Interim Remedial Action Annual Performance Report

Document No: PPS1206221113PDX
Revision No: Draft

Union Pacific Railroad Company

Grain Handling Facility at Freeman, Freeman, Washington

December 2022

Interim Remedial Action Annual Performance Report

Client Name:	Union Pacific Railroad Company		
Project Name:	Grain Handling Facility at Freeman, Freeman, Washington		
Document No:	PPS1206221113PDX	**Project No:**	UPSRWA05
Date:	December 2022	**Project Manager:**	David Hodson

Jacobs Engineering Group Inc.

2020 SW Fourth Avenue
3rd Floor
Portland, OR 97201
United States

T +1.503.235.5000
F +1.503.736.2000
www.jacobs.com

Interim Remedial Action Annual Performance Report
Grain Handling Facility at Freeman
Freeman, Washington

December 2022

Prepared for:

Washington State Department of Ecology
Toxics Cleanup Program – Eastern Region Office
4601 North Monroe Street
Spokane, WA 99205

Attention: Sandra Treccani

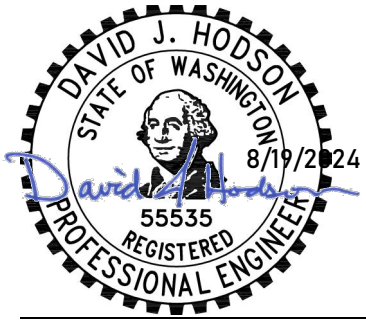
On behalf of:

Union Pacific Railroad Company
4315 E Sprague Avenue
Spokane, WA 99212

Cenex Harvest States, Inc.
14603 Highway 27
Freeman, WA 99015

Technical Certification

This report has been prepared under the direction of a Registered Civil Engineer in the State of Washington.



David J Hodson, P.E. No. 55535
Project Manager

December 23, 2022
Date

Executive Summary

This annual performance report for the Grain Handling Facility at Freeman (GHFF), located at 14603 Highway 27, Freeman, Washington (site) presents the performance to date of the groundwater extraction, treatment, and infiltration (GWETI) system installed as an interim remedial action (IRA) to address carbon tetrachloride and other constituents in groundwater. Ecology requested development of an IRA "to remove contaminant mass and lessen the risk to downgradient drinking water receptors." Construction of the GWETI system was completed in June 2021. The system consists of an extraction well, water treatment plant, and infiltration wells. Following a period of system shakedown testing, operation, troubleshooting, and operational improvements and modifications, consistent operation began in February 2022.

Through October 2022, the cumulative mass of carbon tetrachloride removed from groundwater is about 4.42 kilograms. While evaluation to determine the optimum extraction rate is ongoing, extraction at 25 gallons per minute (gpm) appears to establish an effective capture zone at an optimal location within the core of the contaminated aquifer without any observed adverse impact to the water supply and quality of the surrounding domestic wells. Additionally, the system is enhanced by providing clean (treated) infiltration water flushing the aquifer inward toward the core of the impacted area. Despite active system operation of less than 1 year and observed operational challenges, significant decreasing carbon tetrachloride trends have been observed in many domestic and monitoring wells.

Continued operation and monitoring is recommended to evaluate the capability to operate the GWETI system up to the full design capacity of the treatment system (about 50 gpm) and determine the optimum long-term operational flow rate.

Contents

Appendices

Tables

Figures

Acronyms and Abbreviations

ATP	adenosine triphosphate
bgs	below ground surface
CHS	Cenex Harvest States, Inc.
COC	constituent of concern
DBP	disinfection byproduct
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FSD	Freeman School District
GHFF	Grain Handling Facility at Freeman
gpm	gallon(s) per minute
GWETI	groundwater extraction, treatment, and infiltration
HDPE	high-density polyethylene
HP	horsepower
IRA	interim remedial action
Jacobs	Jacobs Engineering Group Inc.
kg	kilogram(s)
LGAC	liquid-phase granular activated carbon
MK	Mann-Kendall
MTCA	Model Toxics Control Act
Order	Enforcement Order No. DE 12863
PVC	polyvinyl chloride
RI	remedial investigation
SDR	standard dimension ratio
UPRR	Union Pacific Railroad Company

1. Introduction

On behalf of Union Pacific Railroad Company (UPRR) and in consultation with Cenex Harvest States, Inc. (CHS), Jacobs Engineering Group Inc. (Jacobs) has prepared this annual performance report for operation of the groundwater extraction, treatment, and infiltration (GWETI) system installed as an interim remedial action (IRA) at the Grain Handling Facility at Freeman (GHFF), located at 14603 Highway 27, Freeman, Washington (site). The GWETI system was constructed and operated in accordance with the January 2020 Third Revised Interim Action Work Plan, Grain Handling Facility at Freeman (IRA Work Plan) (Jacobs 2020a), approved by the Washington State Department of Ecology (Ecology) on January 9, 2020 (Ecology 2020a). Previously provided monthly performance reports and this annual report provide a summary of the system performance during operational portions of the period July 2021 through October 2022.

Figure 1-1 provides a site map; figures are presented at the end of the report.

1.1 Purpose and Scope

The purposes of this annual IRA performance report are the following:

- Describe the construction, physical characteristics, and general operating conditions of the GWETI system installed as an IRA at the site.
- Summarize the GWETI system operation, maintenance, and monitoring activities conducted to ensure proper system functioning, evaluate regulatory compliance, and provide the data necessary to document, evaluate, and optimize system performance.
- Document the performance to date of the GWETI system toward achieving the IRA data quality objectives (DQOs).
- Provide recommendations regarding the continued operation of the IRA

1.2 Regulatory Framework

A remedial investigation (RI) and other activities were conducted from May 2016 through August 2019 at the site in accordance with the 2015 Enforcement Order No. DE 12863 (2015 Order) issued to UPRR and CHS by Ecology (Ecology 2015). The purpose of the 2015 Order was to require the completion of an RI and feasibility study (FS) at the GHFF where there has been a suspected historical release. Ecology identifies carbon tetrachloride, carbon disulfide, and chloroform as constituents of concern (COCs). The 2015 Order required an RI to define the extent of contaminated media at the GHFF.

In compliance with the 2015 Order, an RI was conducted in accordance with the Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 Washington Administrative Code). The Site was listed on the U.S. Environmental Protection Agency (EPA) National Priorities List with the EPA site identification WAN001003081 on September 30, 2015. The draft RI report was submitted to Ecology on September 1, 2018 (Jacobs 2018).

Ecology requested that UPRR develop an IRA "to remove contaminant mass and lessen the risk to downgradient drinking water receptors" (Ecology 2018). The Ecology-approved IRA Work Plan (Jacobs 2020a) provided a description of the IRA. The IRA was designed to achieve these goals. The DQOs for the IRA include the following:

- Remove contaminant mass from the core of the plume, thereby reducing contaminant concentrations in groundwater and lessening the risk to downgradient drinking water receptors.
- Document and evaluate hydraulic and hydrogeochemical effects of the IRA on the local groundwater aquifers, the existing contaminant plume, and the domestic water supply wells to support final remedy selection.

The IRA is projected to remove a significant mass of carbon tetrachloride from the site and will reduce concentrations over time to meet the first DQO. The second DQO will be met as the IRA is operated and optimized over time.

After several revisions of a combined RI/FS report, a Draft Final RI/FS was submitted (Jacobs 2020b) and approved (Ecology 2020b) by Ecology on August 25, 2020. The Final RI/FS was submitted on February 3, 2021 (Jacobs 2021). The Final RI/FS recommended a final remedy consistent with the IRA. This annual performance report is submitted to support Ecology's evaluation of whether the current configuration of the GWETI system is accepted as the permanent cleanup action. If accepted as the permanent cleanup action, Ecology will issue a Draft Cleanup Action Plan.

1.3 Organization of this Report

This report is organized into the following sections:

- **Section 1, Introduction,** presents the purpose, regulatory framework, and general organization of the report.
- **Section 2, Interim Remedial Action Systems,** describes the primary features of the IRA and GWETI system.
- **Section 3, System Operation, Maintenance, and Monitoring,** describes the inspection, monitoring, and sampling tasks associated with the operation and maintenance of the GWETI system.
- **Section 4, System Performance,** summarizes the performance of the GWETI system during the operational period of February 2021 through October 2022.
- **Section 5, Conclusions and Recommendations,** summarizes the conclusions of this annual performance review for the GWETI system and provides recommendations for ongoing operation of the IRA.
- **Section 6, References,** provides a list of documents used in preparing this report.

2. Interim Remedial Action Systems

The Ecology-approved IRA Work Plan (Jacobs 2020a) describes the IRA consisting of groundwater recirculation (extraction, treatment, and infiltration) targeting the core of contaminated groundwater at the site and consisting of the following primary GWETI components (Figure 1-1):

- Groundwater extraction at one new well, EW-01, in the core of the impacted aquifer in the vicinity of well MW-19D and well cluster MW-27 through MW-31
- Treatment of extracted groundwater above ground using liquid-phase granular activated carbon (LGAC) at a new treatment plant located at the GHFF
- Infiltration (recirculation) of treated groundwater at four new wells located up- and cross-gradient of the plume (IW-01, IW-02, IW-03, and IW-04/IW-04R)
- Conveyance piping systems between the extraction and infiltration wells and the treatment plant

The IRA was constructed in accordance with the IRA Work Plan (Jacobs 2020a). However, some modifications (Section 2.3) to the construction, operation, and monitoring of the system were made to optimize its performance. These modifications are summarized in this section. Work was conducted in close coordination with and at the approval of Ecology.

This section describes the construction of the GWETI system, the initial shakedown testing and early operations period, system modifications, and the general treatment process train.

2.1 GWETI System Construction

Construction activities to install the GWETI system components (Figure 1-1) were completed during the period of June 2020 through June 2021.

2.1.1 Well Installation

A combination of sonic and air rotary drilling methods were used to advance pilot borings for downhole testing and subsequent drilling and installation of four injection wells (IW-01 through IW-04) and one extraction well (EW-01). Borehole drilling, downhole testing, and well construction activities were conducted from July 2020 to March 2021. Well boring logs and well completion diagrams are included in Appendix A.

A combination of sonic and air rotary drilling methods were used to first advance pilot borings for downhole testing prior to installing EW-01, IW-01, and IW-04. Pilot borings were advanced through unconsolidated materials and the underlying basalt down to the local granite formation. After drilling, the pilot boreholes were left open to conduct downhole testing, consisting of optical televiewer and three-arm caliper logging, ambient hydro-logging, pumping hydro-logging, and discrete interval packer testing. Deionized water was used during hydro-testing to identify zones where groundwater was entering the borehole from the basalt formation. Areas showing the greatest flow into the boring were isolated with packers and tested individually, and groundwater samples with water quality parameters were collected. Downhole testing results were used to finalize the well designs for EW-01, IW-01, and IW-04. Ecology approved the well designs prior to installation.

Following downhole testing at pilot boreholes, the following wells were installed:

- IW-01: 6-inch steel blank casing to 87 feet below ground surface (bgs) with nominal 6-inch open borehole (no well screen) to 143 feet bgs
- IW-02: 6-inch Schedule 80 polyvinyl chloride (PVC) casing with 0.020-inch slot stainless steel well screen from 21 to 54 feet bgs
- IW-03: 6-inch Schedule 80 PVC casing with 0.020-inch slot stainless steel well screen from 21 to 54 feet bgs

- IW-04: 6-inch Schedule 80 PVC casing with 0.060-inch slot stainless steel well screen from 42 to 172.5 feet bgs
- EW-01: 6-inch steel blank casing to 91.5 feet bgs with nominal 6-inch open borehole (no well screen) to 202 feet bgs

A combination of sonic and air rotary drilling methods was used to complete EW-01, IW-01, and IW-04, while only sonic was used for IW-02 and IW-03. The final wells for EW-01, IW-01, and IW-04 were installed within 5 to 7 feet of the corresponding pilot location (IW-02 and IW-03 did not have pilot borings and were installed within the initial sonic boreholes). Following well construction activities, the wells were developed using a submersible pump until field parameters stabilized with clear water or the well pumped dry. During well development, approximately 2,750 gallons of water were pumped from EW-01, 1,800 gallons from IW-01, 85 gallons from IW-02, 160 gallons from IW-03, and 1,750 gallons from IW-04. Remediation-derived waste from the well installation and development activities included drill cuttings and development water, which were removed from the site and transported to approved waste disposal facilities.

2.1.2 Treatment System Installation

Remediation construction included installation of the groundwater treatment plant and system controls, conveyance piping systems, and underground wellhead vaults and appurtenances.

System conveyance piping and collocated electrical supply wiring were installed in underground trenches and through a horizontally drilled steel conduit underneath Highway 70 (Figure 1-1). The extraction and infiltration wellheads were completed within underground concrete vaults with locking metal lids. The treatment plant was constructed within a climate-controlled steel building on a concrete slab and footing foundation.

Construction activities began in June of 2020 and were completed in June of 2021, concluding with treatment plant and conveyance piping shakedown testing.

2.1.2.1.1 Well Vault Components

The extraction and infiltration well vaults include the following equipment:

- Well water level transmitter
- Well piping pressure transmitter
- Variable speed, stainless steel, 4-inch, 2-horsepower (HP), 460-volt 3-phase, Grundfos Model SP 45S20-5 submersible extraction pump with pump fault controls (EW-01 only)
- Vault flood sensor and alarm controls (infiltration wells only)
- Heat trace freeze prevention and controls

2.1.2.1.2 Conveyance Piping System

The piping system includes the following:

- High-density polyethylene (HDPE), standard dimension ratio (SDR) 11 piping to injection wells; 2-inch piping to infiltration wells IW-01 and IW-04, and 1-inch piping to wells IW-02 and IW-03
- Double containment piping consisting of a 2-inch inside by 4-inch outside HDPE SDR 11 by 17 piping between extraction well EW-01 and the treatment plant, including electronic leak detection and alarming
- 10-inch diameter steel casing conduit (0.25-inch-thick wall) beneath Highway 70
- Detectable marking tape installed in trench bedding/fill above all pipeline runs

2.1.2.1.3 Treatment Plant

The GWETI treatment plant includes the following equipment:

- Feed (influent) tank and effluent tank: Poly Processing (Model 1101150) 1,150-gallon integrally molded flange outlet polyethylene tanks with level transmitters
- LGAC vessels: two 4-foot-diameter, Calgon Model LM-72 vessels in a series (lead-lag) configuration
- LGAC manifold: manually operated ball valve manifold to establish reversible lead-lag LGAC vessel order and supporting carbon backflushing
- Bag filters: two Rosedale Model 6, duplex bag filters with high-efficiency bags (one pre-treatment and one post-treatment)
- Feed pump: variable speed, stainless steel, 1.5-HP, 460-volt 3-phase Grundfos Model CRI 10-2 A-CA-A-V-HQQV vertical multistage centrifugal pump
- Infiltration pump: variable speed, stainless steel, 1.5-HP, 460-volt 3-phase Grundfos Model CRI 10-2 A-CA-A-V-HQQV vertical multistage centrifugal pump
- Infiltration manifold: individual injection well flow totalizers, piping pressure transmitters, and electronic flow control valves
- System controls: remotely operable programmable logic controller with local and wi-fi remote log-in human machine interface; includes system alarms email notification system

2.2 System Shakedown Testing and Initial Operation

Shakedown testing of the GWETI system was completed during June 2021 to confirm proper functioning of local and remote-operating human-machine interface controls, system pumps, level transmitters and controls, flow and valve controllers, major alarm systems, and building climate control systems. Full-time system operation began on July 6, 2021. It was quickly determined that infiltration well IW-04 exhibited significantly lower well capacity than was observed during the initial adjacent pilot borehole testing program and was only able to accommodate about 2.5 gallons per minute (gpm), so IW-01 would need to be the primary infiltration well. IW-02 and IW-03 were expected to have low capacity because of purposeful completion within the fine-grained overburden sediments overlying the productive basalt. IW-02 was able to accommodate less than 0.2 gpm, while IW-03 was able to accommodate about 1 gpm. IW-01 was able to accommodate a range of flows up to 15 gpm that were planned during the initial 2 months of system operation.

The GWETI system was taken offline on August 25, 2021, because of a rapid loss of capacity resulting in vault flooding alarm conditions at primary IW-01. Downhole camera inspections, specialty lab sample collection and analyses, and field testing identified bacterial fouling of IW-01 that was intensified by oxygenation of treated water at and between the treatment plant and the infiltration well. The oxygenation was determined to be largely a result of necessary plant operating conditions during early months of GWETI system operation. During this time, low flow rates were required to assess potential impacts of EW-01 extraction on nearby domestic supply wells. These low-flow operating conditions led to regular on-off cycling of infiltration well IW-01 that exacerbated the issue due to short-term vacuum conditions in wellhead piping and entry of air via an air/vacuum release valve included as part of a design to remove air during expected long-term infiltration conditions.

The GWETI system remained off until February 2022, during which time the following took place:

1. Identification and resolution of operating conditions and equipment contributing to treated effluent oxygenation
2. Procurement of a specialty well reconditioning vendor to restore IW-01 well capacity

3. Development of a bacterial fouling monitoring and disinfection plan for conducting infiltration well disinfection shock treatments and evaluating the potential installation of an automated disinfection metering system at the treatment plant

Following IW-01 rehabilitation and treatment system operating condition and equipment modifications to reduce or eliminate oxygen entry, the GWETI system resumed operation on February 18, 2022. A bacterial monitoring program was implemented following system restart, as described in Section 3.

2.3 Treatment System Modifications

Various GWETI system components and operations were modified as follows to reduce or eliminate oxygenation of treated effluent directed to the infiltration wells:

- Drop piping was added to the inlets of the feed and effluent tanks to eliminate free-fall of water directed into the tanks.
- A combination air vent and vacuum release valve within the well vault piping was isolated by closing an existing manually operated ball valve to eliminate oxygen entry during times when the well vault piping experiences mild vacuum conditions.
- The drop piping within operating infiltration wells was replaced with a flexible drop hose, terminated with a constant flow fitting. The constant flow fitting provides light backpressure that generally eliminates the potential for vacuum conditions in the drop hose; the fittings allow a designated maximum flow to pass above the point at which the line pressure would increase but flow would not. The sizing of the constant flow fitting is changed to match the desired infiltration rate for a given well; the flexible drop hose greatly simplifies the changing of the flow fitting versus changing flow fittings with hard piping.
- System operating conditions were revised to establish the extraction well flow rate (treatment plant influent) at least 1 gpm higher than the total flow directed to infiltration wells. This change allows the infiltration pump to run continuously while only the extraction well pump cycles on/off when balancing tank levels at the plant. The previous cycling of infiltration wells was determined to be a primary contributor to biofouling.

Infiltration wells IW-02 and IW-03 were turned off and isolated when the GWETI system was restarted on February 18, 2022. Well IW-02 was only able to accommodate infiltration flow of less than 0.2 gpm, which was below the control limits achievable by the installed flow control valve. Well IW-03 was only able to accommodate infiltration flow of 0.8 to 1 gpm, and this flow rate was determined to be of limited value at this time. Potential infiltration to IW-03 in the future will continue to be evaluated over time.

Based on findings from the bacterial monitoring program (Section 3), it was determined that an automated chlorine metering system would provide the most cost-effective control of biofouling versus conducting routine down-well chlorine shock treatments. IW-01 shock treatments were sometimes necessary every 1 to 2 weeks of operation to keep bacterial growth below target values in the absence of chlorination applied at the treatment plant. A chlorine dosing/metering system was installed during September 2022 and set to provide a target chlorine residual of 2 parts per million to the treated water leaving the plant.

The original infiltration well IW-04 was found to exhibit significantly lower well capacity than was observed during the initial adjacent pilot borehole testing program, so a higher capacity replacement, IW-04R, was drilled and developed during the July through September 2022 time period. The boring lithology and well construction logs are provided in Appendix A. The concrete subsurface well vault and wellhead appurtenances were moved from IW-04 to IW-04R, and the conveyance piping was redirected to the replacement well location during September 2022. The original IW-04 well was converted to a monitoring well completed with a 12-inch-diameter flush-mount well box with a steel bolt-down lid installed within a small concrete pad. Infiltration at the new IW-04R was initiated on September 30, 2022.

2.4 GWETI System Operations Description

The IRA was predicted via groundwater model simulations (Jacobs 2020a) to provide effective hydraulic capture of the core of contaminated groundwater and to provide valuable clean water flushing through the aquifer. The extraction well location was selected to be within a relatively high concentration area, just upgradient of water supply wells, and is within a fairly uniform fractured basalt unit that will facilitate effective contaminant mass removal. The infiltration wells are at the up- and cross-gradient margins just outside of the existing carbon tetrachloride plume and will enhance aquifer restoration efforts by directing clean water flushing toward the interior extraction well. Infiltration is also intended to mitigate potential aquifer dewatering from groundwater extraction alone, thus limiting adverse impacts on nearby domestic water wells and providing a net-zero impact on the volume of groundwater in the aquifer system.

The overall GWETI system operation and treatment process train incorporates the following:

- The EW-01 well pump extracts groundwater conveyed in piping to the treatment plant and discharges the groundwater via drop pipe into the feed tank. Depending on the overall system control scheme desired, the EW-01 pump can do either of the following:
  - Turn on or off at a fixed pump speed (flow rate) based on operator-defined low (pump on) and high (pump off) feed tank levels.
  - Use variable pump speed control to maintain an operator-defined fixed feed tank level and continuous water to downstream treatment plant demands.
- The feed pump transfers water from the feed tank through a duplex bag filter and the lead-lag LGAC vessels, and into the effluent tank via a drop pipe. Depending on the overall system control scheme desired, the feed pump can do either of the following:
  - Turn on or off at a fixed pump speed (flow rate) based on operator-defined low and high feed tank and/or effluent tank levels.
  - Use variable pump speed control to maintain an operator-defined fixed effluent tank level and continuous water to downstream treatment plant demands.
- The lead-lag LGAC vessels remove (adsorb) COCs from groundwater during passage through the activated carbon. Monthly samples are collected at influent, midpoint, and effluent sampling ports at the LGAC manifold to 1) evaluate overall COC removal and confirm effluent achieves the cleanup criteria; and 2) evaluate when the lead vessel is near contaminant saturation and requires a carbon exchange. Following a carbon exchange for a lead vessel, the former lag vessel is plumbed to be the new lead vessel, and the freshly exchanged vessel is plumbed in the lag position.
- The infiltration pump transfers water from the effluent tank, through a duplex bag filter and a metered chlorine injection system, and through flow controllers and conveyance piping to individual infiltration wells. Depending on the overall system control scheme desired, the infiltration pump operating options include, but are not limited to, the following:
  - Turn pump on or off at a fixed speed (flow rate) based on operator-defined low and high effluent tank levels (undesirable because of potential oxygenation when cycling infiltration wells).
  - Maintain an operator-defined pump speed (flow rate) to maintain operator-defined (or down-well constant flow device limited) fixed continuous infiltration flow rates.
  - Use variable pump speed control to maintain an operator-defined pipeline pressure feed for the infiltration manifold flow control valves that are individually programmed to operator-defined flow rates to individual infiltration wells.
- Chlorine is metered into the treated effluent at a point between the effluent bag filter and the infiltration well distribution manifold and flow controllers. Chlorine dosing is tied to an inline flow meter that can communicate with a peristaltic chlorine delivery pump injecting 5.25 percent sodium hypochlorite through an injection quill in the system piping, followed by passage through a static inline mixer.

- The infiltration well down-well discharge hoses can be terminated with assorted constant flow limiting devices (Dole valves). The constant flow limiting devices can be used to establish a pre-determined flow rate for each well where the associated treatment plant flow control valve is simply left fully open. On the other hand, the down-well constant flow limiting devices can be selected to provide a safety ceiling flow rate limit while the treatment plant flow control valves maintain steady individual infiltration well flows at rates below those of the down-well flow limiters.

3. System Operation, Maintenance, and Monitoring

This section describes the operation, maintenance, and monitoring activities conducted for the GWETI system to ensure proper functioning, maximize system uptime, evaluate regulatory compliance, and provide the data necessary to document, evaluate, and optimize system performance toward the IRA objectives.

3.1 Treatment System Inspections and Data Collection

In accordance with the IRA Work Plan (Jacobs 2020a), long-term monitoring of the GWETI system is conducted at least monthly to evaluate and document system operation, including the following:

- Inspect extraction and injection wellheads, in-vault piping/fitting connections, and totalizing flow meters.
- Inspect aboveground extraction and injection piping and fittings, including sampling ports and connections to the treatment system.
- Record current flow rate and cumulative extracted and injected groundwater volume from each totalizing flow meter.
- Inspect the treatment system, including piping, fittings, pumps, carbon vessels, instrumentation, control systems, and power supply.
- Record readings from all treatment system flow and pressure gauges.
- Download depth-to-water transducer data for the new extraction well and each injection well.
- Download depth-to-water transducer data from the IRA monitoring network.

The above data are generally recorded automatically at 1-minute intervals by the treatment plant and reported via automated daily emails to system operators; manual data downloads are occasionally required.

3.2 Treatment System Sampling

In accordance with the IRA Work Plan (Jacobs 2020a), treatment system samples of the influent, midpoint, and treated effluent water at the treatment plant are collected from sampling ports installed before, between, and after the two LGAC treatment vessels. These samples are used to evaluate the LGAC vessel change-out schedule. Treatment plant water samples are handled consistent with the existing quarterly groundwater monitoring program and submitted to a Washington-certified laboratory for analysis of volatile organic compounds. A carbon exchange for the lead LGAC vessel is scheduled when midpoint treatment system samples indicate that the lead vessel is nearing contaminant saturation. The decision criteria for conducting a lead LGAC vessel carbon exchange include the following:

- Midpoint sample (and confirmation sample) chloroform concentration equal to or exceeding the MTCA Method B Cancer criteria of 1.4 micrograms per liter

OR

- Midpoint sample (and confirmation sample) carbon tetrachloride concentration equal to or exceeding 10 percent of the influent carbon tetrachloride concentration

Following a carbon exchange for a lead vessel, the former lag vessel is plumbed to be the new lead vessel, and the freshly exchanged vessel is plumbed into the lag position.

The first carbon exchange was triggered by midpoint treatment system samples collected on August 24, 2022, and confirmation samples collected on August 30, 2022. The first carbon exchange was conducted during September 2022, including manufacturer-recommended carbon backflushing, and the fresh LGAC vessel was plumbed into the lag position.

Table 3-1 (tables are presented at the end of the report) summarizes the treatment system sampling results for carbon tetrachloride, chloroform, and carbon disulfide.

3.3 Microbial Monitoring Program and Disinfection System

As described in Section 2, the GWETI system was not operable from August 25, 2021 through February 17, 2022, because of bacterial fouling of one infiltration well. Following well rehabilitation in February 2022, the system resumed operation with additional bacterial monitoring, including collection of grab samples for field analysis of dissolved oxygen and adenosine triphosphate (ATP), which is a molecule present in living cells and commonly used as a direct analog for biological concentration. The field ATP meter used bioluminescence chemistry to measure biological concentration in relative light units; replicate grab ATP samples were periodically submitted to a specialty lab to identify a potential correlation of field instrument relative light unit values to biological concentration values in cells per milliliter.

A simple correlation was not apparent after several weeks of sampling, and the field ATP sampling was discontinued, although samples for laboratory analysis continued to be collected regularly. Laboratory ATP values exceeding 100,000 cells per milliliter were used to identify the timing of periodic disinfection (chlorine) shock treatments to the primary infiltration well IW-01. Shock treatments were regularly triggered and performed during the period of March through June 2022, sometimes within only 1 to 2 weeks of the previous treatment. Dissolved oxygen and ATP sampling results through October 2022 are provided in Tables 3-2 and 3-3, respectively.

The high frequency of triggered IW-01 disinfection shock treatments indicated that direct disinfection of treatment plant effluent water would be more cost effective and less disruptive for long-term control of infiltration well biofouling, and a metered disinfection injection system design was prepared and approved by Ecology (Ecology 2022). The disinfection system began operation in September 2022, and chlorine dosing was set to a target of 2 parts per million for treatment plant effluent. No shock treatments were triggered through October 2022 following startup of the disinfection system. Laboratory ATP samples will be collected at least monthly from IW-01 and IW-04R until data indicate a reduction in frequency is warranted.

3.4 Disinfection Byproduct Monitoring Program

A disinfection byproduct (DBP) monitoring program was implemented to evaluate the potential generation and distribution of disinfection byproducts within infiltration wells resulting from individual well chlorine shock treatments or metered disinfection of treatment plant effluent. Table 3-4 presents the plan and objectives for the DBP monitoring program. Samples are collected and analyzed for trihalomethanes (Method 524.3), haloacetic acids (Method 552.3), and total residual chlorine (Method 4500CL G). Sampling and analysis for DBPs is anticipated to be included until data indicate that potential generation of DBPs would not adversely affect drinking water. DBP results through October 2022 are presented in Table 3-5.

3.5 Groundwater Monitoring Program

A long-term quarterly groundwater monitoring program has been in place for monitoring wells and domestic supply wells at the site since the RI. The groundwater monitoring program includes collection of groundwater levels and groundwater samples for analysis of volatile organic compounds at a Washington-certified laboratory. A summary of water levels and laboratory analytical results is provided to Ecology on a quarterly basis.

Twenty one water level transducers (plus one spare) were installed in select IRA monitoring wells on July 13, 2021, and set to record measurements every 10 minutes. Table 3-6 summarizes the instrumented wells, the measured depth to water during installation, and the sensor reference depth for each transducer.

4. System Performance

This section summarizes the performance of the GWETI system toward achieving the IRA DQOs identified in the IRA Work Plan (Jacobs 2020a). The GWETI system performance is evaluated as follows:

- Reviewing the extraction well pumping rates implemented during system operation through October 2022 and the associated hydraulic responses of the pumping and surrounding monitoring wells to evaluate the zone of influence, or capture zone, of the extraction well and potential adverse impact on water levels at surrounding domestic and Freeman School District (FSD) drinking water wells
- Documenting the mass of site COCs removed by the GWETI system over time
- Performing a review of monitoring well sampling data to evaluate the presence of statistically significant trends toward achieving the IRA DQOs

4.1 Extraction Flow Rate and Water Level Measurement

The EW-01 extraction rate was set to 12 gpm beginning at system startup on July 6, 2021, increased to 15 gpm on July 13, 2021, and further increased to about 19.5 gpm on July 20, 2021. This extraction flow rate was maintained until the treatment system required shutdown in late August 2021, to evaluate a loss of infiltration capacity at IW-01, which was determined to be a result of bacterial fouling. The treatment system was off during evaluation, testing, and implementation of corrective actions to address bacterial fouling of IW-01. The treatment system was brought back online on February 18, 2022, with an EW-01 target extraction rate of 18 gpm established and maintained through late September 2022 with the exception of maintenance and repair disruptions. This slightly lower flow rate was a result of stopping infiltration at IW-02 and IW-03 because of low well capacity. The extraction rate set point was increased to 22 to 25 gpm during October 2022. These extraction rate set points specify the flow delivered by the EW-01 pump during times when the pump is on. Because of regular pump on/off cycling and system downtime events, the effective flow rate averaged over daily, weekly, and monthly time scales is less than the set point.

Figure 4-1 plots the EW-01 extraction rate and the EW-01 water levels for the period of February through October 2022. The regular cycling of EW-01 (about 15 minutes off every 1.5 to 2 hours) is evident given the flow rate measurements (orange points) ranging between zero and somewhat above the set point, while the thick band of orange measurements is centered on the EW-01 rate set point of 18 gpm during the period of February through September 2022. The consistent on/off cycling of the EW-01 pump leads to similar fluctuation in the recorded EW-01 water level, which is visible on Figure 4-1 as a blue band of measurements between higher water levels when the pump is off and lower water levels when the pump is running at 18 gpm. The magnitude of this water level fluctuation during EW-01 pump cycling is about 10 feet (thickness of blue band on Figure 4-1), while longer EW-01 off periods during system shutdowns exhibit about 1 additional foot of rise to the natural static water level (rise noted above gaps in the blue band on Figure 4-1). The rapid recovery of water levels during the brief 15-minute off periods of EW-01 cycling are a favorable indicator of high well capacity, while the very consistent 10-foot water level fluctuation (blue band thickness) over the course of 9 months indicates that this well's capacity remains stable over long periods with no hydraulic evidence of well fouling.

IW-04R became operational on September 30, 2022, allowing the extraction rate to be increased to about 22 gpm through most of October 2022. The capacity of IW-04R was further increased once the wellhead was fully sealed to allow low-pressure injection, and the EW-01 extraction rate was set to about 25 gpm on October 27, 2022. These extraction rate increases are visible on Figure 4-1 as orange measurement bands centered at 22 and 25 gpm, respectively. These increased October 2022 extraction rates exhibit the expected additional water level declines to about 68 feet bgs (additional 3.5 feet versus 18 gpm extraction rate) and 71 feet bgs (further 2.5 feet) for rates of 22 and 25 gpm, respectively (blue bands on Figure 4-1).

4.2 Groundwater Response

As described in Section 3, 21 water level transducers (plus one spare) were installed on July 13, 2021 and set to record measurements every 10 minutes. Table 3-6 summarizes the instrumented wells, the measured depth to water during installation, and the sensor reference depth for each transducer.

Figure 4-2 plots the water level response to the February 18, 2022 treatment system restart event with the extraction well flow set to 18 gpm; water levels are shown for nearby monitoring wells MW-11S, MW-30, and MW-19D based on data from the transducers, downloaded through October 2022. Treatment system data for extraction well EW-01, shown in Figure 4-2, are corrected from system readings of "feet below flange" to "feet bgs" (offset of -2.5 feet) for more direct comparison against transducer data also corrected to feet bgs, and the transducer data shown are the average daily water level for each monitoring well.

Figures 4-1 and 4-2 both show the cyclic behavior of EW-01 water levels (blue banding) while Figure 4-2 shows the net response of nearby monitoring wells to this cyclic extraction. As on Figure 4-1, Figure 4-2 illustrates that the 18-gpm EW-01 extraction rate set point leads to about 10 feet of water level decline at EW-01 (blue banding thickness), with an additional 3.5 feet and 2.5 feet of water level decline for extraction rates of 22 gpm and 25 gpm, respectively.

EW-01 and the adjacent monitoring wells all exhibit the same seasonal trend in gradual water level rise between late winter and late spring and gradual water level decline between early summer and late autumn. These seasonal changes result from groundwater recharge during spring snowmelt and precipitation followed by regional groundwater pumping to support FSD irrigation during the dry summer and autumn. Figure 4-2 illustrates the clear, yet distance-dependent, influence of EW-01 pumping on surrounding wells, particularly for well MW-19D, as evidenced by a spike in monitoring well water levels (recovery) when EW-01 pumping stops because of planned or unplanned system downtime (gaps in blue banding). The direct influence of EW-01 on surrounding monitoring wells is best illustrated during a week in late October 2022, when the treatment system remained off for about 1 week for a feed pump seal leak and seal replacement. During this time, EW-01, MW-19D, MW-30, and MW-11S all exhibited a return to local static water levels followed by clear drawdown when EW-01 was turned back on. The magnitude of water level response to EW-01 restart at 25 gpm following repairs was about 1 foot at well MW-11S, 2.5 feet at well MW-30, and 7.5 feet at MW-19S (Figure 4-2). These responses in surrounding monitoring wells provide an indication of the radial influence, or approximate capture zone, of EW-01 within the basalt aquifer.

The water level responses at MW-19D, MW-30, and MW-11S to EW-01 extraction at 25 gpm, as measured on Figure 4-2, are shown on Figure 4-3 to illustrate the approximate EW-01 capture zone at this pumping rate. Wells MW-30 and MW-11S are both screened in the uppermost portion of the shallow basalt at distances of about 40 feet and 200 feet, respectively, from EW-01. The actual hydraulic capture zone for EW-01 would be somewhat larger than the area exhibiting clear, measurable (within the interpreted 1-foot contour line) EW-01 radial influence on surrounding wells.

The measurable influence at MW-19D, screened within the middle portion of the shallow basalt through which EW-01 is also screened, is greater than that measured in shallow wells, and the overall radial extent of influence (capture zone) within this portion of the basalt is expected to be larger than that measured in shallow wells. However, nearby domestic wells are not instrumented in a manner allowing such measurements, and interpretation of any such data for clear EW-01 signatures would be confounded by the highly variable on-demand pumping at the domestic wells. As such, the radial influence of EW-01 on surrounding shallow, instrumented monitoring wells is interpreted to provide the simplest, and conservatively small, indication of the EW-01 capture zone. Figure 4-3 illustrates such capture under a 25-gpm extraction rate. Figure 4-3 also illustrates that the existing capture zone is optimally placed for mitigation of the core area of carbon tetrachloride impacts within the basalt aquifer. Groundwater extraction from EW-01 at a rate of 25 gpm leads to measurable water level declines in nearby monitoring wells that are of sufficient magnitude to clearly identify the area of hydraulic influence (capture zone) of EW-01 while remaining sufficiently small to support the lack of unacceptable adverse impacts to local domestic water wells in similar proximity to EW-01 at this extraction rate (that is, less than 1 foot of water level decline at radial distance of local Marlow and Randall domestic wells).

The capture zone shown on Figure 4-3 is for EW-01 pumping at 25 gpm while the full design capacity of the treatment system is about 50 gpm. Extraction rates are planned to increase by 5 gpm per month to about 40 gpm in early February 2023. The EW-01 capture zone at these increased pumping rates will be at least as extensive and is expected to provide good hydraulic containment and mitigation of carbon tetrachloride within the basalt aquifer. Treated groundwater infiltrated at wells IW-01 and IW-04R will continue to flush the aquifer and limit impacts of extraction pumping on local domestic wells.

