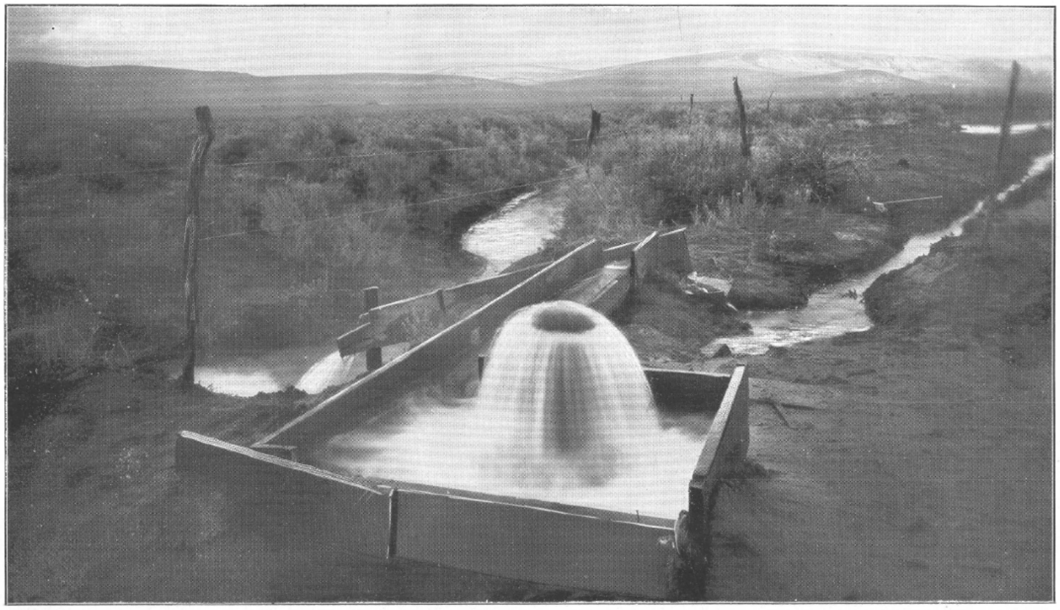
# Quality Assurance Project Plan

## City of Moxee ASR Feasibility Study

U. S. GEOLOGICAL SURVEY

WATER-SUPPLY PAPER NO. 55 PL. VII



GANO WELL, MOXEE VALLEY.

October 2023

State of Washington Department of Ecology
Office of Columbia River
Agreement No. WRYBIP-2123-Moxeec-00036

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# Publication Information

Each study conducted by the Washington State Department of Ecology (Ecology) must have an approved Quality Assurance Project Plan (QAPP). The QAPP describes the objectives of the study and the procedures to be followed to achieve those objectives.

This QAPP was prepared by a licensed hydrogeologist. A signed and stamped copy of the report is available upon request. This QAPP is available via Ecology's publication database and upon request. The Ecology publication number for this QAPP is 23-12-015. This QAPP is valid through August 31, 2028.

Field data collected for this project will be uploaded to Ecology's Environmental Information Management (EIM) database under Study ID: WRYBIP-2123-Moxeec-00036.

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# Quality Assurance Project Plan

# City of Moxee ASR Feasibility Study

October 2023

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# 2.0 Abstract

The proposed Aquifer Storage and Recovery (ASR) program is being considered as a component of the City of Moxee's (City's) long-term water supply strategy of developing a surface water source to offset declining groundwater supplies while also improving seasonal groundwater flow to the Yakima River.

The feasibility study implementation plan (referred to herein as the Study) will assess the technical, operational, regulatory, and cost requirements to implement a future ASR project in the City's municipal water system. Tasks have been designed to address key components required in an ASR reservoir permit application as outlined in Washington Administrative Code (WAC) 173-157-110. As such, tasks under this Study include:

1. Developing a hydrogeologic conceptual model detailing the target aquifer system;
2. Assess source water availability, legal framework, and water rights to implement project;
3. Evaluating existing infrastructure and establishing targets for injection, storage, and recovery;
4. Assessing water quality characteristics of potential source water (e.g., canal water) and the target aquifer to evaluate compliance with groundwater standards and antidegradation policy, as described in WAC 173-200; and
5. Developing treatment requirements and alternatives for injected water (if needed).

A large part of this Study will rely on existing information and build off past efforts funded by the Yakima Basin Integrated Plan (YBIP) Groundwater Storage Subcommittee and Ecology. However, based on a review of all the past work, State of Washington Department of Ecology (Ecology) and the City determined that additional information needs to be collected under this Study to better understand source water quality, aquifer water quality and aquifer characteristics (Aspect, 2022). Key data collection tasks and schedule are identified below by section of this QAPP:

- Section 3.2.3: Provides a description of the water quality constituents to be evaluated;
- Section 4.4: Presents the details of the tasks to be completed, in sequential order;
- Section 5: Outlines the project schedule and team;
- Section 7.2: Describes water quality sampling locations and frequency (sampling schedule); and
- Section 8.2: Details the water quality sampling and well/aquifer testing procedures.

# 3.0 Background

The Ellensburg Formation aquifer is currently the City's only available water supply source. As a component of its long-term water supply strategy, the City is evaluating development of an ASR program to offset declining water levels in the lower Ellensburg Formation aquifer (Aspect, 2022). The City's proposed ASR project has the potential to address multiple goals of the YBIP, including expanding instream and out of stream uses and a Total Water Supply Available (TWSA)-positive outcome.

## 3.1 Introduction and Problem Statement

The goal of the proposed Study is to address key components required in an ASR reservoir permit application as outlined in WAC 173-157-110. Much of the information required for an ASR reservoir permit application was documented through past efforts funded by Ecology and the YBIP Groundwater Subcommittee. However, specific data gaps and proposed data collection were documented in a technical memorandum (herein referred to as the Data Gap Memo; Aspect, 2022) warranting additional data collection and analyses under this Study.

Following Ecology's review of the technical memo, specific project objectives were identified:

- Develop a hydrogeologic conceptual model to evaluate ASR feasibility and address informational requirements of Chapter 173-157-120 WAC;
- Assess source water availability, legal framework, and water rights to implement ASR in accordance with Chapter 173-157-130 and -140 WAC;
- Perform an engineering evaluation and determine the feasibility of incorporating ASR operations into the City's municipal water system;
- Assess water quality in the target aquifer and source water to identify constituents of concern, water quality compatibility, and compliance with:
    - Groundwater quality standards and antidegradation policy (Chapter 173-200 WAC);
    - Surface water treatment (Chapter 246-290 portions of Part 6);
    - Drinking water standards (Chapter 246-290-310); and
    - Source approval (Chapter 246-290-130).
- Identify the additional information requirements of WAC 173-157 that are not addressed in this Study.

The purpose of this QAPP is to describe the project objectives and procedures to achieve the goals for bullet 4 above. A future QAPP is necessary to address additional data collection (well and aquifer testing, additional water quality sampling, and surface water treatment) for the ASR program. This QAPP addresses the following elements:

- Study design;
- Data and measurement quality objectives;

- Field and laboratory procedures;
- Quality control procedures;
- Data verification and validation protocols;
- Data management procedures; and
- Reporting.

The objective of this assessment is to:

1. Collect water quality samples from both source water supply and groundwater to perform geochemical analysis of water compatibility and assess treatment.
2. Collect one round of groundwater level measurements taken at all relevant wells to produce a consistent groundwater elevation map and confirm the City's SCADA system function.

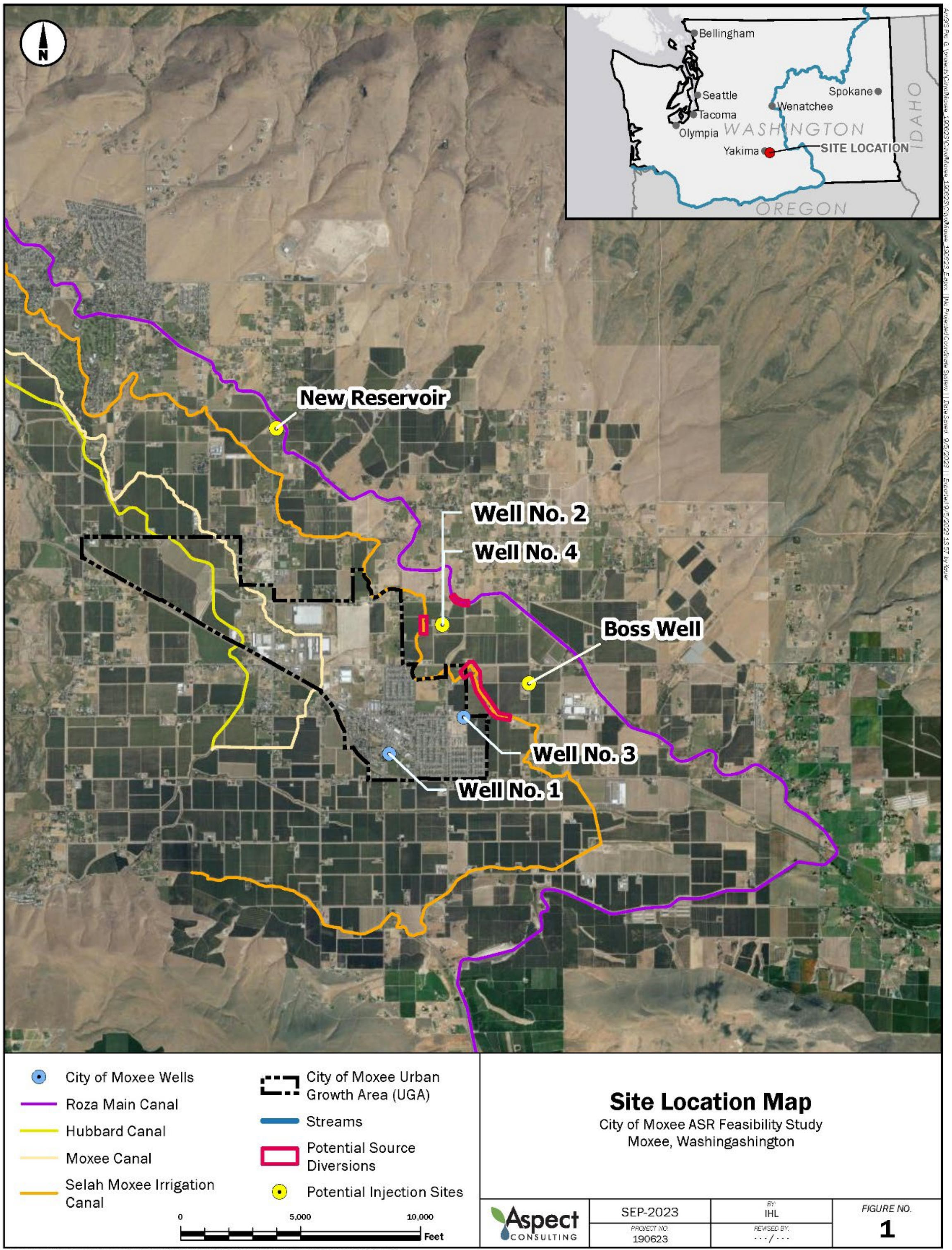
The QAPP follows the recommended guidelines from Ecology's *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology, 2004; updated 2016) to conduct water level and water quality analyses effectively and accurately as part of the Study.

The Study and development of this QAPP are funded under the YBIP Groundwater Subcommittee (Agreement No. WRYBIP-2123-Moxeec-00036) between the City and Ecology. Aspect and HLA Engineering and Surveying (HLA) are under contract to the City to prepare this QAPP and complete the Study.

## 3.2 Study Area and Surroundings

The Study is within the Moxee Valley, located in Yakima County, Washington, as shown on Figure 1.

The City's water system serves a population between 3,000 and 4,000 people. Three groundwater wells (Well Nos. 1, 3, and 4) are active sources to the City's water system, Well No. 2 is maintained as an emergency backup source. Within the Moxee Valley there are three main sources of surface water within the Study area: (1) the Yakima River; (2) the Selah-Moxee Irrigation Canal system; and (3) the Roza Irrigation Canal system. Surface water is the primary source of irrigation water and groundwater serves as the primary source of drinking water in the Study area. Figure 1 shows the Moxee Valley, the City's Urban Growth Area, City water supply wells, irrigation canals, and the Yakima River.



Data source credits: None || Basemap Service Layer Credits: Yakima GIS, Earthstar Geographics, Esri, HERE, Garmin, USGS, EPA, NPS

Figure 1. City of Moxee ASR Site Location Map

The Moxee Valley lies within the Yakima Fold and Thrust Belt (YFTB), a broad region of east-west compression and clockwise plate rotation that has created several northwest and west trending anticlines and thrust faults, and northwest and north trending regional strike slip faults. Pending development of the project-specific hydrogeologic conceptual model, within the YFTB, the Study area is bounded to the:

- West by the Yakima River;
- East by an unconformity between the Ellensburg Formation and Columbia River Basalt Group (CRBG);
- North by Yakima Ridge anticline; and
- South by the Ahtanum-Moxee syncline (Jones et al., 2006).

A generalized cross section of the Moxee Valley as depicted by Bentey el al. (1993) is provided as Figure 2.

The City relies on groundwater supply from the Upper Undifferentiated Ellensburg Formation (Ellensburg Formation). The Ellensburg Formation was deposited as a vertically stratified semi-consolidated to consolidated sedimentary units that overly the CRGB. All City wells are completed across water bearing zones of the Ellensburg Formation and as such, the Ellensburg Aquifer is the target aquifer for ASR.

The Ellensburg Aquifer is a semi-confined to confined multi-layered aquifer system. The City's wells are completed in a portion of the Ellensburg Aquifer that appears semi-confined (S = 2.4 x $10^{-4}$) based on estimation of storativity (S) from Well No. 4 pumping test data (Aspect, 2020), which is consistent with the range of estimates (2 x $10^{-3}$ to 7 x $10^{-4}$) by others complied in Vaccaro et al., 2009.

### 3.2.1 History of Study Area

G.O. Smith (1901) first described the hydrogeologic conditions (folds and confining units) and water bearing units of the Ellensburg Formation that resulted in artesian conditions in the Moxee Valley. G.O. Smith (1901) documented several Ellensburg Aquifer wells completed from 525 to 1,026 feet below ground surface (bgs) that capture water from singular to multiple water bearing units with a depth to top of unit from 515 to 1,020 feet bgs. The wells had a potentiometric surface of 30 to 115 feet (Clark Well Nos 2 and 3) of water above ground surface flowing 0.5 to 2.00 cubic feet per second (cfs). Some City wells (e.g., Well No. 2) have experienced water level declines of approximately 70 feet since time of construction in the

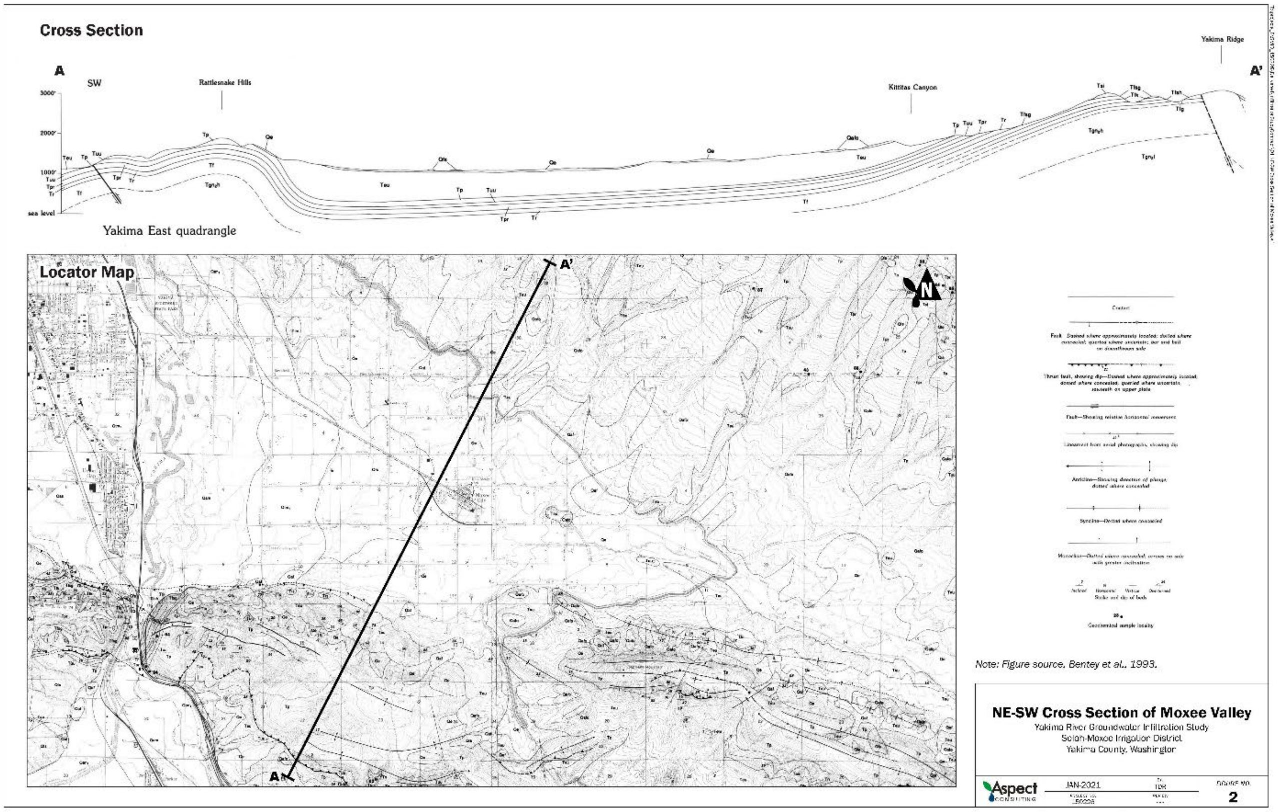


Figure 2. NE-SW Cross Section of Moxee Valley adapted from Bentley et al, 1993

1980s. The City's Well No. 2 is located in the same section as Clark Well Nos. 2 and 3. Offsetting groundwater level decline is the impetus for ASR as a future water supply strategy, using available groundwater storage capacity.

The ASR project proposes use of Yakima River water as the source water to offset the decline in groundwater levels and provide additional supply to the City. The City is considering using water that is either diverted from the Selah-Moxee Irrigation District (SMID) or the Roza Irrigation canal systems, which may require treatment to drinking water standards (Chapter 246-290-310) prior to injection. Three potential points of diversion (two from the SMID Canal and one from the Roza Main Canal) were identified based on proximity to existing wells as shown on Figure 1.

The Study is part of the YBIP which was developed between 2009 and 2012 in response to growing concerns about water availability in the Yakima River Basin. This is a 30-year resiliency plan that aims to protect fish habitat and improve water availability and reliability. The YBIP is currently being implemented in phases through funds from the state and federal governments. This Study falls under the groundwater storage element of the YBIP and aims to address municipal water reliability and instream flow augmentation.

### 3.2.2 Summary of Previous Studies and Existing Data

The City's proposed ASR plan has been identified by the YBIP's Groundwater Subcommittee as a potential method to improve groundwater supplies within the Yakima River Basin. Therefore, the subcommittee elected to fund the Study, which includes a Data Gap Memo (Aspect, 2022) detailing the existing geology, hydrology, and water chemistry data and gaps in the data that will need to be addressed during the project. The Data Gaps Memo identified that the existing data is generally of sufficient quality to support the Study, with minimal additional improvements.

Key findings include:

- The existing hydrogeologic data and reports provide a solid foundational knowledge for assessing the hydrogeologic setting and viability of the local Ellensburg Formation aquifer near the City for ASR once synthesis of additional existing and new data is completed for the FS.
- The condition of the City's wells are documented, and completion information is sufficient to support analysis required for the FS. Additionally, many neighboring well logs exist with sufficient completion information to inform additional hydrologic interpretation. Opportunistically, additional exploration and/or testing of existing wells may be incorporated into the conceptual model developed under the FS.
- A survey of City wellhead conditions and approximate elevations is needed to determine absolute groundwater elevations across the aquifer near the City.
- Manual water level data collection is needed for all City production wells, as allowed by wellhead access, to validate past automated measurements and correct data to groundwater elevations.
- Site-specific data provided from the City's SCADA data and recent pumping tests at Well 4 provide local validation (and support future updates) of the regional numerical model and aquifer parameters. Additional processing of SCADA data may be required to utilize higher frequency measurements. This will allow for estimation of aquifer performance during ASR as part of the FS.
- Water quality data exists for all sources and for the City's wells but has a variable analyte list and temporal coverage. A complete set of water quality samples will need to be collected for the proposed source waters and storage aquifer in order to assess chemical compatibility, treatment needs, and regulatory compliance. Sampling will be performed for all potential water sources consistent with WAC 246-290-310 and 173-200.

The Yakima River Basin has been the focus of multiple existing efforts by federal, state, tribal, and local groups, including the YBIP workgroups, to characterize and plan for long term sustainability of the surface and groundwater resources within the watershed. This includes:

- A series of conceptual and numerical modeling reports prepared for the City of Yakima during development of its ASR program within the Ellensburg Formation aquifer of the Ahtanum-Moxee subbasin. (Golder, 2001, 2002, 2007, and 2014).
- Previous studies that assess the suitability of areas within the Yakima Basin for shallow aquifer recharge and aquifer storage and recovery (Aspect, 2021; Gibson and Campana, 2018; Sleeper, 2020).
- Development of the hydrogeologic framework and characterization of the geochemistry of various aquifer systems within the Columbia River Basalt Group (CRBG; Whiteman et al., 1994).
- Mapping of the extent and depth to the top of basalt and interbedded hydrogeologic units, Yakima River Basin aquifer system (Jones and Watkins, 2008).
- A characterization of six sedimentary sub-basins, their hydrogeologic framework, and aquifers parameters within the Yakima River Basin (Jones et al., 2006).
- Development of a hydrogeologic framework, geologic characterization, geochemistry, and groundwater trends, and aquifer parameters for aquifers of the Yakima River Basin (Vaccaro et al., 2009).
- Numerical modeling of the Yakima River Basin Aquifer System (Vaccaro et al., 2009; Ely et. al., 2011).
- Analysis of ambient groundwater quality in the Moxee Valley Surficial Aquifer (Ecology, 2007).

Results from these studies include geologic framework and estimates of aquifer parameters, including storage coefficients, transmissivities, and groundwater velocities of the associated aquifer systems. Many of these reports focus on the larger areal extents than the Study Area. Additional site-specific evaluation of aquifer characteristics, and water level and water quality data, is necessary to characterize the target aquifer.

A data gap memorandum (Aspect, 2023) outlines available existing data and hydrogeologic reports and data needs pertaining to aquifer parameters, groundwater levels, groundwater quality, and surface water quality. Key findings from the data gap analysis are highlighted below.

### Aquifer Parameters

Aquifer and well testing reports are available for City Well No. 4 (Aspect, 2020); this report was completed to document well construction and testing. Pumping test results for the well were used to determine parameters for the Ellensburg Formation, which was screened from 750 to 1,104 feet below ground surface (bgs) at Well 4. In addition, detailed mapping and testing results collected for the USGS CPRAS and Yakima Models yield general aquifer parameters for the Ellensburg Formation and surrounding aquifers. In addition, detailed aquifer testing and modeling of the Ellensburg Formation aquifer were completed as part of the City of Yakima ASR program development. Results documented in these reports are summarized in Table 1.

**Table 1. Aquifer Test Results for Ellensburg Formation**

| Study Area | Study / Aquifer Test | Hydraulic Conductivity (ft/d) | Transmissivity ($ft^2/d$) | Storativity (unitless) |
|---|---|---|---|---|
| City of Moxee | City Well No. 4[1] | - | 38,600 | $2.4 \times 10^{-4}$ |
| Regional | Vaccaro et al (2009)[2] | 72 | - | $2 \times 10^{-3}$ to $7 \times 10^{-4}$ |
| Modeled | Ely (2011)[3] | 12.9 to 69.2 | - | $4.62 \times 10^{-5}$ |
| City of Yakima | Golder (2009) | 7.5 | - | $7 \times 10^{-4}$ |

**Notes:**

1. Aspect, 2020
2. Average value, K ranged from 0.01 to 2,265 ft/d
3. Model-calibrated results

Ecology's Environmental Information Management System (EIM) records 73 wells in the area, 42 of which were completed at depths associated with the Ellensburg Formation and had associated well logs; however, little additional well testing data was yielded from these logs and no studies with aquifer testing data were identified.

## Groundwater Levels

The City has had a Supervisory Control And Data Acquisition (SCADA) system in place since 2015 to continuously monitor and record water levels and pumping rates at each of its water supply wells. Periodic water level data from 2015 to 2022 has been retrieved from the wells, but they only report depth of water above the sensor. Data has been corrected for elevations reported in well logs and pump set depth. However, field verification of SCADA water level readings, and refinement of measuring point data will need to be performed to improve accuracy to the level required for modelling.

The USGS National Water Information System (NWIS) and Ecology's EIM database provide publicly available groundwater monitoring within the Yakima Basin. The EIM systems identified eight wells near the City with groundwater level measurements spanning a discontinuous period from 1977 through 2021. These data were entered into the EIM database as part of data compilation efforts completed for the Ecology's Columbia River Groundwater Database (CRGWDB) study.

Well water level data were also queried from the USGS NWIS database. The NWIS database contained over 300 groundwater wells within an approximate 48-square-mile area surrounding the City, with periods of record spanning from 1890 to 2008 (discontinuous). Twenty-two of these wells are listed as completed within the Ellensburg Formation, of which five have two or more recorded water levels. Several of these are mapped directly with hydrographs via a USGS monitoring website (Keys, 2008).

## Groundwater Quality

The City conducts water quality sampling at each of its groundwater wells to comply with DOH drinking water source requirements. Although these water quality data are useful in characterizing ambient groundwater, the chemical analyses completed per DOH requirements do not include several constituents and field parameters important for assessing geochemical compatibility with treated surface water (e.g., silica, sulfide, and oxidation-reduction potential [ORP]) and only report total metals concentrations rather than total and dissolved concentration components. Additionally, water quality analyses completed under DOH requirements are reported only to the State Reporting Limit (SRL) as opposed to the Method Detection Limit (MDL) and, consequently, water quality results obtained from DOH records are often qualitatively reported as “less than” the SRL rather than reporting the measured concentration.

The DOH SENTRY database contains results for routine compliance sampling for each of the City’s wells. Table 2 identifies the periods of record of various analyte suites for the City’s wells from the DOH database.

**Table 2. Water Quality Data Available from DOH SENTRY Database**

| Analyte Suite / Test Panel | Period of Record[1] | Note |
|---|---|---|
| Inorganic Constituents | 1985 – 2022[2] | As, Ag, Ba, Be, Ca, Cd, Cl, Cr, Cu, Cyanide, Fe, Fl, Hg, Mg, Mn, Na, Ni, NO3, Pb, Sb, Se, SO4, Th, Zn, Color, Sp. Cond., Hardness, Turbidity |
| Synthetic Organic Compounds | 1991 - 2022[3] | Analytical suites vary annually between insecticides, pesticides, and soil fumigants |
| Volatile Organic Compounds | 1988 - 2022 | Results for various temporal resolutions from each well |
| Radionuclides | 2001 - 2021 | Results for various temporal resolutions from each well |

**Notes:**

1. Not all wells span full periods of record
2. Not all constituents span whole record, full constituents list first recorded in 2003.

In addition to the City’s data, the EIM database listed an ambient groundwater quality study (ID KSIN0002), which measured water quality of 20 wells in the Moxee area in 2006. The study reported field parameters of temperature, pH, conductivity, and dissolved oxygen (DO), and a limited analytical suite including bacteria, total dissolved solids, iron, magnesium, chloride, nitrate, phosphorous. Multiple samples were reported with bacterial contamination, but no other exceedances were reported.

## Source Water Quality

Water quality data are limited for the source waters being considered (SMID and Roza irrigation canals). USGS NWIS database includes water quality results for all three potential sources, but they vary spatially and temporally. From 1970 to 2004, USGS collected samples from the Yakima

River at various points along the central Yakima Valley, including physical parameters, major inorganics, nutrients, stable isotopes, and microbiological samples. Sites on the Roza main canal were sampled from 1986 and 2004, including physical parameters, major inorganics, nutrients, and stable isotopes. A single sample was available from the SMID Canal from 2000, which included physical parameters, major inorganics, organics, pesticides, nutrients, and perfluorooctanoic acid (PFOA). The samples for the Roza irrigation canals were collected at approximately the same location 5.5 miles northwest of the City, while the SMID Canal was sampled 1 mile north of the City and immediately adjacent to the City's Well Nos. 2 and 4 (Figure 1). These data are summarized in Table 3 below.

**Table 3. Water Quality Data Available from Ecology EIM Database**

| Source[1] | Period of Record | Number of Samples | Analyte Suites[2] |
|---|---|---|---|
| Yakima River near Selah Gap (12487000) | 1985 – 2022 | 4 | Physical parameters, inorganic constituents (IOC), silica (2004), and stable isotopes (1985) |
| Yakima River near Yakima (12500005) | 1987 | 2 | Physical parameters, IOCs, silica (2004), and stable isotopes (1985) |
| Yakima River near Terrace Heights | 1970-1977 | 98 | Physical parameters, IOCs, silica (1977), bacterial |
| Union Gap Canal (463716120291800) | 2012 | 3 | Volatile organic compounds (VOC) |
| Roza Canal at N 33rd (12485003) | 1986-2004 | 2 | Physical parameters, IOCs, stable isotopes (1986), silica (2004) |
| Selah-Moxee Canal (463411120223900) | 2000 | 1 | Physical parameters, IOCs, VOCs, pesticides and herbicides |

**Notes:**

1. The table does not list outfalls or irrigation drains
2. Not all constituents span the whole record for any given source.

Following the planned water quality assessment and review from Ecology's Water Quality Program and DOH Regional Engineer, feedback from Ecology's Water Resources Program and Office of Columbia River will be necessary to inform a future QAPP to address additional data collection (well and aquifer testing, additional water quality sampling, and surface water treatment).

The City will collect a limited set of data, described in this QAPP, to supplement existing datasets. Specifically, this assessment will:

1. Collect water quality samples from both source water supply and groundwater to perform geochemical analysis of water compatibility and assess treatment.

2. Collect one round of groundwater level measurements taken at all relevant wells to produce a consistent groundwater elevation map and confirm the City's SCADA system function.

### 3.2.3 Parameters of Interest

The water quality analytes were selected to evaluate the potential for water quality impacts related to ASR and compliance with Washington State Groundwater Quality Standards (Chapter 173-200 WAC) and Drinking Water Standards (Chapter 246-290 WAC). The source water supply has limited existing data and will be analyzed for a full analyte suite, whereas the target aquifer has been regularly sampled to DOH drinking water quality standards by the City and will only be sampled with a limited analyte set of field parameters, general chemistry, and bacteria. The following sections describe the water quality analytes selected for this water quality assessment. The schedule for monitoring these constituents during the Study is presented in Section 7.2.

#### Field Parameters

Field parameters will be measured to provide independent corroboration of laboratory results, and to analyze constituents that have short hold times and can be reliably measured in the field. Field parameters also include measurements to develop groundwater elevation contour maps. These include:

- Electrical conductivity
- Dissolved Oxygen (DO)
- Oxidation Reduction Potential (ORP)
- pH
- Temperature
- Turbidity
- Continuous and discrete groundwater depth-to-water
- Groundwater level measuring point elevation

#### General Chemistry

The general chemistry suite includes inorganic constituents and conventional water quality parameters. Groundwater and surface water samples will be analyzed for this suite of constituents in both the dissolved (field-filtered to 45 microns) and total fractions. Geochemical analysis will evaluate chemical compatibility of native groundwater and surface water, and monitor for potential chemical reactions of the recharge water with aquifer material (mineral dissolution and precipitation) during aquifer storage. This analytical suite will also inform source treatment requirements in the context of Chapter 173-200 WAC (Groundwater Quality Standards) and WAC 246-290-310 (Drinking Water standards). Constituents will include:

Alkalinity

Bicarbonate

Chloride

Silica

Arsenic

Antimony

Lead

Magnesium

Manganese

Total Dissolved Solids (TDS)
Total Suspended Solids (TSS)
Total and Dissolved (DOC) Organic Carbon (TOC)
Phosphorus
Bromide
Fluoride
Nitrate-N
Nitrite-N
Sulfate

Aluminum
Barium
Beryllium
Cadmium
Calcium
Chromium
Copper
Iron
Zinc

Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Uranium

### Volatile and Semivolatile Organic Compounds

As described in Section 3.2.2, baseline characterization was completed for the native groundwater in the target storage aquifer (Ellensburg Formation aquifer at City water supply wells). As required by the Washington State Department of Health (DOH), the City has three decades of groundwater quality data including both volatile organic compounds (VOCs) and synthetic organic compounds (SOCs). Over the period of record (1990-present) neither SOCs nor VOCs were detected in the City's water supply wells that are completed in the source aquifer.

