May 15, 2019

Mr. Michael Gipson
Department of Environmental Quality
Remediation Division
1225 Cedar Street
Helena, MT 59601

RE: Remedial Investigation Report, Billings PCE Groundwater Facility, Billings, Montana

Dear Mr. Gipson:

Please find enclosed the Final Remedial Investigation (RI) Report for the Billings PCE Groundwater Facility in Billings, Montana. This submittal is in fulfillment of Task Order No. 39 under Department of Environmental Quality (DEQ) Contract 414031. The RI covers activities from July 2017 through September 2018 including soil, groundwater, indoor air, subslab vapor/crawlspace air, stormwater/surface water, and sediment sampling. The report documents these investigations and presents the nature and extent of contamination.

We appreciate the opportunity to assist you with the Remedial Investigation process at the Facility. Please contact me or Craig Carlson at (307) 745-7474 if you have questions regarding the report or if you would like to discuss the project further.

Sincerely,
Trihydro Corporation

Andrew Vann, P.E.
Project Manager

776-036-001

Enclosures

REMEDIAL INVESTIGATION REPORT

BILLINGS PCE GROUNDWATER FACILITY

BILLINGS, MT

May 15, 2019

Project #: 776-036-001

SUBMITTED BY: Trihydro Corporation

2707 Broadwater Avenue, Helena, MT 59601

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List of Acronyms

°C – degree Celsius

APH – air-phase petroleum hydrocarbons

ATSDR – Agency for Toxic Substances & Disease Registry

bgs – below ground surface

BNSF – Burlington Northern Santa Fe

BPCE – Billings PCE

BSL – Big Sky Linen & Uniform

BTAG – Biological Technical Assistance Group

BTEX – benzene, toluene, ethylbenzene, and xylenes

CAL – Central Avenue Laundry

CECRA – Comprehensive Environmental Cleanup and Responsibility Act

CERCLA – Comprehensive Environmental Response, Compensation and Liability Act

CNS – central nervous system

COPC – contaminants of potential concern

CSM – conceptual site model

CVOCs – chlorinated volatile organic compounds

DCA – dichloroethane

DCE – dichloroethene

DEQ – Montana Department of Environmental Quality

DNAPL – dense non-aqueous phase liquid

D7HRC – District 7 Human Resources Council

DO – dissolved oxygen

DQO – data quality objective

List of Acronyms (cont.)

DSR – Data Summary Report

EC – electrical conductivity

EPA – United States Environmental Protection Agency

EPH – extractable petroleum hydrocarbons

°F – degree Fahrenheit

FID – flame ionization detector

foc – fraction organic carbon

ft – feet

ft/d – feet per day

GC/MS – gas chromatograph/mass spectrometer

gpm – gallons per minute

GWIC – Groundwater Information Center

HLS – Hospital Laundry Services

HSA – hollow-stem auger

HPT – hydraulic profiling tool

HQ – hazard quotient

HVAC – heating ventilation and air conditioning

IDW – investigation derived waste

IRIS – Integrated Risk Information System

ISCO – in-situ chemical oxidation

K_d – partitioning coefficient

K_{oc} – soil organic carbon-water partitioning coefficient

K_{ow} – octanol-water partitioning coefficient

List of Acronyms (cont.)

kPa-m^3/mol – kilopascals meters cubed per mole

LDPE – low-density polyethylene

LEL – lower explosive limit

LNAPL – light non-aqueous phase liquid

LUST – leaking underground storage tank

MADEP – Massachusetts Department of Environmental Protection

MBMG – Montana Bureau of Mines and Geology

MCA – Montana Code Annotated

MCL – maximum contaminant level

MDHES – Montana Department of Health and Environmental Sciences

MDL – method detection limit

MDT – Montana Department of Transportation

mg/kg – milligrams per kilogram

MiHPT – membrane interface hydraulic profiling tool

MIP – membrane interface probe

ml/min – milliliters per minute

MMAD – mass median aerodynamic diameter

MNA – monitored natural attenuation

MRL – Montana Rail Link

msl – mean sea level

MS/MSD – matrix spike/matrix spike duplicate

MTBE – methyl tert-butyl ether

NAPL – non-aqueous phase liquid

List of Acronyms (cont.)

NAVD – North American Vertical Datum

NGVD – National Geodetic Vertical Datum

NOAA – National Oceanic and Atmospheric Administration

ORP – oxidation reduction potential

PAHs – polycyclic aromatic hydrocarbons

PCB – polychlorinated biphenyl

PCE – tetrachloroethene or tetrachloroethylene

PID – photoionization detector

PPE – personal protective equipment

ppb – parts per billion

ppm – parts per million

PPRTV – Provisional Peer-Reviewed Toxicity Values

PVC – polyvinyl chloride

QA/QC – quality assurance/quality check

QAPP – Quality Assurance Project Plan

R#E/W – range number east or west

RBCA – risk-based corrective action

RBSL – risk-based screening level

RCRA – Resource Conservation and Recovery Act

RI – Remedial Investigation

RIWP – Remedial Investigation Work Plan

RL – reporting limit

RPD – relative percent difference

List of Acronyms (cont.)

RSL – regional screening level

SAP – Sampling and Analysis Plan

SIM – selective ion monitoring

SL – screening level

SPLP - synthetic precipitation leaching procedure

SSL – soil screening level

START – Superfund Technical Assessment and Response Team

SVOC – semi-volatile organic compounds

TCE – trichloroethene or trichloroethylene

TCLP – toxicity characteristic leaching procedure

TD – total depth

TIAC – Typical Indoor Air Concentration

TOC – top of casing

toc – total organic carbon

TR – target cancer risk

T#N/S – township number north/south

USCGS – United States Coast and Geodetic Survey

USGS – United States Geological Survey

UST – underground storage tank

VC – vinyl chloride

VCP – vitrified clay pipe

VI – vapor intrusion

VOC – volatile organic compounds

List of Acronyms (cont.)

VPH – volatile petroleum hydrocarbons

WWTP – wastewater treatment plant

XSD – halogen specific detector

µg/L – micrograms per liter

µg/m^3 – micrograms per cubic meter

1.0 INTRODUCTION

This Remedial Investigation (RI) Report for the Billings PCE (BPCE) Groundwater Comprehensive Environmental Cleanup and Responsibility Act (CECRA) Facility (Facility) was prepared for the Montana Department of Environmental Quality (DEQ). DEQ ranked the Facility as a high priority site on its CECRA priority list. The Facility is located in Billings, Montana. Tetrachloroethene (PCE) contamination was historically observed in soil, soil vapor, and groundwater at various locations across the Facility in previous investigations and interim remedial actions. Additional petroleum constituents were also observed adjacent to or within the Facility in ancillary investigation work. The previous investigations and interim actions were performed from 1993 through 2016 by various contractors and government agencies, but current conditions and a more comprehensive review of media and contaminants of potential concern (COPCs) was requested by DEQ for the Facility. To address current conditions and a comprehensive assessment for the Facility, DEQ contracted with Trihydro Corporation (Trihydro) to prepare a Data Summary Report (DSR) followed by a Remedial Investigation Work Plan (RIWP), conduct the RI, and provide results and analysis of the investigation in the RI Report.

1.1 REPORT ORGANIZATION

This RI report is organized to present Facility background information, RI investigation objectives, methods used to conduct the investigation and gather information, analytical results, data usability, nature and extent of contamination, and RI findings. Report sections are as follows:

- Section 2 – Facility History, Previous Investigations, and Setting
- Section 3 – Data Gaps and Remedial Investigation Scope
- Section 4 – Laboratory Analytical Approach
- Section 5 – Remedial Investigation Activities
- Section 6 – Field Observations and Work Plan Compliance
- Section 7 – Contaminants of Potential Concern
- Section 8 – Nature and Extent of Contamination – Known and Potential Source Area Soils
- Section 9 – Nature and Extent of Contamination – Groundwater
- Section 10 – Nature and Extent of Contamination – Vapor Intrusion
- Section 11 – Nature and Extent of Contamination – Stormwater/Surface Water and Sediment
- Section 12 – Contaminant Fate and Transport

- Section 13 – Conclusions and Recommendations
- Section 14 – References

1.2 PURPOSE AND OBJECTIVES

The primary objective of the RI is to assess the current nature and extent of contamination at the Facility using observations and data collected following the RIWP (Trihydro 2017b). Investigations were performed for Facility soil, groundwater, vapor, stormwater system/interaction with surface water, and stormwater/surface water system sediment. The RI was also intended to assess potential source areas to provide an evaluation of the fate and transport of contaminants originating from those source areas from soil and groundwater. Additional objectives of the RI are to provide data to support human health and ecological risk assessments and provide preliminary data to support feasibility analysis of cleanup alternatives. To achieve these objectives, groundwater, stormwater/surface water system, stormwater system sediment, surface soil, subsurface soil, ambient air, subslab/crawlspace air, and indoor air samples were collected and analyzed. RI tasks that aid in meeting RI objectives included records review, site visits/inspections, locational surveys, direct-push subsurface screening investigations, monitoring well installation, sewer pipeline scoping, and aquifer testing.

1.3 FACILITY DESCRIPTION

DEQ defines the Facility as any site or area where a hazardous or deleterious substance has been deposited, stored, disposed of, placed, or otherwise come to be located (§75-10-701(4), Montana Code Annotated [MCA]). The BPCE Facility includes approximately 855 acres where groundwater is impacted by chlorinated volatile organic compounds (CVOCs) at or exceeding 1 µg/L PCE in groundwater, emanating from sources of CVOCs in and around downtown Billings. CVOCs are chemical compounds containing chlorine that have been widely used in industries as solvents or are degradation products of common solvents, and commonly include PCE, trichloroethene (TCE), and vinyl chloride (VC). The Facility location and boundary is illustrated on Figure 1-1. This Facility boundary is inclusive of chlorinated solvent sampling results exceeding screening levels (SLs) for subsurface soil, indoor air, and subslab/basement/crawlspace air as discussed in Section 5. However, the Facility boundary may be modified and refined based on DEQ's facility definition and the results of future investigations.

Based on the RI CVOCs results presented within this RI Report, the Facility extends from the southeast corner of the Mountview Cemetery near the intersection of Edward Street and Industrial Avenue to the northeast near the intersection of 2nd Avenue North and North 27th Street, and eastward to just east of the intersection of Minnesota Avenue and 1st Avenue South. The Facility generally runs from the southwest to the northeast in length, but varies in width to the northeast and southwest (Figure 1-1). The Facility encompasses 855 acres, with a length of approximately

3.3 miles, and at its widest appears to be 0.6 miles across, stretching from Lewis Avenue in the northwest, to 3rd Avenue South in the southeast.

A grid system has been established at the Facility to aid in identification of investigation areas during the RI. Grids are 500 foot by 500 foot squares and are identified by an approximately east-west and north-south grid number (i.e. an X and Y value). Grid coordinates are presented using the standard convention of providing the X coordinate followed by the Y coordinate. For example, a grid located at the X location -6, and Y location 2, would have its coordinates listed as (-6,2). Investigation areas in the RI extend from west to east from grid -13 to grid 21, and south to north from grid -6 to grid 12. One of the Facility source locations, Big Sky Linen & Uniform (BSL) is located at the origin of the Facility grid (0,0), which is located in the SW1/4, SW1/4 of Section 4, Township 1 South (T1S) and Range 26 East (R26E). The Facility includes parts of Sections 3, 4, 5, 8, and 9 of T1S, R26E, and Section 33 of T1N, R26E. The Facility may extend into Section 7 of T1S, R26E and Section 32 of T1N, R26E. Multiple potential sources may contribute to contamination at the Facility and are located throughout downtown Billings. The geographical coordinates of BSL are latitude 45°46’11.53” North and longitude 108°32’02.46” West. The former Central Avenue Laundry (CAL) is primarily in grid (-8,-1) and is located in the NE1/4, NW1/4 of Section 8, T1S, and R26E. The geographical coordinates of former CAL are 45°46'9.86" North and 108°32' 55.0428" West. Former Rex Cleaners is primarily in grid (16,8) and is located in the SW1/4, NE1/4 of Section 3, T1S, and R26E. The geographical coordinates of former Rex are 45°46'47.73"North and 108°30'11.55"West.