4.3 Mass Removal

The GWETI system removes COCs from extracted groundwater via carbon adsorption within the plant LGAC vessels. Monthly samples are collected from the system influent, LGAC midpoint, and post-LGAC system effluent to document the successful removal of COCs. Table 3-1 summarizes the GWETI system sampling results through October 2022. The mass of each COC removed monthly by the GWETI system is determined by multiplying the cumulative monthly volume passed through the LGAC vessels by the difference between the monthly influent and effluent COC concentrations. Tables of monthly and cumulative mass removal have been documented in monthly reports and are presented for the full history of GWETI operation in Appendix B. Through October 2022, about 5.5 million gallons of groundwater have been extracted from EW-01, treated through the GWETI system, and infiltrated back to the local aquifer. Figure 4-4 plots the cumulative volume of extracted groundwater sent to the treatment plant over time. The cumulative mass of each COC removed through October 2022 is about 4.42 kilograms (kg) of carbon tetrachloride, about 0.26 kg of chloroform, and about 0.01 kg of carbon disulfide (Appendix B).

4.4 Concentration Trends in Wells

The data from the quarterly site-wide monitoring and sampling program were evaluated for temporal trends using the Mann-Kendall (MK) test, which is commonly applied to evaluate whether a series of data exhibit a decreasing or increasing trend over time or simply exhibit random fluctuations about a mean value (no trend). The specific methodology for the MK testing is described in Appendix C. The MK testing was performed using all available monitoring data over the period of January 2016 through October 2022; this represents the period of record for the monitoring wells installed during the RI. The results of the MK testing are summarized in Appendix C as a collection of trend plots showing measured data over the selected period of record, a trend line if such exists, and statistical confidence intervals for each of the monitoring, domestic, and school wells included in the monitoring program. Appendix C also presents the summary statistics (Table C-1) for carbon tetrachloride data and the MK test for each well (i.e., minimum, maximum, mean, standard deviation, trend result) and a collection of time-series plots showing the changes in concentrations (on a logarithmic scale) to illustrate the chronological order of sampling results.

The MK test was run for 58 wells across the site; the locations of site wells are shown on Figure 4-5, and a cross section is presented on Figure 4-6 illustrating well screen locations and depths along the interpreted downgradient groundwater flow path from the GHFF to primary FSD well W5. As summarized in Table C-1, three wells had insufficient data (fewer than four samples) to complete the MK test. Of the 39 wells exhibiting no trend, there were 29 wells where greater than one-half the sampling results were non-detect, thus indicating a lack of significant aquifer impact. Of the 16 wells exhibiting a trend, there were 13 wells with a decreasing concentration trend and only 3 wells with an increasing trend. Wells MW-24S and MW-25S, located on the southern side of the GHFF, indicated increasing trends that are consistent with localized redistribution of mass at the source area.

The trends for wells MW-9S, MW-9U, and MW-9D at the downgradient boundary of the GHFF are all decreasing, as is the trend for nearby cross-gradient MW-8S. All of these wells are anticipated to exhibit decreasing trends over time (first few years of GWETI system operation) as groundwater is flushed toward extraction well EW-01. Well MW-6U is the only other well to exhibit an increasing trend over the full well history (2017 to 2022). Review of the trend and time-series plots for this well (Appendix C) suggests a period of increasing concentrations from 2017 through 2020 and a subsequent period of decreasing concentrations from 2020 through 2022. This latter decreasing trend is expected to continue and could eventually lead to a future MK test result of no trend for some period of time before a longer-term

decreasing trend is revealed; these anticipated trends will be further evaluated in subsequent annual reports. For example, alternative MK tests can be conducted in subsequent annual reports, following multiple years of GWETI operation, to specifically assess trends beginning with the initial operation of the GWETI system, in addition to trends over the full period of record for monitoring wells.

The current MK test results indicate progress toward plume stability and cleanup. Monitoring wells MW-5D, MW-12, and MW-17D along the western flank of the site continue to exhibit consistent undetectable carbon tetrachloride concentrations while the low aquifer impacts in this western area indicated at MW-20D exhibit a clear decreasing trend. The Lashaw agricultural well near primary FSD well W5 continues to exhibit variable (no trend), and generally low, concentrations, but the further downgradient Lashaw domestic well has exhibited a decreasing trend in concentrations at or below the carbon tetrachloride cleanup standard during 2021 and 2022. The decreasing trend in concentrations downgradient indicate favorable and expected gradual retraction of the downgradient limit of groundwater aquifer impacts. Decreasing trends at the deepest intervals of the core area of fractured basalt aquifer impacts, at MW-27 and MW-28 near extraction well EW-01, are favorable, as are decreasing concentration trends for shallow domestic wells (Marlow Well and Randall Well) in this core area.

Moreover, concentrations at the downgradient boundary of the GHFF, at MW-9S, MW-9U, and MW-9D, exhibit a continued decreasing trend within the source area. Strong evidence for effective aquifer flushing is illustrated by the decreasing concentration trend at Out-of-Use FSD Well W26; concentrations at this well were generally stable during the historical monitoring period beginning in 2016 and through 2020, followed by a distinct reduction in carbon tetrachloride concentrations to near or below the cleanup goal for late 2021 and through 2022 when the GWETI was operational. This indicates that a clean water front is moving through the aquifer from the IW-01 infiltration well and passed Out-of-Use FSD Well W26, and is expected to continue toward extraction well EW-01.

5. Conclusions and Recommendations

The current observed hydraulic capture from extraction well EW-01 in combination with favorable trends exhibited by the MK testing results indicate that the GWETI system is providing the anticipated hydraulic capture and achieving the established IRA DQOs. These results are apparent even at the EW-01 extraction rate of 22 to 25 gpm that was initiated beginning in October 2022 following the successful replacement of a critical infiltration well (IW-04) with a higher capacity well (IW-04R). Expanded hydraulic capture and faster mass removal are anticipated as the EW-01 extraction rate increases. Additional extraction rate increases up to the 50-gpm maximum design capacity of the GWETI system will be considered based on review of hydraulic data collected and reported in ongoing monthly system status reports, in consideration of potential adverse impacts on nearby domestic water users, and in ongoing evaluation of infiltration well capacity. However, potential adverse impacts on nearby domestic water users have not been observed and are anticipated to be largely mitigated by the infiltration well operation that returns water back to the aquifer. It is recommended that infiltration wells IW-02 and IW-03 remain off for the next year of operation due to minimal well capacity and to monitor effectiveness of using just infiltration wells IW-01 and IW-04R.

The existing IRA design using a single extraction well (EW-01) flanked by two primary infiltration wells (IW-01 and IW-04R) is providing hydraulic capture at an optimal location within the core of the contaminated aquifer, and providing clean (treated) infiltration water flushing the aquifer inward toward the core. Direct evidence for such aquifer flushing is provided by groundwater sampling results for Out-of-Use FSD Well W26. Continued operation of the system in this existing configuration is recommended, with a goal of achieving IRA DQOs and collecting the necessary operational data to evaluate the following:

- Whether extraction rates approaching the maximum design limits of the GWETI system present any adverse impacts on local domestic water users, particularly during the dry summer and autumn agricultural pumping seasons
- Whether extraction rates are accommodated by sufficient well capacity of the existing infiltration wells IW-01 and IW-04R

6. References

Jacobs Engineering Group Inc. (Jacobs). 2018. *Remedial Investigation Report, Grain Handling Facility at Freeman, Freeman, Washington*. Draft. September 1.

Jacobs Engineering Group Inc. (Jacobs). 2020a. *Third Revised Interim Remedial Action Work Plan, Grain Handling Facility at Freeman, Freeman, Washington*. January.

Jacobs Engineering Group Inc. (Jacobs). 2020b. *Remedial Investigation/Feasibility Study Report, Grain Handling Facility at Freeman, Freeman, Washington*. Draft Final. August 25.

Jacobs Engineering Group, Inc. (Jacobs). 2021. *Remedial Investigation/Feasibility Study Report, Grain Handling Facility at Freeman, Freeman, Washington*. Final. February 3.

Washington State Department of Ecology (Ecology). 2018. Grain Handling Facility at Freeman Site – Response to Feasibility Study Schedule Extension Request. October 19.

Washington State Department of Ecology (Ecology). 2020a. Email from Sandra Treccani/Ecology to David Hodson/Jacobs. RE: GHFF: Third Revised Interim Remedial Action Work Plan, Grain Handling Facility at Freeman, Freeman, Washington. January 9.

Washington State Department of Ecology (Ecology). 2020b. Draft Final RI/FS for the Grain Handling Facility at Freeman Site. August 25.

Washington State Department of Ecology (Ecology). 2022. Email from Sandra Treccani/Ecology to David Hodson/Jacobs. RE: GHFF: Work Plan Addendum, Disinfection System Installation, Grain Handling Facility at Freeman, Freeman, Washington. July 18.

Tables

Table 3-1. Summary of System Sampling Results - Carbon Disulfide, Carbon Tetrachloride, and Chloroform
Grain Handling Facility in Freeman, Freeman, WA

			Carbon disulfide	Carbon tetrachloride	Chloroform
			Screening Levels (µg/L)		
	MTCA Method B Cancer		NE	0.63	1.4
	MTCA Method B Non-cancer		800	NU	NU
Sample Date	Sample Port	Type		Analytical Data (µg/L) **	
6/10/2021	Influent	N	0.11 U	**319**	**11.8**
6/10/2021	Mid-LGAC	--	--	--	--
6/10/2021	Effluent	N	0.11 U	0.14 U	0.14 U
7/7/2021	Influent	N	**0.124** J	**189**	**18.1**
7/7/2021	Mid-LGAC	N	**0.409** J	0.128 U	**0.329** J
7/7/2021	Effluent	N	0.0962 U	0.128 U	0.111 U
7/13/2021	Influent	N	**0.19** J	**244**	**18.7**
7/13/2021	Mid-LGAC	N	0.0962 U	0.128 U	0.111 U
7/13/2021	Effluent	N	0.0962 U	**0.144** J	0.111 U
7/20/2021	Influent	N	**0.502**	**301**	**18.6**
7/20/2021	Mid-LGAC	N	0.0962 U	0.128 U	0.111 U
7/20/2021	Effluent	N	0.0962 U	0.128 U	0.111 U
7/26/2021	Influent	N	**0.189** J	**259**	**17.9**
7/26/2021	Mid-LGAC	N	0.0962 U	0.128 U	0.111 U
7/26/2021	Effluent	N	0.0962 U	0.128 U	0.111 U
8/3/2021	Influent	N	0.0962 U	**223**	**18.5**
8/3/2021	Mid-LGAC	N	0.0962 U	**0.262** J	0.111 U
8/3/2021	Effluent	N	0.0962 U	**0.171** J	0.111 U
8/9/2021	Influent	N	**0.202** J	**232**	**13.7**
8/9/2021	Mid-LGAC	N	0.0962 U	**0.18** J	0.111 U
8/9/2021	Effluent	N	0.0962 U	**0.184** J	0.111 U
8/16/2021	Influent	N	0.481 U	**342**	**15.9**
8/16/2021	Mid-LGAC	N	0.0962 U	0.128 U	0.111 U
8/16/2021	Effluent	N	0.0962 U	0.128 U	0.111 U
8/23/2021	Influent	N	0.481 U	**196**	**13.1**
8/23/2021	Mid-LGAC	N	0.0962 U	**0.293** J	0.111 U
8/23/2021	Effluent	N	0.0962 U	0.128 U	0.111 U
2/21/2022	Influent	N	0.481 U	**300**	**13**
2/21/2022	Mid-LGAC	N	0.0962 U	0.128 U	0.111 U
2/21/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
3/7/2022	Influent	N	0.24 U	**297**	**11.4**
3/7/2022	Mid-LGAC	N	0.24 U	0.13 U	0.23 U
3/7/2022	Effluent	N	0.24 U	0.13 U	0.23 U
3/17/2022	Influent	N	0.481 U	**230**	**12.9**
3/17/2022	Mid-LGAC	N	0.0962 U	0.128 U	0.111 U
3/17/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
3/28/2022	Influent	N	**0.427** J	**237**	**14.8**
3/28/2022	Mid-LGAC	N	0.0962 U	0.128 U	0.111 U
3/28/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
4/11/2022	Influent	N	**0.841**	**232**	**13.7**
4/11/2022	Mid-LGAC	N	0.0962 U	**0.401 J**	**0.118 J**
4/11/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
4/28/2022	Influent	N	**0.643**	**250**	**14.5**
4/28/2022	Mid-LGAC	N	0.0962 U	**0.338 J**	0.111 U
4/28/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
5/4/2022	Influent	N	**1.6**	**212**	**11.8**
5/4/2022	Mid-LGAC	N	0.0962 U	**0.422 J**	0.111 U
5/4/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
6/6/2022	Influent	N	**0.577**	**231**	**10.5**
6/6/2022	Mid-LGAC	N	0.0962 U	**1.28**	**0.261 J**
6/6/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
6/20/2022	Influent	N	**1.76**	**195**	**10.2**
6/20/2022	Mid-LGAC	N	0.0962 U	**1.35**	**0.36 J**
6/20/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
7/6/2022	Influent	N	0.0962 U	**223**	**12.8**
7/6/2022	Mid-LGAC	N	0.0962 U	**7.56**	**0.813**
7/6/2022	Effluent	N	0.0962 U	0.128 U	**0.119 J**
7/22/2022	Influent	N	**0.239 J**	**223**	**13.3**
7/22/2022	Mid-LGAC	N	0.0962 U	**10.4**	**1.22**
7/22/2022	Effluent	N	0.0962 U	0.128 U	**0.136** J

Table 3-1. Summary of System Sampling Results - Carbon Disulfide, Carbon Tetrachloride, and Chloroform
Grain Handling Facility in Freeman, Freeman, WA

			Carbon disulfide	Carbon tetrachloride	Chloroform
			Screening Levels (µg/L)		
	MTCA Method B Cancer		NE	0.63	1.4
	MTCA Method B Non-cancer		800	NU	NU
Sample Date	Sample Port	Type	Analytical Data (µg/L) **		
8/16/2022	Influent	N	0.0962 U	**179**	**9.65**
8/16/2022	Mid-LGAC	N	0.0962 U	**12.8**	**1.34**
8/16/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
8/24/2022	Influent	N	0.0962 U	**164**	**8.76**
8/24/2022	Mid-LGAC	N	0.0962 U	**19.7**	**1.68**
8/24/2022	Effluent	N	**0.153**	0.128 U	**0.868**
8/30/2022	Influent	N	0.0962 U	**153**	**11.7**
8/30/2022	Mid-LGAC	N	0.0962 U	**24.8**	**2.15**
8/30/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
9/8/2022	Influent	N	0.0962 U	**178**	**10.2**
9/8/2022	Mid-LGAC	N	0.0962 U	**33.8**	**2.9**
9/8/2022	Effluent	N	0.0962 U	0.128 U	0.111 U
9/28/2022			Carbon Changeout		
10/6/2022	Influent	N	**1.92 J**	**174**	**9.84**
10/6/2022	Mid-LGAC	N	0.0962 U	0.128 U	0.111 U
10/6/2022	Effluent	N	0.0962 U	0.128 U	0.111 U

Notes:
** = unvalidated data from laboratory analytical reports
Detected concentrations are shown in **bold**
-- = not collected or not analyzed
J = estimated value
MTCA = Washington State Department of Ecology Model Toxic Control Act
NA = not available
NE = not established
NU = not used
ug/L = micrograms per liter
U = not detected at or above the indicated reporting limit

Table 3-2. Dissolved Oxygen Results
Grain Handling Facility at Freeman, Freeman, WA

Date	Plant Influent	Post Feed & Bag Filters	Post LGAC	Post Injection Pump & Bag Filters	IW-01 Vault	IW-01 70 feet
2/19/2022	4.06	4.64	0.83	1.08	--	6.95
2/20/2022	3.95	4.42	3.45	0.86	--	6.35
2/21/2022	4.74	4.89	3.84	1.47	--	--
2/22/2022	4.85	5.23	4.3	2.41	--	7.85
2/23/2022	4.67	5.39	4.48	2.78	--	4.69
2/24/2022	4.86	5.46	3.51	2.55	--	6.49
3/1/2022	--	--	--	--	--	6.51
3/4/2022	4.14	4.4	1.21	2.09	--	--
3/7/2022	4.64	5.48	2.19	2.2	--	7.48
3/10/2022	6.48	6.91	1.81	2.46	--	7.27
3/11/2022	5.38	5.89	3.43	1.96	3.06	9.79
3/14/2022	5.11	6.06	3.64	3.67	5.3	8.62
3/18/2022	4.81	5.7	4	3.61	4.58	6.7
3/22/2022	4.41	4.86	3.31	3.46	4.91	--
3/25/2022	4.59	5.91	0.83	3.12	4.7	--
3/26/2022	5.48	5.86	4.71	3.36	4.6	8.19
3/28/2022	4.97	5.43	4.41	3.81	4.38	4.59
3/31/2022	6.17	6.38	5.62	4.59	6.19	7.89
4/11/2022	4.12	5.4	4.89	3.71	7.26	10.45
4/14/2022	6.04	6.57	5.66	5.18	6.39	8.78
4/26/2022	3.87	4.53	3.87	3.51	5.38	8.24
4/28/2022	4.48	5.3	4.45	3.71	5.1	6.72
5/3/2022	4.58	4.24	3.99	4.04	5.53	7.71
5/5/2022	5.87	6.18	4.6	4.68	4.43	7.58
5/11/2022	3.65	4.62	3.66	2.55	4.09	6.03
5/16/2022	4.88	5.53	4.24	2.89	4.69	5.81
5/25/2022	5.78	5.55	4.6	4.61	5.05	7.37
5/30/2022	6.08	5.65	1.59	1.68	--	--
5/31/2022	5.68	6.1	4.26	4.13	4.68	7.21
6/2/2022	6.04	6.38	4.52	4.57	4.97	5.95
6/7/2022	4.82	5.38	2.98	2.71	2.83	6.54
6/9/2022	5.07	5.65	4.62	4.51	4.36	5.2
6/13/2022	5.07	5.54	2.73	2.96	3.65	8.29
6/22/2022	5.01	6.72	4.81	3.65	4.65	6.27
6/27/2022	4.78	5.52	3.68	4.26	4.56	5.34
6/30/2022	5.1	5.66	4.32	4.11	4.73	5.21
7/5/2022	5.01	5.86	4.72	3.82	4.81	6.21
7/8/2022	4.65	5.33	4.11	3.79	4.64	6.13
7/22/2022	4.95	5.81	4.84	3.94	4.64	5.29
8/2/2022	4.82	5.18	3.98	4.34	5.24	6.18

-- = not measured
LGAC - liquid-phase granular actived carbon
Results in milligrams per liter

Table 3-3. ATP Results

Grain Handling Facility in Freeman, Freeman, WA

Sample Date	IW-01 Vault Lab ATP (cells/ml)	IW-01 70 feet Lab ATP (cells/ml)	IW-04R 50 feet Lab ATP (cells/ml)	Notes
2/22/2022	--	145,000	--	
3/7/2022	--	112,000	--	
3/11/2022	37,000	35,000	--	
3/14/2022	138,000	--	--	
3/16/2022	42,000	107,000	--	
3/22/2022	40,000	--	--	Shock disinfection 3/24/2022
3/25/2022	47,000	--	--	
3/26/2022	31,000	31,000	--	
3/28/2022	31,000	35,000	--	
3/31/2022	36,000	56,000	--	
4/4/2022	37,000	62,000	--	
4/7/2022	43,000	91,000	--	
4/11/2022	42,000	95,000	--	
4/14/2022	37,000	133,000	--	Shock disinfection 4/18/2022
4/26/2022	31,000	55,000	--	
4/28/2022	76,000	86,000	--	
5/3/2022	35,000	75,000	--	
5/5/2022	68,000	133,000	--	Shock disinfection 5/9/2022
5/16/2022	49,000	144,000	--	Shock disinfection 5/23/2022
5/25/2022	58,000	31,000	--	
5/31/2022	54,000	303,000	--	Shock disinfection 6/3/2022
6/7/2022	52,000	29,000	--	
6/9/2022	55,000	207,000	--	
6/13/2022	30,000	185,000	--	Shock disinfection 6/17/2022
6/27/2022	37,000	38,000	--	
6/30/2022	19,000	26,000	--	
7/5/2022	34,000	69,000	--	
7/8/2022	34,000	106,000	--	Shock disinfection 7/11/2022
7/22/2022	35,000	76,000	--	
8/2/2022	23,000	42,000	--	
8/10/2022	25,000	25,000	--	
8/24/2022	28,000	39,000	--	
8/30/2022	32,000	37,000	--	
9/7/2022	27,000	57,000	--	
9/26/2022	29,000	33,000	--	Disinfection system online
10/3/2022	29,000	29,000	23,000	IR-04R operation begins
11/1/2022	39,000	33,000	33,000	
11/15/2022	48,000	37,000	56,000	

Notes:

-- = not collected or analyzed

ATP = adenosine triphosphate

ml = milliliter

Table 3-4. Disinfection Byproduct Monitoring Plan

Grain Handling Facility at Freeman, Freeman, WA

Location	Frequency	Objectives
Out-of-Use Freeman School District Well (W26) (Surrogate to IW-01)	- Day after backflushing. - One week after backflushing. If monitoring shows the presence of DBPs, then additional weekly samples collected until they are no longer present - Quarterly as part of the groundwater monitoring program.	Evaluate the presence of DBPs immediately after shock disinfection treatment and quarterly at the shock disinfection treatment location.
MW-17D	- Quarterly as part of the groundwater monitoring program.	Evaluate the presence of DBPs directly downgradient of IW-01 but upgradient of the FSD well.
EW-01 (from treatment plant)	- Monthly as part of remedial treatment system sampling.	Evaluate the presence of DBPs in recirculation water reaching the remedial extraction well.
Randall Well	- Monthly as part of residential treatment system sampling.	Evaluate presence of DBPs cross gradient of primary DBP flow direction. Particles released at IW-01 are not predicted to be intercepted at the Randall well (under current modeled extraction/infiltration scenario) due to remedial extraction at EW 01
MW-34 (Surrogate to Freeman School District Well)	- Quarterly as part of the groundwater monitoring program.	Evaluate the presence of DBPs near the FSD Well.

Note:

Additional monitoring will be evaluated and proposed if shock disinfection treatment is conducted at additional infiltration wells.

Table 3-5. Summary of Disinfection Byproduct Results
Grain Handling Facility in Freeman, Freeman, WA

Sample Date	Maximum Contaminant Level (µg/L)	Chlorine (Total) 4 (residual disinfection level)	Haloacetic Acids (Total) 60	Trihalomethanes (Total) 80
	Sample Location	mg/L	µg/L	µg/L
4/19/2022	Out-of-Use Freeman School District Well (W26)	0.1 U	0.9 U	0.47 U
4/26/2022	Out-of-Use Freeman School District Well (W26)	0.1 U	0.9 U	**0.48 (Chloroform)** J
5/5/2022	Treatment Plant Influent (EW-01)	0.1 U	0.9 U	**11.6 (Chloroform)**
5/4/2022	Randall Well	0.1 U	0.9 U	**4.4 (Chloroform)**
5/10/2022	Out-of-Use Freeman School District Well (W26)	0.1 U	0.9 U	0.47 U
5/17/2022	Out-of-Use Freeman School District Well (W26)	**0.21**	0.9 U	0.47 U
5/24/2022	Out-of-Use Freeman School District Well (W26)	0.1 U	0.9 U	0.47 U
5/30/2022	MW-17D	0.1 U	0.9 U	0.47 U
5/31/2022	Out-of-Use Freeman School District Well (W26)	0.1 U	0.9 U	0.47 U
5/31/2022	MW-34	0.1 U	0.9 U	0.47 U
5/31/2022	Out-of-Use Freeman School District Well (W26)	**0.1**	0.9 U	0.47 U
6/6/2022	Out-of-Use Freeman School District Well (W26)	0.1 U	0.9 U	0.47 U
6/6/2022	Randall Well	0.1 U	0.9 U	**5.5 (Chloroform)**
6/6/2022	Treatment Plant Influent (EW-01)	0.1 U	0.9 U	**9.8 (Chloroform)**
6/13/2022	Out-of-Use Freeman School District Well (W26)	0.1 U	0.9 U	0.47 U
6/20/2022	Out-of-Use Freeman School District Well (W26)	0.1 U	0.9 U	0.47 U
6/27/2022	Out-of-Use Freeman School District Well (W26)	0.1 U	0.9 U	0.47 U
7/13/2022	Out-of-Use Freeman School District Well (W26)	0.1 U	**2.6**	**3.2**
7/20/2022	Out-of-Use Freeman School District Well (W26)	**0.16**	**3.8**	**5.5**
8/9/2022	Randall Well	0.1 U	0.9 U	**4.1 (Chloroform)**
8/18/2022	MW-34	NA	NA	0.47 U
8/18/2022	Out-of-Use Freeman School District Well (W26)	NA	NA	**2.1**
8/18/2022	MW-17D	NA	NA	0.47 U
8/30/2022	Treatment Plant Influent (EW-01)	0.1 U	0.9 U	0.334 U
9/8/2022	Treatment Plant Influent (EW-01)	NA	NA	NA
9/9/2022	Randall Well	**0.11**	NA	**3.4 (Chloroform)**
10/6/2022	Treatment Plant Influent (EW-01)	NA	NA	NA
10/7/2022	Randall Well	0.1 U	0.9 U	**2.6 (Chloroform)**

Notes:
Detected concentrations are shown in **bold**
NA = not analyzed
J = estimated value
mg/L = milligrams per liter
µg/L = micrograms per liter
U = not detected at or above the indicated reporting limit

Haloacetic Acids (Total)
Dibromoacetic Acid
Dichloroacetic Acid
Monobromoacetic Acid
Monochloroacetic Acid
Trichloroacetic Acid

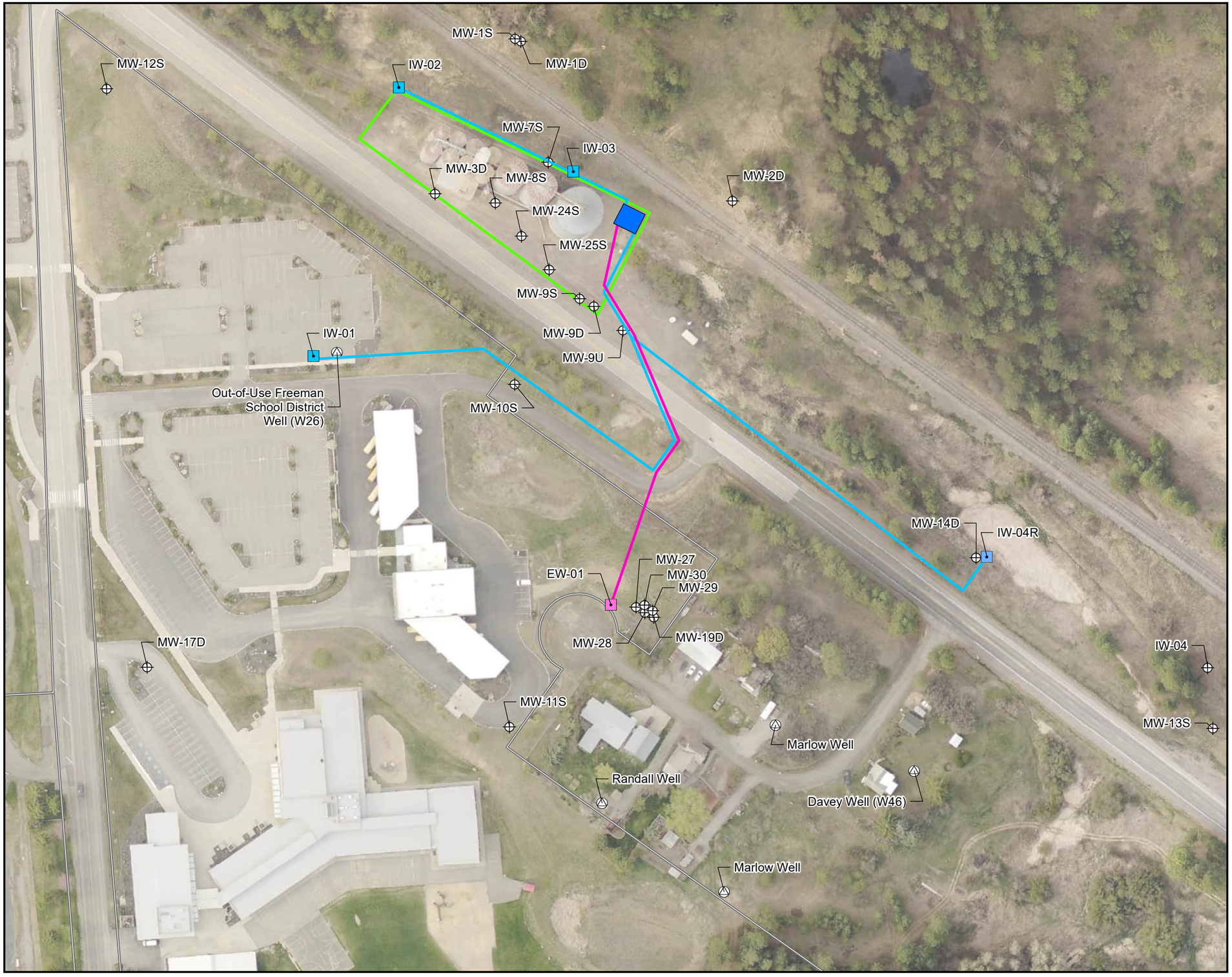
Total Trihalomethanes (Calc.)
Bromodichloromethane
Bromoform
Chloroform
Dibromochloromethane

Table 3-6. Transducer Installation Summary
Grain Handling Facility at Freeman, Freeman, WA

Well ID	Install Date	Model Number	Cable Length (feet)	Initial Depth to Water (feet btoc)	Sensor Reference Depth (feet btoc)	Notes
W26	7/13/2021	Solinst 3001-10	75	66.12	74.97	
MW-4D	7/13/2021	Solinst 3001-10	130	108.73	130.25	
MW-6D	7/13/2021	Solinst 3001-10	150	128.47	151.04	
MW-7S	7/13/2021	Solinst 3001-10	40	31.61	40.17	
MW-9S	7/13/2021	Solinst 3001-10	40	34.16	40.30	
MW-9D	7/13/2021	Solinst 3001-10	40	33.94	41.00	
MW-9U	7/13/2021	Solinst 3001-10	40	33.05	40.93	
MW-10S	7/13/2021	Solinst 3001-10	70	50.3	70.22	
MW-11S	7/13/2021	Solinst 3001-10	70	59.22	70.27	
MW-13S	7/13/2021	Solinst 3001-10	35	11.64	33.24	
MW-14D	7/13/2021	Solinst 3001-10	35	16.55	36.22	
MW-17D	7/13/2021	Solinst 3001-10	75	62.47	71.09	75-feet steel cable
MW-19D	7/13/2021	Solinst 3001-20	100	62.66	100.89	
MW-26	7/13/2021	Solinst 3001-20	120	113.02	139.15	
MW-27	7/13/2021	Solinst 3001-10	75	69.28	75.70	
MW-28	7/13/2021	Solinst 3001-10	75	63.66	75.83	
MW-29	7/13/2021	Solinst 3001-10	75	60.75	75.66	
MW-30	7/13/2021	Solinst 3001-10	75	60.59	75.74	
MW-34	7/13/2021	Solinst 3001-20	140	126.11	141.09	
MW-35	7/13/2021	Solinst 3001-20	140	117.15	141.33	
MW-36	7/13/2021	Solinst 3001-10	40	22.63	41.07	

Notes:
btoc = below top of casing

Figures



LEGEND

- Monitoring Well
- Domestic Well
- Grain Handling Facility at Freeman
- Freeman School District
- Treatment Plant
- Injection Well
- Extraction Well
- Injection Pipeline
- Extraction Pipeline

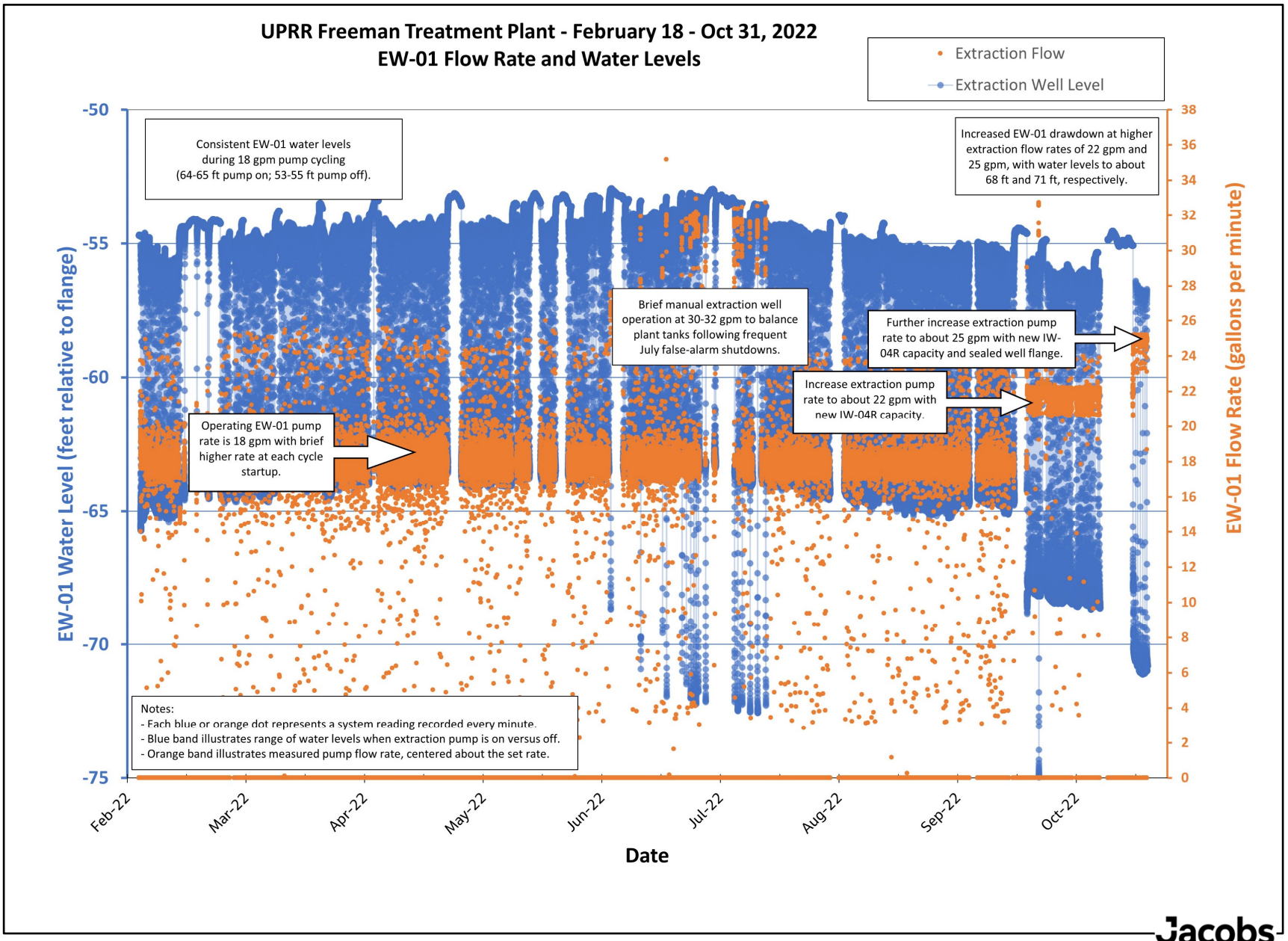
Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

N

0 75 150 300 Feet

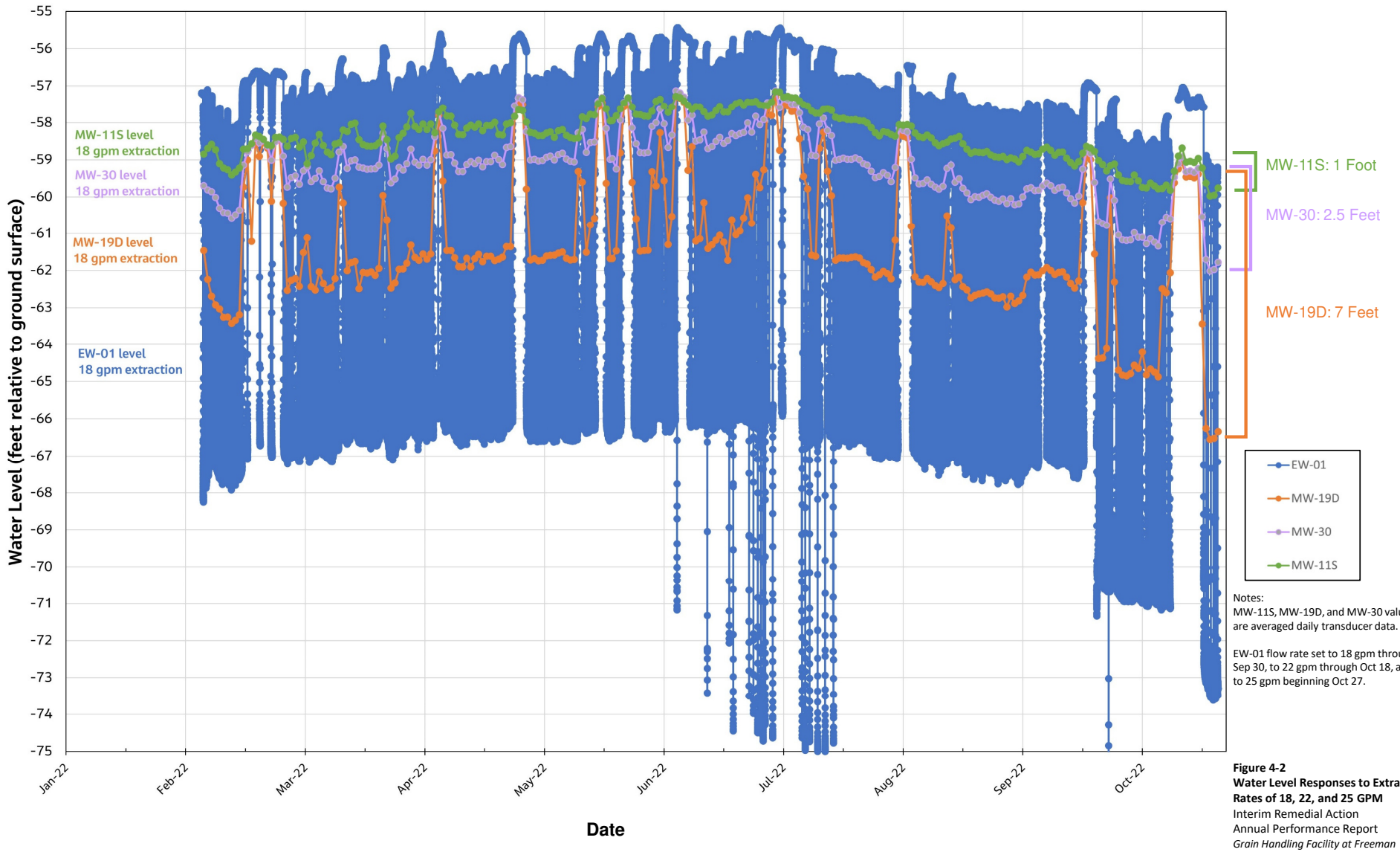
Figure 1-1
Interim Remedial Action Layout
Grain Handling Facility at Freeman,
Freeman, Washington

Jacobs



Jacobs

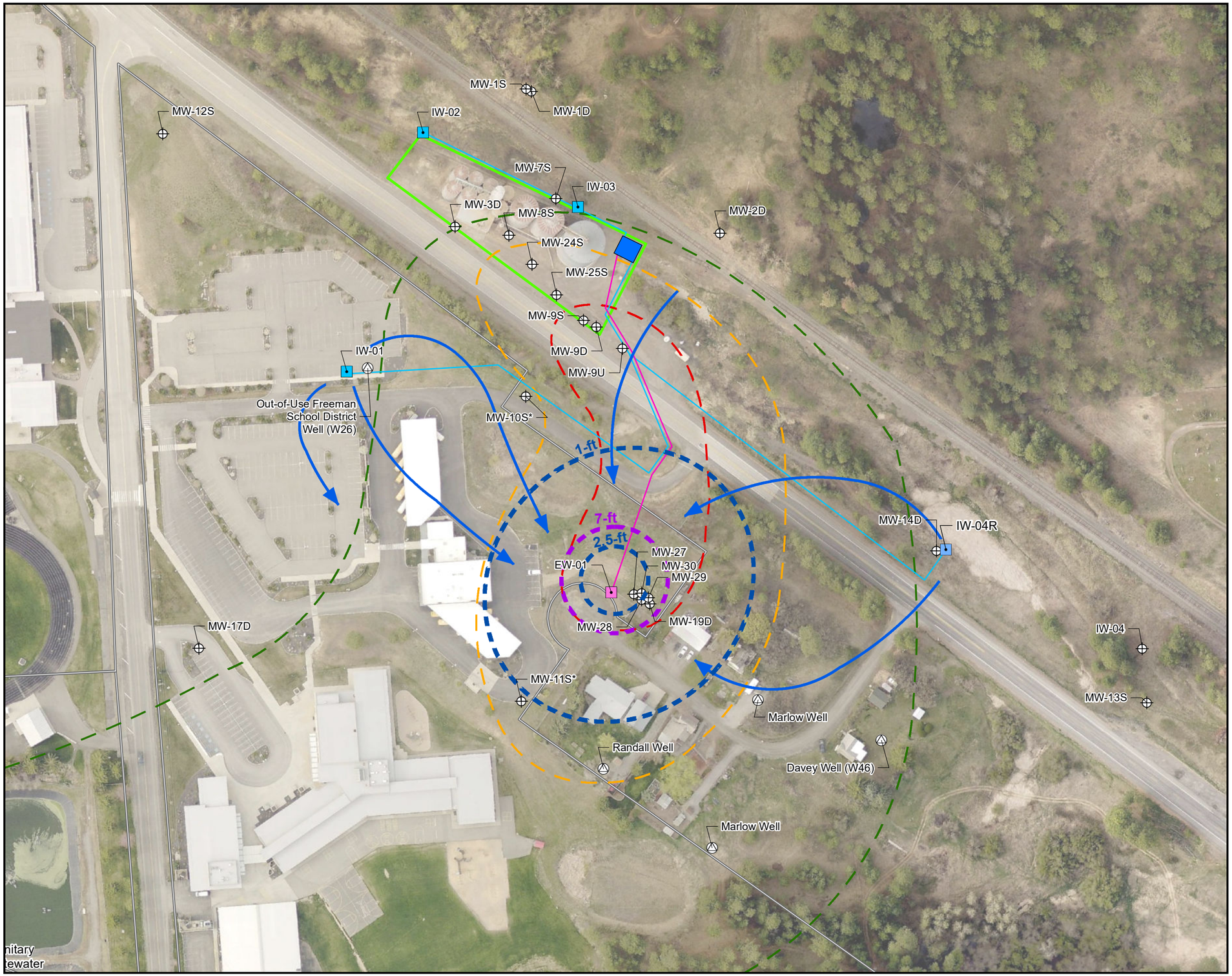
Figure 4-1
EW-01 Flow Rate and Water Levels
Interim Remedial Action Annual Performance Report
Grain Handling Facility at Freeman
Freeman, Washington



Notes:
MW-11S, MW-19D, and MW-30 values are averaged daily transducer data.