The Study will evaluate potential surface water sources (e.g., SMID Canal and Roza Main Canal) for both VOCs and SOCs. Therefore, measurement of VOCs and SVOCs is necessary to accurately assess surface water quality.

### Herbicides and Pesticides

The City has evaluated herbicides and pesticides for DOH drinking water compliance. Over the period of record (1990-present) neither herbicides or pesticides were detected in the City's water supply wells that are completed in the source aquifer.

The Study will evaluate potential surface water sources (e.g., SMID Canal and Roza Main Canal) for both herbicides and pesticides. Therefore, herbicides and pesticides will be measured at potential surface water sources as part of this Study. This will include the analytes specified in U.S. Environmental Protection Agency (EPA) Methods:

- Chlorinated Pesticides
- Chlorinated Acid Herbicides
- Pesticides as carbamates
- Herbicides – diquat, paraquat, endothall, and glyphosate

### Bacteriological Constituents

The Study will evaluate bacteriological constituents (total coliform and E. Coli) in native groundwater and potential surface water sources (e.g., SMID Canal and Roza Main Canal) to determine baseline conditions. The Study will evaluate the following constituents:

- E. coli (presence/absence)
- Total coliforms (plate count)

### Radionuclides

Radionuclides were detected in groundwater at City wells. In addition, radionuclides have not been analyzed for potential surface water sources. Thus, the Study will evaluate the following radionuclides in potential surface water sources:

- Radium 226 + Radium 228
- Gross Alpha radiation
- Gross Beta radiation

### Per- and polyfluoroalkyl substances (PFAS)

PFAS were not detected in groundwater at City wells. PFAS have not been analyzed for potential surface water sources. Thus, the Study will evaluate the following PFAS in potential surface water sources:

- Perfluorooctanoic acid (PFOA)
- Perfluorooctane sulfonate (PFOS)
- Perfluorohexane sulfonate (PFHxS)
- Perflourononanoic acid (PFNA)
- Perfluorobutane sulfonate (PFBS)

## 3.2.4 Regulatory Criteria or Standards

The introduction of recharge water to the Ellensburg Formation aquifer is subject to the Antidegradation Rule and the numerical groundwater quality standards (GWQS) defined in Groundwater Quality Standards (Chapter 173-200 WAC). Table 4 presents the regulatory criteria by analyte method that will be considered during the project.

**Table 4. Groundwater and Drinking Water Regulatory Limits**

| Analyte | Unit | WAC 173-200-040 | WAC 246-290 Primary Drinking Water Standard | WAC 246-290 Secondary Drinking Water Standard |
|---|---|---|---|---|
| Field Parameters | | | | |
| Specific conductance | uS/cm | | | 700 |
| Turbidity | NTU | | 5* | |

| Analyte | Unit | WAC 173-200-040 | WAC 246-290 Primary Drinking Water Standard | WAC 246-290 Secondary Drinking Water Standard |
|---|---|---|---|---|
| pH | SU | 6.5-8.5 | | 6.5-8.5 |
| EPA 200.7 and 200.8 (General Chemistry) | | | | |
| Aluminum | ug/L | | | |
| Antimony | ug/L | | 6 | |
| Arsenic | ug/L | 0.05 | 10 | |
| Barium | ug/L | 1,000 | 2,000 | |
| Beryllium | ug/L | | 4 | |
| Cadmium | ug/L | 10 | 5 | |
| Calcium | ug/L | | | |
| Chromium | ug/L | 50 | 100 | |
| Copper | ug/L | 1,000 | 1,300 | |
| Iron | ug/L | 300 | | 300 |
| Lead | ug/L | 50 | 15 | |
| Magnesium | ug/L | | | |
| Manganese | ug/L | 50 | | 50 |
| Nickel | ug/L | | | |
| Potassium | ug/L | | | |
| Selenium | ug/L | 10 | 50 | |
| Silica (SiO2) | ug/L | | | |
| Silver | ug/L | 50 | | 100 |
| Sodium | ug/L | | 20 | |
| Thallium | ug/L | | 2 | |
| Uranium | Ug/L | | 30 | |
| Zinc | ug/L | 5,000 | | 5,000 |
| EPA 245.7 (General Chemistry) | | | | |
| Mercury | ug/L | 2 | 2 | |
| EPA 300.0 (General Chemistry) | | | | |
| Bromide | mg/L | | | |
| Chloride | mg/L | 250 | | 250 |
| Fluoride | mg/L | 4 | 4 | 2 |
| Sulfate | mg/L | 250 | | 250 |
| Nitrate as Nitrogen | mg/L | 10 | 10 | |
| Nitrite as Nitrogen | mg/L | | 1 | |
| EPA 335.1 / SM4500 CN-G (General Chemistry) | | | | |
| Cyanide, Total | ug/L | | 200 | |
| SM2320B (General Chemistry) | | | | |
| Alkalinity as Carbonate | mg/L | | | |
| Bicarbonate Ion | mg/L | | | |
| SM2540C (General Chemistry) | | | | |
| Total Dissolved Solids | mg/L | 500 | | 500 |

| Analyte | Unit | WAC 173-200-040 | WAC 246-290 Primary Drinking Water Standard | WAC 246-290 Secondary Drinking Water Standard |
|---|---|---|---|---|
| SM2540D (General Chemistry) | | | | |
| Total Suspended Solids | mg/L | | | |
| SM5310B (General Chemistry) | | | | |
| Total Organic Carbon | mg/L | | | |
| Dissolved Organic Carbon | mg/L | | | |
| SM 4500-P F (General Chemistry) | | | | |
| Phosphorus | mg/L | | | |
| EPA 524.3 (VOCs and SVOCs) | | | | |
| 1,1,1,2-Tetrachloroethane | ug/L | | | |
| 1,1,1-Trichloroethane | ug/L | 200 | 200 | |
| 1,1,2,2-Tetrachloroethane | ug/L | | | |
| 1,1,2-Trichloroethane | ug/L | | 5 | |
| 1,1-Dichloroethane | ug/L | 1 | | |
| 1,1-Dichloroethylene | ug/L | | 7 | |
| 1,1-Dichloropropene | ug/L | | | |
| 1,2,3-Trichlorobenzene | ug/L | | | |
| 1,2,3-Trichloropropane | ug/L | | | |
| 1,2,4-Trichlorobenzene | ug/L | | 70 | |
| 1,2,4-Trimethylbenzene | ug/L | | | |
| Dibromochloropropane (DBCP) | ug/L | | 0.2 | |
| 1,2-Dibromoethane (EDB) | ug/L | 0.001 | 0.05 | |
| 1,2-Dichlorobenzene | ug/L | | 600 | |
| 1,2-Dichloroethane (EDC) | ug/L | 0.5 | 5 | |
| 1,2-Dichloropropane | ug/L | 0.6 | 5 | |
| 1,3,5-Trimethylbenzene | ug/L | | | |
| 1,3-Dichlorobenzene | ug/L | | | |
| 1,3-Dichloropropane | ug/L | | | |
| 1,3-Dichloropropene | ug/L | 0.2 | | |
| 1,4-Dichlorobenzene | ug/L | 4 | 75 | |
| 2,2-Dichloropropane | ug/L | | | |
| 2-Chlorotoluene | ug/L | | | |
| 4-Bromofluorobenzene | ug/L | | | |
| 4-Chlorotoluene | ug/L | | | |
| Acetone | ug/L | | | |
| Benzene | ug/L | 1 | 5 | |
| Bromobenzene | ug/L | | | |
| Bromochloromethane | ug/L | | | |
| Bromodichloromethane | ug/L | 0.3 | 0 | |
| Bromoform | ug/L | 5 | 0 | |
| Bromomethane | ug/L | | | |

| Analyte | Unit | WAC 173-200-040 | WAC 246-290 Primary Drinking Water Standard | WAC 246-290 Secondary Drinking Water Standard |
|---|---|---|---|---|
| Carbon Tetrachloride | ug/L | 0.3 | 5 | |
| Chlorobenzene | ug/L | | 100 | |
| Chloroethane | ug/L | | | |
| Chloroform | ug/L | 7 | 70 | |
| Chloromethane | ug/L | | | |
| cis-1,2-Dichloroethylene (DCE) | ug/L | | 70 | |
| 1,3-Dichloropropene | ug/L | 0.2 | | |
| Dibromochloromethane | ug/L | 0.5 | 60 | |
| Dibromomethane | ug/L | | | |
| Dichlorodifluoromethane | ug/L | | | |
| Ethylbenzene | ug/L | | 700 | |
| Hexachlorobutadiene | ug/L | | | |
| Isopropylbenzene | ug/L | | | |
| Methyl tert-butyl ether (MTBE) | ug/L | | | |
| Methylene Chloride | ug/L | 5 | 5 | |
| Naphthalene | ug/L | | | |
| n-Butylbenzene | ug/L | | | |
| n-Propylbenzene | ug/L | | | |
| Xylenes (Total)(o-, m-, p-) | ug/L | | 10,000 | |
| p-Isopropyltoluene | ug/L | | | |
| sec-Butylbenzene | ug/L | | | |
| Styrene | ug/L | | 100 | |
| tert-Butylbenzene | ug/L | | | |
| Tetrachloroethane (PCE) | ug/L | 0.8 | 5 | |
| Toluene | ug/L | | 1,000 | |
| trans-1,2-Dichloroethylene | ug/L | | 100 | |
| Trichloroethane | ug/L | | 5 | |
| Trichloroethene (TCE) | ug/L | 3 | 5 | |
| Trichlorofluoromethane | ug/L | | | |
| Total trihalomethanes (TTHM) | ug/L | | 80 | |
| Vinyl Chloride | ug/L | 0.02 | 2 | |
| EPA 525.2 (VOCs and SVOCs) | | | | |
| Alachlor | ug/L | | 2 | |
| Atrazine | ug/L | | 3 | |
| Benzo(a)pyrene | ug/L | 0.008 | 0.2 | |
| Bis(2-ethylhexyl) adipate | ug/L | | 400 | |
| Bis(2-ethylhexyl) phthalate | ug/L | 6 | 6 | |
| Bromacil | ug/L | | | |
| Butachlor | ug/L | | | |

| Analyte | Unit | WAC 173-200-040 | WAC 246-290 Primary Drinking Water Standard | WAC 246-290 Secondary Drinking Water Standard |
|---|---|---|---|---|
| Fluorene | ug/L | | | |
| Hexachlorobenzene | ug/L | 0.05 | 1 | |
| Hexachlorocyclopentadiene | ug/L | | 50 | |
| Metolachlor | ug/L | | | |
| Metribuzin | ug/L | | | |
| Propachlor | ug/L | | | |
| Simazine | ug/L | | 4 | |
| EPA 505 (Herbicides and Pesticides) | | | | |
| gamma-BHC (Lindane) | ug/L | 0.06 | | |
| Aldrin | ug/L | 0.005 | | |
| Endrin | ug/L | 0.2 | 2 | |
| DDT (DDE, DDD, DDT) | ug/L | 0.3 | | |
| Dieldrin | ug/L | 0.005 | | |
| Heptachlor | ug/L | 0.02 | 0.4 | |
| Heptachlor epoxide | ug/L | 0.009 | 0.2 | |
| lindane | ug/L | 0.06 | 0.2 | |
| Methoxychlor | ug/L | 100 | 40 | |
| PCB polychlorinated biphenyls | ug/L | 0.01 | 0.5 | |
| Chlordane | ug/L | 0.06 | 2 | |
| Toxaphene | ug/L | 0.08 | 3 | |
| EPA 515.4 (Herbicides and Pesticides) | | | | |
| 2,4-D | ug/L | 100 | 70 | |
| 2,4-DB | ug/L | | | |
| 3,5-Dichlorobenzoic acid | ug/L | | | |
| Acifluorfen | ug/L | | | |
| Chloramben | ug/L | | | |
| Chlorthal (Dacthal) | ug/L | | | |
| Dalapon | ug/L | | 200 | |
| Dicamba | ug/L | | | |
| Dichloroprop | ug/L | | | |
| Dinoseb | ug/L | | 7 | |
| Pentachlorophenol | ug/L | | 1 | |
| Picloram | ug/L | | 500 | |
| Silvex | ug/L | 10 | 50 | |
| EPA 531.2 (Herbicides and Pesticides) | | | | |
| 3-Hydroxycarbofuran | ug/L | | | |
| Aldicarb | ug/L | | | |
| Aldicarb Sulfoxide | ug/L | | | |
| Aldoxycarb | ug/L | | | |
| Carbaryl | ug/L | | | |

| Analyte | Unit | WAC 173-200-040 | WAC 246-290 Primary Drinking Water Standard | WAC 246-290 Secondary Drinking Water Standard |
|---|---|---|---|---|
| Carbofuran | ug/L | | 40 | |
| Methiocarb | ug/L | | | |
| Methomyl | ug/L | | | |
| Oxamyl | ug/L | | 260 | |
| Propoxur | ug/L | | | |
| EPA 547 (Pesticides and Herbicides) | | | | |
| Glyphosate | ug/L | | 700 | |
| EPA 548.1 (Pesticides and Herbicides) | | | | |
| Endothall | ug/L | | 100 | |
| EPA 549.2 (Pesticides and Herbicides) | | | | |
| Diquat | ug/L | | 0.2 | |
| EPA 1613 (Pesticides and Herbicides) | | | | |
| Dioxin [2,3,7,8-TCDD] | ug/L | 0.0000007 | 30 | |
| SM9221B (Bacteriological) | | | | |
| Fecal Coliform | MPN/100mL | | | |
| SM9223B (Bacteriological) | | | | |
| E. coli | MPN/100mL | | | |
| Total Coliform | MPN/100mL | 1/100 | | |
| EPA 900 (Radionuclides) | | | | |
| Gross Alpha | pCi/l | 15 | 15 | |
| Gross Beta | pCi/l | 50 | 4* | |
| EPA 903/904 (Radionuclides) | | | | |
| Radium-226 | pCi/l | 3 | | |
| Radium-226+228 | pCi/l | 5 | 5 | |
| EPA 533 (PFOAs) | | | | |
| PFOA | ng/L | | 10 | |
| PFOS | ug/L | | 15 | |
| PFHxS | ug/L | | 65 | |
| PFNA | ug/L | | 9 | |
| PFBS | ug/L | | 345 | |

**Notes:**
ug/L – Micrograms per liter
mg/L – Milligrams per liter
uS/cm – microsiemens per centimeter
SU. – standard units
* drinking water limit for turbidity is based on a treatment technique in lieu of a Maximum Contaminant Level, where unfiltered surface water cannot exceed 5 NTU (WAC 246-290-632).

## 3.3 Water Quality Impairment Studies

Not applicable.

## 3.4 Effectiveness Monitoring Studies

Not applicable.

# 4.0 Project Description

## 4.1 Project Goals

The overall project goal is to assess the potential for ASR to augment existing water supplies and meet future water demands within the City's water service area. This phase of the project focuses specifically on understanding the water quality conditions of the source water and the aquifer planned for reservoir storage to support geochemical evaluation. Tasks have been designed to determine water quality characteristics.

## 4.2 Project Objectives

The objectives of the Study include:

- Refine the hydrogeologic conceptual model to evaluate ASR feasibility and address informational requirements of Chapter 173-157-120 WAC;
- Assessment of source water quality;
- Assessment of groundwater quality in the target aquifer; and
- Collection of groundwater level measurements in the target aquifer.

## 4.3 Information Needed and Sources

Manual water level measurements are needed to corroborate and correct existing water level measurements (documented in the City's SCADA systems). This information will be used to normalize past measurements (relative to sea level) which will allow a better assessment of groundwater trends and aquifer conditions (e.g., groundwater flow direction and velocity, and available storage volumes of the target aquifer). Pressure transducers will also be deployed as needed to continuously monitor groundwater levels.

Water quality data is also needed from potential surface water sources and the target aquifer. Previous water quality data collected by the City (as part of DOH compliance) will be compiled, along with the data that is the subject of this QAPP. Additional data collected by the City under its own funding in 2023 will also be compiled, but appropriately caveated since it will be collected outside the scope of this QAPP.

Additional details on field data collection for the Study are provided in Section 7.2.

## 4.4 Tasks Required

Study objectives require completing the following tasks.

### Task 1: Water Quality Sampling and Analyses

The task will determine source water quality and background water quality in the target aquifer, in accordance with Ecology guidelines.

**Task 1.1: Water Quality Sampling.** This task includes sampling of potential surface water sources (e.g., SMID Canal and Roza Main Canal) and groundwater. Source water quality data will be used to determine water treatment requirements for municipal and ASR uses. Groundwater sampling will be collected from at least two and up to four City wells during a single sampling event to assess spatial variability of water quality within the target aquifer. During both groundwater and surface water sampling, field water quality parameters (i.e., pH, specific conductance, temperature, ORP, dissolved oxygen, and turbidity) will be collected.

### Task 2: Development of a Conceptual Hydrogeologic Model

The task is to refine the existing conceptual hydrogeologic model to evaluate the feasibility of implementing ASR and address information requirements of Chapter 173-157-120 WAC.

**Task 2.1: Water Level Measurements.** This task includes taking water levels in all the City wells to evaluate groundwater trends and aquifer conditions (e.g., groundwater flow direction and velocity, and available storage volumes of the target aquifer). Groundwater level measurements will be compared to historical SCADA data to evaluate long-term groundwater trends as documented in City wells.

It is recognized that additional testing and data collection may be required to satisfy certain information requirements of Chapter 173-157 WAC, which may be beyond the scope of this phase of the Study and will be identified for data collection in subsequent project phases.

## 4.5 Systematic Planning Process

Finalization of this QAPP is adequate systematic planning for the project.

# 5.0 Organization and Schedule

## 5.1 Key Individuals and Their Responsibilities

Table 5 shows the responsibilities of those who will be involved in this project.

**Table 5. Organization of Project Staff and Responsibilities**

| Staff | Title | Responsibilities |
|---|---|---|
| Scott Tarbutton<br>Office of Columbia River<br>Phone: (509) 867-6534 | OCR Quality Assurance Coordinator | Provides internal review of the QAPP and approves the final QAPP |
| McKenna Murray<br>Office of Columbia River<br>Phone: (509) 823-0996 | OCR Project Manager | Provides oversight for the Study and Ecology Grant. Clarifies scope of the project. Provides review of the QAPP. |
| John Kirk<br>Water Resources Program<br>Phone: (509) 457-7146 | Hydrogeologist | Provides technical oversight and review of the study, provides technical and permitting support |
| Jeff Burkett<br>City of Moxee<br>Phone: (509) 575-8851 | Public Works | Reviews the draft and final QAPP and project deliverables, submittals for the Ecology Grant |
| Justin Bellamy<br>HLA Engineering<br>Phone: (509) 966-7000 | City Engineer | HLA Project Manager, Completes the Engineering Evaluation of Water System |
| Tyson Carlson<br>Aspect Consulting<br>Phone: (509) 895-5923 | Principal Investigator and Project Manager | Co-author of QAPP, Aspect Project Manager, approach development, data analysis, QA/QC |
| Jason Shira<br>Aspect Consulting<br>Phone: (206) 838-5843 | Senior Hydrogeologist | Technical oversight data analysis |
| Silas Sleeper<br>Aspect Consulting<br>Phone: (206) 453-6058 | Field Geologist | Co-author of QAPP. Collects data and records field information. |
| Ian Lauer<br>Aspect Consulting<br>Phone: (509) 888-1527 | Field Geologist | Plans/schedules field dates/logistics. Procures equipment. Collects data and records field information. |
| Lea Beard<br>Aspect Consulting<br>Phone (206) 780-7749 | Data Scientist | Reviews and uploads EIM data. |
| Giles Hamilton<br>LabTest<br>(509) 575-3999 | Laboratory Manager | Prepares laboratory reports, conducts laboratory QA/QC. |
| Justin Doty<br>Anatek Labs, Inc.<br>(208) 883-2839 | Project Manager | Prepares laboratory reports |
| Todd Taruscio<br>Anatek Labs, Inc.<br>(208) 883-2839 | Laboratory Manager | Prepares laboratory reports, conducts laboratory QA/QC. |

## 5.2 Special Training and Certifications

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

## 5.3 Organization Chart

Not applicable – See Table 5.

## 5.4 Proposed Project Schedule

Table 6 below provides the anticipated project schedule proposed under this project.

**Table 6. Tentative Project Schedule**

| Task | Completion Date | Note |
|---|---|---|
| Final QAPP | September 2023 | -- |
| Groundwater and Surface Water Quality Testing | October 2023 | Task will commence at the start of the irrigation season |
| Submit Draft Feasibility Analysis Report | September 2024 | -- |
| Receive Ecology Comments | October / November 2024 | |
| Database uploaded to EIM | December 2024 | -- |
| Complete Final Report | December 2024 | Following receipt and discussion of Ecology comments on the draft report. |

## 5.5 Budget and Funding

The City has received funding from Ecology's Office of Columbia River and the YBIP Groundwater Subcommittee (Agreement No. WRYBIP-2123-Moxeec-00036) to conduct the Study and all tasks as described in Section 4.4. Aspect and HLA are under contract to the City to prepare this QAPP and complete the Study. This work builds upon two Moxee Valley shallow aquifer recharge studies (Aspect, 2020; Sleeper, 2020) that were completed with previous YBIP Groundwater Subcommittee funding.

# 6.0 Quality Objectives

## 6.1 Data Quality Objectives [1]

The main data quality objective (DQO) for this Study is to collect water quality samples from potential surface water and groundwater sites, as well as measure (periodic and continuous) water levels from City wells shown on Figure 1. These analyses will use common methodologies to evaluate water quality and groundwater flow direction that meet the measurement quality objectives (MQOs) described below.

## 6.2 Measurement Quality Objectives

Measurement Quality Objectives (MQOs) are statements of the precision, bias, and lower measurement limits necessary to meet the Study objectives. Precision and bias together express data accuracy, whereas other considerations include the representativeness, completeness, and comparability of the data.

The field investigation will be conducted to measure water levels, collect representative water samples for analyses, and measure water quality field parameters. The MQOs for the field investigation are described by the analytical methods and field equipment used to collect measurements, and the standard operating procedures employed to make descriptions in the field.

### 6.2.1 Targets for Precision, Bias, and Sensitivity

The data collection instrumentation will meet the MQOs listed in Table 7, and the groundwater samples will be analyzed using standard methods that meet the MQOs listed in Table 8.

---

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

## Table 7. Field Method MQOs and Field Equipment Information

| Parameter | Equipment /Method | Bias (median) | Precision Field Duplicates (median) | Equipment Information | | | Expected Range |
|---|---|---|---|---|---|---|---|
| | | | | Accuracy | Resolution | Range | |
| **Air Monitoring** | | | | | | | |
| Temperature | Van Essen Baro-Diver | -- | -- | 0.1°C | 0.01°C | -10 to 50°C | -7 to 31°C |
| Barometric Pressure | Van Essen Baro-Diver | -- | -- | 0.016 ft-$H_2O$ | 0.003 ft-$H_2O$ | -- | 29 to 33 ft-$H_2O$ |
| **Groundwater Level Measurements** | | | | | | | |
| Temperature | Van Essen TD-Diver | -- | -- | 0.1°C | 0.01°C | 0 to 50°C | 1 to 25°C |
| Pressure | Van Essen TD-Diver | -- | -- | 0.016 ft-$H_2O$ | 0.007 ft-$H_2O$ | max 330 ft-$H_2O$ | 20 to 200 ft-$H_2O$ |
| | Weiss | -- | -- | 0.5% Full Scale | 0.01 PSI | Max 200 PSI | |
| Depth to Water Table | Electronic Water level | -- | -- | 0.05 ft | 0.01 ft | -- | 250 to 750 ft |
| Wellhead Position (GPS) | Arrow Gold+ GNSS Receiver | -- | -- | 0.3 feet | 0.01 ft | -- | -- |
| **Field Water Quality Parameters** | | | | | | | |
| pH | AquaTroll 500 | -- | -- | 0.1 SU | 0.01 SU | 0 to 14 SU | 6.5 to 8.5 SU |
| Specific conductivity | | -- | -- | ±0.5% + 1 uS/cm | 0. 1 uS/cm | 0 to 350,000 uS/cm | 150 to 500 uS/cm |
| Dissolved oxygen | | -- | -- | ± 0.1mg/L | 0.01 mg/L | 0 to 20 mg/L | 0 to 10 mg/L |
| Oxidation-Reduction Potential | | -- | -- | ±5 mV | 0.1 mV | -1400 to +1400 mV | -300 to +300 mV |
| Temperature | | -- | -- | ±0.1°C | 0.01°C | -5 to 50°C | 1 to 25°C |

**Notes:** mV = millivolts; ft $H_2O$ = feet of water; PSI = pounds per square inch; SU = standard units; uS/cm = microsiemens per centimeter; mg/L = milligrams per liter; °C = temperature in Celsius

## Table 8. Laboratory MQOs of Water Samples

| Analytical Method | Analyte | Method Detection Limit | Method Reporting Limit | Units | Field Dup. (RPD) | Matrix Spike (%Rec) | Matrix Spike (RPD) | Blank Spike (LCS % Rec) | Blank Spike (RPD) |
|---|---|---|---|---|---|---|---|---|---|
| **General Chemistry, Inorganics in Drinking Water** | | | | | | | | | |
| EPA 300.0 | Bromide | 0.0130 | 0.100 | mg/L | - | 90-110 | 20 | 90-110 | 20 |
| EPA 300.0 | Chloride | 0.0280 | 0.100 | mg/L | - | 90-110 | 20 | 90-110 | 20 |
| EPA 300.0 | Fluoride | 0.0140 | 0.100 | mg/L | - | 90-110 | 20 | 90-110 | 20 |
| EPA 300.0 | Nitrate/N | 0.0180 | 0.100 | mg/L | 20 | 90-110 | 20 | 90-110 | 20 |
| EPA 300.0 | Nitrite/N | 0.0180 | 0.100 | mg/L | - | 90-110 | 20 | 90-110 | 20 |
| EPA 300.0 | Sulfate | 0.0170 | 0.100 | mg/L | - | 90-110 | 20 | 90-110 | 20 |
| SM 2320 B | Alkalinity | 2.00 | 2.00 | mg/L | - | 85-115 | 20 | 85-115 | 20 |
| SM 2320 B | Bicarbonate | 2.00 | 2.00 | mg/L | - | - | - | - | - |
| SM 2540 C | TDS | 43.6 | 50.0 | mg/L | 10 | 80-120 | 20 | 80-120 | 20 |
| SM 2540 D | TSS | 1.00 | 1.00 | mg/L | 10 | - | - | - | - |
| SM 4500-P F | Total P | 0.00698 | 0.0100 | mg/L | - | 80-120 | 25 | 80-120 | 25 |
| SM 5310 B | DOC | 0.100 | 0.500 | mg/L | - | 70-130 | 30 | 80-120 | 20 |
| SM 5310 B | TOC | 0.0600 | 0.100 | mg/L | - | 70-130 | 30 | 85-115 | 15 |
| **Metals by ICP in Drinking Water** | | | | | | | | | |
| EPA 200.7 | Aluminum | 0.00800 | 0.0100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.7 | Calcium | 0.0182 | 0.100 | mg/L | 20 | 70-130 | 20 | 85-115 | 20 |
| EPA 200.7 | Dissolved Aluminum | 0.00700 | 0.0100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.7 | Dissolved Calcium | 0.0173 | 0.100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.7 | Dissolved Iron | 0.00720 | 0.0100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.7 | Dissolved Magnesium | 0.0154 | 0.100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.7 | Dissolved Potassium | 0.0521 | 0.500 | mg/L | - | 70-130 | 20 | 85-115 | 20 |
| EPA 200.7 | Dissolved Silicon | 0.0435 | 0.100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.7 | Dissolved Sodium | 0.0124 | 0.100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.7 | Iron | 0.00720 | 0.0100 | mg/L | 20 | 70-130 | 20 | 85-115 | 20 |
| EPA 200.7 | Magnesium | 0.0154 | 0.100 | mg/L | 20 | 70-130 | 20 | 85-115 | 20 |
| EPA 200.7 | Potassium | 0.0521 | 0.500 | mg/L | 20 | 70-130 | 20 | 85-115 | 20 |
| EPA 200.7 | Silica (as SiO2) | 0.0930 | 0.214 | mg/L | - | - | - | - | - |
| EPA 200.7 | Silicon | 0.100 | 0.100 | mg/L | 20 | 70-130 | 20 | 85-115 | 20 |
| EPA 200.7 | Sodium | 0.0124 | 0.100 | mg/L | 20 | 70-130 | 20 | 85-115 | 20 |
| EPA 200.7 | Diss. Silica (as SiO2) | 0.0930 | 0.214 | mg/L | - | - | - | - | - |
| **Metals by ICP-MS in Drinking Water** | | | | | | | | | |
| EPA 200.8 | Antimony | 0.000330 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Arsenic | 0.000830 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Barium | 0.0000800 | 0.000130 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Beryllium | 0.000150 | 0.000300 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Cadmium | 0.000132 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Chromium | 0.000990 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Copper | 0.000267 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Antimony | 0.000330 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Arsenic | 0.000830 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Barium | 0.000130 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |

| Analytical Method | Analyte | Method Detection Limit | Method Reporting Limit | Units | Field Dup. (RPD) | Matrix Spike (%Rec) | Matrix Spike (RPD) | Blank Spike (LCS % Rec) | Blank Spike (RPD) |
|---|---|---|---|---|---|---|---|---|---|
| EPA 200.8 | Dissolved Beryllium | 0.000150 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Cadmium | 0.000132 | 0.00100 | mg/L | 20 | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Chromium | 0.000990 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Copper | 0.000267 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Lead | 0.000430 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Manganese | 0.000110 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Nickel | 0.000430 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Selenium | 0.000460 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Silver | 0.000270 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Thallium | 0.000160 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Uranium | 0.000290 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Dissolved Zinc | 0.000760 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Lead | 0.000430 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Manganese | 0.000110 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Nickel | 0.000430 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Selenium | 0.000460 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Silver | 0.000270 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Thallium | 0.000160 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Uranium | 0.000290 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| EPA 200.8 | Zinc | 0.000760 | 0.00100 | mg/L | - | 70-130 | 20 | 85-115 | - |
| **Mercury in Water** | | | | | | | | | |
| EPA 245.7 | Dissolved Mercury | 0.000200 | 0.00100 | ug/L | 18 | 63-111 | 18 | 76-113 | 18 |
| EPA 245.7 | Mercury | 0.000200 | 0.00100 | ug/L | 18 | 63-111 | 18 | 63-113 | - |
| **Semivolatiles in Drinking Water** | | | | | | | | | |
| EPA 505 | gamma-BHC (Lindane) | 0.00320 | 0.0200 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Heptachlor | 0.00360 | 0.0400 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Aldrin | 0.00480 | 0.100 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Heptachlor epoxide | 0.00160 | 0.0200 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | 4,4'-DDE | 0.00180 | 0.100 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Dieldrin | 0.00170 | 0.100 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Endrin | 0.00240 | 0.0100 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | 4,4'-DDD | 0.00210 | 0.100 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | 4,4'-DDT | 0.00520 | 0.100 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Methoxychlor | 0.00460 | 0.100 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Aroclor 1232 (PCB-1232) | 0.100 | 0.500 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Aroclor 1242 (PCB-1242) | 0.100 | 0.300 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Aroclor 1248 (PCB-1248) | 0.100 | 0.100 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Aroclor 1254 (PCB-1254) | 0.100 | 0.100 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Aroclor 1260 (PCB-1260) | 0.0375 | 0.200 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | PCBs | 0.0950 | 0.500 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Chlordane | 0.0715 | 0.200 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 505 | Toxaphene | 0.227 | 1.00 | ug/L | 25 | 65-135 | 25 | 70-130 | 20 |
| EPA 515.4 | Dalapon | 0.531 | 1.00 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 515.4 | Dicamba | 0.0710 | 0.200 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 515.4 | Dichloroprop | 0.260 | 0.500 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |

| Analytical Method | Analyte | Method Detection Limit | Method Reporting Limit | Units | Field Dup. (RPD) | Matrix Spike (%Rec) | Matrix Spike (RPD) | Blank Spike (LCS %Rec) | Blank Spike (RPD) |
|---|---|---|---|---|---|---|---|---|---|
| EPA 515.4 | 2,4-D | 0.0330 | 0.100 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 515.4 | Pentachlorophenol | 0.00900 | 0.0400 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 515.4 | 2,4,5-TP (Silvex) | 0.0350 | 0.200 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 515.4 | 2,4-DB | 0.240 | 1.00 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 515.4 | Dinoseb | 0.0680 | 0.200 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 515.4 | Picloram | 0.0480 | 0.100 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 515.4 | 3,5-Dichlorobenzoic Acid | 0.156 | 0.500 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 515.4 | Chloramben | 0.0490 | 0.200 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 515.4 | Acifluorofen | 0.322 | 1.00 | ug/L | 20 | 70-130 | 30 | 70-130 | 20 |
| EPA 525.2 | Alachlor | 0.0550 | 0.200 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | Atrazine | 0.0670 | 0.100 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | Benzo[a]pyrene | 0.0100 | 0.0200 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | bis(2-Ethylhexyl)phthalate | 0.127 | 0.600 | ug/L | 30 | 20-150 | 30 | 20-150 | 25 |
| EPA 525.2 | bis-2(ethylhexyl)adipate | 0.0690 | 0.600 | ug/L | 30 | 20-150 | 30 | 20-150 | 25 |
| EPA 525.2 | Bromacil | 0.0500 | 0.100 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | Butachlor | 0.0590 | 0.100 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | Fluorene | 0.0350 | 0.200 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | gamma-BHC (Lindane) | 0.0152 | 0.0400 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | Hexachlorobenzene | 0.0370 | 0.100 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | Hexachlorocyclopentadiene | 0.0410 | 0.100 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | Methoxychlor | 0.0480 | 0.200 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | Metribuzin | 0.0570 | 0.100 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | Propachlor | 0.0540 | 0.100 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 525.2 | Simazine | 0.0630 | 0.0700 | ug/L | 30 | 20-130 | 30 | 20-130 | 25 |
| EPA 549.2 | Diquat | 0.208 | 0.400 | ug/L | 20 | 70-130 | 25 | 70-130 | 20 |
| SM 6251 B | Monochloroacetic acid | 0.437 | 2.00 | ug/L | 20 | 70-130 | 20 | 70-130 | 20 |
| SM 6251 B | Monobromoacetic acid | 0.272 | 1.00 | ug/L | 20 | 70-130 | 20 | 70-130 | 20 |
| SM 6251 B | Dichloroacetic acid | 0.374 | 1.00 | ug/L | 20 | 70-130 | 20 | 70-130 | 20 |
| SM 6251 B | Trichloroacetic acid | 0.483 | 1.00 | ug/L | 20 | 70-130 | 20 | 70-130 | 20 |
| SM 6251 B | Bromochloroacetic acid (BCAA) | 0.191 | 1.00 | ug/L | 20 | 70-130 | 20 | 70-130 | 20 |
| SM 6251 B | Dibromoacetic acid | 0.275 | 1.00 | ug/L | 20 | 70-130 | 20 | 70-130 | 20 |
| SM 6251 B | Total HAA5 | 0.500 | 1.00 | ug/L | 20 | 70-130 | 20 | 70-130 | 20 |
| **Volatiles in Drinking Water** | | | | | | | | | |
| EPA 524.3 | 1,3-Dichloropropene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Total Trihalomethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Benzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Bromochloromethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Bromodichloromethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Bromoform | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Bromomethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Carbon Tetrachloride | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Chlorobenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Chloroform | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Chloromethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |

| Analytical Method | Analyte | Method Detection Limit | Method Reporting Limit | Units | Field Dup. (RPD) | Matrix Spike (%Rec) | Matrix Spike (RPD) | Blank Spike (LCS % Rec) | Blank Spike (RPD) |
|---|---|---|---|---|---|---|---|---|---|
| EPA 524.3 | cis-1,2-dichloroethene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | cis-1,3-Dichloropropene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,2-Dibromo-3-chloropropane (DBCP) | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,2-Dibromoethane (EDB) | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,2-Dichlorobenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,3-Dichlorobenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,4-Dichlorobenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Dichlorodifluoromethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,1-Dichloroethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,2-Dichloroethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,1-Dichloroethene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | trans-1,2-Dichloroethene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,2-Dichloropropane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | trans-1,3-Dichloropropene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Ethylbenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Hexachlorobutadiene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Isopropylbenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Methylene chloride | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Naphthalene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Styrene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,1,1,2-Tetrachloroethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,1,2,2-Tetrachloroethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Tetrachloroethene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Toluene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,2,4-Trichlorobenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,1,1-Trichloroethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,1,2-Trichloroethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Trichloroethene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Trichlorofluoromethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,2,3-Trichloropropane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Vinyl Chloride | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | m+p-Xylene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | o-Xylene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Total Xylene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,1-dichloropropene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,2,3-Trichlorobenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,2,4-Trimethylbenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Chloroethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,3,5-Trimethylbenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 2,2-Dichloropropane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 1,3-Dichloropropane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 2-Chlorotoluene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | 4-Chlorotoluene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Bromobenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |

| Analytical Method | Analyte | Method Detection Limit | Method Reporting Limit | Units | Field Dup. (RPD) | Matrix Spike (%Rec) | Matrix Spike (RPD) | Blank Spike (LCS % Rec) | Blank Spike (RPD) |
|---|---|---|---|---|---|---|---|---|---|
| EPA 524.3 | Dibromochloromethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Dibromomethane | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | methyl-t-butyl ether | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | (MTBE) n-Butylbenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | n-Propylbenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | p-isopropyltoluene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | sec-Butylbenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | tert-Butylbenzene | 0.100 | 0.500 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | Acetone | 0.500 | 2.50 | ug/L | - | 70-130 | 30 | 70-130 | 20 |
| EPA 524.3 | MTBE-d3 | - | - | Surr. | - | 70-130 | - | - | - |
| EPA 524.3 | 4-Bromofluorobenzene | - | - | Surr. | - | 70-130 | - | - | - |
| EPA 524.3 | 1,2-Dichlorobenzene-d4 | - | - | Surr. | - | 70-130 | - | - | - |

**Notes:** Dup. = Duplicate Sample, RPD = relative percent difference, LCS = laboratory control sample, %Rec = percent recovered, Surr. = Surrogate

**Water Quality Analyses**

The MQOs for the water quality analyses are summarized above in Table 8, including samples, laboratory blanks, and duplicates. Water quality sampling will be performed using industry-standard procedures to minimize bias and maximize precision. One field duplicate and data validation (DV) sample will be collected during each sampling event (Section 7, Table 9). All sampling equipment will be decontaminated before and after completion of sampling activities. Additional quality control procedures are detailed in Section 10.

Anatek Labs, Inc. (Anatek) and LabTest are accredited by Ecology for all analytical procedures performed for this project and by the National Environmental Laboratory Accreditation Program (NELAP) for a comprehensive analytical laboratory accreditation. LabTest will perform nitrate, nitrite, and bacteriological analyses and Anatek will perform all remaining analyses. The laboratories are responsible for ensuring that all procedures performed comply with all requirements specified in the accreditation programs, laboratory quality assurance (QA) manuals, individual analytical methods, and this QAPP. Copies of the lab accreditation for Anatek and LabTest are included as Appendix A.

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

### 6.2.1.1 Precision

Precision is defined as the degree of agreement between or among independent, similar, or repeated measurements. Precision is a measure of variability in the results of replicate measurements due to random error. Precision is usually assessed by analyzing duplicate field measurements and random error is imparted by the variation in field procedures. Therefore, field sampling precision is addressed by collection of replicate measurements.

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

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

where:

S = analyte concentration in a sample

D = analyte concentration in a duplicate sample

The resultant RPD will be compared with criteria established by this QAPP in Table 8, and deviations from these criteria will be reported. If the QAPP criteria are not met, the laboratory will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. The RPD will be evaluated during data review and validation. The data reviewer will note deviations from the specified limits and will comment on the effect of the deviations on the reported data.

#### 6.2.1.2 Bias

Bias is the difference between the sample mean and the true value. It will be measured as the percent recoveries of MS and MSD, organic surrogate compounds, and the laboratory control sample (LCS). Additional potential bias will be assessed using calibration standards and blank samples (e.g., method blanks), which are detailed in Section 7, Table 9 and Section 10. In cases where accuracy is determined from spiked samples, accuracy will be expressed as the percent recovery. The closer these values are to 100 percent, the more accurate the data.

**Surrogate recovery will be calculated as follows:**

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

where:

SC = spiked concentration

MC = measured concentration

**MS percent recovery will be calculated as follows:**

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

where:

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

**MSD percent recovery will be calculated as follows:**

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

where:

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

and

$$\text{RPD (\%)} = \frac{MC - MDC}{(MC+MDC)/2} \times 100,$$

where:

RPD = relative percent difference.

Field staff will minimize bias in the field measurements by strictly following equipment calibration and measurement protocols. Potential sources of field bias in measurements include measurement procedure, inability to measure all forms of the parameter of interest, and calibration problems. Table 7 presents the bias data quality objectives for pressure transducer and temperature sensor data for instrument QC checks.

The resultant percent recoveries will be compared with criteria established by this QAPP in Table 8, and deviations from these criteria will be reported (and in laboratory limits for RPD reported by the lab in individual reports). If the objective criteria are not met, the laboratory will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. Percent recoveries will be evaluated during data review and validation, and the data reviewer will comment on the effect of the deviations on the reported data.

### Groundwater Level Monitoring

The MQOs for the groundwater level monitoring of supply wells are as follows:

- Obtain horizontal well locations within 2-meter (6.5 feet) accuracy;
- Obtain the elevation (if not already obtained) of the wellhead or water level reference point relative to ground surface;
- Obtain ground surface elevations within a 3-foot accuracy (using GPS measurements, with elevations cross-referenced with a 10-meter digital elevation model available from the Washington State Department of Natural Resources);
- Obtain groundwater level measurements within a 0.1-foot accuracy. Measurements are recorded to ±0.01 foot and are accurate to ± 0.05 foot per 100 feet (Jelinski et al., 2015); and
- Continuous measurement of groundwater levels is conducted using a pressure transducer with an onboard datalogger. Measurement of barometric pressure is necessary to correct measured water level data for the effects of changes in atmospheric pressure. Calibration and maintenance of pressure transducers are provided by the manufacturer and should be consulted. Table 7 provides accuracy and resolution for Van Essen Baro- and TD-Diver typically used for long-term deployments.

A description of the water level monitoring techniques that will be used to obtain the MQOs for the water level measurements and well locations is provided in the *Field Procedures* section (Section 8.2).

#### 6.2.1.3 Sensitivity

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

Sensitivity is also a measure of the capability of the field method and instrument used to detect a change. It is described by its range, accuracy, and resolution. This is usually reported for each instrument by the manufacturer. Examples of this information are provided in Table 7.

### 6.2.2 Targets for Comparability, Representativeness, and Completeness

#### 6.2.2.1 Comparability

Comparability is the degree to which the data can be compared to historical data, reference values (such as background), and reference materials. This will be achieved through the use of standard operating procedures (SOPs) to collect field measurements and samples, training of field staff, field data-collection similarities (location, duration, time of year, weather conditions, etc.), instrumentation sensitivity, EPA-approved methods to analyze samples, and consistent units to report analytical results. Data comparability also depends on data quality. Data of unknown quality cannot be compared.

#### 6.2.2.2 Representativeness

Representativeness is the degree to which sample results represent the system under Study. This component is generally considered during the design phase of a program. This program will use the results of all analyses to evaluate the data in terms of its intended use. Typically, a combination of continuous measurements, spot measurements, and historical data is needed to represent the expected variability of spatial and temporal conditions.

Representativeness of the measurements and samples will be ensured during the collection process by: (1) employing proper decontamination procedures, (2) thorough purging of the well and ensuring stability of field parameters prior to collecting groundwater samples (Section 6.3), and (3) and use of continuous monitoring equipment for groundwater level monitoring. The representativeness of analytical results will be determined by evaluating hold times, sample preservation, and blank contamination (e.g., trip blanks). Samples with expired hold times, improper preservation, or contamination may not be representative.

#### 6.2.2.3 Completeness

**Completeness will be calculated as follows:**

$$Completeness\ (\%)\ = \frac{V}{P} \times\ 100$$

where:

V = number of valid measurements

P = number of planned measurements

Valid and invalid data (i.e., data qualified with the R flag [rejected]) will be identified during data validation. The completeness target for the Study is 100 percent of water quality samples. However, problems occasionally arise during data collection. A completeness of 95 percent is acceptable for discrete measurements. In general, the project is designed to accommodate some data loss and still meet project goals and objectives.

For continuous deployed measurements, additional variables can negatively impact completeness, including vandalism/theft/tampering, equipment failure, unacceptable fouling or drift, and unpredictable hydrologic events (steep drops in water level between visits). For these reasons, a completeness of 80 percent is acceptable for continuous measurements. Given these difficulties, redundancy is an important component when designing studies with continuous data collection, particularly at important boundary conditions and within the most critical areas. If completeness targets are not achieved, then a determination will be made as to whether the data that were successfully collected are sufficient to meet project needs. This will depend on a number of factors, such as the needs of the analysis framework, and the times and locations where data were lost. If successfully collected data are not sufficient, then one or a combination of the following approaches will be used:

1. Estimate missing data values from existing data, if this can be done with reasonable confidence;

2. Conduct targeted additional sampling to fill data gaps; and
3. Recollect all or a portion of data.

If completeness targets are not met, the study report will analyze the effect of the incomplete data on meeting the study objectives, account for data completeness (or incompleteness) in any data analyses, and document data completeness and its consequences in any study reports.

## 6.3 Acceptance Criteria for Quality of Existing Data

Existing groundwater quality data was collected in the study area under YBIP Groundwater Subcommittee funding (Sleeper, 2020). A QAPP was prepared to support that 2020 study and the data collected follows the same measurement quality objectives discussed in Section 6.2 of this QAPP. The City also conducts water quality sampling at each of its groundwater wells to comply with DOH drinking water source requirements, but no Ecology-approved QAPP was prepared for this work.

## 6.4 Model Quality Objectives

Not applicable.

# 7.0 Study Design

The study-design is a non-randomized study design. Sampling locations and analytical suites are preselected based on opportunistically available locations and the study objectives. A narrative of the overall study objective is provided in Section 4. This section provides the details of the data collection and analysis.

## 7.1 Study Boundaries

The study area is shown on Figure 1. Overall, this Study considers the performance of the target storage aquifer over the conceptual boundary shown on Figure 1. However, the data collection activities for the Study will not extend beyond the footprint of the Moxee Valley.

## 7.2 Field Data Collection

### 7.2.1 Sampling Locations and Frequency

Water quality sampling and water level measurements will occur according to the schedule shown in Table 9. The analyte suite is described in Sections 3.2.3 and 6.2 and will be sampled according to the quality objectives described in Section 6. The key considerations for the sampling schedule are outlined in the following sections.

**Table 9. Water Quality Sampling and Groundwater Level Monitoring Schedule**

| **Anticipated Scheduling Date** | **Surface Water Sources (SMID Canal and Roza Main Canal)** | | | | | | **City Owned Groundwater Wells (Wells 1, 2, 3, and 4)** |
|---|---|---|---|---|---|---|---|
| Fall 2023 | Gen Chem | SVOC | Herbicide and & Pesticides | Bact. | Radionuclide | PFAS | General Chemistry, PFAS |
| Fall 2023 | | | | | | | Depth to Water – Manual<br>Pressure - Continuous |

**Notes:**

Field parameters will be measured during every sampling event.

One field duplicate and data validation (DV) sample will be collected during each sampling event. The DV sample for a trip blank will include the VOC, general chemistry, and bacteria sample suites (note that no MS/MSD analyses will be completed for bacteria).

### Water Quality Sampling Schedule

To characterize ambient water quality conditions in the target aquifer, water quality samples will be collected from four spatially distributed production wells during a single sampling event to assess spatial variability of water quality within the target aquifer.

The locations of City Wells are presented in Figure 1 and well construction details are included in Table 10 and well logs are included in Appendix B.

Within 1-2 days of the groundwater sampling all source water samples will be collected during a single sampling event to obtain a snapshot of water quality delivered by the potential source water canals.

**Table 10. City of Moxee Well Attributes Summary**

| City Well No. | Ground Surface Elevation (ft amsl)[a] | Well Depth (feet) | Open Interval (ft amsl) | Initial Static Water Level[b] (ft amsl) | Current Static Water Level[c, d] (ft amsl) |
|---|---|---|---|---|---|
| 1 | 1,049 | 1,326 | -176 to -231 | 1,065 | 1,060 |
| 2 | 1,177 | 978 | 411 to 207 | 1,155 | 1,085 |
| 3 | 1090 | 783 | Unknown | Unknown | 1,094 |
| 4 | 1,177 | 1,110 | 302 to 78 | 1,078 | 1,078 |

**Notes:**

a - Approximate elevation obtained from Google Earth.

b - Initial static water level measurement dates: Well 1 (January 1943), Well 2 (March 1983), Well 3 (January 2015), Well 4 (January 2021)

c - Current static water level measurement dates: Well 1 (January 2022), Well 2 (March 2022), Well 3 (January 2022), Well 4 (January 2022)

d - Well 1 is currently artesian

amsl = above mean sea level; ft = feet

### 7.2.2 Field Parameters and Laboratory Analytes to be Measured

Field parameters will be measured using an AquaTroll 500 multimeter, as described in Section 8.2, to provide independent corroboration of laboratory results, and to analyze constituents that have short hold times and can be reliably measured in the field. These include:

- Electrical conductivity
- Dissolved Oxygen
- ORP
- pH
- Temperature
- Turbidity

In addition to manual measurements of the above constituents during sampling events measurements will be collected until values are stable, as described in Section 8.2.

Groundwater depth-to-water measurements will be conducted using an electronic water level indicator as discussed in Section 8. A dedicated pressure transducer will be installed in the subject wells to collect continuous groundwater level measurements.

Laboratory analytes to be measured from water quality sampling throughout the Study are listed above in Section 6.

## 7.3 Modeling and Analysis Design

### 7.3.1 Analytical Framework

Data analysis will include evaluating water quality and groundwater levels, following these key considerations:

- Groundwater level trends in City wells will be determined using historical and contemporary groundwater level data.
- Comparison to applicable regulatory criteria summarized in Section 3.2.4.

### 7.3.2 Model Setup and Data Needs

Not Applicable.

## 7.4 Assumptions of Study Design

The Study assumes that existing water quality and groundwater level data are of sufficient quality to compare with contemporary data collected under this QAPP.

## 7.5 Possible Challenges and Contingencies

### 7.5.1 Logistical Problems

Logistical problems that interfere with measurement collection may occur during field work. These problems include:

1. Inability to access source water and groundwater measurement locations;
2. Inability to install pressure transducers into City wells;
3. Inability to retrieve data from the City's SCADA system;
4. Data quality retrieved from the City's SCADA system does not meet this QAPP MQOs; and
5. Water quality samples meeting hold times and temperature criteria when shipping samples to laboratory for analysis.

### 7.5.2 Practical Constraints

No practical constraints have been identified for this study.

### 7.5.3 Schedule Limitations

Schedule limitations include iterative QAPP review and approval and sampling during the irrigation season (about April 1 through October 31) while the canals are fully charged and operational. No other limitations have been currently identified but could potentially arise from unforeseen circumstances.

# 8.0 Field Procedures

## 8.1 Invasive Species Evaluation

Field staff will follow EPA's SOP EAP070, on minimizing the spread of invasive species (Ecology, 2023). At the end of each field visit, field staff will clean field gear in accordance with the SOP for minimizing the spread of invasive species for areas of both moderate and extreme concern.

Field staff will minimize the spread of invasive species after conducting field work by:

Inspecting and cleaning all equipment by removing any visible soil, vegetation, vertebrates, invertebrates, plants, algae, or sediment. If necessary, a scrub brush will be used and then rinsed with clean water either from the site or brought for that purpose. The process will be continued until all equipment is clean.

Draining all water in samplers or other equipment that may harbor water from the site. This step will take place before leaving the sampling site or at an interim site. If cleaning after leaving the sampling site, field staff will ensure that no debris will leave the equipment and potentially spread invasive species during transit or cleaning.

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

## 8.2 Measurement and Sampling Procedures

The procedures used in this Study are typical for hydrogeologic investigations. SOPs to be followed include the following: *Standard Operating Procedure for Manually Obtaining Surface Water Samples* (Ecology, 2006), *Manual Well-Depth and Depth-to-Water Measurements* (Ecology, 2018a), *Standard Operating Procedures to Minimize the Spread of Invasive Species* (Ecology, 2018b), *General Sampling Procedure, Office of Drinking Water* (DOH, 2003), *Use of Submersible Pressure Transducers During Groundwater Studies* (Ecology, 2019), *Purging and Sampling Monitoring Wells for General Chemistry Parameters (Ecology, 2018c)*.

### 8.2.1 Well Location Survey

The horizontal location of the well will be determined using a Trimble GPS. Care will be taken to collect a GPS location with a greater horizontal accuracy than 6.5 feet, as discussed in the *Quality Objectives* section (Section 6). The ground surface elevation will also be determined based on the Trimble GPS and shall have a vertical accuracy of equal to, or better than, 3 feet.

### 8.2.2 Groundwater Level Monitoring

Manual groundwater levels will be measured at the City's four wells with either an electronic water level indicator or pressure gage. The manual water level measurements will be used to convert the City's SCADA data to depth to water and a common datum (elevation above mean sea level).

Automated water level data will be obtained from pressure transducers reporting to the City's SCADA system. These transducers are vented to the atmosphere, allowing measurement of gaged (submergence) pressure. Data obtained from the City's SCADA system will be examined for inconsistencies and suspect data flagged for evaluation.

Water levels should be collected using an electrical water level meter with engineer's scale accurate to a hundredth of a foot (0.01 feet). Shut-in pressures should be collected using a pressure gage with an appropriate pressure range and accurate to less than 5 percent of the full range. A permanent measuring point (MP) will be made from which all depth-to-water measurements are taken at each well to ensure data comparability. An MP will be established, or the existing MP will be used if already established.

Establish a permanent measuring point (MP) via the method below:

1. MPs are normally established on the top rim of the actual well casing; this position is commonly referred to as "top of casing" (TOC). Locate the MP at a convenient place from which to measure the water level. If the TOC is level, collect the measurement from the north edge.
2. Clearly mark the MP. The MP must be as permanent as possible and be clearly visible and easily located. The MP may be marked using a permanent black marker, bright colored paint stick, or with a notch filed into the TOC.
3. Describe the position of the MP clearly in the field-data sheets.
4. The MP height is established in reference to a land surface datum (LSD). The LSD is generally chosen to be approximately equivalent to the average altitude of the ground surface around the well.
5. Measure the height of the MP in feet relative to the LSD. Generally, MPs are established to the nearest 0.1 feet using a pocket tape to measure the distance from the MP to the LSD. Note that values for measuring points that lie below land surface should be preceded by a minus sign (-). Record the height of the MP and the date it was established.
6. MPs and the LSD may change over time, the distance between the two should be checked whenever there have been activities, such as land development that could have affected either the MP or LSD at the site. Such changes must be measured as accurately as possible, documented and dated in field-data sheets, and in any database(s) into which the water-level data are entered.

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

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

1. Open the top of the well and note any popping sounds that would indicate pressure buildup, any odors, and the condition of the well head.
2. If there is a pressure transducer attached to the well cap carefully note the initial position of the cap (mark cap position on casing with permanent marker). If the well was airtight, wait a few minutes for the water level to return to equilibrium with atmospheric pressure.

3. Turn the water level meter on and slowly lower the probe into the well until it makes a tone indicating contact with the water level. To confirm contact with the distinct water boundary, slowly raise and lower the electric-tape probe in and out of the water column. If necessary, adjust the sensitivity setting of the meter to provide a “crisp” indication of the water surface. Measure the depth to water against the MP and mark down the date and time the reading was made.
4. At the precise location the indicator shows contact with the water surface, pinch the tape between your fingernails at the MP. Read the depth-to-water.
5. Repeat measurement to ensure that the water level is stable (not rising or falling over time).
6. When the probe is pulled back up, make a note of any mud, staining, or anything else on the tip. Before moving on to the next well, decontaminate the probe with a brush or paper towel, then rinse with distilled water and 10 percent bleach.

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

### 8.2.3 Atmospheric Pressure Monitoring

A barometric pressure transducer and datalogger will be deployed within City limits. Data from this transducer will be used to assess the effects of barometric pressure on water level measurements in City wells. Barometric efficiency can affect the representativeness of water level measurements from vented and unvented transducers (Spane, 2002). Corrections for barometric efficiency of wells will be made, as appropriate.

### 8.2.4 Groundwater and Source Water Sampling

Groundwater quality samples from City Wells will be collected in general accordance with Ecology (2018c) and DOH (2003) when using existing turbine pumps. Groundwater samples will be collected from the existing sample port at City Wells during operation of the existing pump, prior to any type of water storage or chlorine feed. The well will be purged for a minimum of 10 minutes (or three well volumes) prior to the collection of the groundwater samples or until the water quality parameters stabilize. If necessary, groundwater quality samples will be collected during using low-flow groundwater sampling techniques via a bladder pump.

Field water quality parameters (temperature, pH, specific conductivity, ORP, dissolved oxygen, and turbidity) will be monitored from each well at approximately 3- to 5-minute intervals throughout well purging using an Aqua Troll 500 and flow-through cell plumbed into the sampling port. Water quality parameters will be considered stable when three successive measurements indicate that the parameters fall within the stabilization criteria established in Standard Operating Procedure EAP099 Purging and Sampling Monitoring Wells for General Chemistry Parameters (Ecology, 2018) and shown in Table 11 below. Once the water quality parameters have stabilized, the groundwater quality samples shall be collected from the respective sampling port.

**Table 11. Field Parameter Stabilization Criteria**

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

Source water samples will be collected from the canal bank of the surface water body. Field water quality parameters (temperature, pH, specific conductivity, ORP, dissolved oxygen, and turbidity) will be obtained using an AquaTroll 500 water quality probe. Surface water samples will be collected as a grab sample either by directly dipping the laboratory-supplied sample bottle through the water column, or by pumping water with a peristaltic pump directly into the laboratory-supplied sample bottle, if the canal is too shallow to collect a sample without disturbing the canal bottom.

All samples collected for dissolved metals will be field filtered. Sample will be collected after pumping three filter volumes through filter cartridge. A minimum of one surface water sample will be collected for each site and submitted to the laboratory for analysis.

## 8.3 Containers, Preservation Methods, Holding Times

The sample bottles and respective preservatives for each sample will be provided by the laboratory and filled accordingly. A description of the sample bottles, preservatives and analytical methods are provided in Table 12.

New latex gloves will be worn at all times during the collection of the water quality parameters and samples and switched between locations. Samples for dissolved metal analyses shall be filtered with a 0.45-micron pore-size filter. All bottles shall be clearly labeled with a unique sample name, location name, date, time, and preservative. Samples shall be stored in a cooler at 4 degrees Celsius (°C) and delivered to the laboratory under standard chain-of-custody protocols, within the hold times provided in Table 12.

**Table 12. Containers, Preservation Methods, and Holding Times**

| Parameter | Container | Preservative | Holding Time |
|---|---|---|---|
| **General Chemistry / Water Quality Parameters (all metals and Dissolved fractions)** | | | |
| Alkalinity (mg/L) | 250 mL Plastic | Unpreserved | 14 days |
| Bicarbonate (mg/L) | 1 L Plastic | | |
| Chloride (mg/L) | | | 28 days |
| TDS (mg/L) | | | 7 days |
| TSS (mg/L) | | | |
| Total Organic Carbon (mg/L) | 1 L Plastic | $H_2SO_4$ | 28 days |

| Parameter | Container | Preservative | Holding Time |
|---|---|---|---|
| Phosphorous, Total (mg/L) | | | |
| Bromide (mg/L) | 1 L Plastic | Unpreserved | |
| Fluoride (mg/L) | | | |
| Nitrate-N (mg/L) | | | 48 hours |
| Nitrite-N (mg/L) | | | |
| Sulfate (mg/L) | | | 28 days |
| Silica (silicon) (µg/L) | 1 L Plastic | HNO3 | 6 months |
| Arsenic (µg/L) | 1 L Plastic | HNO3 | 6 months |
| Antimony (µg/L) | | | |
| Aluminum (µg/L) | | | |
| Barium (µg/L) | | | |
| Beryllium (µg/L) | | | |
| Cadmium (µg/L) | | | |
| Calcium (µg/L) | | | |
| Chromium (µg/L) | | | |
| Copper (µg/L) | | | |
| Iron (µg/L) | | | |
| Lead (µg/L) | | | |
| Magnesium (µg/L) | | | |
| Manganese (µg/L) | | | |
| Mercury (ug/L) | | | 28 days |
| Nickel (µg/L) | | | 6 months |
| Potassium (µg/L) | | | |
| Selenium (µg/L) | | | |
| Silver (µg/L) | | | |
| Sodium (µg/L) | | | |
| Thallium (µg/L) | | | |
| **Volatile Organic Compounds (VOCs)** | | | |
| All VOCs | 40 mL VOA | Na2S203 | 14 Days |
| **Synthetic Organic Compounds (SOCs)** | | | |
| SOCs Measured Via EPA Methods 508.1 and 525.2 | 1 L Amber | HCl + Na2SO3 | 14 Days |
| SOCs Measured Via EPA Method 515.4 | 250 mL Amber | Na2SO3 | 14 Days |
| **Herbicides and Pesticides** | | | |

| Parameter | Container | Preservative | Holding Time |
|---|---|---|---|
| Chlorinated Pesticides | 1 L Amber | HCl + Na2SO3 | 14 Days |
| Chlorinated Acid Herbicides | G, Amber, Teflon-Lined Cap | <6ºC | 14 days until extraction, 21 days after extraction |
| Pesticides as carbamates | 60 mL glass container | 30mL/L of C2H3ClO2, 80mg/L of Na2S2O3.[1] Cool 4ºC | 28 Days |
| Herbicides – diquat | G, Amber, Teflon-Lined Cap | 100mg/L of Na2S2O3, 4ºC | 14 days until extraction, 21 days after extraction |
| Herbicides – endothall | G, Amber, Teflon-Lined Cap | 4ºC | 14 days until extraction, 21 days after extraction |
| Herbicides – glyphosate | Glass Container | 100mg/L Na2S2O3, 4ºC | 14 Days |
| **Bacteriological (LabTest)** | | | |
| E. coli | 250 mL sterile plastic | Na2S2O3 | 30 hours |
| Total Coliform | | | |

1. After the addition of C2H3ClO2 and Na2S2O3, seal and shake sample bottle for 1 min prior to storage.

## 8.4 Equipment Decontamination

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

## 8.5 Sample ID

All bottles shall be clearly labeled with a unique sample name, location name, date, time, and preservative. Samples shall be stored in a cooler at 4°C and delivered to the laboratory under standard chain-of-custody protocols, within the hold times provided in Table 12.

## 8.6 Chain of Custody

After collection, samples will be maintained in Aspect's custody until formally transferred to the analytical laboratory. For purposes of this work, custody of the samples will be defined as follows:

- In plain view of the field representatives
- Inside a cooler that is in plain view of the field representative

- Inside any locked space, such as a cooler, locker, car, or truck to which the field representative has the only immediately available key(s)

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

## 8.7 Field Log Requirements

During the collection of any field samples accompanying field documentation must be made clearly stating:

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

For this Study, data collected in the field will be contained in a field log (a binder backed by electronic scans of documents) that will consist of field notes (freehand notes) and Aspect field data sheets (Appendix C).

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

While conducting field work, the field hydrogeologist or technician (Section 5) will document general pertinent observations and events in waterproof field notes and, when warranted, provide photographic documentation of specific sampling efforts. Data collected during the sample collection procedures will be recorded on standard Aspect field data sheets (Appendix D). Field notes will include a description of each field activity, sample descriptions, and associated details, such as the date, time, and field conditions. The laboratory chain-of-custody forms will be filled out before leaving the site. Upon completion of a field task, the field personnel will then scan field notes and Aspect field data sheets into computer files and provide the original versions to the Aspect Project Manager. Copies of Aspect field data sheet and laboratory chain of custody are provided in Appendix D.

## 8.8 Other Activities

Not Applicable.

# 9.0 Laboratory Procedures

## 9.1 Lab Procedures Table

Table 13 presents the lab procedures for each analyte including the sample matrix, number of samples, expected range of results, reporting limit, and analytical method.