The Facility appears to have CVOCs contributions from at least 4 source areas (Figure 1-1). The highest CVOCs groundwater concentrations are observed near BSL at 715 Central Avenue and extend from BSL to the northeast on both the northern and southern sides of the railroad corridor, which is located just south of Montana Avenue. Additional elevated CVOCs groundwater concentrations and contaminant contributions are also observed near former CAL at 1246 Central Ave., the former Rex at 19 South Broadway, and an additional source(s) near the intersection of South 23rd Street and Minnesota Avenue. These and other investigated potential source areas for CVOCs are discussed further in Sections 5.0, 8.0, 9.0, 10.0 and 11.0.

2.0 FACILITY HISTORY, PREVIOUS INVESTIGATIONS, AND SETTING

2.1 FACILITY HISTORY BACKGROUND

The BPCE Groundwater Facility was noted as an "area of issue" as early as March 1991 by DEQ (formerly called Montana Department of Health and Environmental Sciences [MDHES]), after being notified of the presence of elevated concentrations of halogenated solvents during an underground storage tank (UST) investigation at a Cenex gas station (1201 Central Avenue) (MDHES 1993). Several past investigations into potential source(s) of solvent contamination have focused on several locations along Central Avenue, a location along the 1st Avenue South corridor, and a location near Riverstone Health Clinic at S 27th St. and 1st Ave. S. These past investigation areas include BSL at 715 Central Avenue, former CAL at 1246 Central Avenue, and former Rex at 19 South Broadway. In addition, there are other former dry cleaning facilities in the area that were previously identified as possible PCE source locations.

2.2 SUMMARY OF PREVIOUS INVESTIGATIONS AND ACTIONS

Previous investigations and interim actions have been conducted at the Facility, including both DEQ and United States Environmental Protection Agency (EPA) led actions. Several investigations were conducted specifically to address the chlorinated solvent plume originating from BSL and other solvent source sites. Additional analytical and geological data are available for the Facility due to the prevalence of Leaking Underground Storage Tanks (LUST) sites within the Facility boundary. Many of the investigations or interim actions within or near the Facility included chlorinated solvents and/or petroleum constituent evaluations. The Facility investigation and interim activities are summarized in the bulleted list below. Additional details regarding historical investigations are presented in the DSR. Information not included in the DSR, which became available after the DSR publication, are detailed below with respect to CVOCs investigations or occurrences.

- 1993 – MDHES: Preliminary Assessment by DEQ's predecessor, MDHES, to evaluate hazards posed by chlorinated solvents in groundwater along Central Avenue. During the course of investigating nearby LUST releases, chlorinated solvents were found in the subsurface.
- 1998 – DEQ: BSL site data from DEQ UST permit program – a 1,000-gallon petroleum UST was removed and replaced on the BSL property.
- 1998 – Maxim: As part of an UST release investigation, groundwater sampling was conducted at the former Tom's Conoco service station located directly upgradient from BSL.

- 1999 – Pioneer: Near BSL, Pioneer conducted a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Site Inspection to evaluate volatile organic compound (VOC) contamination in groundwater, soil and soil vapor.
- 2001 – Pioneer: Near BSL an expanded site investigation was initiated based upon the results of the 1999 site inspection. The expanded investigation focused on evaluating whether PCE contamination in the subsurface was affecting public water supplies in the contaminant plume, as well as conducting sampling to evaluate the nature and extent of vapor intrusion (VI) impacts to buildings located within the plume.
- 2002 – Tetratech (formerly Maxim): Former Rex soil and groundwater investigation.
- 2006 – HKM: Along 1st Avenue South, an investigation was conducted to evaluate impacts from a variety of service stations and abandoned UST/LUST facilities.
- 2006 – URS: Near BSL, a site investigation was conducted on behalf of EPA with the primary objective to define the extent and magnitude of groundwater contamination.
- 2006 – URS: Near BSL and in conjunction with the field investigations of contamination in groundwater, soil, and indoor air, a range of removal alternatives was explored to address chlorinated solvent impacts, with a primary objective of rapid and permanent PCE reduction in groundwater (i.e. investigation to look at interim action alternatives).
- 2008 – URS: At BSL from June to December 2008, URS conducted an interim removal action near BSL and adjacent properties to address possible chlorinated solvent source areas. Interim actions included excavating and disposing of 6,600 tons of contaminated soil, sheet piling was installed to allow for deeper contamination excavation in areas along Central Avenue, and in situ chemical oxidation was implemented in four injection events to reduce contaminant concentrations in the east of the sheet pile in utility corridor source area in Central Avenue.
- 2009 – Olympus: At the Riverstone Health Clinic (formerly the Deering Community Health Clinic), Phase I and Phase II LUST RIs were conducted to evaluate petroleum hydrocarbon impacts, but also indicated issues with CVOCs in analytical results.
- 2009 – Lockheed Martin: Supporting EPA BSL investigations, a flow and transport model was prepared by Lockheed Martin's Information Systems and Global Services group. The results of a flow and transport model were presented to aid EPA in "developing an appropriate removal action that would minimize/eliminate the potential risk of indoor air VI" and as a tool to evaluate the effectiveness of the removal action by comparing future plume concentrations to model predictions.
- 2010 – 2012 URS: Supporting BSL investigation and interim actions, five rounds of groundwater sampling were conducted in May 2009, April 2010, June 2010, 2011, and 2012 to evaluate the chlorinated solvent groundwater

plume magnitude and extent following the EPA 2008 interim removal action. In 2011, eleven air samples were collected to further evaluate impacts to indoor air due to the solvent plume.

- 2012 – Olympus: At former Bair's Self Service UST site, a LUST RI was conducted to investigate petroleum hydrocarbon impacts from a release observed in 1992.
- 2014 – Weston: Supporting BSL investigation and interim actions, a sixth round of groundwater sampling was conducted on behalf of EPA after the 2008 interim removal action.
- 2015 – Olympus: Near the Riverstone Health Clinic at 27th Street and 1st Avenue South groundwater was sampled from September 2015 through August 2016. The objective of the investigation was to assess the state of chlorinated solvent concentrations near the Clinic, as well as further define the extent and magnitude of the CVOCs plumes.
- 2015 – Weston: Supporting BSL investigation and interim actions, EPA conducted the seventh round of post-removal groundwater sampling at the Facility.
- 2016 – Pinnacle: As part of continuing investigations at the Farstad Oil LUST Site at 3317 1st Avenue South, which is downgradient from Central Avenue, at the far northeastern edge of the identified BSL PCE plume, seven soil samples and eight groundwater samples were collected.
- 2017 – EPA/DEQ Meeting: On February 24, 2017, DEQ, its consultant Trihydro, EPA, and its consultant Leidos, met in Helena to discuss the BPCE Groundwater Facility, recent rounds of EPA groundwater analytical sampling, and the development and updates to the groundwater model that EPA is using to evaluate site progress.
- 2017 – Trihydro: Supporting CVOCs investigation near potential identified sources in and around Billings, (including BSL, former CAL, and former Rex/Riverstone Health Clinic), Trihydro compiled the DSR. The DSR summarized known Facility information and the nature and extent of known contamination based on historic investigations, and identified spatial and media-specific data gaps (Trihydro 2017a).
- 2017 – Trihydro: Supporting CVOCs investigation near potential identified sources in and around Billings, a preliminary groundwater monitoring event was conducted in July and August 2017. The groundwater monitoring event was conducted to focus on extent of contamination near potential sources at BSL, former CAL, and former Rex, and to evaluate locations where additional samples were needed to establish edges of the groundwater plume(s). Trihydro measured groundwater hydraulic gradients to evaluate contaminant transport, changes in plume shape and orientation, and the effects of interim remedial actions approximately 10-years after implementation.

- 2017 – Trihydro: Trihydro prepared and submitted the RIWP, outlining the scope, schedule and approaches to be used to conduct the RI at the Facility to assess DSR data gaps and distal extent of contamination (Trihydro 2017b). RI field work activities were completed in November 2018 and are detailed in this Report.
- 2017 – AECOM: AECOM reported groundwater analytical results at the Phillips 66 Refinery in Billings to DEQ's Resource Conservation and Recovery Act (RCRA) program. The Phillips 66 Refinery in Billings is located east of the edge of the known extent of the PCE groundwater plume at the Facility. AECOM conducts investigation and remediation activities as part of the corrective actions being conducted at the refinery. DEQ provided Trihydro with the second, third, and fourth quarter 2017, and first and second quarter 2018 progress reports to provide information about conditions at the farthest downgradient extent of the Facility. AECOM currently operates a groundwater interception system, three biosparging systems, an ozone-peroxide sparge system, non-aqueous phase liquid recovery (NAPL) at 58 locations, and quarterly sitewide groundwater monitoring. Groundwater monitoring contaminants of interest are benzene, toluene, ethylbenzene, and xylenes (BTEX), VC, hexavalent chromium, bromate, and arsenic.
- 2018 – Hydrometrics: The Montana Department of Transportation (MDT) project #NH 115-1(1)0 consisted of the reconstruction of the 1st Avenue North corridor in Billings, stretching from Division Street in the east to North 9th Street in the west. In preparation for that work, MDT commissioned an investigation into known and potential impacts from LUST, UST, and CECRA sites, as well as potential unknown source contributions from service stations, storage facilities, and commercial services that historically existed along 1st Avenue North. Hydrometrics collected 29 subsurface soil samples and 3 groundwater samples from newly-installed wells. Petroleum hydrocarbon impacts were observed in soil along the corridor with risk-based corrective action (RBCA) risk-based screening level (RBSL) exceedances in 7 locations, but chlorinated solvent impacts were not observed in subsurface soil samples. One groundwater monitoring well was installed within the known extent of the PCE groundwater plume for the Facility (along 1st Avenue North between N 31st and 32nd Street), and contained PCE at 27 µg/L and TCE at 38 µg/L. Two additional wells were installed downgradient of the known impacts along 1st Avenue North, and did not contain measurable PCE or chlorinated solvent breakdown products (Hydrometrics 2018).

2.3 TOPOGRAPHY AND SURFACE WATER DRAINAGE

Facility topography is presented in Figure 2-1. Topography is generally flat across the Facility, but grades downward to the east-northeast along one of three distinct gravel terraces that comprise the valley floor along the northern banks of the Yellowstone River, which runs south of the City of Billings (Lopez 2000). The Rimrocks, a Billings landmark of distinctive 300-500 foot sandstone cliffs, form a natural boundary and topographic high on the northern edge of the city. Surface features are generally dominated by urban development including local roadways, the I-90 corridor, and

residential and commercial structures. Topography in the immediate vicinity of the western edge of the Facility outline and the former CAL area slopes sharply upward to the west with a 45 to 50 feet (ft) elevation increase west of the facility as the topography grades up the alluvial terrace transition. From the western edge of the Facility, topography along the facility length grades slowly downward to the east-southeast from around 3,170 ft above mean sea level (msl) to the end of the Facility at around 3,115 ft above msl. Figure 2-1 shows the topography with the Facility boundary for reference. The Facility topography is dominated by alluvial depositions between the Rimrock sandstone outcrops.