EW-01 flow rate set to 18 gpm through Sep 30, to 22 gpm through Oct 18, and to 25 gpm beginning Oct 27.

Figure 4-2
Water Level Responses to Extraction Rates of 18, 22, and 25 GPM
Interim Remedial Action
Annual Performance Report
Grain Handling Facility at Freeman
Freeman, Washington



LEGEND

- Monitoring Well
- Domestic Well
- Grain Handling Facility at Freeman
- Freeman School District
- Treatment Plant
- Injection Well
- Extraction Well
- Injection Pipeline
- Extraction Pipeline
- Groundwater Flow Path Conceptual Illustration
- Shallow Basalt Water Level Drawdown (ft)Mid-
- Basalt Water Level Drawdown (ft)

Carbon Tetrachloride Concentration (Basalt Aquifer)

- 10 ug/L
- 100 ug/L
- 200 ug/L

Note:
Concentration contours based on third quarter 2022 sampling data
* = well not used for concentration contouring
ft = feet
GPM - gallons per minute
ug/L = micrograms per liter

N

0 87.5 175 350 Feet

Figure 4-3
EW-01 Drawdown-Induced Groundwater Capture (25 GPM) Shallow and Mid-Basalt Interval
Interim Remedial Action Performance Report
Grain Handling Facility at Freeman,
Freeman, Washington

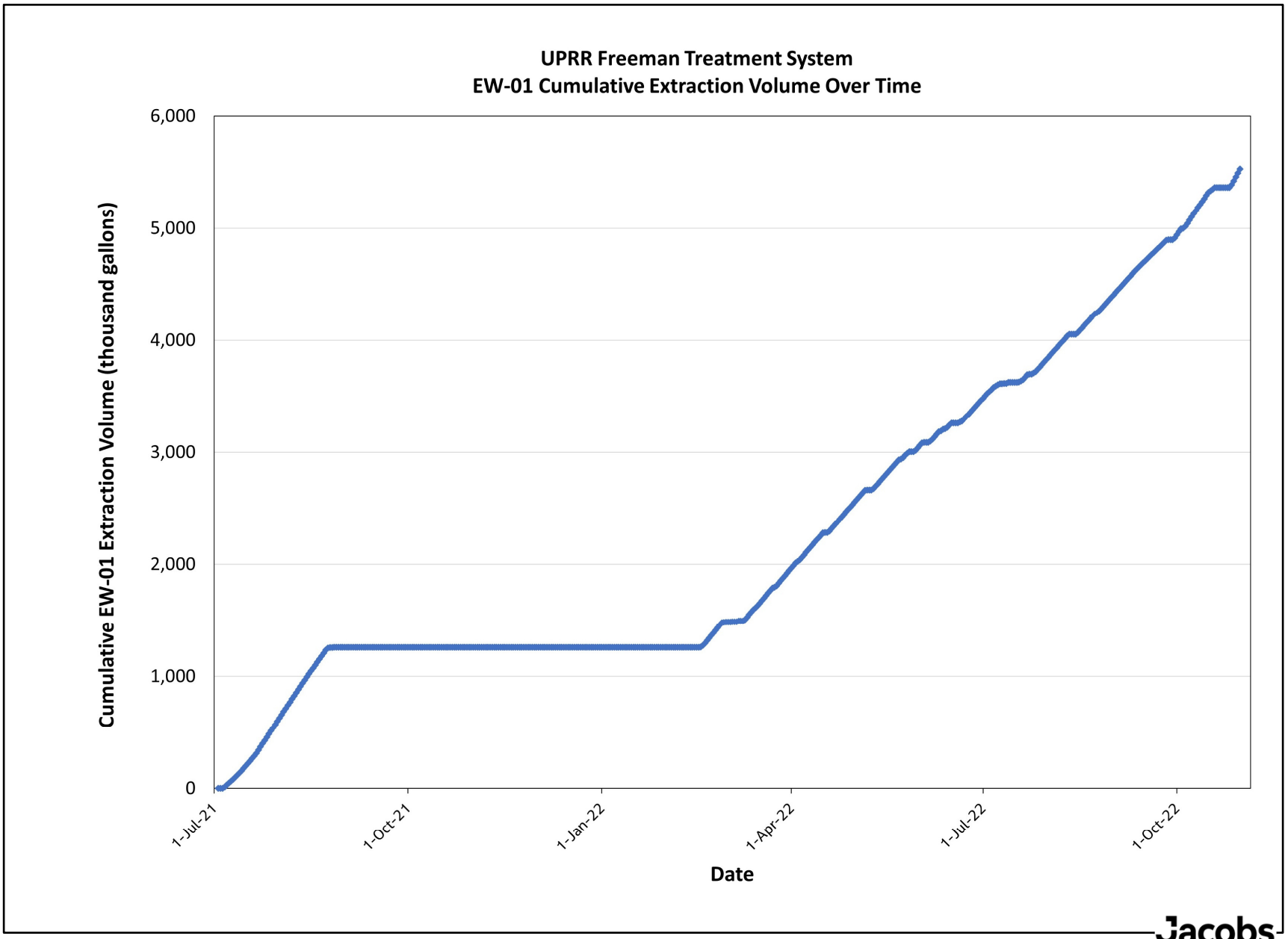
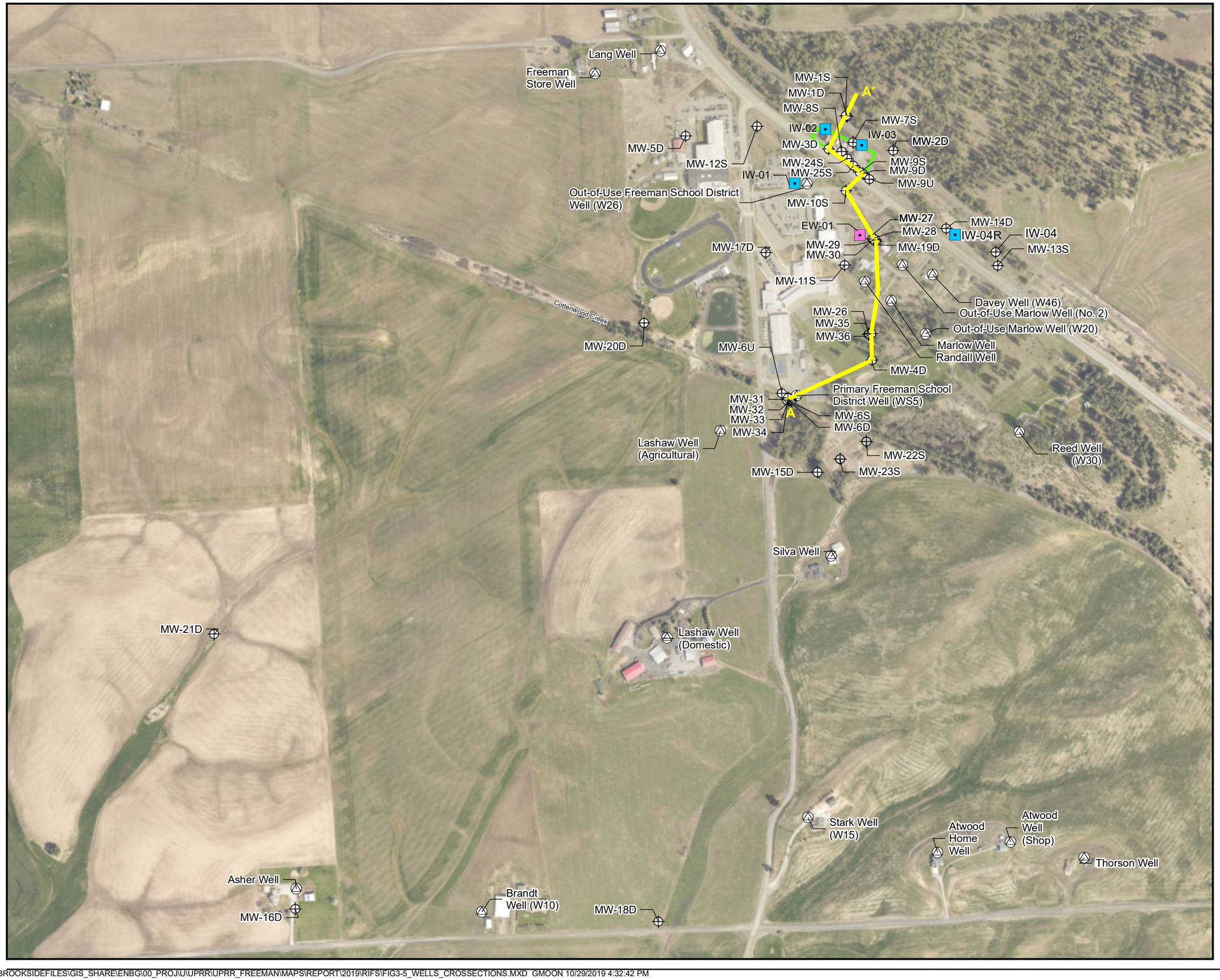


Figure 4-4
EW-01 Cumulative Extraction Volume Over Time
Interim Remedial Action Annual Performance Report
Grain Handling Facility at Freeman
Freeman, Washington



LEGEND

- Monitoring Well
- Domestic Well
- Injection Well
- Extraction Well
- Grain Handling Facility at Freeman
- **Cross Section**
- A-A'

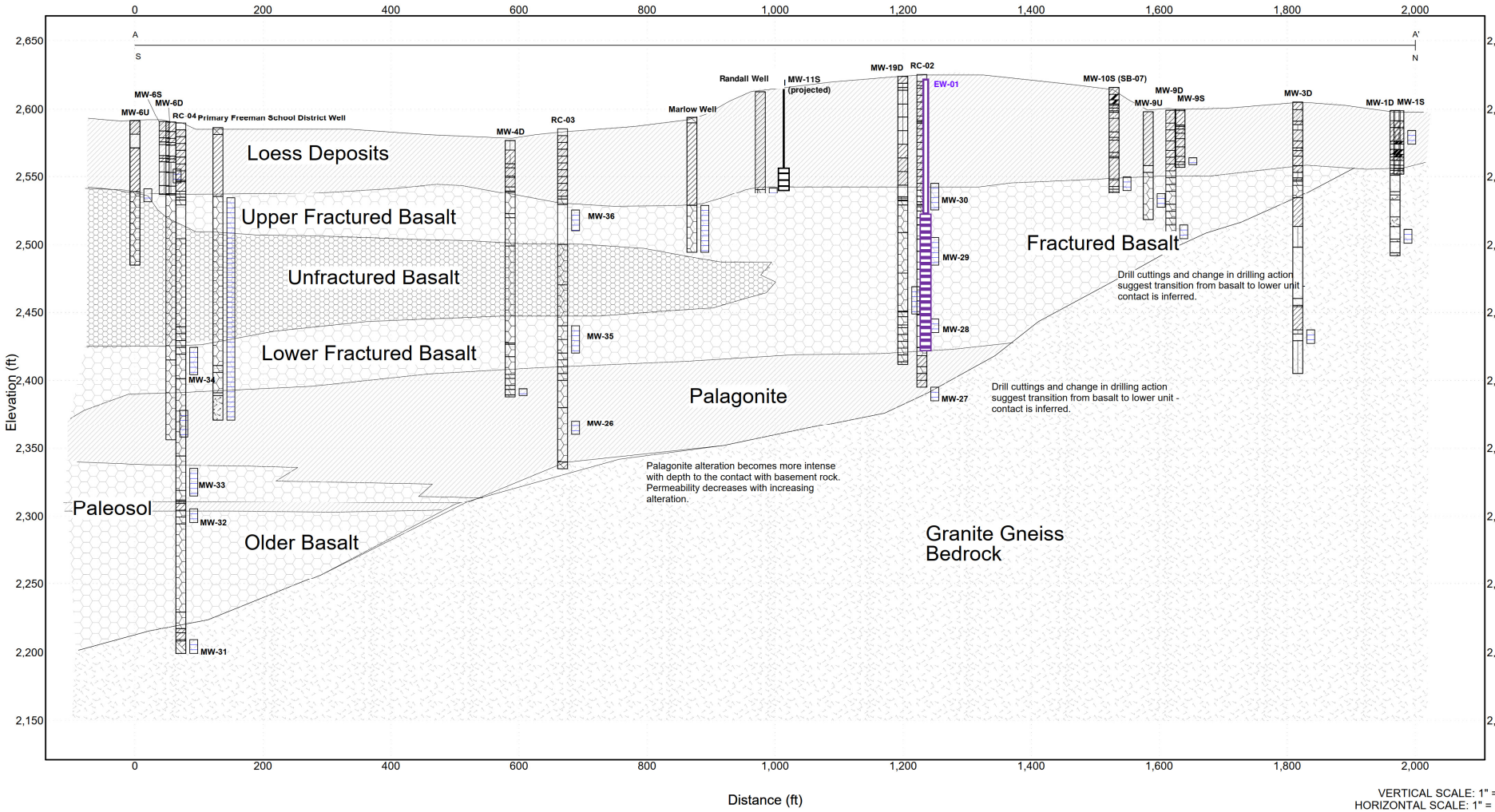
Notes:
Greyed out wells have been decomissioned.

N

0 350 700 1,400 Feet

Figure 4-5
Well Location Map and Cross Section Location
Interim Remedial Action Annual Performance Report
Grain Handling Facility at Freeman,
Freeman, Washington

Jacobs



VERTICAL SCALE: 1" = 73.0'
HORIZONTAL SCALE: 1" = 155.0'

11X17 STICK LOG WITH LEGEND; DRAFT CH2M GEOTECH_12.GLB; FREEMAN LOGS_7-26-19.GPJ; CH2M GEOTECH_12.GDT; 11/8/19

Jacobs

LITHOLOGY GRAPHICS

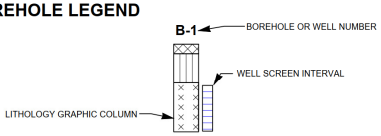
- Organic Clay or Silt
- BR-Lean Clay
- Well-Graded Sand
- Basalt
- Silt
- Fat Clay
- Well-Graded Sand with Silt
- Poorly Graded Sand with Silt
- BR-Lean Clay
- Clayey Sand
- Clayey Gravel
- Poorly Graded Sand
- Bedrock

LEGEND

– – – – – Inferred Geologic Contact

Note:
Ground surface shown is connected between boring logs and does not represent actual surface topography on the section line.

BOREHOLE LEGEND



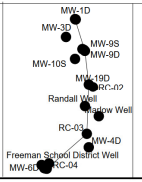


Figure 4-6
Hydrogeologic Cross Section (North to South)
Interim Remedial Action Annual Performance Report
Grain Handling Facility at Freeman
Freeman, Washington

Appendix A
Lithology and Well Construction Logs

Jacobs

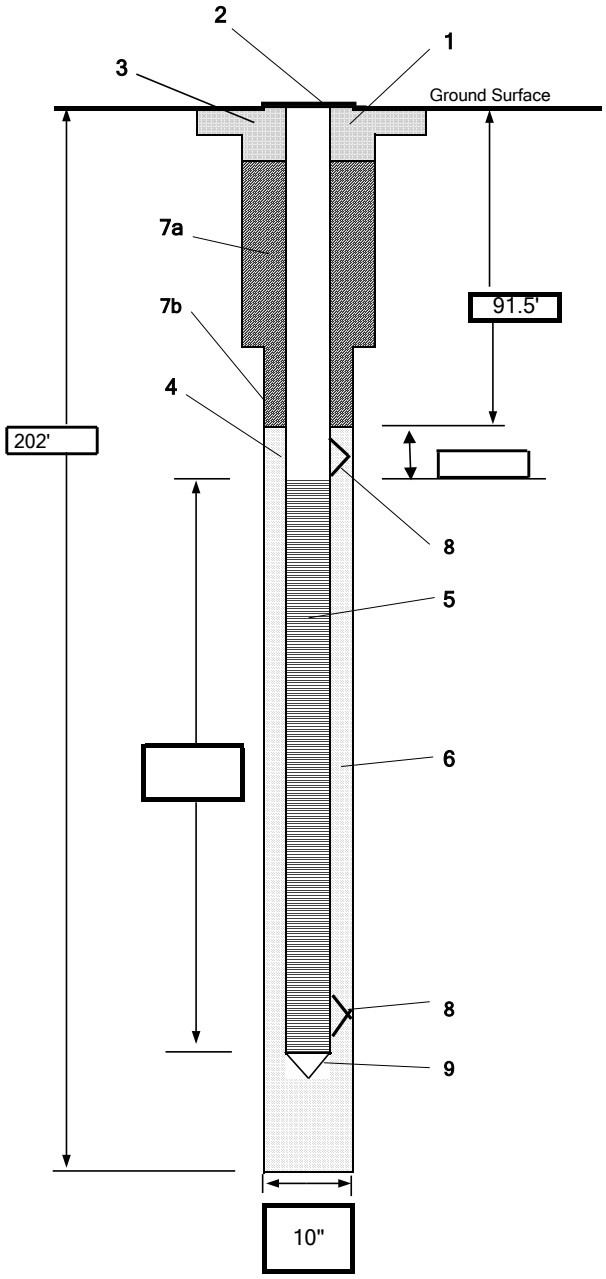
DATE: 2/26/2021 WELL ID: EW-01

EXTRACTION WELL COMPLETION DIAGRAM

PROJECT : UPRR Freeman LOCATION : Field behind FSD bus barn. Near MW-19D cluster.

Drilling Method: Sonic/Air Rotary Drilling Contractor: Environmental West

Well Construction Start Date: 2/26/2021 Completion Date: 3/9/21 Project Number : UPSRWA05



Generalized Monitoring Well Completion Diagram

1- Surface completion: Concrete vault

2- Casing flush mount: Vault Lid

3- Surface completion/pad: Concrete Vault

4- Dia./type of well casing: 6" Mild Steel Casing

5- Type/slot/size of screen: NA

6- Type screen filter: NA
NA

7a- Type of seal - depth: Neat cement
7b- Type of seal - depth:

8- Centralizers (if applicable):

9- Sump below screen: NA

Well development: Developed on 3/10/21. Approx. 2,750 gallons of water removed from well.

Comments: Extraction well completed as an open hole well below sealed 6" SS casing installed at 91.5'. Borehole diameter was reduced from 10" to 6" nominal at 91.5'.

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	EW-01	SHEET 1 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near RC-02 cluster

ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : ---
START : 7/31/2020
END : 8/2/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
0.0				**Topsoil** 0.0 - 0.5'			PID results taken every 5', all results were 0 ppm
				Clay (CL) 0.5 - 45.0' - brown, dry, medium dense, medium plasticity			
5							
10							Began adding water at 10', rest of cuttings will be wet
15							
20							
25							
30							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	EW-01	SHEET 2 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near RC-02 cluster
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Air Rotary
WATER LEVELS : ---
START : 7/31/2020
END : 8/2/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
35							
40							
45				**Clay (CL)** 45.0 - 88.0' - brown, wet, soft, some small angular black 1/4" gravel, some sand			Softer drilling at 45'
50							
55							
60							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	EW-01	SHEET 3 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near RC-02 cluster
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Air Rotary
WATER LEVELS : ---
START : 7/31/2020
END : 8/2/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
65							
70							
75							
80							Added more water, dry
85							
90				**Basalt** 88.0 - 93.0' - variety of colors, weak, highly decomposed, some soft clay			

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	EW-01	SHEET 4 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near RC-02 cluster
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Air Rotary
WATER LEVELS : ---
START : 7/31/2020
END : 8/2/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
							Harder drilling
95				**Basalt** 93.0 - 96.0' - black with some red oxidation, moderate, some soft clay			
				Basalt 96.0 - 105.0' - black with less red oxidation, strong, slightly decomposed to fresh			
100							Water in borehole at 100', formation water, sealed at 101'
105				**Basalt** 105.0 - 115.0' - black, strong, fresh, competent			
110							
115				**Basalt** 115.0 - 145.0' - black with some red oxidation, strong, slightly decomposed			
120							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	EW-01	SHEET 5 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near RC-02 cluster
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Air Rotary
WATER LEVELS : ---
START : 7/31/2020
END : 8/2/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
125							
130							
135							
140							
145				**Basalt** 145.0 - 175.0' - black, strong, fresh			Harder drilling at 145'
150							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	EW-01	SHEET 6 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near RC-02 cluster
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Air Rotary
WATER LEVELS : ---
START : 7/31/2020
END : 8/2/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
155							
160							
165							
170							
175				**Basalt** 175.0 - 180.0' - black with red oxidation, moderate to strong, slight to moderate decomposed			Increase in water production
180							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	EW-01	SHEET 7 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near RC-02 cluster
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Air Rotary
WATER LEVELS : ---
START : 7/31/2020
END : 8/2/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
				Basalt 180.0 - 185.0' - brown to tan with some black, moderate density, highly decomposed			Increase in water production
185				**Basalt** 185.0 - 195.0' - black, moderate to strong, fresh, slight oxidation at 190'			
190							
195				**Basalt** 195.0 - 202.0' - dark brown with black, moderate density, slightly decomposed			Increase in water production
200							
205				**Clay with Weathered Basalt (CL)** 202.0 - 215.0' - very few cuttings, hammer having hard time firing, gray, very soft			Increase in water production
210							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	EW-01	SHEET 8 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near RC-02 cluster

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/31/2020 END : 8/2/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
215				**Clay (CL)** 215.0 - 218.0' - white, very soft, high plasticity			Very few cuttings from borehole, increase in water production, hammer almost unable to fire, color change in water to tan/orange
220				**Clay with Sand (CL)** 218.0 - 222.0' - tan orangish tan, very soft, high plasticity with fine quartz sand and trace amounts of muscovite at the bottom			
225							
	228.0			Bottom of Boring at 228.0 ft bgs.			6,300 gallons of water produced from 101 - 228'
230							
235							
240							

Jacobs

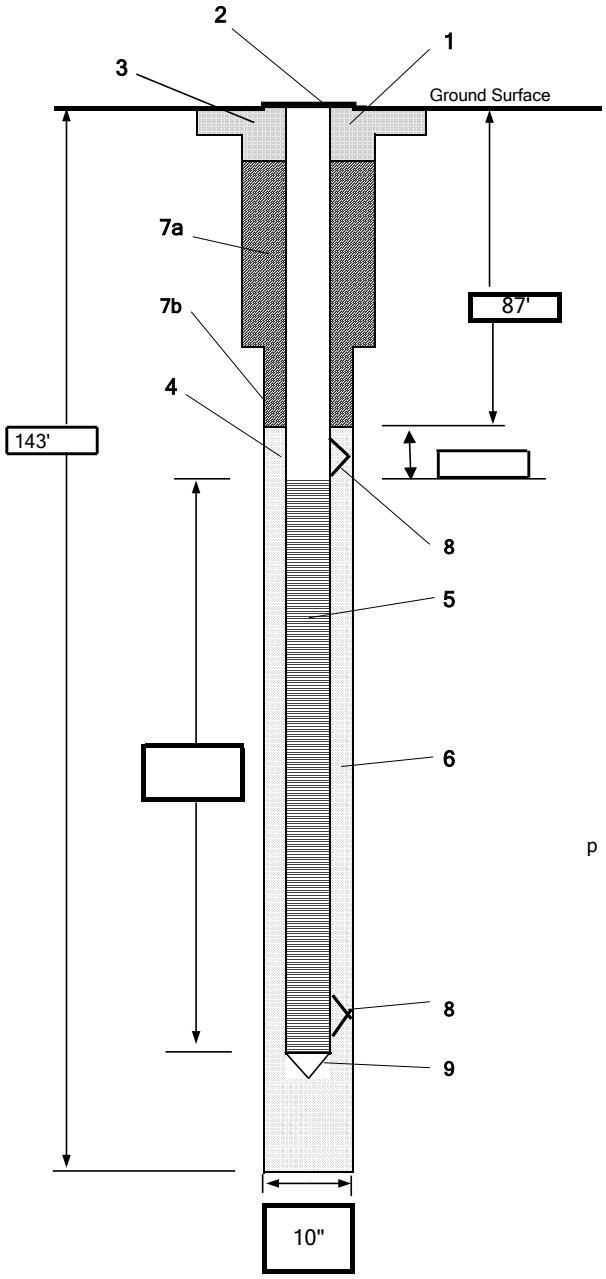
DATE: 2/17/2021 WELL ID: IW-01

INJECTION WELL COMPLETION DIAGRAM

PROJECT : UPRR Freeman LOCATION : Freeman School District Overflow Parking Lot

Drilling Method: Sonic/Air Rotary Drilling Contractor: Environmental West

Well Construction Start Date: 2/17/2021 Completion Date: 2/25/21 Project Number : UPSRWA05



Generalized Monitoring Well Completion Diagram

1- Surface completion: Concrete vault

2- Casing flush mount: Vault lid

3- Surface completion/pad: Concrete vault

4- Dia./type of well casing: 6" Mild Steel Casing

5- Type/slot/size of screen: NA

6- Type screen filter: NA
NA

7a- Type of seal - depth: Neat cement
7b- Type of seal - depth:

8- Centralizers (if applicable):

9- Sump below screen: NA

Well development: Developed on 3/10/21. Approx. 1,800 gallons of water removed from well.

Comments: Injection well was completed as an open hole well below sealed 6" mild steel casing installed at 87'. Borehole diameter was reduced from 10" to 6" nominal at 87'.

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-01	SHEET 1 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near school Freeman sign

ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : ---
START : 7/25/2020
END : 7/28/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
0.0				**Topsoil** 0.0 - 0.5'			PID readings = 0 ppm
				Silt (ML) 0.5 - 5.0' - brown, dry, medium dense, non-plastic, trace soft clay			
5							Add water at 5', all samples will be wet
				Clay (CL) 5.0 - 31.0' - brown, wet, medium dense, medium plasticity			
10							
15							
20							
25							
30							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-01	SHEET 2 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near school Freeman sign

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/25/2020 END : 7/28/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
				Clayey Gravel with Sand (GW) 31.0 - 33.0' - brown to tan, some soft medium plasticity, some coarse sand			
35				**Clay (CL)** 33.0 - 55.0' - brown, soft, medium plasticity			
40							
45							
50							
55				**Clay (CL)** 55.0 - 120.0' - brown, saturated, soft, plastic, some black sand and gravel, increases in size to small gravel at 75', few medium sand in tan clay at 106'			
60							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-01	SHEET 3 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near school Freeman sign
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Air Rotary
WATER LEVELS : ---
START : 7/25/2020
END : 7/28/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
65							
70							
75							
80							
85							
90							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-01	SHEET 4 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near school Freeman sign

ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : ---
START : 7/25/2020
END : 7/28/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
95							
100							
105							Very difficult to take sample due to water added creating mud
110							
115							
120							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-01	SHEET 5 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near school Freeman sign
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Air Rotary
WATER LEVELS : ---
START : 7/25/2020
END : 7/28/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
125				**Clayey Sand (SC)** 120.0 - 155.0' - tan, soft, low plasticity clay, poorly graded quartz sand, muscovite present			
130							
135							
140							Stop injecting water
145							
150							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-01	SHEET 6 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near school Freeman sign
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Air Rotary
WATER LEVELS : ---
START : 7/25/2020
END : 7/28/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
155				**Sand (SP)** 155.0 - 177.0' - tan, moist, dense, fine grained, some quartz and muscovite, trace silt and clay			
160							
165							
170							
175							
180				**Clayey Sand (SC)** 177.0 - 218.0' - tan, dry, soft, low plasticity, poorly graded quartz sand, muscovite present, wet at 190' and then moist			

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-01	SHEET 7 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near school Freeman sign

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/25/2020 END : 7/28/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
185							
190							Water in borehole
195							
200							Increase in water downhole
205							Increase in water downhole
210							Increase in water downhole

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-01	SHEET 8 OF 8

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near school Freeman sign

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/25/2020 END : 7/28/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
215							
220				**Granite** 218.0 - 222.0' - pieces of feldspar approx 1/4" in size, fine quartz and muscovite, all loose, no competent granite, weathered, moist at 215'			
	222.0			Bottom of Boring at 222.0 ft bgs.			
225							
230							
235							
240							

Jacobs

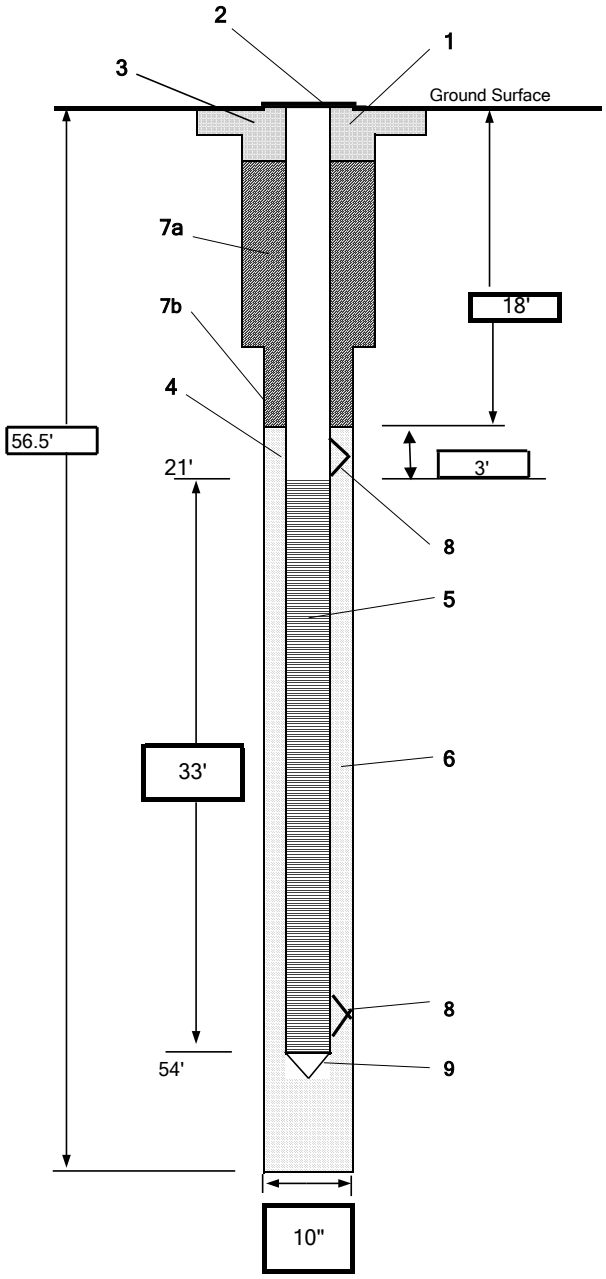
DATE: 11/6/2020 WELL ID: IW-02

INJECTION WELL COMPLETION DIAGRAM

PROJECT : UPRR Freeman LOCATION : NE of Grain Silos

Drilling Method: Sonic Drilling Contractor: Environmental West

Well Construction Start Time: 12:00 Completion Time: 14:30 Project Number : UPSRWA05



Generalized Monitoring Well Completion Diagram

1-	Surface completion	Concrete vault
2-	Casing flush mount	Vault lid
3-	Surface completion/Pad	Concrete vault
4-	Dia./type of well casing	6" Sch 80 PVC
5-	Type/slot/size of screen	0.020" Slot
6-	Type screen filter	8x16 Filter pack 20x40 Transition sand
7a-	Type of seal - depth	Neat cement
7b-	Type of seal - depth	3/8" Bentonite chips
8-	Centralizers (if applicable)	11', 21', 37.5', and 54'
9-	Sump below screen	2' flat bottom

Well development: Well developed on 3/11/21. Purged dry, approx. 85 gallons of water removed from well.

Comments: Backfilled with bentonite from 66' to 56.5'.

