Former Baron-Blakeslee Facility
Portland, Oregon

In Situ Chemical Oxidation Pilot Study Work Plan

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Honeywell International Inc.

Contents

Appendixes

Figures

Acronyms and Abbreviations

µg/L	micrograms per liter
BBI	Baron-Blakeslee Inc.
bgs	below ground surface
CRSA	Columbia River sand aquifer
DEQ	Oregon Department of Environmental Quality
DO	dissolved oxygen
GCW	groundwater circulation well
gpm	gallons per minute
GWETS	groundwater extraction and treatment system
IRMs	interim remedial measures
ISCO	in situ chemical oxidation
MCL	maximum contaminant level
mg/L	milligrams per liter
NaMnO4	sodium permanganate
NFA	No Further Action
ORP	oxidation-reduction potential
PCE	tetrachloroethene
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
TCE	trichloroethene
TGA	Troutdale gravel aquifer
UGA	unconsolidated gravel aquifer
VOCs	volatile organic compounds

1. Introduction

This pilot study work plan provides the objectives and methods for conducting an in situ chemical oxidation (ISCO) injection pilot study at the former Baron-Blakeslee Facility (site), in Portland, Oregon, (Figure 1) to facilitate expedited groundwater treatment in lieu of active groundwater extraction and treatment.

The purpose of the pilot study is to collect the treatment effectiveness data and injection design data needed for a potential full-scale, "surgical," and possibly phased ISCO application to treat dissolved phase volatile organic compounds (VOCs) associated with the site. Tetrachloroethene (PCE) and trichloroethene (TCE) are the primary site constituents. The pilot study will aid in determining whether a passive/periodic injection event can rely on groundwater flow alone to distribute the oxidant and treat the plume underneath inaccessible buildings/properties or whether a more active approach or other reagent needs to be explored.

The goal of implementing a full-scale, surgical, and potentially phased ISCO program is to decrease the overall remediation life cycle in both time and costs by quickly and aggressively reducing the contaminant mass of the dilute plume core and residual source area.

This pilot study will consist of the following primary tasks:

- Install new wells to perform and monitor the pilot study effectiveness.
- Perform baseline groundwater monitoring to establish conditions prior to injecting the oxidant.
- Inject sodium permanganate ($NaMnO_4$) and tracers.
- Conduct performance groundwater monitoring to measure effectiveness of pilot study.

The work plan includes the following sections:

- Section 1—Introduction, presents the pilot study purpose, site background and history, geologic and hydrogeologic conditions, extent of groundwater contamination, and remedial action objectives.
- Section 2—Pilot Study Plan, discusses the technology overview, pilot study design, implementation, and the permitting and administrative requirements.
- Section 3—Reporting, describes reports that will follow the completion of the pilot study.
- Section 4—Schedule, presents the proposed pilot study schedule.
- Section 5—References, lists the various works referenced in this plan.

1.1 Site Background and History

The former BBI property is located at 5920 NE 87th Avenue, Portland, Multnomah County, Oregon (Figure 1). The property is situated in the southwest quarter of Section 16, Township 1 North, Range 2 East, Willamette Baseline and Meridian at approximately 45° 33′ 57″ north latitude and 122° 34′ 16″ west longitude. The property is roughly triangular, covering approximately 0.7 acre, and is located in an industrial park generally consisting of light industrial facilities (Figure 2).

Before 1972, the property was owned by Ethyl Corporation, which operated the property as a chlorinated solvent distribution center. It was reported that a dry cleaning fluid distributor operated on the property prior to 1972. In 1972, the property was acquired by Purex Industries, parent company to BBI. Later, in the mid-1980s, BBI was acquired by AlliedSignal Inc.

Under Purex Industries' ownership, the facility was used for solvent recycling, including solvent distribution, storage, and resource recovery. The property included an office area, former warehouse, tank farm, and both indoor and outdoor drum storage areas. As part of the Resource Conservation and

Recovery Act (RCRA) Hazardous Waste Management Unit closure completed by Honeywell per an approved closure plan, all storage tanks and drums of spent and virgin solvent were removed from the property.

RCRA closure of the facility was accepted by Oregon Department of Environmental Quality (DEQ) on June 8, 1994. The property now is vacant and has been inactive for solvent sales and recycling since 1993.

The site has been the subject of numerous investigations to determine subsurface hydrogeologic conditions and the nature and extent of chemicals of concern, including facility closure activities, phased site assessments, surface water and sediment sampling from storm drains, a soil gas survey, and groundwater monitoring. Closure activities indicated that onsite soil, downgradient groundwater, and onsite groundwater had been affected by VOCs. The site layout and groundwater monitoring well locations in close proximity to the site are depicted on Figure 3.

1.1.1 Selected Remedy

The selected soil remedy identified in the Record of Decision (ROD) (DEQ, 2008) was soil excavation and disposal, including the following:

- Excavation of onsite soil to the extent that the 90 percent upper confidence limit of the remaining onsite soil does not exceed the leaching to groundwater hot spot concentrations
- Segregation of soil based on concentration
- Potential onsite treatment to reduce contaminant concentrations below RCRA land disposal restriction limits
- Transportation of soil determined to contain a hazardous waste to an offsite hazardous waste disposal facility (RCRA Subtitle C landfill) for disposal

The selected groundwater remedy includes the following components:

- Excavation and onsite treatment/offsite disposal of soil in the remedial action areas (completed)
- Further evaluation of vapor intrusion pathway for impacted soil beneath the building (completed)
- Active remediation and hydraulic control of groundwater hot spot with two extraction wells (ongoing)
- Pump-and-treat remediation of groundwater within the hot spot area (the plume area exceeding maximum contaminant levels, or MCLs) (ongoing)
- In situ stripping and groundwater circulation near the origin of the release (postponed indefinitely)
- Groundwater monitoring (ongoing)
- Contingency measures implemented as necessary to achieve the remedial action objectives for the facility

All buildings previously onsite were demolished in 2010, and the site is currently vacant. The selected remedy for soil meets the target cleanup criteria and meets the levels for mitigating vapor intrusion into buildings.

1.1.2 Remediation History

Prior to the ROD being signed in 2008, two interim remedial measures (IRMs) were implemented on-site to address the source of contamination during implementation of the remedial investigation/feasibility study. The IRMs included:

- A soil vapor extraction system for vadose zone soil
  - Three vapor extraction wells

  - The system recovered VOCs from the vadose zone for approximately 6 years (began operation in September 1999 and was shut down in September 2005)
- A groundwater circulation well (GCW) system for groundwater
  - Initially, a single GCW was installed to pilot test the technology. The first GCW operated from December 1999 through November 2000.
  - Three additional GCW wells were installed and full-scale operation began in November 2000 and continued for 3 months. At that time the system was optimized and focused on recirculating groundwater at 2 of the GCW wells and vapor extraction at the other 2 GCWs. The system operated through September 2005.

The following activities have been completed since the ROD was signed in 2008:

- Onsite building demolition
- Excavation and disposal of over 3,000 cubic yards of soil from the former BBI property and neighboring Superior Tank Wash property with the determination of a conditional No Further Action (NFA) for soil
- Removal of a 2,000-gallon steel underground storage tank
- Installing a groundwater extraction and treatment system (GWETS), consisting of the following:
  - Two extraction wells, each equipped with separate pumps and piping for groundwater extraction at a combined rate of up to 220 gallons per minute (gpm)
  - An air stripper to remove VOCs
  - A rapid mix, flocculation, and filtration process (to reduce lead and phosphorous)
  - Associated piping and conveyance infrastructure
- Full-time operation of the GWETS from March 2014 through present
  - Operation and maintenance of the GWETS system
- Groundwater and VOC plume monitoring

The remedial action for soil was implemented in 2011 and 2012 to address the remedial action objectives for soil. The soil remedy included excavation and offsite disposal of soil to reduce soil concentrations to below the most conservative screening levels for protection of site workers, vapor intrusion risk, and leaching to groundwater. Details regarding this excavation are documented in the *Offsite Soil Excavation Construction Completion Report* (CH2M, 2013a).

DEQ issued a Conditional NFA Determination for Soil in 2015 (DEQ, 2015). The NFA applies to soil onsite and offsite that was associated with BBI releases. The NFA determined that the residual soil contamination associated with the site is currently protective of public health and the environment. Groundwater is not covered under the NFA.

1.1.3 Groundwater Extraction and Treatment System Operating History

As stated in the ROD, the groundwater remedy relies on groundwater extraction wells to hydraulically control the groundwater plume near the extraction wells and prevent the further downgradient migration of groundwater with concentrations of chemicals of concern above the MCL for specific VOCs. The selected remedy does not require hydraulic capture of all areas exceeding MCLs downgradient of the final remedy extraction wells as long as the uncaptured portion of the plume does not result in wellhead concentrations that exceed DEQ risk-based concentrations in a hypothetical future drinking water well downgradient of the final remedy extraction wells within the Columbia River sand aquifer (CRSA).

The pump and treat component of the remedy currently includes two extraction wells (EW-1 and EW-2) located along the approximate centerline of the groundwater plume. Groundwater from the extraction wells is conveyed through pipelines to the treatment plant building, treated for VOCs, and then discharged into the Columbia Slough under a Cleanup Authorization Discharge Permit. The treatment system construction was completed in 2013 and is documented in the *Groundwater Extraction and Treatment System Construction Completion Report* (CH2M, 2013b).

On March 10, 2014, the GWETS began operation. Based on transducer studies and capture zone analysis prior to system startup, operation of the GWETS at 160 gpm total combined flow from EW-1 and EW-2 was confirmed to sufficiently capture the MCL remedial action area (CH2M, 2014).

The GWETS has been operating with a combined annual flow between 124 and 160 gpm since 2014 and has provided effective capture across the remedial action area. Approximately 244 million gallons of water has been extracted since the GWETS began operation.

Discharge monitoring reports for the GWETS that include dates of system operations, data validation memos, and a comparison of discharge sampling results to the discharge limits have been completed quarterly. Influent and effluent sampling results from the GWETS indicate that the removal rate for all VOCs is nearly 100 percent. All concentrations of VOCs in effluent samples have been below their respective discharge criterion.

1.2 Geology and Hydrogeology

The property lies within the historical Columbia River floodplain. Five main geologic units have been identified at the site: Overbank deposits, the CRSA, the unconsolidated gravel aquifer (UGA), the Troutdale gravel aquifer (TGA), and Confining Unit 1.

The depth to groundwater beneath the BBI site has historically been approximately 13 to 26 feet below ground surface (bgs), with seasonal fluctuations on the order of 5 to 10 feet. Groundwater flow in the UGA, TGA, and CRSA aquifers is generally to the north–northwest. During periods of high-river stage in the Columbia River, such as after storm events or dam releases, the natural hydraulic gradient may temporarily reverse, with the hydraulic gradient directed southeast towards the site and away from the Columbia River.

Because the UGA and TGA are similar in appearance, are difficult to distinguish from one another, are not separated by an aquitard, and were previously thought to have similar hydraulic properties, these aquifers have been discussed historically as a combined aquifer unit (the UGA-TGA).

1.3 Extent of Groundwater Contamination

Total VOC concentrations from the fourth quarter 2018 monitoring event are shown on Figure 4. Over the past 15 years, concentrations in the center of the plume nearest the GWETS (that is, at GW-17 and GW-18) have decreased from greater than 1,000 micrograms per liter (µg/L) to less than 100 µg/L. The highest concentrations detected during this monitoring event were at DW-4 (466.5 µg/L total VOCs).

The revised remedial action target area is the area within both the 5-µg/L PCE and 5-µg/L TCE contours and is based on data from November 2018. This is shown on Figure 5, as well as the prime line for cross-section A-A'. The remedial action target area has decreased in both the east and west directions compared to previous years, though it is similar to that of November 2017 (CH2M, 2018). The south distribution is roughly the same as it has been in the past. The northwestern distribution increased slightly in November 2018 to include monitoring well GW-14D.

The vertical extent of the VOC plume, along the length of the plume, based on sitewide data in November 2018 is shown in a cross-section A-A' depicted on Figure 6. This is consistent with previous delineations of the plume extent (CH2M, 2018), showing decreased concentrations in the center of the plume near EW-1 and EW-2.

1.4 Long-Term Remedial Approach

The change from active treatment to focused in situ treatment will result in a more sustainable and effective treatment for the dissolved phase groundwater plume consistent with U.S. Environmental Protection Agency (EPA) Principles for Greener Cleanups (U.S. EPA, 2019).

Long term:

- Perform ISCO injections periodically to reduce VOC concentrations, with GWETS operation as contingency only
- Document change in remedial approach in the administrative record:
  - 2008 ROD—explanation of significant difference
  - 2009 consent decree— update monitoring, performance evaluation, and contingency plan (CH2M, 2013c)
  - 2009 RCRA Corrective Action Permit— see Consent Decree

Short term:

- Implement a pilot study to collect full-scale design parameters and demonstrate the efficacy of in situ treatment
- Shut down GWETS for 12–18 months during the pilot study; therefore, natural flow conditions prevail and oxidant distribution under these conditions can be assessed.

GWETS shut down is low risk, in that over that past 4½ years, the leading edge of the plume has been shown to be stable and should continue to remain stable without extracting groundwater. This will be validated during the pilot study. Groundwater potentiometric maps show a very low gradient, and the Columbia River periodically pushes groundwater south (Jacobs, 2019). Select groundwater potentiometric surface maps are included in Appendix B. The closest municipal water supply well is located approximately 2,500 feet east and cross-gradient of the current plume, and is northeast of the proposed pilot study location. It is therefore not anticipated to be impacted by site activities.

2. Pilot Study Plan

This section includes the pilot study objectives, pilot study design, pilot study implementation, and environmental management requirements.

The distribution of oxidant in the subsurface is largely dependent on effective porosity and permeability of the aquifer and the injection volume. The findings of the pilot study will provide insight into potential effectiveness and design considerations for future full-scale applications, which could reduce life cycle costs and meet overall site remedial objectives in a shorter timeframe.

The cost-effectiveness of permanganate ISCO is also dependent on the aquifer soil matrix oxidant demand. Saturated soil samples will be collected from the aquifer during monitoring well installation and will be analyzed for the oxidant demand, to determine the final amount of oxidant needed for the pilot study.

2.1 Pilot Study Objectives

The specific objectives of the ISCO pilot study are as follows:

- Evaluate the oxidant distribution and radius of influence, travel time, and VOC reduction/or rebound.
- Assess injection parameters, such as achievable flow rates and injection pressures.

The pilot study will be considered effective if the following occur:

- Permanganate is distributed throughout the treatment zone, which would be demonstrated by observing the effects of the injection in a vertical cluster of monitoring wells about 20 feet from the injection well during injection or within weeks of the injection.
- VOC concentrations are reduced, which will be demonstrated by lower concentrations of VOCs in the injection and nearby monitoring wells.
- The permanganate persists migrating with groundwater flow to expand the treatment zone and to minimize VOC concentration rebound. This will be demonstrated by observing the impacts of the injection (presence of oxidant and reduced VOC concentrations) in the injection and nearby monitoring wells in the weeks and months following injection.

2.2 Pilot Study Design

2.2.1 Predesign Groundwater Sampling

Predesign groundwater samples were collected from seven wells at five locations on March 26, 2019. These are summarized below. The well locations for the predesign groundwater sampling event were near the source zone and are shown on Figure 3.

- DW-2 (Groundwater Zone C, 106 feet bgs)—sampled for VOCs
- GCW-1S (Groundwater Zone A, 15–30 feet bgs)—sampled for VOCs
- GCW-1D (Groundwater Zone C, 75–90 feet bgs)—sampled for VOCs, select metals, and tracers
- GCW-2S (Groundwater Zone A, 15–30 feet bgs)—sampled for VOCs
- GCW-2S (Groundwater Zone C, 75–90 feet bgs)—sampled for VOCs
- GW-3 (Groundwater Zone A, 14–24 feet bgs)—sampled for VOCs
- PZ-1C (Groundwater Zone C, 79–89 feet bgs)—sampled for VOCs

The laboratory reports from the predesign groundwater sampling are provided in Appendix A. The VOC results were relatively low, with total VOC concentrations less than 50 µg/L. These were determined to be

too low for the purposes of this pilot study. Tracers (eosine and fluorescein dye) were not detected above the laboratory's reporting limits. Also, metals were analyzed to establish baseline conditions to assess if metals solubilize for the duration of changed oxidative groundwater conditions.

2.2.2 Pilot Study Location

Figure 2 shows the location for the pilot study. The pilot study area was selected based on recent groundwater monitoring results (November 2018 annual groundwater monitoring and March 2018 predesign groundwater sampling) and access constraints. Initially, a pilot study in the former BBI Facility was anticipated due to no access constraints. However, the remaining VOC concentrations are lower than preferred for this pilot study. Therefore, the area with the highest VOC concentrations, as shown on Figure 4, was considered more appropriate for the pilot study. Within the area indicating the highest VOC concentrations, the right-of-way along NE 87th Avenue is the most suitable due to the ease of access and it is in the vicinity of the migrating plume core.

2.2.3 Injection and Monitoring Well Installation

For this pilot study, two well pairs will be installed approximately 20 feet apart, generally parallel to groundwater flow. Final well locations will be adjusted based on access constraints and locations of subsurface utilities. All wells will be constructed such that they can be used for groundwater monitoring, injection, or groundwater extraction for flexible future uses. The general proposed locations for each well pair are shown on Figures 4 and 5, and the well screen intervals are shown on Figure 6. At each location both well screens will be installed in Groundwater Zone C, with the screens in the zone of highest VOC concentrations. It is anticipated that each screen will be 15 feet long; however, the final well design will be determined during drilling based on field observations (i.e., lithology and field VOC screening). The preferred well construction would be a nested configuration with both wells in a common borehole, as shown on Figure 7. However, if a waiver for installing nested wells cannot be obtained from Oregon DEQ, the wells will be installed as well pairs, with each of the two wells installed in their own boreholes at each of the 3 locations, as shown on Figure 8. At each location the individual wells will be placed approximately 5 feet apart.

The rotosonic drilling method will be used for the drilling and installation of the wells. This drilling method is needed due to the depth and lithology, and to collect continuous cores for detailed logging and soil sampling. This information will be used to finalize the well installation details. The continuous core will be screened using a portable photoionization detector and in the Groundwater Zone C interval, samples will be collected every 5 feet for headspace photoionization detector readings. The results will be used to determine the final screen lengths (between 5 and 15 feet long) and depth intervals.