**Table 13. Lab Procedures**

| Analytical Method | Analyte | Sample Matrix | Number of Samples[1] | Expected Range of Results | Method Reporting Limit | Units |
|---|---|---|---|---|---|---|
| **General Chemistry, Inorganics in Drinking Water** | | | | | | |
| EPA 300.0 | Bromide | Water | 8 | 0.02-0.2 | 0.100 | mg/L |
| EPA 300.0 | Chloride | Water | 8 | 45279 | 0.100 | mg/L |
| EPA 300.0 | Fluoride | Water | 8 | 1.7-3.6 | 0.100 | mg/L |
| EPA 300.0 | Nitrate/N | Water | 8 | 0.02-2.3 | 0.100 | mg/L |
| EPA 300.0 | Nitrite/N | Water | 8 | 0.02-2.3 | 0.100 | mg/L |
| EPA 300.0 | Sulfate | Water | 8 | 26-32 | 0.100 | mg/L |
| SM 2320 B | Alkalinity | Water | 8 | 138-144 | 2.00 | mg/L |
| SM 2320 B | Bicarbonate | Water | 8 | 130-142 | 2.00 | mg/L |
| SM 2540 C | TDS | Water | 8 | 250-335 | 50.0 | mg/L |
| SM 2540 D | TSS | Water | 8 | <5-5 | 1.00 | mg/L |
| SM 4500-P F | Total P | Water | 8 | 0.01-1.75 | 0.0100 | mg/L |
| SM 5310 B | DOC | Water | 8 | <0.5 | 0.500 | mg/L |
| SM 5310 B | TOC | Water | 8 | 0.5-0.61 | 0.100 | mg/L |
| **Metals by ICP in Drinking Water (All metals are total)** | | | | | | |
| EPA 200.7 | Aluminum | Water | 8 | 3-17 | 0.0100 | mg/L |
| EPA 200.7 | Calcium | Water | 8 | 2400-9900 | 0.100 | mg/L |
| EPA 200.7 | Iron | Water | 8 | 8-550 | 0.0100 | mg/L |
| EPA 200.7 | Magnesium | Water | 8 | 530-6230 | 0.100 | mg/L |
| EPA 200.7 | Potassium | Water | 8 | 8200-12500 | 0.500 | mg/L |
| EPA 200.7 | Silica (as SiO2) | Water | 8 | 55000-64000 | 0.214 | mg/L |
| EPA 200.7 | Sodium | Water | 8 | 59500-80000 | 0.100 | mg/L |
| **Metals by ICP-MS in Drinking Water** | | | | | | |
| EPA 200.8 | Antimony | Water | 8 | 0.02-0.08 | 0.00100 | mg/L |
| EPA 200.8 | Arsenic | Water | 8 | 0.1-1.7 | 0.00100 | mg/L |
| EPA 200.8 | Barium | Water | 8 | 7.7-20 | 0.000130 | mg/L |
| EPA 200.8 | Beryllium | Water | 8 | <0.3 | 0.000300 | mg/L |
| EPA 200.8 | Cadmium | Water | 8 | <0.4 | 0.00100 | mg/L |
| EPA 200.8 | Chromium | Water | 8 | <2.1 | 0.00100 | mg/L |
| EPA 200.8 | Copper | Water | 8 | <2.1 | 0.00100 | mg/L |
| EPA 200.8 | Lead | Water | 8 | 2-50 | 0.00100 | mg/L |
| EPA 200.8 | Manganese | Water | 8 | 0.9-2.1 | 0.00100 | mg/L |
| EPA 200.8 | Nickel | Water | 8 | 0.9-18 | 0.00100 | mg/L |

| Analytical Method | Analyte | Sample Matrix | Number of Samples[1] | Expected Range of Results | Method Reporting Limit | Units |
|---|---|---|---|---|---|---|
| EPA 200.8 | Selenium | Water | 8 | 0.1-0.3 | 0.00100 | mg/L |
| EPA 200.8 | Silver | Water | 8 | 56000-66300 | 0.00100 | mg/L |
| EPA 200.8 | Thallium | Water | 8 | 0.009-0.07 | 0.00100 | mg/L |
| EPA 200.8 | Uranium | Water | 8 | Unknown | 0.00100 | mg/L |
| EPA 200.8 | Zinc | Water | 8 | Unknown | 0.00100 | mg/L |
| **Mercury in Water** | | | | | | |
| EPA 245.7 | Mercury | Water | 8 | Unknown | 0.00100 | ug/L |
| **Semivolatiles in Drinking Water** | | | | | | |
| EPA 505 | gamma-BHC (Lindane) | Water | 3 | <RL | 0.0200 | ug/L |
| EPA 505 | Heptachlor | Water | 3 | <RL | 0.0400 | ug/L |
| EPA 505 | Aldrin | Water | 3 | <RL | 0.100 | ug/L |
| EPA 505 | Heptachlor epoxide | Water | 3 | <RL | 0.0200 | ug/L |
| EPA 505 | 4,4'-DDE | Water | 3 | <RL | 0.100 | ug/L |
| EPA 505 | Dieldrin | Water | 3 | <RL | 0.100 | ug/L |
| EPA 505 | Endrin | Water | 3 | <RL | 0.0100 | ug/L |
| EPA 505 | 4,4'-DDD | Water | 3 | <RL | 0.100 | ug/L |
| EPA 505 | 4,4'-DDT | Water | 3 | <RL | 0.100 | ug/L |
| EPA 505 | Methoxychlor | Water | 3 | <RL | 0.100 | ug/L |
| EPA 505 | Aroclor 1232 (PCB-1232) | Water | 3 | <RL | 0.500 | ug/L |
| EPA 505 | Aroclor 1242 (PCB-1242) | Water | 3 | <RL | 0.300 | ug/L |
| EPA 505 | Aroclor 1248 (PCB-1248) | Water | 3 | <RL | 0.100 | ug/L |
| EPA 505 | Aroclor 1254 (PCB-1254) | Water | 3 | <RL | 0.100 | ug/L |
| EPA 505 | Aroclor 1260 (PCB-1260) | Water | 3 | <RL | 0.200 | ug/L |
| EPA 505 | PCBs | Water | 3 | <RL | 0.500 | ug/L |
| EPA 505 | Chlordane | Water | 3 | <RL | 0.200 | ug/L |
| EPA 505 | Toxaphene | Water | 3 | <RL | 1.00 | ug/L |
| EPA 515.4 | Dalapon | Water | 3 | <RL | 1.00 | ug/L |
| EPA 515.4 | Dicamba | Water | 3 | <RL | 0.200 | ug/L |
| EPA 515.4 | Dichloroprop | Water | 3 | <RL | 0.500 | ug/L |
| EPA 515.4 | 2,4-D | Water | 3 | <RL | 0.100 | ug/L |
| EPA 515.4 | Pentachlorophenol | Water | 3 | <RL | 0.0400 | ug/L |
| EPA 515.4 | 2,4,5-TP (Silvex) | Water | 3 | <RL | 0.200 | ug/L |
| EPA 515.4 | 2,4-DB | Water | 3 | <RL | 1.00 | ug/L |
| EPA 515.4 | Dinoseb | Water | 3 | <RL | 0.200 | ug/L |
| EPA 515.4 | Picloram | Water | 3 | <RL | 0.100 | ug/L |
| EPA 515.4 | 3,5-Dichlorobenzoic Acid | Water | 3 | <RL | 0.500 | ug/L |
| EPA 515.4 | Chloramben | Water | 3 | <RL | 0.200 | ug/L |
| EPA 515.4 | Acifluorofen | Water | 3 | <RL | 1.00 | ug/L |
| EPA 525.2 | Alachlor | Water | 3 | <RL | 0.200 | ug/L |
| EPA 525.2 | Atrazine | Water | 3 | <RL | 0.100 | ug/L |
| EPA 525.2 | Benzo[a]pyrene | Water | 3 | <RL | 0.0200 | ug/L |
| EPA 525.2 | bis(2-Ethylhexyl)phthalate | Water | 3 | <RL | 0.600 | ug/L |
| EPA 525.2 | bis-2(ethylhexyl)adipate | Water | 3 | <RL | 0.600 | ug/L |
| EPA 525.2 | Bromacil | Water | 3 | <RL | 0.100 | ug/L |
| EPA 525.2 | Butachlor | Water | 3 | <RL | 0.100 | ug/L |

| Analytical Method | Analyte | Sample Matrix | Number of Samples[1] | Expected Range of Results | Method Reporting Limit | Units |
|---|---|---|---|---|---|---|
| EPA 525.2 | Fluorene | Water | 3 | <RL | 0.200 | ug/L |
| EPA 525.2 | gamma-BHC (Lindane) | Water | 3 | <RL | 0.0400 | ug/L |
| EPA 525.2 | Hexachlorobenzene | Water | 3 | <RL | 0.100 | ug/L |
| EPA 525.2 | Hexachlorocyclopentadiene | Water | 3 | <RL | 0.100 | ug/L |
| EPA 525.2 | Methoxychlor | Water | 3 | <RL | 0.200 | ug/L |
| EPA 525.2 | Metribuzin | Water | 3 | <RL | 0.100 | ug/L |
| EPA 525.2 | Propachlor | Water | 3 | <RL | 0.100 | ug/L |
| EPA 525.2 | Simazine | Water | 3 | <RL | 0.0700 | ug/L |
| EPA 549.2 | Diquat | Water | 3 | <RL | 0.400 | ug/L |
| SM 6251 B | Monochloroacetic acid | Water | 3 | <RL | 2.00 | ug/L |
| SM 6251 B | Monobromoacetic acid | Water | 3 | <RL | 1.00 | ug/L |
| SM 6251 B | Dichloroacetic acid | Water | 3 | <RL | 1.00 | ug/L |
| SM 6251 B | Trichloroacetic acid | Water | 3 | <RL | 1.00 | ug/L |
| SM 6251 B | Bromochloroacetic acid (BCAA) | Water | 3 | <RL | 1.00 | ug/L |
| SM 6251 B | Dibromoacetic acid | Water | 3 | <RL | 1.00 | ug/L |
| SM 6251 B | Total HAA5 | Water | 3 | <RL | 1.00 | ug/L |
| **Volatiles in Drinking Water** | | | | | | |
| EPA 524.3 | 1,3-Dichloropropene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Total Trihalomethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Benzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Bromochloromethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Bromodichloromethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Bromoform | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Bromomethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Carbon Tetrachloride | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Chlorobenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Chloroform | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Chloromethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | cis-1,2-dichloroethene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | cis-1,3-Dichloropropene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,2-Dibromo-3-chloropropane (DBCP) | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,2-Dibromoethane (EDB) | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,2-Dichlorobenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,3-Dichlorobenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,4-Dichlorobenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Dichlorodifluoromethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,1-Dichloroethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,2-Dichloroethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,1-Dichloroethene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | trans-1,2-Dichloroethene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,2-Dichloropropane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | trans-1,3-Dichloropropene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Ethylbenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Hexachlorobutadiene | Water | 3 | <RL | 0.500 | ug/L |

| Analytical Method | Analyte | Sample Matrix | Number of Samples[1] | Expected Range of Results | Method Reporting Limit | Units |
|---|---|---|---|---|---|---|
| EPA 524.3 | Isopropylbenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Methylene chloride | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Naphthalene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Styrene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,1,1,2-Tetrachloroethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,1,2,2-Tetrachloroethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Tetrachloroethene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Toluene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,2,4-Trichlorobenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,1,1-Trichloroethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,1,2-Trichloroethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Trichloroethene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Trichlorofluoromethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,2,3-Trichloropropane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Vinyl Chloride | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | m+p-Xylene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | o-Xylene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Total Xylene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,1-dichloropropene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,2,3-Trichlorobenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,2,4-Trimethylbenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Chloroethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,3,5-Trimethylbenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 2,2-Dichloropropane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 1,3-Dichloropropane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 2-Chlorotoluene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | 4-Chlorotoluene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Bromobenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Dibromochloromethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Dibromomethane | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | methyl-t-butyl ether (MTBE) | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | n-Butylbenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | n-Propylbenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | p-isopropyltoluene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | sec-Butylbenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | tert-Butylbenzene | Water | 3 | <RL | 0.500 | ug/L |
| EPA 524.3 | Acetone | Water | 3 | <RL | 2.50 | ug/L |
| EPA 524.3 | MTBE-d3 | Water | 3 | <RL |  | Surr. |
| EPA 524.3 | 4-Bromofluorobenzene | Water | 3 | <RL |  | Surr. |
| EPA 524.3 | 1,2-Dichlorobenzene-d4 | Water | 3 | <RL |  | Surr. |

**Note:**
1. See Section 7.2.1 and Table 9 for sampling schedule.

## 9.2 Sample Preparation Method(s)

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

## 9.3 Special Method Requirements

Not applicable.

## 9.4 Laboratories Accredited for Methods

Analysis of water quality samples will be performed by Anatek of Moscow, Idaho or their Spokane, Washington office, with the exception of bacteriological, nitrate, and nitrite analysis. Anatek is accredited by Ecology for analysis of all parameters included in this project (see Appendix A).

Contact information for the laboratory is:

Anatek Labs, Inc
1282 Alturas Dr
Moscow, ID

Project Manager: Justin Doty
Phone: 208 883 2839
Email: Justin@anateklabs.com

Bacteriological, nitrate, and nitrite analysis will be performed by LabTest of Yakima, Washington, to minimize holding times for analysis. LabTest is accredited by Ecology for these analysis (see Appendix A).

Contact information for the laboratory is:

LabTest
201 East D Street
Yakima, WA

Lab Supervisor: Giles Hamilton
Phone: 509-575-3999
Email: vws155@gmail.com

# 10.0 Quality Control Procedures

Implementing QC procedures provides the information needed to assess the quality of the data that is collected. These procedures also help identify problems or issues associated with data collection or data analysis while the project is underway.

## 10.1 Field and Laboratory Quality Control

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

### Data Validation Samples

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

### Trip Blank

Trip blank samples will be used to monitor any possible cross-contamination that occurs during the transport of VOCs and samples. Trip blank samples are prepared by the laboratory using organic-free reagent-grade water into a VOA vial prior to the collection of field samples. Two vials per trip blank sample are placed with and accompany the VOCs samples through the entire transport process. Trip blank samples will be prepared and analyzed only for VOCs.

### Field Duplicates

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

A set of DV samples will be collected for at least every 10 water samples collected. The DV sample set will include the following for calculation of DV parameters and acceptance criteria, and Section 9 for description of lab procedures):

- A MS/MSD
- A “blind” field duplicate (i.e., not indicated to the lab as a field duplicate)
- Trip blanks (for VOCs, bacteria, and inorganic constituent suites)

Except for the trip blank, the chemical analysis of DV samples will include the entire list of chemical analytes (Section 6). The trip blank will include only analysis of VOCs. The blind field duplicate will be labeled in a manner that does not indicate its true sample location, and the MS/MSD will be labeled, as such, for laboratory processing.

## 10.2 Corrective Action Processes

The laboratory will follow the analytical method for corrective action procedures when the sample results do not meet the QC acceptance criteria. The laboratory will notify the Aspect hydrogeologist that submitted the samples and include a narrative in the laboratory report when following the analytical method corrective action procedure results in a sample result not meeting the QC acceptance criteria. Findings will be reviewed by the Aspect project manager. QC results may indicate problems with data during the course of the project. Corrective action processes (such as recalibration) will be used if:

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

# 11.0 Data Management Procedures

## 11.1 Data Recording and Reporting Requirements

Field technicians will record all field data in a water-resistant field notebook, electronic data forms, or Aspect standard field data sheet. Before leaving each site, staff will check field notebooks, data sheets, or electronic data forms for missing or improbable measurements. Field technicians will enter field-generated data into spreadsheets or a project database as soon as practical after they return from the field. For data collected electronically, data will be backed up on servers when staff return from the field. Raw data files will be stored separate from processed data files.

The Aspect field hydrogeologist and field technician will check data entry against the field notebook data for errors and omissions. The hydrogeologist will notify the Aspect project manager of missing or unusual data.

All final spreadsheet files, paper field notes, and final products created as part of the data collection and data QA process will be kept with the project data files.

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

## 11.2 Laboratory Data Package Requirements

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

## 11.3 Electronic Transfer Requirements

The lab will provide an EPA Level II data package as a pdf and an electronic data deliverable (EDD).

## 11.4 Data Upload Procedures

Following completion of the QC procedures described in Section 10 and the DV procedures described in Section 8.2, all quality assured data will be formatted and uploaded to Ecology's EIM database by an Aspect data scientist. The EIM study ID will be *WRYBIP-2123-Moxeec-00036.*

## 11.5 Model Information Management

Not applicable.

# 12.0 Audits and Reports

## 12.1 Audits

Field technicians will be required to review this QAPP prior to each monitoring event and to maintain a copy of the QAPP and its appendices in the field. Field technicians may be audited at any time by appropriate project manager or the Aspect data manager (Section 5) to ensure that field work is being completed according to this QAPP, work plan, and published SOPs. Projects that involve complex data analysis may be audited by the appropriate project manager or other personnel familiar with the analysis procedures.

## 12.2 Responsible Personnel

Personnel responsible for the audits are as follows:

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

Personnel assigned to these roles are listed in Table 2.

## 12.3 Frequency and Distribution of Reports

Results of the field data collection, data quality assessment, and any data analysis will be documented in the final ASR Feasibility Study Report. The final report will be distributed to all other stakeholders involved or interested in the Study as determined by the City and Ecology.

Data analysis documentation may be accomplished in one document at the end of the project or in stages during different phases of the project. For complex projects, the project team may elect to write separate reports on the data collected, QA/QC, and model scenarios. For this project, the data analysis documentation will be included in the Water Quality Evaluation section (and appendices) of the final ASR Feasibility Study Report.

Field and Laboratory Data will be entered into EIM when data collection is complete.

## 12.4 Responsibility for Reports

The Aspect Project Manager is responsible for verifying data completeness and usability before the data are used in the technical report and entered into Environmental Information Management (EIM) database. The Aspect Project Manager is also responsible for writing the final technical report, unless an alternate author is agreed upon and documented at the start of the project.

The Aspect Project Manager is responsible for assigning a peer reviewer with the appropriate expertise for the technical report. Depending on the type of final report, there may be an internal and external review process. The peer reviewer is responsible for working with the report author to resolve or clarify any issues with the report.

# 13.0 Data Verification

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

## 13.1 Field Data Verification, Requirements, and Responsibilities

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

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

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

**Review Discrete Field QC Checks**

The field check of instrumentation will consist of a manual measurement for water levels, and measurement of water quality standards in the field (checks with water quality standards will be completed separate from calibration events). Review of the field checks will consist of the following:

1. Review post check data for field QC instrument check (water quality and water level), reject data as appropriate.
2. Assign a criteria to the field check values indicating either acceptance, rejection, or qualification of the data and assign a data flag detailing the reason to rejection or qualify data based on the post-check.

**Review/Adjust Time Series (Continuous) Data**

1. Plot compensated pressure data converted to depth-to-water time series with field checks.

2. Reject data based on deployment/retrieval times, site visit disruption, blatant fouling events, and sensor/equipment failure.
3. Review sensor offsets for recalibration. Flag any potential chronic drift or bias issues specific to the instrument.
4. If applicable, review fouling check and make drift adjustment, if necessary. In some situations, an event fouling adjustment may be warranted based on abrupt changes in groundwater levels, barometric pressure, etc.
5. Review residuals from both field checks and post-checks, together referred to as QC checks. Adjust data, as appropriate, using a weight-of-evidence approach. Give the most weight to checks rated excellent, then good, and then fair. Do not use field checks rated poor. Potential data adjustments include:
    a. **Bias –** Data are adjusted by the average difference between the QC checks and deployed instrument. Majority of QC checks must show bias to use this method.
    b. **Regression –** Data adjusted using regression, typically linear, between QC checks and deployed instrument. This accounts for both a slope and bias adjustment. The regression must have at least five data points and an $R^2$ value of >0.95 to use for adjustment. Do not extrapolate regressions beyond the range of the QC checks.
    c. **Calibration/Sensor Drift –** Data adjusted using linear regression with time from calibration or deployment to post-check or retrieval. Majority of QC checks, particularly post-checks, must confirm pattern of drift.
6. Typically, choose the adjustment that results in the smallest residuals and bias between the adjusted values and QC checks. Best professional judgement and visual review are necessary to confirm adjustment.
7. If the evidence is weak, or inconclusive, do not adjust the data.

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

## 13.2 Laboratory Data Verification

The lab will provide an EPA Level II data package. Additional laboratory data validation (check batch QC) will be conducted by Aspect’s project data scientist (Table 2). Laboratory validation results will be summarized on the laboratory reports, and Aspect’s validation results will be summarized in the final report. An Aspect hydrogeologist will verify the validated laboratory results.

## 13.3 Validation Requirements, if Necessary

Not applicable.

## 13.4 Model Quality Assessment

Not applicable.

# 14.0 Data Quality (Usability) Assessment

## 14.1 Process for Determining Project Objectives were Met

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

## 14.2 Treatment of Nondetects

Nondetects will be reported as the MRL for that analyte with the appropriate flag ("<") indicating it as a nondetect.

## 14.3 Data Analysis and Presentation Methods

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

The report will contain a summary table of chemistry; figures of continuous data (water level hydrographs, potentiometric maps, etc.); discussion of results pertaining to each sample location; and a map of study area. Additionally, a conceptual hydrogeologic model will be included showing a cross section of the target aquifer in relation to the City Wells and Yakima River.

## 14.4 Sampling Design Evaluation

The Aspect Project Manager will decide whether the data package meets the MQOs and the criteria for completeness, representativeness, and comparability. If so, the sampling design will be considered effective. If the sampling design is found ineffective, the approach will be modified in accordance with Ecology, and/or the Study will be halted for redesign.

## 14.5 Documentation of Assessment

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

# 15.0 References

Aspect Consulting, LLC, 2022. City of Moxee Aquifer Storage and Recovery: Assessment of Existing Data

Jelinski, J., Clayton, C.S., and Fulford, J.M., 2015, Accuracy testing of electric groundwater-level measurement tapes: U.S. Geological Survey Open-File Report 2014–1236, 27 p.

Jones, M.A., Vaccaro, J.J., and Watkins, A.M., 2006, Hydrogeologic framework of sedimentary deposits in six structural basins, Yakima River Basin, Washington: U.S. Geological Survey Scientific Investigations Report 2006-5116, 24 p., 6 pls.

Sleeper, S.S., 2020, A Geochemical Assessment of Potential Groundwater Storage Locations within the Yakima River Basin, 1372, https://digitalcommons.cwu.edu/etd/1372.

Spane, F. A., 2002. Considering Barometric Pressure in Groundwater Flow Investigations. J. Water Resources Research, Vol. 38, No. 6. Published June 18, 2002.

U.S. environmental Protection Agency (EPA,) 1995,Technical Guidance Manual for Hydrogeologic Investigations and Groundwater Monitoring, Chapter 4: Slug and Pumping Tests, February 1995.

Wagner, R.J., Kimbrough, R.A., and Turney, G.L., 2007, Quality-assurance plan for water-quality activities in the U.S. Geological Survey Washington Water Science Center: U.S. Geological Survey Open-File Report 2007–1307, 48 p.

Washington State Department of Ecology (Ecology), 2004, Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies, Publication No. 04-03-030, July 2004.

Washington State Department of Ecology (Ecology), 2006, Environmental Assessment Program – Standard Operating Procedure for Manually Obtaining Surface Water Samples, October 24, 2006.

Washington State Department of Ecology (Ecology), 2018a, Standard Operating Procedures for Manual Well-Depth and Depth-to-Water Measurements Version 1.2, EAP052 Pub. No. 18-03-215, Prepared by Pamela Marti, Environmental Assessment Program, Washington State Department of Ecology.

Washington State Department of Ecology (Ecology), 2018b, Standard Operating Procedures to Minimize the Spread of Invasive Species, Version 2.2, EAP070 Pub. No. 18-03-201, Prepared by Parsons, J., Hallock, D., Seiders, K., Ward, B., Coffin, C., Newell, E., Deligeannis, C., and Welch K., Environmental Assessment Program, Washington State Department of Ecology.

Washington State Department of Ecology (Ecology), 2018c, Standard Operating Procedure EAP099, Version 1.2: Standard Operating Procedure EAP099, Version 1.0: Purging and Sampling Monitoring Wells for General Chemistry Parameters. Washington State Department of Ecology, Olympia. https://apps.ecology.wa.gov/publications/SummaryPages/1803214.html

Washington State Department of Ecology (Ecology), 2019, Standard Operating Procedure EAP074, Version 1.2: Use of Submersible Pressure Transducers During Groundwater Studies. Washington State Department of Ecology, Olympia. https://fortress.wa.gov/ecy/publications/SummaryPages/1903205.html.

Washington State Department of Ecology (Ecology), 2020, Aquifer Test Procedures, Publication No. 20-11-093, October 2020.

Washington State Department of Health (DOH), 2003, General Sampling Procedure, Office of Drinking Water No. 331-219, July 2003.

# 16.0 Appendices

## Appendix A. Laboratory Accreditations

## Appendix B. Well Logs

## Appendix C. Aspect Field Data Sheets

# Appendix D. Glossaries, Acronyms, and Abbreviations

## Glossary of General Terms

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

**Clean Water Act:** A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

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

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

**Dilution factor:** The relative proportion of effluent to stream (receiving water) flows occurring at the edge of a mixing zone during critical discharge conditions as authorized in accordance with the state's mixing zone regulations at WAC 173-201A-100.
http://apps.leg.wa.gov/WAC/default.aspx?cite=173-201A-020

**Effluent:** An outflowing of water from a natural body of water or from a human-made structure. For example, the treated outflow from a wastewater treatment plant.

**Fecal coliform (FC):** That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. Fecal coliform bacteria are "indicator" organisms that suggest the possible presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100 mL).

**Nutrient:** Substance such as carbon, nitrogen, and phosphorus used by organisms to live and grow. Too many nutrients in the water can promote algal blooms and rob the water of oxygen vital to aquatic organisms.

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

**Surface waters of the state:** Lakes, rivers, ponds, streams, inland waters, salt waters, wetlands

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

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

## Acronyms and Abbreviations

| | |
|---|---|
| Aspect | Aspect Consulting, LLC |
| ASR | Aquifer Storage and Recovery |
| Anatek | Anatek Labs, Inc |
| City | City of Moxee |
| Commerce | State of Washington Department of Commerce |
| DBPs | Disinfection Byproducts |
| DO | Dissolved oxygen |
| DOC | Dissolved organic carbon |
| DOH | Department of Health |
| DQI | data quality indicator |
| DQO | data quality objective |
| DV | design verification |
| ECBID | East Columbia Basin Irrigation District |
| EDD | Electronic Data Deliverable |
| e.g. | For example |
| Ecology | Washington State Department of Ecology |
| EIM | Environmental Information Management database |
| EPA | U.S. Environmental Protection Agency |
| et al. | And others |
| FC | Fecal coliform |
| GIS | Geographic Information System software |
| GPS | Global Positioning System |
| GWMA | Groundwater Management Area |
| GWQS | Groundwater Quality Standards |
| HAAs | Haloacetic Acids |
| i.e. | In other words |
| LCS | laboratory control sample |
| MDL | minimum detection limit |
| MQO | measurement quality objective |
| MRL | minimum reporting limit |

| | |
|---|---|
| MS | matrix spike |
| MSD | matrix spike duplicate |
| NELAP | National Environmental Laboratory Accreditation Program |
| NTR | National Toxics Rule |
| OCR | Office of Columbia River |
| PFAS | per- and polyfluoroalkyl substances |
| QA | quality assurance |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |
| Reclamation | U.S. Bureau of Reclamation |
| RPD | relative percent difference |
| RSD | relative standard deviation |
| SAP | Sampling Analysis Plain |
| SCADA | Supervisory Control and Data Acquisition |
| SOP | Standard operating procedures |
| Study | Feasibility Study |
| THMs | Trihalomethanes |
| TDS | total dissolved solids |
| TOC | total organic carbon |
| TSS | total suspended solids |
| USFS | United States Forest Service |
| USGS | U.S. Geological Survey |
| VOA | volatile organic analysis |
| VOCs | volatile organic compounds |
| WAC | Washington Administrative Code |
| WRIA | Water Resource Inventory Area |

## Units of Measurement

| | |
|---|---|
| °C | degrees centigrade |
| cfs | cubic feet per second |
| cfu | colony forming units |
| cms | cubic meters per second, a unit of flow |

| | |
|---|---|
| dw | dry weight |
| ft | feet |
| g | gram, a unit of mass |
| gpm | gallons per minute |
| kcfs | 1,000 cubic feet per second |
| km | kilometer, a unit of length equal to 1,000 meters |
| L/s | liters per second (0.03531 cubic foot per second) |
| m | meter |
| mg | milligram |
| mgd | million gallons per day |
| mg/L | milligrams per liter (parts per million) |
| mL | milliliter |
| NTU | nephelometric turbidity units |
| s.u. | standard units |
| ug/L | micrograms per liter (parts per billion) |
| uS/cm | microsiemens per centimeter, a unit of conductivity |

## Quality Assurance Glossary

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$RPD = [Abs(a-b)/((a + b)/2)] * 100\%$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Systematic planning:** A step-wise process which develops a clear description of the goals and objectives of a project, and produces decisions on the type, quantity, and quality of data that will be needed to meet those goals and objectives. The DQO process is a specialized type of systematic planning (USEPA, 2006).

## References for QA Glossary

40 CFR 136. Title 40 Code of Federal Regulations, Part 136: Guidelines Establishing Test Procedures for the Analysis of Pollutants. Available at: https://www.ecfr.gov/cgi-bin/text-idx?SID=3cf9acace214b7af340ea8f6919a7c39&mc=true&node=pt40.25.136&rgn=div5 (accessed 26 Feb. 2020).

Ecology, 2004. Guidance for the Preparation of Quality Assurance Project Plans for Environmental Studies. Washington State Department of Ecology, Olympia, WA. Available at: https://fortress.wa.gov/ecy/publications/SummaryPages/0403030.html (accessed 6 Mar. 2020).

Gilbert, R.O., 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, New York, NY.

Kammin, W., 2010. Definition developed or extensively edited by William Kammin, 2010. Washington State Department of Ecology, Olympia, WA.

USEPA, 1992. Guidelines for exposure assessment. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, D.C. EPA/600/Z-92/001. Available at: https://www.epa.gov/sites/production/files/2014-11/documents/guidelines_exp_assessment.pdf (accessed 26 Feb. 2020).

USEPA, 2001. EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5. U.S. Environmental Protection Agency, Washington, DC. EPA/240/B-01/003. Available at: https://www.epa.gov/quality/epa-qar-5-epa-requirements-quality-assurance-project-plans (accessed 26 Feb. 2020).

USEPA, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4. U.S. Environmental Protection Agency, Washington, DC. Available at: https://www.epa.gov/sites/production/files/2015-06/documents/g4-final.pdf (accessed 26 Feb. 2020).

USEPA, 2009. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, OSWER No. 9200.1-85, EPA 540-R-08-005. U.S. Environmental Protection Agency, Washington, DC. Available at: https://www.epa.gov/nscep.

USEPA, 2014. Compendium: Project Quality Assurance and Quality Control: Chapter 1. U.S. Environmental Protection Agency, Washington, DC. SW-846 Update V. Available at: https://www.epa.gov/sites/production/files/2015-10/documents/chap1_1.pdf (accessed 26 Feb. 2020).

USEPA, 2016. Definition and Procedure for the Determination of the Method Detection Limit, Revision 2. EPA 821-R-16-006. U.S. Environmental Protection Agency, Washington, DC. Available at: https://www.epa.gov/sites/production/files/2016-12/documents/mdl-procedure_rev2_12-13-2016.pdf (accessed 6 Mar. 2020).

USEPA, 2020. Glossary: Environmental Sampling and Analytical Methods (ESAM) Program. U.S. Environmental Protection Agency, Washington, DC. Available at: https://www.epa.gov/esam/glossary (accessed 26 Feb. 2020).

USGS, 1998. Principles and Practices for Quality Assurance and Quality Control. Open-File Report 98-636. U.S. Geological Survey, Reston, VA. Available at: https://pubs.usgs.gov/of/1998/ofr98-636/ (accessed 26 Feb. 2020).

WAC 173-50-040. Title 173 Washington Administrative Code. Accreditation of Environmental Laboratories: Definitions. Available at: https://apps.leg.wa.gov/WAC/default.aspx?cite=173-50-040 (accessed 26 Feb. 2020).

# APPENDIX A

# Laboratory Accreditations

**The State of Washington**
**Department of Ecology**

1889

# Anatek Labs, Inc - Moscow

## Moscow, ID

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective March 21, 2023 and shall expire March 20, 2024.