The nearest river is the Yellowstone River, and is located approximately 0.6 miles southeast of the northeastern edge of the Facility, but as far as 1.75 miles from the western edge of the Facility. The City of Billings provides treated drinking water from the Yellowstone River as the City of Billings drinking water source (Trihydro 2017a). Two identified stormwater system utilities cross or enter the Facility area, but there are no identified surface water body features within the Facility boundaries. One of the identified stormwater systems, the City/County Drain, crosses the Facility from north to south as it runs along S. Plainview Street east of former CAL. The other identified stormwater system, the Suburban Ditch, enters the Facility from the south near BSL and flows north and east before joining the City of Billings' storm sewer system at the intersections of Central Avenue and Montana Avenue. The Suburban Ditch flows through a large area of the Facility, and eventually conveys stormwater to state waters at an outfall to the Yellowstone River. There are three main surface water features near, but not within, the Facility: a sugar refinery's industrial ponds and associated wetlands, the Yellowstone River, and a canal that directs Yellowstone River water to the north and northwest of the Facility. Stormwater systems and surface water bodies/areas are depicted in Section 11 figures.

2.4 SOILS AND GEOLOGY

The geologic setting is critical for the Facility conceptual site model (CSM) and transport evaluations. The geological setting is influenced by topography (as described above in Section 2.3), soils, localized alluvial geology near the Yellowstone River, and the underlying regional bedrock geology.

As noted in Section 2.3, the Facility is located in the Yellowstone River Valley as close as 0.6 miles from the Yellowstone River at the estimated leading (northeastern) edge of the identified contamination and within 0.8 miles of the Rimrocks sandstone bedrock outcrops that run generally east-west just north of downtown Billings. The Facility location in a river valley indicates that alluvial processes are responsible for deposition of unconsolidated geology. The following subsections detail the Facility's soils, alluvial geology, and underlying bedrock geology based on reference materials and RI observations.

2.4.1 SOILS

The Facility is located in an urban environment, so native soils are often covered with fill material, bedding, and surface completions, such as asphalt, concrete, or landscaping. The United States Department of Agriculture's Natural Resource Conservation Service maintains a soil database and maps of the soil classification types, which were detailed in the DSR (Trihydro 2017a). In general, the Facility covers eight soil types. The soil types are predominantly silty clay to silty clay loams, which are typical of flood plain and alluvial terrace depositions (USDA 2017). There is some variation on the northeast side of the facility near the former Rex (17,9) where the soils grade to silty-clay soil types as the slope of topography increases (Trihydro 2017a). Clay has smaller particle sizes and therefore is a finer grained soil type. Clays, being low permeability soils that expand in volume when wet and often shrink or crack when dry, can hold liquid chemicals or dissolved phase impacted water in source zones. Loams are a mixture of soil types, which grade between clay and silts or sands. Loams are more permeable than clays and less likely to expand significantly in volume based on moisture content than clays; however, silts have a higher surface area which can adsorb more chemical constituents.

Due to the potential for fine-grained soils to become residual source zones, the soil type beneath a source zone or between a groundwater plume and an indoor air receptor can influence the contaminant transport pathway. RI drilling and direct push activities provided observations of lithology and soil types specific to each potential source investigation area. The lithology boring logs are included in Appendix A. In general, the lithology of the unsaturated zone and upper soils area are typically covered in asphalt or similar hardscape materials, with medium brown, loose, dry silty sands just beneath to about 1 ft below ground surface (bgs), which may also be weathered road base material in most instances. However, there are some locations where clayey materials are mixed with sand and gravels close to the surface and some locations where, likely due to recent precipitation, the soils were moist. Beneath that top soil area with silty sands and intermittent clayey sands, the lithology in the unsaturated vadose zone at potential source investigation areas was comprised of intermittent layers of light to dark brown silty clays, silty sands, and clayey sands (Appendix A). However, there is discontinuity at depth between these layers in the unsaturated zone that indicates no continuous layering of clays or aquitard type materials. Instead, the lithology is comprised of small, localized lenses of alluvial materials throughout the unsaturated zone.

During the RI activities, the residential areas generally had lawns and landscaping or concrete driveways and sidewalks covering the soil areas. The soils were not accessible for examination during winter-time RI VI activities due to snow coverage and frozen ground.

2.4.2 ALLUVIAL GEOLOGY

The unsaturated alluvial soils are part of regional alluvial geological deposits that extend from the surface soils into a saturated alluvial aquifer above bedrock. The alluvial geology is critical for understanding potential contaminant transport and fate of contaminants beneath the Facility. The Yellowstone River Valley is the primary geological driver for the unconfined, alluvial groundwater unit beneath the Facility. The Yellowstone River Valley was formed through alluvial activity throughout the quaternary period (Zelt et al. 1999). Alluvial activities deposited gravels, sands, and silts during overland flow of the Yellowstone and tributaries from Yellowstone Plateau southwest of Billings to the confluence with the Missouri River near Williston, North Dakota, northeast of Billings.

In the area of the BPCE Groundwater Facility, there are three prominent quaternary alluvial terraces noted as Quaternary 1 (Qat1), Quaternary 2 (Qat2), and Quaternary 3 (Qat3), which developed from down-cutting of the Yellowstone River (Madison et al. 2014). Appendix A has a figure by Lopez (2000) that illustrates the relationship between the mapped quaternary alluvium terraces and the City of Billings. The unconsolidated Quaternary deposits are as much as 120 ft thick in areas along the Yellowstone River Valley and usually overlie the Eagle Sandstone and Telegraph Creek Formations discussed in Section 2.4.3 below (Lopez 2000). These three terraces generally run parallel to the current Yellowstone River and are separated by offsets in vertical elevation called “scarps,” with the alluvial terrace 1 (Qat1) being about 10-20 ft above the river elevation, alluvial terrace 2 (Qat2) being about 20-40 ft above the river elevation, and terrace 3 (Qat3) being about 50-90 ft above the river elevation (Lopez 2000). The scarp between Qat1 and Qat2 is 10-20 ft high. The scarp between Qat2 and Qat3 is 30 to 50 ft high (Appendix A-1, Gosling et al. 1973). A basal gravel layer, which likely comprises the most conductive water bearing unit in the Qat2 lithologic profile, narrows with lateral distance towards the northwest and pinches out near the Qat3 – Qat2 terrace scarp as it transitions to a silt layer at the scarp north to northwest of the Facility (-8,6); however, the gravel is again present under the Qat3 further northwest (Appendix A-1, Gosling et al. 1973). The continuity of the gravel layer west, immediately upgradient, of the Facility at the nearest Qat3 – Qat2 scarp (-13,-4) is unknown, but Facility groundwater presence and potentiometric surface figures are discussed further in Section 2.5.

More specifically, the Facility lies on the alluvial terrace 2, or Qat2 (Lopez 2000). Qat2 alluvial geology covers the Facility area, but the Facility’s western edge abuts the scarp between alluvial terrace 2 (Qat2) and alluvial terrace 3 (Qat3) near the western edge of the Facility on Central Avenue to the western edge off Industrial Avenue. Figure 2-1 has the Facility topography, and the steeper topography contours sloping up to the alluvial terrace 3 on the western edge can be observed from the grids -13,-3 to grid 6,14, along a northeast transect. Qat2 is the second youngest alluvial gravel terrace deposit of the Yellowstone River Valley. Qat2 is from the Pleistocene epoch and is also comprised of mostly cobbles and pebbles with minor amounts of sand and silt (Lopez 2000). The Qat2 alluvium is typically 40-60 ft thick (Gosling et al. 1973). The majority of the Facility is within the Qat2 alluvium geological area; however, there

does appear to be a slight change in groundwater direction to a more easterly flow between the Quaternary alluvium geological formations at the eastern edge of the Facility where the Qat2 formations meet the Qat1 surficial formations and the Rimrocks narrow (21,11). Groundwater resources are discussed in Section 2.5.

Figures 2-2 through 2-6 show geology and alluvial lithology specific to the Facility in lithologic cross-sections based on local irrigation and monitoring well logs. Figure 2-2 shows a plan view of the four cross-sections. Cross section A-A' uses irrigation and private well data from the Montana Groundwater Information Center (GWIC) website from the Montana Bureau of Mines and Geology (MBMG) in addition to RI wells MW-127 (1,1) and MW-125 (2,-1) to show the depth to bedrock beneath the Qat2 alluvial gravels from the northwest to southeast across the BSL source area (Figure 2-3) (GWIC/MBMG 2017). The B-B' cross section uses GWIC irrigation and private well lithology in addition to RI wells MW-130 (-11,-4), MW-101 (-8,-1), and MW-123 (-3,3) to examine the bedrock and alluvial cross-section along the western portion of the plume from the southwest to the northeast (Figure 2-4). This cross-section runs, generally, from the furthest upgradient/western well for the Facility through the former CAL source area along the groundwater flow direction across Central Avenue towards the northeast. A third cross-section, C-C', on Figure 2-5 examines the alluvial lithology and instances where bedrock may have been encountered from southeast of the source area near BSL south of the railroad corridor along 1st Avenue South to the easternmost RI alluvial well at MW-115 just west of the Phillips 66 refinery property. (Figure 2-2). This C-C' cross-section covers the southern Facility boundary after passing the BSL area. C-C', examines the alluvial lithology and depth to bedrock from existing monitoring wells from LUST or UST facilities, irrigation/monitoring wells from the GWIC database, and RI alluvial wells, along the length of the southern plume boundary. A fourth cross-section, D-D', on Figure 2-6 examines the alluvial lithology and bedrock encounters from the source area near BSL north of the railroad corridor along Montana Avenue to the eastern extent of the Facility just northeast of downtown Billings (Figure 2-2). D-D' examines the alluvial lithology and depth to bedrock from EPA well logs for the EPA Superfund Technical Assessment and Response Team (START) activities, RI alluvial and bedrock well installation activities, and irrigation/monitoring well installation data from GWIC along the length of the northern Facility area emanating from the BSL to the northeast (Figures 2-2 and 2-6).

In general, the four cross-sections show alluvial materials from about 15 to 25 ft bgs across the Facility area, as well as the underlying shale, when encountered, at 20-25 ft bgs (Figures 2-2 through 2-6). The exception is observed in the wells to the north of BSL well MW-127 in cross-section A-A' (Figure 2-3), which are on the third quaternary alluvial terrace, Qat3, and have up to 80 ft bgs of alluvial materials. The upper alluvial is comprised of a finer heterogeneous alluvial shallow material of sandy clay, sandy silt, clayey sand, silt, or clay that is approximately 10 to 15 ft thick. This finer heterogeneous alluvial material was observed during RI alluvial and bedrock well installation to have lithologies that are typically medium brown silty clays, silty sands, and clayey sands interspersed with smaller sand layers. These

layers were typically moist to wet, but not saturated. Similar to the shallow soil lithology described in Section 2.4.1, the upper alluvial material is present in smaller, disconnected alluvial lenses rather than continuous layers. Beneath that layer of lenticular upper alluvium is a coarser, more homogenous sand or gravel alluvial layer that is approximately 10 to 20 ft thick. This lower alluvial layer is typically a medium brown gravely sand or a brown to gray sandy gravel. There is very little silt and little to no clay noted in the RI boring logs (Appendix A). This lower alluvium is typically wet to saturated. Additional discussion of the hydrogeology is presented in Section 2.5.

2.4.3 BEDROCK GEOLOGY

The deeper bedrock geology beneath the alluvial deposits near Billings is dominated by horizontal bedrock layers that were deposited as part of the Western Interior Seaway shore in the mid to late Cretaceous period of 145 – 66 million years ago (Lopez 2000). Much of the bedrock is comprised of alternating layers of shale and sandstone deposits in horizontal bedding about 6,600 ft in thickness. Beneath that Cretaceous bedding is a granite gneiss of the Archean eon (4,000 – 2,500 million years ago). Appendix A includes figures of the regional geology of the area (Lopez 2000) (Gosling and Pashley. 1973).