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-02	SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : North end of grain silos
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Sonic
WATER LEVELS : ---
START : 11/5/2020
END : 11/6/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
0.0				**Topsoil** 0.0 - 1.0'			PID readings = 0 ppm
				Clay (CL) 1.0 - 3.0' - brown, dry, hard, medium to low plasticity			
5				**Clay (CL)** 3.0 - 7.0' - tan, dry, hard, medium to low plasticity, quartz and muscovite present, contains some angular gravel, large, a couple inches in size			
10				**Silt (ML)** 7.0 - 19.0' - gray with reddish brown, dry, medium to stiff, non plastic, trace amounts of low plasticity clay, lots of muscovite and quartz, weathered granite			
15							
20				**Sand (SP)** 19.0 - 24.0' - gray with reddish brown and white, dry, medium dense, fine sand, contains non plastic fines and trace amounts of clay, very large muscovite over 1-7" in size			
25				**Silt (ML)** 24.0 - 34.0' - gray with white, dry, medium to stiff, non plastic, trace amounts of fine sand and plastic clay, muscovite present			Water in borehole, no water in sample
30							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-02	SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : North end of grain silos

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Sonic

WATER LEVELS : --- START : 11/5/2020 END : 11/6/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
35				**Silt with Sand (ML)** 34.0 - 51.0' - gray with reddish brown, dry, medium dense, non plastic, fine sand, trace clay, muscovite, wet at 36', samples remain mostly dry, little moist			
40							
45							
50				**Sand (SP)** 51.0 - 53.0' - gray, moist, loose, fine to medium sand, muscovite			
55				**Silt with Sand (ML)** 53.0 - 65.0' - tan with gray and white, moist, medium to stiff, fine sand, muscovite and quartz, trace clay			
60							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-02	SHEET 3 OF 3

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : North end of grain silos

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Sonic

WATER LEVELS : --- START : 11/5/2020 END : 11/6/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (ft) / SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
65					Harder drilling
66.0		**Sand (SP)** 65.0 - 66.0' - gray, moist, medium to dense, fine to medium sand, muscovite Bottom of Boring at 66.0 ft bgs.			
70					
75					
80					
85					
90					

Jacobs

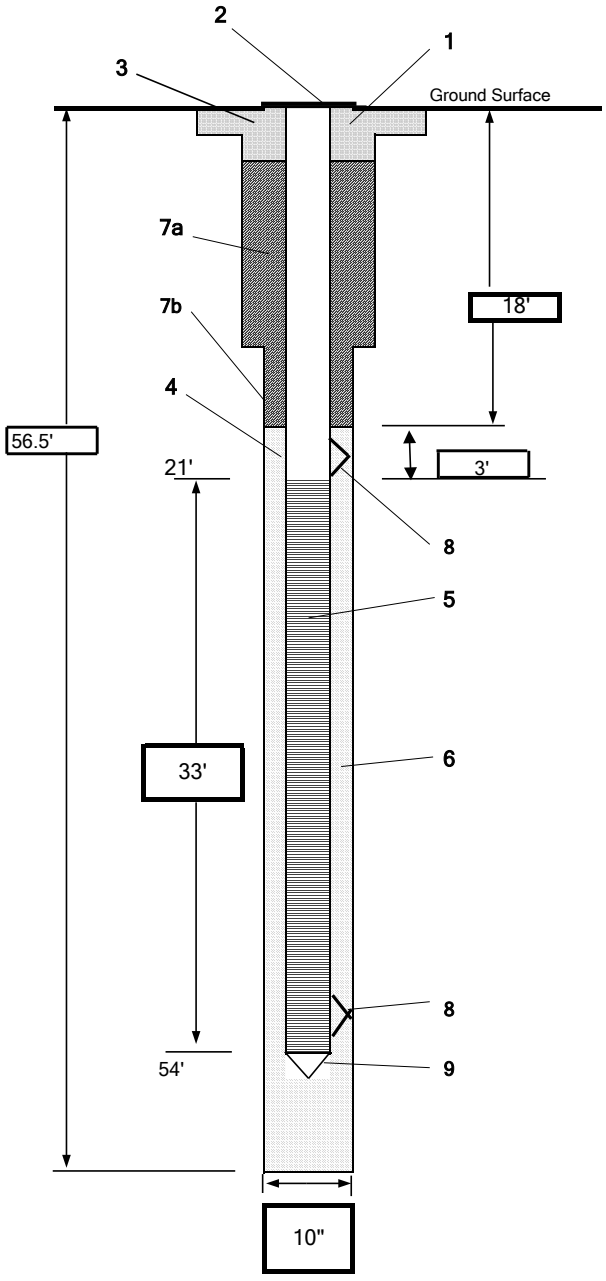
DATE: 11/4/2020 WELL ID: IW-03

INJECTION WELL COMPLETION DIAGRAM

PROJECT : UPRR Freeman LOCATION : NE of Grain Silos

Drilling Method: Sonic Drilling Contractor: Environmental West

Well Construction Start Time: 13:00 Completion Time: 16:30 Project Number : UPSRWA05



Generalized Monitoring Well Completion Diagram

1-	Surface completion	Concrete vault
2-	Casing flush mount	Vault lid
3-	Surface completion/pad	Concrete vault
4-	Dia./type of well casing	6" Sch 80 PVC
5-	Type/slot/size of screen	0.020" Slot
6-	Type screen filter	8x16 Filter pack 20x40 Transition sand
7a-	Type of seal - depth	Bentonite grout
7b-	Type of seal - depth	3/8" Bentonite chips
8-	Centralizers (if applicable)	11', 21', 37.5', and 54'
9-	Sump below screen	2.5' flat bottom

Well development: Developed on 3/11/21. Approx. 160 gallons of water

Comments:

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-03	SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near 75

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Sonic

WATER LEVELS : --- START : 11/3/2020 END : 11/3/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
0.0				**Topsoil** 0.0 - 0.5'			PID readings = 0 ppm
				Gravel (GW) 0.5 - 1.0' - black, loose, well-graded, some sand, old railroad ballast material			
5				**Clay (CL)** 1.0 - 2.0' - brown dry, stiff, high plasticity, some small gravel			
				Silt (ML) 2.0 - 4.0' - reddish brown with gray, dry, soft, no plasticity, few very soft low plasticity clay			
10				**Clay (CL)** 4.0 - 12.0' - brown with reddish brown and gray, dry, medium density, medium plasticity			
				Clay (CL) 12.0 - 13.0' - red with orange and brown, dry, medium density, medium to low plasticity, few silts			
15				**Clay (CL)** 13.0 - 25.0' - reddish brown, dry, medium density, low to medium plasticity, few silt, 2" gravel seam at 20'			
20							
25				**Clay (CL)** 25.0 - 26.0' - gray with reddish brown, dry, medium density, high plasticity			
				Clay (CL) 26.0 - 39.0' - reddish brown, dry, medium to soft, low to medium plasticity, few silt			
30							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-03	SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near 75

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Sonic

WATER LEVELS : --- START : 11/3/2020 END : 11/3/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
35							
40				**Clay (CL)** 39.0 - 41.0' - gray, moist, very soft, high plasticity, few fine sand			
				Clay (CL) 41.0 - 42.0' - gray, dry, stiff, medium plasticity			
				Clay with Sand (CL) 42.0 - 44.0' - gray, moist, very soft, high plasticity, medium to fine sand			
45				**Silt with Sand (ML)** 44.0 - 46.0' - brown, dry, very stiff, no plasticity, medium to fine sand			
				Basalt 46.0 - 53.0' - dark gray with red oxidation, dry, weak, lots of gravel and fine to medium sand, wet at bottom			
50							Water, DTW in borehole at 28'
				No recovery 53.0 - 56.0'			
55							
	56.0			Bottom of Boring at 56.0 ft bgs.			
60							

Jacobs

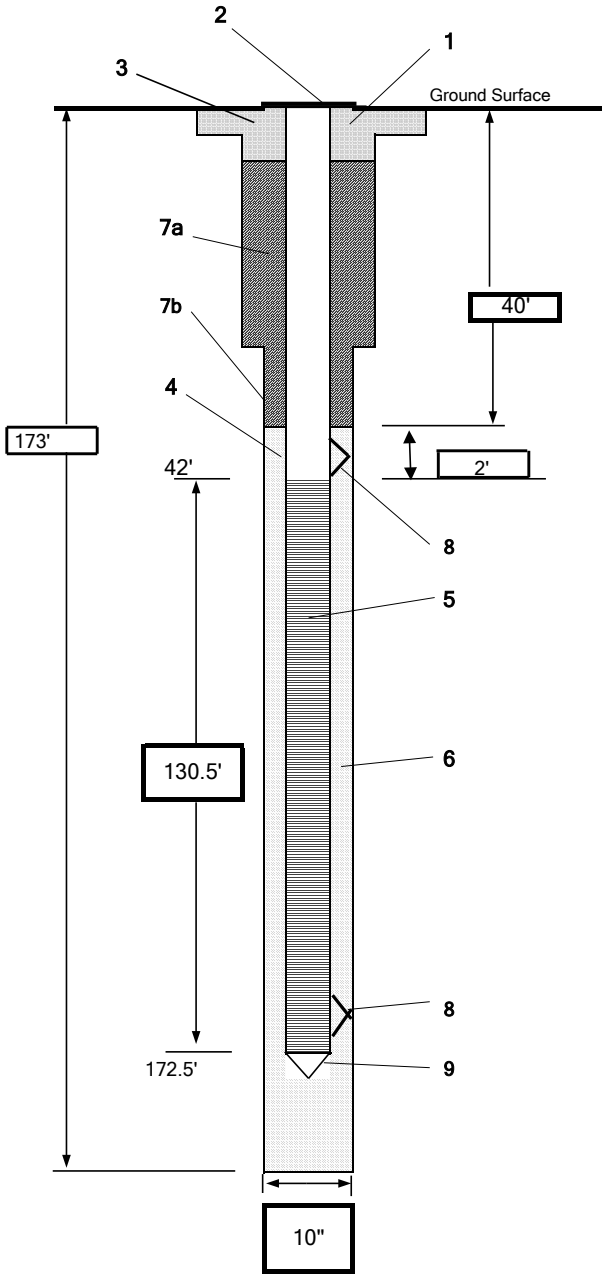
DATE: 2/11/2021 WELL ID: IW-04

INJECTION WELL COMPLETION DIAGRAM

PROJECT : UPRR Freeman LOCATION : Southeast of Grain Handling Facility, near MW-13S.

Drilling Method: Sonic/Air Rotary Drilling Contractor: Environmental West

Well Construction Start Date: 2/11/2021 Completion Date: 2/16/21 Project Number : UPSRWA05



Generalized Monitoring Well Completion Diagram

1-	Surface completion	Concrete vault
2-	Casing flush mount	Vault lid
3-	Surface completion/pad	Concrete vault
4-	Dia./type of well casing	6" Sch 80 PVC
5-	Type/slot/size of screen	Stainless Steel 0.060" Slot
6-	Type screen filter	6x12 Filter pack
7a-	Type of seal - depth	Neat cement
7b-	Type of seal - depth	Benonite pellets (TR30)
8-	Centralizers (if applicable)	
9-	Sump below screen	6" flat bottom

Well development: Developed on 3/11/21. Approx. 1,750 gallons of water removed from well.

Comments: Borehole diameter transitioned from 10" to 8" at 91.5'.

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04	SHEET 1 OF 7

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near MW-13S

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/23/2020 END : 7/25/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
0.0				**Topsoil** 0.0 - 0.5'			PID readings = 0 ppm
				Clay (CL) 0.5 - 20.0' - brown, dry, medium density, low to medium plasticity			
5							
10							Begin injecting water downhole, all samples will be wet
15							
20				**Clay (CL)** 20.0 - 35.0' - brown, wet, very soft, low plasticity, trace silt nodules			
25							
30							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04	SHEET 2 OF 7

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near MW-13S

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/23/2020 END : 7/25/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
35				**Clay (CL)** 35.0 - 42.0' - brown, wet, very soft, low plasticity, trace to few weathered basalt chips, very weak, highly decomposed			
40							Water from formation, end injection
45				**Basalt** 42.0 - 85.0' - black with red, very weak, highly decomposed, trace clay at 42', chip size increasing, less red color with depth, then soft at 46'			
50							End 10' casing sections, begin 5' sections
55							
60							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04	SHEET 3 OF 7

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near MW-13S

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/23/2020 END : 7/25/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
65							
70							
75							
80							
85				**Basalt** 85.0 - 88.0' - black with some discoloration, very weak, highly decomposed			1500 gallons of water from 42 - 85'
				Basalt 88.0 - 94.0' - black, moderate, slightly decomposed			Hard drilling
90							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04	SHEET 4 OF 7

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near MW-13S

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/23/2020 END : 7/25/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
							Very hard drilling
95				**Basalt** 94.0 - 100.0' - black with some red, moderate to weak, slightly decomposed, softer than above			Soft drilling
100				**Basalt** 100.0 - 105.0' - black, moderate to strong, fresh, very hard drilling, sealed at 105'			Very hard 1500 gallons of water from 85 - 103'
105				**Basalt** 105.0 - 120.0' - black, moderate to strong, fresh			Signifcantly less water after setting seal
110							Water resumes
115							
120							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04	SHEET 5 OF 7

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near MW-13S

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/23/2020 END : 7/25/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
				Basalt 120.0 - 125.0' - black with some red discoloration, weak to moderate, slightly decomposed			Softer drilling
125				**Basalt** 125.0 - 135.0' - black with red and some green, moderate to weak, moderately decomposed with increasing discoloration, highly decomposed			Color change to brown, formation water
130							
							Softer drilling
135				**Basalt** 135.0 - 145.0' - brown with red and some black, weak, highly decomposed, some soft plastic clay			Hard drilling
140							
145							450 gallons of water from 105 - 144'
				Basalt 145.0 - 170.0' - black with some red discoloration, moderate, slightly to moderately decomposed, some clay and discoloration at 165'			
150							

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04	SHEET 6 OF 7

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington
LOCATION : Near MW-13S
ELEVATION :
DRILLING CONTRACTOR : Environmental West Exploration, Inc
DRILLING METHOD AND EQUIPMENT : Air Rotary
WATER LEVELS : ---
START : 7/23/2020
END : 7/25/2020
LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft) / RECOVERY (ft) / SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
155					
160					Hard drilling
165					Increase in water
170		**Basalt** 170.0 - 178.0' - mostly green with some black, moderate, decomposed			
175					
180		**Clay (CL)** 178.0 - 179.0' - tan, soft, plastic, with some basalt			

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04	SHEET 7 OF 7

SOIL BORING LOG

PROJECT : Grain Handling Facility at Freeman, Washington LOCATION : Near MW-13S

ELEVATION : DRILLING CONTRACTOR : Environmental West Exploration, Inc

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/23/2020 END : 7/25/2020 LOGGER : JE

DEPTH BELOW EXISTING GRADE (ft)	INTERVAL (ft)	RECOVERY (ft)	SAMPLE TYPE/#	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLLIC LOG	PID (ppm)	COMMENTS
				Clay (CL) 179.0 - 182.0' - white, soft, some fine sand, quartz present, high plasticity, some basalt			
				Sand (SP) 182.0 - 184.0' - clear with some white, coarse grained, some white clay, trasition from basalt to granite			
184.0							
185				Bottom of Boring at 184.0 ft bgs.			6000 gallons of water produced from 144 - 184'
190							
195							
200							
205							
210							

Jacobs

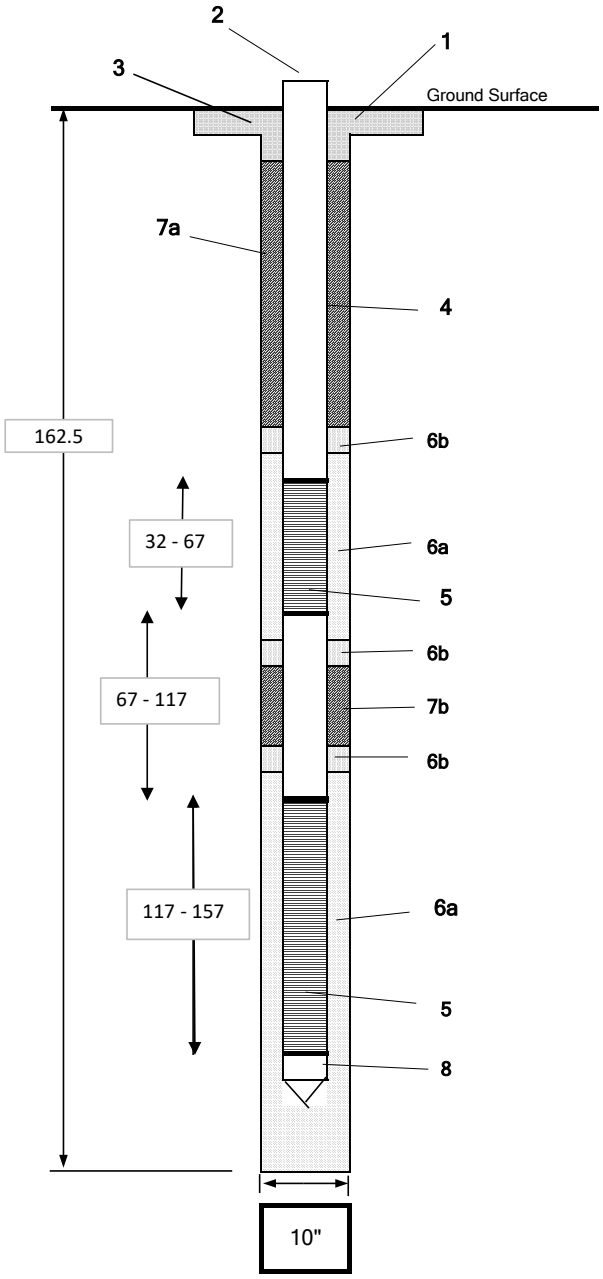
DATE: 8/11/2022 WELL ID: IW-04R

INJECTION WELL COMPLETION DIAGRAM

PROJECT : UPRR Freeman LOCATION : Southeast of Grain Handling Facility, near MW-14D

Drilling Method: Air Rotary Drilling Contractor: Environmental West

Well Construction Start Date: 7/11/2022 Completion Date: 8/11/22 Project Number : UPSRWA05



Generalized Well Completion Diagram

1- Surface completion	Concrete vault
2- Top of Casing	Vault lid
3- Surface completion/pad	Concrete vault
4- Dia./type of well casing	6" Sch 80 PVC
5- Type/slot/size of screen	0.060" Slot, stainless steel Upper sceen in fractured basalt Lower screen in decomposed granite
6a- Screen Pack	3/8-inch rounded pea gravel
6b- Transition sand	#8 - 12 sand to 2 feet above pea gravel
7a- Type of seal - depth	3/8-inch benonite chips (hydrated)
7b- Type of seal - depth	3/8-inch benonite pellets (TR30)
8- Sump below screen	5-foot blank with 6-inch threaded (flat) end cap (157 - 162)

Well development: Significant fines in bottom of borehole necessitated airlifting, surging, bailing, and pumping

Upper (basalt) screened interval much cleaner than lower (decomposed granite) screened interval

Comments:

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 1 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman | LOCATION : Freeman, WA

ELEVATION : | DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- | START : 7/11/22 09:30 | END : 8/4/22 10:35 | LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
		0.0-9.0' LEAN CLAY (CL) very dark grayish brown (10YR 3/2), slightly damp, soft, medium plasticity, no odor		0		
5						
		9.0-19.0' SILT WITH GRAVEL (ML) dark brown (7.5YR 3/3) with pale brown mottling (2.5Y 8/3), stiff, trace subrounded to subangular fine gravel, some clumps of very dense fine to medium-grained sand, possible chucks of weathered basalt at 16.0'				Start adding water, unable to determine moisture content
10						
15						

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 2 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman LOCATION : Freeman, WA

ELEVATION : DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/11/22 09:30 END : 8/4/22 10:35 LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
				0		
20		**19.0-28.0' LEAN CLAY (CL)** grayish brown (10YR 5/2), very stiff to hard, some silty clumps				Clay getting emmulsified in water to push out of hose
				0.4		
25						
		28.0-47.0' WEATHERED BASALT dark greenish gray (G1 4/10Y) to trace pale yellowish green (10Y 5G Y/6) minerals, trace dark reddish brown rock fragments, rock fragments are fine-grained sand to coarse-grained gravel, rock fragments are wet				No water added, but still wet from residued water in system
30						

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 3 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman LOCATION : Freeman, WA

ELEVATION : DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/11/22 09:30 END : 8/4/22 10:35 LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
35						Hydraulic test conducted in temp well from 37.0-47.0' bgs
40						
45						

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 4 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman LOCATION : Freeman, WA

ELEVATION : DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/11/22 09:30 END : 8/4/22 10:35 LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
		47.0-57.0' WEATHERED BASALT WITH CLAY dark greenish gray (G1 4/10Y) with light yellowish brown (2.5Y 6/3) clay, pale yellowish green (5GY/4), dark reddish brown (5YR 4/2) rock fragments, lots of water produced				
50				0		
55		**57.0-67.0' WEATHERED BASALT WITH CLAY** dark greenish gray (G1 4/10Y) with light yellowish brown (2.5Y 6/3) clay, pale yellowish green (5GY/4), dark reddish brown (5YR 4/2) rock fragments, more clay than above unit		0		Most of clay is getting emmulsified in water
60						

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 5 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman LOCATION : Freeman, WA

ELEVATION : DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/11/22 09:30 END : 8/4/22 10:35 LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
65						
		67.0-72.0' LEAN CLAY (CL) brown (7.5YR 5/4), wet, some sand and fine-grained gravel sized rock fragments		0		
70						Cuttings are still wet, but borehole is producing less water
		72.0-75.0' WEATHERED BASALT WITH CLAY dark greenish gray (G1 4/10Y) with light yellowish brown (2.5Y 6/3) clay, pale yellowish green (5GY/4), dark reddish brown (5YR 4/2) rock fragments, chunks of gray clay				
75						

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 6 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman | LOCATION : Freeman, WA

ELEVATION : | DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- | START : 7/11/22 09:30 | END : 8/4/22 10:35 | LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
		75.0-83.0' LEAN CLAY (CL) chunks of gray (G1 7/N) and reddish brown clay, fine-grained sand to coarse-grained gravel size rock fragments				Driller thinks water is following the bit down from the upper productive zone
80		color change to yellow (10YR 7/6)				
		83.0-87.0' SAND WITH SILT (SM) brown (10YR 5/3), wet, fine grained, some silt, trace fine-grained gravel				
85		**87.0-90.0' BASALT** grayish brown sand with few pale green minerals, fine to coarse grained		0		hard drilling, competent rock, not producing water
90						

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 7 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman LOCATION : Freeman, WA

ELEVATION : DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/11/22 09:30 END : 8/4/22 10:35 LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
		90.0-98.0' LEAN CLAY (CL) yellowish red (5YR 5/6), wet				Clay getting emmulsified in water from the borehole. Unclear if water is from this zone or followed down from upper productive zone
95						
		98.0-100.0' SILTY SAND (SM) light red (2.5YR 6/8), abundant mica				Lots of water produced from formation
100		**100.0-105.0' LEAN CLAY (CL)** red (2.5YR 5/8), micaceous		0		Driller added water. Very little cutting make it to surface from emmulsification
105						

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 8 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman | LOCATION : Freeman, WA

ELEVATION : | DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- | START : 7/11/22 09:30 | END : 8/4/22 10:35 | LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
		105.0-112.0' LEAN CLAY (CL) red (2.5), micaceous		0		
110						
		112.0-123.0' WELL GRADED SAND WITH SILT AND CLAY (SW) light gray to gray, wet, medium to coarse grained, subangular to angular, quartz throughout with mica and some feldspar				
115						Abundant water from formation
						Abundant water from formation
120						

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 9 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman LOCATION : Freeman, WA

ELEVATION : DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/11/22 09:30 END : 8/4/22 10:35 LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
				0		
		123.0-125.0' WELL GRADED SAND WITH SILT AND CLAY (SW) light gray to gray, wet, medium to coarse grained, subangular to angular, quartz throughout with mica and some feldspar, thick layers of medium gray clay, micaceous				Water not as abundant but present
125		**125.0-160.0' DECOMPOSED GRANITE** well graded "sands" with mica and some very fine (pulverized?) sands				2' "cavern". Driller believes it caused by pea gravel from top well
130						
135						

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 10 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman LOCATION : Freeman, WA

ELEVATION : DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/11/22 09:30 END : 8/4/22 10:35 LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
140						~ 1500 gals produced in last 10' section
145						Hammer not firing, very fine sands
150						

Jacobs

PROJECT NUMBER:	BORING NUMBER:	
UPSRWA05	IW-04R	SHEET 11 OF 11

SOIL BORING LOG

PROJECT : UPRR Freeman LOCATION : Freeman, WA

ELEVATION : DRILLING CONTRACTOR : Environmental West

DRILLING METHOD AND EQUIPMENT : Air Rotary

WATER LEVELS : --- START : 7/11/22 09:30 END : 8/4/22 10:35 LOGGER : G. Gardner & M. Henry

DEPTH BELOW SURFACE AND ELEVATION (ft)	SAMPLE INTERVAL (ft) / RECOVERY (ft) / SAMPLER (TYPE)	SOIL DESCRIPTION: DEPTH INTERVAL, SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	PID (ppm)	Grain Size Distribution G/S/M/C (%)	COMMENTS
						significant water produced (~2000 gals)
155						last 5-7 ft section was firmer, longer water column
160		**160.0-162.0' SANDY LEAN CLAY (CL)** tan, medium stiff, sand is fine to medium-grained				
		Bottom of Boring at 162.0 ft below ground surface				
165						

Appendix B
Treatment System Flow and Mass Removal Totals

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting week 3 July 2021 to 9 July 2021)					
Saturday, July 3, 2021	0		0	0	0	0
Sunday, July 4, 2021	0		0	0	0	0
Monday, July 5, 2021	0		0	0	0	0
Tuesday, July 6, 2021	12,101	11,904	10,080	0	0	1,592
Wednesday, July 7, 2021	17,264	16,885	14,399	0	0	2,254
Thursday, July 8, 2021	17,281	16,823	14,310	0	0	2,218
Friday, July 9, 2021	17,275	16,908	14,498	0	0	2,263
Weekly Total (Gallons)	**63,922**	**62,519**	**53,287**	**0**	**0**	**8,327**
Weekly Total (Liters)	**241,944**	**236,636**	**201,692**	**0**	**0**	**31,518**

EW-01 Pumping Duration (Hours)	88.82
Average Extraction Rate (GPM)	11.99
Influent Carbon Tetrachloride (ug/L) **	189
Carbon Tetrachloride Removal (kg)	0.046
Influent Chloroform (ug/L) **	18.1
Chloroform Removal (kg)	0.004
Influent Carbon Disulfide (ug/L) **	0.124
Carbon Disulfide Removal (kg)	0.00003

Notes:
GPM = gallons per minute
kg = kilograms
ug/L = micrograms per liter
** = Results from July 7, 2021 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting week 10 July 2021 to 16 July 2021)					
Saturday, July 10, 2021	17,287	17,056	14,397	0	0	2,252
Sunday, July 11, 2021	17,286	16,776	14,312	0	0	2,247
Monday, July 12, 2021	17,286	17,047	14,498	0	0	2,272
Tuesday, July 13, 2021	19,497	18,916	16,129	0	0	2,520
Wednesday, July 14, 2021	21,621	21,165	18,006	0	0	2,822
Thursday, July 15, 2021	21,615	21,160	18,095	0	0	2,819
Friday, July 16, 2021	21,613	21,313	17,993	0	0	2,827
Weekly Total (Gallons)	**136,204**	**133,433**	**113,430**	**0**	**0**	**17,758**
Weekly Total (Liters)	**515,532**	**505,044**	**429,334**	**0**	**0**	**67,216**

EW-01 Pumping Duration (Hours)	168.00		
Average Extraction Rate (gpm)	13.51		
		Prior Week Removal (kg)	**Cumulative Removal (kg)**
Influent Carbon Tetrachloride (µg/L) **	244		
Effluent Carbon Tetrachloride (µg/L)**	0.144 J		
Carbon Tetrachloride Removal (kg)	0.126	0.046	0.171
Influent Chloroform (µg/L) **	18.7		
Effluent Chloroform (µg/L) **	ND		
Chloroform Removal (kg)	0.0096	0.0044	0.014
Influent Carbon Disulfide (µg/L) **	0.190 J		
Effluent Carbon Disulfide (µg/L) **	ND		
Carbon Disulfide Removal (kg)	0.00010	0.00003	0.00013

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from July 13, 2021 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting week 17 July 2021 to 23 July 2021)					
Saturday, July 17, 2021	21,610	21,082	17,961	0	0	2,806
Sunday, July 18, 2021	21,607	21,076	17,994	0	0	2,819
Monday, July 19, 2021	21,606	21,342	18,072	0	0	2,811
Tuesday, July 20, 2021	22,188	21,614	18,028	0	506	2,783
Wednesday, July 21, 2021	24,754	24,305	19,705	0	988	2,993
Thursday, July 22, 2021	28,746	28,020	22,494	0	1,578	3,509
Friday, July 23, 2021	28,760	27,992	22,276	G	1,677	3,647
Weekly Total (gallons)	**169,270**	**165,430**	**136,529**	**0**	**4,750**	**21,368**
Weekly Total (liters)	**640,688**	**626,154**	**516,761**	**0**	**17,979**	**80,878**

EW-01 Pumping Duration (hours)	161.15		
Average Extraction Rate (gpm)	17.51		
Influent Carbon Tetrachloride (µg/L) **	301	**Prior Week Removal (kg)**	**Cumulative Removal (kg)**
Effluent Carbon Tetrachloride (µg/L)**	ND		
Carbon Tetrachloride Removal (kg)	0.193	0.126	0.364
Influent Chloroform (µg/L) **	18.6		
Effluent Chloroform (µg/L) **	ND		
Chloroform Removal (kg)	0.012	0.0096	0.026
Influent Carbon Disulfide (µg/L) **	0.502		
Effluent Carbon Disulfide (µg/L) **	ND		
Carbon Disulfide Removal (kg)	0.00032	0.00010	0.00045

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from July 20, 2021 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting week 24 July 2021 to 30 July 2021)					
Saturday, July 24, 2021	28,805	28,159	22,466	0	1,553	3,826
Sunday, July 25, 2021	28,075	27,496	21,770	0	1,509	3,681
Monday, July 26, 2021	28,849	28,073	22,337	0	1,527	3,831
Tuesday, July 27, 2021	28,829	28,209	22,413	0	1,442	3,801
Wednesday, July 28, 2021	28,726	27,946	22,368	0	1,394	3,819
Thursday, July 29, 2021	28,374	27,778	22,139	0	1,404	3,745
Friday, July 30, 2021	28,765	28,222	22,489	0	1,408	3,771
Weekly Total (gallons)	**200,422**	**195,882**	**155,982**	**0**	**10,237**	**26,473**
Weekly Total (liters)	**758,596**	**741,415**	**590,391**	**0**	**38,745**	**100,202**

EW-01 Pumping Duration (hours)	167.00		
Average Extraction Rate (gpm)	20.00		
Influent Carbon Tetrachloride (µg/L) **	259	**Prior Week Removal (kg)**	**Cumulative Removal (kg)**
Effluent Carbon Tetrachloride (µg/L)**	ND		
Carbon Tetrachloride Removal (kg)	0.196	0.193	0.560
Influent Chloroform (µg/L) **	17.9		
Effluent Chloroform (µg/L) **	ND		
Chloroform Removal (kg)	0.014	0.0120	0.039
Influent Carbon Disulfide (µg/L) **	0.189		
Effluent Carbon Disulfide (µg/L) **	ND		
Carbon Disulfide Removal (kg)	0.00014	0.00032	0.00060

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from July 26, 2021 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting week 31 July 2021 to 6 August 2021)					
Saturday, July 31, 2021	28,913	28,205	22,592	0	1,411	3,775
Sunday, August 1, 2021	28,859	28,288	22,569	0	1,411	3,807
Monday, August 2, 2021	28,840	28,258	22,584	0	1,397	3,759
Tuesday, August 3, 2021	28,741	27,979	22,363	0	1,383	3,757
Wednesday, August 4, 2021	28,372	27,838	22,282	0	1,278	3,792
Thursday, August 5, 2021	28,458	27,893	22,137	0	1,268	3,766
Friday, August 6, 2021	26,696	26,082	20,937	0	1,204	3,528
Weekly Total (gallons)	**198,878**	**194,542**	**155,464**	**0**	**9,352**	**26,185**
Weekly Total (liters)	**752,755**	**736,343**	**588,430**	**0**	**35,398**	**99,110**

EW-01 Pumping Duration (hours)	166.57
Average Extraction Rate (gpm)	19.90

		Prior Week Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	223		
Effluent Carbon Tetrachloride (µg/L)**	0.171 J		
Carbon Tetrachloride Removal (kg)	0.168	0.196	0.728
Influent Chloroform (µg/L) **	18.5		
Effluent Chloroform (µg/L) **	ND		
Chloroform Removal (kg)	0.014	0.0136	0.053
Influent Carbon Disulfide (µg/L) **	ND		
Effluent Carbon Disulfide (µg/L) **	ND		
Carbon Disulfide Removal (kg)	0	0.00014	0.00060

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from August 3, 2021 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting week 31 July 2021 to 6 August 2021)					
Saturday, August 7, 2021	28,272	27,613	22,178	0	1,306	3,802
Sunday, August 8, 2021	28,327	27,767	21,998	0	1,269	3,823
Monday, August 9, 2021	28,295	27,550	22,081	0	1,305	3,822
Tuesday, August 10, 2021	28,372	27,902	22,088	0	1,292	3,993
Wednesday, August 11, 2021	28,336	27,749	21,777	0	1,323	3,842
Thursday, August 12, 2021	28,255	27,516	21,848	0	1,270	3,884
Friday, August 13, 2021	27,771	27,061	21,696	0	1,151	3,764
Weekly Total (gallons)	**197,629**	**193,159**	**153,667**	**0**	**8,918**	**26,929**
Weekly Total (liters)	**748,025**	**731,105**	**581,629**	**0**	**33,754**	**101,927**

EW-01 Pumping Duration (hours)	167.73
Average Extraction Rate (gpm)	19.64

		Prior Week Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	232		
Effluent Carbon Tetrachloride (µg/L)**	0.184 J		
Carbon Tetrachloride Removal (kg)	0.173	0.168	0.901
Influent Chloroform (µg/L) **	13.7		
Effluent Chloroform (µg/L) **	ND		
Chloroform Removal (kg)	0.010	0.0139	0.064
Influent Carbon Disulfide (µg/L) **	0.202 J		
Effluent Carbon Disulfide (µg/L) **	ND		
Carbon Disulfide Removal (kg)	0.00015	0.00000	0.00075

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from August 9, 2021 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting week 31 July 2021 to 6 August 2021)					
Saturday, August 14, 2021	27,589	27,022	21,634	0	1,149	3,759
Sunday, August 15, 2021	27,551	27,215	21,573	0	1,148	3,766
Monday, August 16, 2021	26,194	25,831	20,731	0	903	3,486
Tuesday, August 17, 2021	26,269	26,103	20,748	0	1,114	3,440
Wednesday, August 18, 2021	26,556	25,975	20,802	0	1,112	3,440
Thursday, August 19, 2021	26,273	25,985	20,796	0	1,111	3,438
Friday, August 20, 2021	26,497	25,926	20,785	0	1,110	3,436
Weekly Total (gallons)	**186,929**	**184,056**	**147,071**	**0**	**7,647**	**24,765**
Weekly Total (liters)	**707,525**	**696,652**	**556,665**	**0**	**28,942**	**93,736**

EW-01 Pumping Duration (hours)	160.15
Average Extraction Rate (gpm)	19.45

		Prior Week Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	342		
Effluent Carbon Tetrachloride (µg/L)**	ND		
Carbon Tetrachloride Removal (kg)	0.242	0.173	1.143
Influent Chloroform (µg/L) **	15.9		
Effluent Chloroform (µg/L) **	ND		
Chloroform Removal (kg)	0.011	0.0100	0.075
Influent Carbon Disulfide (µg/L) **	ND		
Effluent Carbon Disulfide (µg/L) **	ND		
Carbon Disulfide Removal (kg)	0	0.00015	0.00075

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from August 16, 2021 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting week 31 July 2021 to 6 August 2021)					
Saturday, August 21, 2021	26,390	25,988	20,811	0	1,109	3,436
Sunday, August 22, 2021	26,343	26,059	20,800	0	1,108	3,436
Monday, August 23, 2021	26,363	26,016	20,771	0	1,109	3,439
Tuesday, August 24, 2021	17,590	17,364	13,812	0	742	2,341
Wednesday, August 25, 2021	5,220	4,895	3,995	0	234	779
Thursday, August 26, 2021	0	0	0	0	0	0
Friday, August 27, 2021	2,378	2,682	1,805	0	132	428
Weekly Total (gallons)	**104,285**	**103,004**	**81,993**	**0**	**4,434**	**13,859**
Weekly Total (liters)	**394,717**	**389,869**	**310,343**	**0**	**16,784**	**52,455**

EW-01 Pumping Duration (hours)	89.40
Average Extraction Rate (gpm)	19.44

		Prior Week Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	196		
Effluent Carbon Tetrachloride (µg/L)**	0.293		
Carbon Tetrachloride Removal (kg)	0.077	0.242	1.220
Influent Chloroform (µg/L) **	13.1		
Effluent Chloroform (µg/L) **	ND		
Chloroform Removal (kg)	0.005	0.0110	0.080
Influent Carbon Disulfide (µg/L) **	ND		
Effluent Carbon Disulfide (µg/L) **	ND		
Carbon Disulfide Removal (kg)	0	0.00000	0.00075

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from August 23, 2021 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting period 18 February 2022 to 28 February 2022)					
Friday, February 18, 2022	14,358	14,237	11,803	0	0	2,081
Saturday, February 19, 2022	19,443	18,889	15,723	0	0	2,879
Sunday, February 20, 2022	23,061	22,437	18,713	0	0	3,439
Monday, February 21, 2022	23,670	23,257	19,064	0	0	3,605
Tuesday, February 22, 2022	22,418	22,093	18,204	0	0	3,402
Wednesday, February 23, 2022	23,158	22,885	18,806	0	0	3,527
Thursday, February 24, 2022	23,013	22,415	18,459	0	0	3,581
Friday, February 25, 2022	23,270	22,719	18,662	0	0	3,684
Saturday, February 26, 2022	23,304	23,018	18,606	0	0	3,640
Sunday, February 27, 2022	22,956	22,718	18,546	0	0	3,605
Monday, February 28, 2022	3,364	3,553	3,234	0	0	416
Weekly Total (gallons)	**222,015**	**218,222**	**179,820**	**0**	**0**	**33,859**
Weekly Total (liters)	**840,328**	**825,969**	**680,619**	**0**	**0**	**128,157**

EW-01 Pumping Duration (hours)	Cycling
Extraction Rate Target (gpm)	18.00

		Aug 21-27, 2021 Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	300		
Effluent Carbon Tetrachloride (µg/L)**	ND		
Carbon Tetrachloride Removal (kg)	0.252	0.077	1.472
Influent Chloroform (µg/L) **	13.0		
Effluent Chloroform (µg/L) **	ND		
Chloroform Removal (kg)	0.011	0.0050	0.091
Influent Carbon Disulfide (µg/L) **	ND		
Effluent Carbon Disulfide (µg/L) **	ND		
Carbon Disulfide Removal (kg)	0	0.00000	0.00075