Two saturated soil samples from different vertical depths of Groundwater Zone C and groundwater from either nearby well DW-4 or the newly installed wells will be collected and sent to a laboratory for the Total Oxidant Demand test (sometimes also referred to as the Natural Oxidant Demand test). In addition, two composite saturated soil samples from Groundwater Zone C will be sent to the laboratory for grain size distribution analysis. The resulting curves will provide insight into the formation porosity and permeability.

All well casings will be new, unused, decontaminated 2-inch-diameter Schedule 40 PVC pipe with internal flush-joined threaded joints that conform to ASTM International's Standard F-480-88A or the National Sanitation Foundation's Standard 14 (Plastic Pipe System). Glue- or solvent-welded joints will not be used below ground. Wells will be constructed with a 0.010-inch slot size continuous wire-wound design screens (e.g., Johnson Vee-Wire or equivalent) to provide maximum inlet area consistent with strength requirements.

The filter pack material will consist of inert, washed, well-rounded No. 2/16 silica sand and will be free of roots, trash, and other deleterious material. The filter pack will extend from 1 foot below to 1 to 2 feet above each well screen. The filter pack will be installed with a bottom-discharge tremie pipe. The tremie pipe will be lifted from the bottom of the hole at the same rate the filter pack is set. The filter pack will be tagged continuously during this process to ensure proper placement. The outer casing will be vibrated periodically to aid in the settling and packing of the filter pack and to prevent bridging. Approximately 1

foot of No. 30 transition sand will be placed between the filter pack and the bentonite seal. Compressed, 0.5-to-0.75-inch time-release bentonite pellets or bentonite chips, where applicable, will be used to seal the well screen completion intervals. The bentonite pellets/chips will be installed by gravity methods. If the seal is placed above the water table, then sufficient water will be added to the bentonite chips to allow complete hydration of the bentonite. The bentonite chip seal will be allowed to hydrate for a minimum of 2 hours prior to the installation of the annular grout seal. A cement/powdered bentonite grout will be used for the annular seals above the bentonite seals. The annular seals will extend to the base of the finished well box. Wells will be set flush mounted to ground completions, well casings will be cut at approximately 12 inches bgs, and a female threaded PVC National Pipe Thread (NPT) coupling and a watertight well cap will be installed on the wells. The threaded coupling can be used to connect the injection header to the well.

After construction, each well will be developed to remove drilling-induced turbidity through a combination of surge block, bailing, and pumping. Development will continue until the development water turbidity stabilizes and is visibly clear or until 5 to 10 casing volumes have been removed (though more may be required in some cases to ensure good connectivity with the formation and to minimize injection pressures). During well development, the total depth of each injection and monitoring well will be measured, documented, and compared against the installed depth. Development water will be containerized, labeled, and disposed of off-site.

Finally, a licensed surveyor will survey the new wells to determine the top-of-casing elevation, ground surface elevation, and horizontal coordinates of the well locations.

2.2.4 Baseline Groundwater Sampling

Baseline groundwater sampling will be performed no sooner than 72 hours after well development is completed at newly installed wells. The following wells will be sampled:

- IW-1S
- IW-1D
- IW-2S
- IW-2D
- DW-4-4 (115 feet)
- DW-4-5 (138 feet)

During sampling the following field parameters will be recorded:

- Dissolved oxygen (DO)
- pH
- Oxidation-reduction potential (ORP)
- Conductivity
- Temperature

Samples will be submitted to analytical laboratories for the following analyses:

- VOCs
- metals (for select 4 wells)
- Groundwater samples from two wells will be submitted for Tracers (eosine and fluorescein)

2.2.5 Tracer Testing

Two different conservative tracers (e.g., eosine and fluorescein) will be used for this pilot study. However, eosine and fluorescein can possibly be degraded by strong oxidants, so a lab test will be performed to evaluate the magnitude of dye degradation, of both eosine and fluorescein, by sodium permanganate. One tracer will be added in the shallow screen and the other tracer will be added in the deep screen. These tracers will be added during the first injection event to monitor the flow path and velocity. The tracers will only be used for the first injection, a total of two injections are planned for this pilot study scheduled approximately 3 to 6 months apart.

Eosine and fluorescein are the selected tracers because they are conservative tracers commonly used to evaluate groundwater flow and transport. For groundwater monitoring during and after tracer tests that use fluorescein or eosine, the concentration of tracer is typically measured using a fluorometer. Fluorometers can be used for field measurements or samples can be sent to a specialty analytical laboratory for analysis. The detection limits of the field and laboratory fluorometers are less than 1 parts per billion.

2.2.6 ISCO

Sodium permanganate was selected as the oxidant to be injected because permanganate is effective on chlorinated ethenes, and sodium permanganate (liquid) is easier to handle in the field than potassium permanganate (dry powder). Sodium permanganate is commonly delivered as a 40-percent-by-weight solution and can be diluted to the designed injection concentration in the field. Sodium permanganate is a very stable oxidant and can persist in the subsurface for weeks to months given low natural oxidant demand from organic matter and reduced material present in the formation. The oxidation process is accomplished without generating heat or off-gassing, as may occur with hydrogen peroxide and other oxidants.

The soil's oxidant demand will not be available until new wells are installed and saturated soil samples can be collected; therefore, the design is based on an assumed permanganate natural oxidant demand of 2 grams per kilogram wet soil. This results in a 100,000-cubic-foot treatment zone (50 feet long by 40 feet wide by 50 feet thick). With an assumed effective porosity of 25 percent, 2,481 gallons of 40 percent by weight sodium permanganate will be needed per injection event. A total of two injection events, approximately 3 to 6 months apart are planned, resulting in a total of 4,962 gallons of 40 percent by weight sodium permanganate. The need for and timing of a second injection will be based on the groundwater monitoring results following the first injection to evaluate tracer and oxidant migration and persistence of oxidant.

2.3 Pilot Study Implementation

This section describes the path forward for implementing the ISCO pilot study. Once the three nested wells or three well pairs are installed, the GWETS system will be shutdown and baseline groundwater monitoring will be completed. After ambient groundwater conditions are determined, the pilot study will proceed with tracer and oxidant injections and performance monitoring.

2.3.1 GWETS Shutdown

Before and during the pilot study, the existing GWETS system will be shut down and placed into caretaker status to allow the groundwater table to return to non-pumping condition, so that tracer and oxidant transport can be assessed under non-pumping conditions.

Additional groundwater monitoring of the leading edge of the dissolved phase groundwater plume will be performed to evaluate plume stability during the GWETS shutdown, as described in Section 2.3.5. Based on ongoing groundwater monitoring, with respect to trends in dissolved phased concentrations and groundwater gradients, it is anticipated that the groundwater plume will remain relatively stable during the GWETS shutdown (Jacobs, 2019).

2.3.2 Chemical Purchase and Storage

The eosine and fluorescein dyes, which will be provided by Ozark Underground Laboratory, will be delivered as a powder. For this pilot study, approximately 2 pounds of eosine dye and 1 pound of fluorescein dye are needed.

A total of 2,481 gallons of $NaMnO_4$ solution (RemOx-L from Carus or equivalent) as a 40 percent by weight solution delivered and stored in pails (5-gallon), drums (55-gallon) or intermediate bulk containers (263-gallon) will be offloaded from a delivery truck and stored within secondary containment at the former BBI site. Optionally, the oxidant will be delivered to the selected injection subcontractor and mobilized to the site on an as needed basis during the injection. Materials will be stored in a designated, secure location. Receipt and acceptance of delivered materials will be documented on a chemical inventory form. The pails, drums, or containers will be transported from the site to the injection location using a forklift.

2.3.3 Tracer and ISCO Injection

The ISCO injection system will be a portable, truck or trailer mounted, batch mix system. The system will consist of a mixing tank, pump(s), control panel, and fittings and instrumentation such as valves, flow meters with totalizers, and pressure gauges. The flowmeters will be capable of measuring flow between 0.5 and 20 gpm, although a target flow rate of 10 gpm will be used during delivery. Flow rates may be adjusted during delivery, and the decision will be made in the field based on observations of flow rates and pressure at the injection well. The pressure gauges will be capable of measuring between 0 and 100 pounds per square inch. The mixing and injection equipment will be operational and pressure tested with hydrant water prior to the first day of injection. Injection during the first injection event will be performed into wells IW-1S and IW-1D.

If eosin and fluorescein are not significantly oxidized by sodium permanganate, then the tracers will be mixed and injected with the sodium permanganate solution. However, assuming that permanganate partially oxidizes eosine and fluorescein when in direct contact, it is anticipated that the two will be injected sequentially. The powdered dye will be dissolved into 1 gallon of water per pound of dye powder. The concentrated dye solution will then be poured into the injection well (fluorescein in IW-1S and eosine in IW-1D) and 1,000 gallons of chase water will be injected into each injection well to flush the dye into the aquifer. Following addition of dye and injection of 1,000 gallons of chase water, a total of 16,990 gallons of 4 percent sodium permanganate will be injected into each injection well (IW-1S and IW-1D). The injections at IW-1S and IW-1D may be performed concurrently or sequentially. At the end of each work shift the mixing tanks and hoses will be flushed with water and the rinsate will be injected into IW-1S and IW-1D. It is anticipated that the rinsate volume each day will be less than 100 gallons total (less than 50 gallons per injection well). Based on professional experience, 100 gallons of chase water will be injected into each of the injection wells at the end of the injection event.

2.3.4 Post-injection Performance Monitoring

Wells to be sampled weekly for 1 month, then monthly for 2 additional months, then quarterly thereafter. Well locations are shown on Figures 4 through 6.

- IW-1S (field parameters only)
- IW-1D (field parameters only)
- IW-2S
- IW-2D
- DW-4-4 (115 feet)
- DW-4-5 (138 feet)

Parameters

The following parameters will be measured or analyzed as part of the pilot study.

- DO
- pH
- ORP
- Conductivity
- Temperature
- VOCs
- Sodium permanganate
- Tracers
- Metals

Samples will be collected for tracers (eosine and fluorescein) and will be analyzed either at an analytical laboratory or in the field or both. Sampling and analysis for tracers will be performed following the first injection, and will be continued after the second injection.

During baseline sampling and after 1 year, select wells will be sampled for metals to assess changes as a result of oxidizing the groundwater. Changes are usually short-lived and reverse once oxidant is consumed.

Sodium permanganate concentrations will be monitored in the field using colorimetric test Method 8034 for manganese with a Hach DR 850 Colorimeter or similar field test kit, to evaluate the presence and concentration of $NaMnO_4$ in monitoring wells. The test measures the concentration of manganese in water, which is proportional to the $NaMnO_4$ concentration. Dilution may be required prior to testing using graduated cylinders (10, 100, or 1,000 milliliters). Calibration of the Hach Colorimeter will be performed each week, at a minimum.

Prior to the start of injection, data logging water quality monitoring probes will be deployed at IW-2S and IW-2D during injection activities. The probes will be capable of monitoring water level, DO, pH, ORP, conductivity, and temperature.

2.3.5 Dissolved Plume Stability Monitoring

During the GWETS shutdown, the following monitoring wells will be sampled for VOCs and field parameters (DO, pH, ORP, conductivity, and temperature) semiannually to verify dissolved plume stability: GW-12, GW-13C, GW-13D, GW-14D, GW-20, GW-21, GW-22, GW-23, GW-25.

2.4 Administrative Activities

2.4.1 Permitting and Administrative Requirements

An underground injection control permit will be obtained from the DEQ to inject sodium permanganate.

Injection wells will be registered with EPA's underground injection control program (Region X) as Class V aquifer remediation wells (this is a registration; no permit is issued).

A hydrant use permit may be obtained from the Portland Water Bureau to supply nonpotable water for diluting the permanganate and chase water since a water source does not exist onsite. Alternatively, water will be brought to the site by truck.

A Federal Aviation Administration construction permit is needed for well installation activities because of the site's proximity to the airport.

2.4.2 Spill Response

Materials, including $NaMnO_4$ (40 percent solution delivered) will be handled in the pails, drums, and/or totes in which they are shipped.

Other material-handling best management practices include the following:

- Allowing sufficient separation between storage containers to allow for cleanup and emergency response.
- Storing chemically incompatible materials apart and not in the same storage facility.
- Properly and legibly labeling containers and materials.
- Using secondary containment for chemical storage areas and mix/injection tanks.
- Beginning spill response immediately upon discovery of a spill, including daylighting. Spill response materials and procedures for injection activities will be provided by the specialty subcontractor, but potentially include absorbent pads, neutralizing agents, and/or aqueous dilution for liquid spills. Used absorbent pads will be containerized for proper waste management. Cleanup of dry chemical spills will likely involve cleanup with shovels and placing recovered chemical and other contacted media into drums for proper waste management.

2.4.3 Waste Management

Waste generated as part of this pilot study will be limited to soil cuttings from drilling, well development/sampling groundwater, and decontamination fluids. Drill cuttings will be contained generally in lined soil roll-off bins, and decontamination and well development water will be contained generally in Department of Transportation–approved 55-gallon drums. The water will be transferred to the GWETS for treatment. Each container will be appropriately labeled with the content of the bin/drum, the location(s) from which the waste was derived, and the date. Representative samples will be collected from the bins/drums for disposal characterization purposes. The drums will be stored in a secure location onsite for ultimate offsite disposal by Honeywell based on disposal characterization analytical results. All wastes will be disposed of at facilities that are permitted to accept the materials.

2.4.4 Health and Safety

The current project health and safety plan for the site will be revised to address any additional health and safety issues pertinent to the work proposed in this work plan. All work will be performed in accordance with the updated health and safety plan and Honeywell requirements. In accordance with Jacobs' standard safety procedures, site-specific safety requirements and procedures will be conveyed to all staff working at the site in a tailgate meeting prior to start of any field activities. All personnel working at the site will read, understand, and sign the health and safety plan.

Hazardous materials, hazardous substances, and/or hazardous wastes will be present during field activities. All individuals working at the site will have received Occupational Safety and Health Administration 40-hour hazardous waste operations training, related field training, and annual updates as required. Personnel without appropriate, current Occupational Safety and Health Administration training certificates will not be allowed onsite.

Organic vapor analysis of the breathing zone will be performed periodically during field activities. Work will begin with personnel using Level D personal protective equipment. However, all workers will be

prepared to change to Level C personal protective equipment if deemed necessary based on air monitoring. In this case, air-purifying respirators would be worn within a designated exclusion zone by all onsite personnel.

3. Reporting

At the completion of the ISCO injection pilot study performance monitoring, a pilot study report will be submitted to DEQ. The report will briefly summarize the injection activities and field and laboratory results and will provide the conclusions and recommendations regarding future sodium permanganate injections. The pilot test findings may result in changes to oxidant selection, oxidant dosing, injection volumes, and injection pressures for full-scale design and application.

4. Schedule

The following is the proposed milestone schedule and durations to complete anticipated activities in this pilot study plan:

- Well installation: Duration of 3 weeks for well installation and development, following regulatory approval of this pilot study work plan. Mobilization dependent upon subcontractor availability.
- Sampling and analysis of saturated soil for TOD and grain-size distribution analyses. The results will be evaluated for refining the oxidant concentration and overall volume to be injected.
- Baseline groundwater sampling: Duration of 2 days following well installation and development. Sampling to be performed no sooner than 72 hours after completion of well development.
- ISCO injection: Duration of 1 week following data evaluation from baseline groundwater sampling.
- Pilot study report: Duration of 120 days following the receipt of validated laboratory data packages from performance monitoring activities.

Task Description	Preliminary Date[a]
Issue the Pilot Study Work Plan to DEQ	June 2019
Receive DEQ approval of the Pilot Study Work Plan	July 2019
Well Installation (including sampling of saturated soil for TOD and grain-size distribution analyses)	August 2019
Baseline groundwater monitoring	September 2019
Evaluate soil sampling results and baseline groundwater monitoring results and revise the injection plan as needed	September 2019
Oxidant and tracer injection	October 2019
Post-injection monitoring	October 2019 through March 2020
Second injection of oxidant, if needed	April 2020
Post-injection monitoring	April through September 2020
Issue Pilot Study Report to DEQ	January 2021

[a] Subject to change based on DEQ review and approval, site access permission and permitting, contractor availability, and actual time required to implement and complete the proposed activities.

5. References

CH2M. 2013a. *Offsite Soil Excavation Construction Completion Report, Former Baron-Blakeslee, Inc., Solvent Recycling Facility, Portland, Oregon*. Prepared for Honeywell International Inc. February.

CH2M. 2013b. *Groundwater Extraction and Treatment System Construction Completion Report, Former Baron-Blakeslee, Inc., Solvent Recycling Facility, Portland, Oregon. Draft Report*. Prepared for Honeywell International Inc. August.

CH2M. 2013c. *Monitoring, Performance Evaluation, and Contingency Plan, Former Baron-Blakeslee, Inc., Solvent Recycling Facility, Portland, Oregon*. May.

CH2M. 2014. *Groundwater Extraction and Treatment System Performance Monitoring and Evaluation Report, January–June 2014, Former Baron-Blakeslee Facility, Portland, Oregon*. Prepared for Honeywell International Inc. August.

CH2M. 2018. *Groundwater Extraction and Treatment System Performance Monitoring and Evaluation Report, 2017, Former Baron-Blakeslee Facility, Portland, Oregon*. Prepared for Honeywell International Inc. February.

Jacobs. 2019. *Groundwater Extraction and Treatment System Performance Monitoring and Evaluation Report, 2018, Former Baron-Blakeslee Facility, Portland, Oregon*. Prepared for Honeywell International Inc. February.

Oregon Department of Environmental Quality (DEQ). 2008. *Record of Decision, Final Remedial Action for Former Blakeslee, Inc. Solvent Recycling Facility Site*. September.

Oregon Department of Environmental Quality (DEQ). 2015. Conditional No Further Action Determination for Soil for Former Baron-Blakeslee, Inc. Solvent Recycling Facility, Portland, ECSI #1274. November.

U.S. Environmental Protection Agency (EPA). 2019. EPA Principles for Greener Cleanups. https://www.epa.gov/greenercleanups/epa-principles-greener-cleanups. Website accessed May.