The uppermost bedrock layer beneath the Facility is comprised of shale, and sandy shale units with minor interbedded sandstone beds and lenses, which were formed in the Montana region in the late cretaceous period (Pashley 1973) (Gosling and Pashley 1973). Both the Eagle Sandstone and Telegraph Creek Formation Shale are dominant Cretaceous formations in the region near the Facility. The Eagle Sandstone outcrops are most prominent as the ‘Rimrock” cliffs, exposed less than 1 mile to the north in an east-west direction with a slight north-northeast dip and are cut by the Yellowstone River Valley alluvium (Gosling and Pashley 1973). The Eagle Sandstone is a light brownish gray to pale yellow-orange, fine-grained sandstone, and the sandstone color variation is attributed to differing sandy calcareous concretions (Lopez 2000). This sandstone can be a low-yield water-bearing unit, and typically yields less than 10 gallons per minute (gpm) in wells (Gosling and Pashley 1973). The Telegraph Creek Formation outcrops to the south-southeast of the Yellowstone River Valley approximately 1-2 miles from the Facility (Lopez 2000). The Telegraph Creek Formation is from the late Cretaceous period, underlies the Eagle Sandstone Formation, and overlies the Niobrara shale (Colorado Group) in the vicinity of Billings (Thom 1923). This formation is a transitional formation between the Montana Group and the Colorado Group and developed at the head of Telegraph Creek on the Crow Indian Reservation in Montana (Thom 1923). This formation is predominantly a shale, with some sandy shale, and grading into a sandstone when underlying the Eagle Sandstone Formation, which as noted above comprises the Rimrock outcrops north of the Facility.

Beneath the Facility, unconsolidated Quaternary deposits overlie the transitional Telegraph Creek Formation before grading to the underlying Colorado Group (Thom 1923 and Gosling and Pashley 1973). The Telegraph Creek Formation color varies from brownish-gray to medium dark-gray, but can be reddish at its base (Lopez 2000). The Telegraph Creek Formation can be up to 150 ft thick from the top of the contact (Lopez 2000), which was observed to occur at just over 25 ft bgs at the BSL area of the Facility. The Telegraph Creek Formation typically yields less than 10 gpm and is not considered a water-bearing unit (Lopez 2000).

In the vicinity of the Facility, the DSR cross-section figures noted that three GWIC database wells and eight EPA boring wells had boring logs that inferred that they are completed in the Telegraph Creek shale or are screened through the alluvium down to the top of the shale (Trihydro 2017a). As part of this RI, two additional RI bedrock wells were installed near BSL to assess the depth to shale and competency of the alluvium/shale interface: MW-126 and MW-127 (Figure 2-2). Details on the installation and completions of MW-126 and MW-127 are describe in Section 5; however, both were installed into the dark gray, unweathered shale found at 26 ft bgs and 28 ft bgs beneath BSL, respectively. The drilling method for installing the wells is described in Section 5, but the method did not recover much material at times due to difficult drilling conditions into the hard shale unit. The recovered shale material was dry, gray cuttings of small silty shale rock particles that had been angularly fractured by the drilling method. The saturated groundwater in the alluvium above did not appear to be significantly mobile within the shale (Sections 2.5.2 and 9.5). The cuttings and difficulty in drilling into the underlying shale infers that the bedrock below BSL is competent and dry. Field methods and observations are documented in Section 5, and RI boring logs and well construction diagrams are documented in Appendix A. Appendix A also includes the regional geology figures and well logs for the 13 identified deeper GWIC and EPA wells.

2.5 HYDROGEOLOGY

Section 2.4 above discusses some of the water bearing capabilities of the geologic formations for the Facility; however, evaluation of the hydrogeology and aquifers contribute to the CSM and fate and transport understanding of the Facility setting. The following subsections present the hydrogeology of the alluvial aquifer and underlying bedrock based on reference literature and direct RI field activities and observations. Much of the hydrogeology details are presented in Section 5 and Section 9 of this report and are briefly summarized here for the Facility setting discussion.

2.5.1 ALLUVIAL AQUIFER HYDROGEOLOGY

As noted in Section 2.4, the alluvial aquifer geology is primarily silty sand to clayey sand in the unsaturated zone, which overlays a coarser sand and gravel formation above the shale bedrock (Appendix A). The coarse sand and gravel formation is primarily saturated and likely accounts for the majority of the groundwater flow in the alluvial aquifer. In

addition to evaluating alluvial lithology properties, fluid level measurements were collected from three monitoring events, and in source areas a direct push Membrane Interface Hydraulic Profiling Tool (MiHPT) evaluated subsurface hydraulic conductivity. A summary of the alluvial aquifer hydrogeologic properties is included in this section based on previous and RI activities.

Three groundwater potentiometric surface maps were completed for the 2017 and 2018 RI groundwater investigations. These potentiometric surface maps and flow directions are discussed in detail in Section 9. These figures were created from measuring fluid levels at existing EPA monitoring wells, existing LUST site monitoring wells, newly installed RI alluvial wells, and several existing irrigation wells. The DSR also included potentiometric surface figures from 2006 through 2008 from EPA well data (Trihydro 2017a). In general, the groundwater flow direction in the Facility area is primarily to the northeast with a slightly more easterly flow between the former CAL and BSL and at the northeast edge of the Facility near the former Rex. The groundwater depth from RI groundwater fluid level monitoring ranged from 2.48 ft bgs at MW-113 (19,9) to 17.09 ft bgs at MW-109 (12,3) for alluvial aquifer wells, with an average of 12.04 ft bgs. This equates to a groundwater elevation range for the Facility from 3108.26 to 3158.89 ft above msl. The RI depth to water data for 2017 through 2018 is, on average, several ft shallower than the historic EPA alluvial aquifer data, which noted the alluvial aquifer fluctuated annually from 14 to 17 ft bgs (Lockheed Martin 2009). Section 9.7 details the temporal groundwater fluctuation for the RI monitoring periods, but in general elevation changes ranged from 0.02 to 5.65 ft, with median fluctuations of 0.59 ft and average fluctuations of 0.78 ft between July 2017, May 2018, and September 2018.

Using the potentiometric surface figures (Section 9) and historic potentiometric figures from the DSR (Trihydro 2017a), the average gradients are calculated for each of the RI groundwater monitoring periods as follows:

- Average EPA gradients 2006 - 2008: 0.0027 ft/ft (Trihydro 2017a)
- RI Groundwater Gradient July 2017: 0.0035 ft/ft
- RI Groundwater Gradient May 2018: 0.0031 ft/ft
- RI Groundwater Gradient September 2018: 0.0034 ft/ft

The historical EPA average gradients presented in the DSR were between 0.0004 and 0.008 ft/ft lower than the observed RI average gradients for July 2017 through September 2018. Potential differences in the gradients are not significant for groundwater flow calculations, and cannot be directly attributed to seasonal groundwater fluctuations since the size and spacing of the monitoring well networks were considerably different. The EPA gradients were measured in a much smaller area with fewer wells than the RI groundwater events. Hydrographs for four areas of the

Facility are included in Appendix C to show the fluid level changes upgradient of BSL, near BSL in the main plume area downgradient of BSL, and at the distal northeast area of the PCE plume area. Appendix C hydrographs show the following general fluid level trends:

- Upgradient of BSL (Appendix C5) – Generally the wells' fluid levels were collected primarily in new wells installed for the RI and therefore do not have long-term trends to evaluate. The upgradient wells do not appear to have significant elevation changes to insinuate a temporal trend. Only four wells were sampled in 2017 and 2018, and those four wells show a small increase from July 2017 to May 2018 in groundwater elevation of typically less than 2 ft.
- Near BSL (Appendix C5) – Generally the wells near BSL show a significant increase in groundwater elevation from 2006 to 2014 through the July/August 2017 (Q3 2017) sampling event. More recently the majority of the wells near BSL show a slight trend downward from Q3 2017 through Q3 2018 sampling events. Three wells show a more marked change from Q3 2017 through Q3 2018: BPGP76 and BPGP74, which are both within the sheet pile wall, show a decrease in groundwater elevation of greater than 5 ft from July 2017 through May 2018; and BPGP02, which is in the alley north of BSL, that had an increase in groundwater elevation of almost 2 ft from July 2017 through May 2018.
- Main Plume (Appendix C5) – Generally the wells in the main plume area show a slight increase in groundwater elevations from 2006 to 2018. Main plume wells also seem to exhibit slightly higher groundwater elevations; however, there are less significant differences in the groundwater elevation in these wells in general, showing changes of less than 2 ft in elevation from Q3 2017 through Q3 2018.
- Distal Northeast Plume Area (Appendix C5) – due to the recent installation or inclusion of sampling of the majority of the wells in the distal area of the plume, historic and recent groundwater elevation trends are difficult to assess; however, recently sampled wells at the distal northeast plume area appear to have a higher groundwater elevation in May 2018 than observed in September 2018.

In the DSR, Trihydro noted that the alluvial aquifer groundwater hydraulic conductivity (K) was estimated to be generally around 109 to 299 feet per day (ft/d) for the sands and gravels in the alluvial aquifer formation, but only 0.2 to 1.1 ft/d in the finer-grained material (Trihydro 2017a). That calculation and literature values were consistent with the EPA calculated and field measurements of K conducted in irrigation and EPA wells in 2006 to 2008. The EPA evaluated hydraulic properties and reported 40.8 ft/d for vertical K and 408 ft/d for horizontal K, for a calculated approximate velocity of 3.3 ft/d, which was used for modeling purposes in 2008-2010 (URS Operating Services 2010). EPA also performed slug tests near the BSL source area, but these were less quantitative and resulted in a range of hydraulic conductivities from 7.7 to 71.5 ft/d (Trihydro 2017a). During the RI, MiHPT investigations in the alluvial

aquifer source zone investigations found the following hydraulic profiling tool (HPT)-calculated K values (Section 8 and Appendix D) and associated seepage velocities (Appendix A):

- BSL area: HPT-calculated K values are relatively uniform in the saturated alluvial zone, typically ranging from 60 to 80 ft/d
- Former CAL area: HPT-calculated K values are relatively uniform in the deeper water saturated alluvial zone, typically around 80 to 100 ft/d
- Former Rex area: HPT-calculated K values are relatively uniform in the saturated alluvial zone, consistent with the values reported above for other MiHPT investigation areas, and typically range from around 60 to 80 ft/d

These high hydraulic conductivities are consistent with previous investigation alluvial aquifer K values and represent zones for higher groundwater velocity. Seepage velocities were calculated ranging from 0.93 to 3.71 ft/d (Appendix A-3). These K values and seepage velocities are also consistent with velocities in gravels and are important to understanding the shape (longer length compared to width) of the Facility groundwater plume

2.5.2 BEDROCK HYDROGEOLOGY

Reference materials suggest that the Telegraph Creek Formation shale in this region can be 160 ft thick (Lopez 2000). A thickness of 160 ft for a competent shale, combined with reference groundwater yields of less than 10 gpm (Lopez 2000), indicates that the bedrock is likely an aquitard and barrier to downward groundwater or contaminant migration. To confirm that the bedrock beneath the Facility was consistent with regional groundwater evaluations, bedrock monitoring wells MW-126 and MW-127 were installed near BSL to evaluate the competency of the shale, evaluate evidence of dense non-aqueous phase liquid (DNAPL) at the alluvial aquifer interface with the underlying bedrock shale, and perform slug tests to establish K values for the shale at the BSL source. Wells MW-126 and MW-127 were cased-off from the alluvial aquifer above. MW-126 was installed into the shale with its screened interval beginning approximately 4.5 ft below the top of shale, from 30.5 to 35.5 ft bgs. MW-127 was installed into the shale with its screened interval beginning approximately 11.5 below the top of shale, from 40 to 45.0 ft bgs (Appendix A – Well Logs and Construction Diagrams). Descriptions of these bedrock well installations and investigation activities are included in Sections 5, 9, and 12. Specific to hydrogeology, the deep borings advanced during the RI near BSL confirmed that as the lithology transitions from saturated sands and gravels in the alluvial formations to shale bedrock, the bedrock appears to be intact, dry, and with no visible fractures or weathering that would indicate a fractured bedrock connection to the alluvial aquifer at those two locations. The bedrock well hydraulic tests were performed from September through December 2018 and K values of 4.23×10^{-5} ft/d and 2.88×10^{-4} ft/d were calculated for

MW-126 and MW-127, respectively. These low K values are consistent with literature-reported ranges of unweathered shale that are typically on the order of less than 1 x 10^{-4} or 1 x 10^{-5} ft/d (Freeze and Cherry 1979).

