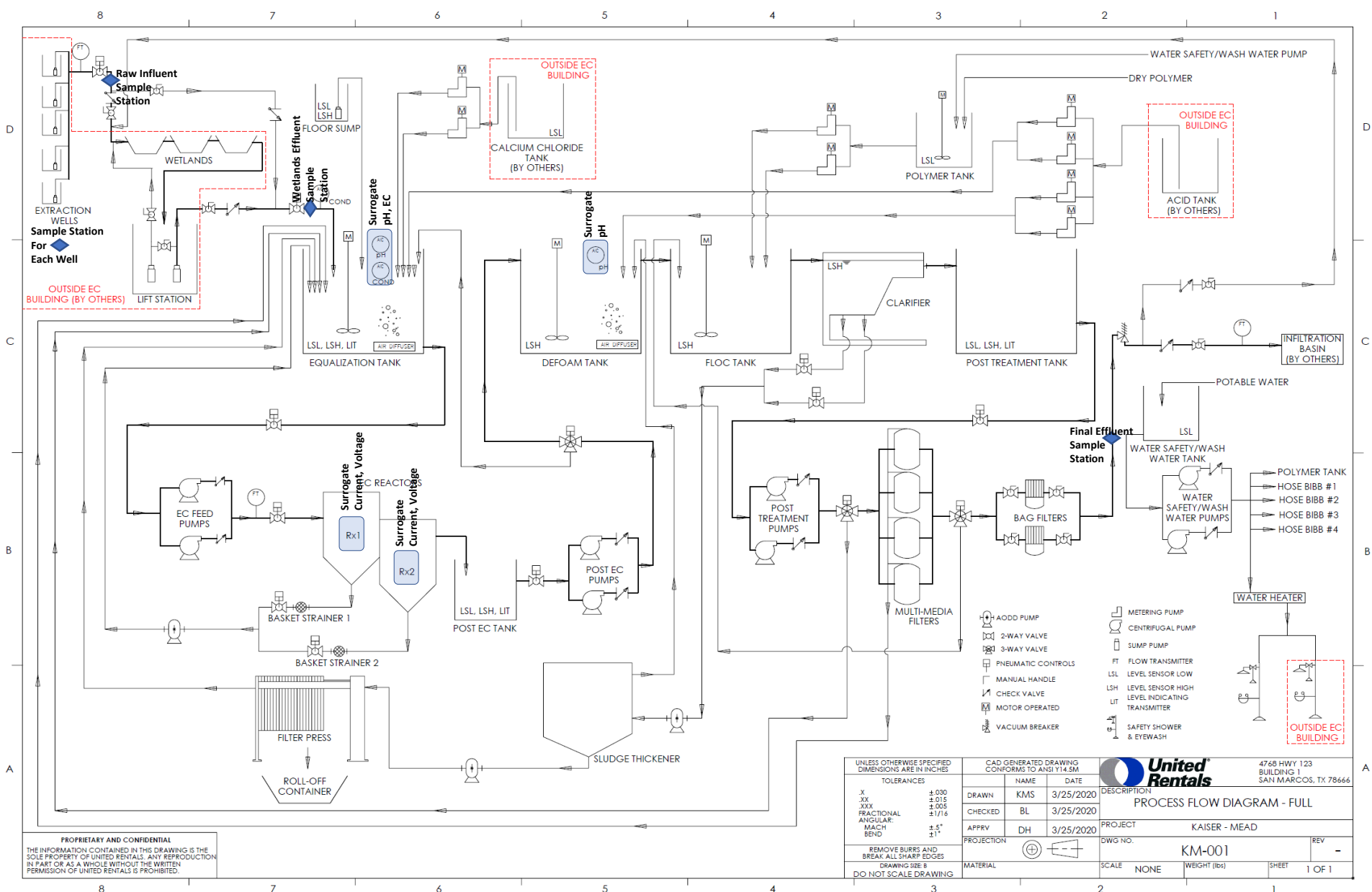


FIGURE 3
Process Flow Diagram
KAISER MEAD CUSTODIAL TRUST
SPOKANE, WASHINGTON



Raw Influent Sampling Station
 Sampling located on the extraction force main from the well field, prior to valves to wetlands or EC system.