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from February 21, 2022 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting period 1-11 March 2022)					
Tuesday, March 1, 2022	1,335	1,327	1,459	0	0	261
Wednesday, March 2, 2022	0	0	0	0	0	0
Thursday, March 3, 2022	0	0	0	0	0	0
Friday, March 4, 2022	2,703	2,747	1,978	0	0	330
Saturday, March 5, 2022	0	0	0	0	0	0
Sunday, March 6, 2022	0	0	0	0	0	0
Monday, March 7, 2022	7,011	6,834	5,365	0	0	979
Tuesday, March 8, 2022	0	0	0	0	0	0
Wednesday, March 9, 2022	0	0	0	0	0	0
Thursday, March 10, 2022	10,997	10,564	8,853	0	0	1,565
Friday, March 11, 2022	22,805	22,264	18,447	0	0	3,395
Weekly Total (gallons)	**44,850**	**43,736**	**36,102**	**0**	**0**	**6,531**
Weekly Total (liters)	**169,757**	**165,540**	**136,648**	**0**	**0**	**24,719**

EW-01 Pumping Duration (hours)	Cycling
Extraction Rate Target (gpm)	18.00

		Feb 18-28, 2022 Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	297		
Effluent Carbon Tetrachloride (µg/L)**	ND		
Carbon Tetrachloride Removal (kg)	0.050	0.025	1.295
Influent Chloroform (µg/L) **	11.4		
Effluent Chloroform (µg/L) **	ND		
Chloroform Removal (kg)	0.002	0.0010	0.083
Influent Carbon Disulfide (µg/L) **	ND		
Effluent Carbon Disulfide (µg/L) **	ND		
Carbon Disulfide Removal (kg)	0	0.00000	0.00075

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from March 7, 2022 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting period 12 March 2022 to 29 March 2022)					
Saturday, March 12, 2022	23,605	23,273	19,139	0	0	3,569
Sunday, March 13, 2022	22,578	22,411	18,406	0	0	3,432
Monday, March 14, 2022	22,751	22,273	18,334	0	0	3,420
Tuesday, March 15, 2022	17,565	16,990	15,553	0	0	1,032
Wednesday, March 16, 2022	15,583	15,648	12,690	0	0	2,504
Thursday, March 17, 2022	23,243	22,385	18,425	0	0	3,607
Friday, March 18, 2022	22,356	22,113	18,123	0	0	3,445
Saturday, March 19, 2022	22,686	22,066	18,237	0	0	3,499
Sunday, March 20, 2022	22,764	21,999	18,215	0	0	3,503
Monday, March 21, 2022	22,689	21,900	18,189	0	0	3,500
Tuesday, March 22, 2022	22,091	21,515	17,708	0	0	3,531
Wednesday, March 23, 2022	22,464	21,638	17,841	0	0	3,674
Thursday, March 24, 2022	7,426	7,267	5,870	0	0	1,211
Friday, March 25, 2022	12,605	12,057	10,288	0	0	1,862
Saturday, March 26, 2022	22,873	21,957	18,375	0	0	3,460
Sunday, March 27, 2022	22,746	21,915	18,251	0	0	3,462
Monday, March 28, 2022	22,438	21,724	18,206	0	0	3,465
Tuesday, March 29, 2022	22,623	21,839	18,166	0	0	3,465
Period Total (gallons)	**371,085**	**360,968**	**300,018**	**0**	**0**	**55,641**
Period Total (liters)	**1,404,557**	**1,366,263**	**1,135,567**	**0**	**0**	**210,601**

EW-01 Pumping Duration (hours)	Cycling
Extraction Rate Target (gpm)	18.00

		Mar 1-11, 2021 Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	237		
Effluent Carbon Tetrachloride (µg/L)**	ND		
Carbon Tetrachloride Removal (kg)	0.333	0.050	1.628
Influent Chloroform (µg/L) **	14.8		
Effluent Chloroform (µg/L) **	ND		
Chloroform Removal (kg)	0.021	0.0020	0.104
Influent Carbon Disulfide (µg/L) **	0.427		
Effluent Carbon Disulfide (µg/L) **	ND		
Carbon Disulfide Removal (kg)	0	0.00000	0.00135

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from March 28, 2022 sampling event

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting period 30 March 2022 to 30 April 2022)					
Wednesday, March 30, 2022	22,610	21,915	18,134	0	0	3,464
Thursday, March 31, 2022	22,408	21,966	18,058	0	0	3,481
Friday, April 1, 2022	22,426	21,998	17,942	0	0	3,509
Saturday, April 2, 2022	22,403	21,862	17,921	0	0	3,507
Sunday, April 3, 2022	22,397	21,798	17,928	0	0	3,510
Monday, April 4, 2022	12,448	12,121	10,032	0	0	1,910
Tuesday, April 5, 2022	15,199	15,081	12,214	0	0	2,344
Wednesday, April 6, 2022	22,607	21,945	18,096	0	0	3,496
Thursday, April 7, 2022	22,396	21,970	17,995	0	0	3,485
Friday, April 8, 2022	22,391	21,588	17,952	0	0	3,486
Saturday, April 9, 2022	22,351	21,784	17,924	0	0	3,498
Sunday, April 10, 2022	22,371	21,569	17,887	0	0	3,474
Monday, April 11, 2022	21,688	21,034	17,873	0	0	2,827
Tuesday, April 12, 2022	21,485	21,129	17,864	0	0	2,768
Wednesday, April 13, 2022	21,707	21,057	17,858	0	0	2,766
Thursday, April 14, 2022	21,129	20,423	17,579	0	0	2,692
Friday, April 15, 2022	21,468	20,951	17,784	0	0	2,713
Saturday, April 16, 2022	21,265	20,913	17,750	0	0	2,694
Sunday, April 17, 2022	2,936	2,582	2,990	0	0	451
Monday, April 18, 2022	669	945	0	0	0	0
Tuesday, April 19, 2022	12,190	11,517	10,124	0	0	1,420
Wednesday, April 20, 2022	21,692	21,377	18,212	0	0	2,612
Thursday, April 21, 2022	21,855	21,377	18,077	0	0	2,696
Friday, April 22, 2022	21,577	21,316	18,024	0	0	2,715
Saturday, April 23, 2022	21,766	21,095	17,986	0	0	2,713
Sunday, April 24, 2022	21,637	21,064	17,956	0	0	2,709
Monday, April 25, 2022	21,524	21,242	17,921	0	0	2,707
Tuesday, April 26, 2022	21,671	21,254	17,903	0	0	2,708
Wednesday, April 27, 2022	21,441	20,976	17,884	0	0	2,710
Thursday, April 28, 2022	21,585	21,023	17,867	0	0	2,709
Friday, April 29, 2022	21,629	21,288	17,860	0	0	2,723
Saturday, April 30, 2022	21,368	20,982	17,844	0	0	2,732
Period Total (gallons)	**634,286**	**619,142**	**519,441**	**0**	**0**	**87,226**
Period Total (liters)	**2,400,772**	**2,343,451**	**1,966,084**	**0**	**0**	**330,150**

EW-01 Pumping Duration (hours)	Cycling
Extraction Rate Target (gpm)	18.00

System Sampling Results	Apr 11, 2022	Apr 28, 2022	Mar 12 - 29 2022 Removal (kg)	Mar 30 - Apr 15 2022 Removal (kg)	Apr 16 - 30 2022 Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	232	250				
Effluent Carbon Tetrachloride (µg/L)**	ND	ND				
Carbon Tetrachloride Removal (kg)			0.333	0.316	0.260	2.204
Influent Chloroform (µg/L) **	13.7	14.5				
Effluent Chloroform (µg/L) **	ND	ND				
Chloroform Removal (kg)			0.0210	0.0186	0.0151	0.138
Influent Carbon Disulfide (µg/L) **	0.841	0.643				
Effluent Carbon Disulfide (µg/L) **	ND	ND				
Carbon Disulfide Removal (kg)			0.0006	0.00114	0.00067	0.003

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from April 11 and 28, 2022 sampling events; used to calculate mass for periods Mar 30 - Apr 15 and Apr 16-30, respectively

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting period 30 March 2022 to 30 April 2022)					
Sunday, May 1, 2022	21,535	21,058	17,833	0	0	2,731
Monday, May 2, 2022	21,555	21,166	17,817	0	0	2,730
Tuesday, May 3, 2022	21,546	20,951	17,820	0	0	2,732
Wednesday, May 4, 2022	21,264	21,206	17,806	0	0	2,725
Thursday, May 5, 2022	21,541	21,054	17,792	0	0	2,778
Friday, May 6, 2022	21,542	20,993	17,770	0	0	2,790
Saturday, May 7, 2022	1,101	1,078	1,534	0	0	238
Sunday, May 8, 2022	0	0	0	0	0	0
Monday, May 9, 2022	0	0	0	0	0	0
Tuesday, May 10, 2022	12,059	11,996	9,449	0	0	1,345
Wednesday, May 11, 2022	21,575	21,276	18,166	0	0	2,640
Thursday, May 12, 2022	21,701	21,196	18,039	0	0	2,674
Friday, May 13, 2022	21,643	21,363	17,976	0	0	2,665
Saturday, May 14, 2022	21,523	20,859	17,938	0	0	2,665
Sunday, May 15, 2022	21,334	21,346	17,896	0	0	2,661
Monday, May 16, 2022	21,524	20,937	17,871	0	0	2,679
Tuesday, May 17, 2022	20,691	20,152	17,125	0	0	2,551
Wednesday, May 18, 2022	21,173	21,163	17,799	0	0	2,647
Thursday, May 19, 2022	21,412	20,737	17,764	0	0	2,651
Friday, May 20, 2022	21,397	21,189	17,751	0	0	2,651
Saturday, May 21, 2022	21,218	20,772	17,732	0	0	2,649
Sunday, May 22, 2022	21,265	21,017	17,727	0	0	2,647
Monday, May 23, 2022	7,498	7,248	6,220	0	0	930
Tuesday, May 24, 2022	11,113	11,188	9,334	0	0	1,379
Wednesday, May 25, 2022	21,580	20,966	17,898	0	0	2,704
Thursday, May 26, 2022	17,528	17,074	14,567	0	0	2,145
Friday, May 27, 2022	16,143	16,325	14,432	0	0	2,132
Saturday, May 28, 2022	0	0	0	0	0	0
Sunday, May 29, 2022	0	0	0	0	0	0
Monday, May 30, 2022	11,600	11,044	8,801	0	0	1,243
Tuesday, May 31, 2022	21,714	21,152	18,081	0	0	2,628
Period Total (gallons)	**505,774**	**496,505**	**420,940**	**0**	**0**	**63,011**
Period Total (liters)	**1,914,356**	**1,879,272**	**1,593,260**	**0**	**0**	**238,496**

EW-01 Pumping Duration (hours)	Cycling
Extraction Rate Target (gpm)	18.00

System Sampling Results	May 4, 2022	Mar 30 - Apr 30 2022 Removal (kg)	May 1 - 31 2022 Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	232			
Effluent Carbon Tetrachloride (µg/L)**	ND			
Carbon Tetrachloride Removal (kg)		0.576	0.444	2.648
Influent Chloroform (µg/L) **	13.7			
Effluent Chloroform (µg/L) **	ND			
Chloroform Removal (kg)		0.0337	0.0262	0.164
Influent Carbon Disulfide (µg/L) **	0.841			
Effluent Carbon Disulfide (µg/L) **	ND			
Carbon Disulfide Removal (kg)		0.00181	0.00161	0.005

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from May 4, 2022 sampling event used to calculate removal mass for period May 1-31

Table 1. Weekly Flow and Mass Removal Totals.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting period 1 June to 30 June 2022)					
Wednesday, June 1, 2022	21,346	20,819	17,951	0	0	2,621
Thursday, June 2, 2022	21,550	20,635	17,875	0	0	2,623
Friday, June 3, 2022	6,299	6,211	5,395	0	0	794
Saturday, June 4, 2022	0	0	0	0	0	0
Sunday, June 5, 2022	0	0	0	0	0	0
Monday, June 6, 2022	11,645	11,344	9,752	0	0	1,387
Tuesday, June 7, 2022	16,374	16,083	13,658	0	0	2,018
Wednesday, June 8, 2022	21,829	21,129	18,039	0	0	2,733
Thursday, June 9, 2022	21,520	20,917	17,943	0	0	2,757
Friday, June 10, 2022	21,700	20,942	17,875	0	0	2,772
Saturday, June 11, 2022	9,231	9,340	8,685	0	0	1,317
Sunday, June 12, 2022	13,608	13,260	11,323	0	0	1,715
Monday, June 13, 2022	4,443	4,252	3,523	0	0	495
Tuesday, June 14, 2022	12,229	11,622	9,486	0	0	1,353
Wednesday, June 15, 2022	21,661	21,114	18,114	0	0	2,617
Thursday, June 16, 2022	17,636	17,540	15,684	0	0	2,277
Friday, June 17, 2022	461	441	0	0	0	0
Saturday, June 18, 2022	0	0	0	0	0	0
Sunday, June 19, 2022	0	0	0	0	0	0
Monday, June 20, 2022	10,316	10,096	9,000	0	0	1,326
Tuesday, June 21, 2022	6,190	5,986	4,306	0	0	612
Wednesday, June 22, 2022	21,903	21,226	18,158	0	0	2,682
Thursday, June 23, 2022	21,506	21,027	17,981	0	0	2,699
Friday, June 24, 2022	15,018	14,624	12,621	0	0	1,881
Saturday, June 25, 2022	21,662	21,024	17,971	0	0	2,669
Sunday, June 26, 2022	21,482	20,913	17,824	0	0	2,681
Monday, June 27, 2022	21,466	20,860	17,773	0	0	2,713
Tuesday, June 28, 2022	21,295	20,932	17,737	0	0	2,708
Wednesday, June 29, 2022	21,476	20,877	17,719	0	0	2,706
Thursday, June 30, 2022	21,228	20,745	17,688	0	0	2,699
Period Total (gallons)	**425,076**	**413,960**	**354,081**	**0**	**0**	**52,856**
Period Total (liters)	**1,608,912**	**1,566,839**	**1,340,196**	**0**	**0**	**200,058**

EW-01 Pumping Duration (hours)	Cycling
Extraction Rate Target (gpm)	18

System Sampling Results	Jun 6, 2022	Jun 20, 2022	May 1 - May 31 2022 Removal (kg)	Jun 1 - Jun 15 2022 Removal (kg)	Jun 16 - Jun 30 2022 Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	231	195				
Effluent Carbon Tetrachloride (µg/L)**	ND	ND				
Carbon Tetrachloride Removal (kg)			0.444	0.178	0.164	2.989
Influent Chloroform (µg/L) **	10.5	10.2				
Effluent Chloroform (µg/L) **	ND	ND				
Chloroform Removal (kg)			0.0262	0.0081	0.0086	0.181
Influent Carbon Disulfide (µg/L) **	0.577	1.760				
Effluent Carbon Disulfide (µg/L) **	ND	ND				
Carbon Disulfide Removal (kg)			0.00161	0.00044	0.00148	0.007

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from Jun 6 and Jun 20, 2022 sampling events used to calculate removal mass for periods Jun 1-15 and Jun 16-30, respectively

Table 1. Monthly Flow and Mass Removal Totals - July 2022.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting period 1 July to 31 July 2022)					
Friday, July 1, 2022	18,496	17,956	15,401	0	0	2,290
Saturday, July 2, 2022	21,269	20,570	17,740	0	0	2,616
Sunday, July 3, 2022	21,239	20,645	17,696	0	0	2,639
Monday, July 4, 2022	17,952	17,677	15,942	0	0	2,402
Tuesday, July 5, 2022	15,855	15,069	12,295	0	0	1,868
Wednesday, July 6, 2022	19,598	19,110	17,165	0	0	2,640
Thursday, July 7, 2022	12,043	11,399	9,166	0	0	1,358
Friday, July 8, 2022	13,086	12,845	11,307	0	0	1,679
Saturday, July 9, 2022	10,261	9,922	8,986	0	0	1,326
Sunday, July 10, 2022	31	43	0	0	0	0
Monday, July 11, 2022	1,627	1,573	999	0	0	142
Tuesday, July 12, 2022	0	0	0	0	0	0
Wednesday, July 13, 2022	8,427	8,165	7,419	0	0	1,082
Thursday, July 14, 2022	0	0	0	0	0	0
Friday, July 15, 2022	0	0	0	0	0	0
Saturday, July 16, 2022	0	0	0	0	0	0
Sunday, July 17, 2022	0	0	0	0	0	0
Monday, July 18, 2022	4,439	4,309	3,707	0	0	547
Tuesday, July 19, 2022	9,807	9,521	8,209	0	0	1,170
Wednesday, July 20, 2022	12,178	11,438	9,235	0	0	1,324
Thursday, July 21, 2022	21,502	21,410	18,041	0	0	2,663
Friday, July 22, 2022	21,623	20,794	17,878	0	0	2,691
Saturday, July 23, 2022	3,826	4,202	4,199	0	0	646
Sunday, July 24, 2022	1,488	953	0	0	0	0
Monday, July 25, 2022	7,785	8,116	7,815	0	0	1,117
Tuesday, July 26, 2022	12,399	11,850	9,396	0	0	1,378
Wednesday, July 27, 2022	21,635	20,937	17,967	0	0	2,691
Thursday, July 28, 2022	21,252	21,176	17,852	0	0	2,698
Friday, July 29, 2022	21,447	20,696	17,782	0	0	2,705
Saturday, July 30, 2022	21,365	20,677	17,740	0	0	2,705
Sunday, July 31, 2022	21,142	20,885	17,703			2,696
Period Total (gallons)	**361,773**	**351,941**	**301,640**	**0**	**0**	**45,074**
Period Total (liters)	**1,369,311**	**1,332,097**	**1,141,708**	**0**	**0**	**170,606**

EW-01 Pumping Duration (hours)	Cycling
Extraction Rate Target (gpm)	18

System Sampling Results	Jul 5, 2022	Jul 22, 2022	Jun 1 - Jun 30 2022 Removal (kg)	Jul 1 - Jul 15 2022 Removal (kg)	Jul 16 - Jul 31 2022 Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	223	223				
Effluent Carbon Tetrachloride (µg/L)**	ND	ND				
Carbon Tetrachloride Removal (kg)			0.342	0.135	0.170	3.294
Influent Chloroform (µg/L) **	12.8	13.3				
Effluent Chloroform (µg/L) **	0.119	0.136				
Chloroform Removal (kg)			0.0167	0.0077	0.0101	0.199
Influent Carbon Disulfide (µg/L) **	ND	0.239				
Effluent Carbon Disulfide (µg/L) **	ND	ND				
Carbon Disulfide Removal (kg)			0.00192	0.00000	0.00018	0.007

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from Jul 5 and Jul 22, 2022 sampling events used to calculate removal mass for periods Jul 1-15 and Jul 16-31, respectively

Table 1. Monthly Flow and Mass Removal Totals. August 2022.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04
	(Reporting period 1 August to 31 August 2022)					
Monday, August 1, 2022	21,347	20,889	17,680	0	0	2,715
Tuesday, August 2, 2022	21,087	20,596	17,662	0	0	2,709
Wednesday, August 3, 2022	21,337	20,488	17,636	0	0	2,708
Thursday, August 4, 2022	21,311	20,624	17,619	0	0	2,707
Friday, August 5, 2022	21,045	20,712	17,604	0	0	2,704
Saturday, August 6, 2022	21,270	20,639	17,595	0	0	2,705
Sunday, August 7, 2022	20,977	20,669	17,581	0	0	2,703
Monday, August 8, 2022	21,213	20,550	17,569	0	0	2,685
Tuesday, August 9, 2022	20,922	20,425	17,561	0	0	2,672
Wednesday, August 10, 2022	21,163	20,344	17,542	0	0	2,671
Thursday, August 11, 2022	15,159	14,657	12,525	0	0	1,910
Friday, August 12, 2022	0	0	0	0	0	0
Saturday, August 13, 2022	0	0	0	0	0	0
Sunday, August 14, 2022	0	0	0	0	0	0
Monday, August 15, 2022	14,411	14,261	12,072	0	0	1,781
Tuesday, August 16, 2022	21,462	20,660	17,790	0	0	2,681
Wednesday, August 17, 2022	21,163	20,855	17,692	0	0	2,684
Thursday, August 18, 2022	21,264	20,792	17,632	0	0	2,679
Friday, August 19, 2022	21,000	20,426	17,596	0	0	2,681
Saturday, August 20, 2022	21,109	20,615	17,567	0	0	2,689
Sunday, August 21, 2022	21,157	20,728	17,541	0	0	2,682
Monday, August 22, 2022	20,941	20,348	17,518	0	0	2,677
Tuesday, August 23, 2022	21,019	20,524	17,507	0	0	2,677
Wednesday, August 24, 2022	9,254	8,834	7,583	0	0	1,155
Thursday, August 25, 2022	13,221	13,020	11,083	0	0	1,700
Friday, August 26, 2022	21,266	20,844	17,629	0	0	2,764
Saturday, August 27, 2022	21,271	20,710	17,550	0	0	2,766
Sunday, August 28, 2022	21,084	20,469	17,517	0	0	2,769
Monday, August 29, 2022	21,060	20,657	17,497	0	0	2,767
Tuesday, August 30, 2022	21,167	20,727	17,478	0	0	2,752
Wednesday, August 31, 2022	21,019	20,310	17,451			2,753
Period Total (gallons)	**559,698**	**545,370**	**465,280**	**0**	**0**	**71,545**
Period Total (liters)	**2,118,458**	**2,064,227**	**1,761,083**	**0**	**0**	**270,796**

EW-01 Pumping Duration (hours)	Cycling
Extraction Rate Target (gpm)	18

System Sampling Results	Aug 2, 2022	Aug 16, 2022	Jul 1 - Jul 31 2022 Removal (kg)	Aug 1 - Aug 15 2022 Removal (kg)	Aug 16 - Aug 31 2022 Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L) **	158	179				
Effluent Carbon Tetrachloride (µg/L)**	ND	ND				
Carbon Tetrachloride Removal (kg)			0.305	0.144	0.216	3.654
Influent Chloroform (µg/L) **	9.7	9.7				
Effluent Chloroform (µg/L) **	ND	ND				
Chloroform Removal (kg)			0.0178	0.0089	0.0116	0.219
Influent Carbon Disulfide (µg/L) **	ND	ND				
Effluent Carbon Disulfide (µg/L) **	ND	ND				
Carbon Disulfide Removal (kg)			0.00018	0.00000	0.00000	0.007

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
** = results from Aug 2 and Aug 16, 2022 sampling events used to calculate removal mass for periods Aug 1-15 and Aug 16-31, respectively

Table 1. Monthly Flow and Mass Removal Totals. September 2022.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04(R)
	(Reporting period 1 September to 30 September 2022)					
Thursday, September 1, 2022	21,013	20,672	17,439	0	0	2,762
Friday, September 2, 2022	21,119	20,540	17,424	0	0	2,757
Saturday, September 3, 2022	20,957	20,318	17,418	0	0	2,760
Sunday, September 4, 2022	20,967	20,437	17,407	0	0	2,758
Monday, September 5, 2022	21,091	20,533	17,398	0	0	2,759
Tuesday, September 6, 2022	20,798	20,480	17,388	0	0	2,756
Wednesday, September 7, 2022	21,063	20,275	17,378	0	0	2,754
Thursday, September 8, 2022	20,864	20,310	17,370	0	0	2,746
Friday, September 9, 2022	21,001	20,280	17,358	0	0	2,745
Saturday, September 10, 2022	20,962	20,280	17,354	0	0	2,745
Sunday, September 11, 2022	20,841	20,363	17,341	0	0	2,740
Monday, September 12, 2022	21,009	20,378	17,329	0	0	2,738
Tuesday, September 13, 2022	18,874	18,488	17,346	0	0	861
Wednesday, September 14, 2022	18,065	17,734	17,347	0	0	0
Thursday, September 15, 2022	18,198	17,816	17,335	0	0	55
Friday, September 16, 2022 *	18,132	17,775	17,341	0	0	0
Saturday, September 17, 2022	18,110	17,576	17,312	0	0	0
Sunday, September 18, 2022	18,094	17,526	17,307	0	0	0
Monday, September 19, 2022	18,096	17,511	17,304	0	0	0
Tuesday, September 20, 2022	18,067	17,555	17,306	0	0	0
Wednesday, September 21, 2022	18,073	17,551	17,293	0	0	0
Thursday, September 22, 2022	18,085	17,524	17,290	0	0	0
Friday, September 23, 2022	18,075	17,558	17,289	0	0	0
Saturday, September 24, 2022	18,044	17,571	17,289	0	0	0
Sunday, September 25, 2022	18,057	17,592	17,286	0	0	0
Monday, September 26, 2022	18,059	17,603	17,276	0	0	0
Tuesday, September 27, 2022	6,044	6,662	6,727	0	0	0
Wednesday, September 28, 2022	0	0	0	0	0	0
Thursday, September 29, 2022	0	0	0	0	0	0
Friday, September 30, 2022	14,774	14,084	8,286	0	0	5,424
Period Total (gallons)	**526,532**	**512,990**	**465,940**	**0**	**0**	**39,358**
Period Total (liters)	**1,992,923**	**1,941,669**	**1,763,582**	**0**	**0**	**148,971**

EW-01 Pumping Duration (hours)	Cycling
Extraction Rate Target (gpm)	18

System Sampling Results	Sep 8, 2022	Aug 1 - Aug 31 2022 Removal (kg)	Sep 1 - Sep 30 2022 Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L)	178			
Effluent Carbon Tetrachloride (µg/L)	ND			
Carbon Tetrachloride Removal (kg)		0.360	0.355	4.009
Influent Chloroform (µg/L)	10.2			
Effluent Chloroform (µg/L)	ND			
Chloroform Removal (kg)		0.0205	0.0203	0.239
Influent Carbon Disulfide (µg/L)	ND			
Effluent Carbon Disulfide (µg/L)	ND			
Carbon Disulfide Removal (kg)		0.00000	0.00000	0.007

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
* = estimated flow is average of two previous days due to corrupted/missing treatment system daily data file

Table 1. Monthly Flow and Mass Removal Totals. October 2022.
UPRR Grain Handling Facility, Freeman, WA

Daily Flow (Gallons)	EW-01	Feed Pump	IW-01	IW-02	IW-03	IW-04(R)
	(Reporting period 1 October to 31 October 2022)					
Saturday, October 1, 2022	29,093	28,830	17,505	0	0	10,739
Sunday, October 2, 2022	28,651	27,691	17,400	0	0	10,066
Monday, October 3, 2022	25,694	24,834	16,188	0	0	9,152
Tuesday, October 4, 2022	2,743	2,695	1,715	0	0	952
Wednesday, October 5, 2022	17,161	16,758	10,180	0	0	5,719
Thursday, October 6, 2022	28,543	27,806	17,539	0	0	9,987
Friday, October 7, 2022	28,730	27,480	17,437	0	0	10,166
Saturday, October 8, 2022	28,686	27,491	17,379	0	0	10,172
Sunday, October 9, 2022	28,454	27,615	17,341	0	0	10,148
Monday, October 10, 2022	28,164	27,329	17,308	0	0	9,838
Tuesday, October 11, 2022	27,810	26,891	17,295	0	0	9,443
Wednesday, October 12, 2022	24,269	23,497	15,135	0	0	8,164
Thursday, October 13, 2022	27,730	26,615	17,306	0	0	9,352
Friday, October 14, 2022	27,589	26,648	17,255	0	0	9,326
Saturday, October 15, 2022	27,516	26,564	17,236	0	0	9,354
Sunday, October 16, 2022	27,643	26,765	17,220	0	0	9,382
Monday, October 17, 2022	13,376	12,907	8,188	0	0	4,466
Tuesday, October 18, 2022	15,668	15,111	9,993	0	0	5,323
Wednesday, October 19, 2022 *	15,668	15,111	9,993	0	0	5,323
Thursday, October 20, 2022	0	0	0	0	0	0
Friday, October 21, 2022	0	0	0	0	0	0
Saturday, October 22, 2022	0	0	0	0	0	0
Sunday, October 23, 2022	0	0	0	0	0	0
Monday, October 24, 2022	0	0	0	0	0	0
Tuesday, October 25, 2022	0	0	0	0	0	0
Wednesday, October 26, 2022	0	0	0	0	0	0
Thursday, October 27, 2022	22,475	21,746	11,492	0	0	9,913
Friday, October 28, 2022	35,308	34,383	17,750	0	0	16,446
Saturday, October 29, 2022	35,185	34,316	17,632	0	0	16,492
Sunday, October 30, 2022	35,255	34,356	17,555	0	0	16,503
Monday, October 31, 2022	35,195	34,269	17,489			16,548
Period Total (gallons)	**616,606**	**597,705**	**361,529**	**0**	**0**	**232,974**
Period Total (liters)	**2,333,854**	**2,262,315**	**1,368,386**	**0**	**0**	**881,807**

EW-01 Pumping Duration (hours)	Cycling
Extraction Rate Target (gpm)	18

System Sampling Results	Oct 6, 2022	Sep 1 - Sep 30 2022 Removal (kg)	Oct 1 - Oct 31 2022 Removal (kg)	Cumulative Removal (kg)
Influent Carbon Tetrachloride (µg/L)	174			
Effluent Carbon Tetrachloride (µg/L)	ND			
Carbon Tetrachloride Removal (kg)		0.355	0.406	4.415
Influent Chloroform (µg/L)	9.8			
Effluent Chloroform (µg/L)	ND			
Chloroform Removal (kg)		0.0203	0.0230	0.262
Influent Carbon Disulfide (µg/L)	1.920			
Effluent Carbon Disulfide (µg/L)	ND			
Carbon Disulfide Removal (kg)		0.00000	0.00448	0.011

Notes:
gpm = gallons per minute
J = estimated concentration
kg = kilograms
ND = not detected
µg/L = micrograms per liter
* = estimated flow is same as previous day based on similar partial-day operation (missing/corrupt treatment system daily data file)

Appendix C
Mann-Kendall Analysis

Appendix C - Trend Evaluation Method

Carbon tetrachloride concentrations were evaluated for temporal trends in the data using the Mann-Kendall (MK) test (Mann 1945; Kendall 1975; Gilbert 1987). The MK test is a nonparametric procedure that compares the relative magnitudes of sample data rather than the data values themselves. As a nonparametric procedure, the MK test does not require the underlying data to follow a specific distribution. The test is based on the idea that a lack of trend should correspond to a time series plot fluctuating randomly about a constant mean level, with no visually apparent upward or downward pattern (USEPA 2009). For this analysis, a 0.05 significance level (corresponding to 95 percent confidence) was used to test the null hypothesis that there is no trend in the data with the alternative hypothesis that a monotonic (upward or downward) trend exists in the data. If the calculated probability from the test is below this significance level, a conclusion is drawn to reject the null hypothesis and instead determine that a significant trend exists.

To gauge the magnitude of the trend, the Theil-Sen slope was calculated for wells exhibiting a statistically significant trend in carbon tetrachloride concentrations. Although nonparametric, the Theil-Sen slope estimator does not use data ranks but rather the concentrations themselves. The method is nonparametric because the median pairwise slope is utilized, thus ignoring extreme values that might otherwise skew the slope estimate. Confidence bands were constructed around the Theil-Sen trend line using bootstrapping (USEPA 2009). In this method, the Theil-Sen trend was first computed using the sample data. Then a large number of bootstrap resamples were drawn from the original sample, and an alternate Theil-Sen trend was conducted on each bootstrap sample. Variability in these alternate trend estimates was then used to construct lower and upper confidence limits around the original trend. For this analysis, these limits were constructed to represent a nonparametric simultaneous confidence band around the Theil-Sen trend line with 95 percent confidence.

Where there was insufficient evidence for identifying a significant, non-zero trend at the 95 percent confidence level, concentrations were deemed stable if the coefficient of variation (CV) was less than 1. Values less than or near 1 indicate that the data form a relatively close group about the mean value; values larger than 1.0 indicate that the data show a greater degree of scatter about the mean.

Summary statistics (mean, median, standard deviation, and CV) were calculated using the Kaplan-Meier (KM) product-limit estimator (Kaplan and Meier 1958) for non-detects with the censoring limit set at the reporting limit. The USEPA (2009) recommends the use of the KM method when dealing with environmental data sets containing a mixture of detects and non-detects. Descriptive statistics were not calculated for those data sets containing greater than 50% non-detects. If a data set is a mixture of detects and non-detects, but the non-detect fraction is no more than 50%, a censored estimation method such as the KM product-limit can be used to compute adjusted estimates of the mean and standard deviation. Because parameter estimation can suffer for data sets with low detection frequencies, the USEPA (2009) recommends that these methods should not be used when more than 50% of the data are non-detects.

References

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley, New York.

Kaplan, E.L. and O. Meier. 1958. Nonparametric Estimation from Incomplete Observations. *Journal of the American Statistical Association*, 53, 457-481.

Kendall, M.G. 1975. *Rank Correlation Techniques, 4th ed*. Charles Griffen. London.

Mann, H.B. 1945. Nonparametric Tests Against Trend. *Econometrica*, 13, 245-259.

United States Environmental Protection Agency (EPA). 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance*. EPA-530-R-09-007. Office of Resource Conservation and Recovery, U.S. Environmental Protection Agency. March.