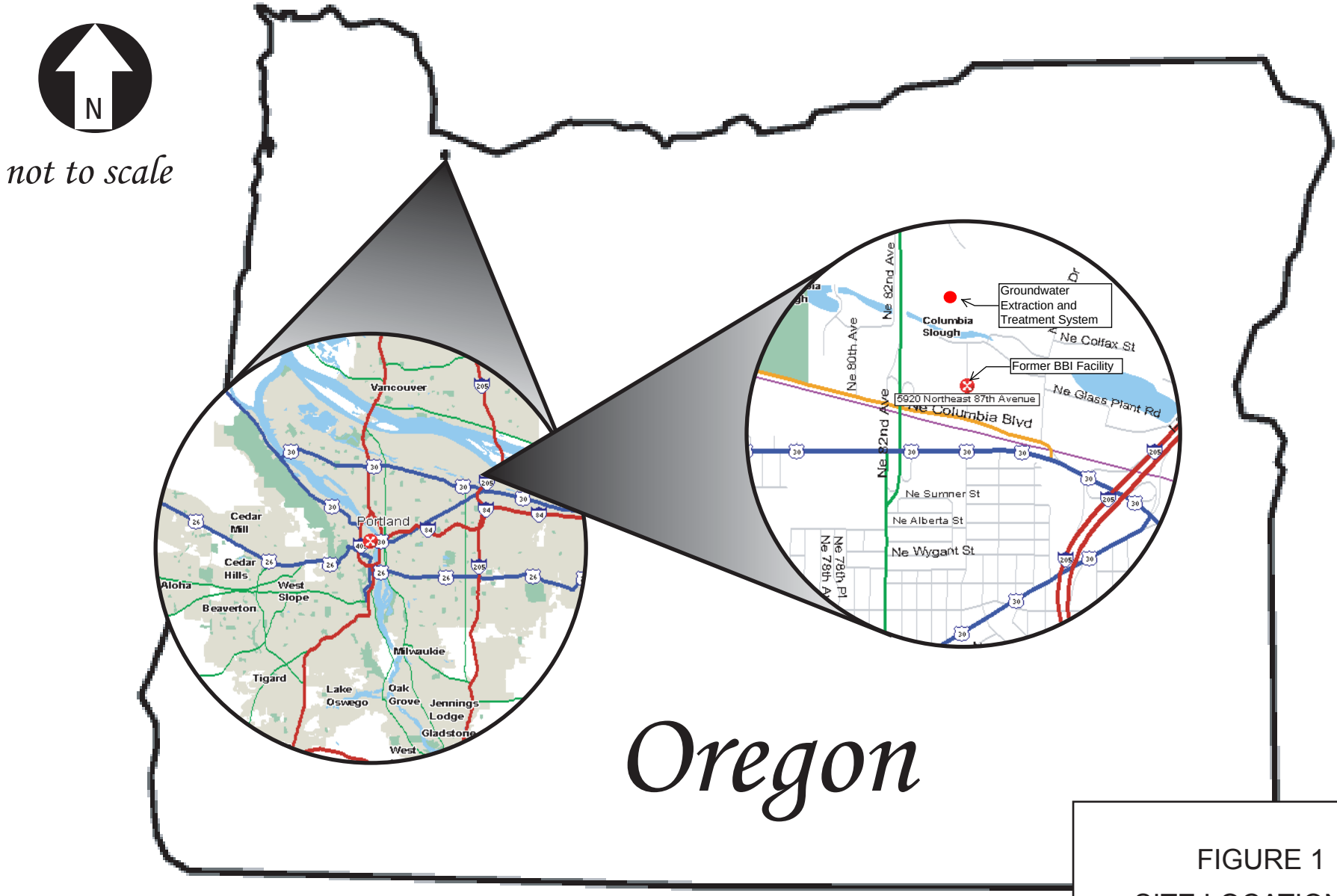

FIGURE 1

SITE LOCATION MAP

Former Baron-Blakeslee Facility
Portland, Oregon

Source: Parsons, 2004

E042005001PDX 326958.PO.TR 4/22/05 AN/LH

Legend

- Extraction Well
- A Zone Monitoring Well (screened above -45 ft. elevation)
- C Zone Monitoring Well (screened between -45 ft. and -120 ft. elevation)
- D Zone Monitoring Well (screened below -120 ft. elevation)
- CMT Multilevel Well
- Tri-Level Monitoring Well (three separate wells screened at different depths)
- Railroad Tracks
- Buildings
- Tax Lots
- BBI Facility
- Treatment System Building
- Pilot Study Area

Notes:
Extraction well TW-1 is not in operation

N

0 250 500
Feet

Figure 2
Site Layout and
Monitoring Well Locations
Former Baron-Blakeslee Facility
Portland, Oregon

JACOBS

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Legend

- A Zone Monitoring Well (screened above -45 ft. elevation)
- C Zone Monitoring Well (screened between -45 ft. and -120 ft. elevation)
- D Zone Monitoring Well (screened below -120 ft. elevation)
- CMT Multilevel Well
- Tri-Level Monitoring Well (three separate wells screened at different depths)
- Groundwater Circulation Well (GCW)
- Railroad Tracks
- Cross Section Prime Lines
- Buildings
- Tax Lots
- BBI Facility

Notes:
1. Locations with highlighted well IDs were sampled for pre-design purposes.

N

0 100 200
Feet

Figure 3
Source Area Well Locations
Former Baron-Blakeslee Facility
Portland, Oregon

JACOBS

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Legend

- Extraction Well
- A Zone Monitoring Well (screened above -45 ft. elevation)
- C Zone Monitoring Well (screened between -45 ft. and -120 ft. elevation)
- D Zone Monitoring Well (screened below -120 ft. elevation)
- CMT Multilevel Well
- Tri-Level Monitoring Well (three separate wells screened at different depths)
- Railroad Tracks
- Buildings
- BBI Facility
- MCL Remedial Action Area (5 ug/L concentration of maximum PCE or TCE concentrations from November 2018. Dashed where inferred).
- Isoconcentration (in ug/l) of total VOCs Highest concentrations are used for locations with multiple wells/multiple depths. For wells where duplicate samples were collected, the highest value from parent or duplicate shown.Dashed where inferred.
- Proposed nested well location

Sample Depth	TVOC (ug/L)
60'	10.4

Notes:

1. Sample data for all monitoring wells collected in November 2018.
2. The molar fraction of VOC compounds at GW-15C and its location (i.e., west of the range of potential flow paths from the BBI facility to the north) suggests a VOC source independent of the BBI Facility. Observations from the current monitoring event at GW-15C are consistent with historical measurements.

N

0 250 500

Feet

Figure 4
Total VOC Concentrations in Groundwater
November 2018
Former Baron-Blakeslee Facility
Portland, Oregon

JACOBS

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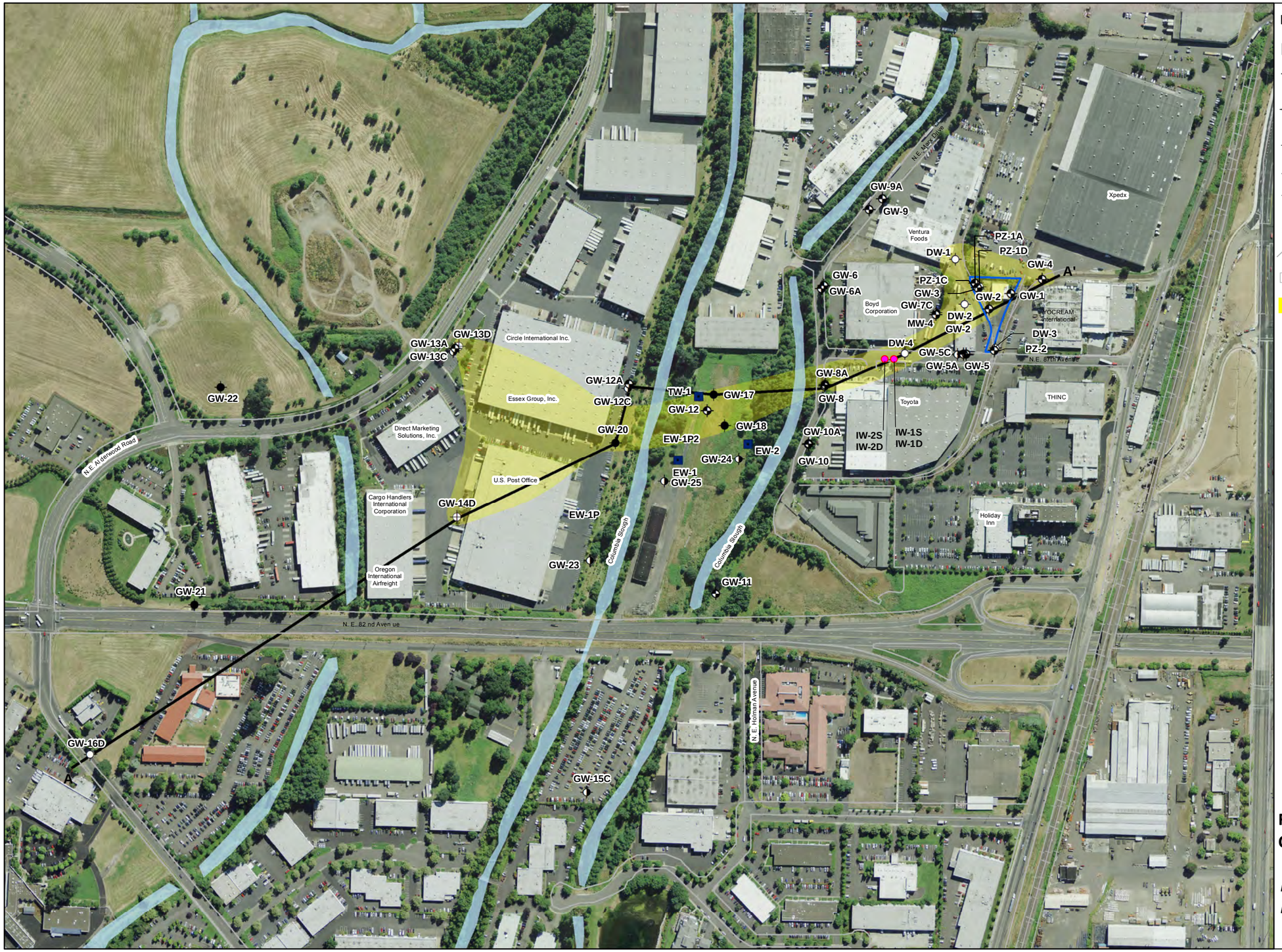

Legend

- Extraction Well
- A Zone Monitoring Well (screened above -45 ft. elevation)
- C Zone Monitoring Well (screened between -45 ft. and -120 ft. elevation)
- D Zone Monitoring Well (screened below -120 ft. elevation)
- CMT Multilevel Well
- Tri-Level Monitoring Well (three separate wells screened at different depths)
- Pilot Borehole
- Railroad Tracks
- Buildings
- MCL Remedial Action Area based on data from November 2018
- Proposed nested well location

N

0 250 500

Feet

Figure 5
Cross Section Locations

Former Baron-Blakeslee Facility
Portland, Oregon

JACOBS

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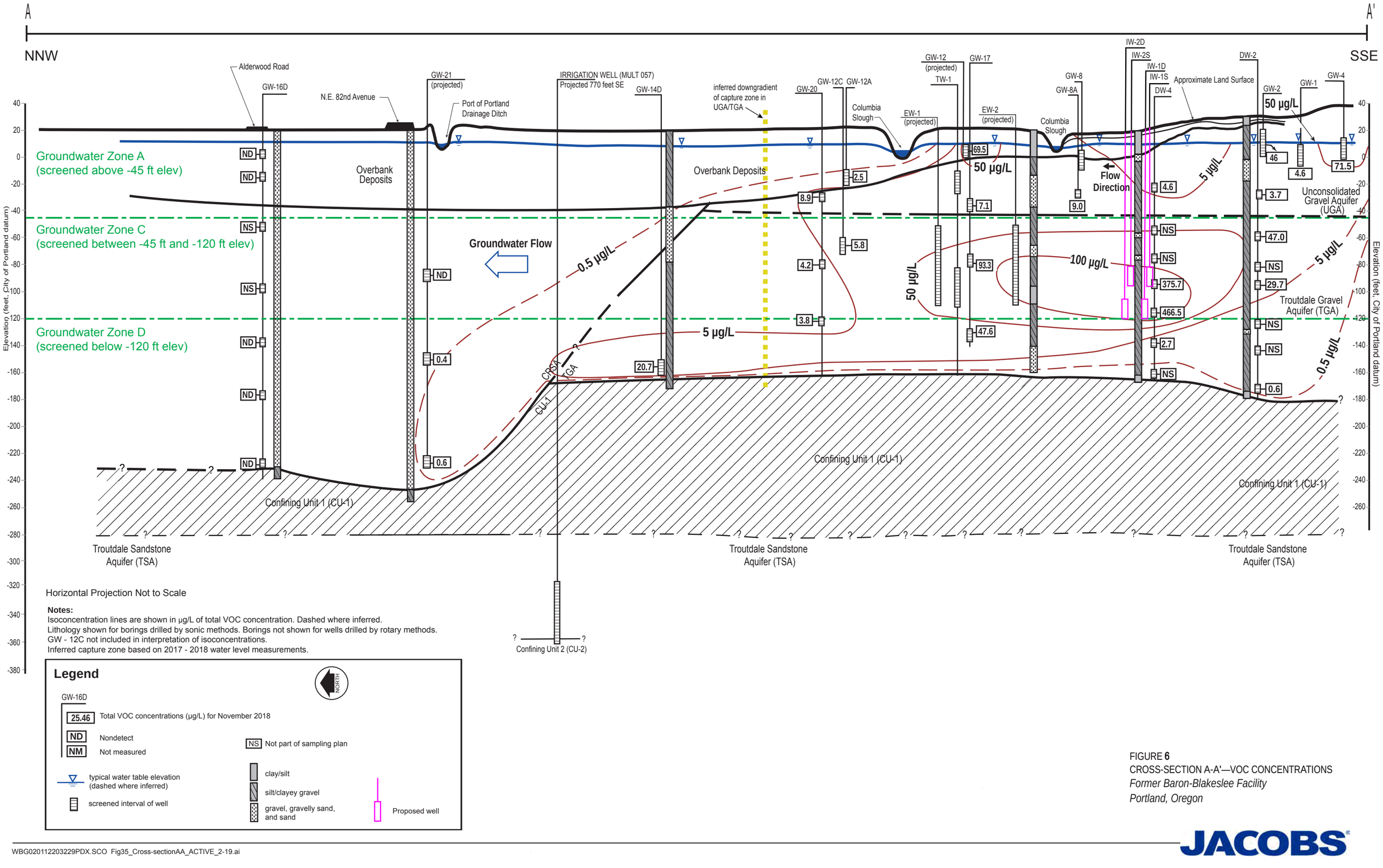
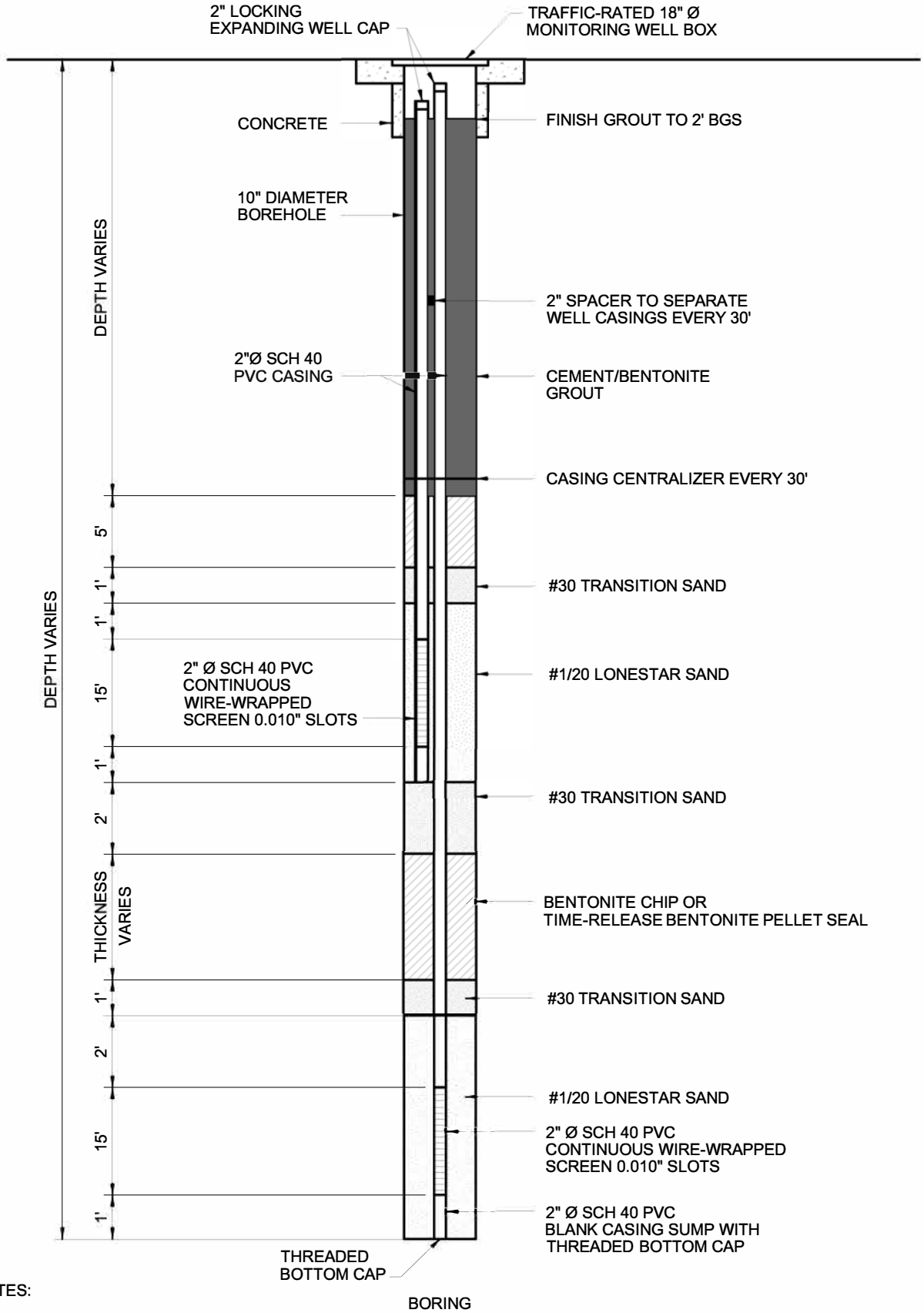