2.6 CLIMATE

The climate in Billings is humid continental with warm summers and no dry season (WeatherSpark 2017). The annual average temperature is 47.1 degrees Fahrenheit (°F). In winter, average high temperatures are 43°F in Billings. Average winter daily minimum temperature is 16°F. The lowest temperature on record was -38°F on February 15, 1936 (National Oceanic and Atmospheric Administration [NOAA] 2018). In summer, the average temperature is 76°F. The summer average daily high is 87°F and the summer average daily low is 60°F (WeatherSpark 2017). The highest temperature on record was 108°F on July 14, 2002 (NOAA 2018). The 2017 average annual temperature was 48.4°F, which is the 25th warmest year out of the last 83 years (NOAA 2018).

Annual precipitation at the City of Billings is 14.77 inches. The record one-day precipitation total is 3.12 inches, recorded on May 24, 2011 (NOAA 2018). The growing season generally falls between May and September, and generally about 53 percent of annual precipitation falls during this period. The total annual precipitation for 2017 was 17.63 inches and it was the 13th wettest year out of the last 83 years (NOAA 2018). The average seasonal snowfall is 57 inches at the City of Billings. On average, 57 days per year have at least one inch of snow on the ground. The heaviest one-day snowfall on record was 23.7 inches, recorded on April 4, 1955 (NOAA 2018). The total annual snowfall for 2017 was 76 inches and it was the 11th highest quantity of snowfall for the last 83 years (NOAA 2018).

The average relative humidity typically ranges from 24% to 82%. Humidity is highest around June, and it is driest around August. There are typically 205 days of sunshine per year. The prevailing wind is most often out of the southwest (about 32% of the time) but also from the north (13%), and west and northeast (11% each). Average wind speed is highest, around 13 miles per hour, in December (WeatherSpark 2017)

2.7 SUSPECTED SOURCE FACILITIES

The RI focused on several dry cleaning facilities, as well as other known or potential solvent sources within the Facility. Based upon previous investigations and historical records review, suspected source areas include BSL, former CAL, and former Rex. During the RI, investigations were also conducted at cleaning operations including Hospital Laundry Services (HLS) at 45 South 7th Street West, ALSCO Cleaners at 348 Calhoun Lane, and Wetzel's Cleaners at 117 North 30th Street, as well as at District-7 Human Resource Council offices at 3124 North 32nd Street, where a former auto shop had been located with known solvent contamination. The RIWP (Trihydro 2017b) presents additional potential sources of PCE within and near the Facility boundary.

2.7.1 BIG SKY LINEN

BSL has operated at its location at 715 Central Avenue in Billings since 1965, according to the Montana Secretary of State and property ownership records (Montana Secretary of State accessed 2018). BSL is a domestic profit organization formed November 16, 1964, according to the Montana Secretary of State business entity search. Records from the Montana Cadastral service indicate that a building was constructed on the property in 1955, but provide no indication if other operations existed at the location prior to the dry cleaners (Montana Cadastral accessed 2018). The property at 715 Central Avenue, from which BSL operates, is owned by Billings Laundry Company, which is a separate domestic profit corporation registered with the Montana Secretary of State. The Billings Laundry Company was formed on December 12, 1906, and is in active good standing with the Secretary of State. Sanborn maps for the block of BSL indicate no building in existence at the location prior to 1963 (Sanborn Fire Insurance Maps 2017). BSL operates out of a 14,040 square foot commercial building on the property, providing commercial cleaning services. Chlorinated solvent use was documented at the site, though the duration of its use is unknown and may have started as early as 1967, and extended to as late as 1994 (Pioneer Technical Services, Inc. 2000). A floor drain in the building reportedly discharged to a French drain east of the building, but was modified to connect to the city storm sewer in 1970, and in 1975, the floor drain was closed permanently. As of 2000, a water softener has been allowed to discharge to the storm sewer (Pioneer Technical Services, Inc. 2000).

The 2010 EPA Site Assessment and Remediation Alternatives Report (URS Operating Services, Inc. 2010) notes that a variety of dry cleaning equipment was used on site, and was located in the northeastern corner of the BSL building. Three separate styles of dry cleaning apparatuses were reported to operate between 1967 and 1993, including 35-pound and 65-pound transfer units, as well as a 55-pound “dry-to-dry” system. Both types of systems typically used solvent recovery processes via a “still” or “cooker unit” as part of the dry cleaning operation. The overflow discharge from the PCE recovery systems was reported to discharge to the floor drain (URS Operating Services, Inc. 2010). DEQ Hazardous Waste program records contained no information for BSL, and it does not appear to have been registered as a chlorinated solvent user.

2.7.2 FORMER CENTRAL AVENUE LAUNDRY AND CLEANERS

Former CAL, located at 1246 Central Avenue, was in operation from 1982 to 1990 (Pioneer Technical Services, Inc. 2000). According to a 1993 DEQ report, solvents were disposed of onsite in a “sewer lagoon”, and PCE was reclaimed with an onsite distillation system. In 1989, former CAL was noted as disposing 50 gallons of solvents annually (MDHES, 1993). RCRA hazardous waste records for the Facility noted that David E. Smith of CAL registered as a halogenated solvent user in 1989, but contained no other records after the initial registration. Prior to housing a dry cleaning establishment, a coin-operated laundromat occupied the former CAL building from 1961 to 1981 (URS

Operating Services, Inc. 2010). Since CAL's closure in 1990, the building has served as a pawnshop, an appliance repair business, a sign making shop, a bookkeeper's office, and most recently, The Cigarette Store, which operated on the premises during the RI (Pioneer Technical Services, Inc. 2000) (URS Operating Services, Inc. 2010). The building is located in a mixed residential/commercial area, adjacent to both residential structures and small businesses. Montana Cadastral notes the property owner as Twelve Hundred Partnership. The Montana Secretary of State records indicate that Twelve Hundred Partnership L.L.C is in active good standing, and was formed on October 3, 2002.

Prior to the RI limited investigation had been conducted in and around former CAL; however, PCE contamination in groundwater was detected near the site. Due to the short timeframe of dry cleaning operations at the site, and the fact that contaminant concentrations in the vicinity of former CAL were observed to be significantly lower than those from proximal source areas, most historical EPA investigations did not include extensive sampling of the former CAL location. Limited investigations were conducted in 1993, 2000, and 2007.

2.7.3 FORMER REX CLEANERS

Chlorinated solvent impacts were discovered in downtown Billings, near the Riverstone Health Clinic (formerly the Deering Clinic) at 123 South 27th Street in 2009 (Olympus Technical Services, Inc. 2016). The clinic is located at the distal northeastern edge of the historical PCE plume boundary identified in previous investigations. During investigation of a nearby UST, CVOCs were discovered in groundwater. PCE concentrations in groundwater wells near the clinic were an order of magnitude greater than concentrations previously observed in the leading plume edge. A laundry cleaning business operated at 21 South Broadway (also known as South 28th Street) from as early as 1912 according to Sanborn fire insurance maps (Sanborn Map Company 1912). Former Rex is first noted on the 1949 Sanborn map. According to the Montana Secretary of State, Billings Rex Fabric Cleaners, Inc., was a business entity in good standing from 1919 to 1973. A used car sales and repair business occupied the property during the beginning of the RI, at an address of 19 South Broadway. The property is currently vacant. The property is currently owned by Erving Properties LLC. The Montana Secretary of State notes that Erving Properties LLC was formed July 1, 2010, and is in active good standing. Sparse information is available on activities conducted at former Rex, and the use of chlorinated solvents during previous operations has not been verified.

CVOCs concentrations have been observed below DEQ-7 standards (5 micrograms per liter (µg/L) for PCE) upgradient of former Rex, while downgradient concentrations have been observed as high as 150 µg/L, suggesting a distinct source in the area of former Rex (Weston Solutions, Inc. 2014) (Olympus Technical Services, Inc. 2016). DEQ files contain an executive summary from a 2002 Phase II investigation conducted on the former Rex property. This excerpt does not include figures or tables, and the consultant that prepared the report indicated that the rest of the report has

been lost or destroyed. However, the text indicates that soil collected from 13 ft bgs had a PCE concentration of 790 milligrams per kilogram (mg/kg); groundwater was not sampled from this location. Additionally, a groundwater sample with a PCE concentration of 95 µg/L was collected from a location with a soil PCE concentration of 5 mg/kg, collected at 19 to 20 ft bgs.

2.7.4 OTHER SOLVENT SOURCES

During the RI, several other areas were investigated for potential CVOCs contributions to groundwater or source areas. Those potential source area investigations are described further in Sections 5, 6, 8, 9, and 10. During RI activities, one area was discovered near monitoring well MW-115 at the northeast area of the Facility. MW-115 was installed near the intersection of Minnesota Avenue and South 23rd Street to help delineate the distal edge of the groundwater plume exceeding 5 µg/L. During the May 2018 and September 2018 groundwater monitoring events, this well was found to contain PCE at concentrations of 956 and 1,790 µg/L, respectively, which is more than an order of magnitude higher than PCE concentrations observed at the up- and slightly cross-gradient former Rex property, which suggests that an otherwise unidentified source may be contributing to PCE contamination in the area. Groundwater table fluctuations in MW-115 from May 2018 to September 2018 had decreased by approximately 4.5 inches, which may have affected the change in contaminant concentrations.

2.7.5 PETROLEUM HYDROCARBON AND OTHER CONTAMINANT SOURCES

Petroleum hydrocarbon impacts have been observed discontinuously at the Facility. Several known contributors to hydrocarbon contamination include a former gasoline UST located at the BSL property, the Burlington Northern Santa Fe (BNSF) railyard, through which the southern portion of the groundwater plume passes, the former Short Stop service station, located upgradient of BSL, the Cenex Zip Trip, located downgradient of former CAL, the Pepsi Bottling Plant located within the BSL groundwater plume, the 1st Avenue South UST Fields sites located along the southern Facility boundary, releases at the Wells Fargo Building UST, and Greyhound Bus Lines, both located at the distal end of the main plume body, as well as unidentified hydrocarbon contributors near North 35th Street.

2.8 REGULATORY HISTORY

Although a low-level PCE detection was noted in a monitoring well in 1988, the BPCE Groundwater Facility was noted as an “area of issue” in March 1991 by MDHES, after being notified of the presence of elevated concentrations of halogenated solvents during an UST investigation at a Cenex gas station at 1201 Central Avenue (MDHES 1993). Several past investigations into potential source(s) of solvent contamination have culminated in focusing on the BSL and former CAL locations along Central Avenue, in addition to the former Rex location/South Downtown Solvent Site on Broadway. Additional investigations associated with USTs and groundwater contamination were performed at

former service/UST locations and along 1st Avenue South. Current MDT investigations also have examined CVOCs concentrations in the vicinity of 1st Avenue North in Downtown Billings. Phillips 66 owns a refinery in Billings that is under a RCRA permit and has also investigated CVOCs in groundwater in the past. A complete regulatory history is provided in Section 3.3 of the DSR (Trihydro 2017a) and expanded with new data in Section 2.2 above.