Table C-1. Mann-Kendall Trend Evaluation Results for Carbon Tetrachloride (Jan. 2016 - Nov. 2022)

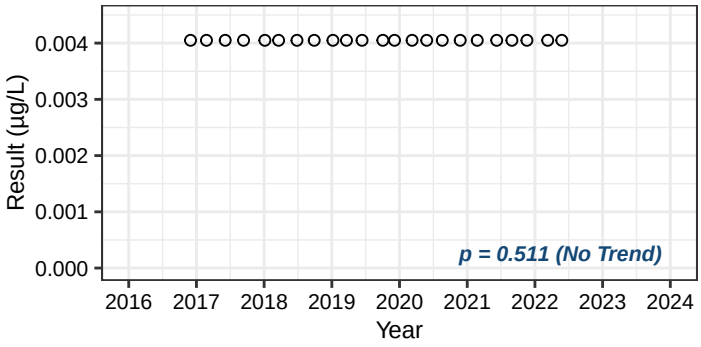
Well	Total Samples	Detect Results	Detect Freq. (%)	Min Non-Detect (µg/L)	Min Detect (µg/L)	Max Non-Detect (µg/L)	Max Detect (µg/L)	Mean (µg/L)	Median (µg/L)	Std Dev. (µg/L)	CV	Last Result (µg/L)	Last Sample Date	MK Test Value (S)	MK p-value	Sen's Slope Estimator (µg/L/yr)	Mann-Kendall Result	Trend Analysis Result	Stability Based On CV	Min Sample Spacing (days)
Asher Well	23	0	0	0.0790	---	0.200	---	---	---	---	---	0.13 U	May-22	0	0.500	---	50% (+)	No Trend	>50% ND	63
Atwood House	18	0	0	0.130	---	0.500	---	---	---	---	---	0.13 U	May-22	0	0.500	---	50% (+)	No Trend	>50% ND	59
Atwood Shop	7	0	0	0.190	---	0.200	---	---	---	---	---	0.19 U	Jun-19	0	0.500	---	50% (+)	No Trend	>50% ND	59
Davey Well (W46)	3	3	100	---	17.0	---	22.3	19.2	18.3	2.76	0.144	17.0	Feb-17	IS	IS	IS	IS	IS	IS	43
Freeman Store Well	2	0	0	0.0790	---	0.120	---	---	---	---	---	0.12 U	Aug-16	IS	IS	---	50% (+)	IS	IS	23
Lang Well	26	1	3.85	0.0790	0.160	0.200	0.160	---	---	---	---	0.13 U	Aug-22	-25	0.300	---	70% (-)	No Trend	>50% ND	40
Lashaw Well (Agricultural)	13	13	100	---	1.50	---	34.4	7.91	4.10	9.19	1.16	34.4	Aug-22	22	0.102	---	89.8% (+)	No Trend	Not Stable	73
Lashaw Well (Domestic)	24	24	100	---	0.220	---	1.20	0.595	0.555	0.217	0.365	0.570	Aug-22	-96	0.009	-0.0488	99.1% (sig -)	**Decreasing**	---	15
Marlow Well	28	27	96.4	0.190	21.4	0.190	167	92.6	105	41.4	0.447	21.4	Aug-22	-233	0.000	-16.5	100% (sig -)	**Decreasing**	---	20
MW-10S	24	18	75.0	0.140	0.310	0.190	34.0	4.83	0.675	9.89	2.05	0.740	Aug-22	-104	0.005	-0.458	99.5% (sig -)	**Decreasing**	---	61
MW-11S	23	0	0	0.0790	---	0.200	---	---	---	---	---	0.13 U	May-22	0	0.500	---	50% (+)	No Trend	>50% ND	63
MW-12S	23	1	4.35	0.0790	0.970	0.200	0.970	---	---	---	---	0.13 U	May-22	-6	0.448	---	55.2% (-)	No Trend	>50% ND	63
MW-13S	22	1	4.55	0.0790	0.560	0.200	0.560	---	---	---	---	0.13 U	May-22	-3	0.478	---	52.2% (-)	No Trend	>50% ND	60
MW-14D	18	0	0	0.0790	---	0.200	---	---	---	---	---	0.14 U	Jun-21	0	0.500	---	50% (+)	No Trend	>50% ND	63
MW-15D	16	16	100	---	7.50	---	10.7	8.91	8.80	0.990	0.111	7.70	Jun-21	-33	0.077	---	92.3% (-)	No Trend	Stable	79
MW-16D	21	0	0	0.0790	---	0.200	---	---	---	---	---	0.13 U	Aug-22	0	0.500	---	50% (+)	No Trend	>50% ND	72
MW-17D	18	0	0	0.0790	---	0.200	---	---	---	---	---	0.14 U	Jun-21	0	0.500	---	50% (+)	No Trend	>50% ND	62
MW-18D	17	0	0	0.0790	---	0.200	---	---	---	---	---	0.14 U	Jun-21	0	0.500	---	50% (+)	No Trend	>50% ND	74
MW-19D	23	23	100	---	76.0	---	509	383	402	93.5	0.244	221	Aug-22	-27	0.248	---	75.2% (-)	No Trend	Stable	36
MW-1D	20	0	0	0.0790	---	0.200	---	---	---	---	---	0.159 U	Jun-21	0	0.500	---	50% (+)	No Trend	>50% ND	72
MW-1S	17	0	0	0.0790	---	0.200	---	---	---	---	---	0.159 U	Jun-21	0	0.500	---	50% (+)	No Trend	>50% ND	60
MW-20D	17	17	100	---	20.0	---	38.2	27.6	27.7	4.77	0.173	21.9	Jun-21	-87	0.000	-2.61	100% (sig -)	**Decreasing**	---	59
MW-21D	16	0	0	0.0790	---	0.200	---	---	---	---	---	0.14 U	Jun-21	0	0.500	---	50% (+)	No Trend	>50% ND	73
MW-22S	1	1	100	---	2.20	---	2.20	2.20	2.20	---	---	2.20	Dec-17	IS	IS	---	50% (+)	IS	IS	Inf
MW-24S	16	16	100	---	6.90	---	122	89.9	97.2	30.0	0.333	87.6	Aug-22	50	0.013	14.2	98.7% (sig +)	**Increasing**	---	61
MW-25S	5	5	100	---	34.0	---	225	112	119	75.2	0.674	225	Dec-19	8	0.042	169	95.8% (sig +)	**Increasing**	---	76
MW-26	11	1	9.09	0.130	148	0.190	148	---	---	---	---	0.13 U	Jun-22	-4	0.411	---	59% (-)	No Trend	>50% ND	63
MW-27	15	15	100	---	0.170	---	15.6	3.17	1.30	4.42	1.39	0.970	Aug-22	-79	0.000	-0.982	100% (sig -)	**Decreasing**	---	6
MW-28	13	13	100	---	157	---	429	347	359	72.1	0.208	288	Aug-22	-34	0.021	-46.0	97.9% (sig -)	**Decreasing**	---	60
MW-29	13	13	100	---	87.5	---	412	256	241	97.8	0.382	229	Aug-22	-17	0.169	---	83.2% (-)	No Trend	Stable	60
MW-2D	24	2	8.33	0.0790	0.290	0.200	1.20	---	---	---	---	0.13 U	Jun-22	-7	0.442	---	55.9% (-)	No Trend	>50% ND	59
MW-30	11	2	18.2	0.130	0.180	0.190	0.430	---	---	---	---	0.13 U	Aug-22	-9	0.271	---	72.9% (-)	No Trend	>50% ND	60
MW-31	12	0	0	0.130	---	0.190	---	---	---	---	---	0.13 U	Jun-22	0	0.500	---	50% (+)	No Trend	>50% ND	62
MW-32	12	0	0	0.130	---	0.190	---	---	---	---	---	0.13 U	Jun-22	0	0.500	---	50% (+)	No Trend	>50% ND	62
MW-33	13	2	15.4	0.130	1.10	0.190	11.2	---	---	---	---	0.13 U	Jun-22	-23	0.092	---	90.8% (-)	No Trend	>50% ND	37
MW-34	11	0	0	0.130	---	0.190	---	---	---	---	---	0.13 U	May-22	0	0.500	---	50% (+)	No Trend	>50% ND	57
MW-35	13	13	100	---	40.0	---	161	69.6	52.9	39.3	0.564	47.4	Aug-22	-12	0.255	---	74.5% (-)	No Trend	Stable	63
MW-36	13	12	92.3	0.140	48.9	0.140	180	102	109	47.9	0.470	48.9	Aug-22	-43	0.004	-39.7	99.6% (sig -)	**Decreasing**	---	63
MW-3D	20	0	0	0.0790	---	0.200	---	---	---	---	---	0.14 U	Jun-21	0	0.500	---	50% (+)	No Trend	>50% ND	58
MW-4D	23	21	91.3	0.159	0.370	0.159	11.9	4.04	4.40	3.07	0.759	11.9	Aug-22	-48	0.109	---	89.1% (-)	No Trend	Stable	63
MW-5D	20	0	0	0.0790	---	0.200	---	---	---	---	---	0.14 U	Jun-21	0	0.500	---	50% (+)	No Trend	>50% ND	60
MW-6D	19	15	79.0	0.140	0.340	0.190	3.90	1.71	1.80	1.26	0.734	0.159 U	Jun-21	-33	0.133	---	86.7% (-)	No Trend	Stable	62
MW-6S	23	1	4.35	0.0790	1.30	0.200	1.30	---	---	---	---	0.13 U	May-22	6	0.448	---	55.2% (+)	No Trend	>50% ND	63
MW-6U	21	21	100	---	15.3	---	125	70.0	68.1	26.8	0.384	61.7	Aug-22	80	0.008	9.19	99.2% (sig +)	**Increasing**	---	48
MW-7S	25	23	92.0	0.130	0.250	0.200	3.40	1.11	1.10	0.725	0.655	0.990	Aug-22	-70	0.054	---	94.6% (-)	No Trend	Stable	61
MW-8S	25	25	100	---	42.3	---	274	159	153	50.6	0.317	86.8	Aug-22	-159	0.000	-20.0	100% (sig -)	**Decreasing**	---	61
MW-9D	23	23	100	---	14.9	---	135	81.0	86.8	37.7	0.465	21.6	Aug-22	-125	0.001	-16.8	99.9% (sig -)	**Decreasing**	---	72
MW-9S	25	25	100	---	64.5	---	1,000	351	326	192	0.547	172	Aug-22	-176	0.000	-72.0	100% (sig -)	**Decreasing**	---	61
MW-9U	22	22	100	---	15.9	---	820	460	504	219	0.476	206	Aug-22	-93	0.004	-83.3	99.6% (sig -)	**Decreasing**	---	48
Out-of-Use Freeman School District Well (W26	25	24	96.0	0.130	0.330	0.130	34.9	21.5	25.4	11.5	0.535	0.13 U	Aug-22	-126	0.001	-4.02	99.9% (sig -)	**Decreasing**	---	57
Out-of-Use Marlow Well (No. 2)	75	75	100	---	0.250	---	120	31.1	28.8	18.8	0.605	23.3	Sep-22	241	0.136	---	86.4% (+)	No Trend	Stable	1
Out-of-Use Marlow Well (W20)	24	0	0	0.0790	---	0.200	---	---	---	---	---	0.13 U	May-22	0	0.500	---	50% (+)	No Trend	>50% ND	56
Primary Freeman School District Well (WS5)	55	46	83.6	0.500	0.00810	0.500	61.8	9.92	6.70	11.4	1.15	5.50	Aug-22	-2	0.497	---	50.3% (-)	No Trend	Not Stable	5
Randall Well	26	26	100	---	103	---	364	214	201	67.4	0.316	103	Aug-22	-245	0.000	-31.9	100% (sig -)	**Decreasing**	---	23
Reed Well (W30)	22	0	0	0.0790	---	0.200	---	---	---	---	---	0.13 U	Aug-22	0	0.500	---	50% (+)	No Trend	>50% ND	71
Silva Well	23	3	13.0	0.0760	0.670	0.200	1.30	---	---	---	---	0.13 U	May-22	-3	0.479	---	52.1% (-)	No Trend	>50% ND	4
Stark Well (W15)	22	0	0	0.0790	---	0.200	---	---	---	---	---	0.13 U	May-22	0	0.500	---	50% (+)	No Trend	>50% ND	72
Thorson Well	21	0	0	0.0790	---	0.200	---	---	---	---	---	0.13 U	May-22	0	0.500	---	50% (+)	No Trend	>50% ND	73

Notes:

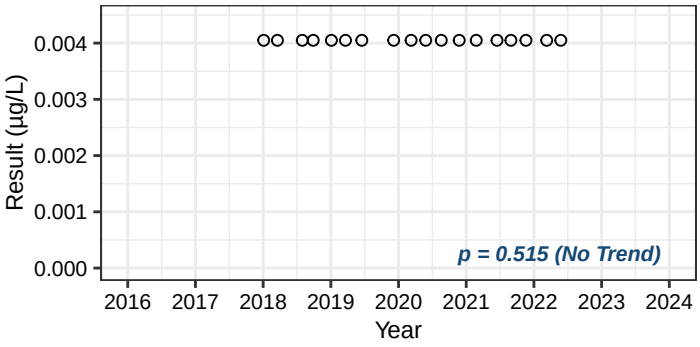
"---" = not applicable
% = percent
(-) = negative trend
(+) = positive trend
>50% ND = greater than 50 percent non-detects
µg/L = micrograms per liter
µg/L/yr = micrograms per liter per year
CV = coefficient of variation
Freq. = frequency
IS = insufficient data (less than 4 samples)
Max = maximum
Min = minimum
MK = Mann-Kendall
ND = non-detect
p-value = probability value
sig = (statistically) significant.
Std Dev. = standard deviation
Trend analysis performed using Mann-Kendall single-tailed test at 0.05 significance level with non-detects assigned a common value less than the smallest measured value in the dataset.
Descriptive statistics were not calculated for those data sets containing greater than 50% non-detects. For data sets containing less than 50% non-detects, descriptive statistics were calculated using the Kaplan-Meier product-limit estimator.
For monitoring points exhibiting no trend at the 95 percent confidence level, concentrations are deemed stable if the coefficient of variation (CV) is equal to or less than one.

Theil−Sen Trend Plots with Bootstrapped 95% Confidence Limits
(nondetects plotted using open symbols at one−half the minimum detected value)

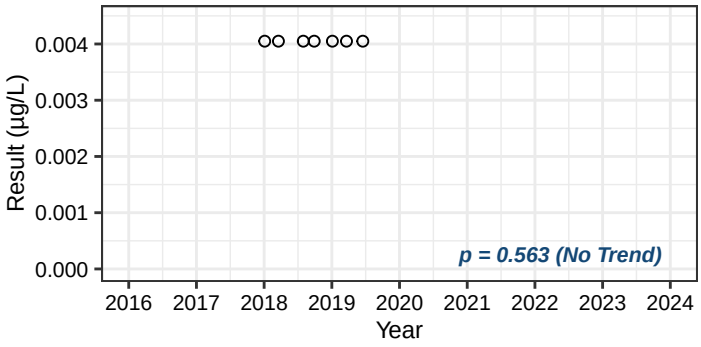
Carbon tetrachloride
Asher Well



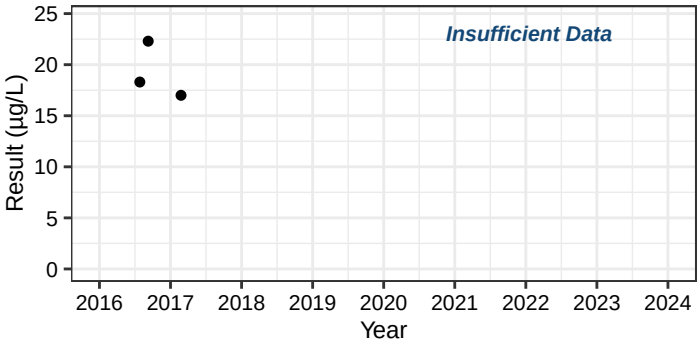
Carbon tetrachloride
Atwood House



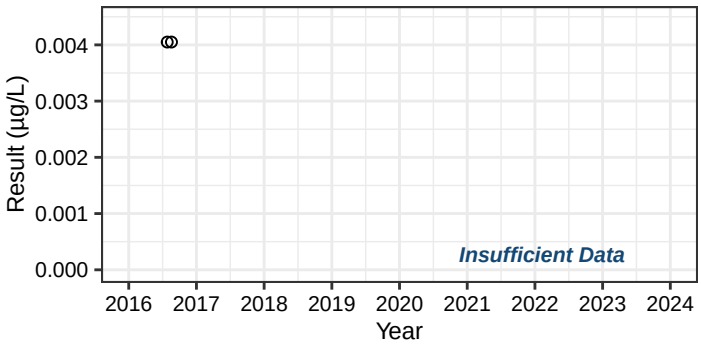
Carbon tetrachloride
Atwood Shop



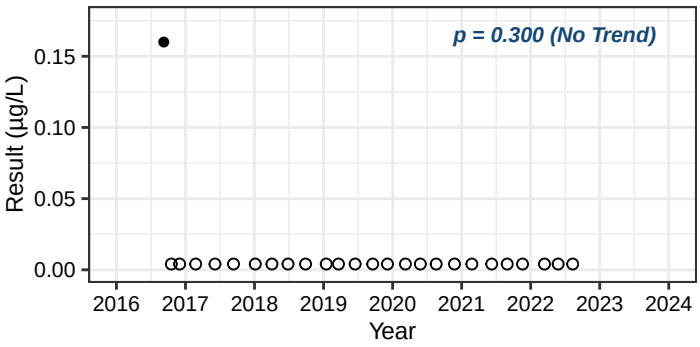
Carbon tetrachloride
Davey Well (W46)



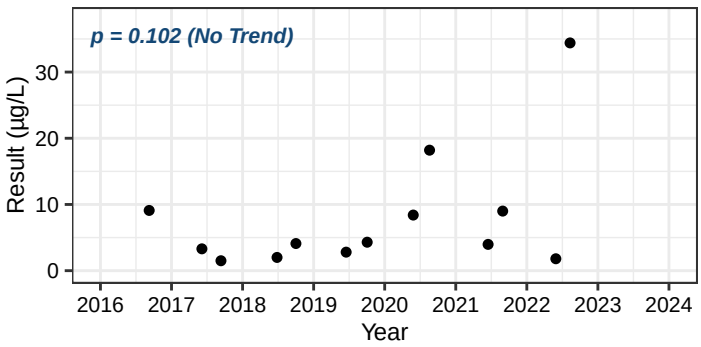
Carbon tetrachloride
Freeman Store Well



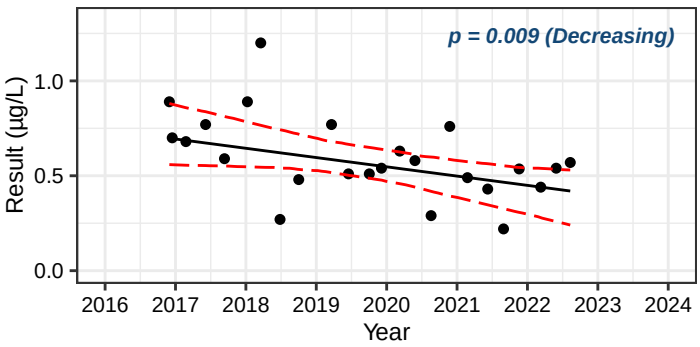
Carbon tetrachloride
Lang Well



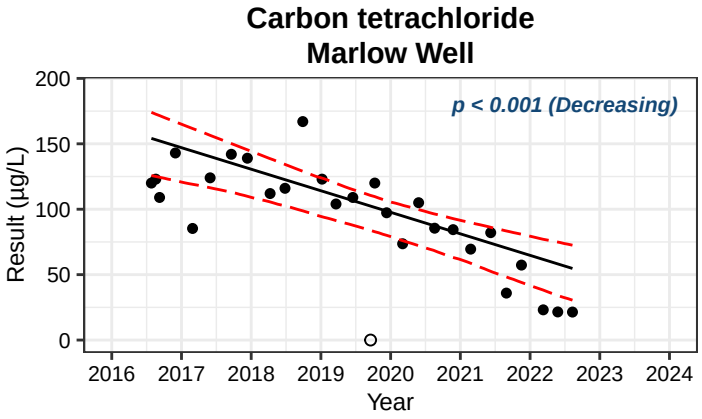
Carbon tetrachloride
Lashaw Well (Agricultural)

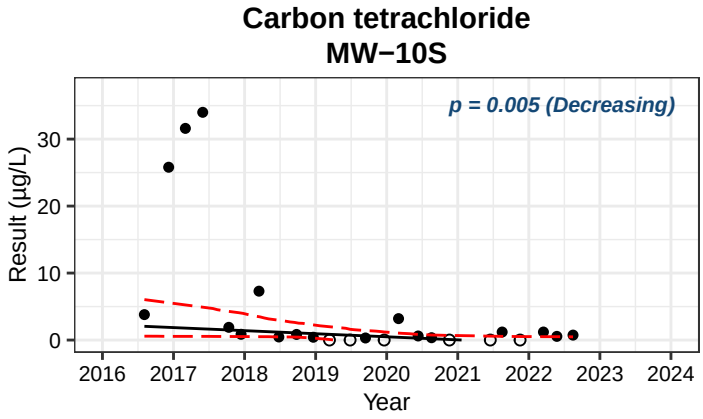


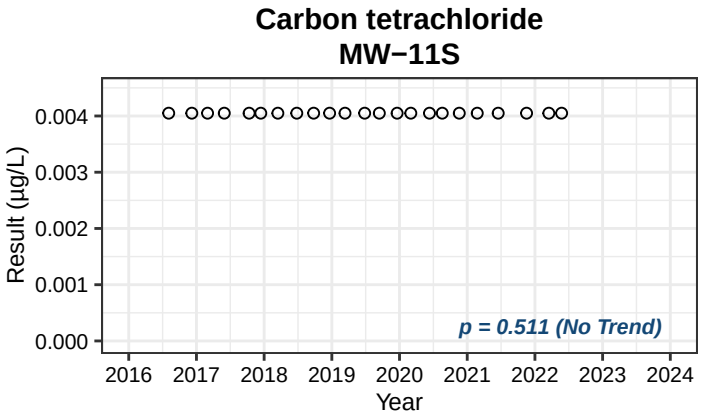
Carbon tetrachloride
Lashaw Well (Domestic)

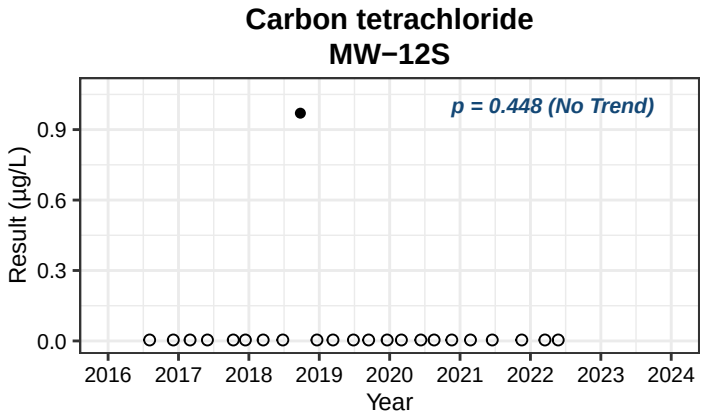


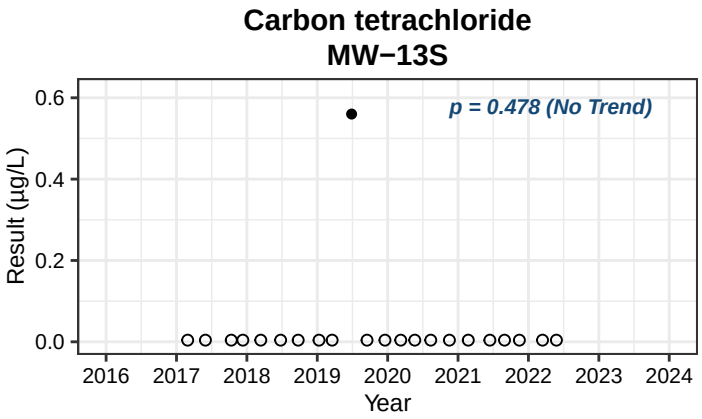
Theil−Sen Trend Plots with Bootstrapped 95% Confidence Limits
(nondetects plotted using open symbols at one−half the minimum detected value)

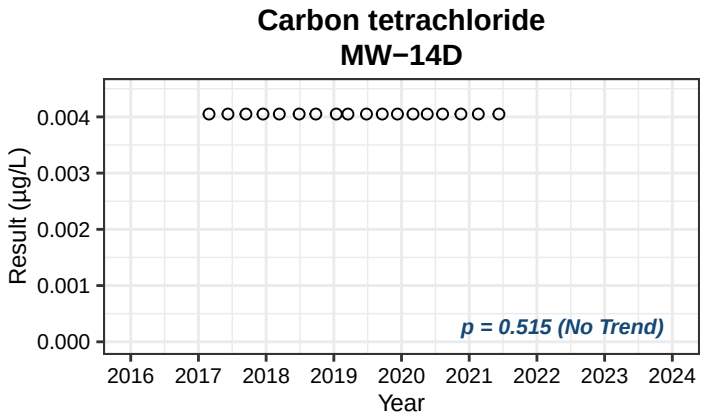


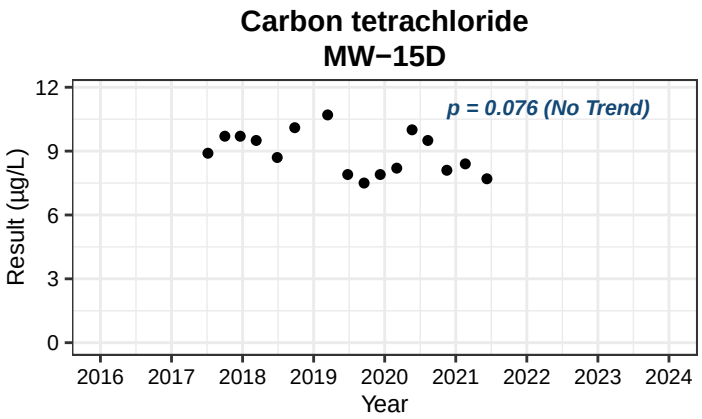


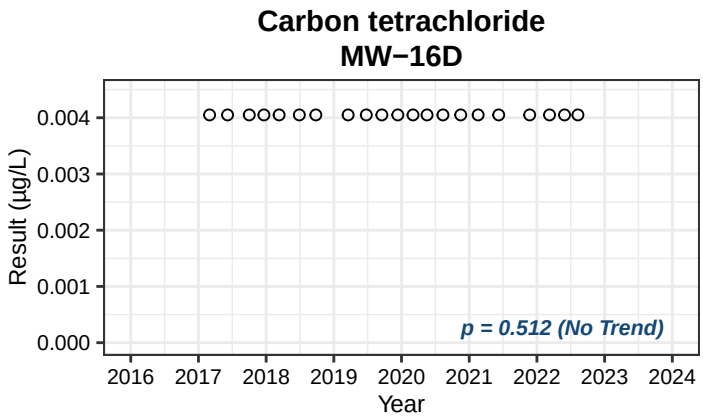






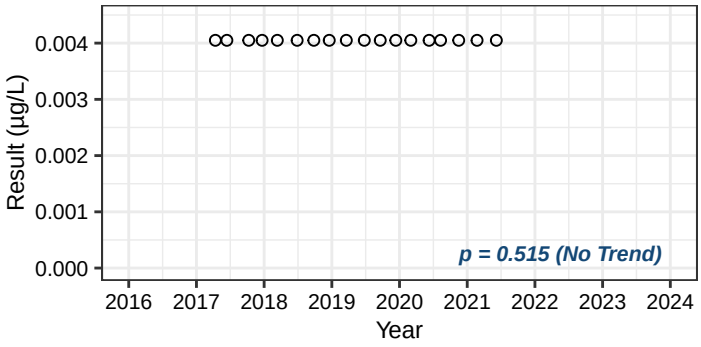




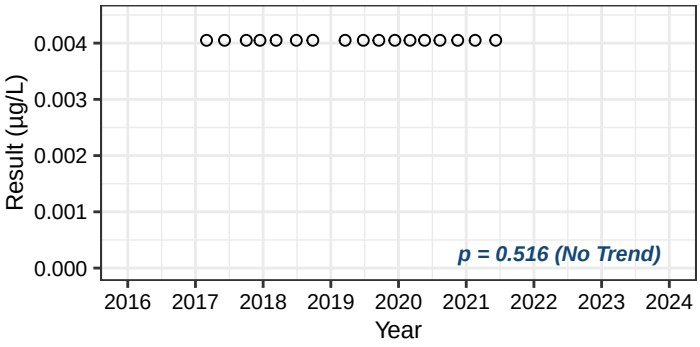


Theil−Sen Trend Plots with Bootstrapped 95% Confidence Limits
(nondetects plotted using open symbols at one−half the minimum detected value)

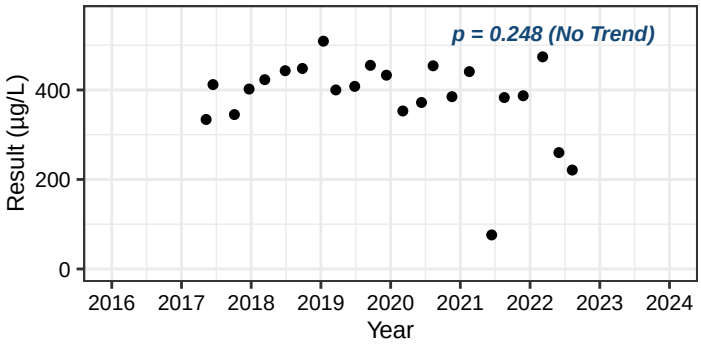
Carbon tetrachloride
MW−17D



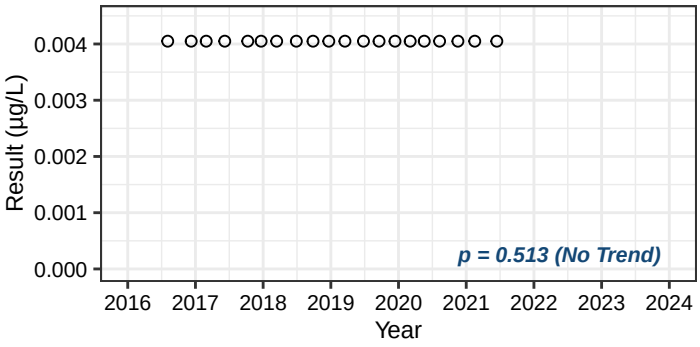
Carbon tetrachloride
MW−18D



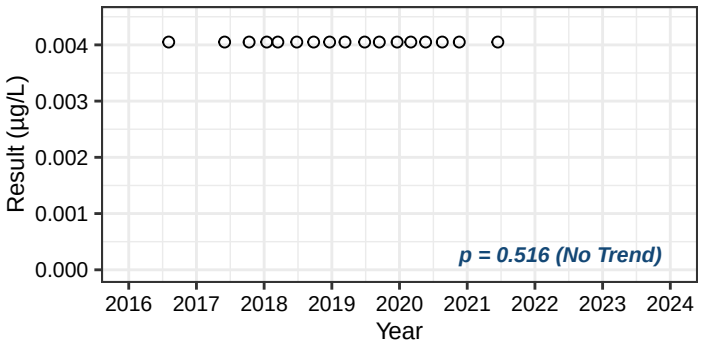
Carbon tetrachloride
MW−19D



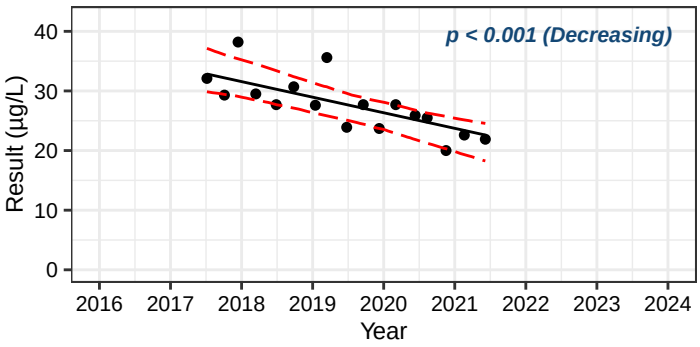
Carbon tetrachloride
MW−1D



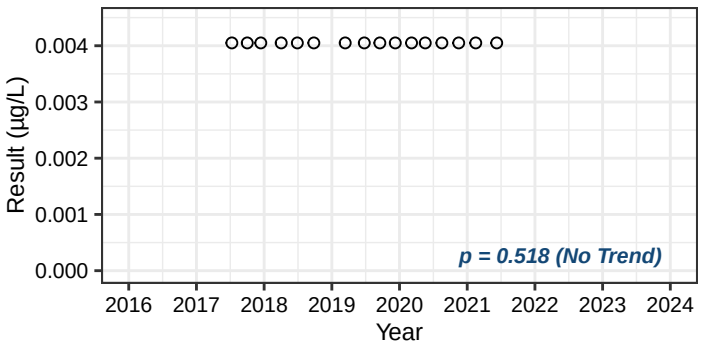
Carbon tetrachloride
MW−1S



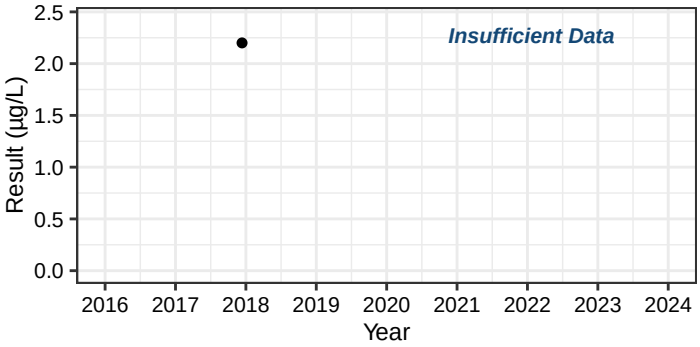
Carbon tetrachloride
MW−20D



Carbon tetrachloride
MW−21D

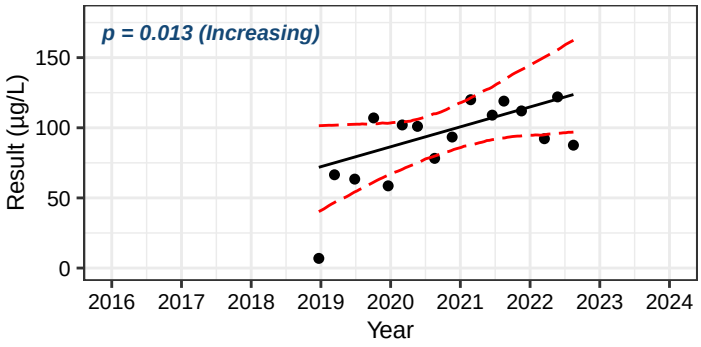


Carbon tetrachloride
MW−22S

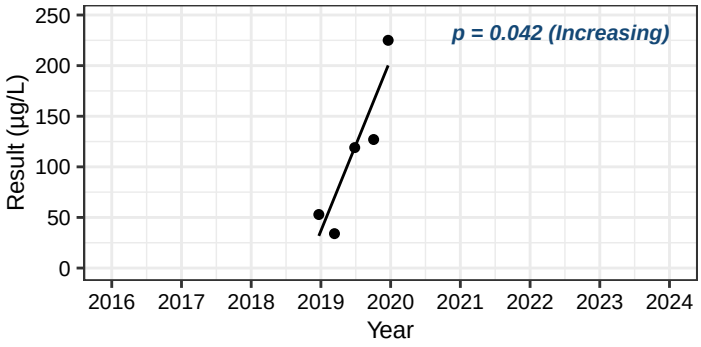


Theil−Sen Trend Plots with Bootstrapped 95% Confidence Limits
(nondetects plotted using open symbols at one−half the minimum detected value)

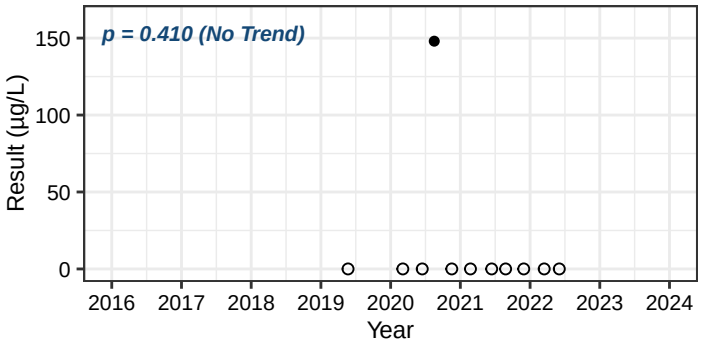
Carbon tetrachloride
MW−24S



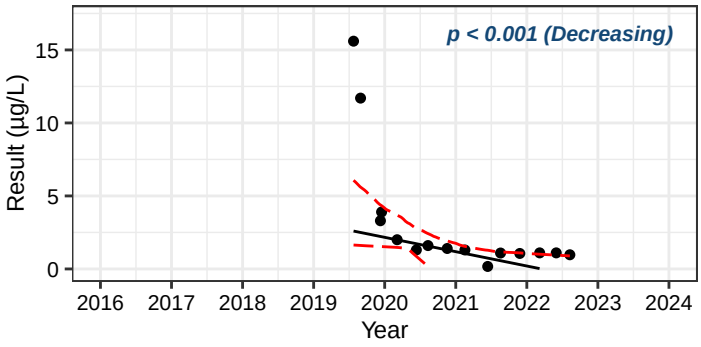
Carbon tetrachloride
MW−25S



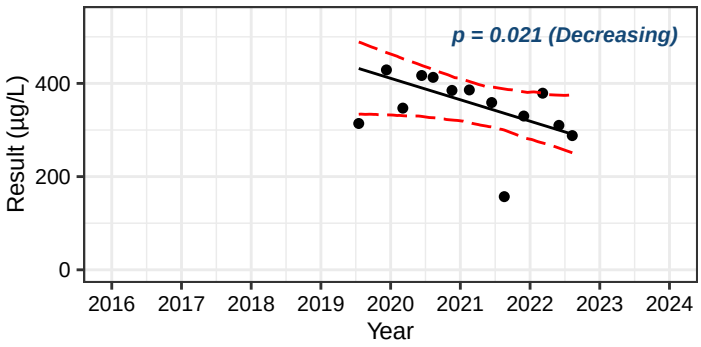
Carbon tetrachloride
MW−26



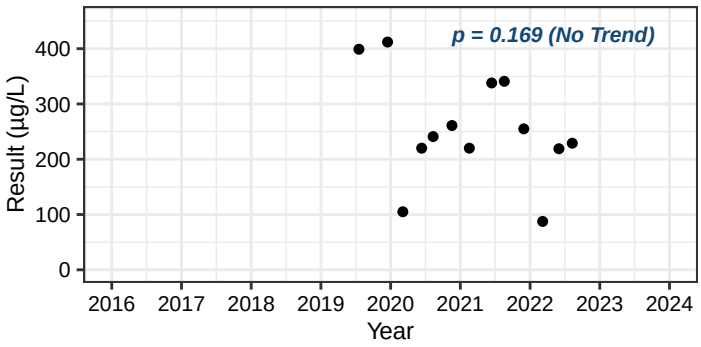
Carbon tetrachloride
MW−27



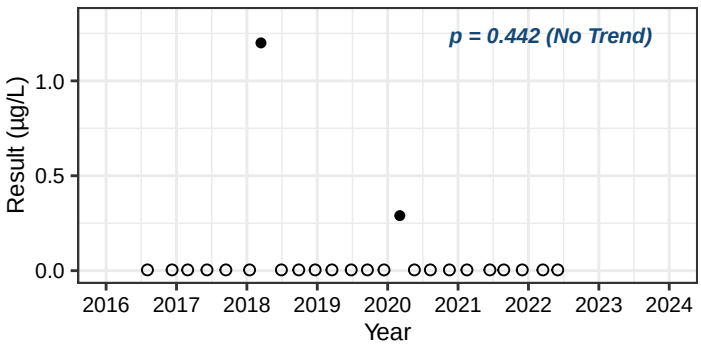
Carbon tetrachloride
MW−28



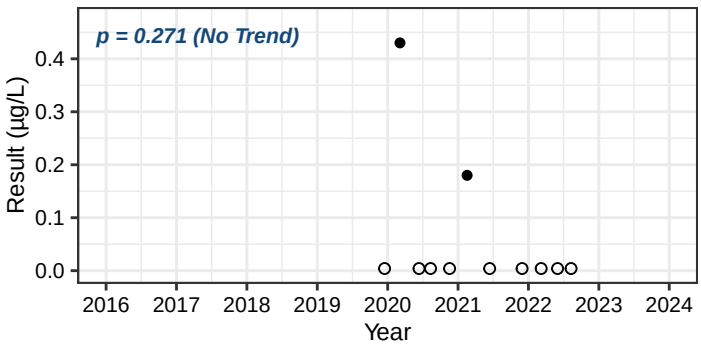
Carbon tetrachloride
MW−29



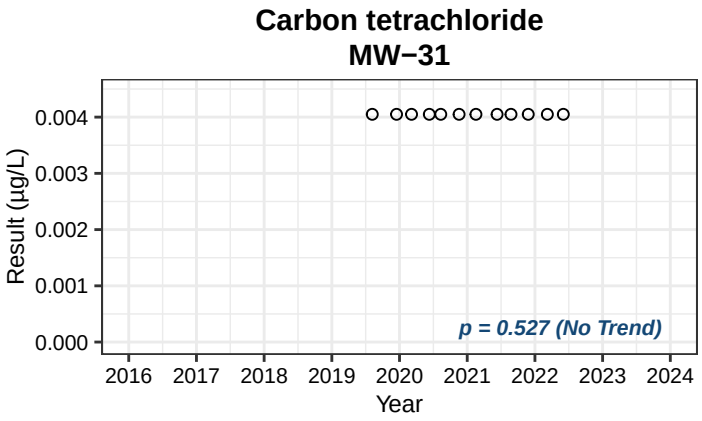
Carbon tetrachloride
MW−2D

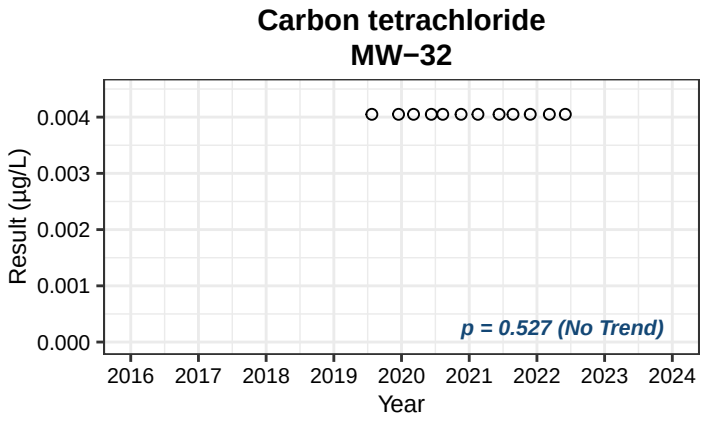


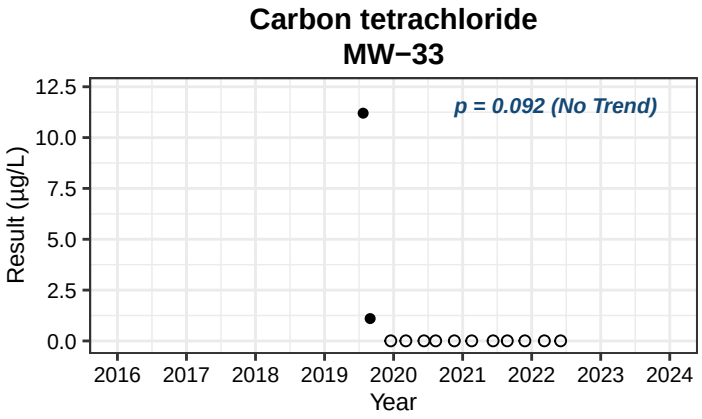
Carbon tetrachloride
MW−30

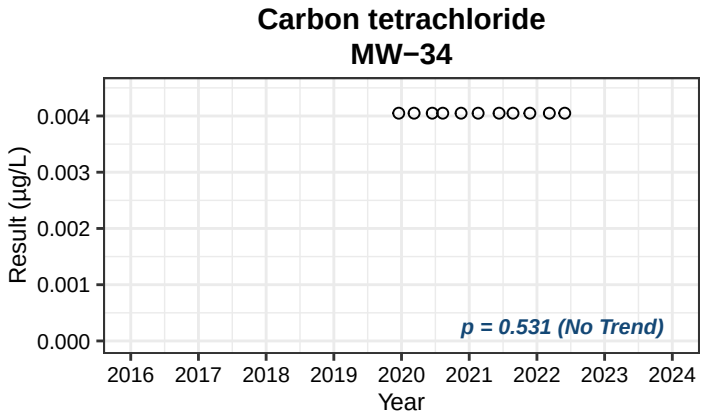


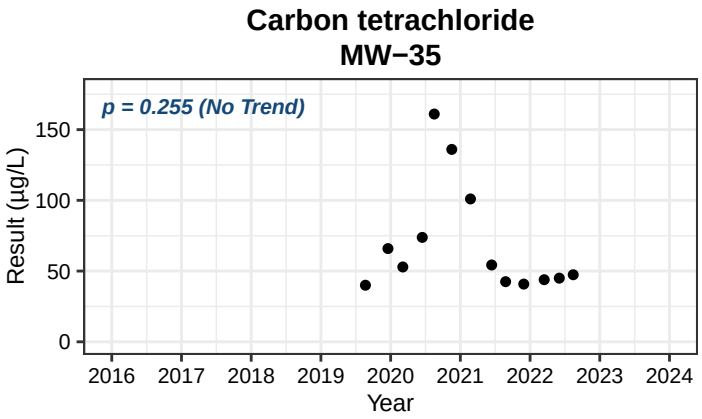
Theil−Sen Trend Plots with Bootstrapped 95% Confidence Limits
(nondetects plotted using open symbols at one−half the minimum detected value)