FIGURE **6**
CROSS-SECTION A-A'—VOC CONCENTRATIONS
Former Baron-Blakeslee Facility
Portland, Oregon

JACOBS



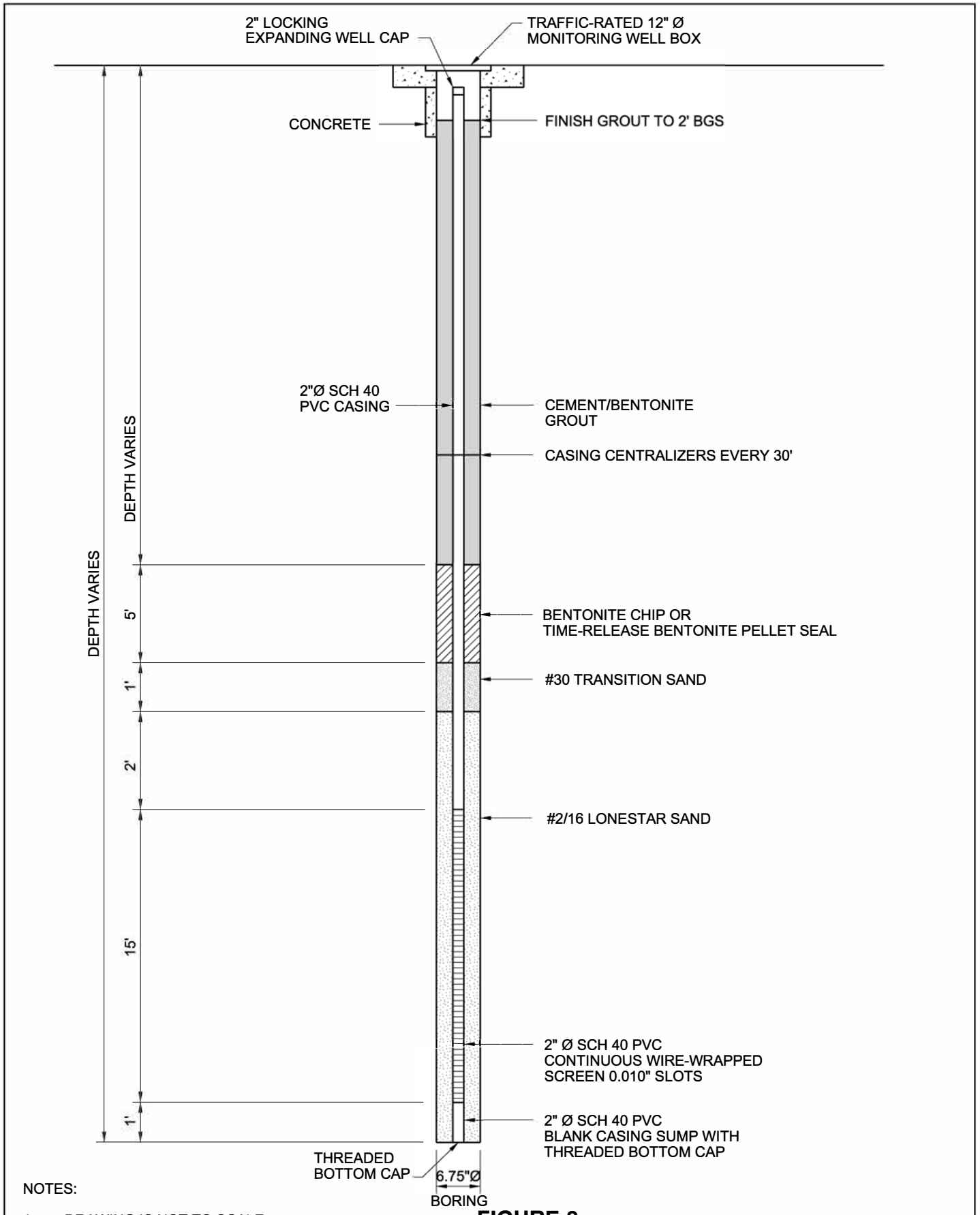
NOTES:

1. DRAWING IS NOT TO SCALE.
2. EXACT DEPTHS TO BE DETERMINED BY FIELD GEOLOGIST.
3. FINAL SCREEN LENGTH AND SCREEN INTERVAL TO BE FINALIZED DURING DRILLING BASED ON FIELD OBSERVATIONS.

FIGURE 7
CONSTRUCTION SCHEMATIC FOR VERTICAL INJECTION WELL, DUAL SCREEN
Former Baron-Blakeslee Facility
Portland, Oregon

JACOBS

Figure 6.dwg



NOTES:

1. DRAWING IS NOT TO SCALE.
2. EXACT DEPTHS TO BE DETERMINED BY FIELD GEOLOGIST.
3. FINAL SCREEN LENGTH AND SCREEN INTERVAL TO BE FINALIZED DURING DRILLING BASED ON FIELD OBSERVATIONS.

FIGURE 8
CONSTRUCTION SCHEMATIC FOR VERTICAL INJECTION WELL, SINGLE SCREEN
Former Baron-Blakeslee Facility,
Portland, Oregon

JACOBS

elsegundo_iwd-SingleScreen.dgn

Appendix A
Laboratory Reports

Ozark UNDERGROUND LABORATORY 1572 Aley Lane • Protem, MO 65733 • (417) 785-4289 • fax (417) 785-4290 • contact@ozarkundergroundlab.com

Certificate of Analysis

Date of certificate: April 2, 2019

Client: Jacobs
2020 SW 4th Ave, 3rd Floor
Portland, OR 97201

Project name/location: Honeywell Portland Groundwater
Portland, Oregon

Contact people: Jennifer.Ulrich@Jacobs.com)
Bernice.Kidd@Jacobs.com)
Cindy.Donnerberg@jacobs.com)

Project number: 707764CH.HW.02.40.41

Samples collected by: Paige Molzahn

Date samples shipped: March 26, 2019

Date samples rec'd at OUL: March 28, 2019

Date analyzed by OUL: March 29, 2019

Included with certificate of analysis:
Table of results, copy of chain of custody record and analysis graphs

Results for water samples analyzed for the presence of fluorescein dye.

Peak wavelengths are reported in nanometers (nm); dye concentrations are reported in parts per billion (ppb).

OUL Number	Station Name	Date/Time Collected	Fluorescein Results	
			Peak (nm)	Conc. (ppb)
D5953	GCW-1D-0319	3/26/19 1200	ND	
D5954	GCW-1D-0319-1	3/26/19 1203	ND	

Note: Dye concentrations are based upon standards used at the OUL. The standard concentrations are based upon the as sold weight of the dye that the OUL uses. If the client is not using OUL dyes, the client should provide the OUL with a sample of the dye to compare to the OUL dyes.

Footnotes: ND = No dye detected

Thomas J. Aley, PHG and RG

Thomas J. Aley

F:\docs\COA\Jacobs_Honeywell_BBI_01

CHAIN OF CUSTODY

OZARK UNDERGROUND
~~Curtis & Tompkins Laboratories~~
ENVIRONMENTAL ANALYTICAL TESTING LABORATORY
In Business Since 1878

~~2323 Fifth Street~~ 1572 Aley Lane ~~Phone (510) 486-0900~~
~~Berkeley, CA 94710~~ Protem, MO 65773 ~~Fax (510) 486-0532~~

Chain of Custody # _____

C&T LOGIN # _____

Project No: 707764CH.HW.02.40.41 Sampler: Paige Molzahn

Project Name: Honeywell BBI Report To: Jenn Ulrich

Project P. O. No: Company: Jacobs

EDD Format: Report Level ☐ II ☐ III ☐ IV Telephone: 907-792-9633

Turnaround Time: ☑ RUSH 10-DAY ☐ Standard Email: Jennifer.Ulrich@jacobs.com

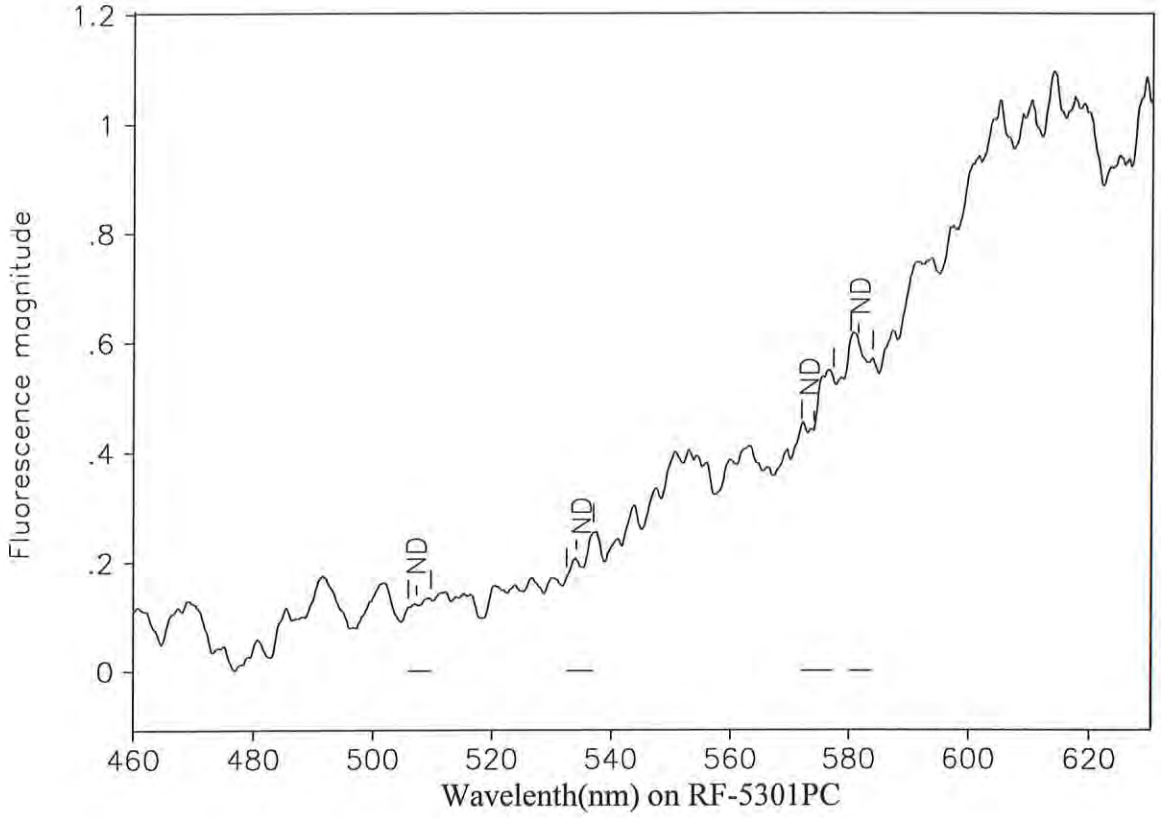
Lab No.	Sample ID.	SAMPLING		MATRIX				# of Containers	CHEMICAL PRESERVATIVE					ANALYTICAL REQUEST: Fluorescein (RFS30/SFP)	#g Charcoal Packets Rec'd by OUL	#g Water Bottles Rec'd by OUL
		Date Collected	Time Collected	Water	Solid				HCl	H2SO4	HNO3	NaOH	None			
D5953	GCW-ID-0319	3/26/19	1200	X				1					X	X	0	-
D5954	GCW-ID-0319-1	3/26/19	1203	X				1					X	X	0	-

Notes:
OUL project # 1780
Analyzed 3/29/2019 by KC/OUL
Charts for samples on this page proofed by OUL: AC/dw

SAMPLE RECEIPT
☐ Intact
☐ Cold
☐ On Ice
☐ Ambient

RELINQUISHED BY:		RECEIVED BY:	
Paige Molzahn	DATE: 3/26 TIME: 16:30	KC/OUL	DATE: 3/28/19 TIME: 1230
	DATE: TIME:		DATE: TIME:
	DATE: TIME:		DATE: TIME:

Ozark Underground Laboratory



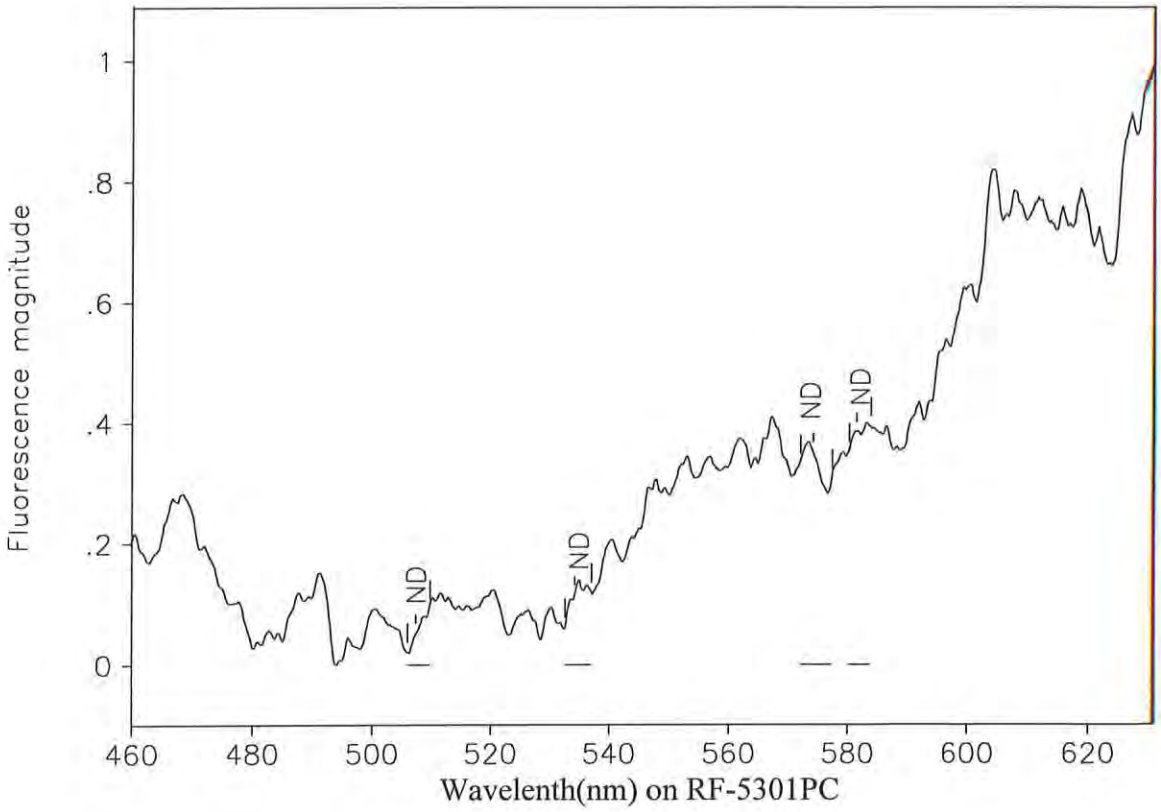
Station 1: GCW-1D-0319
OUL Number: D5953 Analyzed: 3/29/19
Matrix: Water
Date collected: 3/26/19 1200

Peaks within the normal range of tracer dyes:

Peak nm	Left X	Right X	Height	Area	Conc.
507.3	505.9	509.7	0.00	0.00	ND
534.1	532.5	537.0	0.00	0.00	ND
574.0	571.9	577.2	0.00	0.00	ND
581.3	580.1	583.7	0.00	0.00	ND

Peaks close to the normal range of tracer dyes:

Ozark Underground Laboratory



Station 1: GCW-1D-0319-1
OUL Number: D5954 Analyzed: 3/29/19
Matrix: Water
Date collected: 3/26/19 1203

Peaks within the normal range of tracer dyes:

Peak nm	Left X	Right X	Height	Area	Conc.
507.3	505.9	509.7	0.00	0.00	ND
534.1	532.5	537.0	0.00	0.00	ND
574.0	571.9	577.2	0.00	0.00	ND
581.3	580.1	583.7	0.00	0.00	ND

Peaks close to the normal range of tracer dyes:

ENTHALPY

ANALYTICAL

Enthalpy Analytical

2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 308458
ANALYTICAL REPORT

CH2M	Project : HW BBI PORTLAND OM&M
2443 Tie Plant road	Location : HW Portland
The Dalles, or 97058	Level : II

Sample ID	Lab ID
DW-2-3-0319	308458-001
GCW-1S-0319	308458-002
GCW-1D-0319	308458-003
GCW-1D-0319-1	308458-004
GW-3-0319	308458-005
PZ-1C-0319	308458-006
GCW-2S-0319	308458-007
GCW-2D-0319	308458-008
TRIP-0319	308458-009

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature which applies to this PDF file as well as any associated electronic data deliverable files. The results contained in this report meet all requirements of NELAP and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: _____ Date: 04/01/2019

Patrick McCarthy
Project Manager
patrick.mccarthy@enthalpy.com
(510) 204-2236 ext 13115

CA ELAP# 2896, NELAP# 4044-001

ENTHALPY ANALYTICAL

CASE NARRATIVE

Laboratory number:	**308458**
Client:	**CH2M**
Project:	**HW BBI PORTLAND OM&M**
Location:	**HW Portland**
Request Date:	**03/27/19**
Samples Received:	**03/27/19**

This data package contains sample and QC results for nine water samples, requested for the above referenced project on 03/27/19. The samples were received cold and intact. This report was revised and reissue don 4/3/19.

Volatile Organics by GC/MS (EPA 624):
TRIP-0319 (lab # 308458-009) was analyzed with more than 1 mL of headspace in the VOA vial. No other analytical problems were encountered.

Metals (EPA 6020 and EPA 7470A):
Copper was detected between the MDL and the RL in the method blank for batch 269103; this analyte was not detected in samples at or above the RL. No other analytical problems were encountered.

Ion Chromatography (EPA 300.0):
No analytical problems were encountered.

***** Missing Items *****

The following items are valid in the narrative, but for some reason didn't end up in the above report:

Item 33 (MSVOA/Water): Naphthalene was detected between the MDL and the RL in the method blank for batch 269069; this analyte was not detected in samples at or above the RL.

Item 55 (MSVOA/Water): High response was observed for 1,2,4-trichlorobenzene in the CCV analyzed 04/01/19 12:52; affected data was qualified with "b".

Item 56 (MSVOA/Water): 1,2,4-trichlorobenzene was detected between the MDL and the RL in the method blank for batch 269108; this analyte was not detected in the sample at or above the RL.