2.9 CURRENT LAND USE

The Facility encompasses a broad mixture of land uses. The majority of the Facility is covered by commercial businesses, residences, schools, parks, open spaces, streets, industrial or manufacturing businesses, a railroad corridor (used by both BNSF and Montana Rail Link [MRL]), and municipal right of ways. The DSR details the typical break-up of the property types according to zoning maps from the City of Billings (Trihydro 2017a). Properties directly adjacent to the Central Avenue and Montana Avenue corridors are generally zoned Community Commercial or Controlled Industrial (along the BNSF/MRL railyard). Properties located further from these corridors are typically zoned for Residential and Residential Multi-Family use. The northeastern edge of the plume extends into the Central Business District, as well as the South 27th Street Permit Zoning district along 27th Street South. A number of parks and public spaces are located adjacent to or within the plume boundary, including Central Park, Terry Park, Highland Park, South Park, and the Downtown Skate Park (City of Billings 2017). The highway business corridor for I-90 also runs through the Facility along Montana Avenue. Due to the large size and urban environment of the Facility, it is difficult to assess the amount of privately owned property compared to publicly owned areas by city, county, state, or federal entities. The Yellowstone River is a navigable waterway less than a mile from the Facility and managed by the U.S. Army Corps of Engineers in conjunction with the State of Montana. The area is a corridor for ecological migration and details on the ecological habitat in conjunction with the urban nature of the Facility is included in the DSR (Trihydro 2017a).

3.0 DATA GAPS

The primary objective of the RI is to assess the current nature and extent of contamination at the Facility using observations and data collected following the RIWP (Trihydro 2017b) to fill in data gaps and expand investigations spatially and within focused source media. Investigations were performed for Facility groundwater, ambient air, subslab or crawlspace vapor and indoor air, stormwater/surface water, and sediment associated with the stormwater systems. To achieve the RI objectives, groundwater, stormwater system/surface water, sediment associated with the stormwater systems, surface soil, subsurface soil, ambient air, sub-slab/crawlspace air, and indoor air samples were collected and analyzed. RI tasks that aid in filling data gaps and meeting RI scope included records review, site visits/inspections, locational surveys, direct-push subsurface screening investigations, monitoring well installation, sewer pipeline scoping, and aquifer testing.

- The scope of this RI was developed based upon the following:
  - The DEQ State Superfund example RIWP scope, provided on DEQ's website (DEQ August 2017) and included in DEQ's Task Order 39 with Trihydro.
  - The pre-RI data gaps identified in the DSR (Trihydro 2017).
  - The CSM developed during the DSR (Trihydro 2017).
  - The RI Scoping Meeting attended by DEQ and Trihydro personnel, April 25, 2017.
  - Phased implementation of the RIWP allowed field screening results or recent investigative results to guide sampling decisions for future RI investigative phases in 2017 and 2018.
- The Facility background, environmental evaluations, and investigations completed to date will be considered to the extent that data is useable to evaluate existing Facility conditions as well as potential historical releases.

3.1 PRE-REMEDIAL INVESTIGATION DATA GAPS

Data gaps were identified in the DSR following a review of EPA, DEQ, and private investigation reports, for and within the Facility, from the late 1990s through 2015. The following data gaps were identified as necessary information to understand current conditions and nature and extent of contamination for the Facility. These data gaps are numbered below and addressed in the data quality objectives (DQOs) (Trihydro 2017b):

1. General Facility Data Gaps
   a. **Uncertainty for localized geology and hydrogeology**: The geology and hydrogeology data gaps included a lack of information about downgradient or leading edge plume groundwater flow direction and potential

interactions with the gaining Yellowstone River. Additionally, very few monitoring wells or boreholes at the Facility had been completed to bedrock during the course of previous investigations. The RI included a more comprehensive mapping of the bedrock/alluvium interface at the Facility through MiHPT borings and lithologic observation, especially in the source areas, to evaluate whether DNAPL is present at BSL or other potential source areas of the Facility, to document bedrock elevations across the Facility, and to investigate the competence (i.e., degree of fracturing/weathering) of bedrock in potential source areas. Information regarding the NAPL mobility or potential for transport (if present) was also collected.

b. **Utility corridor as a secondary source/preferential pathway or interaction with groundwater:** Utility corridor construction projects and improvements have been conducted in Billings over the period between the earliest Facility source area operations to present. The RI included evaluation of utility corridors as potential secondary sources near known source areas and collected additional information regarding the condition and construction of utilities in and near the known source areas.

c. **Identified sources or potential contributing sources**: The Facility includes a large area with other potential industrial facilities, repair shops, RCRA sites, LUST sites, and other commercial facilities present or historically present. Varying information was known about these sites and their potential contribution to the chlorinated solvent and petroleum contamination at the Facility. This data gap was addressed through file evaluations, direct push soil and groundwater sampling, sampling of previously existing monitoring wells, and installation/sampling of additional monitoring wells.

2. Groundwater and Surface Water Data Gaps

a. **Groundwater hydrology and low-level concentrations at the edges of the inferred plume are not well delineated:** EPA investigations primarily focused on high-concentration areas, and did not fully delineate the extent of groundwater contamination beyond 100 µg/L for PCE.

- In general, fluid levels had only been reported twice from 2008-2016, and sufficient data was not available to allow for mapping of seasonal variations in the potentiometric surface. The RI included three fluid level monitoring events during various seasons. Additionally, monitoring wells were installed to evaluate groundwater flow and contaminant concentrations in the perimeter and distal plume areas.
- The presence/concentrations of contaminants in the area between former CAL and BSL needed further delineation. The monitoring well network was expanded to the south-southeast and north-northeast, between former CAL and BSL.
- The monitoring well network also needed expansion at the leading edge of the plume east of well BPGP50 (grid X:14,Y:10), and west of former Rex investigation area (grids 19,7 through 19,9). The monitoring

well network was expanded by adding four monitoring wells east of well BPGP50, and by adding six wells west, east and northeast of former Rex.

- Additional fluid level measuring points were needed to the south and east of the Central Avenue/BNSF corridor to better understand groundwater flow patterns and potential dissolved contaminant transport (grid 3,1 northeast to grid 13,6). This area runs along a portion of the PCE groundwater plume that was inferred to be lower concentration, but did not have adequate data to support if there were localized groundwater flow patterns that contributed to the northeast flow of the groundwater or if there was a more expansive leading edge to the diffuse groundwater solvent plume. The monitoring well network was expanded to south and east of the Central Avenue/BNSF corridor along 1st Avenue South and on the BNSF property, adding 8 monitoring wells along and south/east of the BNSF corridor.

b. **Records of groundwater geochemical parameters (pH, temperature, oxidation reduction potential [ORP], dissolved oxygen [DO] content, specific conductance, and turbidity) are very limited:** One set of parameters was collected in 2014, but temporal variation in groundwater conditions was not available. Additional information regarding groundwater parameters was collected to assist with fate and transport evaluation, and permit evaluation of the reduction-oxidation chemistry in the subsurface.

c. **Analysis for non-PCE constituents:** There were several groundwater analytical constituent data gaps.

- Very little data had been gathered regarding contaminants other than VOCs, with a primary focus for the area on chlorinated solvents. Additionally, many of the chlorinated solvent constituents, such as *trans*-1,2-dichloroethene (DCE), *cis*-1,2-DCE, and VC data from 1988-2015 have detection limits above DEQ-7 human health standards in groundwater. The detection limits associated with the chlorinated solvent daughter products was an analytical data gap. Groundwater samples were analyzed to evaluate non-VOC contamination, including semi-volatile organic compounds (SVOCs), petroleum hydrocarbons, and dissolved metals. Analytical laboratory methods were used with detection limits lower than applicable SLs, to the extent practicable.

- A limited suite of dissolved metals was evaluated in four samples in 2006, but additional metals data had not been collected. Dissolved metals analytical results are important due to the potential for metal mobilization by reducing conditions in the subsurface, which are sometimes observed in conjunction with reductive degradation. Groundwater samples from 50 monitoring wells across the Facility were evaluated for potential metals contamination.

- Petroleum VOC data was available for select wells at the Facility and was not ubiquitous. While petroleum source areas were expected to be small compared to the total PCE plume area, the presence of petroleum hydrocarbons comingled with chlorinated solvents can interfere with accurate analytical

evaluation of daughter product concentrations and may potentially affect VI impacts and remediation efforts. Although the delineation of petroleum VOCs was not a primary focus of this investigation, groundwater samples from 64 monitoring wells across the Facility were evaluated for potential petroleum contamination.

d. **Stormwater/Surface Water sampling of City-County Drain and Suburban Ditch**: The impacts of groundwater or stormwater that surfaces or is transported in channels and ditches in the area had not been well documented at the Facility. These two main stormwater systems both include irrigation surface water in open channels as part of the system and have potential to encounter subsurface groundwater when transported through subsurface stormwater piping. These two stormwater systems were further characterized:

- The City-County Drain runs north/south along South Plainview Street, and intersects Central Avenue between BSL and former CAL. This part of the stormwater system has upgradient influence from open-channel irrigation surface water, but the stormwater is channelized through subsurface piping as it crossed the facility in Grids -7,2 through -6,-11. This stormwater system was evaluated for VOCs, total metals, extractable petroleum hydrocarbons (EPH), and volatile petroleum hydrocarbons (VPH) impacts.
- The Suburban Ditch is primarily an open channel surface water section of the stormwater system that originates south of the City of Billings and travels north and east entering the Facility near Central Avenue and 7th Street West before entering the City's underground stormwater collection system at Central Avenue and Montana Avenue (grids -2,-9 through 2,-1). This stormwater system was evaluated for VOCs, total metals, EPH, and VPH impacts.
- Groundwater gradients had also not been well characterized at the Facility near the two stormwater systems, which may affect understanding of contaminant fate and transport in groundwater at the Facility. This groundwater interaction is especially important to understand with the City-County Drain, which is 8-ft in diameter and the base of the pipe ends at around 12-14 ft bgs. The RI included three fluid level monitoring events during various seasons. Additionally, monitoring wells were installed to evaluate groundwater flow and help understand contaminant fate and transport.
- Sampling from utility corridors and ditches can provide understanding of interaction between groundwater, surface water, and stormwater. Sampling from the stormwater system upgradient of the Facility, across the Facility, and downgradient of the Facility following a storm event was performed to better understand contaminant concentrations and potential for surface water and groundwater interaction in the stormwater system. The analytical results for the stormwater system investigation were compared to surface water and sediment SLs for evaluation.

3. Soil Data Gaps

a. **Expand the understanding of subsurface lithology at the Facility:** Lithologic profiles for the Facility often stopped prior to reaching bedrock. Soil evaluation was focused on the subsurface contamination stemming from utility line discharges of chlorinated solvents near BSL. Confirmation samples collected during excavation activities confirmed that soil contamination extends below the water table, and beyond the limits of excavation, which were restricted by the presence of aboveground structures and constraints on practical excavation depths. Understanding lithology down to bedrock would help with evaluating contaminant migration and the exposure pathways for contaminants. Localized lithology data was collected during soil investigations at source areas and during installation of groundwater wells.

b. **Evaluate the extent of residual contamination at the Facility:** Previous soil sampling for the Facility was limited spatially to a small area around BSL, limited in depth to soil samples at BSL greater than 9 ft bgs, and limited in the constituent analysis, primarily PCE.

- Further evaluation of the extent of residual contamination at the Facility for BSL was required
  - Surface soil (0-2 ft bgs) was not evaluated during EPA investigations. Surface soil samples were collected from 15 locations/depth intervals and evaluated for contaminant impacts.
  - Subsurface soil (>2 ft bgs) had limited evaluations, primarily >9 ft bgs, and may not have been representative of current conditions. Post-excavation soil sample results may not represent current conditions since no additional soil sampling was performed after the in-situ chemical oxidation (ISCO) remediation activities. Subsurface soil samples were collected at 40 locations/depth intervals evaluated for contaminant impacts.
  - Soil contamination had been noted at high levels in the intersection of 7th Street West and Central Avenue, but delineation of contamination had not been explored further, and this area was not excavated during the removal action. Multiple soil borings were completed in the area of 7th Street West and Central Avenue and soil samples were collected to evaluate extent of contamination.
  - DNAPL was discovered at 19 ft bgs within excavations in a sheet piling cell on Central Avenue. However, downgradient locations where soil PCE concentrations were elevated in proximity to the storm sewer were either not excavated or were excavated to a depth of only 14 ft bgs. Therefore, the extent of the DNAPL migration was not well understood. Direct-push subsurface soil samples were completed in known or potential source areas, an MiHPT investigation was conducted to evaluate potential source material, and bedrock wells were installed near BSL to evaluate the potential for DNAPL presence at the bedrock/alluvial aquifer interface.