Witnessed under my hand on June 27, 2023

Rebecca Wood
Lab Accreditation Unit Supervisor

Laboratory ID
**C595**

# WASHINGTON STATE DEPARTMENT OF ECOLOGY

## ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

## SCOPE OF ACCREDITATION

## Anatek Labs, Inc - Moscow

### Moscow, ID

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

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Drinking Water** | | |
| Turbidity | EPA 180.1_2_1993 | 1,8 |
| Chloride | EPA 300.0_2.1_1993 | 1 |
| Fluoride | EPA 300.0_2.1_1993 | 1,8 |
| Nitrate | EPA 300.0_2.1_1993 | 1,8 |
| Nitrate + Nitrite | EPA 300.0_2.1_1993 | 1 |
| Nitrite | EPA 300.0_2.1_1993 | 1,8,9 |
| Orthophosphate | EPA 300.0_2.1_1993 | 1 |
| Sulfate | EPA 300.0_2.1_1993 | 1 |
| Perchlorate | EPA 331.0_1.0_2005 | 1 |
| Cyanide, Total | EPA 335.4_1_1993 | 1,8 |
| Color | SM 2120 B-2011 | 1,9 |
| Alkalinity | SM 2320 B-2011 | 1 |
| Hardness (calc.) | SM 2340 B-2011 | 1 |
| Specific Conductance | SM 2510 B-2011 | 1 |
| Solids, Total Dissolved | SM 2540 C-2011 | 1 |
| pH | SM 4500-H+ B-2011 | 1,6 |
| Nitrate | SM 4500-NO3¯ F-2011 | 1,8 |
| Nitrate + Nitrite | SM 4500-NO3¯ F-2011 | 1 |
| Nitrite | SM 4500-NO3¯ F-2011 | 1,8 |
| Total Organic Carbon | SM 5310 B-2011 | 1 |
| Anionic Surfactants (MBAS) | SM 5540 C-2011 | 1 |
| Aluminum | EPA 200.7_4.4_1994 | 1 |
| Barium | EPA 200.7_4.4_1994 | 1 |
| Beryllium | EPA 200.7_4.4_1994 | 1 |
| Cadmium | EPA 200.7_4.4_1994 | 1 |
| Calcium | EPA 200.7_4.4_1994 | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Drinking Water** | | |
| Chromium | EPA 200.7_4.4_1994 | 1 |
| Copper | EPA 200.7_4.4_1994 | 1 |
| Iron | EPA 200.7_4.4_1994 | 1 |
| Magnesium | EPA 200.7_4.4_1994 | 1 |
| Manganese | EPA 200.7_4.4_1994 | 1 |
| Nickel | EPA 200.7_4.4_1994 | 1,8 |
| Potassium | EPA 200.7_4.4_1994 | 1 |
| Sodium | EPA 200.7_4.4_1994 | 1,8 |
| Aluminum | EPA 200.8_5.4_1994 | 1 |
| Antimony | EPA 200.8_5.4_1994 | 1,8 |
| Arsenic | EPA 200.8_5.4_1994 | 1,8 |
| Barium | EPA 200.8_5.4_1994 | 1,8 |
| Beryllium | EPA 200.8_5.4_1994 | 1,8 |
| Cadmium | EPA 200.8_5.4_1994 | 1,8 |
| Chromium | EPA 200.8_5.4_1994 | 1,8 |
| Copper | EPA 200.8_5.4_1994 | 1,8 |
| Lead | EPA 200.8_5.4_1994 | 1,8 |
| Manganese | EPA 200.8_5.4_1994 | 1 |
| Mercury | EPA 200.8_5.4_1994 | 1,8 |
| Nickel | EPA 200.8_5.4_1994 | 1,8 |
| Selenium | EPA 200.8_5.4_1994 | 1,8 |
| Silver | EPA 200.8_5.4_1994 | 1 |
| Thallium | EPA 200.8_5.4_1994 | 1,8 |
| Total Uranium | EPA 200.8_5.4_1994 | 1,8 |
| Zinc | EPA 200.8_5.4_1994 | 1 |
| 1,2,3-Trichloropropane | EPA 504.1_1.1_1995 | 1 |
| 1,2-Dibromo-3-chloropropane (DBCP) | EPA 504.1_1.1_1995 | 1,8 |
| 1,2-Dibromoethane (EDB, Ethylene dibromide) | EPA 504.1_1.1_1995 | 1,8 |
| Aldrin | EPA 505_2.1_1995 | 1 |
| Aroclor-1016 (PCB-1016) | EPA 505_2.1_1995 | 1,8 |
| Aroclor-1221 (PCB-1221) | EPA 505_2.1_1995 | 1,8 |
| Aroclor-1232 (PCB-1232) | EPA 505_2.1_1995 | 1,8 |
| Aroclor-1242 (PCB-1242) | EPA 505_2.1_1995 | 1,8 |
| Aroclor-1248 (PCB-1248) | EPA 505_2.1_1995 | 1,8 |
| Aroclor-1254 (PCB-1254) | EPA 505_2.1_1995 | 1,8 |
| Aroclor-1260 (PCB-1260) | EPA 505_2.1_1995 | 1,8 |
| Chlordane (tech.) | EPA 505_2.1_1995 | 1,8 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Drinking Water** | | |
| Dieldrin | EPA 505_2.1_1995 | 1 |
| Endrin | EPA 505_2.1_1995 | 1,8 |
| gamma-BHC (Lindane, gamma-Hexachlorocyclohexane) | EPA 505_2.1_1995 | 1,8 |
| Heptachlor | EPA 505_2.1_1995 | 1,8 |
| Heptachlor epoxide | EPA 505_2.1_1995 | 1,8 |
| Methoxychlor | EPA 505_2.1_1995 | 1,8 |
| Toxaphene (Chlorinated camphene) | EPA 505_2.1_1995 | 1,8 |
| 2,4,5-T | EPA 515.4_1_2000 | 1 |
| 2,4-D | EPA 515.4_1_2000 | 1,8 |
| 2,4-DB | EPA 515.4_1_2000 | 1 |
| 3,5-Dichlorobenzoic acid | EPA 515.4_1_2000 | |
| Acifluorfen | EPA 515.4_1_2000 | 1 |
| Bentazon | EPA 515.4_1_2000 | |
| Chloramben | EPA 515.4_1_2000 | |
| Dacthal Acid Metabolites | EPA 515.4_1_2000 | 1 |
| Dalapon | EPA 515.4_1_2000 | 1,8 |
| Dicamba | EPA 515.4_1_2000 | 1 |
| Dichloroprop (Dichlorprop) | EPA 515.4_1_2000 | 1 |
| Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP) | EPA 515.4_1_2000 | 1,8 |
| Pentachlorophenol | EPA 515.4_1_2000 | 1,8 |
| Picloram | EPA 515.4_1_2000 | 1,8 |
| Silvex (2,4,5-TP) | EPA 515.4_1_2000 | 1,8 |
| 3-Hydroxycarbofuran | EPA 531.2_1_2001 | 1 |
| Aldicarb (Temik) | EPA 531.2_1_2001 | 1 |
| Aldicarb sulfone | EPA 531.2_1_2001 | 1 |
| Aldicarb sulfoxide | EPA 531.2_1_2001 | 1 |
| Carbaryl (Sevin) | EPA 531.2_1_2001 | 1 |
| Carbofuran (Furaden) | EPA 531.2_1_2001 | 1,8 |
| Methiocarb (Mesurol) | EPA 531.2_1_2001 | 1 |
| Methomyl (Lannate) | EPA 531.2_1_2001 | 1 |
| Oxamyl | EPA 531.2_1_2001 | 1,8 |
| Propoxur (Baygon) | EPA 531.2_1_2001 | 1 |
| Glyphosate | EPA 547_1990 | 1,8 |
| Diquat | EPA 549.2_1_1997 | 1,8 |
| Bromoacetic acid (MBAA, BAA) | SM 6251 B-05 | 1,8 |
| Bromochloroacetic acid (BCAA) | SM 6251 B-05 | 1 |
| Chloroacetic acid (MCAA, CAA) | SM 6251 B-05 | 1,8 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Drinking Water** | | |
| Dibromoacetic acid (DBAA) | SM 6251 B-05 | 1,8 |
| Dichloroacetic acid (DCAA) | SM 6251 B-05 | 1,8 |
| Total haloacetic acids (HAA5) | SM 6251 B-05 | 1,8 |
| Trichloroacetic acid (TCAA) | SM 6251 B-05 | 1,8 |
| 1,1,1,2-Tetrachloroethane | EPA 524.3_1.0_2009 | 1 |
| 1,1,1-Trichloroethane | EPA 524.3_1.0_2009 | 1 |
| 1,1,2,2-Tetrachloroethane | EPA 524.3_1.0_2009 | 1 |
| 1,1,2-Trichloroethane | EPA 524.3_1.0_2009 | 1 |
| 1,1-Dichloroethylene | EPA 524.3_1.0_2009 | 1 |
| 1,1-Dichloropropene | EPA 524.3_1.0_2009 | 1 |
| 1,2,3-Trichlorobenzene | EPA 524.3_1.0_2009 | 1 |
| 1,2,3-Trichloropropane | EPA 524.3_1.0_2009 | 1 |
| 1,2,4-Trichlorobenzene | EPA 524.3_1.0_2009 | 1 |
| 1,2,4-Trimethylbenzene | EPA 524.3_1.0_2009 | 1 |
| 1,2-Dichlorobenzene | EPA 524.3_1.0_2009 | 1 |
| 1,2-Dichloroethane (Ethylene dichloride) | EPA 524.3_1.0_2009 | 1 |
| 1,2-Dichloropropane | EPA 524.3_1.0_2009 | 1 |
| 1,3,5-Trimethylbenzene | EPA 524.3_1.0_2009 | 1 |
| 1,3-Dichlorobenzene | EPA 524.3_1.0_2009 | 1 |
| 1,3-Dichloropropane | EPA 524.3_1.0_2009 | 1 |
| 1,4-Dichlorobenzene | EPA 524.3_1.0_2009 | 1 |
| 2,2-Dichloropropane | EPA 524.3_1.0_2009 | |
| 2-Chlorotoluene | EPA 524.3_1.0_2009 | 1 |
| 4-Chlorotoluene | EPA 524.3_1.0_2009 | 1 |
| 4-Isopropyltoluene (p-Cymene) | EPA 524.3_1.0_2009 | 1 |
| Benzene | EPA 524.3_1.0_2009 | 1 |
| Bromobenzene | EPA 524.3_1.0_2009 | 1 |
| Bromochloromethane | EPA 524.3_1.0_2009 | 1 |
| Bromodichloromethane | EPA 524.3_1.0_2009 | 1,8 |
| Bromoform | EPA 524.3_1.0_2009 | 1,8 |
| Carbon disulfide | EPA 524.3_1.0_2009 | 1 |
| Carbon tetrachloride | EPA 524.3_1.0_2009 | 1 |
| Chlorobenzene | EPA 524.3_1.0_2009 | 1 |
| Chlorodibromomethane | EPA 524.3_1.0_2009 | 1,8 |
| Chloroethane (Ethyl chloride) | EPA 524.3_1.0_2009 | |
| Chloroform | EPA 524.3_1.0_2009 | 1,8 |
| cis-1,2-Dichloroethylene | EPA 524.3_1.0_2009 | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Drinking Water** | | |
| cis-1,3-Dichloropropene | EPA 524.3_1.0_2009 | 1 |
| Dibromomethane | EPA 524.3_1.0_2009 | 1 |
| Dichlorodifluoromethane (Freon-12) | EPA 524.3_1.0_2009 | 1 |
| Diethyl ether | EPA 524.3_1.0_2009 | 1 |
| Ethylbenzene | EPA 524.3_1.0_2009 | 1 |
| Hexachlorobutadiene | EPA 524.3_1.0_2009 | 1 |
| Iodomethane (Methyl iodide) | EPA 524.3_1.0_2009 | 1 |
| Isopropylbenzene | EPA 524.3_1.0_2009 | 1 |
| m+p-xylene | EPA 524.3_1.0_2009 | 1 |
| Methyl bromide (Bromomethane) | EPA 524.3_1.0_2009 | 1 |
| Methyl chloride (Chloromethane) | EPA 524.3_1.0_2009 | 1 |
| Methyl tert-butyl ether (MTBE) | EPA 524.3_1.0_2009 | 1 |
| Methylene chloride (Dichloromethane) | EPA 524.3_1.0_2009 | 1 |
| Naphthalene | EPA 524.3_1.0_2009 | 1 |
| n-Butylbenzene | EPA 524.3_1.0_2009 | 1 |
| n-Propylbenzene | EPA 524.3_1.0_2009 | 1 |
| o-Xylene | EPA 524.3_1.0_2009 | 1 |
| sec-Butylbenzene | EPA 524.3_1.0_2009 | 1 |
| Styrene | EPA 524.3_1.0_2009 | 1 |
| tert-Butylbenzene | EPA 524.3_1.0_2009 | 1 |
| Tetrachloroethylene (Perchloroethylene) | EPA 524.3_1.0_2009 | 1 |
| Toluene | EPA 524.3_1.0_2009 | 1 |
| Total Trihalomethanes | EPA 524.3_1.0_2009 | 1,8 |
| trans-1,2-Dichloroethylene | EPA 524.3_1.0_2009 | 1 |
| trans-1,3-Dichloropropylene | EPA 524.3_1.0_2009 | 1 |
| Trichloroethene (Trichloroethylene) | EPA 524.3_1.0_2009 | 1 |
| Trichlorofluoromethane (Freon 11) | EPA 524.3_1.0_2009 | 1 |
| Vinyl chloride | EPA 524.3_1.0_2009 | 1,8 |
| Xylene (total) | EPA 524.3_1.0_2009 | 1 |
| 2,4-Dinitrotoluene (2,4-DNT) | EPA 525.2_2_1995 | 1 |
| 2,6-Dinitrotoluene (2,6-DNT) | EPA 525.2_2_1995 | 1 |
| 4,4'-DDD | EPA 525.2_2_1995 | 1 |
| 4,4'-DDE | EPA 525.2_2_1995 | 1 |
| 4,4'-DDT | EPA 525.2_2_1995 | 1 |
| Acenaphthylene | EPA 525.2_2_1995 | 1 |
| Acetochlor | EPA 525.2_2_1995 | 1 |
| Alachlor | EPA 525.2_2_1995 | 1,8 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Drinking Water** | | |
| alpha-BHC (alpha-Hexachlorocyclohexane) | EPA 525.2_2_1995 | 1 |
| alpha-Chlordane | EPA 525.2_2_1995 | 1 |
| Anthracene | EPA 525.2_2_1995 | 1 |
| Atrazine | EPA 525.2_2_1995 | 1,8 |
| Benzo(a)anthracene | EPA 525.2_2_1995 | 1 |
| Benzo(a)pyrene | EPA 525.2_2_1995 | 1 |
| Benzo(g,h,i)perylene | EPA 525.2_2_1995 | 1 |
| Benzo(k)fluoranthene | EPA 525.2_2_1995 | 1 |
| Benzo[b]fluoranthene | EPA 525.2_2_1995 | 1 |
| beta-BHC (beta-Hexachlorocyclohexane) | EPA 525.2_2_1995 | 1 |
| bis(2-Ethylhexyl) phthalate (DEHP) | EPA 525.2_2_1995 | 1,8 |
| Bromacil | EPA 525.2_2_1995 | 1 |
| Butachlor | EPA 525.2_2_1995 | 1 |
| Butyl benzyl phthalate | EPA 525.2_2_1995 | 1,8 |
| Chrysene | EPA 525.2_2_1995 | 1 |
| Cyanazine | EPA 525.2_2_1995 | 1 |
| delta-BHC | EPA 525.2_2_1995 | 1 |
| Di(2-ethylhexyl)adipate | EPA 525.2_2_1995 | 1,8 |
| Diazinon | EPA 525.2_2_1995 | 1 |
| Dibenz(a,h) anthracene | EPA 525.2_2_1995 | 1 |
| Diethyl phthalate | EPA 525.2_2_1995 | 1,8 |
| Dimethyl phthalate | EPA 525.2_2_1995 | 1,8 |
| Di-n-butyl phthalate | EPA 525.2_2_1995 | 1,8 |
| EPTC (Eptam, s-ethyl-dipropyl thio carbamate) | EPA 525.2_2_1995 | 1 |
| Fluorene | EPA 525.2_2_1995 | 1 |
| gamma-Chlordane | EPA 525.2_2_1995 | 1 |
| Hexachlorobenzene | EPA 525.2_2_1995 | 1,8 |
| Hexachlorocyclopentadiene | EPA 525.2_2_1995 | 1,8 |
| Indeno(1,2,3-cd) pyrene | EPA 525.2_2_1995 | 1 |
| Metolachlor | EPA 525.2_2_1995 | 1 |
| Metribuzin | EPA 525.2_2_1995 | 1 |
| Molinate | EPA 525.2_2_1995 | 1 |
| Phenanthrene | EPA 525.2_2_1995 | 1 |
| Prometon | EPA 525.2_2_1995 | 1 |
| Propachlor (Ramrod) | EPA 525.2_2_1995 | 1 |
| Pyrene | EPA 525.2_2_1995 | 1 |
| Simazine | EPA 525.2_2_1995 | 1,8 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Drinking Water** | | |
| Terbacil | EPA 525.2_2_1995 | 1 |
| trans-Nonachlor | EPA 525.2_2_1995 | 1 |
| 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS) | EPA 533 | 1 |
| 1H,1H,2H,2H,-Perfluorodecanesulfonic acid (8:2 FTS) | EPA 533 | 1 |
| 1H,1H,2H,2H,-Perfluorooctanesulfonic acid (6:2 FTS) | EPA 533 | 1 |
| 1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 FTS) | EPA 533 | 1 |
| 4,8-Dioxa-3H-perfluorononanoic acid (ADONA) | EPA 533 | 1 |
| 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS) | EPA 533 | 1 |
| Hexafluoropropylene oxide dimer acid (HFPO-DA) | EPA 533 | 1 |
| Nonafluoro-3,6-dioxaheptanoic acid (NFDHA) | EPA 533 | 1 |
| Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA) | EPA 533 | 1 |
| Perfluoro-3-methoxypropanoic acid (PFMPA) | EPA 533 | 1 |
| Perfluoro-4-methoxybutanoic acid (PFMBA) | EPA 533 | 1 |
| Perfluorobutane sulfonic acid (PFBS) | EPA 533 | 1 |
| Perfluorobutanoic acid (PFBA) | EPA 533 | 1 |
| Perfluorodecanoic acid (PFDA) | EPA 533 | 1 |
| Perfluorododecanoic acid (PFDoA) | EPA 533 | 1 |
| Perfluoroheptane sulfonic acid (PFHpS) | EPA 533 | 1 |
| Perfluoroheptanoic acid (PFHpA) | EPA 533 | 1 |
| Perfluorohexane sulfonic acid (PFHxS) | EPA 533 | 1 |
| Perfluorohexanoic acid (PFHxA) | EPA 533 | 1 |
| Perfluorononanoic acid (PFNA) | EPA 533 | 1 |
| Perfluorooctane sulfonic acid (PFOS) | EPA 533 | 1 |
| Perfluorooctanoic acid (PFOA) | EPA 533 | 1 |
| Perfluoropentane sulfonic acid (PFPeS) | EPA 533 | 1 |
| Perfluoropentanoic acid (PFPeA) | EPA 533 | 1 |
| Perfluoroundecanoic acid (PFUnA) | EPA 533 | 1 |
| 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS) | EPA 537.1 revison 2 (3/20) | 10 |
| 4,8-Dioxa-3H-perfluorononanoic acid (ADONA) | EPA 537.1 revison 2 (3/20) | 10 |
| 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS) | EPA 537.1 revison 2 (3/20) | 10 |
| Hexafluoropropylene oxide dimer acid (HFPO-DA) | EPA 537.1 revison 2 (3/20) | 10 |
| N-Ethylperfluorooctane sulfonamido acetic acid (NEtFOSAA) | EPA 537.1 revison 2 (3/20) | 10 |
| N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluorobutane sulfonic acid (PFBS) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluorodecanoic acid (PFDA) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluorododecanoic acid (PFDoA) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluoroheptanoic acid (PFHpA) | EPA 537.1 revison 2 (3/20) | 10 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Drinking Water** | | |
| Perfluorohexane sulfonic acid (PFHxS) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluorohexanoic acid (PFHxA) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluorononanoic acid (PFNA) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluorooctane sulfonic acid (PFOS) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluorooctanoic acid (PFOA) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluorotetradecanoic acid (PFTeDA) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluorotridecanoic acid (PFTrDA) | EPA 537.1 revison 2 (3/20) | 10 |
| Perfluoroundecanoic acid (PFUnA) | EPA 537.1 revison 2 (3/20) | 10 |
| N-Ethylperfluorooctane sulfonamido acetic acid (NEtFOSAA) | EPA 537_1.1_2009 | 1 |
| N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA) | EPA 537_1.1_2009 | 1 |
| Perfluorobutane sulfonic acid (PFBS) | EPA 537_1.1_2009 | 1 |
| Perfluorodecanoic acid (PFDA) | EPA 537_1.1_2009 | 1 |
| Perfluorododecanoic acid (PFDoA) | EPA 537_1.1_2009 | 1 |
| Perfluoroheptanoic acid (PFHPA) | EPA 537_1.1_2009 | 1 |
| Perfluorohexane sulfonic acid (PFHxS) | EPA 537_1.1_2009 | 1 |
| Perfluorohexanoic acid (PFHxA) | EPA 537_1.1_2009 | 1 |
| Perfluorononanoic acid (PFNA) | EPA 537_1.1_2009 | 1 |
| Perfluorooctane sulfonic acid (PFOS) | EPA 537_1.1_2009 | 1 |
| Perfluorooctanoic acid (PFOA) | EPA 537_1.1_2009 | 1 |
| Perfluorotetradecanoic acid (PFTeDA) | EPA 537_1.1_2009 | 1 |
| Perfluorotridecanoic acid (PFTrDA) | EPA 537_1.1_2009 | 1 |
| Perfluoroundecanoic acid (PFUnA) | EPA 537_1.1_2009 | 1 |
| Endothall | EPA 548.1_1_1992 | 1,8 |
| Total coli/E.coli - detect | SM 9223 B Colilert 18® (PA) | 8,9 |
| **Non-Potable Water** | | |
| n-Hexane Extractable Material (O&G) | EPA 1664B -10 (HEM) | 1 |
| Turbidity | EPA 180.1_2_1993 | 1 |
| Chloride | EPA 300.0_2.1_1993 | 1 |
| Fluoride | EPA 300.0_2.1_1993 | 1 |
| Nitrate | EPA 300.0_2.1_1993 | 1 |
| Nitrate + Nitrite | EPA 300.0_2.1_1993 | 1 |
| Nitrite | EPA 300.0_2.1_1993 | 1 |
| Orthophosphate | EPA 300.0_2.1_1993 | 1 |
| Sulfate | EPA 300.0_2.1_1993 | 1 |
| Perchlorate | EPA 331.0_1.0_2005 | 7 |
| Cyanide, Total | EPA 335.4_1_1993 | 1 |
| Phenolics, Total | EPA 420.1_1978 | 1,9 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Non-Potable Water** | | |
| Perchlorate | EPA 6850-07 | 1 |
| Alkalinity | SM 2320 B-2011 | 1 |
| Hardness (calc.) | SM 2340 B-2011 | 1 |
| Specific Conductance | SM 2510 B-2011 | 1 |
| Solids, Total Dissolved | SM 2540 C-2011 | 1 |
| Solids, Total Suspended | SM 2540 D-2011 | 1,9 |
| Cyanide, Weak Acid Dissociable | SM 4500 CN¯I-2011 | |
| Cyanides, Amenable to Chlorination | SM 4500-CN¯ G-2011 | 9 |
| pH | SM 4500-H+ B-2011 | 1,6 |
| Ammonia | SM 4500-NH3 G-2011 | 1 |
| Nitrate | SM 4500-NO3¯ F-2011 | 1 |
| Nitrate + Nitrite | SM 4500-NO3¯ F-2011 | 1 |
| Nitrite | SM 4500-NO3¯ F-2011 | 1 |
| Nitrogen, Total Kjeldahl | SM 4500-Norg C-2011 | 1 |
| Orthophosphate | SM 4500-P F-2011 | 1 |
| Phosphorus, total | SM 4500-P F-2011 | 1 |
| Total Organic Carbon | SM 5310 B-2011 | 1 |
| Phenolics, Total | SM 5530 D-2010 | 1,9 |
| Mercury | EPA 1631 E-02 | 1 |
| Aluminum | EPA 200.7_4.4_1994 | 1 |
| Barium | EPA 200.7_4.4_1994 | 1 |
| Beryllium | EPA 200.7_4.4_1994 | 1 |
| Boron | EPA 200.7_4.4_1994 | 1 |
| Cadmium | EPA 200.7_4.4_1994 | 1 |
| Calcium | EPA 200.7_4.4_1994 | 1 |
| Chromium | EPA 200.7_4.4_1994 | 1 |
| Cobalt | EPA 200.7_4.4_1994 | 1 |
| Copper | EPA 200.7_4.4_1994 | 1 |
| Iron | EPA 200.7_4.4_1994 | 1 |
| Lead | EPA 200.7_4.4_1994 | 1 |
| Magnesium | EPA 200.7_4.4_1994 | 1 |
| Manganese | EPA 200.7_4.4_1994 | 1 |
| Molybdenum | EPA 200.7_4.4_1994 | 1 |
| Nickel | EPA 200.7_4.4_1994 | 1 |
| Sodium | EPA 200.7_4.4_1994 | 1 |
| Titanium | EPA 200.7_4.4_1994 | 1 |
| Vanadium | EPA 200.7_4.4_1994 | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Non-Potable Water** | | |
| Zinc | EPA 200.7_4.4_1994 | 1 |
| Aluminum | EPA 200.8_5.4_1994 | 1 |
| Antimony | EPA 200.8_5.4_1994 | 1 |
| Arsenic | EPA 200.8_5.4_1994 | 1 |
| Barium | EPA 200.8_5.4_1994 | 1 |
| Beryllium | EPA 200.8_5.4_1994 | 1,9 |
| Cadmium | EPA 200.8_5.4_1994 | 1 |
| Chromium | EPA 200.8_5.4_1994 | 1 |
| Cobalt | EPA 200.8_5.4_1994 | 1 |
| Copper | EPA 200.8_5.4_1994 | 1 |
| Lead | EPA 200.8_5.4_1994 | 1 |
| Manganese | EPA 200.8_5.4_1994 | 1 |
| Molybdenum | EPA 200.8_5.4_1994 | 1 |
| Nickel | EPA 200.8_5.4_1994 | 1 |
| Selenium | EPA 200.8_5.4_1994 | 1 |
| Silver | EPA 200.8_5.4_1994 | 1 |
| Strontium | EPA 200.8_5.4_1994 | |
| Thallium | EPA 200.8_5.4_1994 | 1 |
| Tin | EPA 200.8_5.4_1994 | 1 |
| Titanium | EPA 200.8_5.4_1994 | 1 |
| Total Uranium | EPA 200.8_5.4_1994 | 1 |
| Vanadium | EPA 200.8_5.4_1994 | 1 |
| Zinc | EPA 200.8_5.4_1994 | 1 |
| Mercury | EPA 245.7_2005 | 1 |
| 4,4'-DDD | EPA 608.3 | 1 |
| 4,4'-DDE | EPA 608.3 | 1 |
| 4,4'-DDT | EPA 608.3 | 1 |
| Aldrin | EPA 608.3 | 1 |
| alpha-BHC (alpha-Hexachlorocyclohexane) | EPA 608.3 | 1 |
| Aroclor-1016 (PCB-1016) | EPA 608.3 | 1 |
| Aroclor-1221 (PCB-1221) | EPA 608.3 | 1 |
| Aroclor-1232 (PCB-1232) | EPA 608.3 | 1 |
| Aroclor-1242 (PCB-1242) | EPA 608.3 | 1 |
| Aroclor-1248 (PCB-1248) | EPA 608.3 | 1 |
| Aroclor-1254 (PCB-1254) | EPA 608.3 | 1 |
| Aroclor-1260 (PCB-1260) | EPA 608.3 | 1 |
| beta-BHC (beta-Hexachlorocyclohexane) | EPA 608.3 | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Non-Potable Water** | | |
| Chlordane (tech.) | EPA 608.3 | 1 |
| delta-BHC | EPA 608.3 | 1 |
| Dieldrin | EPA 608.3 | 1 |
| Endosulfan I | EPA 608.3 | 1 |
| Endosulfan II | EPA 608.3 | 1 |
| Endosulfan sulfate | EPA 608.3 | 1 |
| Endrin | EPA 608.3 | 1 |
| Endrin aldehyde | EPA 608.3 | 1 |
| Endrin ketone | EPA 608.3 | 1 |
| gamma-BHC (Lindane, gamma-Hexachlorocyclohexane) | EPA 608.3 | 1 |
| Heptachlor | EPA 608.3 | 1 |
| Heptachlor epoxide | EPA 608.3 | 1 |
| Methoxychlor | EPA 608.3 | 1 |
| Toxaphene (Chlorinated camphene) | EPA 608.3 | 1 |
| 1,1,1,2-Tetrachloroethane | EPA 624.1 | 1 |
| 1,1,1-Trichloroethane | EPA 624.1 | 1 |
| 1,1,2,2-Tetrachloroethane | EPA 624.1 | |
| 1,1,2-Trichloroethane | EPA 624.1 | 1 |
| 1,1-Dichloroethane | EPA 624.1 | 1 |
| 1,1-Dichloroethylene | EPA 624.1 | 1 |
| 1,1-Dichloropropene | EPA 624.1 | 1 |
| 1,2,3-Trichlorobenzene | EPA 624.1 | 1 |
| 1,2,3-Trichloropropane | EPA 624.1 | 1 |
| 1,2,4-Trimethylbenzene | EPA 624.1 | 1 |
| 1,2-Dibromo-3-chloropropane (DBCP) | EPA 624.1 | 1 |
| 1,2-Dibromoethane (EDB, Ethylene dibromide) | EPA 624.1 | 1 |
| 1,2-Dichlorobenzene | EPA 624.1 | 1 |
| 1,2-Dichloroethane (Ethylene dichloride) | EPA 624.1 | 1 |
| 1,2-Dichloropropane | EPA 624.1 | 1 |
| 1,3,5-Trimethylbenzene | EPA 624.1 | 1 |
| 1,3-Dichlorobenzene | EPA 624.1 | 1 |
| 1,3-Dichloropropane | EPA 624.1 | 1 |
| 1,4-Dichlorobenzene | EPA 624.1 | 1 |
| 2,2-Dichloropropane | EPA 624.1 | 1 |
| 2-Butanone (Methyl ethyl ketone, MEK) | EPA 624.1 | |
| 2-Chloroethyl vinyl ether | EPA 624.1 | 1 |
| 2-Chlorotoluene | EPA 624.1 | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Non-Potable Water** | | |
| 2-Hexanone | EPA 624.1 | |
| 4-Chlorotoluene | EPA 624.1 | 1 |
| 4-Isopropyltoluene (p-Cymene) | EPA 624.1 | 1 |
| 4-Methyl-2-pentanone (MIBK) | EPA 624.1 | |
| Acrolein (Propenal) | EPA 624.1 | 1 |
| Acrylonitrile | EPA 624.1 | 1 |
| Benzene | EPA 624.1 | 1 |
| Bromobenzene | EPA 624.1 | 1 |
| Bromochloromethane | EPA 624.1 | 1 |
| Bromodichloromethane | EPA 624.1 | 1 |
| Bromoform | EPA 624.1 | 1 |
| Carbon disulfide | EPA 624.1 | |
| Carbon tetrachloride | EPA 624.1 | 1 |
| Chlorobenzene | EPA 624.1 | 1 |
| Chlorodibromomethane | EPA 624.1 | 1 |
| Chloroethane (Ethyl chloride) | EPA 624.1 | 1 |
| Chloroform | EPA 624.1 | 1 |
| cis-1,2-Dichloroethylene | EPA 624.1 | 1 |
| cis-1,3-Dichloropropene | EPA 624.1 | 1 |
| Dibromomethane | EPA 624.1 | 1 |
| Diethyl ether | EPA 624.1 | 1 |
| Ethylbenzene | EPA 624.1 | 1 |
| Iodomethane (Methyl iodide) | EPA 624.1 | 1 |
| Isopropylbenzene | EPA 624.1 | 1 |
| m+p-xylene | EPA 624.1 | 1 |
| Methyl bromide (Bromomethane) | EPA 624.1 | 1 |
| Methyl chloride (Chloromethane) | EPA 624.1 | 1 |
| Methyl tert-butyl ether (MTBE) | EPA 624.1 | 1 |
| Methylene chloride (Dichloromethane) | EPA 624.1 | 1 |
| n-Butylbenzene | EPA 624.1 | 1 |
| n-Propylbenzene | EPA 624.1 | 1 |
| o-Xylene | EPA 624.1 | 1 |
| sec-Butylbenzene | EPA 624.1 | 1 |
| Styrene | EPA 624.1 | 1 |
| tert-Butylbenzene | EPA 624.1 | |
| Tetrachloroethylene (Perchloroethylene) | EPA 624.1 | 1 |
| Toluene | EPA 624.1 | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Non-Potable Water** | | |
| trans-1,2-Dichloroethylene | EPA 624.1 | 1 |
| trans-1,3-Dichloropropylene | EPA 624.1 | 1 |
| trans-1,4-Dichloro-2-butene | EPA 624.1 | 1 |
| Trichloroethene (Trichloroethylene) | EPA 624.1 | 1 |
| Trichlorofluoromethane (Freon 11) | EPA 624.1 | 1 |
| Vinyl chloride | EPA 624.1 | 1 |
| Xylene (total) | EPA 624.1 | 1 |
| 1,2,4-Trichlorobenzene | EPA 625.1 | 1 |
| 1,2-Dinitrobenzene | EPA 625.1 | |
| 1,2-Diphenylhydrazine | EPA 625.1 | 1 |
| 1,3-Dinitrobenzene (1,3-DNB) | EPA 625.1 | |
| 1-Methylnaphthalene | EPA 625.1 | |
| 2,2'-Oxybis(1-chloropropane) | EPA 625.1 | 1 |
| 2,3,4,6-Tetrachlorophenol | EPA 625.1 | 1 |
| 2,3,5,6-Tetrachlorophenol | EPA 625.1 | |
| 2,4,5-Trichlorophenol | EPA 625.1 | 1 |
| 2,4,6-Trichlorophenol | EPA 625.1 | 1 |
| 2,4-Dichlorophenol | EPA 625.1 | 1 |
| 2,4-Dimethylphenol | EPA 625.1 | 1 |
| 2,4-Dinitrophenol | EPA 625.1 | 1 |
| 2,4-Dinitrotoluene (2,4-DNT) | EPA 625.1 | 1 |
| 2,6-Dinitrotoluene (2,6-DNT) | EPA 625.1 | 1 |
| 2-Chloronaphthalene | EPA 625.1 | 1 |
| 2-Chlorophenol | EPA 625.1 | 1 |
| 2-Methylnaphthalene | EPA 625.1 | 1 |
| 2-Methylphenol (o-Cresol) | EPA 625.1 | |
| 2-Nitroaniline | EPA 625.1 | 1 |
| 2-Nitrophenol | EPA 625.1 | 1 |
| 3,3'-Dichlorobenzidine | EPA 625.1 | 1 |
| 3-Nitroaniline | EPA 625.1 | 1 |
| 4,6-Dinitro-2-methylphenol | EPA 625.1 | 1 |
| 4-Bromophenyl phenyl ether (BDE-3) | EPA 625.1 | 1 |
| 4-Chloro-3-methylphenol | EPA 625.1 | 1 |
| 4-Chloroaniline | EPA 625.1 | 1 |
| 4-Chlorophenyl phenylether | EPA 625.1 | 1 |
| 4-Methylphenol (p-Cresol) | EPA 625.1 | |
| 4-Nitroaniline | EPA 625.1 | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Non-Potable Water** | | |
| 4-Nitrophenol | EPA 625.1 | 1 |
| Acenaphthene | EPA 625.1 | 1 |
| Acenaphthylene | EPA 625.1 | 1 |
| Aniline | EPA 625.1 | |
| Anthracene | EPA 625.1 | 1 |
| Benzidine | EPA 625.1 | 1 |
| Benzo(a)anthracene | EPA 625.1 | 1 |
| Benzo(a)pyrene | EPA 625.1 | 1 |
| Benzo(g,h,i)perylene | EPA 625.1 | 1 |
| Benzo(k)fluoranthene | EPA 625.1 | 1 |
| Benzo[b]fluoranthene | EPA 625.1 | 1 |
| Benzyl alcohol | EPA 625.1 | 1 |
| bis(2-Chloroethoxy)methane | EPA 625.1 | 1 |
| bis(2-Chloroethyl) ether | EPA 625.1 | 1 |
| bis(2-Ethylhexyl) phthalate (DEHP) | EPA 625.1 | 1 |
| Butyl benzyl phthalate | EPA 625.1 | 1 |
| Carbazole | EPA 625.1 | |
| Chrysene | EPA 625.1 | 1 |
| Dibenz(a,h) anthracene | EPA 625.1 | 1 |
| Diethyl phthalate | EPA 625.1 | 1 |
| Dimethyl phthalate | EPA 625.1 | 1 |
| Di-n-butyl phthalate | EPA 625.1 | 1 |
| Di-n-octyl phthalate | EPA 625.1 | 1 |
| Fluoranthene | EPA 625.1 | 1 |
| Fluorene | EPA 625.1 | 1 |
| Hexachlorobenzene | EPA 625.1 | 1 |
| Hexachlorobutadiene | EPA 625.1 | 1 |
| Hexachlorocyclopentadiene | EPA 625.1 | 1 |
| Hexachloroethane | EPA 625.1 | 1 |
| Indeno(1,2,3-cd) pyrene | EPA 625.1 | 1 |
| Isophorone | EPA 625.1 | 1 |
| m+p Cresol | EPA 625.1 | |
| Naphthalene | EPA 625.1 | 1 |
| n-Decane | EPA 625.1 | 1 |
| Nitrobenzene | EPA 625.1 | 1 |
| N-Nitrosodimethylamine | EPA 625.1 | 1 |
| N-Nitroso-di-n-propylamine | EPA 625.1 | 1 |