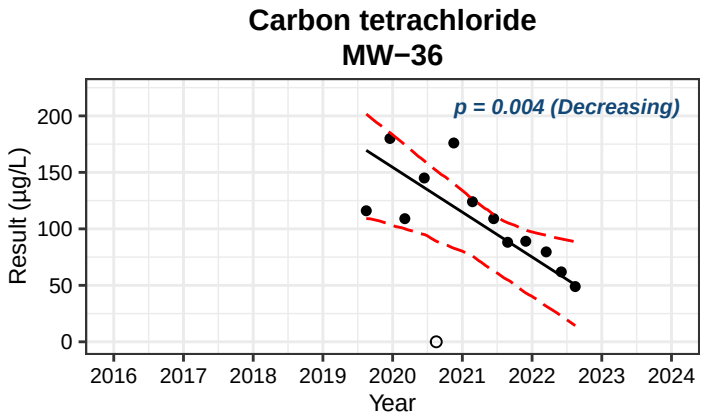


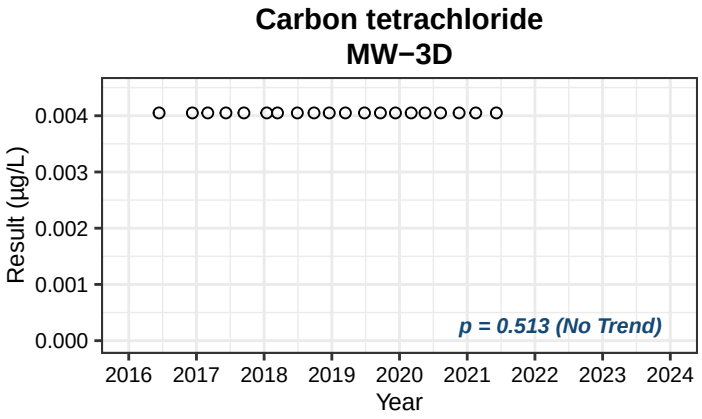


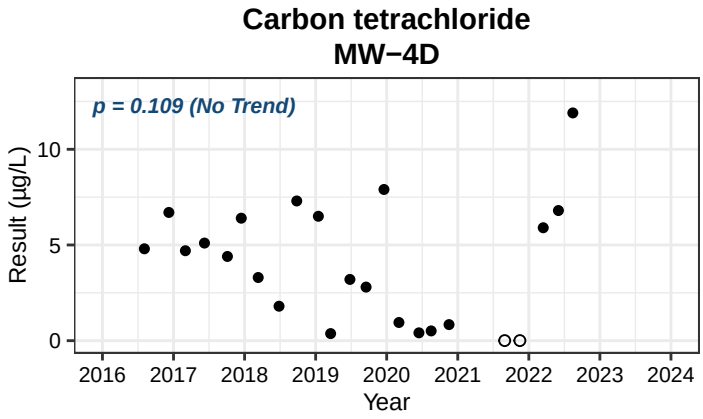




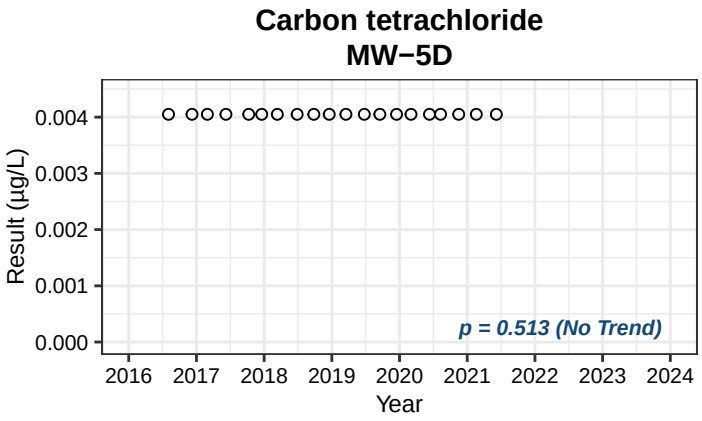


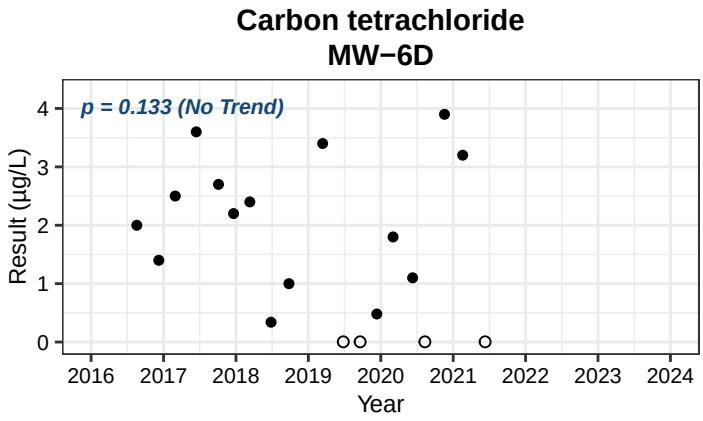


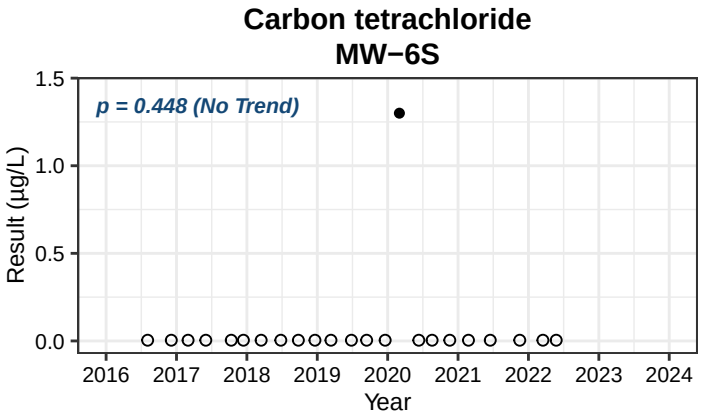


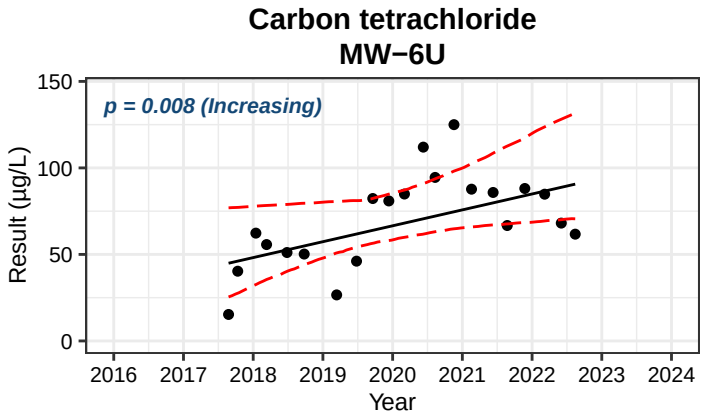


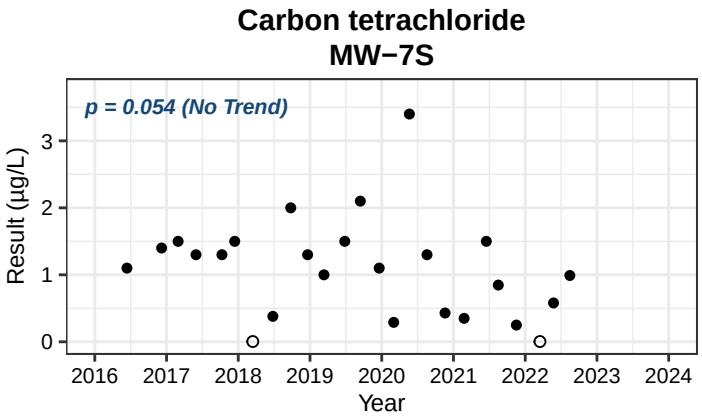
Theil−Sen Trend Plots with Bootstrapped 95% Confidence Limits
(nondetects plotted using open symbols at one−half the minimum detected value)

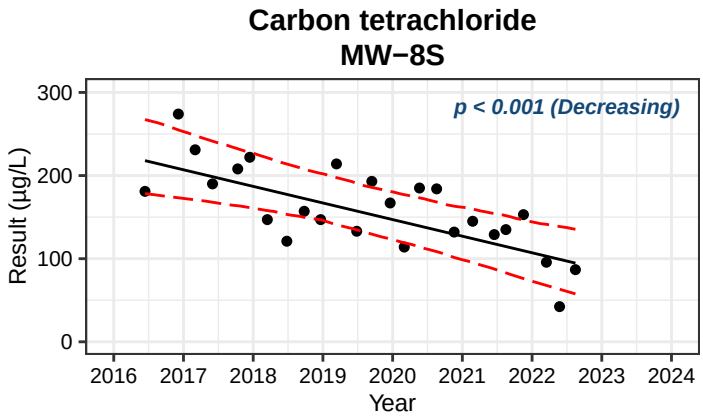


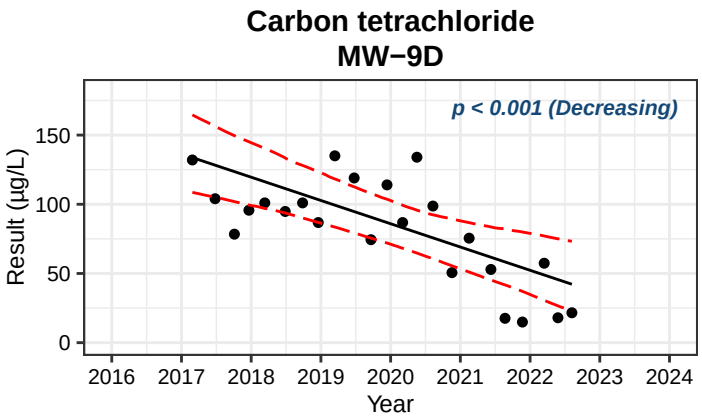


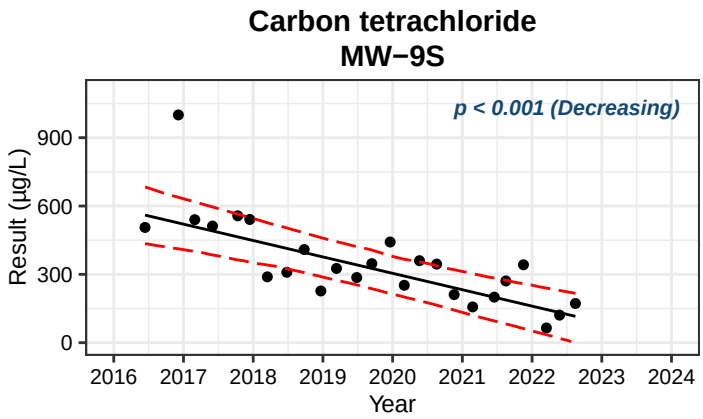






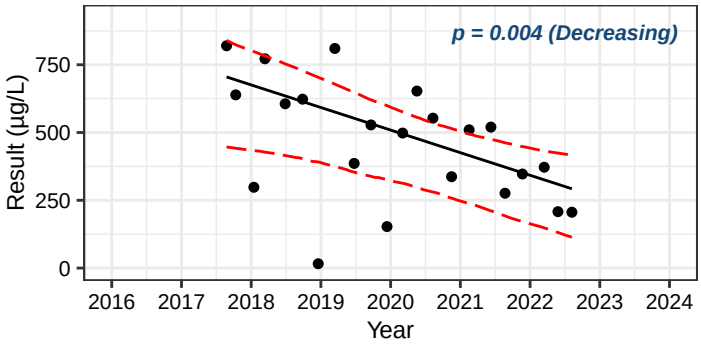




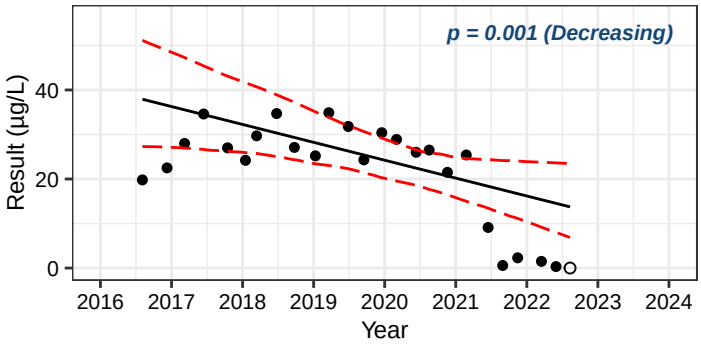


Theil−Sen Trend Plots with Bootstrapped 95% Confidence Limits
(nondetects plotted using open symbols at one−half the minimum detected value)

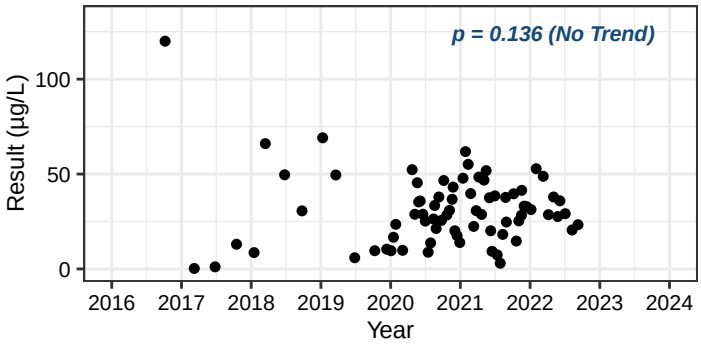
Carbon tetrachloride
MW−9U



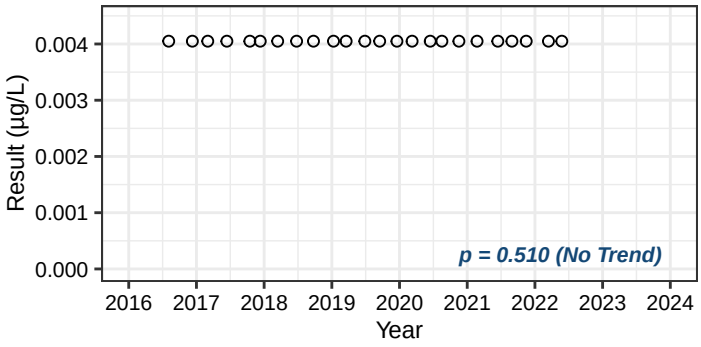
Carbon tetrachloride
Out−of−Use Freeman School District Well (W26)



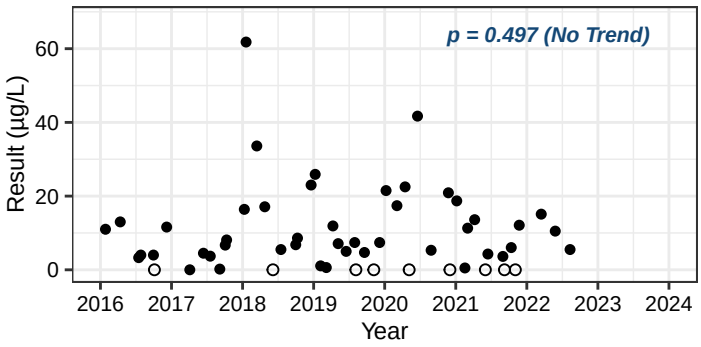
Carbon tetrachloride
Out−of−Use Marlow Well (No. 2)



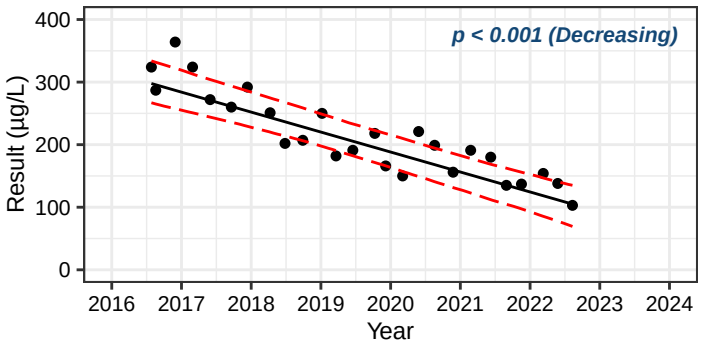
Carbon tetrachloride
Out−of−Use Marlow Well (W20)



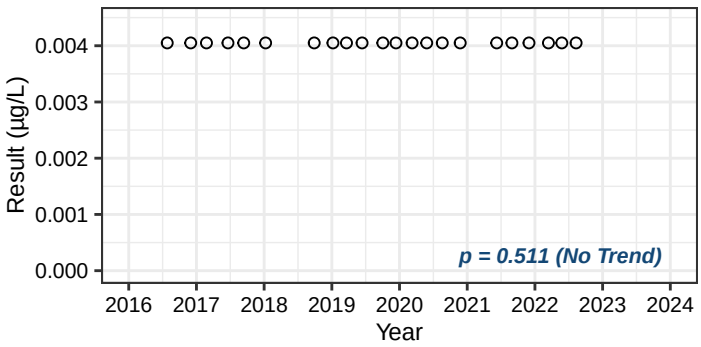
Carbon tetrachloride
Primary Freeman School District Well (WS5)



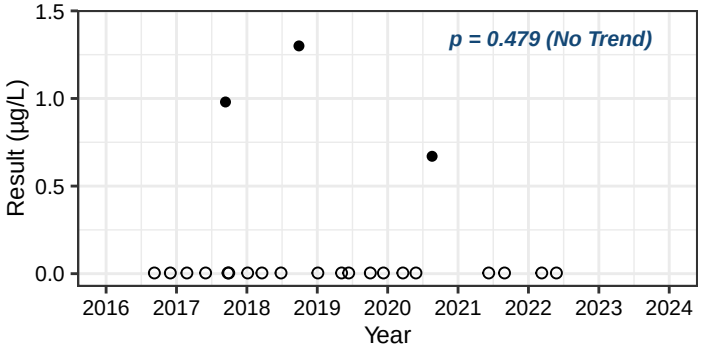
Carbon tetrachloride
Randall Well



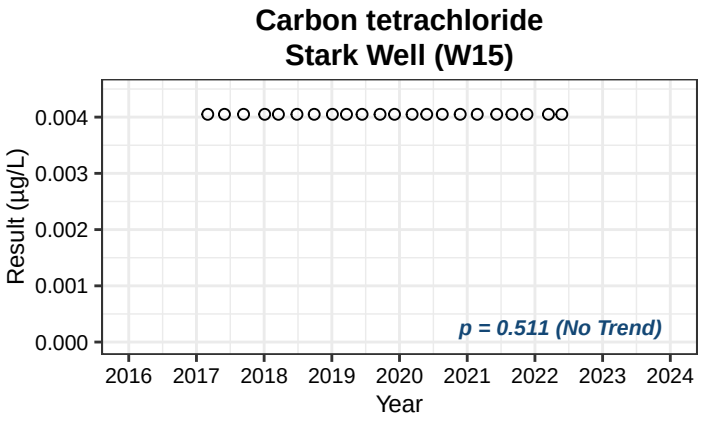
Carbon tetrachloride
Reed Well (W30)

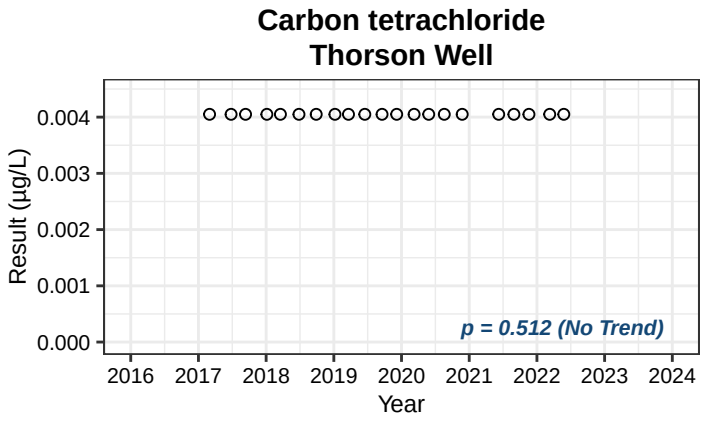


Carbon tetrachloride
Silva Well



Theil−Sen Trend Plots with Bootstrapped 95% Confidence Limits
(nondetects plotted using open symbols at one−half the minimum detected value)

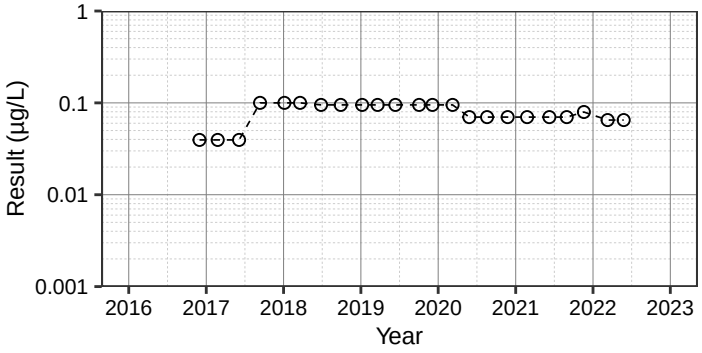




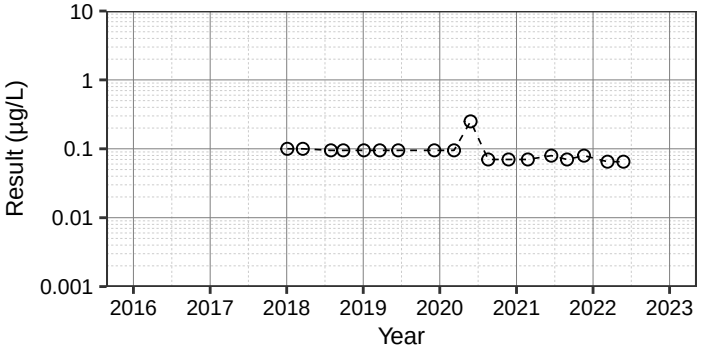
Time−Series Plots

(non−detects plotted using open symbols at one−half the reporting limit)

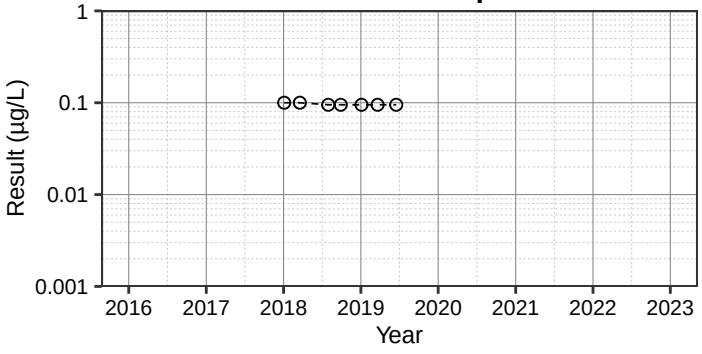
Carbon tetrachloride
Asher Well



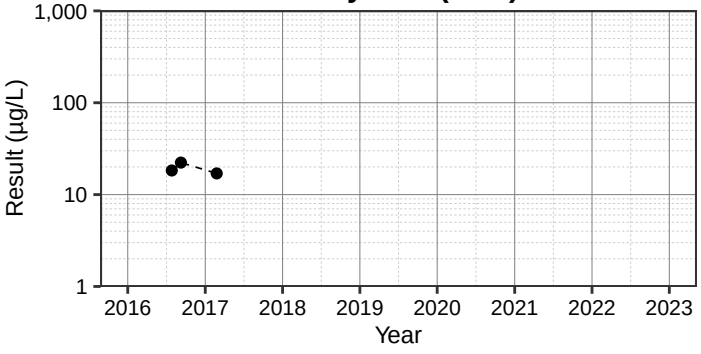
Carbon tetrachloride
Atwood House



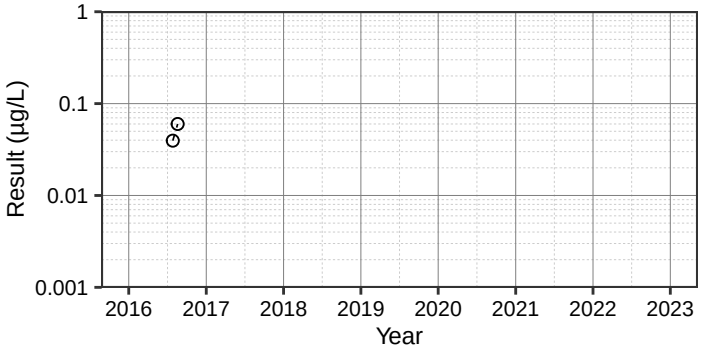
Carbon tetrachloride
Atwood Shop



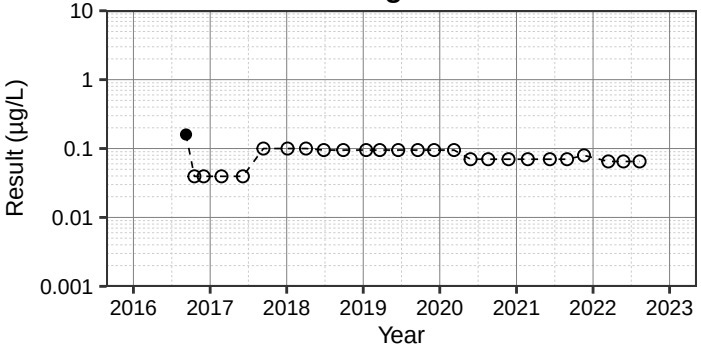
Carbon tetrachloride
Davey Well (W46)



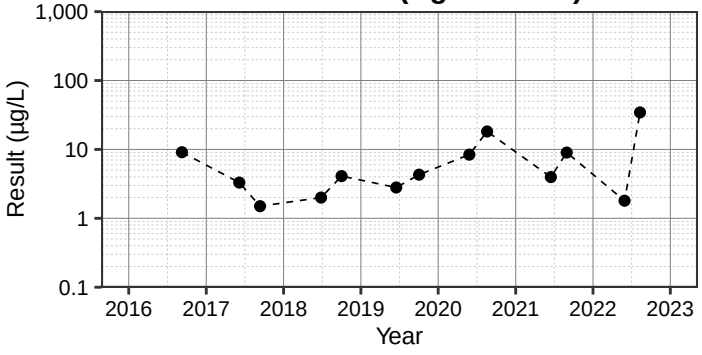
Carbon tetrachloride
Freeman Store Well



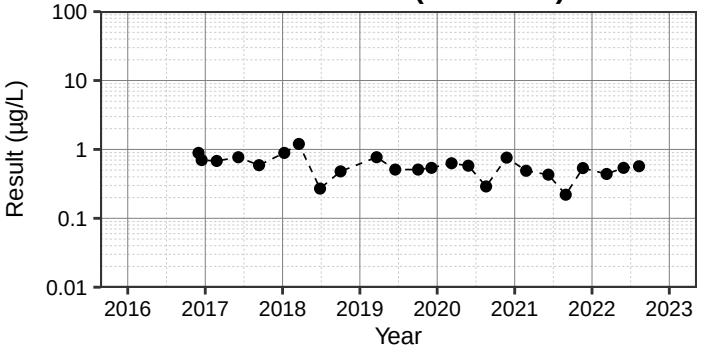
Carbon tetrachloride
Lang Well



Carbon tetrachloride
Lashaw Well (Agricultural)

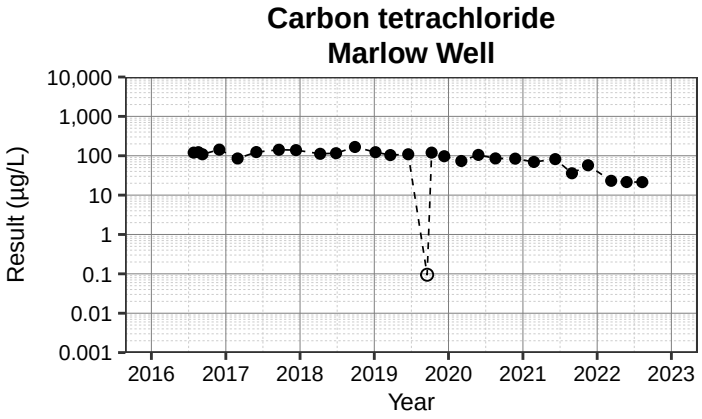


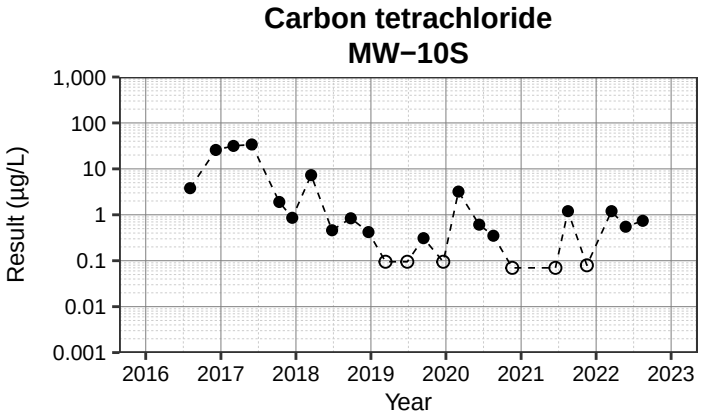
Carbon tetrachloride
Lashaw Well (Domestic)

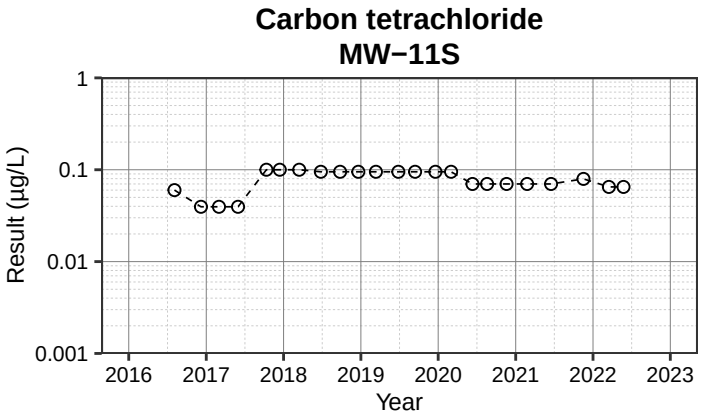


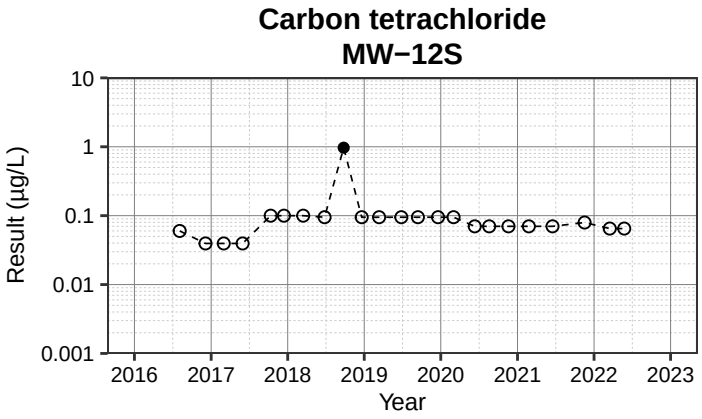
Time−Series Plots

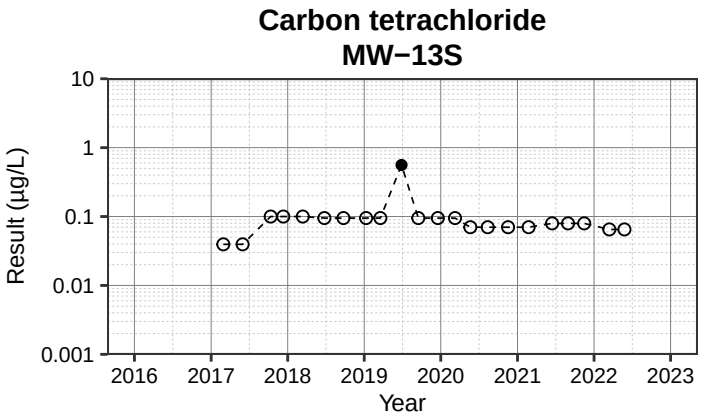
(non−detects plotted using open symbols at one−half the reporting limit)