You can invalidate these items, or adjust rgroup/matrix/method ([C] button) for each until they appear in the main body of the report. See the operations manager or LIMS staff for assistance if necessary.

CHAIN OF CUSTODY

ENTHALPY ANALYTICAL
Formerly Curtis & Tompkins Labs
2323 Fifth Street
Berkeley, CA 94710
Phone (510) 486-0900
Fax (510) 486-0532

Chain of Custody #

C&T LOGIN # 308458

Project No: Honeywell BBI
Project Name: 707764Ct. HW.02.40.41
Project P. O. No:
EDD Format: Report Level ☐ II ☐ III ☐ IV
Turnaround Time: ☒ RUSH 3Day ☐ Standard

Sampler: P. Molzahn
Report To: Jenn Ulrich
Company: Jacobs
Telephone: 907-792-9633
Email: jennifer.ulrich@jacobs.com

Lab No.	Sample ID.	SAMPLING Date Collected	SAMPLING Time Collected	MATRIX Water	MATRIX Solid	# of Containers	CHEMICAL PRESERVATIVE HCl	H2SO4	HNO3	NaOH	None	ANALYTICAL REQUEST: VOCs 8260	E300.0	SW6020A
1	DW-2-3-0319	3/26/19	0945	X		3	X					X		
2	GCW-1S-0319	3/26/19	1050	X		3	X					X		
3	GCW-1S-0319-MS	3/26/19	1050	X		3	X					X		
4	GCW-1S-0319-SD	3/26/19	1050	X		3	X					X		
3	GCW-1D-0319	3/26/19	1200	X		5	X		X		X	X	X	X
4	GCW-1D-0319-1	3/26/19	1203	X		5	X		X		X	X	X	X
5	GW-3-0319	3/26/19	1255	X		3	X					X		
6	PZ-1C-0319	3/26/19	1400	X		3	X					X		
7	GCW-2S-0319	3/26/19	1455	X		3	X					X		
8	GCW-2D-0319	3/26/19	15:30	X		3	X					X		
9	Trip-0319	3/26/19	15:45	X		1	X					X		

Notes:

SAMPLE RECEIPT
☐ Intact
☐ Cold
☐ On Ice
☐ Ambient

RELINQUISHED BY:
Paige Molzahn DATE: 3/26 TIME: 16:30
DATE: TIME:
DATE: TIME:

RECEIVED BY:
DATE: 3/27/19 TIME: 10:10
DATE: TIME:
DATE: TIME:

SAMPLE RECEIPT CHECKLIST

Section 1: Login # 308458 Client: Jacobs

Date Received: 3/27/19 Project:

Section 2: Samples received in a cooler? ☑ Yes, how many? 1 ☐ No (skip Section 3 below)

If no cooler Sample Temp (°C): _____ using IR Gun # ☐ A, or ☐ B

☐ Samples received on ice directly from the field. Cooling process had begun

If in cooler: Date Opened 3/27/19 By (print) AC (sign) _____

Shipping info (if applicable) 7862 7122 3221 FedEx

Are custody seals present? ☐ No, or ☑ Yes. If yes, where? ☑ on cooler, ☐ on samples, ☐ on package

☑ Date: 3/26/19 How many _____ ☑ Signature, ☐ Initials, ☐ None

Were custody seals intact upon arrival? ☑ Yes ☐ No ☐ N/A

Section 3: ***Important*: Notify PM if temperature exceeds 6°C or arrive frozen.**

Packing in cooler: (if other, describe) _____

☐ Bubble Wrap, ☐ Foam blocks, ☑ Bags, ☐ None, ☐ Cloth material, ☐ Cardboard, ☐ Styrofoam, ☐ Paper towels

☐ Samples received on ice directly from the field. Cooling process had begun

Type of ice used: ☑ Wet, ☐ Blue/Gel, ☐ None Temperature blank(s) included? ☐ Yes, ☑ No

Temperature measured using ☐ Thermometer ID: _____, or IR Gun # ☐ A ☑ B

Cooler Temp (°C): #1: 2.9, #2: _____, #3: _____, #4: _____, #5: _____, #6: _____, #7: _____

Section 4:	YES	NO	N/A
Were custody papers dry, filled out properly, and the project identifiable	✓		
Were Method 5035 sampling containers present?		✓	
If YES, what time were they transferred to freezer? _____			
Did all bottles arrive unbroken/unopened?	✓		
Are there any missing / extra samples?		✓	
Are samples in the appropriate containers for indicated tests?	✓		
Are sample labels present, in good condition and complete?	✓		
Does the container count match the COC?	✓		
Do the sample labels agree with custody papers?	✓		
Was sufficient amount of sample sent for tests requested?	✓		
Did you change the hold time in LIMS for unpreserved VOAs?			✓
Did you change the hold time in LIMS for preserved terracores?			✓
Are bubbles > 6mm absent in VOA samples?		✓	
Was the client contacted concerning this sample delivery?		✓	
If YES, who was called? _____ By _____ Date: _____			

Section 5:	YES	NO	N/A
Are the samples appropriately preserved? (If N/A, skip the rest of section 5)	✓		
Did you check preservatives for all bottles for each sample?		✓	
Did you document your preservative check?	✓		

pH strip lot# HC547770, pH strip lot# _____, pH strip lot# _____

Preservative added:

☐ H2SO4 lot# _____ added to samples _____ on/at _____

☐ HCL lot# _____ added to samples _____ on/at _____

☐ HNO3 lot# _____ added to samples _____ on/at _____

☐ NaOH lot# _____ added to samples _____ on/at _____

Section 6:

Explanations/Comments: * sample a "InP-0319" 1/1 VOA jarred with bubbles

Date Logged In 3/27/19 By (print) AC (sign) AC

Date Labeled 3/27/19 By (print) AC (sign) AC

Enthalpy Sample Preservation for 308458

Sample	pH: <2	>9	>12	Other
-003a	[ ]	[ ]	[ ]	_____
b	[ ]	[ ]	[ ]	_____
c	[ ]	[ ]	[ ]	_____
d	[ ]	[ ]	[ ]	_____
e	[✓]	[ ]	[ ]	_____
-004a	[ ]	[ ]	[ ]	_____
b	[ ]	[ ]	[ ]	_____
c	[ ]	[ ]	[ ]	_____
d	[ ]	[✓]	[ ]	_____
e	[✓]	[ ]	[ ]	_____

Analyst: _____
Date: 3/27/19

ENTHALPY ANALYTICAL

Detections Summary for 308458

Results for any subcontracted analyses are not included in this summary.

Client : CH2M
Project : HW BBI PORTLAND OM&M
Location : HW Portland

Client Sample ID : DW-2-3-0319 Laboratory Sample ID : 308458-001

Analyte	Result	Flags	RL	MDL	Units	Basis	IDF	Method	Prep Method
cis-1,2-Dichloroethene	0.3	J	0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Trichloroethene	1.6		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Tetrachloroethene	3.3		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B

Client Sample ID : GCW-1S-0319 Laboratory Sample ID : 308458-002

Analyte	Result	Flags	RL	MDL	Units	Basis	IDF	Method	Prep Method
cis-1,2-Dichloroethene	0.1	J	0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Chloroform	0.7		0.5	0.2	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Trichloroethene	0.7		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Tetrachloroethene	2.5		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B

Client Sample ID : GCW-1D-0319 Laboratory Sample ID : 308458-003

Analyte	Result	Flags	RL	MDL	Units	Basis	IDF	Method	Prep Method
Chloroform	0.7		0.5	0.2	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Trichloroethene	0.5		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Tetrachloroethene	1.6		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Arsenic	1.2		1.0	0.025	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Barium	6.1		1.0	0.049	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Chromium	0.34	J	1.0	0.13	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Copper	0.44	J	1.0	0.32	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Molybdenum	0.15	J	1.0	0.038	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Nickel	0.38	J	1.0	0.13	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Vanadium	10		1.0	0.33	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8

Client Sample ID : GCW-1D-0319-1 Laboratory Sample ID : 308458-004

Analyte	Result	Flags	RL	MDL	Units	Basis	IDF	Method	Prep Method
Chloroform	0.7		0.5	0.2	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Trichloroethene	0.5		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Tetrachloroethene	1.7		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Arsenic	1.1		1.0	0.025	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Barium	6.1		1.0	0.049	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Chromium	0.34	J	1.0	0.13	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Copper	0.43	J	1.0	0.32	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Molybdenum	0.14	J	1.0	0.038	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Nickel	0.40	J	1.0	0.13	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8
Vanadium	10		1.0	0.33	ug/L	TOTAL	1.000	EPA 6020	EPA 200.8

Client Sample ID : GW-3-0319 Laboratory Sample ID : 308458-005

Analyte	Result	Flags	RL	MDL	Units	Basis	IDF	Method	Prep Method
cis-1,2-Dichloroethene	2.6		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Chloroform	0.4	J	0.5	0.2	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
1,1,1-Trichloroethane	0.1	J	0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Trichloroethene	7.2		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Tetrachloroethene	17		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B

Client Sample ID : PZ-1C-0319 Laboratory Sample ID : 308458-006

Analyte	Result	Flags	RL	MDL	Units	Basis	IDF	Method	Prep Method
1,1-Dichloroethene	0.5	J	0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
cis-1,2-Dichloroethene	1.2		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Chloroform	0.7		0.5	0.2	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
1,1,1-Trichloroethane	0.9		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Trichloroethene	14		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Tetrachloroethene	39		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B

Client Sample ID : GCW-2S-0319 Laboratory Sample ID : 308458-007

Analyte	Result	Flags	RL	MDL	Units	Basis	IDF	Method	Prep Method
1,1-Dichloroethane	0.1	J	0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
cis-1,2-Dichloroethene	4.4		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Chloroform	0.4	J	0.5	0.2	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
1,1,1-Trichloroethane	0.4	J	0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Trichloroethene	7.8		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Tetrachloroethene	38		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B

Client Sample ID : GCW-2D-0319 Laboratory Sample ID : 308458-008

Analyte	Result	Flags	RL	MDL	Units	Basis	IDF	Method	Prep Method
cis-1,2-Dichloroethene	1.4		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Chloroform	0.7		0.5	0.2	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
1,1,1-Trichloroethane	0.7		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Trichloroethene	4.5		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B
Tetrachloroethene	30		0.5	0.1	ug/L	As Recd	1.000	EPA 8260B	EPA 5030B

Client Sample ID : TRIP-0319 Laboratory Sample ID : 308458-009

No Detections

J = Estimated value

ENTHALPY ANALYTICAL

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Field ID:	DW-2-3-0319	Dil'n Fac:	1.000
Lab ID:	308458-001	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Analyzed
Acrolein	ND	10	2.0	269157	04/02/19
Acrylonitrile	ND	10	2.0	269157	04/02/19
Chloromethane	ND	1.0	0.3	269069	03/29/19
Vinyl Chloride	ND	0.5	0.1	269069	03/29/19
Bromomethane	ND	1.0	0.3	269069	03/29/19
Chloroethane	ND	1.0	0.3	269069	03/29/19
Trichlorofluoromethane	ND	1.0	0.1	269069	03/29/19
1,1-Dichloroethene	ND	0.5	0.1	269069	03/29/19
Methylene Chloride	ND	10	0.4	269069	03/29/19
trans-1,2-Dichloroethene	ND	0.5	0.1	269069	03/29/19
1,1-Dichloroethane	ND	0.5	0.1	269069	03/29/19
cis-1,2-Dichloroethene	0.3 J	0.5	0.1	269069	03/29/19
Chloroform	ND	0.5	0.2	269069	03/29/19
1,1,1-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Carbon Tetrachloride	ND	0.5	0.1	269069	03/29/19
1,2-Dichloroethane	ND	0.5	0.2	269069	03/29/19
Benzene	ND	0.5	0.1	269069	03/29/19
Trichloroethene	1.6	0.5	0.1	269069	03/29/19
1,2-Dichloropropane	ND	0.5	0.1	269069	03/29/19
Bromodichloromethane	ND	0.5	0.1	269069	03/29/19
cis-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
Toluene	ND	0.5	0.1	269069	03/29/19
trans-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
1,1,2-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Tetrachloroethene	3.3	0.5	0.1	269069	03/29/19
Dibromochloromethane	ND	0.5	0.1	269069	03/29/19
Chlorobenzene	ND	0.5	0.1	269069	03/29/19
Ethylbenzene	ND	0.5	0.1	269069	03/29/19
m,p-Xylenes	ND	0.5	0.1	269069	03/29/19
o-Xylene	ND	0.5	0.1	269069	03/29/19
Bromoform	ND	1.0	0.1	269069	03/29/19
1,1,2,2-Tetrachloroethane	ND	0.5	0.1	269069	03/29/19
1,3-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,4-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,2-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
2-Chloroethylvinylether	ND	10	1.2	269157	04/02/19

Surrogate	%REC	Limits	Batch#	Analyzed
Dibromofluoromethane	100	80-121	269069	03/29/19
1,2-Dichloroethane-d4	101	80-134	269069	03/29/19
Toluene-d8	99	80-120	269069	03/29/19
Bromofluorobenzene	101	80-120	269069	03/29/19

J= Estimated value
ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Field ID:	GCW-1S-0319	Dil'n Fac:	1.000
Lab ID:	308458-002	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Analyzed
Acrolein	ND	10	2.0	269157	04/02/19
Acrylonitrile	ND	10	2.0	269157	04/02/19
Chloromethane	ND	1.0	0.3	269069	03/29/19
Vinyl Chloride	ND	0.5	0.1	269069	03/29/19
Bromomethane	ND	1.0	0.3	269069	03/29/19
Chloroethane	ND	1.0	0.3	269069	03/29/19
Trichlorofluoromethane	ND	1.0	0.1	269069	03/29/19
1,1-Dichloroethene	ND	0.5	0.1	269069	03/29/19
Methylene Chloride	ND	10	0.4	269069	03/29/19
trans-1,2-Dichloroethene	ND	0.5	0.1	269069	03/29/19
1,1-Dichloroethane	ND	0.5	0.1	269069	03/29/19
cis-1,2-Dichloroethene	0.1 J	0.5	0.1	269069	03/29/19
Chloroform	0.7	0.5	0.2	269069	03/29/19
1,1,1-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Carbon Tetrachloride	ND	0.5	0.1	269069	03/29/19
1,2-Dichloroethane	ND	0.5	0.2	269069	03/29/19
Benzene	ND	0.5	0.1	269069	03/29/19
Trichloroethene	0.7	0.5	0.1	269069	03/29/19
1,2-Dichloropropane	ND	0.5	0.1	269069	03/29/19
Bromodichloromethane	ND	0.5	0.1	269069	03/29/19
cis-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
Toluene	ND	0.5	0.1	269069	03/29/19
trans-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
1,1,2-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Tetrachloroethene	2.5	0.5	0.1	269069	03/29/19
Dibromochloromethane	ND	0.5	0.1	269069	03/29/19
Chlorobenzene	ND	0.5	0.1	269069	03/29/19
Ethylbenzene	ND	0.5	0.1	269069	03/29/19
m,p-Xylenes	ND	0.5	0.1	269069	03/29/19
o-Xylene	ND	0.5	0.1	269069	03/29/19
Bromoform	ND	1.0	0.1	269069	03/29/19
1,1,2,2-Tetrachloroethane	ND	0.5	0.1	269069	03/29/19
1,3-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,4-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,2-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
2-Chloroethylvinylether	ND	10	1.2	269157	04/02/19

Surrogate	%REC	Limits	Batch#	Analyzed
Dibromofluoromethane	101	80-121	269069	03/29/19
1,2-Dichloroethane-d4	105	80-134	269069	03/29/19
Toluene-d8	101	80-120	269069	03/29/19
Bromofluorobenzene	100	80-120	269069	03/29/19

J= Estimated value
ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Field ID:	GCW-1D-0319	Dil'n Fac:	1.000
Lab ID:	308458-003	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Analyzed
Acrolein	ND	10	2.0	269157	04/02/19
Acrylonitrile	ND	10	2.0	269157	04/02/19
Chloromethane	ND	1.0	0.3	269069	03/29/19
Vinyl Chloride	ND	0.5	0.1	269069	03/29/19
Bromomethane	ND	1.0	0.3	269069	03/29/19
Chloroethane	ND	1.0	0.3	269069	03/29/19
Trichlorofluoromethane	ND	1.0	0.1	269069	03/29/19
1,1-Dichloroethene	ND	0.5	0.1	269069	03/29/19
Methylene Chloride	ND	10	0.4	269069	03/29/19
trans-1,2-Dichloroethene	ND	0.5	0.1	269069	03/29/19
1,1-Dichloroethane	ND	0.5	0.1	269069	03/29/19
cis-1,2-Dichloroethene	ND	0.5	0.1	269069	03/29/19
Chloroform	0.7	0.5	0.2	269069	03/29/19
1,1,1-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Carbon Tetrachloride	ND	0.5	0.1	269069	03/29/19
1,2-Dichloroethane	ND	0.5	0.2	269069	03/29/19
Benzene	ND	0.5	0.1	269069	03/29/19
Trichloroethene	0.5	0.5	0.1	269069	03/29/19
1,2-Dichloropropane	ND	0.5	0.1	269069	03/29/19
Bromodichloromethane	ND	0.5	0.1	269069	03/29/19
cis-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
Toluene	ND	0.5	0.1	269069	03/29/19
trans-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
1,1,2-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Tetrachloroethene	1.6	0.5	0.1	269069	03/29/19
Dibromochloromethane	ND	0.5	0.1	269069	03/29/19
Chlorobenzene	ND	0.5	0.1	269069	03/29/19
Ethylbenzene	ND	0.5	0.1	269069	03/29/19
m,p-Xylenes	ND	0.5	0.1	269069	03/29/19
o-Xylene	ND	0.5	0.1	269069	03/29/19
Bromoform	ND	1.0	0.1	269069	03/29/19
1,1,2,2-Tetrachloroethane	ND	0.5	0.1	269069	03/29/19
1,3-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,4-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,2-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
2-Chloroethylvinylether	ND	10	1.2	269157	04/02/19

Surrogate	%REC	Limits	Batch#	Analyzed
Dibromofluoromethane	99	80-121	269069	03/29/19
1,2-Dichloroethane-d4	104	80-134	269069	03/29/19
Toluene-d8	99	80-120	269069	03/29/19
Bromofluorobenzene	101	80-120	269069	03/29/19

ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Field ID:	GCW-1D-0319-1	Dil'n Fac:	1.000
Lab ID:	308458-004	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Analyzed
Acrolein	ND	10	2.0	269157	04/02/19
Acrylonitrile	ND	10	2.0	269157	04/02/19
Chloromethane	ND	1.0	0.3	269069	03/29/19
Vinyl Chloride	ND	0.5	0.1	269069	03/29/19
Bromomethane	ND	1.0	0.3	269069	03/29/19
Chloroethane	ND	1.0	0.3	269069	03/29/19
Trichlorofluoromethane	ND	1.0	0.1	269069	03/29/19
1,1-Dichloroethene	ND	0.5	0.1	269069	03/29/19
Methylene Chloride	ND	10	0.4	269069	03/29/19
trans-1,2-Dichloroethene	ND	0.5	0.1	269069	03/29/19
1,1-Dichloroethane	ND	0.5	0.1	269069	03/29/19
cis-1,2-Dichloroethene	ND	0.5	0.1	269069	03/29/19
Chloroform	0.7	0.5	0.2	269069	03/29/19
1,1,1-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Carbon Tetrachloride	ND	0.5	0.1	269069	03/29/19
1,2-Dichloroethane	ND	0.5	0.2	269069	03/29/19
Benzene	ND	0.5	0.1	269069	03/29/19
Trichloroethene	0.5	0.5	0.1	269069	03/29/19
1,2-Dichloropropane	ND	0.5	0.1	269069	03/29/19
Bromodichloromethane	ND	0.5	0.1	269069	03/29/19
cis-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
Toluene	ND	0.5	0.1	269069	03/29/19
trans-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
1,1,2-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Tetrachloroethene	1.7	0.5	0.1	269069	03/29/19
Dibromochloromethane	ND	0.5	0.1	269069	03/29/19
Chlorobenzene	ND	0.5	0.1	269069	03/29/19
Ethylbenzene	ND	0.5	0.1	269069	03/29/19
m,p-Xylenes	ND	0.5	0.1	269069	03/29/19
o-Xylene	ND	0.5	0.1	269069	03/29/19
Bromoform	ND	1.0	0.1	269069	03/29/19
1,1,2,2-Tetrachloroethane	ND	0.5	0.1	269069	03/29/19
1,3-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,4-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,2-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
2-Chloroethylvinylether	ND	10	1.2	269157	04/02/19

Surrogate	%REC	Limits	Batch#	Analyzed
Dibromofluoromethane	99	80-121	269069	03/29/19
1,2-Dichloroethane-d4	104	80-134	269069	03/29/19
Toluene-d8	101	80-120	269069	03/29/19
Bromofluorobenzene	103	80-120	269069	03/29/19

ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Field ID:	GW-3-0319	Dil'n Fac:	1.000
Lab ID:	308458-005	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Analyzed
Acrolein	ND	10	2.0	269157	04/02/19
Acrylonitrile	ND	10	2.0	269157	04/02/19
Chloromethane	ND	1.0	0.3	269014	03/28/19
Vinyl Chloride	ND	0.5	0.1	269014	03/28/19
Bromomethane	ND	1.0	0.1	269014	03/28/19
Chloroethane	ND	1.0	0.2	269014	03/28/19
Trichlorofluoromethane	ND	1.0	0.1	269014	03/28/19
1,1-Dichloroethene	ND	0.5	0.1	269014	03/28/19
Methylene Chloride	ND	10	0.5	269014	03/28/19
trans-1,2-Dichloroethene	ND	0.5	0.1	269014	03/28/19
1,1-Dichloroethane	ND	0.5	0.1	269014	03/28/19
cis-1,2-Dichloroethene	2.6	0.5	0.1	269014	03/28/19
Chloroform	0.4 J	0.5	0.2	269014	03/28/19
1,1,1-Trichloroethane	0.1 J	0.5	0.1	269014	03/28/19
Carbon Tetrachloride	ND	0.5	0.1	269014	03/28/19
1,2-Dichloroethane	ND	0.5	0.2	269014	03/28/19
Benzene	ND	0.5	0.1	269014	03/28/19
Trichloroethene	7.2	0.5	0.1	269014	03/28/19
1,2-Dichloropropane	ND	0.5	0.1	269014	03/28/19
Bromodichloromethane	ND	0.5	0.1	269014	03/28/19
cis-1,3-Dichloropropene	ND	0.5	0.1	269014	03/28/19
Toluene	ND	0.5	0.1	269014	03/28/19
trans-1,3-Dichloropropene	ND	0.5	0.1	269014	03/28/19
1,1,2-Trichloroethane	ND	0.5	0.1	269014	03/28/19
Tetrachloroethene	17	0.5	0.1	269014	03/28/19
Dibromochloromethane	ND	0.5	0.1	269014	03/28/19
Chlorobenzene	ND	0.5	0.1	269014	03/28/19
Ethylbenzene	ND	0.5	0.2	269014	03/28/19
m,p-Xylenes	ND	0.5	0.1	269014	03/28/19
o-Xylene	ND	0.5	0.1	269014	03/28/19
Bromoform	ND	1.0	0.1	269014	03/28/19
1,1,2,2-Tetrachloroethane	ND	0.5	0.1	269014	03/28/19
1,3-Dichlorobenzene	ND	0.5	0.1	269014	03/28/19
1,4-Dichlorobenzene	ND	0.5	0.1	269014	03/28/19
1,2-Dichlorobenzene	ND	0.5	0.1	269014	03/28/19
2-Chloroethylvinylether	ND	10	1.2	269157	04/02/19

Surrogate	%REC	Limits	Batch#	Analyzed
Dibromofluoromethane	103	80-121	269014	03/28/19
1,2-Dichloroethane-d4	99	80-134	269014	03/28/19
Toluene-d8	102	80-120	269014	03/28/19
Bromofluorobenzene	100	80-120	269014	03/28/19

J= Estimated value
ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Field ID:	PZ-1C-0319	Dil'n Fac:	1.000
Lab ID:	308458-006	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Analyzed
Acrolein	ND	10	2.0	269157	04/02/19
Acrylonitrile	ND	10	2.0	269157	04/02/19
Chloromethane	ND	1.0	0.3	269014	03/28/19
Vinyl Chloride	ND	0.5	0.1	269014	03/28/19
Bromomethane	ND	1.0	0.1	269014	03/28/19
Chloroethane	ND	1.0	0.2	269014	03/28/19
Trichlorofluoromethane	ND	1.0	0.1	269014	03/28/19
1,1-Dichloroethene	0.5 J	0.5	0.1	269014	03/28/19
Methylene Chloride	ND	10	0.5	269014	03/28/19
trans-1,2-Dichloroethene	ND	0.5	0.1	269014	03/28/19
1,1-Dichloroethane	ND	0.5	0.1	269014	03/28/19
cis-1,2-Dichloroethene	1.2	0.5	0.1	269014	03/28/19
Chloroform	0.7	0.5	0.2	269014	03/28/19
1,1,1-Trichloroethane	0.9	0.5	0.1	269014	03/28/19
Carbon Tetrachloride	ND	0.5	0.1	269014	03/28/19
1,2-Dichloroethane	ND	0.5	0.2	269014	03/28/19
Benzene	ND	0.5	0.1	269014	03/28/19
Trichloroethene	14	0.5	0.1	269014	03/28/19
1,2-Dichloropropane	ND	0.5	0.1	269014	03/28/19
Bromodichloromethane	ND	0.5	0.1	269014	03/28/19
cis-1,3-Dichloropropene	ND	0.5	0.1	269014	03/28/19
Toluene	ND	0.5	0.1	269014	03/28/19
trans-1,3-Dichloropropene	ND	0.5	0.1	269014	03/28/19
1,1,2-Trichloroethane	ND	0.5	0.1	269014	03/28/19
Tetrachloroethene	39	0.5	0.1	269014	03/28/19
Dibromochloromethane	ND	0.5	0.1	269014	03/28/19
Chlorobenzene	ND	0.5	0.1	269014	03/28/19
Ethylbenzene	ND	0.5	0.2	269014	03/28/19
m,p-Xylenes	ND	0.5	0.1	269014	03/28/19
o-Xylene	ND	0.5	0.1	269014	03/28/19
Bromoform	ND	1.0	0.1	269014	03/28/19
1,1,2,2-Tetrachloroethane	ND	0.5	0.1	269014	03/28/19
1,3-Dichlorobenzene	ND	0.5	0.1	269014	03/28/19
1,4-Dichlorobenzene	ND	0.5	0.1	269014	03/28/19
1,2-Dichlorobenzene	ND	0.5	0.1	269014	03/28/19
2-Chloroethylvinylether	ND	10	1.2	269157	04/02/19

Surrogate	%REC	Limits	Batch#	Analyzed
Dibromofluoromethane	103	80-121	269014	03/28/19
1,2-Dichloroethane-d4	97	80-134	269014	03/28/19
Toluene-d8	100	80-120	269014	03/28/19
Bromofluorobenzene	99	80-120	269014	03/28/19

J= Estimated value
ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Field ID:	GCW-2S-0319	Dil'n Fac:	1.000
Lab ID:	308458-007	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Analyzed
Acrolein	ND	10	2.0	269157	04/02/19
Acrylonitrile	ND	10	2.0	269157	04/02/19
Chloromethane	ND	1.0	0.3	269014	03/28/19
Vinyl Chloride	ND	0.5	0.1	269014	03/28/19
Bromomethane	ND	1.0	0.1	269014	03/28/19
Chloroethane	ND	1.0	0.2	269014	03/28/19
Trichlorofluoromethane	ND	1.0	0.1	269014	03/28/19
1,1-Dichloroethene	ND	0.5	0.1	269014	03/28/19
Methylene Chloride	ND	10	0.5	269014	03/28/19
trans-1,2-Dichloroethene	ND	0.5	0.1	269014	03/28/19
1,1-Dichloroethane	0.1 J	0.5	0.1	269014	03/28/19
cis-1,2-Dichloroethene	4.4	0.5	0.1	269014	03/28/19
Chloroform	0.4 J	0.5	0.2	269014	03/28/19
1,1,1-Trichloroethane	0.4 J	0.5	0.1	269014	03/28/19
Carbon Tetrachloride	ND	0.5	0.1	269014	03/28/19
1,2-Dichloroethane	ND	0.5	0.2	269014	03/28/19
Benzene	ND	0.5	0.1	269014	03/28/19
Trichloroethene	7.8	0.5	0.1	269014	03/28/19
1,2-Dichloropropane	ND	0.5	0.1	269014	03/28/19
Bromodichloromethane	ND	0.5	0.1	269014	03/28/19
cis-1,3-Dichloropropene	ND	0.5	0.1	269014	03/28/19
Toluene	ND	0.5	0.1	269014	03/28/19
trans-1,3-Dichloropropene	ND	0.5	0.1	269014	03/28/19
1,1,2-Trichloroethane	ND	0.5	0.1	269014	03/28/19
Tetrachloroethene	38	0.5	0.1	269014	03/28/19
Dibromochloromethane	ND	0.5	0.1	269014	03/28/19
Chlorobenzene	ND	0.5	0.1	269014	03/28/19
Ethylbenzene	ND	0.5	0.2	269014	03/28/19
m,p-Xylenes	ND	0.5	0.1	269014	03/28/19
o-Xylene	ND	0.5	0.1	269014	03/28/19
Bromoform	ND	1.0	0.1	269014	03/28/19
1,1,2,2-Tetrachloroethane	ND	0.5	0.1	269014	03/28/19
1,3-Dichlorobenzene	ND	0.5	0.1	269014	03/28/19
1,4-Dichlorobenzene	ND	0.5	0.1	269014	03/28/19
1,2-Dichlorobenzene	ND	0.5	0.1	269014	03/28/19
2-Chloroethylvinylether	ND	10	1.2	269157	04/02/19

Surrogate	%REC	Limits	Batch#	Analyzed
Dibromofluoromethane	103	80-121	269014	03/28/19
1,2-Dichloroethane-d4	99	80-134	269014	03/28/19
Toluene-d8	103	80-120	269014	03/28/19
Bromofluorobenzene	102	80-120	269014	03/28/19

J= Estimated value
ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Field ID:	GCW-2D-0319	Dil'n Fac:	1.000
Lab ID:	308458-008	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Analyzed
Acrolein	ND	10	2.0	269157	04/02/19
Acrylonitrile	ND	10	2.0	269157	04/02/19
Chloromethane	ND	1.0	0.3	269069	03/29/19
Vinyl Chloride	ND	0.5	0.1	269069	03/29/19
Bromomethane	ND	1.0	0.3	269069	03/29/19
Chloroethane	ND	1.0	0.3	269069	03/29/19
Trichlorofluoromethane	ND	1.0	0.1	269069	03/29/19
1,1-Dichloroethene	ND	0.5	0.1	269069	03/29/19
Methylene Chloride	ND	10	0.4	269069	03/29/19
trans-1,2-Dichloroethene	ND	0.5	0.1	269069	03/29/19
1,1-Dichloroethane	ND	0.5	0.1	269069	03/29/19
cis-1,2-Dichloroethene	1.4	0.5	0.1	269069	03/29/19
Chloroform	0.7	0.5	0.2	269069	03/29/19
1,1,1-Trichloroethane	0.7	0.5	0.1	269069	03/29/19
Carbon Tetrachloride	ND	0.5	0.1	269069	03/29/19
1,2-Dichloroethane	ND	0.5	0.2	269069	03/29/19
Benzene	ND	0.5	0.1	269069	03/29/19
Trichloroethene	4.5	0.5	0.1	269069	03/29/19
1,2-Dichloropropane	ND	0.5	0.1	269069	03/29/19
Bromodichloromethane	ND	0.5	0.1	269069	03/29/19
cis-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
Toluene	ND	0.5	0.1	269069	03/29/19
trans-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
1,1,2-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Tetrachloroethene	30	0.5	0.1	269069	03/29/19
Dibromochloromethane	ND	0.5	0.1	269069	03/29/19
Chlorobenzene	ND	0.5	0.1	269069	03/29/19
Ethylbenzene	ND	0.5	0.1	269069	03/29/19
m,p-Xylenes	ND	0.5	0.1	269069	03/29/19
o-Xylene	ND	0.5	0.1	269069	03/29/19
Bromoform	ND	1.0	0.1	269069	03/29/19
1,1,2,2-Tetrachloroethane	ND	0.5	0.1	269069	03/29/19
1,3-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,4-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,2-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
2-Chloroethylvinylether	ND	10	1.2	269157	04/02/19

Surrogate	%REC	Limits	Batch#	Analyzed
Dibromofluoromethane	100	80-121	269069	03/29/19
1,2-Dichloroethane-d4	109	80-134	269069	03/29/19
Toluene-d8	102	80-120	269069	03/29/19
Bromofluorobenzene	102	80-120	269069	03/29/19

ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Field ID:	TRIP-0319	Dil'n Fac:	1.000
Lab ID:	308458-009	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Analyzed
Acrolein	ND	10	2.0	269157	04/02/19
Acrylonitrile	ND	10	2.0	269157	04/02/19
Chloromethane	ND	1.0	0.3	269069	03/29/19
Vinyl Chloride	ND	0.5	0.1	269069	03/29/19
Bromomethane	ND	1.0	0.3	269069	03/29/19
Chloroethane	ND	1.0	0.3	269069	03/29/19
Trichlorofluoromethane	ND	1.0	0.1	269069	03/29/19
1,1-Dichloroethene	ND	0.5	0.1	269069	03/29/19
Methylene Chloride	ND	10	0.4	269069	03/29/19
trans-1,2-Dichloroethene	ND	0.5	0.1	269069	03/29/19
1,1-Dichloroethane	ND	0.5	0.1	269069	03/29/19
cis-1,2-Dichloroethene	ND	0.5	0.1	269069	03/29/19
Chloroform	ND	0.5	0.2	269069	03/29/19
1,1,1-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Carbon Tetrachloride	ND	0.5	0.1	269069	03/29/19
1,2-Dichloroethane	ND	0.5	0.2	269069	03/29/19
Benzene	ND	0.5	0.1	269069	03/29/19
Trichloroethene	ND	0.5	0.1	269069	03/29/19
1,2-Dichloropropane	ND	0.5	0.1	269069	03/29/19
Bromodichloromethane	ND	0.5	0.1	269069	03/29/19
cis-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
Toluene	ND	0.5	0.1	269069	03/29/19
trans-1,3-Dichloropropene	ND	0.5	0.1	269069	03/29/19
1,1,2-Trichloroethane	ND	0.5	0.1	269069	03/29/19
Tetrachloroethene	ND	0.5	0.1	269069	03/29/19
Dibromochloromethane	ND	0.5	0.1	269069	03/29/19
Chlorobenzene	ND	0.5	0.1	269069	03/29/19
Ethylbenzene	ND	0.5	0.1	269069	03/29/19
m,p-Xylenes	ND	0.5	0.1	269069	03/29/19
o-Xylene	ND	0.5	0.1	269069	03/29/19
Bromoform	ND	1.0	0.1	269069	03/29/19
1,1,2,2-Tetrachloroethane	ND	0.5	0.1	269069	03/29/19
1,3-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,4-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
1,2-Dichlorobenzene	ND	0.5	0.1	269069	03/29/19
2-Chloroethylvinylether	ND	10	1.2	269157	04/02/19

Surrogate	%REC	Limits	Batch#	Analyzed
Dibromofluoromethane	101	80-121	269069	03/29/19
1,2-Dichloroethane-d4	104	80-134	269069	03/29/19
Toluene-d8	102	80-120	269069	03/29/19
Bromofluorobenzene	105	80-120	269069	03/29/19

ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Batch QC Report

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Matrix:	Water	Batch#:	269014
Units:	ug/L	Analyzed:	03/28/19
Diln Fac:	1.000		

Type: BS Lab ID: QC969864

Analyte	Spiked	Result	%REC	Limits
1,1-Dichloroethene	10.00	10.16	102	65-133
Benzene	10.00	11.42	114	75-122
Trichloroethene	10.00	10.60	106	73-121
Toluene	10.00	11.26	113	78-120
Chlorobenzene	10.00	11.01	110	80-120

Surrogate	%REC	Limits
Dibromofluoromethane	101	80-121
1,2-Dichloroethane-d4	96	80-134
Toluene-d8	101	80-120
Bromofluorobenzene	95	80-120

Type: BSD Lab ID: QC969865

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	10.00	10.02	100	65-133	1	23
Benzene	10.00	11.18	112	75-122	2	20
Trichloroethene	10.00	10.44	104	73-121	2	20
Toluene	10.00	11.03	110	78-120	2	20
Chlorobenzene	10.00	10.79	108	80-120	2	20