| **Matrix/Analyte** | **Method** | **Notes** |
|---|---|---|
| **Non-Potable Water** | | |
| N-Nitrosodiphenylamine | EPA 625.1 | 1 |
| n-Octadecane | EPA 625.1 | 1 |
| Pentachlorophenol | EPA 625.1 | 1 |
| Phenanthrene | EPA 625.1 | 1 |
| Phenol | EPA 625.1 | 1 |
| Pyrene | EPA 625.1 | 1 |
| Pyridine | EPA 625.1 | |
| Fecal coliform-count | SM 9221 B+E1+C (LTB/BGB/EC-MPN) | |
| Total coliforms-count | SM 9221 B+E1+C (LTB/BGB/EC-MPN) | |
| E.coli-count | SM 9221 B+F+C (LTB/BGB/EC Mug-MPN) | |
| Total coliforms-count | SM 9221 B+F+C (LTB/BGB/EC Mug-MPN) | |
| **Solid and Chemical Materials** | | |
| Chloride | EPA 300.0_2.1_1993 | 1 |
| Fluoride | EPA 300.0_2.1_1993 | 1 |
| Nitrate | EPA 300.0_2.1_1993 | 1 |
| Nitrite | EPA 300.0_2.1_1993 | 1 |
| Orthophosphate | EPA 300.0_2.1_1993 | 1 |
| Sulfate | EPA 300.0_2.1_1993 | 1 |
| Cyanide, Total | EPA 335.4_1_1993 | |
| Cyanide, Total | EPA 9012 B-04 | 1 |
| pH | EPA 9045 D_2004 | 1 |
| Cyanide, Total | SM 4500-CN¯ E-2011 | 1 |
| Cyanides, Amenable to Chlorination | SM 4500-CN¯ G-2011 | 4 |
| Ammonia | SM 4500-NH3 G-2011 | 1,9 |
| Nitrate (calc.) | SM 4500-NO3¯ F-2011 | 1 |
| Nitrogen, Total Kjeldahl | SM 4500-Norg C-2011 | 1 |
| Phosphorus, total | SM 4500-P F-2011 | 1,4 |
| Aluminum | EPA 6010D_(7/14) | 1 |
| Barium | EPA 6010D_(7/14) | 1 |
| Beryllium | EPA 6010D_(7/14) | 1 |
| Boron | EPA 6010D_(7/14) | 1,4 |
| Cadmium | EPA 6010D_(7/14) | 1 |
| Calcium | EPA 6010D_(7/14) | 1 |
| Chromium | EPA 6010D_(7/14) | 1 |
| Cobalt | EPA 6010D_(7/14) | 1,4 |
| Copper | EPA 6010D_(7/14) | 1 |
| Iron | EPA 6010D_(7/14) | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Solid and Chemical Materials** | | |
| Magnesium | EPA 6010D_(7/14) | 1 |
| Manganese | EPA 6010D_(7/14) | 1 |
| Molybdenum | EPA 6010D_(7/14) | 1 |
| Nickel | EPA 6010D_(7/14) | 1 |
| Sodium | EPA 6010D_(7/14) | 1 |
| Vanadium | EPA 6010D_(7/14) | 1 |
| Zinc | EPA 6010D_(7/14) | 1 |
| Aluminum | EPA 6020B_(7/14) | 1 |
| Antimony | EPA 6020B_(7/14) | 1 |
| Arsenic | EPA 6020B_(7/14) | 1 |
| Barium | EPA 6020B_(7/14) | 1 |
| Beryllium | EPA 6020B_(7/14) | 1 |
| Boron | EPA 6020B_(7/14) | 1 |
| Cadmium | EPA 6020B_(7/14) | 1 |
| Chromium | EPA 6020B_(7/14) | 1 |
| Cobalt | EPA 6020B_(7/14) | 1 |
| Copper | EPA 6020B_(7/14) | 1 |
| Iron | EPA 6020B_(7/14) | 1 |
| Lead | EPA 6020B_(7/14) | 1 |
| Magnesium | EPA 6020B_(7/14) | 1 |
| Manganese | EPA 6020B_(7/14) | 1 |
| Mercury | EPA 6020B_(7/14) | 1 |
| Molybdenum | EPA 6020B_(7/14) | 1 |
| Nickel | EPA 6020B_(7/14) | 1 |
| Potassium | EPA 6020B_(7/14) | 1,4 |
| Selenium | EPA 6020B_(7/14) | 1 |
| Sodium | EPA 6020B_(7/14) | 1 |
| Strontium | EPA 6020B_(7/14) | 1 |
| Thallium | EPA 6020B_(7/14) | 1 |
| Tin | EPA 6020B_(7/14) | 1,4 |
| Titanium | EPA 6020B_(7/14) | 1 |
| Vanadium | EPA 6020B_(7/14) | 1 |
| Zinc | EPA 6020B_(7/14) | 1 |
| Methamphetamine | ALI SOP 602 | 1,5 |
| 4,4'-DDD | EPA 8081B_(2/07) | 1 |
| 4,4'-DDE | EPA 8081B_(2/07) | 1 |
| 4,4'-DDT | EPA 8081B_(2/07) | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Solid and Chemical Materials** | | |
| Aldrin | EPA 8081B_(2/07) | 1 |
| alpha-BHC (alpha-Hexachlorocyclohexane) | EPA 8081B_(2/07) | 1 |
| beta-BHC (beta-Hexachlorocyclohexane) | EPA 8081B_(2/07) | 1 |
| Chlordane (tech.) | EPA 8081B_(2/07) | 1 |
| Dacthal (DCPA) | EPA 8081B_(2/07) | 1 |
| delta-BHC | EPA 8081B_(2/07) | 1 |
| Dieldrin | EPA 8081B_(2/07) | 1 |
| Endosulfan I | EPA 8081B_(2/07) | 1 |
| Endosulfan II | EPA 8081B_(2/07) | 1 |
| Endosulfan sulfate | EPA 8081B_(2/07) | 1 |
| Endrin | EPA 8081B_(2/07) | 1 |
| Endrin aldehyde | EPA 8081B_(2/07) | 1 |
| Endrin ketone | EPA 8081B_(2/07) | 1 |
| gamma-BHC (Lindane, gamma-Hexachlorocyclohexane) | EPA 8081B_(2/07) | 1 |
| Heptachlor | EPA 8081B_(2/07) | 1 |
| Heptachlor epoxide | EPA 8081B_(2/07) | 1 |
| Methoxychlor | EPA 8081B_(2/07) | 1 |
| Toxaphene (Chlorinated camphene) | EPA 8081B_(2/07) | 1 |
| Aroclor-1016 (PCB-1016) | EPA 8082A_(2/07) | 1 |
| Aroclor-1221 (PCB-1221) | EPA 8082A_(2/07) | 1 |
| Aroclor-1232 (PCB-1232) | EPA 8082A_(2/07) | 1 |
| Aroclor-1242 (PCB-1242) | EPA 8082A_(2/07) | 1 |
| Aroclor-1248 (PCB-1248) | EPA 8082A_(2/07) | 1 |
| Aroclor-1254 (PCB-1254) | EPA 8082A_(2/07) | 1 |
| Aroclor-1260 (PCB-1260) | EPA 8082A_(2/07) | 1 |
| Azinphos-ethyl (Ethyl guthion) | EPA 8141B_2_(2/07) | 1,4 |
| Azinphos-methyl (Guthion) | EPA 8141B_2_(2/07) | 1 |
| Bolstar (Sulprofos) | EPA 8141B_2_(2/07) | 1,4 |
| Carbophenothion | EPA 8141B_2_(2/07) | 1 |
| Chlorfenvinphos | EPA 8141B_2_(2/07) | 1 |
| Chlorpyrifos | EPA 8141B_2_(2/07) | 1 |
| Coumaphos | EPA 8141B_2_(2/07) | 1,4 |
| Demeton | EPA 8141B_2_(2/07) | |
| Demeton-o | EPA 8141B_2_(2/07) | 1 |
| Demeton-s | EPA 8141B_2_(2/07) | 1,4 |
| Diazinon | EPA 8141B_2_(2/07) | 1,4 |
| Dichlorovos (DDVP, Dichlorvos) | EPA 8141B_2_(2/07) | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Solid and Chemical Materials** | | |
| Dimethoate | EPA 8141B_2_(2/07) | 1 |
| Dioxathion | EPA 8141B_2_(2/07) | |
| Disulfoton | EPA 8141B_2_(2/07) | 1 |
| EPN | EPA 8141B_2_(2/07) | 1 |
| Ethion | EPA 8141B_2_(2/07) | 1,4 |
| Ethoprop | EPA 8141B_2_(2/07) | 1 |
| Famphur | EPA 8141B_2_(2/07) | 1 |
| Fensulfothion | EPA 8141B_2_(2/07) | 1,4 |
| Fenthion | EPA 8141B_2_(2/07) | 1 |
| Malathion | EPA 8141B_2_(2/07) | 1 |
| Merphos | EPA 8141B_2_(2/07) | 1,4 |
| Methyl parathion (Parathion, methyl) | EPA 8141B_2_(2/07) | 1 |
| Mevinphos | EPA 8141B_2_(2/07) | 1,4 |
| Monocrotophos | EPA 8141B_2_(2/07) | 1,4 |
| Naled | EPA 8141B_2_(2/07) | 1 |
| Parathion, ethyl | EPA 8141B_2_(2/07) | 1 |
| Phorate | EPA 8141B_2_(2/07) | 1 |
| Phosmet (Imidan) | EPA 8141B_2_(2/07) | 1,4 |
| Ronnel | EPA 8141B_2_(2/07) | 1 |
| Sulfotepp | EPA 8141B_2_(2/07) | 1 |
| Terbufos | EPA 8141B_2_(2/07) | 1 |
| Tetrachlorvinphos (Stirophos, Gardona) | EPA 8141B_2_(2/07) | 1 |
| Tetraethyl pyrophosphate (TEPP) | EPA 8141B_2_(2/07) | 1 |
| Thionazin (Zinophos) | EPA 8141B_2_(2/07) | 1,4 |
| Tokuthion (Prothiophos) | EPA 8141B_2_(2/07) | 1,4 |
| Trichloronate | EPA 8141B_2_(2/07) | 1,4 |
| 2,4,5-T | EPA 8151A_(1/98) | 1 |
| 2,4-D | EPA 8151A_(1/98) | 1 |
| 2,4-DB | EPA 8151A_(1/98) | 1 |
| Acifluorfen | EPA 8151A_(1/98) | |
| Bentazon | EPA 8151A_(1/98) | |
| Chloramben | EPA 8151A_(1/98) | |
| Dacthal (DCPA) | EPA 8151A_(1/98) | |
| Dalapon | EPA 8151A_(1/98) | 1 |
| DCPA di acid degradate | EPA 8151A_(1/98) | |
| Dicamba | EPA 8151A_(1/98) | 1 |
| Dichloroprop (Dichlorprop) | EPA 8151A_(1/98) | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Solid and Chemical Materials** | | |
| Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP) | EPA 8151A_(1/98) | 1 |
| MCPA | EPA 8151A_(1/98) | 1 |
| MCPP | EPA 8151A_(1/98) | |
| Pentachlorophenol | EPA 8151A_(1/98) | 1 |
| Picloram | EPA 8151A_(1/98) | |
| Silvex (2,4,5-TP) | EPA 8151A_(1/98) | 1 |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | EPA 8330B_(10/06) | 4 |
| 1,3-Dinitrobenzene (1,3-DNB) | EPA 8330B_(10/06) | 4 |
| 2,4,6-Trinitrobenzene | EPA 8330B_(10/06) | 4 |
| 2,4,6-Trinitrotoluene (2,4,6-TNT) | EPA 8330B_(10/06) | 4 |
| 2,4-Dinitrotoluene (2,4-DNT) | EPA 8330B_(10/06) | 4 |
| 2,6-Dinitrotoluene (2,6-DNT) | EPA 8330B_(10/06) | 4 |
| 2-Amino-4,6-dinitrotoluene (2-am-dnt) | EPA 8330B_(10/06) | 4 |
| 2-Nitrotoluene | EPA 8330B_(10/06) | 4 |
| 3-Nitrotoluene | EPA 8330B_(10/06) | 4 |
| 4-Amino-2,6-dinitrotoluene (4-am-dnt) | EPA 8330B_(10/06) | 4 |
| 4-Nitrotoluene | EPA 8330B_(10/06) | 4 |
| Methyl-2,4,6-trinitrophenylnitramine (tetryl) | EPA 8330B_(10/06) | 4 |
| Nitrobenzene | EPA 8330B_(10/06) | 4 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | EPA 8330B_(10/06) | 4 |
| RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) | EPA 8330B_(10/06) | 4 |
| Tetryl (methyl-2,4,6-trinitrophenylnitramine) | EPA 8330B_(10/06) | 4 |
| 1,1,1,2-Tetrachloroethane | EPA 8260D_4_(6/18) | 1 |
| 1,1,1-Trichloroethane | EPA 8260D_4_(6/18) | 1 |
| 1,1,2,2-Tetrachloroethane | EPA 8260D_4_(6/18) | 1 |
| 1,1,2-Trichloroethane | EPA 8260D_4_(6/18) | 1 |
| 1,1-Dichloroethane | EPA 8260D_4_(6/18) | 1 |
| 1,1-Dichloroethylene | EPA 8260D_4_(6/18) | 1 |
| 1,1-Dichloropropene | EPA 8260D_4_(6/18) | 1 |
| 1,2,3-Trichlorobenzene | EPA 8260D_4_(6/18) | 1 |
| 1,2,3-Trichloropropane | EPA 8260D_4_(6/18) | 1 |
| 1,2,4-Trichlorobenzene | EPA 8260D_4_(6/18) | 1 |
| 1,2,4-Trimethylbenzene | EPA 8260D_4_(6/18) | 1 |
| 1,2-Dibromo-3-chloropropane (DBCP) | EPA 8260D_4_(6/18) | 1 |
| 1,2-Dibromoethane (EDB, Ethylene dibromide) | EPA 8260D_4_(6/18) | 1 |
| 1,2-Dichlorobenzene | EPA 8260D_4_(6/18) | 1 |
| 1,2-Dichloroethane (Ethylene dichloride) | EPA 8260D_4_(6/18) | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Solid and Chemical Materials** | | |
| 1,2-Dichloropropane | EPA 8260D_4_(6/18) | 1 |
| 1,3,5-Trimethylbenzene | EPA 8260D_4_(6/18) | 1 |
| 1,3-Dichlorobenzene | EPA 8260D_4_(6/18) | 1 |
| 1,3-Dichloropropane | EPA 8260D_4_(6/18) | 1 |
| 1,4-Dichlorobenzene | EPA 8260D_4_(6/18) | 1 |
| 2,2-Dichloropropane | EPA 8260D_4_(6/18) | 1 |
| 2-Butanone (Methyl ethyl ketone, MEK) | EPA 8260D_4_(6/18) | 1 |
| 2-Chlorotoluene | EPA 8260D_4_(6/18) | 1 |
| 2-Hexanone | EPA 8260D_4_(6/18) | 1 |
| 4-Chlorotoluene | EPA 8260D_4_(6/18) | 1 |
| 4-Isopropyltoluene (p-Cymene) | EPA 8260D_4_(6/18) | 1,4 |
| 4-Methyl-2-pentanone (MIBK) | EPA 8260D_4_(6/18) | 1 |
| Acetone | EPA 8260D_4_(6/18) | 1 |
| Acrylonitrile | EPA 8260D_4_(6/18) | 1 |
| Benzene | EPA 8260D_4_(6/18) | 1 |
| Bromobenzene | EPA 8260D_4_(6/18) | 1 |
| Bromochloromethane | EPA 8260D_4_(6/18) | 1 |
| Bromodichloromethane | EPA 8260D_4_(6/18) | 1 |
| Bromoform | EPA 8260D_4_(6/18) | 1 |
| Carbon disulfide | EPA 8260D_4_(6/18) | 1 |
| Carbon tetrachloride | EPA 8260D_4_(6/18) | 1 |
| Chlorobenzene | EPA 8260D_4_(6/18) | 1 |
| Chlorodibromomethane | EPA 8260D_4_(6/18) | 1,4 |
| Chlorodifluoromethane (Freon-22) | EPA 8260D_4_(6/18) | |
| Chloroethane (Ethyl chloride) | EPA 8260D_4_(6/18) | 1 |
| Chloroform | EPA 8260D_4_(6/18) | 1 |
| cis-1,2-Dichloroethylene | EPA 8260D_4_(6/18) | 1 |
| cis-1,3-Dichloropropene | EPA 8260D_4_(6/18) | 1 |
| Dibromochloropropane | EPA 8260D_4_(6/18) | |
| Dibromomethane | EPA 8260D_4_(6/18) | 1 |
| Dichlorodifluoromethane (Freon-12) | EPA 8260D_4_(6/18) | 1 |
| Diethyl ether | EPA 8260D_4_(6/18) | 1,4 |
| Ethylbenzene | EPA 8260D_4_(6/18) | 1 |
| Hexachlorobutadiene | EPA 8260D_4_(6/18) | 1 |
| Iodomethane (Methyl iodide) | EPA 8260D_4_(6/18) | 1,4 |
| Isopropylbenzene | EPA 8260D_4_(6/18) | 1 |
| m+p-xylene | EPA 8260D_4_(6/18) | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Solid and Chemical Materials** | | |
| Methyl bromide (Bromomethane) | EPA 8260D_4_(6/18) | 1 |
| Methyl chloride (Chloromethane) | EPA 8260D_4_(6/18) | 1 |
| Methyl tert-butyl ether (MTBE) | EPA 8260D_4_(6/18) | 1 |
| Methylene chloride (Dichloromethane) | EPA 8260D_4_(6/18) | 1 |
| Naphthalene | EPA 8260D_4_(6/18) | 1 |
| n-Butylbenzene | EPA 8260D_4_(6/18) | 1 |
| n-Propylbenzene | EPA 8260D_4_(6/18) | 1 |
| o-Xylene | EPA 8260D_4_(6/18) | 1 |
| p-Xylene | EPA 8260D_4_(6/18) | 1 |
| sec-Butylbenzene | EPA 8260D_4_(6/18) | 1 |
| Styrene | EPA 8260D_4_(6/18) | 1 |
| tert-Butylbenzene | EPA 8260D_4_(6/18) | 1 |
| Tetrachloroethylene (Perchloroethylene) | EPA 8260D_4_(6/18) | 1 |
| Toluene | EPA 8260D_4_(6/18) | 1 |
| trans-1,2-Dichloroethylene | EPA 8260D_4_(6/18) | 1 |
| trans-1,3-Dichloropropylene | EPA 8260D_4_(6/18) | 1 |
| trans-1,4-Dichloro-2-butene | EPA 8260D_4_(6/18) | 1,4 |
| Trichloroethene (Trichloroethylene) | EPA 8260D_4_(6/18) | 1 |
| Trichlorofluoromethane (Freon 11) | EPA 8260D_4_(6/18) | 1 |
| Vinyl chloride | EPA 8260D_4_(6/18) | 1 |
| Xylene (total) | EPA 8260D_4_(6/18) | 1 |
| 1,2,4-Trichlorobenzene | EPA 8270E_6_(6/18) | 1 |
| 1,2-Dichlorobenzene | EPA 8270E_6_(6/18) | 1 |
| 1,2-Dinitrobenzene | EPA 8270E_6_(6/18) | |
| 1,2-Diphenylhydrazine | EPA 8270E_6_(6/18) | 1,4 |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | EPA 8270E_6_(6/18) | |
| 1,3-Dichlorobenzene | EPA 8270E_6_(6/18) | 1 |
| 1,3-Dinitrobenzene (1,3-DNB) | EPA 8270E_6_(6/18) | |
| 1,4-Dichlorobenzene | EPA 8270E_6_(6/18) | |
| 1,4-Dinitrobenzene | EPA 8270E_6_(6/18) | 1 |
| 1-Methylnaphthalene | EPA 8270E_6_(6/18) | |
| 2,2'-Oxybis(1-chloropropane) | EPA 8270E_6_(6/18) | |
| 2,3,4,6-Tetrachlorophenol | EPA 8270E_6_(6/18) | 1 |
| 2,3,5,6-Tetrachlorophenol | EPA 8270E_6_(6/18) | |
| 2,4,5-Trichlorophenol | EPA 8270E_6_(6/18) | 1 |
| 2,4,6-Trichlorophenol | EPA 8270E_6_(6/18) | 1 |
| 2,4-Dichlorophenol | EPA 8270E_6_(6/18) | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Solid and Chemical Materials** | | |
| 2,4-Dimethylphenol | EPA 8270E_6_(6/18) | 1 |
| 2,4-Dinitrophenol | EPA 8270E_6_(6/18) | 1 |
| 2,6-Dinitrotoluene (2,6-DNT) | EPA 8270E_6_(6/18) | 1 |
| 2-Chloronaphthalene | EPA 8270E_6_(6/18) | 1 |
| 2-Chlorophenol | EPA 8270E_6_(6/18) | 1 |
| 2-Methylnaphthalene | EPA 8270E_6_(6/18) | 1 |
| 2-Methylphenol (o-Cresol) | EPA 8270E_6_(6/18) | 1 |
| 2-Naphthylamine | EPA 8270E_6_(6/18) | |
| 2-Nitroaniline | EPA 8270E_6_(6/18) | 1 |
| 2-Nitrophenol | EPA 8270E_6_(6/18) | 1 |
| 3,3'-Dichlorobenzidine | EPA 8270E_6_(6/18) | 1 |
| 3-Nitroaniline | EPA 8270E_6_(6/18) | 1 |
| 4,6-Dinitro-2-methylphenol | EPA 8270E_6_(6/18) | 1 |
| 4-Bromophenyl phenyl ether (BDE-3) | EPA 8270E_6_(6/18) | 1 |
| 4-Chloro-3-methylphenol | EPA 8270E_6_(6/18) | 1 |
| 4-Chloroaniline | EPA 8270E_6_(6/18) | 1 |
| 4-Chlorophenyl phenylether | EPA 8270E_6_(6/18) | 1 |
| 4-Methylphenol (p-Cresol) | EPA 8270E_6_(6/18) | 1,4 |
| 4-Nitroaniline | EPA 8270E_6_(6/18) | 1 |
| 4-Nitrophenol | EPA 8270E_6_(6/18) | 1 |
| Acenaphthene | EPA 8270E_6_(6/18) | 1 |
| Acenaphthylene | EPA 8270E_6_(6/18) | 1 |
| Aniline | EPA 8270E_6_(6/18) | 1 |
| Anthracene | EPA 8270E_6_(6/18) | 1 |
| Azinphos-methyl (Guthion) | EPA 8270E_6_(6/18) | 1,3,4 |
| Benzidine | EPA 8270E_6_(6/18) | 1 |
| Benzo(a)anthracene | EPA 8270E_6_(6/18) | 1 |
| Benzo(a)pyrene | EPA 8270E_6_(6/18) | 1 |
| Benzo(g,h,i)perylene | EPA 8270E_6_(6/18) | 1 |
| Benzo(k)fluoranthene | EPA 8270E_6_(6/18) | 1 |
| Benzo[b]fluoranthene | EPA 8270E_6_(6/18) | 1 |
| Benzyl alcohol | EPA 8270E_6_(6/18) | 1 |
| beta-BHC (beta-Hexachlorocyclohexane) | EPA 8270E_6_(6/18) | 3 |
| bis(2-Chloroethoxy)methane | EPA 8270E_6_(6/18) | 1 |
| bis(2-Chloroethyl) ether | EPA 8270E_6_(6/18) | 1 |
| Butyl benzyl phthalate | EPA 8270E_6_(6/18) | 1 |
| Carbazole | EPA 8270E_6_(6/18) | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Solid and Chemical Materials** | | |
| Carbophenothion | EPA 8270E_6_(6/18) | 1 |
| Chlorpyrifos | EPA 8270E_6_(6/18) | 1,3 |
| Chrysene | EPA 8270E_6_(6/18) | 1 |
| Demeton-s | EPA 8270E_6_(6/18) | 1 |
| Di(2-ethylhexyl)adipate | EPA 8270E_6_(6/18) | |
| Di(2-ethylhexyl)phthalate | EPA 8270E_6_(6/18) | 1 |
| Dibenz(a,h) anthracene | EPA 8270E_6_(6/18) | 1 |
| Dibenzofuran | EPA 8270E_6_(6/18) | 1 |
| Diethyl phthalate | EPA 8270E_6_(6/18) | 1 |
| Dimethoate | EPA 8270E_6_(6/18) | 1,3 |
| Dimethyl phthalate | EPA 8270E_6_(6/18) | 1 |
| Di-n-butyl phthalate | EPA 8270E_6_(6/18) | 1 |
| Di-n-octyl phthalate | EPA 8270E_6_(6/18) | 1 |
| Disulfoton | EPA 8270E_6_(6/18) | 1,3 |
| EPN | EPA 8270E_6_(6/18) | 1 |
| Famphur | EPA 8270E_6_(6/18) | 1 |
| Fenthion | EPA 8270E_6_(6/18) | 1,3 |
| Fluoranthene | EPA 8270E_6_(6/18) | 1 |
| Fluorene | EPA 8270E_6_(6/18) | 1 |
| Hexachlorobenzene | EPA 8270E_6_(6/18) | 1 |
| Hexachlorobutadiene | EPA 8270E_6_(6/18) | 1 |
| Hexachlorocyclopentadiene | EPA 8270E_6_(6/18) | 1 |
| Hexachloroethane | EPA 8270E_6_(6/18) | 1 |
| Indeno(1,2,3-cd) pyrene | EPA 8270E_6_(6/18) | 1 |
| Isophorone | EPA 8270E_6_(6/18) | 1 |
| m,p Cresol | EPA 8270E_6_(6/18) | 1 |
| Malathion | EPA 8270E_6_(6/18) | 1,3 |
| Methyl parathion (Parathion, methyl) | EPA 8270E_6_(6/18) | 1,3 |
| Mevinphos | EPA 8270E_6_(6/18) | 1,3 |
| Naled | EPA 8270E_6_(6/18) | 1,3 |
| Naphthalene | EPA 8270E_6_(6/18) | 1 |
| Nitrobenzene | EPA 8270E_6_(6/18) | 1 |
| n-Nitrosodimethylamine | EPA 8270E_6_(6/18) | 1 |
| N-Nitroso-di-n-propylamine | EPA 8270E_6_(6/18) | 1 |
| n-Nitrosodiphenylamine | EPA 8270E_6_(6/18) | 1 |
| Parathion | EPA 8270E_6_(6/18) | 3 |
| Pentachlorophenol | EPA 8270E_6_(6/18) | 1 |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Solid and Chemical Materials** | | |
| Phenanthrene | EPA 8270E_6_(6/18) | 1 |
| Phenol | EPA 8270E_6_(6/18) | 1 |
| Phorate | EPA 8270E_6_(6/18) | 1,3 |
| Pyrene | EPA 8270E_6_(6/18) | 1 |
| Pyridine | EPA 8270E_6_(6/18) | 1 |
| Sulfotepp | EPA 8270E_6_(6/18) | 1,3 |
| Terbufos | EPA 8270E_6_(6/18) | 1,3 |
| Tetrachlorvinphos (Stirophos, Gardona) | EPA 8270E_6_(6/18) | 1,3 |
| Diesel range organics (DRO) | WDOE NWTPH-Dx_(1997) | 1,2 |
| Gasoline range organics (GRO) | WDOE NWTPH-Gx_(1997) | 1,2 |

## Accredited Parameter Note Detail

(1) Accreditation is based in part on recognition of Florida Department of Health NELAP accreditation. (2) Analytical Methods for Petroleum Hydrocarbons, Publication No. ECY 97-602, June 1997. (3) Tributyl phosphate used for internal standard and normal 8270 surrogates used. (4) Accreditation is limited to water only. (5) Anatek Labs, Inc. SOP for determination of methamphetamine by HPLC-MS. (6) Approved for compliance testing only when holding time is met.(7) Method not approved for NPDES testing. (8)Accreditation based in part on recognition of Idaho Department of Health and Welfare accreditation. (9) Provisional accreditation pending submittal of acceptable Proficiency Testing (PT) results (WAC 173-50-110).(10) Interim accreditation pending the successful completion of an on-site audit to verify method capabilities (WAC 173-50-100).