- Soil excavation in the BSL alley was conducted to the BSL/711 Central Avenue property line. However, three confirmation samples along that excavation wall exceeded 100 mg/kg PCE, and one sample exceeded 1,000 mg/kg PCE, suggesting that some contamination extended eastward under the adjacent building. Furthermore, alley excavation confirmation samples at the practicable extent of the floor of the excavation ranged from 354.94 to 4,251.08 mg/kg PCE. These levels suggested that the soil contaminant concentration profile was not fully developed at BSL. Subsurface soil samples were collected outside of building footprints to evaluate the potential for remaining subsurface soil contamination.
- PCE contamination was noted to extend deeper into the gravel, but could not be excavated due to the risk of impacting adjacent building stability. Fenton's reagent was applied to the excavation floor and injected into the subsurface after backfilling, but the extent to which this action addressed PCE residual soil concentrations was unknown. Five MiHPT borings were completed down- and cross-gradient of the sheet piling containment area where deeper contamination was historically observed. A deeper bedrock monitoring well was also installed in the alley between BSL and 711 Central Avenue.

- Evaluate other potential source areas for soil contamination, which have not had soil investigations in the past.
- Expand the soil analytical to include other analytes including chlorinated solvent daughter/degradation products and potential co-mingled petroleum constituents, with appropriate detection limits below the SLs when feasible.

c. **Evaluate utility corridor residual contamination/smear zone**. Similar to data gap 2d, the interaction of remaining soil contamination, focused primarily around BSL, and the utility corridors needed further characterization. The RI included scoping storm and sanitary sewer lines near BSL, the former CAL and the former Rex Cleaners, as well as soil borings to identify pathways and potential sources of contamination near utility corridors.

4. VI Data Gaps

a. **Previous VI investigation was relatively limited compared with the area of the groundwater plume:** While the VI pathway was shown to be complete in a limited number of indoor air locations downgradient from BSL, additional evaluation was needed to assess if the current conditions of the plume pose a potential risk for indoor air exposure. The RI expanded VI sampling spatially and statistically, including sampling buildings at or near the identified source areas, and around sensitive receptor populations.

b. **Evaluate current status of mitigation systems:** EPA identified seven commercial and residential structures that had indoor air concentrations above the EPA action level, and installed mitigation systems. The EPA's action level was higher than DEQ SLs for chlorinated solvents in indoor air, and at several locations the post-interim remedy results were above the DEQ indoor air SLs for PCE and TCE. The RI included the inspection and indoor air evaluation of these seven structures to assess effectiveness of the interim remedies. Property access was arranged for five of the seven structures, and evaluation was completed for those structures.

5. Source Delineation Data Gaps

   a. **Potential source areas had not been investigated with the exception of BSL:** Expanded understanding of source areas with evaluation of potential source areas at former CAL, former Rex, and potential sources identified in the source delineation activities was needed. The results of desktop research to identify potential sources are included in Section 2.9 of the RIWP. Additional soil and groundwater samples were collected during the RI to assist with identifying potential sources of contamination.

   b. **Evaluate the possibility of remaining DNAPL at BSL:** Further evaluation of the residual source area at BSL was needed to determine the presence of residual DNAPL in finer-grained lithology above the gravel alluvial aquifer, at the shale bedrock surface, and potentially downgradient in the utility corridor in Central Ave. Surface and subsurface soil samples were collected at BSL to evaluate the potential for DNAPL in soils above the alluvial aquifer. Monitoring wells were installed in the bedrock at and downgradient of the BSL source area and MiHPT borings were completed to bedrock/refusal to evaluate the presence of DNAPL at the bedrock surface. Utility scoping was performed to evaluate the condition of storm and sanitary sewers in Central Ave.

6. Petroleum Hydrocarbon Constituent Data Gaps

   a. **Further delineate petroleum hydrocarbon sources and contamination within Facility.** Additional information was needed to identify potential hydrocarbon sources effects on the CVOCs plumes and indoor air. The monitoring network and suite of analytes throughout the plume area were expanded during the RI, and temporal groundwater changes were evaluated.

   b. **Examine petroleum hydrocarbon constituent and chlorinated solvent interactions and comingling, including understanding of increased potential carcinogenic risks:** Additional data was needed to evaluate the changes in the CVOCs plumes between areas upgradient and downgradient of historic petroleum release locations. As part of the RI, the monitoring well network was expanded near known historic petroleum releases.

4.0 LABORATORY ANALYTICAL APPROACH

To quantitatively meet RI DQOs and evaluate environmental samples as COPCs for the Facility, Trihydro coordinated with an analytical laboratory to use laboratory analytical methods applicable for DQOs and COPC evaluation. Analytical methods used to analyze each type of media investigated, including soil, groundwater, vapor, stormwater/surface water, and sediment samples, are presented below.

4.1 ANALYTICAL LABORATORY COORDINATION

Samples were submitted for analysis to Pace Analytical Laboratory in Billings, Montana. To the extent practicable, analyses were performed on site; however, certain analyses were performed at Pace labs in Minneapolis, Minnesota; Greensburg, Pennsylvania; and Green Bay, Wisconsin. Analyses were performed as follows:

- Billings, MT - Extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH) by the Montana-modified Massachusetts Department of Environmental Protection (MADEP) Methods (Montana Method), PCE screen by a modified EPA Method 8260, sulfate by EPA Method 300.0, nitrate + nitrite by EPA Method 353.2, pH by SM 4500-H+B and by EPA Method 9045D, sulfide by SM 4500-S2-D, moisture by ASTM D2974, particle size analysis by Method ASA 15-5, and free liquids by EPA Method 9095.
- Minneapolis, MN - VOCs by EPA Method 8260, synthetic precipitation leaching procedure (SPLP) VOCs by EPA Method 8260, SVOCs by EPA Method 8270, polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270 Selective Ion Monitoring (SIM), dissolved metals by EPA Method 200.8, mercury by EPA Method 245.1, methane, ethane, and ethene by method RSK 175, toxicity characteristic leaching procedure (TCLP) metals by EPA Method 6010, TCLP mercury by EPA Method 7470, hexavalent chromium by SM 3500-Cr B, cyanide by SM 4500-CN-E, specific gravity by ASTM D5057, Method 3C fixed gases, Method TO-15 SIM VOCs, and Method TO-15 air-phase petroleum hydrocarbons (APH).
- Green Bay, WI - Total organic carbon (*toc*) by SM 5310C and fraction organic carbon (*foc*) by ASTM D2974-87.
- Greensburg, PA - Flashpoint by EPA Method 1010.

4.2 LIQUID PHASE ANALYTICAL METHODS

Historical groundwater investigations have focused primarily on PCE using a number of methods, including EPA Method 8260 for VOCs, as well as field laboratory gas chromatograph/mass spectrometer (GC/MS) methods. The Facility encompasses multiple locations containing USTs, fuel dispensing operations, as well as historical industrial operations. Groundwater samples collected during the RI were also analyzed for VOCs using EPA Method 8260. However, as the nature and extent of other collocated contaminants was largely unknown, select groundwater samples

were also analyzed for SVOCs by EPA Method 8270, EPH and VPH by the Montana Method, dissolved metals via EPA Method 200.8, and mercury via EPA Method 245.1. Samples evaluated for EPH were first screened, per the Montana Method. Groundwater samples containing total EPH in excess of 1,000 µg/L were then fractionated to evaluate the specific aromatic and aliphatic fractions present in the sample. Samples evaluated for metals were field filtered prior to collection and were analyzed for dissolved metals. Analytical results were evaluated, and sampling suites for groundwater from individual wells were adjusted throughout the investigation to optimize data collection.

Groundwater screening samples were collected from temporary monitoring points, and were evaluated for PCE only, using a modified EPA Method 8260, with limited QC analyses, to allow for rapid, order-of-magnitude evaluation of PCE concentrations in groundwater, for the purpose of locating monitoring wells.

Select wells were also sampled for monitored natural attenuation (MNA) parameters, to aid in understanding subsurface conditions. MNA parameters included field parameters such as ORP, DO, pH, along with laboratory analytical for methane, ethane, ethene by RSK 175, sulfate by EPA Method 300.0, nitrate + nitrite by EPA Method 353.2, and *toc* by SM 5310C.

Sediment and stormwater/surface water samples were collected to determine impacts to stormwater/surface water collection and transport pathways. These samples were analyzed for total metals by EPA Method 200.8, mercury by EPA Method 245.1, VOCs by EPA Method 8260, and EPH/VPH by the Montana Method.

4.3 SOLID PHASE ANALYTICAL METHODS

Surface and subsurface soil were evaluated in known or suspected source areas. All surface and subsurface soil samples were evaluated for VOCs using EPA Method 8260. At select locations, surface and subsurface soil samples were also evaluated for metals using EPA Method 6010, mercury using EPA Method 7471, SVOCs by EPA Method 8270 and 8270 SIM, and EPH/VPH by the Montana Methods. Samples evaluated for EPH were first screened, per the Montana Method. Samples containing total EPH in excess of 200 mg/kg were then fractionated to evaluate the specific aromatic and aliphatic fractions present in the sample. Additionally, for samples exceeding the EPH screening threshold, PAHs SIM analysis was also performed.

Subsurface soil investigations at the three known or suspected source areas (BSL, former CAL, and former Rex) also utilized additional subsurface characterization analyses to evaluate geochemical parameters and transport properties. VOC SPLP analysis by Method 8260B was used to evaluate the potential for contaminants present in subsurface soil to migrate between the liquid and solid phases and were collected from intervals indicated to contain contamination

during MiHPT investigations. Distinct subsurface lithological types were identified during the RI (e.g. sand, clay, gravel, etc.) and a sample of each sediment type were each submitted for specific gravity analysis by ASTM Method D5057, particle size analysis by ASA Method 15-5, and pH by EPA Method 9045. The *foc* of potentially naturally occurring carbon sources was analyzed using ASTM Method D2974-87 at locations determined to be upgradient from potential sources and located in unimpacted areas of the Facility.

4.4 AIR PHASE ANALYTICAL METHODS

Indoor air samples were collected in the living spaces of residential and commercial structures at the Facility and were analyzed for VOCs using method TO-15 SIM. Indoor air samples at select additional structures were analyzed for TO-15 APH based upon field observations, or nearby potential sources of petroleum hydrocarbons. Crawlspace samples were also sampled for VOCs using method TO-15 SIM, and APH based upon field observations and nearby sources.

Subslab vapor samples were analyzed for VOCs using method TO-15, fixed gases using Method 3C (i.e. carbon dioxide, helium, and oxygen), and methane by Method TO-3. Select subslab vapor samples were also evaluated for TO-15 APH depending upon field conditions and potential nearby petroleum sources. Ambient air samples were analyzed for VOCs by Method TO-15 SIM and APH by Method TO-15 APH.

4.5 INVESTIGATION DERIVED WASTE CHARACTERIZATION ANALYTICAL METHODS

Liquid phase investigation derived waste (IDW) was generated primarily from groundwater sampling and well development activities. To dispose of the waste at the City of Billings Wastewater Treatment Plant (WWTP), liquid phase IDW was characterized for VOCs by EPA Method 8260, pH by Method SM 4500-H+B, EPH/VPH by the Montana Method, flashpoint by EPA Method 1010, hexavalent chromium by SM 3500-Cr B, TCLP metals by EPA Method 6010, TCLP mercury by EPA Method 7470, sulfide by method SM 4500-S2-D, and cyanide by SM-4500-CN-E.