Wetlands Effluent Sampling Station
 Sampling located on piping from wetlands prior to the equalization tank.



Final Effluent Sampling Station
 Sampling located after bag filters, prior to valves controlling flow to infiltration basin, wetlands return, or fire pond.

FIGURE 4
 Process Sampling Locations
 KAISER MEAD CUSTODIAL TRUST
 SPOKANE, WASHINGTON

Attachment 1
KMCT Purge and Sampling Form

Station and Groundwater Purging and Sampling Form



SITE: _____ **Location ID:** _____

Field Team: _____ Date: _____

Weather/Temp: _____ Arrival Time: _____

Well Condition: _____ **Initial DTW (ft btc):** _____

Purge Method: _____ Purge Rate : _____

Field Parameters								
Time	DTW/ Flowrate	Purge Vol. (gal)	Temp (°C)	pH	Sp. Cond. (uS/cm)	DO (mg/L)	ORP (mV)	Note color, odor, sheen, etc.
	Begin Pumping							
Stabilization Criteria	-	-	± 0.2	± 0.1 units	± 3%	± 0.3 mg/L	± 10 mV	

Sample ID: _____ **Sample Time:** _____

Analyses: Free cyanide (ASTM D7237), Total cyanide (EPA 335.4), Fluoride (EPA300.0), Nitrate (EPA300.0)

Field Duplicate ID and Time : _____ TOTAL PURGED (GAL): _____

Comments: _____

Attachment 2
Chain of Custody Form



CHAIN OF CUSTODY RECORD

Page ____ of ____

SVL Analytical, Inc. • One Government Gulch • Kellogg, ID 83837 • (208) 784-1258 • FAX: (208) 783-0891

FOR SVL USE ONLY SVL Work Order #
Temperature on Receipt: _____

Report to Company: _____ Contact: _____ Address: _____ _____ Phone Number: _____ FAX Number: _____ E-mail: _____	Invoice Sent To: _____ Contact: _____ Address: _____ _____ Phone Number: _____ FAX Number: _____ PO#: _____
-------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------

Table 1. -- Matrix Type
 1 = Surface Water, 2 = Ground Water
 3 = Soil, 4 = Sediment, 5 = Rock, 6 = Rinsate, 7 = Oil
 8 = Waste, 9 = Other: _____

Project Name: _____
Sampler's Signature: _____

Indicate State of sample origination: _____

Sample ID	Collection		Misc.	Preservative(s)							Analyses Required							Rush Instructions (Days)	Comments									
	Date	Time	Collected by: (Init.)	Matrix Type (From Table 1)	No. of Containers	Unpreserved	HNO ₃ Filtered	HNO ₃ Unfiltered	HCl	H ₂ SO ₄	NaOH	Other (Specify)																
1																												
2																												
3																												
4																												
5																												
6																												
7																												
8																												
9																												
10																												

Relinquished by: _____	Date: _____	Time: _____	Received by: _____	Date: _____	Time: _____
Relinquished by: _____	Date: _____	Time: _____	Received by: _____	Date: _____	Time: _____

* Sample Reject: Return Dispose Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY

Attachment 3
Low-flow, Low-Stress Groundwater
Purging and Sampling SOP

Low-Flow Groundwater Purging and Sample Collection

The purpose of this SOP is to delineate protocols for standardizing the purging of groundwater, the method of sample collection, and low-flow sampling. Groundwater sampling may occur during well construction, development, pump testing, and collection of samples for submittal to the laboratory. Samples that are used to measure only field parameters will be handled just as carefully as samples that are also sent into the laboratory for more complete analysis.