07/03/2023

Authentication Signature
Rebecca Wood, Lab Accreditation Unit Supervisor

Date

The State of Washington
Department of Ecology

1889

# LabTest
## Yakima, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective July 14, 2022 and shall expire July 13, 2023.

Witnessed under my hand on August 2, 2022

Rebecca Wood
Lab Accreditation Unit Supervisor

Laboratory ID
**C1008**

# WASHINGTON STATE DEPARTMENT OF ECOLOGY

## ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

## SCOPE OF ACCREDITATION

# LabTest

## Yakima, WA

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

| **Matrix/Analyte** | **Method** | **Notes** |
|---|---|---|
| **Drinking Water** | | |
| Sulfate | ASTM D516-90 | |
| pH | EPA 150.1_1982 | 1 |
| Turbidity | EPA 180.1_2_1993 | |
| Cyanide, Total | EPA 335.4_1_1993 | |
| Nitrate | EPA 353.2_2_1993 | |
| Nitrite | EPA 353.2_2_1993 | 1 |
| Color | SM 2120 B-2011 | |
| Hardness (calc.) | SM 2340 B-2011 | |
| Specific Conductance | SM 2510 B-2011 | |
| Chloride | SM 4500-Cl¯ E-2011 | |
| Thallium | EPA 200.9 Rev 2.2 (1994) | 2,3 |
| Calcium | SM 3111 B-2011 | 2,3 |
| Iron | SM 3111 B-2011 | 2,3 |
| Magnesium | SM 3111 B-2011 | 2,3 |
| Sodium | SM 3111 B-2011 | 2,3 |
| Zinc | SM 3111 B-2011 | 2,3 |
| Antimony | SM 3113 B-2010 | |
| Arsenic | SM 3113 B-2010 | |
| Barium | SM 3113 B-2010 | |
| Beryllium | SM 3113 B-2010 | |
| Cadmium | SM 3113 B-2010 | |
| Chromium | SM 3113 B-2010 | |
| Copper | SM 3113 B-2010 | |
| Lead | SM 3113 B-2010 | |
| Manganese | SM 3113 B-2010 | |
| Nickel | SM 3113 B-2010 | |

| Matrix/Analyte | Method | Notes |
|---|---|---|
| **Drinking Water** | | |
| Selenium | SM 3113 B-2010 | 2,3 |
| Silver | SM 3113 B-2010 | |
| Fecal coliform-count | SM 9222 D (mFC)-06 | |
| Total coli/E.coli - detect | SM 9223 B Colilert® 24 (PA) | |
| **Non-Potable Water** | | |
| Sulfate | ASTM D516-90 | |
| Turbidity | EPA 180.1_2_1993 | |
| Cyanide, Total | EPA 335.4_1_1993 | |
| Ammonia | EPA 350.1_2_1993 | 1 |
| Nitrate | EPA 353.2_2_1993 | |
| Nitrate + Nitrite | EPA 353.2_2_1993 | |
| Nitrite | EPA 353.2_2_1993 | 1 |
| Specific Conductance | SM 2510 B-2011 | 1 |
| Chloride | SM 4500-Cl¯ E-2011 | |
| Biochemical Oxygen Demand (BOD) | SM 5210 B-2011 | |
| Thallium | EPA 200.9 Rev 2.2 (1994) | 2 |
| Calcium | SM 3111 B-2011 | 2 |
| Iron | SM 3111 B-2011 | 2 |
| Magnesium | SM 3111 B-2011 | 2 |
| Sodium | SM 3111 B-2011 | 2 |
| Zinc | SM 3111 B-2011 | 2 |
| Antimony | SM 3113 B-2010 | |
| Arsenic | SM 3113 B-2010 | |
| Barium | SM 3113 B-2010 | |
| Beryllium | SM 3113 B-2010 | |
| Cadmium | SM 3113 B-2010 | |
| Chromium | SM 3113 B-2010 | |
| Copper | SM 3113 B-2010 | |
| Lead | SM 3113 B-2010 | |
| Manganese | SM 3113 B-2010 | |
| Nickel | SM 3113 B-2010 | |
| Selenium | SM 3113 B-2010 | 2 |
| Silver | SM 3113 B-2010 | |
| Fecal coliform-count | SM 9222 D (mFC)-06 | |

### Accredited Parameter Note Detail

(1) Provisional accreditation pending submittal of acceptable Proficiency Testing (PT) results (WAC 173-50-110).(2) Provisional status pending the submission of an acceptable corrective action plan in response to the 2019 audit findings (3) Provisional status for Drinking Water Parameters must be resolved within 90 days of the scope effective date.

Rebecca Wood

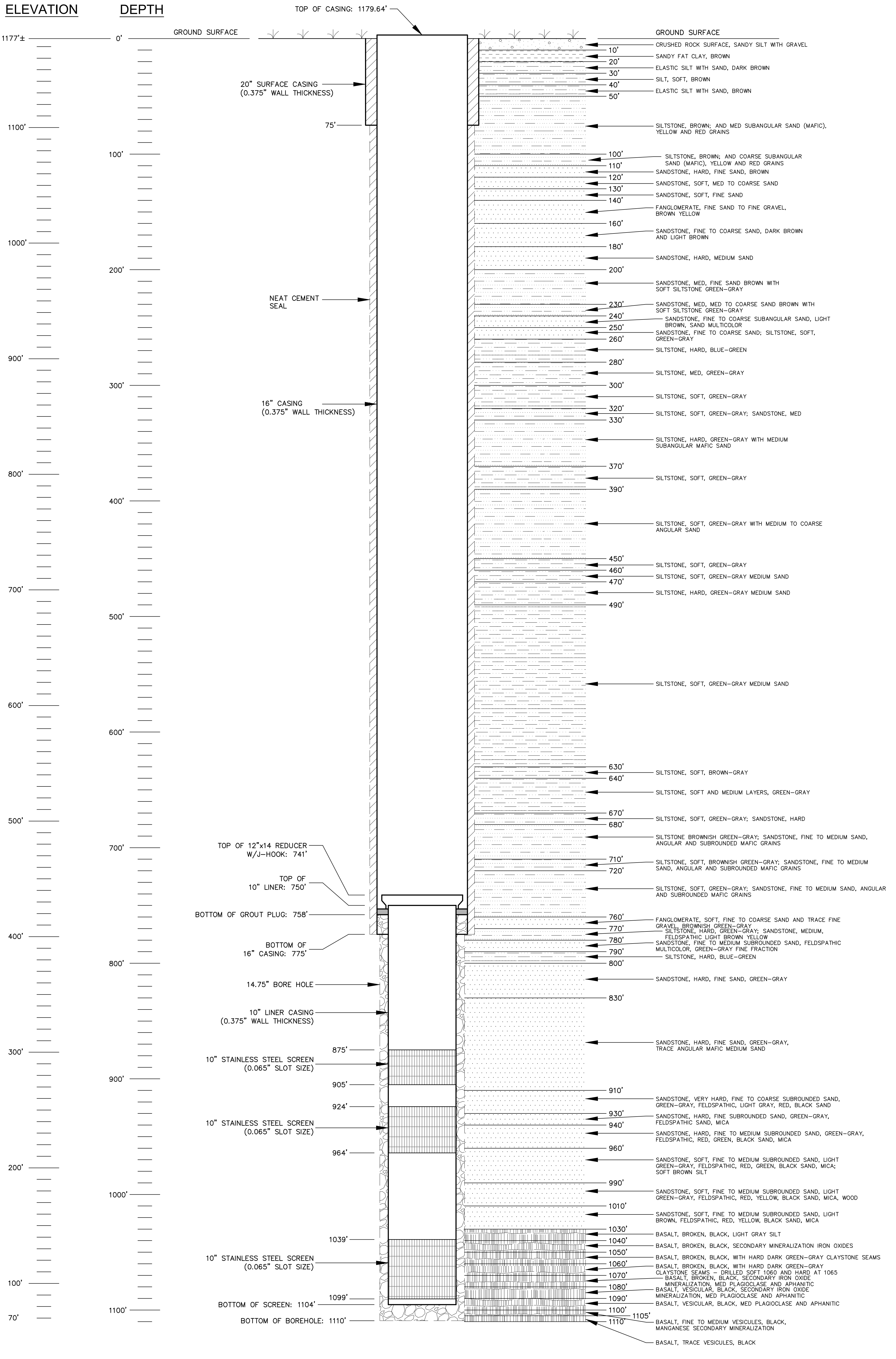
08/02/2022

Authentication Signature
Rebecca Wood, Lab Accreditation Unit Supervisor

Date

# APPENDIX B

# Well Logs



NOTE: WELL CONSTRUCTION DETAILS AND FORMATION INFORMATION FROM WELL LOG DATED AUGUST 25, 2020.

HLA
Engineering and Land Surveying, Inc.

2803 River Road
Yakima, WA 98902
509.966.7000
Fax 509.965.3800
www.hlacivil.com

| | |
|---|---|
| 19218 | 10-20-20 |
| FILE NAMES:<br>DRAWING: 19218.dwg | |
| DESIGNED BY: JLB<br>ENTERED BY: AJH | |

# CITY OF MOXEE

## WELL NO. 4
## WELL CONSTRUCTION SCHEMATIC

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

WELL LOG

No. Appl4.626
Cert. 297A

Date January 1943

Record by

Source Driller's record

*Location:* State of WASHINGTON

County Yakima

Area

Map Sec. 1, T. 12 N., R. 19 E

Town of Moxee City ¼ ¼ sec. T. N., R. E W

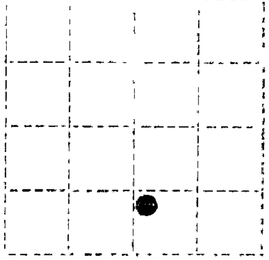


DIAGRAM OF SECTION

*Drilling Co* G. D. Hall & Associates

Address Yakima, Washington

Method of Drilling Date 19

Owner Town of Moxee City,

Address

*Land surface datum* ft above below

| Correlation | Material | Thickness (feet) | Depth (feet) |
|---|---|---|---|

(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)

| | | | |
|---|---|---|---|
| | See attached sheet | | |
| Pump test: | | | |
| | Dim: 1326' x 10" | | |
| | SWL: flowing | | |
| | DD: | | |
| | Meas. Dis: 875 g.p.m. Cert. for 300 | | |
| | Shut-in pressure at g.s. 37 # per sq.in. | | |
| | Controlled by valve | | |
| | Casing: 10" from 0 to 344' | | |
| | 8" " 334' " 789' | | |
| | 6.5 " 765' " 1326' | | |
| | Perf: 12 - ¼" x 1" per ft. | | |

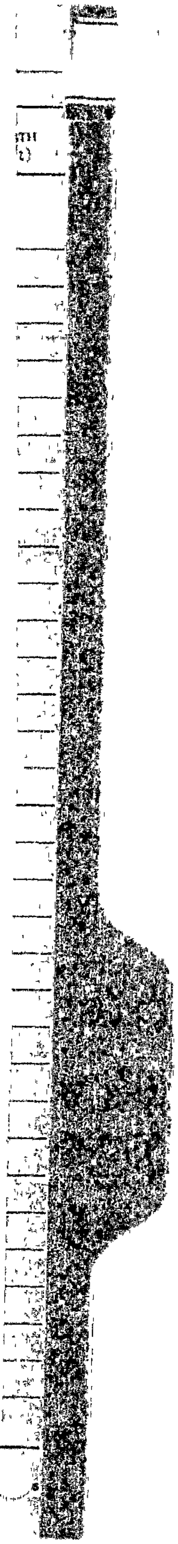
Turn up

Sheet of sheets

12N/19E-1P
File number

A 626

| | | |
|---|---|---|
| Top soil | 35 | 35 |
| Cement gravel | 34 | 69 |
| Brown clay - wet | 51 | 120 |
| Hard Brown clay | 83 | 203 |
| Blue Clay - wet | 72 | 275 |
| Hard Blue shale | 5 | 280 |
| Blue Clay - wet | 30 | 310 |
| Hard blue shale | 15 | 325 |
| Hard blue clay | 54 | 379 |
| Sandstone | 31 | 410 |
| Loose sand | 18 | 428 |
| Hard shale | 7 | 435 |
| Coarse sand | 26 | 461 |
| Clay | 4 | 465 |
| Sand | 15 | 480 |
| Sandstone | 6 | 486 |
| Blue clay - wet | 38 | 524 |
| Hard shale | 45 | 569 |
| Sand | 11 | 580 |
| Blue clay - wet | 65 | 645 |
| Sandstone | 23 | 668 |
| Blue clay | 22 | 690 |
| Sandstone | 8 | 698 |
| Clay - wet | 65 | 763 |
| Sand | 12 | 775 |
| Blue sand | 8 | 783 |
| Sand and gravel | 52 | 835 |
| Sand | 22 | 857 |
| Blue clay | 18 | 875 |
| Sand and clay | 45 | 920 |
| Sandstone | 70 | 990 |
| Blue clay | 31 | 1021 |
| Brown sandstone | 6 | 1027 |
| Packed sand | 45 | 1072 |
| Shale | 15 | 1087 |
| Blue clay | 47 | 1134 |
| Sand and clay | 4 | 1138 |
| Blue clay | 40 | 1178 |
| Gray sandstone | 22 | 1200 |
| Blue shale | 23 | 1223 |
| Sandstone | 53 | 1276 |
| Sand | 50 | 1326 |



S. F. No. 7356—8-46—1M 12687

RECEIVED
1948
DIVISION OF HYDRAULICS

# RECORD BY WELL DRILLER OR OTHER CONSTRUCTOR OF WORKS FOR WITHDRAWAL OF GROUND WATER

Under Permit No. G. W.. 727

("The well driller or other constructor of works for the withdrawal of public ground waters shall be directed to furnish the permittee a certified record of the factual information necessary to show compliance with the provisions of this section." Sec. 8, Chap. 263, Laws of 1945.)

1. The Town of Moxee City, Washington
(Name and address of owner of well or other works for withdrawal of water)

2. Nature of works from which water is withdrawn Well
(Well, tunnel, or infiltration trench)

3. Name or number of works (if any) #1

4. Date on which work on well or other structure was started January 1942

5. Date on which work was completed January 1943

6. If work on well or other structure was abandoned, give date

and reason for abandonment

7. DESCRIPTION OF WORKS

(a) WELL: Depth 1326 ft. Diameter 10 in. or ft. Dug or drilled To be drilled

Flowing or pump well Flowing

IF PUMP WELL. Type and size of pump is

Type and size of motor or engine is

Depth from ground surface to water level before pumping feet

After continuous operation for at least four hours, the measured discharge of the pump is g.p.m., and the drawdown of water level is feet

Date of test

IF FLOWING WELL: Measured discharge 875 g.p.m., on January 6, 1943
(Date)

Shut-in pressure at ground surface 37 lbs. per sq. in. on January 6, 1943
(Date)

Water is controlled by valve
(Cap, valve, etc.)

CASING: (Give diameter, commercial specifications and depth below ground surface of each casing size.)

10 in. diameter Standard weight steel from 0 to 344 ft.
8 in. diameter " " " from 334 to 789 ft.
6.5 in. diameter " " " from 765 to 1326 ft.
in. diameter from to ft.

Describe and show depth of shoe, plug, adapter, liner or other details:

Perforated casing or screens:

12 - 1/4"x 1" per foot from 1225 to 1280 ft.
(Number per foot and size of perforations or describe screen)
from to ft.
from to ft.
from to ft.
from to ft.

LOG OF WELL: (Describe each stratum or formation clearly, indicate if water bearing, and give thickness and depth as indicated.)

| MATERIAL | Thickness (Feet) | Depth to Bottom (Feet) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

(b) INFILTRATION TRENCH: Covered or open

Dimensions: Length ft. Minimum depth ft. Maximum depth ft.

Bottom width ft. Discharge g.p.m. Date of test

(c) TUNNEL Type of lining

Dimensions:
(Length, course, and cross-sectional size)

Position of water bearing stratum with reference to portal of tunnel

LOG OF TUNNEL: (Preceding table for log of well may be used if desired. Give footage from portal and character of materials, as pertinent.)

G. D. HALL & ASSOCIATES, Consulting Engineers,
By Don E. Gray
Don E.Gray
(Signature of well driller or other constructor)

Larson Bldg., Yakima, Wash.
(Address)

STATE OF WASHINGTON,
County of Yakima } ss.

*I,* Don E. Gray *, being first duly sworn, do hereby certify that I am the driller or constructor of the aforesaid well or tunnel or trench who furnished the foregoing statement of facts; that I have read said statement and each and all of the items therein contained are true to the best of my knowledge and belief.*

Don E. Gray
(Signature)
Don E. Gray

*Subscribed and sworn to before me this* 23rd *day of* June *,* 1948

Charles G. Walton
*Notary Public*

Flowing

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
AND DEVELOPMENT

**WELL LOG** No. Decla. #414

Date Jan., 19 43 Cert. #499-D

Record by Lester J. LaCoursier

Source G. W. Decla. Claim

*Location:* State of WASHINGTON

County Yakima

xxx Within limits of town

xxx of Moxee City

SW ¼ SE ¼ sec. 1 T. 12 N., R. 19 E. W.

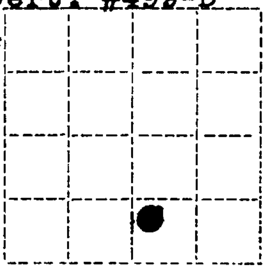


DIAGRAM OF SECTION

*Drilling Co.*

Address

Method of Drilling drilled Date Jan. 6 19 43

Owner Moxee City

Address Moxee City, Wash.

*Land surface, datum* ft. above below

| Correlation | Material | Thickness (feet) | Depth (feet) |
|---|---|---|---|
| | (Transcribe driller's terminology literally but paraphrase as necessary, in parentheses If material water-bearing, so state and record static level if reported Give depths in feet below land-surface datum unless otherwise indicated Correlate with stratigraphic column, if feasible Following log of materials, list all casings, perforations, screens, etc ) | | |
| | See following page | | |
| Pump | Test: | | |
| | Dim: 1326' x 12" | | |
| | Discharge: 875 g.p.m. | | |
| | Shut-in pressure: 37 lbs./ sq. in. | | |
| | Control: Valve | | |
| | Casing: | | |
| | 12" dia. Schedule 40 from | 0' | to 129' |
| | 10" " " " " | 0' | to 344' |
| | 8" " " " " | 334' | to 789 |
| | 6 5/8" " " " " | 765' | to 132 |
| | Perforations: ¼ x 1" per foot | | from |
| | 1225' to 1280'. | | |
| | | | |
| | | | |
| | | | |

Turn up Sheet of sheets

LOG OF WELL. *(Describe each stratum or formation clearly, indicate if water bearing, and give thickness and depth as indicated.)* Moxee City

| MATERIAL | Thickness (Feet) | Depth to Bottom (Feet) |
|---|---|---|
| Top Soil | 35 | 35 |
| Cement Gravel | 34 | 69 |
| Brown Clay | 206 | 275 |
| Blue Clay | 104 | 379 |
| Sandstone | 31 | 410 |
| Loose Sand | 18 | 428 |
| Hard Shale | 7 | 435 |
| Coarse Sand | 26 | 461 |
| Clay | 4 | 465 |
| Sand | 15 | 480 |
| Sandstone | 6 | 486 |
| Blue Clay | 38 | 524 |
| Hard Shale | 45 | 569 |
| Sand | 11 | 580 |
| Blue Clay | 65 | 645 |
| Sandstone | 23 | 668 |
| Blue Clay | 22 | 690 |
| Sandstone | 8 | 698 |
| Clay | 65 | 763 |
| Sand | 12 | 775 |
| Blue Sand | 8 | 783 |
| Sand and Gravel | 52 | 835 |
| Sand | 22 | 857 |
| Blue Clay | 18 | 875 |
| Sand and Clay | 45 | 920 |
| Sandstone | 70 | 990 |
| Blue Clay | 31 | 1021 |
| Brown Sandstone | 6 | 1027 |
| Packed Sand | 45 | 1072 |
| Shale | 15 | 1087 |
| Blue Clay | 47 | 1134 |
| Sand and Clay | 4 | 1138 |
| Blue Clay | 40 | 1178 |
| Grey Sandstone | 22 | 1200 |
| Blue Shale | 23 | 1223 |
| Sandstone | 53 | 1276 |
| Sand | 50 | 1326 |

~~(b) INFILTRATION TRENCH: Covered or open.~~

~~Dimensions: Length ........ ft. Minimum depth ........ ft. Maximum depth ........ ft.~~

~~Bottom width ........ ft. Discharge ........ g.p.m. Date of test~~

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

# WATER WELL REPORT

## STATE OF WASHINGTON

Application No.
Permit No. G4-27813P

**(1) OWNER:** Name City of Moxee Address PO Box 248, Moxee, WA 98936

**(2) LOCATION OF WELL:** County Yakima — NE ¼ SW ¼ Sec 31 T. 13 N., R. 20E W.M.
Bearing and distance from section or subdivision corner

**(3) PROPOSED USE:** Domestic ☐ Industrial ☐ Municipal ☒ Irrigation ☐ Test Well ☐ Other ☐

**(4) TYPE OF WORK:** Owner's number of well (if more than one) 2
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

**(5) DIMENSIONS:** Diameter of well See Attached Exhibit A inches.
Drilled 978 ft. Depth of completed well 978 ft.

**(6) CONSTRUCTION DETAILS:** See Attached Exhibit A

Casing installed: " Diam. from ft. to ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐ See Attached Exhibit A
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☒ No ☐ Size of gravel: See Attached
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 772 ft.
Material used in seal pressure grouted
Did any strata contain unusable water? Yes ☒ No ☐
Type of water? sulfer Depth of strata 440
Method of sealing strata off cased & pressure grouted

**(7) PUMP:** Manufacturer's Name
Type: H.P.

**(8) WATER LEVELS:** Land-surface elevation above mean sea level ft.
Static level 22 ft. below top of well Date
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

**(9) WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom? Valley Pump
Yield: 1600 gal./min. with 189 ft. drawdown after 24 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

| Time | Water Level | Time | Water Level | Time | Water Level |
|---|---|---|---|---|---|
| | | | | | |

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

**(10) WELL LOG:**

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

| MATERIAL | FROM | TO |
|---|---|---|
| brown dirt, sand & small gravel | 0 | 4 |
| large gravel 3"-8" size w/sand & dirt mixed | 4 | 5 |
| soft sandy pea gravel w/sm amt lt brown clay | 5 | 15 |
| soft brown sand w/sand mixed | 15 | 53 |
| dense dark brown hard stickey clay | 53 | 63 |
| brown dense hard clay (sticky) some gravel | 63 | 85 |
| brown soft sand pea gravel w/brown clay | 85 | 150 |
| pea gravel & course sand slightly cemented together (soft formation) | 150 | 220 |
| small gravel w/sand & brown clay | 220 | 235 |
| green soft clay & course sand | 235 | 262 |
| formation changed to more green clay, less course sand | 262 | 284 |
| green clay (soft) & fine silt | 284 | 365 |
| slab of sandstone or coulder | 365 | 367 |
| green clay soft some pea gravel | 367 | 395 |
| hard black slate stone some cracks & seams, water bearing est. 150-175gpm | 395 | 432 |
| blue soft clay w/silt & pea gravel, drilled ft./min. w/5000 lbs | 432 | 478 |
| blue soft clay & sand | 478 | 560 |
| green soft clay & sm gravel | 560 | 582 |
| soft green clay w/course sand & some pea gravel mixed | 582 | 660 |
| greenish gray soft clay & sand | 660 | 755 |
| tan clolored hard sticky clay | 755 | 770 |

continued on Page 2

Work started 12-7, 19 82. Completed 3-28, 19 83

**WELL DRILLER'S STATEMENT:**

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Leach Well Drilling, Inc. (Person, firm, or corporation) (Type or print)

Address 821 W. Broadway, Moses Lake, WA 98837

[Signed] (Well Driller)

License No. 0276 Date 5-9, 19 83

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

# WATER WELL REPORT
## STATE OF WASHINGTON

Application No
Permit No

(1) **OWNER:** Name City of Moxee Address

(2) **LOCATION OF WELL:** County ¼ ¼ Sec. T N., R. W.M.

Bearing and distance from section or subdivision corner

(3) **PROPOSED USE:** Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one)
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) **DIMENSIONS:** Diameter of well inches
Drilled ft. Depth of completed well ft.

(6) **CONSTRUCTION DETAILS:**

**Casing installed:** " Diam. from ft. to ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☐ " Diam. from ft. to ft.

**Perforations:** Yes ☐ No ☐
Type of perforator used

(10) **WELL LOG:**

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

| MATERIAL | FROM | TO |
|---|---|---|
| hard blue slate | 770 | 780 |
| ~~xxx~~ sandstone, large granules | | |
| brown, black blue | 780 | 880 |
| green clay mixed w/coarse sand | | |
| softer formation | 880 | 905 |
| very sticky green clay & course sand | | |
| no water | 905 | 960 |
| starting to pick up some brown | | |
| sandstone, drills slow & tough | 960 | 973 |
| sticky green clay | 973 | 978 |

EXHIBIT "A"

**Leach Well Drilling, Inc.**

OFFICE (509) 762-5995 SHOP (509) 765-6792 821 WEST BROADWAY NO 107
MOSES LAKE, WASHINGTON 98837
*Irrigation—Industrial—Municipal—New Wells*
WELL SIZES FROM 8 TO 24
DEPTH TO 2 000 AND BEYOND
DEEPEN—REAM—REPAIR OLD WELLS

(5) Dimensions: 26" from 0-60
19¼" 60-772
14 3/4" 772-978

(6) Construction Details & Screens

20" 375 casing from +2' to 60'
16" 375 casing from +2' to 772'

700-766 blank casing 8" 362 wall
766-776 Johnson stainless steel V wire screen .070 slot
776-842 blank 8" casing
842-862 Johnson stainless steel V wire screen .070 slot
862-882 blank 8" casing
882-907 Johnson stainless steel V wire screen .070 slot
907-932 blank 8" casing
932-970 Johnson stainless steel V wire screen .070 slot
970-978 blank 8" casing

All screens were gravel packed with no. 6 filter monteray sand out of Calif. It took 240 100 pound bags

(USE ADDITIONAL SHEETS IF NECESSARY)

Map No.

R. 20 E. ~~W~~.

Town. Moxee, Wash

Company.

Farm. E. S. Wiseman

No.

T. 12 N.

Sec 6

NE¼, NW¼

Authority. N. C. Jannsen

Elevation. 1150'

Collector. W. Warren

Confidential. No

Date 1908

| No. | Strata | Thickness Feet | Thickness In. | Depth Feet | Depth In. |
|---|---|---|---|---|---|
| | Alluvium | | | | |
| 1. | Soil and gravel | 18 | | 18 | |
| | Ringold and/or Ellensburg formation | | | | |
| 2. | Sandstone | 20 | | 38 | |
| 3. | Sandstone and shale | 60 | | 98 | |
| 4. | Sandstone | 120 | | 218 | |
| 5. | Shale | 40 | | 258 | |
| 6. | Sandstone | 229 | | 487 | |
| 7. | Shale | 190 | | 677 | |
| 8. | Gravel | 2 | | 679 | |
| 9. | Shale | 31 | | 710 | |
| 10. | Sandstone | 53 | | 763 | |
| 11. | Shale, flow | 65 | | 828 | |
| 12. | Sandstone | 100 | | 928 | |
| | 5" well | | | | |

JBR

County. YAKIMA

Index No. Y.4706.36

# WATER WELL REPORT

DEPARTMENT OF ECOLOGY
State of Washington

**Type of Work:**
☒ Construction
☐ Decommission ⟹ Original installation NOI No. ____

Notice of Intent No. WE 38616
Unique Ecology Well ID Tag No. BJE 651
Site Well Name (if more than one well): WELL #4
Water Right Permit/Certificate No. G4-27813C
Property Owner Name CITY OF MOXEE
Well Street Address 532 FAUCHER RD
City MOXEE County YAKIMA
Tax Parcel No. 20133131007
Was a variance approved for this well? ☐ Yes ☒ No
If yes, what was the variance for? ____

**Proposed Use:** ☐ Domestic ☐ Industrial ☒ Municipal ☐ Dewatering ☐ Irrigation ☐ Test Well ☐ Other ____

**Construction Type:** ☒ New well ☐ Alteration ☐ Deepening ☐ Other ____

**Method:** ☐ Driven ☐ Jetted ☐ Cable Tool ☐ Dug ☐ Air- ☒ Mud-Rotary

**Dimensions:** Diameter of boring 14.75 in., to 1110 ft.
Depth of completed well 1104 ft.

**Construction Details:**

| Casing | Liner | Diameter | From | To | Wall Thickness | Steel | PVC | Welded | Thread |
|---|---|---|---|---|---|---|---|---|---|
| ☒ | ☐ | 20 in. | 0 | 75 | .375 in. | ☒ | ☐ | ☒ | ☐ |
| ☒ | ☐ | 16 in. | +3 | 775 | .375 in. | ☒ | ☐ | ☒ | ☐ |
| ☐ | ☒ | 10 in. | 750 | 1104 | .375 in. | ☒ | ☐ | ☒ | ☐ |
| ☐ | ☐ | in. | | | in. | ☐ | ☐ | ☐ | ☐ |

**Perforations:** ☐ Yes ☒ No Type of perforator used ____
No. of perforations ____ Size of perforations ____ in. by ____ in.
Perforated from ____ ft. to ____ ft. below ground surface

**Screens:** ☒ Yes ☐ No ☐ K-Packer ⟹ Depth ____ ft.
Manufacturer's Name ROSSCOE MOSS
Type SS WIRE WRAP Model No. ____
Diameter 10 Slot size .065 in. from 875 ft. to 905 ft.
Diameter 10 Slot size .065 in. from 924 ft. to 964 ft. 10in .065 1039-1099

**Sand/Filter pack:** ☒ Yes ☐ No Size of pack material 8-12
Materials placed from 1104 ft. to 750 ft.

**Surface Seal:** ☒ Yes ☐ No To what depth? 775 ft.
Material used in seal NEAT CEMENT
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? ____ Depth of strata ____
Method of sealing strata off ____

**Pump:** Manufacturer's Name ____ Type: ____
H.P. ____ Pump intake depth: ____ ft. Designed flow rate: ____ gpm

**Water Levels:** Land-surface elevation above mean sea level 1176 ft.
Stick-up of top of well casing 2.3 ft. above ground surface
Static water level 100.33 ft. below top of well casing Date 8-10-20
Artesian pressure ____ lbs. per square inch Date ____
Artesian water is controlled by ____ (cap, valve, etc.)