Surrogate	%REC	Limits
Dibromofluoromethane	101	80-121
1,2-Dichloroethane-d4	97	80-134
Toluene-d8	103	80-120
Bromofluorobenzene	96	80-120

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC969866	Batch#:	269014
Matrix:	Water	Analyzed:	03/28/19
Units:	ug/L		

Analyte	Result	RL	MDL
Acrolein	NA		
Acrylonitrile	NA		
Chloromethane	ND	1.0	0.3
Vinyl Chloride	ND	0.5	0.1
Bromomethane	ND	1.0	0.1
Chloroethane	ND	1.0	0.2
Trichlorofluoromethane	ND	1.0	0.1
1,1-Dichloroethene	ND	0.5	0.1
Methylene Chloride	ND	10	0.5
trans-1,2-Dichloroethene	ND	0.5	0.1
1,1-Dichloroethane	ND	0.5	0.1
cis-1,2-Dichloroethene	ND	0.5	0.1
Chloroform	ND	0.5	0.2
1,1,1-Trichloroethane	ND	0.5	0.1
Carbon Tetrachloride	ND	0.5	0.1
1,2-Dichloroethane	ND	0.5	0.2
Benzene	ND	0.5	0.1
Trichloroethene	ND	0.5	0.1
1,2-Dichloropropane	ND	0.5	0.1
Bromodichloromethane	ND	0.5	0.1
cis-1,3-Dichloropropene	ND	0.5	0.1
Toluene	ND	0.5	0.1
trans-1,3-Dichloropropene	ND	0.5	0.1
1,1,2-Trichloroethane	ND	0.5	0.1
Tetrachloroethene	ND	0.5	0.1
Dibromochloromethane	ND	0.5	0.1
Chlorobenzene	ND	0.5	0.1
Ethylbenzene	ND	0.5	0.2
m,p-Xylenes	ND	0.5	0.1
o-Xylene	ND	0.5	0.1
Bromoform	ND	1.0	0.1
1,1,2,2-Tetrachloroethane	ND	0.5	0.1
1,3-Dichlorobenzene	ND	0.5	0.1
1,4-Dichlorobenzene	ND	0.5	0.1
1,2-Dichlorobenzene	ND	0.5	0.1
2-Chloroethylvinylether	ND	10	1.2

Surrogate	%REC	Limits
Dibromofluoromethane	102	80-121
1,2-Dichloroethane-d4	100	80-134
Toluene-d8	103	80-120
Bromofluorobenzene	99	80-120

NA= Not Analyzed
ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Batch QC Report

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC970069	Batch#:	269069
Matrix:	Water	Analyzed:	03/29/19
Units:	ug/L		

Analyte	Result	RL	MDL
Acrolein	NA		
Acrylonitrile	NA		
Chloromethane	ND	1.0	0.3
Vinyl Chloride	ND	0.5	0.1
Bromomethane	ND	1.0	0.3
Chloroethane	ND	1.0	0.3
Trichlorofluoromethane	ND	1.0	0.1
1,1-Dichloroethene	ND	0.5	0.1
Methylene Chloride	ND	10	0.4
trans-1,2-Dichloroethene	ND	0.5	0.1
1,1-Dichloroethane	ND	0.5	0.1
cis-1,2-Dichloroethene	ND	0.5	0.1
Chloroform	ND	0.5	0.2
1,1,1-Trichloroethane	ND	0.5	0.1
Carbon Tetrachloride	ND	0.5	0.1
1,2-Dichloroethane	ND	0.5	0.2
Benzene	ND	0.5	0.1
Trichloroethene	ND	0.5	0.1
1,2-Dichloropropane	ND	0.5	0.1
Bromodichloromethane	ND	0.5	0.1
cis-1,3-Dichloropropene	ND	0.5	0.1
Toluene	ND	0.5	0.1
trans-1,3-Dichloropropene	ND	0.5	0.1
1,1,2-Trichloroethane	ND	0.5	0.1
Tetrachloroethene	ND	0.5	0.1
Dibromochloromethane	ND	0.5	0.1
Chlorobenzene	ND	0.5	0.1
Ethylbenzene	ND	0.5	0.1
m,p-Xylenes	ND	0.5	0.1
o-Xylene	ND	0.5	0.1
Bromoform	ND	1.0	0.1
1,1,2,2-Tetrachloroethane	ND	0.5	0.1
1,3-Dichlorobenzene	ND	0.5	0.1
1,4-Dichlorobenzene	ND	0.5	0.1
1,2-Dichlorobenzene	ND	0.5	0.1
2-Chloroethylvinylether	NA		

Surrogate	%REC	Limits
Dibromofluoromethane	101	80-121
1,2-Dichloroethane-d4	105	80-134
Toluene-d8	98	80-120
Bromofluorobenzene	98	80-120

NA= Not Analyzed
ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

Batch QC Report

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Matrix:	Water	Batch#:	269069
Units:	ug/L	Analyzed:	03/29/19
Diln Fac:	1.000		

Type: BS Lab ID: QC970070

Analyte	Spiked	Result	%REC	Limits
1,1-Dichloroethene	20.00	19.91	100	65-133
Benzene	20.00	20.84	104	75-122
Trichloroethene	20.00	19.51	98	73-121
Toluene	20.00	19.78	99	78-120
Chlorobenzene	20.00	20.02	100	80-120

Surrogate	%REC	Limits
Dibromofluoromethane	101	80-121
1,2-Dichloroethane-d4	108	80-134
Toluene-d8	99	80-120
Bromofluorobenzene	96	80-120

Type: BSD Lab ID: QC970071

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	20.00	19.30	97	65-133	3	23
Benzene	20.00	19.12	96	75-122	9	20
Trichloroethene	20.00	18.95	95	73-121	3	20
Toluene	20.00	19.43	97	78-120	2	20
Chlorobenzene	20.00	19.89	99	80-120	1	20

Surrogate	%REC	Limits
Dibromofluoromethane	101	80-121
1,2-Dichloroethane-d4	105	80-134
Toluene-d8	100	80-120
Bromofluorobenzene	101	80-120

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Field ID:	GCW-1S-0319	Batch#:	269069
MSS Lab ID:	308458-002	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L	Analyzed:	03/30/19
Diln Fac:	1.000		

Type: MS Lab ID: QC970111

Analyte	MSS Result	Spiked	Result	%REC	Limits
1,1-Dichloroethene	<0.1000	12.50	13.68	109	54-148
Benzene	<0.1000	12.50	12.91	103	58-134
Trichloroethene	0.7331	12.50	12.80	97	47-141
Toluene	<0.1000	12.50	13.00	104	56-132
Chlorobenzene	<0.1000	12.50	12.37	99	57-131

Surrogate	%REC	Limits
Dibromofluoromethane	101	80-121
1,2-Dichloroethane-d4	106	80-134
Toluene-d8	108	80-120
Bromofluorobenzene	102	80-120

Type: MSD Lab ID: QC970112

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	12.50	14.19	114	54-148	4	54
Benzene	12.50	12.22	98	58-134	6	54
Trichloroethene	12.50	12.30	93	47-141	4	52
Toluene	12.50	12.96	104	56-132	0	55
Chlorobenzene	12.50	12.33	99	57-131	0	55

Surrogate	%REC	Limits
Dibromofluoromethane	100	80-121
1,2-Dichloroethane-d4	105	80-134
Toluene-d8	107	80-120
Bromofluorobenzene	99	80-120

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Matrix:	Water	Batch#:	269157
Units:	ug/L	Analyzed:	04/02/19
Diln Fac:	1.000		

Type: BS Lab ID: QC970432

Analyte	Spiked	Result	%REC	Limits
1,1-Dichloroethene	10.00	10.62	106	65-133
Benzene	10.00	10.74	107	75-122
Trichloroethene	10.00	9.884	99	73-121
Toluene	10.00	10.46	105	78-120
Chlorobenzene	10.00	10.19	102	80-120

Surrogate	%REC	Limits
Dibromofluoromethane	105	80-121
1,2-Dichloroethane-d4	97	80-134
Toluene-d8	106	80-120
Bromofluorobenzene	98	80-120

Type: BSD Lab ID: QC970433

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
1,1-Dichloroethene	10.00	10.18	102	65-133	4	23
Benzene	10.00	10.10	101	75-122	6	20
Trichloroethene	10.00	9.191	92	73-121	7	20
Toluene	10.00	9.931	99	78-120	5	20
Chlorobenzene	10.00	9.590	96	80-120	6	20

Surrogate	%REC	Limits
Dibromofluoromethane	104	80-121
1,2-Dichloroethane-d4	98	80-134
Toluene-d8	105	80-120
Bromofluorobenzene	97	80-120

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 624
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 624
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC970434	Batch#:	269157
Matrix:	Water	Analyzed:	04/02/19
Units:	ug/L		

Analyte	Result	RL	MDL
Acrolein	ND	10	2.0
Acrylonitrile	ND	10	2.0
Chloromethane	ND	1.0	0.3
Vinyl Chloride	ND	0.5	0.1
Bromomethane	ND	1.0	0.1
Chloroethane	ND	1.0	0.2
Trichlorofluoromethane	ND	1.0	0.1
1,1-Dichloroethene	ND	0.5	0.1
Methylene Chloride	ND	10	0.5
trans-1,2-Dichloroethene	ND	0.5	0.1
1,1-Dichloroethane	ND	0.5	0.1
cis-1,2-Dichloroethene	ND	0.5	0.1
Chloroform	ND	0.5	0.2
1,1,1-Trichloroethane	ND	0.5	0.1
Carbon Tetrachloride	ND	0.5	0.1
1,2-Dichloroethane	ND	0.5	0.2
Benzene	ND	0.5	0.1
Trichloroethene	ND	0.5	0.1
1,2-Dichloropropane	ND	0.5	0.1
Bromodichloromethane	ND	0.5	0.1
cis-1,3-Dichloropropene	ND	0.5	0.1
Toluene	ND	0.5	0.1
trans-1,3-Dichloropropene	ND	0.5	0.1
1,1,2-Trichloroethane	ND	0.5	0.1
Tetrachloroethene	ND	0.5	0.1
Dibromochloromethane	ND	0.5	0.1
Chlorobenzene	ND	0.5	0.1
Ethylbenzene	ND	0.5	0.2
m,p-Xylenes	ND	0.5	0.1
o-Xylene	ND	0.5	0.1
Bromoform	ND	1.0	0.1
1,1,2,2-Tetrachloroethane	ND	0.5	0.1
1,3-Dichlorobenzene	ND	0.5	0.1
1,4-Dichlorobenzene	ND	0.5	0.1
1,2-Dichlorobenzene	ND	0.5	0.1
2-Chloroethylvinylether	ND	10	1.2

Surrogate	%REC	Limits
Dibromofluoromethane	105	80-121
1,2-Dichloroethane-d4	99	80-134
Toluene-d8	106	80-120
Bromofluorobenzene	101	80-120

ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

California Title 22 Metals

Lab #:	308458	Project#:	HW BBI PORTLAND OM&M
Client:	CH2M	Location:	HW Portland
Field ID:	GCW-1D-0319	Diln Fac:	1.000
Lab ID:	308458-003	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	1.0	0.031	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Arsenic	1.2	1.0	0.025	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Barium	6.1	1.0	0.049	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Beryllium	ND	1.0	0.057	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Cadmium	ND	1.0	0.14	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Chromium	0.34 J	1.0	0.13	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Cobalt	ND	1.0	0.22	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Copper	0.44 J	1.0	0.32	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Lead	ND	1.0	0.043	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Mercury	ND	0.20	0.040	269017	03/28/19	03/28/19	METHOD	EPA 7470A
Molybdenum	0.15 J	1.0	0.038	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Nickel	0.38 J	1.0	0.13	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Selenium	ND	1.0	0.12	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Silver	ND	1.0	0.039	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Thallium	ND	1.0	0.23	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Vanadium	10	1.0	0.33	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Zinc	ND	10	2.0	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020

J= Estimated value
ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

California Title 22 Metals

Lab #:	308458	Project#:	HW BBI PORTLAND OM&M
Client:	CH2M	Location:	HW Portland
Field ID:	GCW-1D-0319-1	Diln Fac:	1.000
Lab ID:	308458-004	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L		

Analyte	Result	RL	MDL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	1.0	0.031	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Arsenic	1.1	1.0	0.025	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Barium	6.1	1.0	0.049	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Beryllium	ND	1.0	0.057	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Cadmium	ND	1.0	0.14	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Chromium	0.34 J	1.0	0.13	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Cobalt	ND	1.0	0.22	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Copper	0.43 J	1.0	0.32	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Lead	ND	1.0	0.043	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Mercury	ND	0.20	0.040	269017	03/28/19	03/28/19	METHOD	EPA 7470A
Molybdenum	0.14 J	1.0	0.038	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Nickel	0.40 J	1.0	0.13	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Selenium	ND	1.0	0.12	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Silver	ND	1.0	0.039	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Thallium	ND	1.0	0.23	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Vanadium	10	1.0	0.33	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020
Zinc	ND	10	2.0	269103	03/31/19	04/01/19	EPA 200.8	EPA 6020

J= Estimated value
ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

Batch QC Report

California Title 22 Metals

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	METHOD
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 7470A
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	269017
Lab ID:	QC969874	Prepared:	03/28/19
Matrix:	Water	Analyzed:	03/28/19
Units:	ug/L		

Result	RL	MDL
ND	0.20	0.040

ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	METHOD
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 7470A
Analyte:	Mercury	Batch#:	269017
Matrix:	Water	Prepared:	03/28/19
Units:	ug/L	Analyzed:	03/28/19
Diln Fac:	1.000		

Type	Lab ID	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC969875	2.000	2.171	109	80-120		
BSD	QC969876	2.000	2.220	111	80-120	2	20

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	METHOD
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 7470A
Analyte:	Mercury	Batch#:	269017
Field ID:	ZZZZZZZZZZ	Sampled:	03/27/19
MSS Lab ID:	308483-001	Received:	03/27/19
Matrix:	Water	Prepared:	03/28/19
Units:	ug/L	Analyzed:	03/28/19
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC969877	<0.04000	2.000	2.085	104	68-120		
MSD	QC969878		2.000	2.042	102	68-120	2	37

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 200.8
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 6020
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC970208	Batch#:	269103
Matrix:	Water	Prepared:	03/31/19
Units:	ug/L	Analyzed:	04/01/19

Analyte	Result	RL	MDL
Antimony	ND	1.0	0.031
Arsenic	ND	1.0	0.025
Barium	ND	1.0	0.049
Beryllium	ND	1.0	0.057
Cadmium	ND	1.0	0.14
Chromium	ND	1.0	0.13
Cobalt	ND	1.0	0.22
Copper	0.35 J	1.0	0.32
Lead	ND	1.0	0.043
Molybdenum	ND	1.0	0.038
Nickel	ND	1.0	0.13
Selenium	ND	1.0	0.12
Silver	ND	1.0	0.039
Thallium	ND	1.0	0.23
Vanadium	ND	1.0	0.33
Zinc	ND	10	2.0

J= Estimated value
ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 200.8
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 6020
Matrix:	Water	Batch#:	269103
Units:	ug/L	Prepared:	03/31/19
Diln Fac:	1.000	Analyzed:	04/01/19

Type: BS Lab ID: QC970209

Analyte	Spiked	Result	%REC	Limits
Antimony	100.0	102.0	102	80-120
Arsenic	100.0	97.28	97	80-120
Barium	100.0	100.9	101	80-120
Beryllium	100.0	96.65	97	80-120
Cadmium	100.0	101.2	101	80-120
Chromium	100.0	97.52	98	80-120
Cobalt	100.0	97.66	98	80-120
Copper	100.0	103.3	103	80-120
Lead	100.0	97.91	98	80-120
Molybdenum	100.0	99.38	99	80-120
Nickel	100.0	98.91	99	80-120
Selenium	100.0	100.6	101	80-120
Silver	100.0	104.1	104	80-120
Thallium	50.00	47.91	96	80-120
Vanadium	100.0	96.00	96	80-120
Zinc	100.0	99.39	99	80-120

Type: BSD Lab ID: QC970210

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	100.0	99.22	99	80-120	3	20
Arsenic	100.0	97.20	97	80-120	0	20
Barium	100.0	99.14	99	80-120	2	20
Beryllium	100.0	97.63	98	80-120	1	20
Cadmium	100.0	99.71	100	80-120	1	20
Chromium	100.0	98.16	98	80-120	1	20
Cobalt	100.0	98.01	98	80-120	0	20
Copper	100.0	99.71	100	80-120	4	20
Lead	100.0	97.52	98	80-120	0	20
Molybdenum	100.0	101.0	101	80-120	2	20
Nickel	100.0	99.19	99	80-120	0	20
Selenium	100.0	100.3	100	80-120	0	20
Silver	100.0	102.9	103	80-120	1	20
Thallium	50.00	47.96	96	80-120	0	20
Vanadium	100.0	96.93	97	80-120	1	20
Zinc	100.0	99.52	100	80-120	0	20

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Batch QC Report

California Title 22 Metals

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	EPA 200.8
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 6020
Field ID:	GCW-1D-0319	Batch#:	269103
MSS Lab ID:	308458-003	Sampled:	03/26/19
Matrix:	Water	Received:	03/27/19
Units:	ug/L	Prepared:	03/31/19
Diln Fac:	1.000	Analyzed:	04/01/19

Type: MS Lab ID: QC970211

Analyte	MSS Result	Spiked	Result	%REC	Limits
Antimony	<0.03096	100.0	99.32	99	76-120
Arsenic	1.183	100.0	98.05	97	75-125
Barium	6.100	100.0	105.7	100	75-125
Beryllium	<0.05721	100.0	98.54	99	77-125
Cadmium	<0.1418	100.0	99.58	100	75-120
Chromium	0.3363	100.0	95.33	95	78-120
Cobalt	<0.2189	100.0	94.92	95	80-120
Copper	0.4405	100.0	94.77	94	75-122
Lead	<0.04256	100.0	98.16	98	80-121
Molybdenum	0.1509	100.0	100.1	100	77-121
Nickel	0.3814	100.0	95.72	95	76-120
Selenium	<0.1154	100.0	99.23	99	75-122
Silver	<0.03948	100.0	101.9	102	75-120
Thallium	<0.2286	50.00	48.14	96	78-122
Vanadium	10.22	100.0	103.5	93	78-124
Zinc	<2.000	100.0	96.12	96	75-122