1. Equipment and Supplies

- Dedicated pump and tubing
- Generator/compressor
- Pump control box
- Sampling tee (if not installed)
- Sampling supplies
- Purge water storage tank or 55-gallon drums
- Discharge hose from sampling tee to storage tank

2. Low-Flow Purging/Sampling Procedures

The following procedures should be followed for low-flow sampling:

1. Obtain information on well location, diameter(s), depth, and screened interval(s), and the method for disposal of purged water.
2. Calibrate instruments each day prior to sampling according to manufacturer's instructions.
3. Record the well number, site, date, and condition in the groundwater quality sampling diary.
4. Clean and decontaminate all sampling equipment and any other equipment to be placed in the well before sampling in accordance with SOPs.
5. Collect water-level measurements and depth of well measurements in accordance with SOPs.
6. Determine the height of the water column, the midpoint of the saturated portion of the well, and the volume of water in the well. If the depth to water is above the top of the screened interval, place the pump or tubing intake at the midpoint of the screen. If the depth to water is below the top of the screen, place the pump or tubing intake at the midpoint of the saturated interval of the screen.
7. Attach and secure the polyethylene tubing to the low-flow pump. Lower the pump slowly into the well and set it at approximately the middle of the screen, as determined previously. Alternatively, if the formation is stratified, the pump or tubing intake should be placed within the interval of highest transmissivity such as sand or silty sand. Place the pump intake at least 2 feet above the bottom of the well to avoid mobilization of any sediment present in the bottom.

8. Insert the measurement probes into the flow-through cell. Attach the tubing from the pump to the flow-through cell inlet. Attach the discharge tubing to discharge part of the flow-through cell. The purged groundwater is directed through the cell, allowing measurements to be collected before the water contacts the atmosphere.
9. Start purging the well at 0.2 to 0.5 liter per minute. Avoid surging. Purging rates for more transmissive formations could be started at 0.5 to 1 liter per minute. The initial field parameters of pH, specific conductance, dissolved oxygen (DO), oxidation reduction potential (ORP), and temperature of water are measured and recorded in the groundwater quality sampling diary. The purge rate for the well should be measured immediately. To measure, time the filling of a 0.5-liter (16 oz.) measuring cup graduated in at least 50-mL increments. Divide the volume of water collected by time in minutes to establish the purge rate. Record the purge rate in the groundwater sampling diary.
10. The water level should be monitored during purging either prior to or after each series of field parameter readings and, ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well (i.e., less than 0.5 foot). The water level should stabilize for the specific purge rate. There should be at least 1 foot of water over the pump intake, so there is no risk of the pump suction being broken or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the groundwater sampling diary. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.05 to 0.10 liter per minute) to avoid affecting well drawdown.
11. During purging, the field parameters are measured frequently (every 3 to 5 minutes) until the parameters have stabilized. The readings should not be taken at intervals less than the time required to fill the flow-through cell with less than one (1) entire pass-through volume. The time interval for the readings shall be based on the volume and purge rate. Field parameters are considered stabilized when measurements meet the following criteria:
 - pH: within 0.1 pH units
 - Specific conductance: within 3 percent or 5 μ mhos
 - DO: within 10 percent if reading is > 1.0 mg/L, and is 0.1 mg/L if reading is < 1.0 mg/L
 - ORP: within 10 percent
 - Temperature: within 0.2° C (may disregard if due to pump heating)
12. Once purging has been completed, the well is ready to be sampled. The elapsed time between completion of purging and collection of the groundwater sample from the well should be minimized. Typically, the sample is collected immediately after it is determined the water quality parameters have stabilized, but this also depends on well recovery. The goal is to minimize aeration while collecting samples.

3. Recordkeeping

Field measurements, observations, and calculations will be recorded in the field logbook. Information to be recorded specific to this procedure includes the following:

- Well location and number
- Well diameter, total depth, depth to water, and location of the packer, if any
- Bailer type and size
- Pump model

-
- Calibration information for field instruments (pH, temperature, EC, FID, or PID)
 - Field monitoring readings
 - Condition of the well
 - Qualitative information of groundwater color and turbidity
 - Total volume of water purged
 - Sample identification
 - Designation of QC samples, including any blanks, duplicates, or laboratory matrix spike/matrix spike duplicate (MS/MSD)
 - Any other pertinent observations

Attachment B
Discharge Monitoring Reporting Sheets
(electronic)