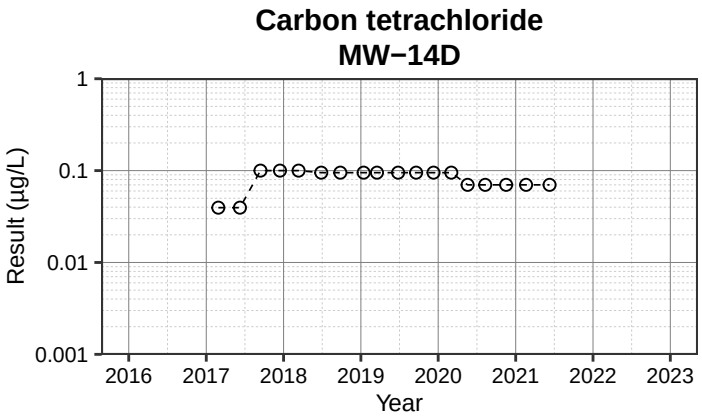


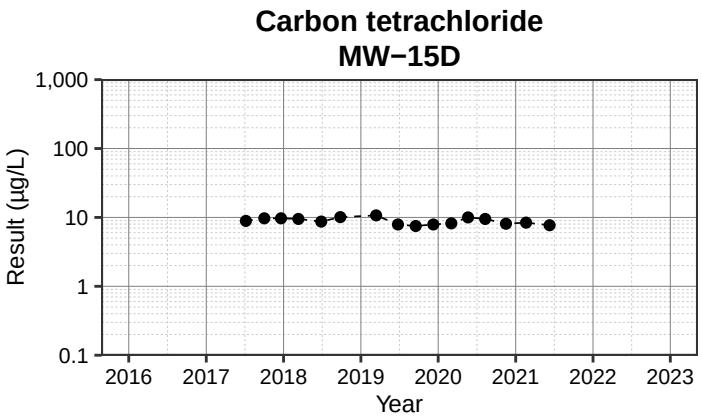


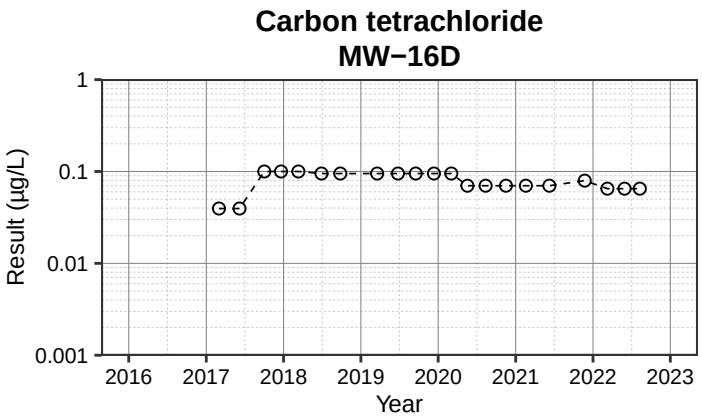




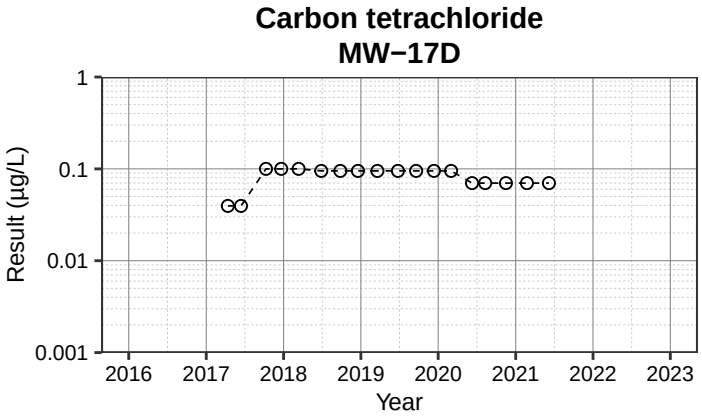


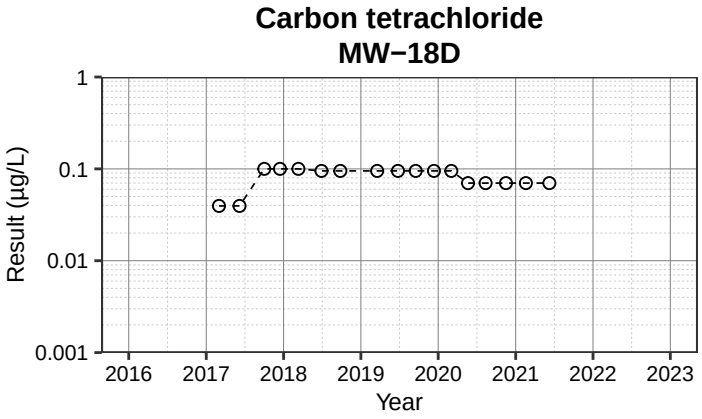


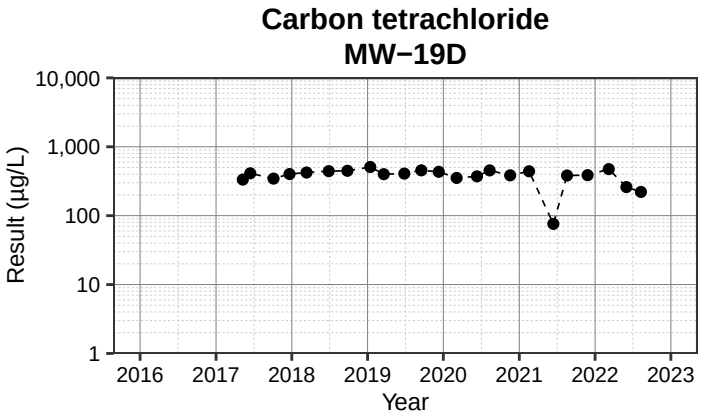


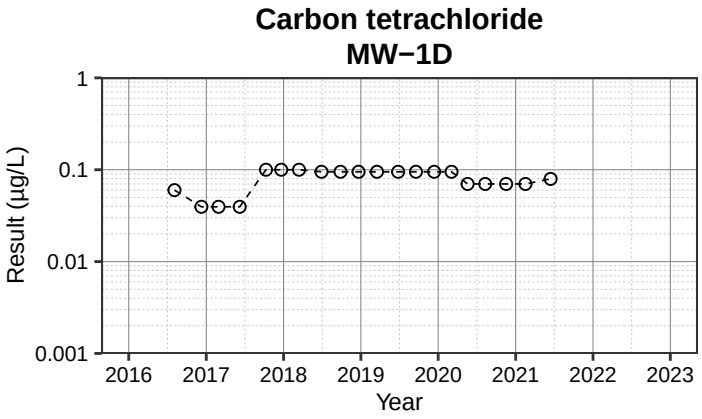


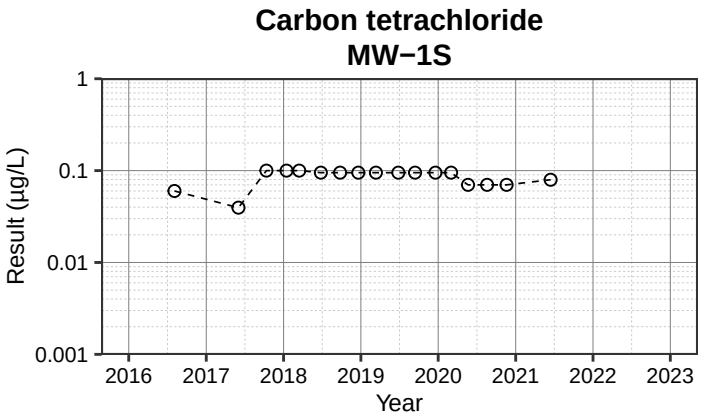
Time−Series Plots
(non−detects plotted using open symbols at one−half the reporting limit)

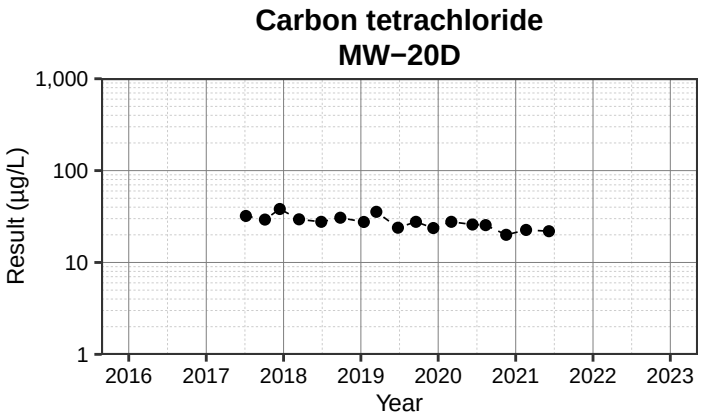


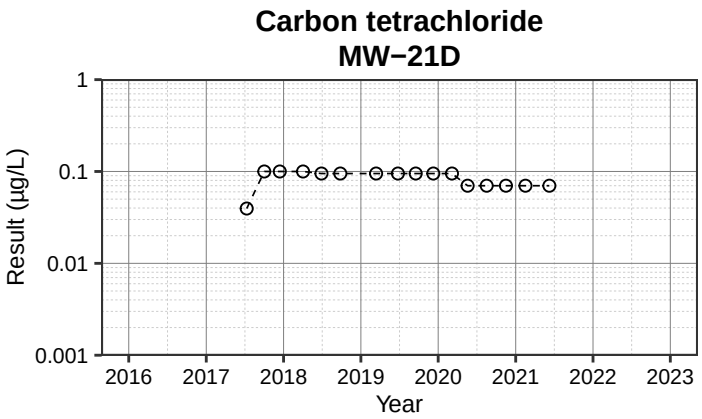


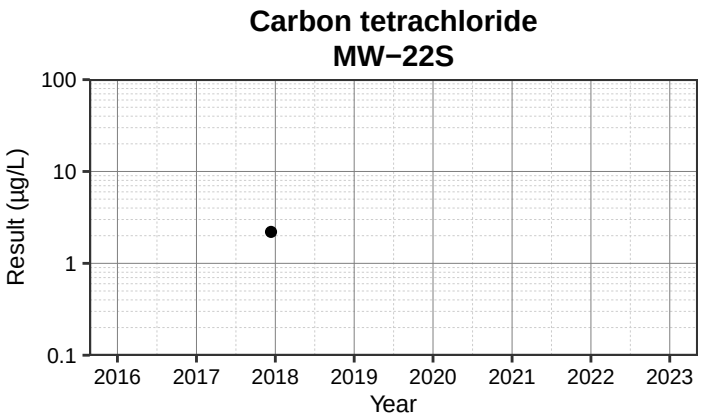




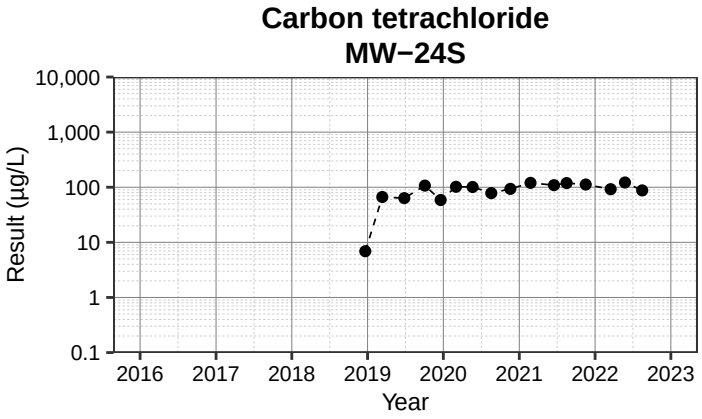


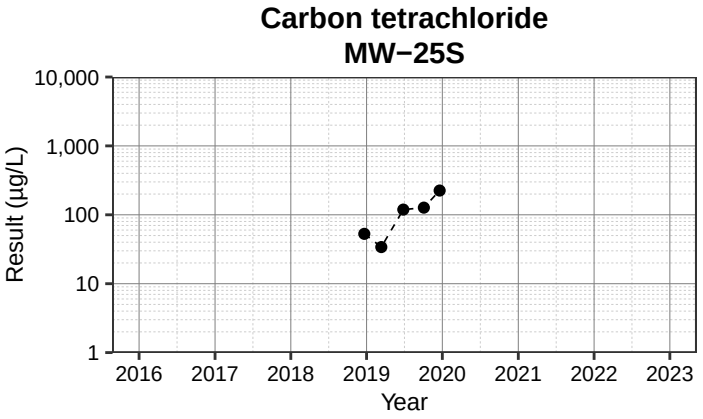


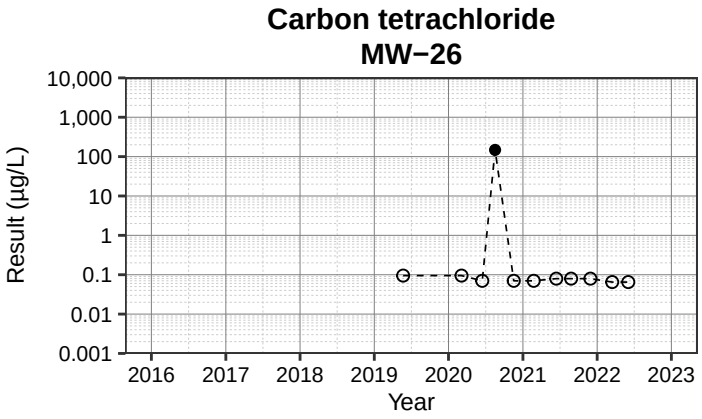


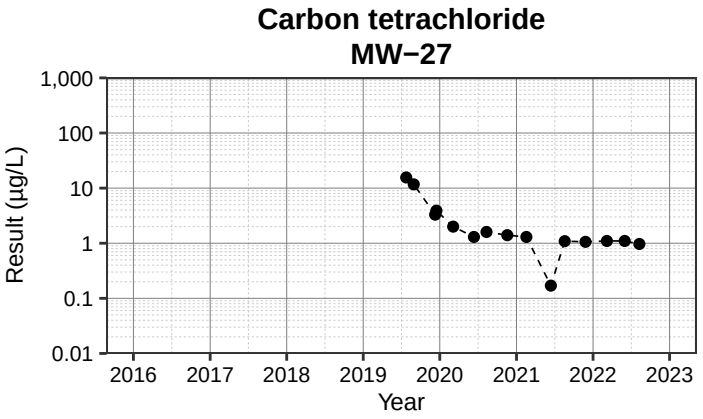


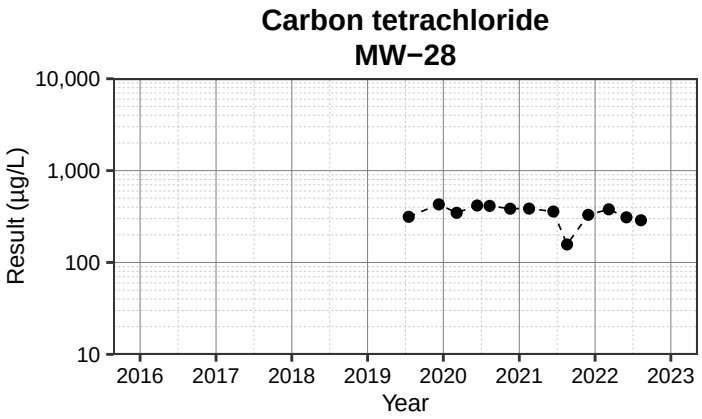
Time−Series Plots
(non−detects plotted using open symbols at one−half the reporting limit)

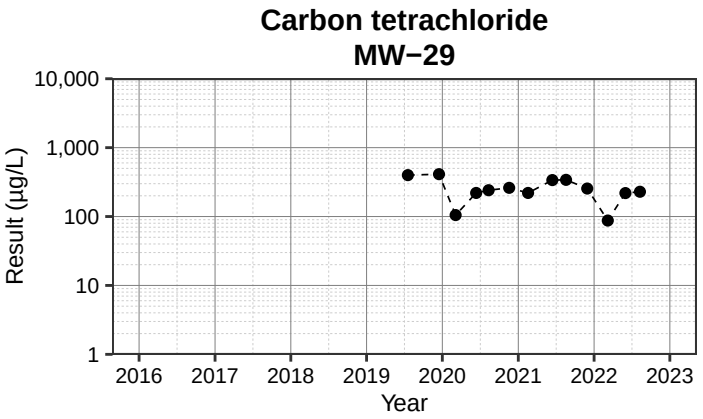


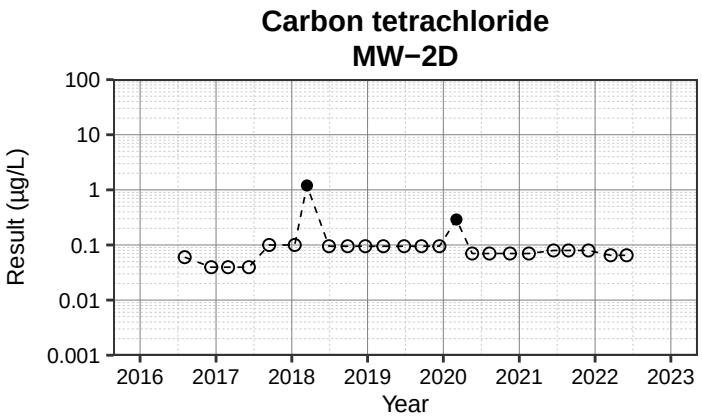


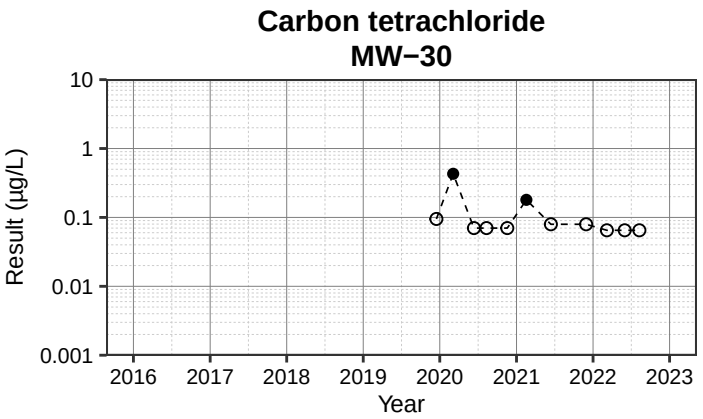




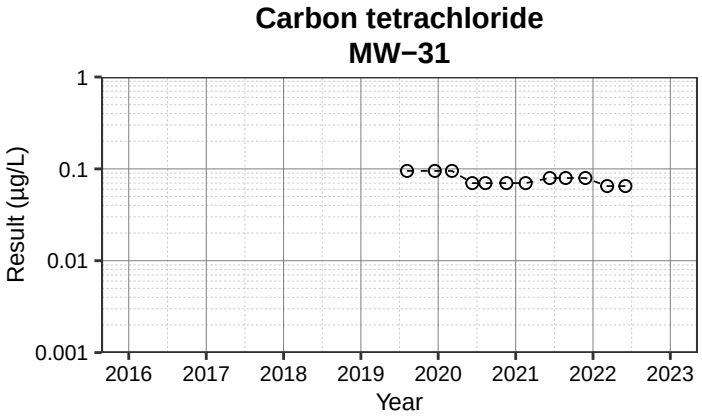


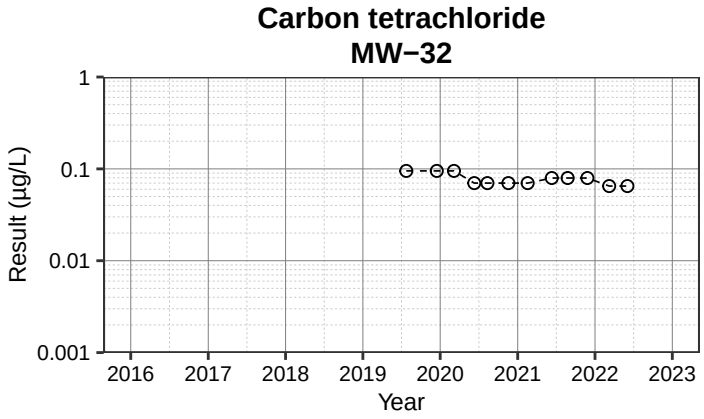


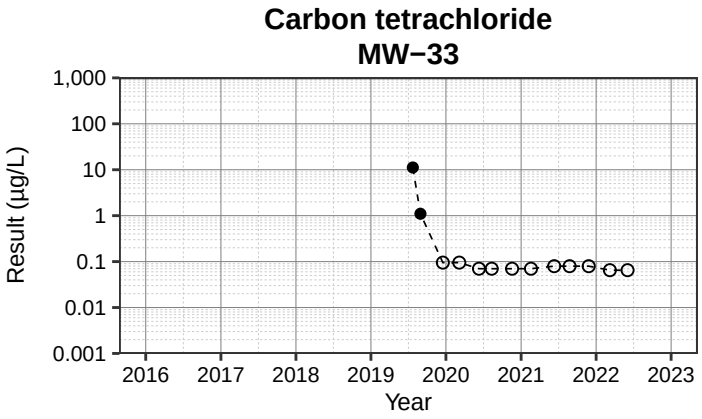


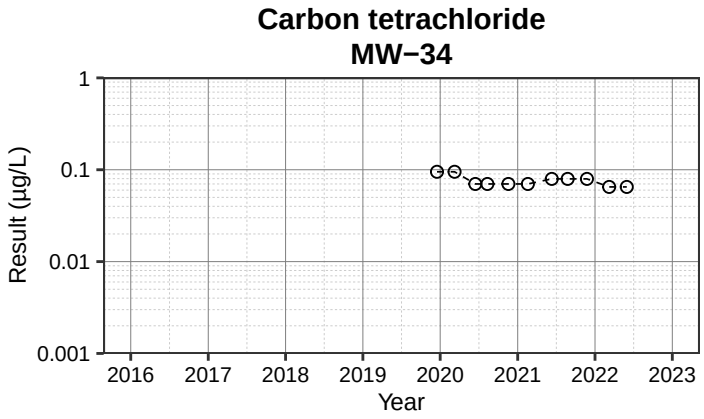


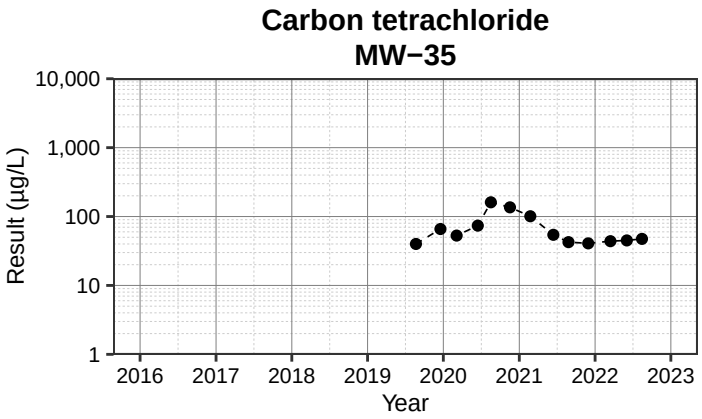
Time−Series Plots
(non−detects plotted using open symbols at one−half the reporting limit)

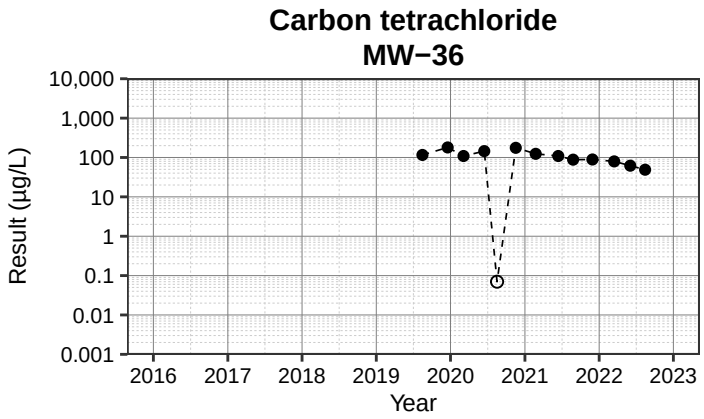


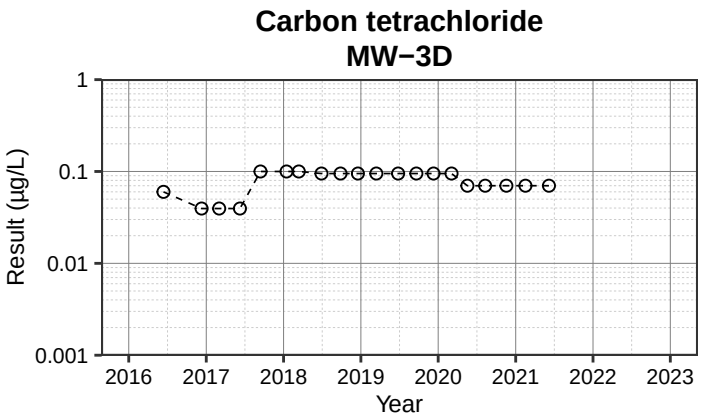


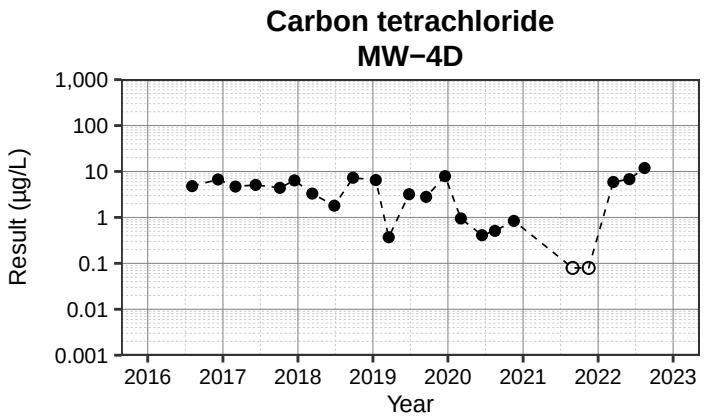




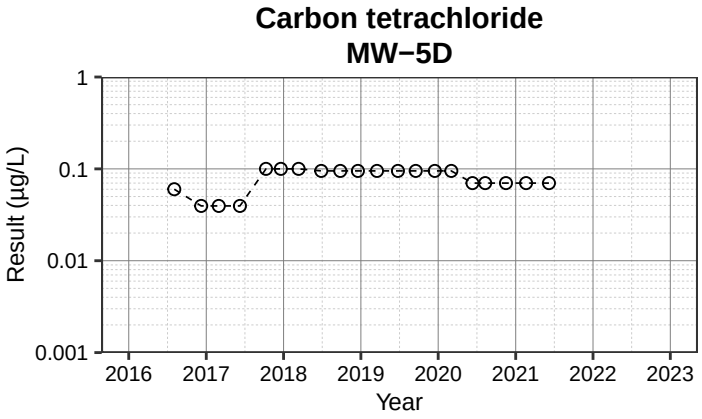


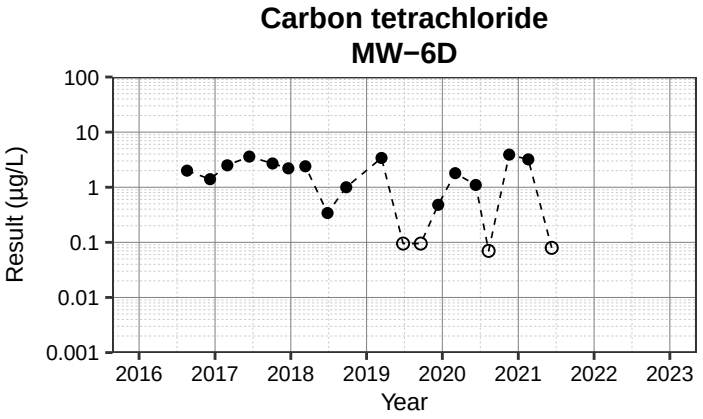


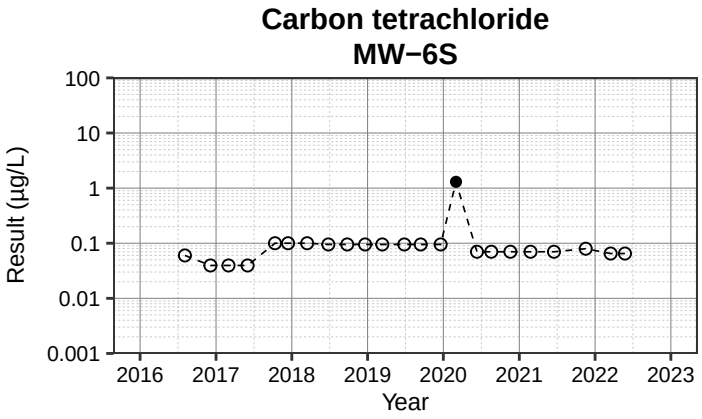


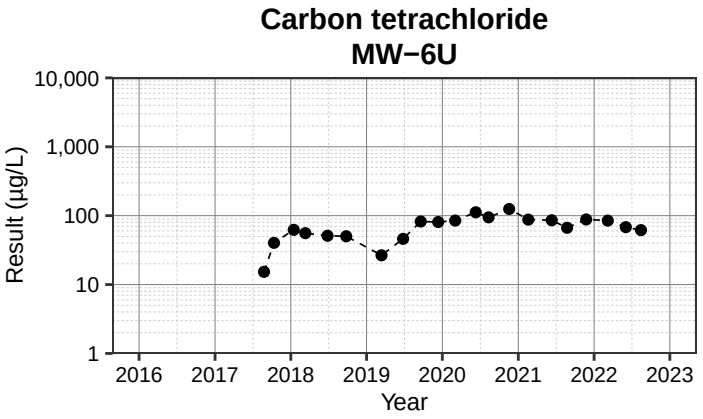


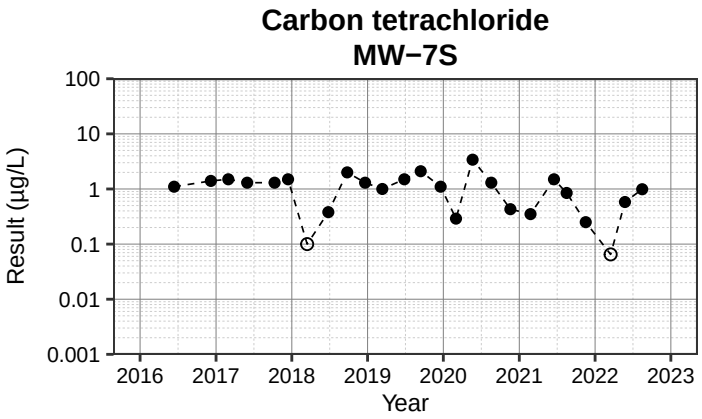
Time−Series Plots
(non−detects plotted using open symbols at one−half the reporting limit)

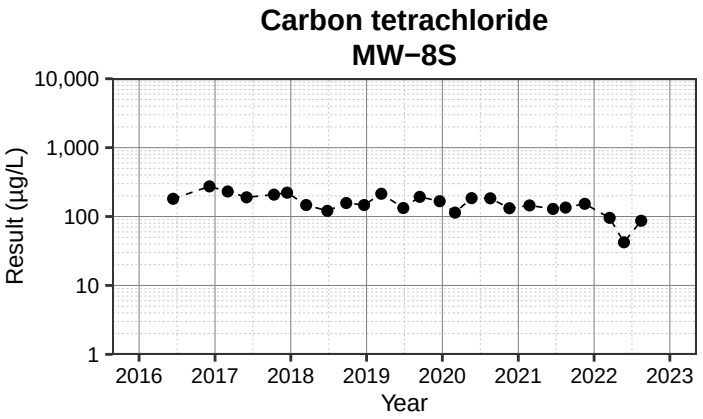


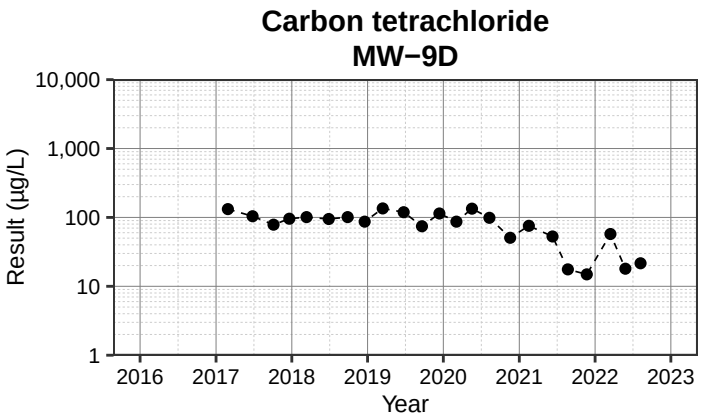


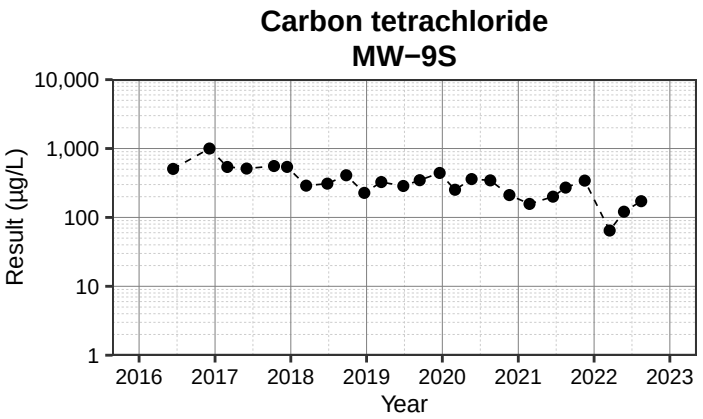








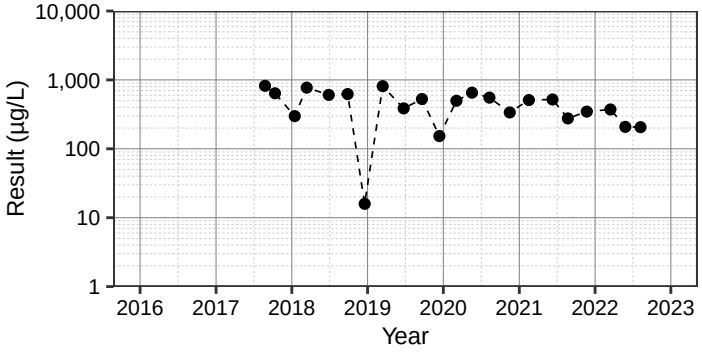




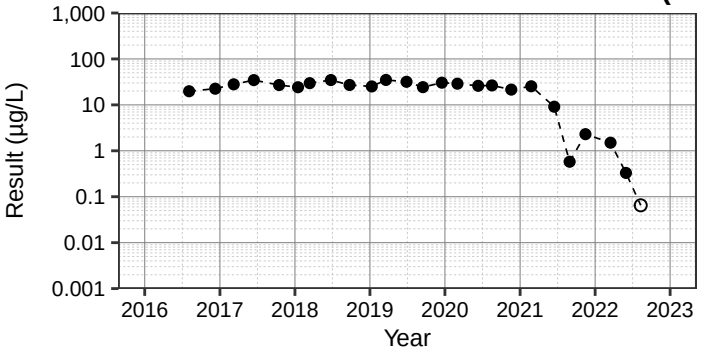
Time−Series Plots

(non−detects plotted using open symbols at one−half the reporting limit)

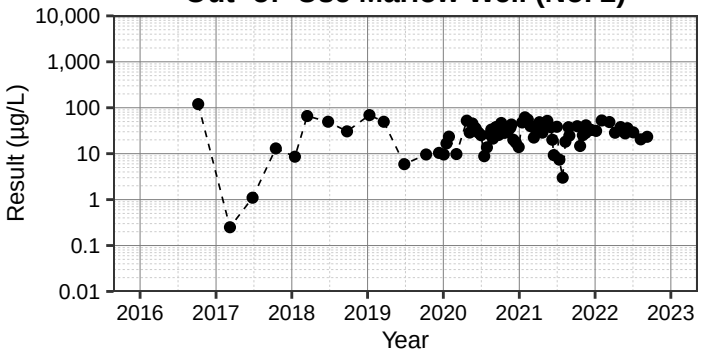
Carbon tetrachloride
MW−9U



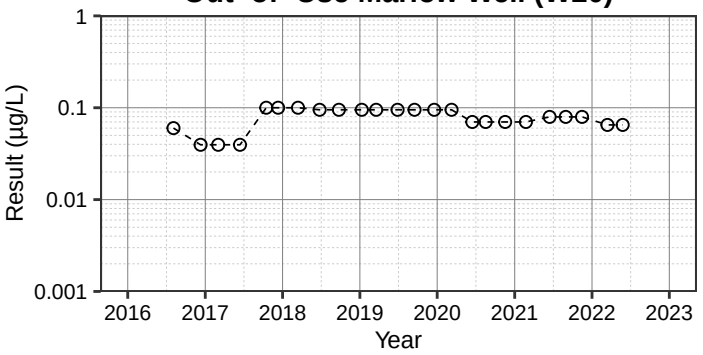
Carbon tetrachloride
Out−of−Use Freeman School District Well (W26)



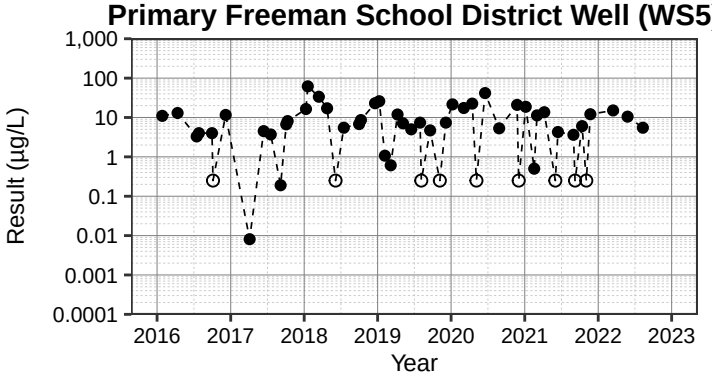
Carbon tetrachloride
Out−of−Use Marlow Well (No. 2)



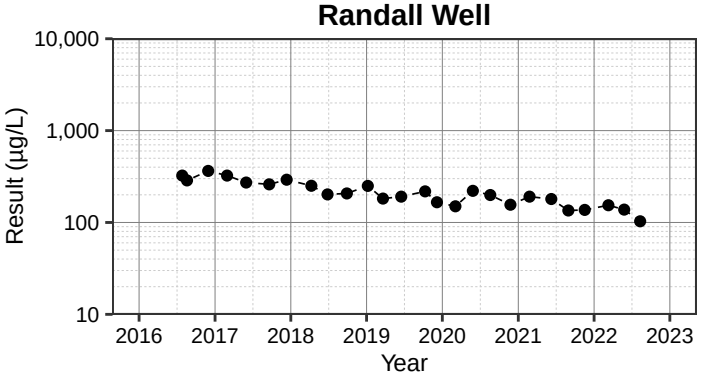
Carbon tetrachloride
Out−of−Use Marlow Well (W20)



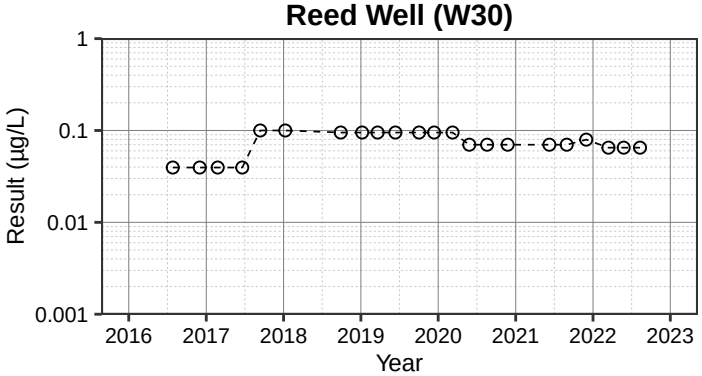
Carbon tetrachloride
Primary Freeman School District Well (WS5



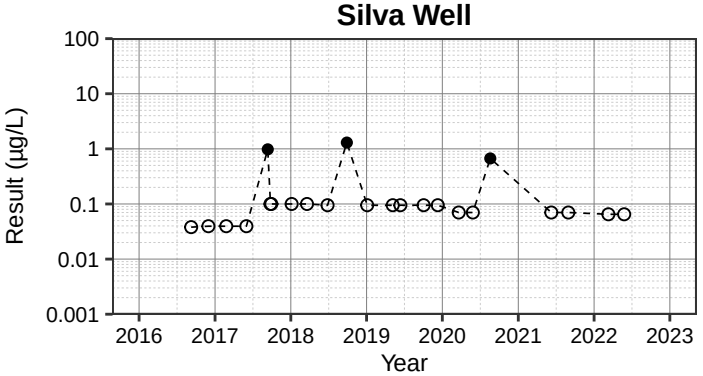
Carbon tetrachloride
Randall Well



Carbon tetrachloride
Reed Well (W30)



Carbon tetrachloride
Silva Well



Time−Series Plots
(non−detects plotted using open symbols at one−half the reporting limit)