Type: MSD Lab ID: QC970212

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	100.0	100.1	100	76-120	1	20
Arsenic	100.0	96.90	96	75-125	1	20
Barium	100.0	104.7	99	75-125	1	20
Beryllium	100.0	98.44	98	77-125	0	20
Cadmium	100.0	98.08	98	75-120	2	20
Chromium	100.0	94.58	94	78-120	1	20
Cobalt	100.0	94.14	94	80-120	1	20
Copper	100.0	94.85	94	75-122	0	20
Lead	100.0	97.35	97	80-121	1	20
Molybdenum	100.0	101.3	101	77-121	1	20
Nickel	100.0	94.19	94	76-120	2	20
Selenium	100.0	97.18	97	75-122	2	20
Silver	100.0	103.1	103	75-120	1	20
Thallium	50.00	48.00	96	78-122	0	20
Vanadium	100.0	103.6	93	78-124	0	20
Zinc	100.0	96.51	97	75-122	0	20

RPD= Relative Percent Difference

ENTHALPY ANALYTICAL

Bromide

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	METHOD
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 300.0
Matrix:	Water	Batch#:	269102
Units:	mg/L	Received:	03/27/19
Diln Fac:	1.000		

Field ID: GCW-1D-0319 Sampled: 03/26/19 12:00
Type: SAMPLE Analyzed: 03/30/19 01:14
Lab ID: 308458-003

Analyte	Result	RL	MDL
Bromide	ND	0.20	0.040

Field ID: GCW-1D-0319-1 Sampled: 03/26/19 12:03
Type: SAMPLE Analyzed: 03/30/19 01:31
Lab ID: 308458-004

Analyte	Result	RL	MDL
Bromide	ND	0.20	0.040

Type: BLANK Analyzed: 03/29/19 23:12
Lab ID: QC970204

Analyte	Result	RL	MDL
Bromide	ND	0.20	0.040

ND= Not Detected at or above MDL
RL= Reporting Limit
MDL= Method Detection Limit

ENTHALPY ANALYTICAL

Batch QC Report

Bromide

Lab #:	308458	Location:	HW Portland
Client:	CH2M	Prep:	METHOD
Project#:	HW BBI PORTLAND OM&M	Analysis:	EPA 300.0
Field ID:	GCW-1D-0319-1	Diln Fac:	1.000
MSS Lab ID:	308458-004	Batch#:	269102
Matrix:	Water	Sampled:	03/26/19 12:03
Units:	mg/L	Received:	03/27/19

Type: LCS Analyzed: 03/29/19 23:30
Lab ID: QC970205

Analyte	Spiked	Result	%REC	Limits
Bromide	2.000	1.843	92	90-110

Type: MS Analyzed: 03/30/19 01:49
Lab ID: QC970206

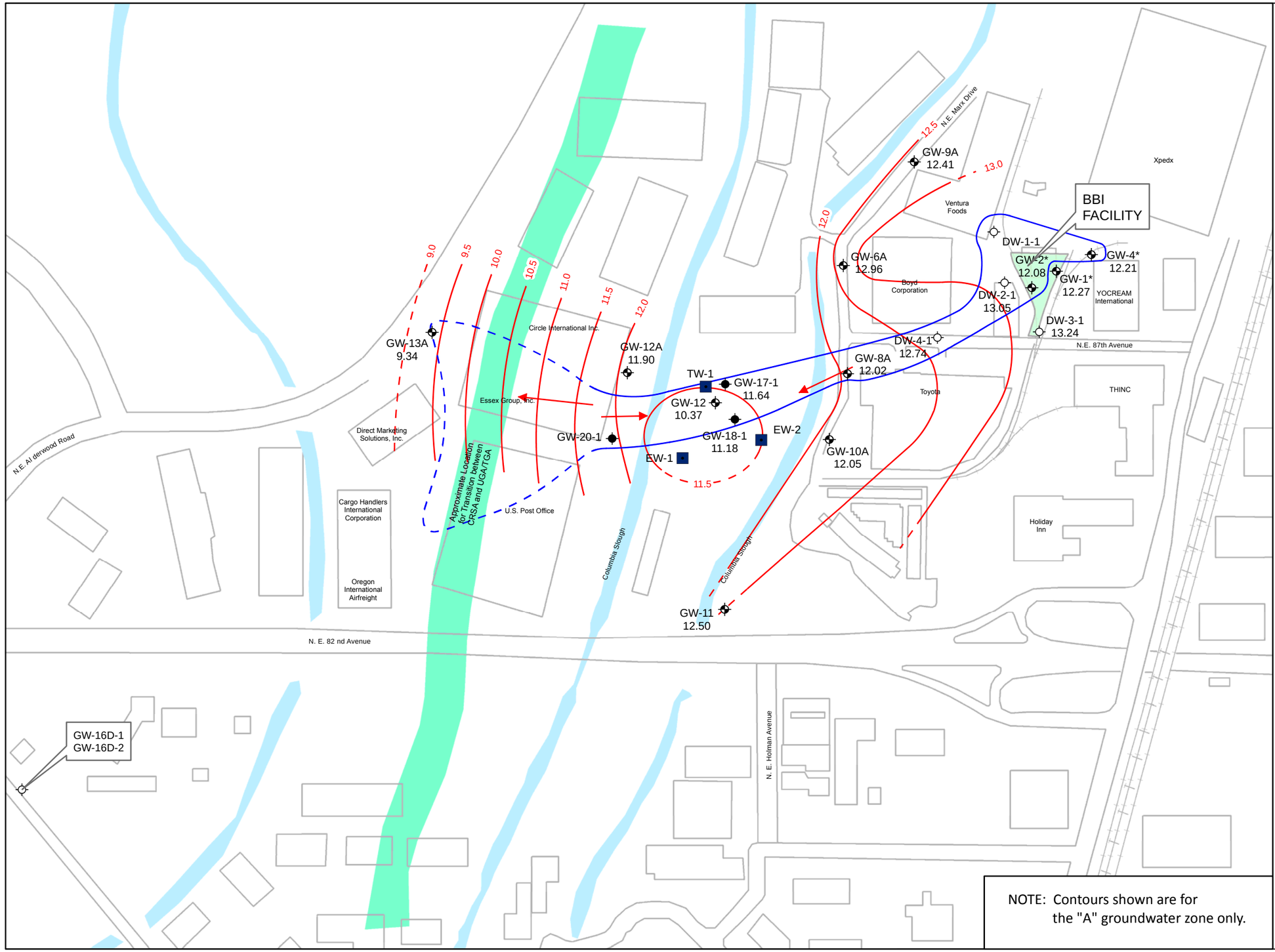
Analyte	MSS Result	Spiked	Result	%REC	Limits
Bromide	<0.04000	1.000	1.012	101	78-123

Type: MSD Analyzed: 03/30/19 02:06
Lab ID: QC970207

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Bromide	1.000	0.9355	94	78-123	8	20

RPD= Relative Percent Difference

Appendix B
Groundwater Potentiometric Surface Maps



Legend

- Groundwater Elevation in feet (Dashed Where Inferred)
- Extraction Well
- A Zone Monitoring Well (screened above -45 ft. elevation)
- C Zone Monitoring Well (screened between -45 ft. and -120 ft. elevation)
- D Zone Monitoring Well (screened below -120 ft. elevation)
- CMT Multilevel Well
- Tri-Level Monitoring Well (three separate wells screened at different depths)
- Inferred Groundwater Flow Direction
- Railroad Tracks
- Tax Lots
- Buildings
- MCL Remedial Action Area (5 ug/L concentration of maximum PCE or TCE concentrations from November 2018. Dashed where inferred).
- Approximate location for transition between CRSA and UGA/TGA. Localized steepening in hydraulic gradient associated with transition zone between CRSA and UGA/TGA.

Notes:
Potentiometric heads are relative to the City of Portland datum, which is approximately 1.375 feet above the National Geodetic Vertical Datum of 1929 (NGVD 29) and 2.10 feet above the North American Vertical Datum of 1988 (NAVD 88).

* Wells not included in contouring

N

0 250 500
Feet

NOTE: Contours shown are for the "A" groundwater zone only.

Figure B-1
Q4 2018 Groundwater Elevations in "A" Groundwater Zone
November 5 - 14, 2018
Former Baron-Blakeslee Facility
Portland, Oregon

JACOBS

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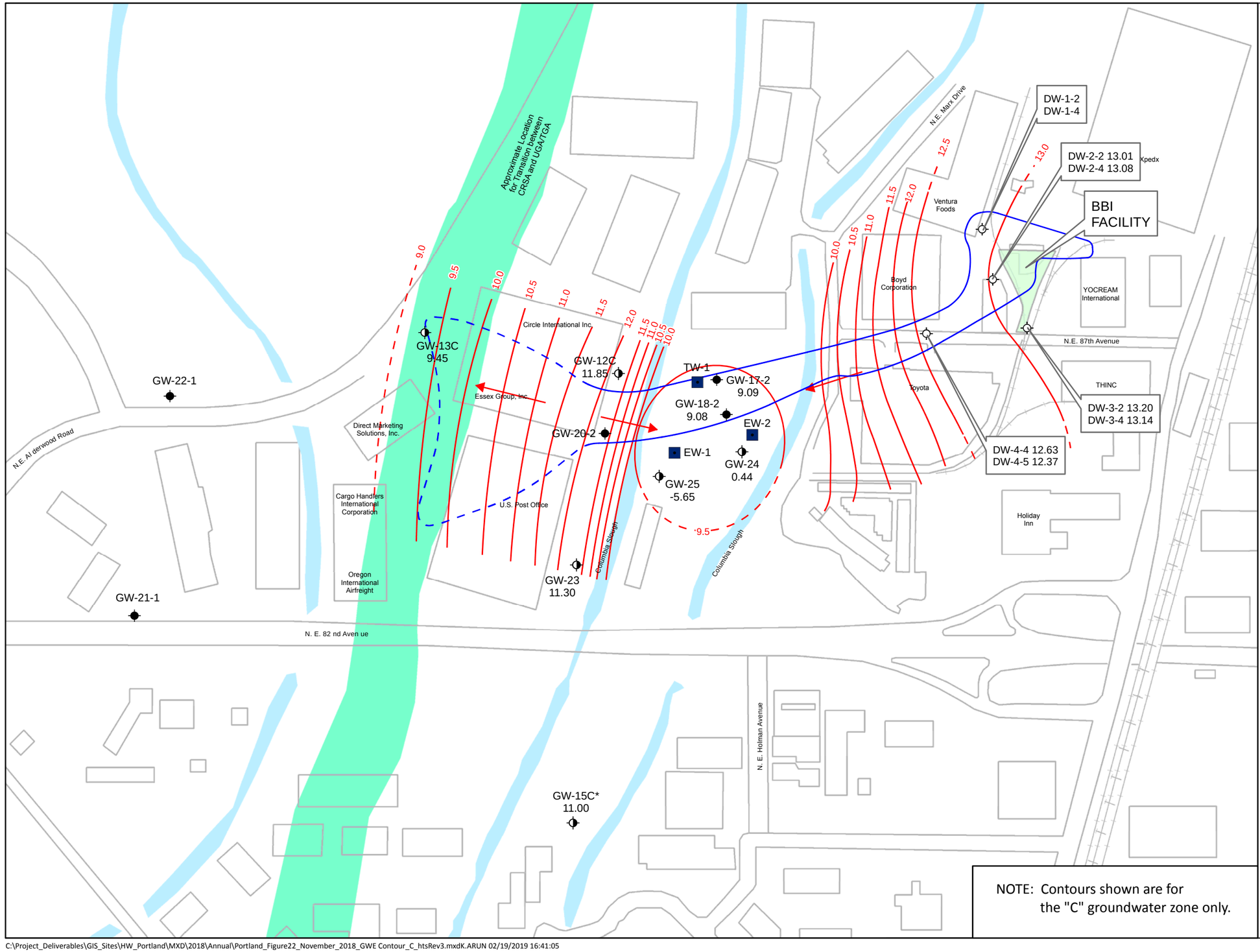

Legend

- Groundwater Elevation in feet (Dashed Where Inferred)
- Extraction Well
- A Zone Monitoring Well (screened above -45 ft. elevation)
- C Zone Monitoring Well (screened between -45 ft. and -120 ft. elevation)
- D Zone Monitoring Well (screened below -120 ft. elevation)
- CMT Multilevel Well
- Tri-Level Monitoring Well (three separate wells screened at different depths)
- Inferred Groundwater Flow Direction
- Railroad Tracks
- Tax Lots
- Buildings
- MCL Remedial Action Area (5 ug/L concentration of maximum PCE or TCE concentrations from November 2018. Dashed where inferred).
- Approximate location for transition between CRSA and UGA/TGA. Localized steepening in hydraulic gradient associated with transition zone between CRSA and UGA/TGA.

Notes:
Potentiometric heads are relative to the City of Portland datum, which is approximately 1.375 feet above the National Geodetic Vertical Datum of 1929 (NGVD 29) and 2.10 feet above the North American Vertical Datum of 1988 (NAVD 88).
* Wells not included in contouring.

N

0 250 500
Feet

NOTE: Contours shown are for the "C" groundwater zone only.

Figure B-2
Q4 2018 Groundwater Elevations in "C" Groundwater Zone
November 5 - 14, 2018
Former Baron-Blakeslee Facility
Portland, Oregon

JACOBS

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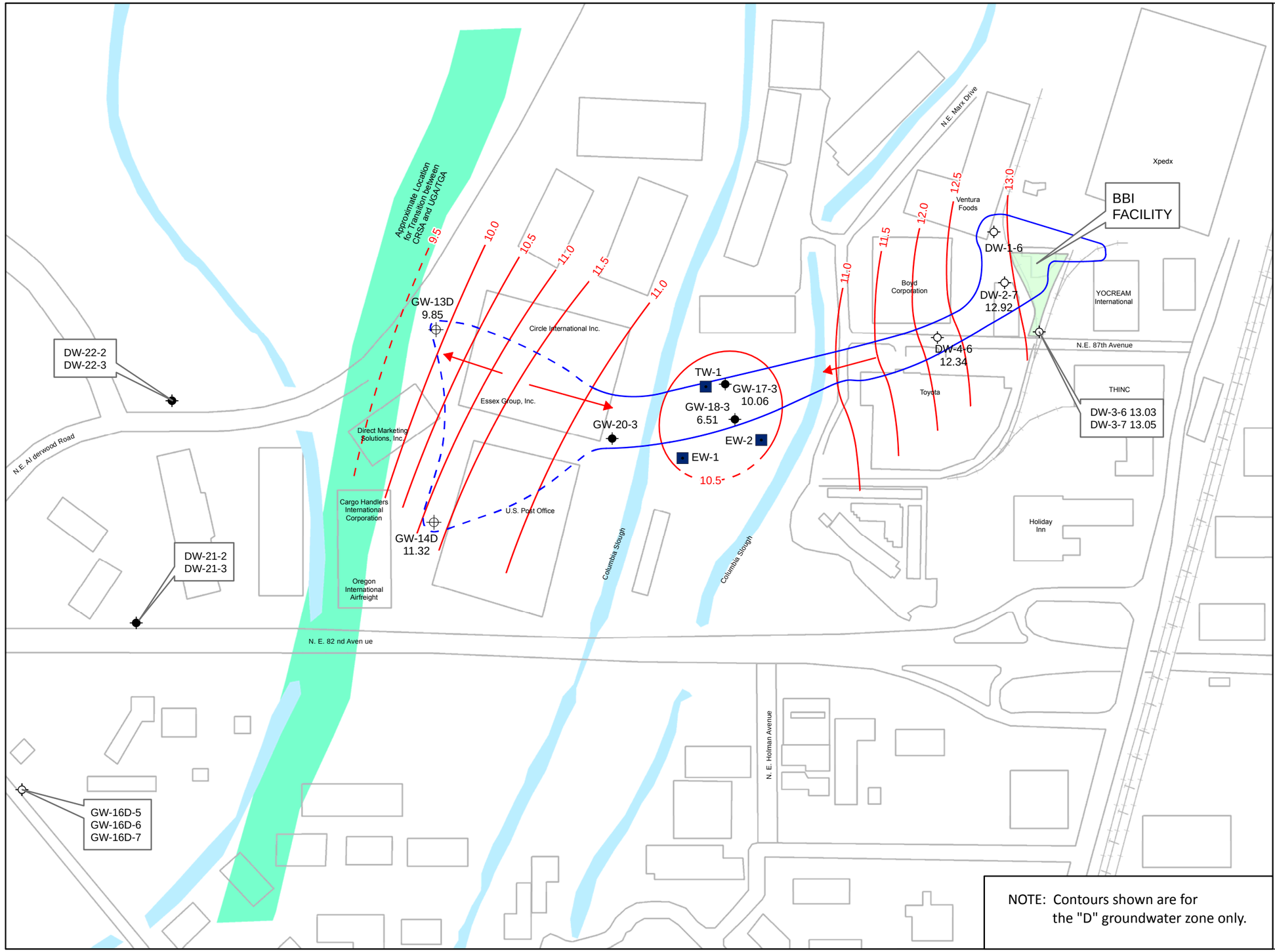

Legend

- Groundwater Elevation in feet (Dashed Where Inferred)
- Extraction Well
- A Zone Monitoring Well (screened above -45 ft. elevation)
- C Zone Monitoring Well (screened between -45 ft. and -120 ft. elevation)
- D Zone Monitoring Well (screened below -120 ft. elevation)
- CMT Multilevel Well
- Tri-Level Monitoring Well (three separate wells screened at different depths)
- Inferred Groundwater Flow Direction
- Railroad Tracks
- Tax Lots
- Buildings
- MCL Remedial Action Area (5 ug/L concentration of maximum PCE or TCE concentrations from November 2018. Dashed where inferred).
- Approximate location for transition between CRSA and UGA/TGA. Localized steepening in hydraulic gradient associated with transition zone between CRSA and UGA/TGA.

Notes:
Potentiometric heads are relative to the City of Portland datum, which is approximately 1.375 feet above the National Geodetic Vertical Datum of 1929 (NGVD 29) and 2.10 feet above the North American Vertical Datum of 1988 (NAVD 88).

N

0 250 500
Feet

NOTE: Contours shown are for the "D" groundwater zone only.

Figure B-3
Q4 2018 Groundwater Elevations in "D" Groundwater Zone
November 5 - 14, 2018
Former Baron-Blakeslee Facility
Portland, Oregon

JACOBS

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