**Well Tests:**
Was a pumping test performed? ☐ No ☒ Yes ⟹ by whom? HOLT
Yield 1050 gpm with 100 ft. drawdown after 24 hrs.
Yield ____ gpm with ____ ft. drawdown after ____ hrs.
Yield ____ gpm with ____ ft. drawdown after ____ hrs.
Recovery data (time = zero when pump is turned off – water level measured from well top to water level)

| Time | Water Level | Time | Water Level | Time | Water Level |
|---|---|---|---|---|---|
| 5 min | 119.45 | 30 min | 113.00 | 90 min | 109.18 |
| 10 min | 117.07 | 45 min | 111.69 | 120 min | 108.22 |
| 15 min | 115.50 | 60 min | 110.49 | 180 min | 106.96 |

Date of pumping test 8-11-20
Bailer test ____ gpm with ____ ft. drawdown after ____ hrs.
Air test ____ gpm with stem set at ____ ft. for ____ hrs.
Artesian flow ____ gpm
Date ____
Temperature of water 75 ° F Was a chemical analysis made? ☒ Yes ☐ No

Location (see instructions on page 2): ☐ WWM or ☒ EWM
NE ¼-¼ of the SW ¼; Section 31 Township 13N Range 20E
Latitude (Example: 47.12345) 46.5672952
Longitude (Example: -120.12345) -120.3757108

## Driller's Log/Construction or Decommission Procedure

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each layer penetrated, with at least one entry for each change of information. Use additional sheets if necessary.

| Material | From | To |
|---|---|---|
| See Attached | | |

Start Date 4-24-20 Completed Date 8-15-20

**WELL CONSTRUCTION CERTIFICATION:** I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Trainee ☐ PE – Print Name CHRISTOPHER PERRY
Signature Christopher Perry
License No. 3252
IF TRAINEE: Sponsor's License No.
Sponsor's Signature

Drilling Company HOLT SERVICES INC.
Address 10621 TODD RD E
City, State, Zip EDGEWOOD, WA 98372
Contractor's Registration No. HOLTSSI898JG Date 8-25-20

*If you need this document in an alternate format, please call the Water Resources Program at 360-407-6872. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.*

Moxee, Washington Well 4

| From | To | Material |
|---|---|---|
| 0 | 10 | crushed rock surface, sandy silt with gravel |
| 10 | 20 | sandy fat clay, brown |
| 20 | 30 | elastic silt with sand, dark brown |
| 30 | 40 | silt, soft, brown |
| 40 | 50 | elastic silt with sand, brown |
| 50 | 100 | siltstone, brown; and med subangular sand (mafic), yellow and red grains |
| 100 | 110 | siltstone, brown; and coarse subangular sand (mafic), yellow and red grains |
| 110 | 120 | sandstone, hard, fine sand, brown |
| 120 | 130 | sandstone, soft, med to coarse sand |
| 130 | 140 | sandstone, soft, fine sand |
| 140 | 160 | fanglomerate, fine sand to fine gravel, brown-yellow |
| 160 | 180 | sandstone, fint to coarse sand, dark brown and light brown |
| 180 | 200 | sandstone, hard, medium sand |
| 200 | 230 | sandstone, med, fine sand brown with soft siltstone green-gray |
| 230 | 240 | sandstone, med, med to coarse sand brown with soft siltstone green-gray |
| 240 | 250 | sandstone, fine to coarse subangular sand, light brown, sand multicolor |

Moxee, Washington Well 4

| From | To | Material |
|---|---|---|
| 250 | 260 | sanstone, fine to coarse sand; siltstone, soft, green-gray |
| 260 | 280 | siltstone, hard, blue-green |
| 280 | 300 | siltstone, med, green-gray |
| 300 | 320 | siltstone, soft, green-gray |
| 320 | 330 | siltstone, soft, green-gray; sandstone, med |
| 330 | 370 | siltstone, hard, green-gray with medium subangular mafic sand |
| 370 | 390 | siltstone, soft, green-gray |
| 390 | 450 | siltstone, soft, green-gray with medium to coarse angular sand |
| 450 | 460 | siltstone, soft, green gray |
| 460 | 470 | siltstone, soft, green gray medium sand |
| 470 | 490 | siltstone, hard, green gray medium sand |
| 490 | 630 | siltstone, soft, green gray medium sand |
| 630 | 640 | siltstone, soft, brown gray |
| 640 | 670 | siltstone, soft and medium layers, green gray |
| 670 | 680 | siltstone, soft, green gray; sandstone, hard |
| 680 | 710 | siltstone brownish green gray; sandstone, fine to medium sand, angular and subrounded mafic grains |

Moxee, Washington Well 4

| From | To | Material |
|---|---|---|
| 710 | 720 | siltstone, soft, brownish green gray; sandstone, fine to medium sand, angular and subrounded mafic grains |
| 720 | 760 | siltstone, soft, green gray; sandstone, fine to medium sand, angular and subrounded mafic grains |
| 760 | 770 | fanglomerate, soft, fine to coarse sand and trace fine gravel, brownish green gray |
| 770 | 780 | siltstone, hard, green gray; sandstone, medium, feldspathic light brown yellow |
| 780 | 790 | sandstone, fine to medium subrounded sand, feldspathic, multicolor, green-gray fine fraction |
| 790 | 800 | siltstone, hard, blue-green |
| 800 | 830 | sandstone, hard, fine sand, green-gray |
| 830 | 910 | sandstone, hard, fine sand, green-gray, trace angular mafic medium sand |
| 910 | 930 | sandstone, very hard, fine to coarse subrounded sand, green-gray, feldspathic, light gray, red, black sand |
| 930 | 940 | sandstone, hard, fine subrounded sand, green gray, feldspathic sand, mica |
| 940 | 960 | sandstone, soft, fine to medium subrounded sand, green gray, feldspathic, red, green, black sand, mica |
| 960 | 990 | sandstone, soft, fine to medium subrounded sand, light green gray, feldspathic, red, green, black sand, mica; soft brown silt |
| 990 | 1010 | sandstone, soft, fine to medium subrounded sand, light green gray, feldspathic, red, yellow, black sand, mica, wood |
| 1010 | 1030 | sandstone, soft, fine to medium subrounded sand, light brown, feldspathic, red, yellow, black sand, mica, |
| 1030 | 1040 | basalt, broken, black, light gray silt |
| 1040 | 1050 | basalt, broken, black, secondary mineralization iron oxides |

Moxee, Washington Well 4

| From | To | Material |
|---|---|---|
| 1050 | 1060 | basalt, broken, black, with hard dark green-gray claystone seams |
| 1060 | 1070 | basalt, broken, black, with hard dark green-gray claystone seams - drilled soft at 1060 and hard at 1065 |
| 1070 | 1080 | basalt, broken, black, secondary iron oxide mineralization, med plagioclase and aphanitic |
| 1080 | 1090 | basalt, vesicular, black, secondary iron oxide mineralization, med plagioclase and aphanitic |
| 1090 | 1100 | basalt, vesicular, black, med plagioclase and aphanitic |
| 1100 | 1105 | basalt, fine to med vesicles, black, manganese secondary mineralization |
| 1105 | 1110 | basalt, trace vesicles, black |

## Moxee Well 4 Hole Penetration Logs

Hole Name: Well 4

Hole Diameter: 19

| Depth | Duration in Minutes | Drilling Description i.e. exact depth of breaks, Rough, fractured, smooth soft, hard etc) | Upper Hoist Guage PSI | Depth | Duration in Minutes | Drilling Description i.e. exact depth of breaks, Rough, fractured, smooth soft, hard etc) | Upper Hoist Guage PSI |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 5 | 25 | compact gravel | — | 155 | 12 | Softer, High clay content | 650 |
| 10 | 60 | Sands gravel | | 160 | 15 | Clay, Silt, Rough | 700 |
| 15 | 60 | clays, silts | | 165 | 25 | Dense clay | 700 |
| 20 | 45 | Clays, Silts | | 170 | 25 | Harder, Rock/Silts | 650<br>700 |
| 25 | 60 | Some cobble, clay | | 175 | 20 | Clay, Silts | 650<br>700 |
| 30 | 70 | clay, silt | | 180 | 20 | 178' Broken up/Rough<br>179-18 High Torque (CLAY) | 600<br>700 |
| 35 | 70 | clay, silt | | 185 | 30 | Broken-up 183'<br>CLAY High Torque, Rough / Smooth | 650-700 |
| 40 | 60 | Clays/silt | | 190 | 10 | 185-187' = CLAY/sandstone<br>MED - 187'-190' | 650 |
| 45 | 60 | Clays/silt | | 195 | 15 | MEDium - HARD Sandstone | 650 |
| 50 | 70 | Gravel/cobbles | | 200 | 15 | Sandstone, MED | 650 |
| 55 | 70 | Gravel/cobbles | | 205 | 20 | HARD | 650 |
| 60 | 60 | Solid dense clay | | 210 | 15 | 206-207' - green CLAY, High Torque CLAY | 650<br>950 |
| 65 | 60 | Solid dense clay | | 215 | 15 | Added to BHA<br>Clay, Silt | 900 |
| 70 | 60 | Solid dense clay | | 220 | 12 | Brown & Grey clay | 900 |
| 75 | 60 | Solid dense clay | | 225 | 20 | Harder, Some Rock | 950 |
| 80 | 25 | Solid, hard silt | | 230 | 20 | Grey clay, Pebbles | 950 |
| 85 | 45 | Solid, hard silt | | 235 | 20 | Grey clay, Rusty Brown some Rock | 950-1100 |
| 90 | 20 | Smooth, HARD | 650 | 240 | 30 | Grey clay, Brown & Blk Pbs | 950-1100 |
| 95 | 16 | MEDium, HARD, Smooth | 650 | 245 | 60 | Grey clay Brown/Blk Pebble | 1200 |
| 100 | 11 | MEDium, Smooth | 650 | 250 | 120 | Grey clay, Brown/Blk rock | 1000-1700 |
| 105 | 14 | MEDium, Soft, Some CLAY 104' 105' | 550 | 255 | 60 | Grey into Brown/Green clay | 1150 |
| 110 | 12 | CLAY 105'-106'<br>Soft, MEDium | 550-<br>650 | 260 | 35 | Brown into Blue/Grey clay | 1150 |
| 115 | 10 | Soft, to MEDium Smooth | 550-<br>650 | 265 | 50 | Grey/Blue clay, | 1150 |
| 120 | 16 | 116' Broken up, HARD | 550-<br>650 | 270 | 60 | Grey/Blue clay, 267 Transition | 1150 |
| 125 | 17 | Broken up 126'-123' HARD\ 125' clay Broken-up | 600-<br>650 | 275 | 20 | Lighter Grey w/ Black Pebbles sand | 1000 |
| 130 | 15 | Smooth, Soft, | 650 | 280 | 12 | Grey & 279 Boulder<br>Some Green & Brown clay | 1050 |
| 135 | 12 | Smooth, Soft | 650 | 285 | 15 | Grey Clay w/ Coarse Sand | 1050 |
| 140 | 15 | High clay Content, Soft | 650 | 290 | 16 | " " " " | 1050-<br>1000 |
| 145 | 20 | High Clay Content, Soft | 650 | 295 | 15 | Brown CLAY, Sandstone Mix<br>Smooth | 1100-<br>1000 |
| 150 | 40 | Harder, Solid/Smooth | | 300 | 45 | Dense\Sticky Clay | 1200-<br>1000 |

206' Formation change greenish clay

# Moxee Well 4 Hole Penetration Logs

Hole Name: Well 4

Hole Diameter: 19

| | Depth | Duration in Minutes | Drilling Description i.e. exact depth of breaks, Rough, fractured, smooth soft, hard etc) | Upper Hoist Guage PSI | Depth | Duration in Minutes | Drilling Description i.e. exact depth of breaks, Rough, fractured, smooth soft, hard etc) | Upper Hoist Guage PSI | |
|---|---|---|---|---|---|---|---|---|---|
| | 305 | 60 | GREY CLAY, TRACES OF SANDSTONE<br>SMOOTH, SOFT | 1100-<br>1200 | 460 | 18 | SOFT, CLAY, SILT | [illegible] | |
| 05/02 | 310 | 30 | Soft Green clay, Some Grey | 1100 | 465 | 35 | SOFT, BROKEN UP,<br>ROUGH 464'-465' | 900-<br>1200 | |
| | 315 | 30 | Soft Green clay, Some Grey | 1100 | 470 | 50 | BLUE CLAY/grey clay | 1000<br>1400 | 5-9 |
| | 320 | 30 | Grey Clay, traces [illegible] 318' Rocks | 1000 | 475 | 1:00 | CLAY\SOFT SMOOTH | 1000<br>1400 | |
| | 325 | 30 | Blue Grey Clay, Hard Cemented fines Rock | 985<br>[illegible] | 480 | 45 | 476 - FINES, SILT | 1200,<br>1000 | |
| | 330 | 30 | Grey clay, Pebbles Cemented fines | 900 | 485 | 35 | SILT, Sand, Soft | 1000-<br>1200 | |
| | 335 | 35 | Grey clay, Coarse sand Pebbles | 900 | 490 | 40 | 486' HARD, BROKEN UP<br>488-490 SILT, CLAY | 1000<br>1300 | 5.10 |
| | 340 | 30 | Grey Clay, Black coarse sand | 1950 | 495 | 45 | SILT, Sand, Clay | 900<br>1300 | |
| | 345 | 60 | 341 dense Blue Clay<br>Black Pebbles/coarse sand | 1100 | 500 | 35 | Sand, SLATE | 900 | |
| | 350 | 130 | Soft Green Clay Very Sticky | 1250 | 505 | 60 | BLUE CLAY\GREY CLAY<br>SILT, coarse Sand | 900<br>1200 | |
| 5-3 | 355 | 180 | SOFT, CLAY\SILT grey 358 Harder | 1150<br>1250 | 510 | 50 | CLAY, CEMENTED FINES smooth | 1000<br>1400 | |
| | 360 | 90 | 356' BROWN CLAY Black/Grey Pebbles Silts coarse sand | 1250 | 515 | 50 | CLAY, sands, coarse sand | 1000<br>1400 | |
| | 365 | 90 | 364' FORMATION CHANGE<br>HARD ROCK TRACE OF CLAY | 1150<br>900 | 520 | 45 | CLAY, COARSE Sand | 1000<br>1400 | |
| | 370 | 80 | 366' BLUE CLAY/TRACE OF SILTS<br>369' BLUE/GREY CLAY | 1250-<br>1150 | 525 | 40 | Clay | 1400-<br>1300 | |
| 5-4 | 375 | 80 | 373' SOME WATER, SOFT CLAY<br>SOME SILT | 1100<br>1250 | 530 | 45 | Clay | 1400<br>1200 | |
| | 380 | 47 | CLAY, SANDSTONE MIX<br>SOFT, MEDIUM | 1250-<br>950 | 535 | 40 | CLAY\SILT | 1400<br>1200 | |
| | 385 | 30 | 382'-WATER<br>CLAY/SANDSTONE-SOFT/MEDIUM | 950-<br>900 | 540 | 45 | 538' SILTSTONE\HARD | 1200<br>1100 | |
| 5-5 | 390 | 30 | CLAY / SILT<br>Green\Grey\Tan mix | 900-<br>1200 | 545 | 40 | CLAY, SILTSTONE\SILTS COARSE Sand | 1000<br>1100 | |
| | 395 | 180 | BLUE CLAY/GRAVEL MIX \ 394' HARD<br>SOFT\MEDIUM \ SOME CLAY | 1000-<br>1200 | 550 | 40 | 546' COARSE SAND/SILTS<br>compact Silts | 1000 | |
| | 400 | 130 | 400 Small gravel with coarse sand<br>HARD, BROKEN UP | 1200-<br>1000 | 555 | 30 | Coarse Sand, Silt<br>Greyish clay | 1000 | |
| | 405 | 50 | HARD, BROKEN UP SLATE STONE | 800-<br>900 | 560 | 25 | Coarse Sand<br>Silts, Grey Clay | 900 | |
| | 410 | 40 | 408' BROKEN UP, ROUGH, HARD | 800-<br>900- | 565 | 25 | Coarse Sand<br>Silts Grey/Blue clay | 950 | |
| | 415 | 43 | HARD, GRAVEL, MIX WITH SLATE | 800-<br>1000 | 570 | 25 | 569' Soft Clay, Cobble | 1100 | |
| | 420 | 46 | HARD. BROKEN UP | 800-<br>1000 | 575 | 25 | Very Soft, Harder @ 575<br>Clay/Sand | 1250 | |
| | 425 | 45 | HARD BLACK ROCK | 800-<br>900 | 580 | 35 | Dense sand/silt harder | 1050 | |
| 5-6 | 430 | 40 | BROKEN UP\GRAVEL\COARSE SAND HARD | 800<br>900 | 585 | 35 | Soft, Rough, Dense Clay | 1150 | |
| | 435 | 45 | BROKEN UP\HARD<br>TRACE OF GREY CLAY | 800-<br>1000 | 590 | 30 | Soft, Coarse Sand/Pebbles | 1300 | |
| 5-7 | 440 | 40 | 439' BROKEN UP\ROUGH\HARD | 800<br>1000 | 595 | 30 | Sand, Pea gravel,<br>Grey clay | 1250 | |
| | 445 | 30 | 440-443 - HARD-ROUGH<br>443-445 SOFT, SILTS SOME CLAY | 800-<br>1100 | 600 | 25 | Soft, Green clay w/Sand | 1250 | |
| | 450 | 30 | SOFT, CLAY, SILT | 1200-<br>1000 | | | | | |
| | 455 | 20 | SOFT CLAY SILT | 1200-<br>1000 | | | | | |

# Moxee Well 4 Hole Penetration Logs

Hole Name: Well 4

Hole Diameter: 19

| Depth | Duration in Minutes | Drilling Description i.e. exact depth of breaks, Rough, fractured, smooth soft, hard etc) | Upper Hoist Guage PSI | Depth | Duration in Minutes | Drilling Description i.e. exact depth of breaks, Rough, fractured, smooth soft, hard etc) | Upper Hoist, Guage PSI | |
|---|---|---|---|---|---|---|---|---|
| 600 | 25 | soft Green Clay w/Sand | 1250 | 755 | 15 | Soft Green/Grey Blue Clay | 1350 | |
| 605 | 20 | Soft Clay, Grey Rock Coarse Sand | 1300 | 760 | 20 | harder Green/Grey Sandy Clay | 1300 | |
| 610 | 45 | 609' Very Sticky Clay Green | 1350 | 765 | 15 | Soft Very at 763 Grey [illegible] | 1350 | |
| 615 | 90 | Very Sticky traces Pea gravel Green [illegible] | 1350 | 770 | 25 | 768 harder sand/siltstone Blue/Grey | 1150 | |
| 620 | 90 | Very Sticky traces Green clay Pea gravel | 1300 | 775 | 45 | Hard Soft Spot 772-773 | 1150 | 06/02 |
| 625 | 25 | coarse Sand & Pea gravel some siltstone clay | 1000 | 780 | 90 | Grout Shoe @ 775 grout to 777 | 490 | |
| 630 | 20 | Coarse sand, Green clay Some Pea gravel Silts | 1100 | 785 | 15 | hard to very soft | 1050 | |
| 635 | 20 | Green Clay traces of Pea gravel, siltstone | 1000 | 790 | 12 | Very Soft Smooth Green/Brown | 1050 | |
| 640 | 25 | Grey clay, Sand Silt | 1,050 | 795 | 12 | Very Soft Smooth Green/Brown | 1050 | |
| 645 | 35 | Sticky clay, very soft 643-645, Green | 1,150 | 800 | 12 | Very Soft, | 1050 | |
| 650 | 45 | Green clay, Sticky | 1,300 | 805 | 12 | Some Rough Spots soft | 1050 | |
| 655 | 90 | 651 Very hard until 653 Very soft clay | 1,350 | 810 | 15 | Grey with Black Specs Rock | 1050 | |
| 660 | 90 | Very soft & Sticky Green Clay | 1,350 | 815 | 12 | Soft Very Rough at 812 Blue/grey | 1050 | |
| 665 | 60 | Getting into some Pea gravel Green Clay | 1,250 | 820 | 12 | Soft Blue/Grey Clay | 1050 | |
| 670 | 75 | Very Sticky Green Clay Reactive [illegible] | 1350 | 825 | 12 | Soft Blue/Grey clay Some Black Rock | 1050 | |
| 675 | 25 | Coarse Sand Pea gravel Blue/Grey Clay | 1100 | 830 | 15 | Soft Blue/Grey clay Some Black Rock | 1050 | |
| 680 | 35 | Siltstone, Blue/Grey clay Coarse Sand | 1100 | 835 | 12 | Soft Blue/Grey clay W/Black | 1050 | |
| 685 | 90 | Very hard, mostly Rock 687 Blue Clay | 1000 | 840 | 22 | Soft Blue/Grey Sticky W/Black | 1050 | |
| 690 | 90 | 686 Soft Clay 687 Hard some Rock chips | 1000 | 845 | 25 | Very Dense Blue clay Sticky some Rock | 1050 | |
| 695 | 75 | Very Rough/hard, | 1000 | 850 | 18 | Dense Blue Clay Black Rock Bits | 1050 | |
| 700 | 30 | Very soft at 698 | 1300 | 855 | 28 | Alot of Rock Chips Various colors, Blue clay | 1000 | |
| 705 | 30 | Very Soft Sticky Grey/Blue Clay | 1400 | 860 | 25 | Hard Smooth, Mostly Rock Chips, Blue clay | 1000 | |
| 710 | 25 | Soft Grey/Blue Coarse [illegible] sand | 1300 | 865 | 14 | Soft @ 864 Blue clay | 1100 | 06/03 |
| 715 | 25 | Soft, Grey/Blue Clay with sand | 1300 | 870 | 15 | Soft Blue clay w/Black sand | 1100 | |
| 720 | 30 | Soft Green/Grey Blue Clay | 1300 | 875 | 20 | harder, more Rock Chips, Some Brown | 1100 | |
| 725 | 30 | Soft Green/Grey/Blue clay | 1250 | 880 | 22 | Very hard until 881 | 1100 | |
| 730 | 35 | traces of Pea Gravel Grey/Blue Clay | 1500 | 885 | 12 | Soft, Smooth Blue/Grey | 1150 | |
| 735 | 20 | Soft Green/blue Clay Grey | 1300 | 890 | 10 | Very Soft, Smooth Blue/Grey | 1150 | |
| 740 | 15 | Very Soft Green/Blue Clay | 1350 | 895 | 10 | Very soft Smooth Blue/Grey | 1150 | |
| 745 | 15 | Very Soft Green/Blue Grey clay | 1350 | 900 | 10 | Very Soft Blue/Grey clay | 1150 | |
| 0 | 15 | Very Soft Green/Blue Grey Clay | 1350 | | | | | |

## Moxee Well 4 Hole Penetration Logs

Hole Name: Well 4

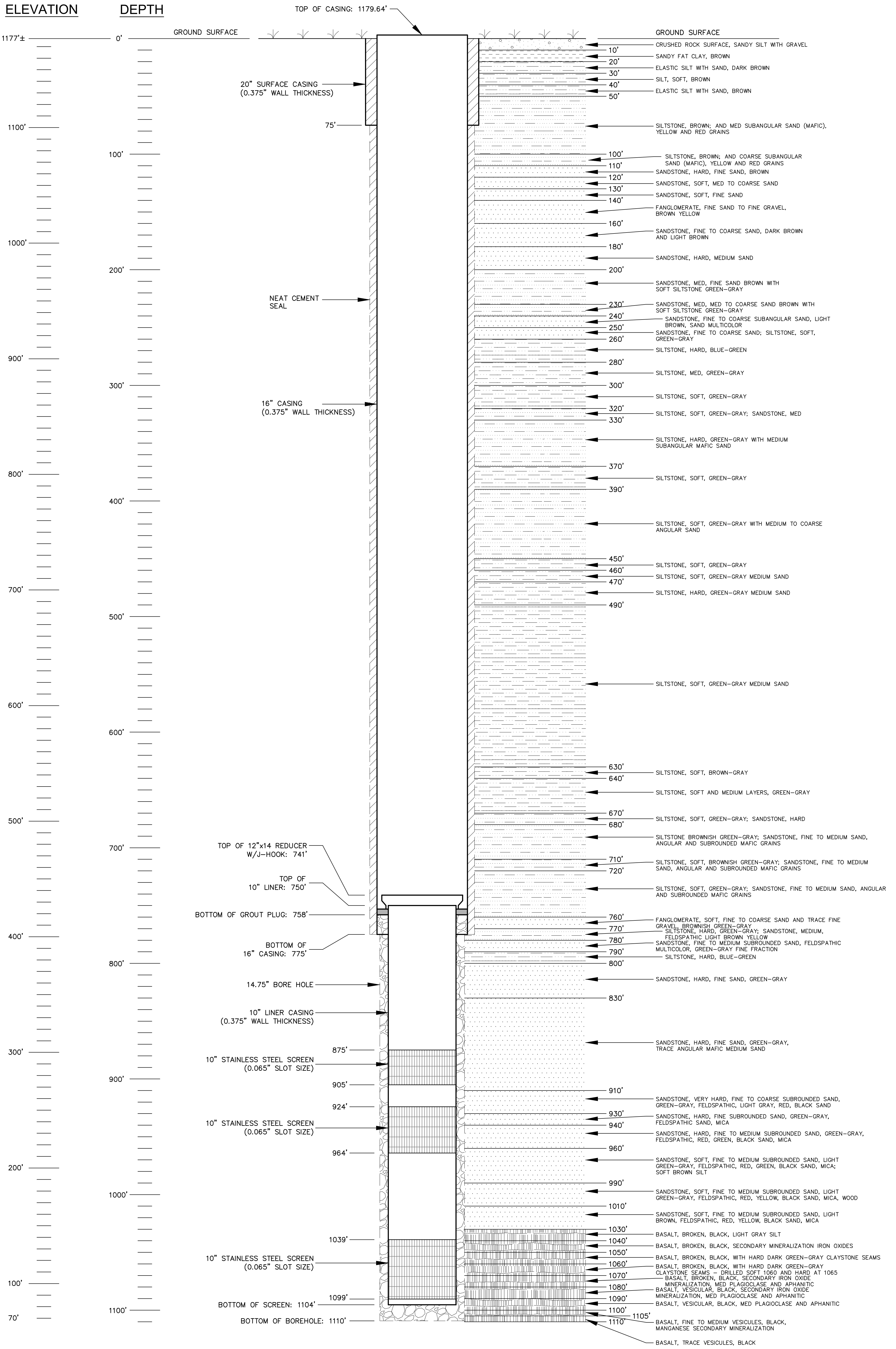
Hole Diameter: 19

| Depth | Duration in Minutes | Drilling Description i.e. exact depth of breaks, Rough, fractured, smooth soft, hard etc) | Upper Hoist Guage PSI | Depth | Duration in Minutes | Drilling Description i.e. exact depth of breaks, Rough, fractured, smooth soft, hard etc) | Upper Hoist Guage PSI |
|---|---|---|---|---|---|---|---|
| 905 | 10 | Very soft Blue Smooth Grey/clay | 1150 | 1060 | 20 | Smooth, Solid Black Rock | 1100 |
| 910 | 12 | Somewhat harder still soft smooth | 1150 | 1065 | 24 | Slightly harder smooth | 1100 |
| 915 | 22 | harder blue/Grey Black Rock | 1100 | 1070 | 30 | Very Rough some Green/Black | 1200 |
| 920 | 28 | Solid/Dense, Blue/Grey w/Rock chips | 1000 | 1075 | 75 | Very hard/Rough some very Rough | 1250 |
| 925 | 17 | Softer, Still Smooth Grey, Blue w/Black [illegible] | 1000 | 1080 | 90 | Very Rough/Hard | 12[illegible] |
| 930 | 18 | Dense/hard clay Grey/Blue traces of Rock | 1100 | 1085 | 120 | Very hard Consistent Dark Rock | 1200 |
| 935 | 18 | Some Very Soft STICKY sections | 1100 | 1090 | 120 | Very hard, consistent Dark Rock | 1200 |
| 940 | 10 | Very soft/Blue Grey w/Green | 1150 | 1095 | 90 | Very hard, Smoother | 1200 |
| 945 | 10 | Very soft/Blue Grey w/Green | 1150 | 1100 | 90 | Solid/very hard | 1200 |
| 950 | 10 | Very soft Blue/Grey | 1150 | 1105 | 90 | Solid/Very hard | 1200 |
| 955 | 10 | Very soft Blue/Grey | 1150 | 1110 | 130 | Very Hard/Rough E.O.H | 1200 |
| 960 | 12 | Very Soft Blue/grey | 1150 | 1115 | | | |
| 965 | 10 | Very soft Blue/Grey | 1150 | 1120 | | | |
| 970 | 10 | Very soft Blue/grey/ | 1200 | 1125 | | | |
| 975 | 10 | Very soft Blue/Grey Brown clay | 1200 | 1130 | | | |
| 980 | 10 | Blue/Grey & Brown | 1200 | 1135 | | | |
| 985 | 10 | Very soft Blue/Grey & Brown | 1200 | 1140 | | | |
| 990 | 10 | Very soft Grey Brown | 1200 | 1145 | | | |
| 995 | 10 | lost circulation little Rough soft | 1200 | 1150 | | | |
| 1000 | 10 | Wood, Black wood | 1200 | 1155 | | | |
| 1005 | 10 | Very soft Sand/wood | 1200 | 1160 | | | |
| 1010 | 8 | Very soft Sand/wood | 1250 | 1165 | | | |
| 1015 | 10 | Very soft Sand | 1250 | 1170 | | | |
| 1020 | 10 | Very soft sand | 1250 | 1175 | | | |
| 1025 | 13 | Slightly harder Rough | 1150 | 1180 | | | |
| 1030 | 28 | Rough harder | 1150 | 1185 | | | |
| 1035 | 65 | Very hard/Rough Dark Rock | 1000 | 1190 | | | |
| 1040 | 90 | Very Rough | 12[illegible] | 1195 | | | |
| 1045 | 90 | Very Rough Black Rock | 1250 | 1200 | | | |
| 1050 | 75 | Getting softer/Stickier at 1050 | 1200 | | | | |
| 1055 | 30 | Softer still hard/smooth | 11[illegible] | | | | |

5-H 12:30

4.5

hr



NOTE: WELL CONSTRUCTION DETAILS AND FORMATION INFORMATION FROM WELL LOG DATED AUGUST 25, 2020.

HLA
Engineering and Land Surveying, Inc.

2803 River Road
Yakima, WA 98902
509.966.7000
Fax 509.965.3800
www.hlacivil.com

19218
10-20-20
FILE NAMES:
DRAWING: 19218.dwg

DESIGNED BY: JLB
ENTERED BY: AJH

# CITY OF MOXEE

## WELL NO. 4
## WELL CONSTRUCTION SCHEMATIC

# APPENDIX C

# Aspect Field Data Sheets

ANATEK LABS

# *Chain of Custody Record*

**Anatek Labs, Inc.**
**1282 Alturas Drive, Moscow ID 83843 (208) 883-2839**
**504 E Sprague Ste D, Spokane WA 99202 (509) 838-3999**

| | |
|---|---|
| Company Name: | Project Manager: |
| Address: | Project Name & # : |
| City: State: Zip: | Purchase Order #: |
| Phone: | Sampler Name & Phone: |
| Email Address(es): | |

## Turn Around Time & Reporting

Please refer to our normal turn around times at
www.anateklabs.com/pricing-lists

__Normal
__Next Day*
__2nd Day*
__Other*________

__Phone
__Email

*All rush order requests must have prior approval

## List Analyses Requested

| | | | | Preservative: | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lab ID | Sample Identification | Sampling Date/Time | Matrix | # of Containers | Sample Volume | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
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| | Printed Name | Signature | Company | Date | Time |
|---|---|---|---|---|---|
| Relinquished by | | | | | |
| Received by | | | | | |
| Relinquished by | | | | | |
| Received by | | | | | |
| Relinquished by | | | | | |
| Received by | | | | | |

## Note Special Instructions/Comments

## Inspection Checklist

| | | |
|---|---|---|
| Received Intact? | Y | N |
| Labels & Chains Agree? | Y | N |
| Containers Sealed? | Y | N |
| No VOC Head Space? | Y | N |
| Cooler? | Y | N |
| Ice/Ice Packs Present? | Y | N |

Temperature (°C):________________________
Number of Containers:____________________
Shipped Via:____________________________
Preservative:______________________________
_____________________________________
Date & Time:____________________________
Inspected By:____________________________

Samples submitted to Anatek Labs may be subcontacted to other accredited labs if necessary. This message serves as notice of this possibility. Subcontracted analyses will be clearly noted on the analytical report.

# DAILY REPORT

350 Madison Avenue North
Bainbridge Island, Washington 98110
(206) 780-9370

710 Second Avenue, Suite 550
Seattle, Washington 98104
(206) 328-7443

**DATE:**

**PROJECT NO.**

**WEATHER:**

**PROJECT NAME:**

**CLIENT:**

**EQUIPMENT USED:**

**PROJECT LOCATION:**

**THE FOLLOWING WAS NOTED:**

**COPIES TO:**

**Aspect Consulting PROJECT MANAGER:**

**Page 1 of 1** **FIELD REP.:**

Sample number ____________________

## GROUNDWATER SAMPLING RECORD

**WELL NUMBER:** _______ **Page:**____ **of** ____

Project Name: ____________________
Date: ____________________
Sampled by: ____________________
Measuring Point of Well: TOC
Screened Interval (ft. TOC) ____________________
Filter Pack Interval (ft. TOC) ____________________

Project Number: ____________________
Starting Water Level (ft TOC): ____________________
Casing Stickup (ft): ____________________
Total Depth (ft TOC): ____________________
Casing Diameter (inches): ____________________

Casing Volume ___________ (ft Water) x ___________ (Lpfv)(gpf) = ___________ (L)(gal)

Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): ___________

## PURGING MEASUREMENTS

| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| **Criteria:** | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
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Total Gallons Purged: ____________________

Total Casing Volumes Removed: ____________________

Ending Water Level (ft TOC): ____________________

Ending Total Depth (ft TOC): ____________________

## SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Color | Turbidity & Sediment | |
| | | | | | | | | |
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## METHODS

Parameters measured with (instrument model & serial number): ____________________

Purging Equipment:

Decon Equipment: ____________________

Disposal of Discharged Water: ____________________

Observations/Comments: ____________________

____________________

Aspect CONSULTING