Solid phase IDW was generated primarily from drill cuttings from well installation activities, and direct-push sampling cores. For disposal of the waste at the City of Billings landfill, solid phase IDW was characterized for TCLP metals by EPA Method 6010, metals by EPA Method 6010, TCLP mercury by EPA Method 7470, TCLP SVOCs by EPA Method 8270, VOCs by EPA Method 8260, TCLP VOCs by EPA Method 8260, EPH/VPH by the Montana Method, and free liquids by EPA Method 9095.

4.6 ANALYTICAL LABORATORY REPORTING

Pace Laboratories reported the analytical results for the RI samples in both electronic database deliverables that are compatible with DEQ TREADS database and in pdf deliverables. Section 5.0 describes the data that was collected and sent to the analytical laboratory, and Appendix F includes the Pace-supplied pdf laboratory report deliverables for the RI activities.

4.7 ANALYTICAL LABORATORY DEVIATION

Analyses were performed in accordance with approved planning documents, with some exceptions. Deviations from the planned analyses included the following:

- During both the July 2017 and May 2018 groundwater sampling events, equipment blank samples for metals were placed into bottles preserved with nitric acid. Distilled water was poured over equipment and directly into sample containers, which precluded filtration of the sample. Dissolved metals analysis could not be run on these samples due to the presence of the nitric acid preservative, and these samples were analyzed for total metals instead. This deviation is not expected to impact data quality results, as the distilled water used for equipment blanks was unlikely to be a source of dissolved metals.

5.0 REMEDIATION INVESTIGATION ACTIVITIES

This section presents the activities conducted and methods used during the RI to gather information and address data gaps described in Section 3. Investigations included pre-sampling activities to gather site condition information, groundwater, soil, stormwater/surface water, sediment from the stormwater system, and indoor air sampling, historical records review, and physical location surveys. Additionally, this section describes procedures used for decontamination, IDW storage and disposal methods, and data validation procedures.

5.1 PRE-SAMPLING ACTIVITIES

Prior to beginning sampling at the Facility, an inventory of existing monitoring wells, investigations of utility corridors, and utility clearance activities were performed. These provided additional information supporting RI activities and addressed data gaps at the Facility.

5.1.1 MONITORING WELL SURVEY

An inventory/inspection of monitoring wells was conducted to evaluate the condition, quantity, and availability of monitoring wells in and around the Facility. The Well Inventory Work Plan memorandum is included as Appendix B of the RIWP (Trihydro 2017b). The inventory/inspection was conducted from May 15 through 17, 2017; additional wells were located during the July 2017 groundwater sampling event. Field activities included verifying well locations; recording the well vault completion type; inspecting well integrity, including the presence of locks and caps and/or damage to the well casing; confirmation of well diameter; and recording other pertinent information. Of the 284 wells targeted for investigation, 44 could not be located, including 5 wells that were sampled by EPA as recently as 2015. Of 81 primary well locations that were of central importance to understand current conditions of the plume in key areas (Well Inventory Work Plan Trihydro 2017b), 78 were located prior to the July 2017 sampling event. The wells that could not be located (BPMW02, BPMW10, and RH-MW-1) have been confirmed to be missing, destroyed, or abandoned. Additional wells were located that had been infrequently used or used in past investigations, or are clustered near each other for smaller localized investigations. Finally, some irrigation wells were identified in areas where a well could be advantageous to delineating the plume or looking at groundwater conditions outside the EPA-focused investigation area. Well inventory information, including updated well locations, was uploaded to the project database to allow tracking of site data. Well inventory results were presented in the RIWP (Trihydro 2017b). In general, the monitoring well survey and inventory was able to provide information used to select wells for the RI groundwater monitoring activities and help identify areas where additional wells may need to be placed to meet data gap objectives and establish current groundwater plume conditions. Section 5.2 discusses the RI monitoring well activities and network.

5.1.2 UTILITY CORRIDOR INVESTIGATIONS

Historical investigations have shown that utility lines and utility corridor bedding have served, and may continue to serve, as secondary sources of contamination to the subsurface at the Facility. During EPA's emergency response action at BSL in 2008, stormwater lines and the fine-grain bedding were reported to be a source of PCE discharge to the subsurface, and these lines were exposed, excavated beneath, and replaced. The stormwater, sanitary sewer, electric, and water lines within the sheet pile area in Central Avenue were removed, a natural gas line was left in place, bedding and soils within the sheet pile area were excavated to bedrock, and new engineered fill was installed prior to re-installation of the utility piping (URS 2010). To the east of the sheet pile area, the stormwater sewer area was investigated; it had pre-excavation ISCO treatments, and the stormwater sewer was removed from the sheet pile area to approximately 15 ft west of the intersection of 7th Street West and Central Avenue, and soil was removed from the bottom of the stormwater sewer to the top of the water table before new bedding and pipe were installed (URS 2010). PCE was known to have been discharged directly to the storm sewer during dry cleaning operations, and EPA discovered that joints in the stormwater sewer were primary release mechanisms to the subsurface (URS 2010). Due to the scope of the emergency response, excavation and repair of these storm sewer lines were limited to the immediate area adjacent to BSL downgradient along Central Avenue, towards 7th Street West, and from BSL to Central Avenue. EPA's investigation found that the highest PCE concentrations in groundwater were closest to BSL and decreased drastically as they continued east of the intersection of 7th Street West and Central Avenue, "indicating that DNAPL was not present" east of the intersection (URS 2010). Utility corridors beyond this were not evaluated in historic investigations, and these became part of the sewer scoping activities for the RI.

A sewer scoping investigation using a remote camera on a rover was conducted in November 2017 and March 2018. The purpose of conducting the sewer scoping was to verify the depth, diameter, and material of construction of the utility lines near potential source areas. Sewer scoping was also used to investigate the condition of the utility lines near potential source areas, the presence of unsealed joints in sewer piping, fractures or failures of piping integrity, root intrusion into the piping, or other signs of potential release to the subsurface. Photos of features identified during scoping activities are included in Appendix B-2. Scoping videos are also contained in Appendix B-3.

5.1.2.1 BIG SKY LINEN

One of the primary release mechanisms identified during EPA's interim actions was the sewer systems associated with BSL. Due to that, much of the interim action investigations and remediation were performed around the historic stormwater and sanitary sewers near BSL as they proceed into Central Avenue. The stormwater sewer system no longer receives BSL wastewater (e.g. wastewater from BSL is directly discharged to the sanitary sewer), and the sanitary sewer was replaced from BSL's building through the sheet pile area in Central Avenue to the eastern edge of

the sheet pile wall (Trihydro 2017a); however, the current conditions of the sanitary sewer east of the sheet pile wall was identified as a data gap. To address this data gap, sanitary sewer scoping was performed near the intersection of 7th Street West and Central Avenue. Sanitary sewer scoping began at manhole 45-5, in the intersection of 7th Street West and Central Avenue, and proceeded west to manhole 45-41, parallel with the front door of the 711 Central Avenue building (Figure B-1 in Appendix B-1). The bottom of the sanitary sewer line appeared to be between 8 and 10 ft bgs. Cold weather conditions and large quantities of warm material running through the sewer caused significant water vapor to fill the sewer during scoping, which reduced visibility. The sanitary sewer was constructed of vitrified clay pipe (VCP) and appeared to be in good condition where visible (i.e. no cracks, seam issues, staining, or obvious defects). Pipe seams occurred every 4 ft, and were sealed with tar, though the presence of tar in individual seams varied; some seams contained tar for the entire length of the joint, and others would show tar only in a fraction of a joint. This did not appear to have an obvious effect on the integrity of the joint. A fracture was noted in the ceiling of the pipe at 38.0 ft west of the manhole 45-5 (Photo BSL 1 in Appendix B). This crack appeared to proceed beneath the sewage line in the sewer pipe (Photo BSL 2 in Appendix B) and may represent a potential pathway for contaminants in the sanitary sewer to reach surrounding soils. Beginning at approximately 74 ft west of manhole 45-5, and continuing to the junction with manhole 45-41 at 111.5 ft, an obstruction below the sewage line hindered movement of the remote camera. The nature of the obstruction was not identified (i.e. sediment, deterioration in the floor of the piping, debris, etc.). Manhole 45-41 appeared to be constructed of concrete. The rover could not proceed further, and the western scoping was terminated. Scoping was then conducted along the sanitary sewer from Manhole 45-5, at the intersection of 7th Street West and Central Avenue, east towards manhole 45-4, along Central Avenue (Figure 11-1 in Appendix B). Scoping was conducted for 130 ft, and no anomalous results were observed along the length of the piping.

Storm sewer scoping was conducted on November 8, 2017. The bottom of the storm sewer line appeared to be located between 8 and 10 ft bgs. Scoping began at manhole 45-42, which is in Central Avenue near the southeast corner of BSL property, and proceeded east towards manhole 45-20, which is located at the intersection of 7th Street West and Central Avenue (Figure B-1 in Appendix B-1). Storm sewer piping was constructed of 30-inch reinforced concrete pipe. Piping appeared in very good condition with no visible cracks, seam issues, pitting, staining, or obvious defects, and is presumably newer due to replacement by EPA in 2008. The reinforced concrete pipe was installed in 8-foot sections. Joints did not appear via internal scoping to be consistently sealed; however, discussion with City of Billings staff indicated that shoulder joints were typically connected with a gasket external to the pipe section that would not normally be visible. The pipe joint at 264 ft appeared to be separated significantly more than others within the pipe section, and may represent a potential pathway for contamination from the storm sewer to reach surrounding soils (Photo BSL 3 in Appendix B-2). No other anomalies were noted along the piping. Storm sewer piping was then scoped from manhole 45-20, near southeast corner of BSL property, towards 6th Street West. The piping in this section appeared to be older than the upstream section, as expected since EPA reports did not indicate replacing this section of

piping. This storm sewer piping was showing normal signs of wear and staining. Piping joints contained a visible tar or gasketing material throughout this section of piping, though the gasketing appeared to be worn away at times along the bottom of the pipe below the sewage line. It was not apparent if this wear had the potential to permit discharge from the piping at the joints in this older section of the line. The pipe sections were approximately 8 ft in length. Scoping was conducted for 120 ft, with no other anomalous observations.

After the DSR identified a major storm sewer directional change downgradient of the storm sewer in front of BSL, storm sewer scoping was also conducted at that location to assess the conditions of the sewer piping near the directional change. Sewer scoping was performed in the City of Billings right-of-way at 4th Street West, from manhole 44-36 north of the intersection of 4th Street West and Montana Avenue, and proceeding south towards Montana Avenue (Figure B-2 in Appendix B-1). The sewer appeared to be constructed of 36" concrete piping that had been formed by pouring concrete over a wooden slat form, indicative of historical piping construction methods. Piping was installed in 4-foot sections. The sewer scoping rover was only advanced approximately a few ft. The storm sewer piping appeared to "Y" beneath Montana Avenue, with a branch of the storm sewer proceeding beneath Montana Avenue towards the railyard (Photo BSL 4 in Appendix B-2). This split is not shown on City of Billings' storm sewer maps. The rover was not advanced far enough, during this section scoping, to determine if the "Y" was capped.

The storm sewer was then scoped from manhole 44-36 towards Cook Avenue to the north. Pipe joints appeared to be grouted, and may have potentially contained rebar reinforcement. Many of the joints showed signs of deterioration, including degraded concrete and rusting rebar. At 74 ft, a portion of the joint appears to have deteriorated concrete, a large crack, pitted concrete around the joint, and may show soil material beyond the crack (Photo BSL 5 in Appendix B). At 100.0 and 106.6 ft, exposed rebar and deteriorated concrete joints are present (Photo BSL 6 in Appendix B). At 113.4 ft, an obstruction was encountered that the rover could not bypass or move, and the scoping was terminated.

In March 2018, further scoping of the "Y" was attempted. However, upon opening the manhole, it was found to contain conduit and other piping, and scoping was not attempted. The scoping rover was unable to reach the "Y" from an upgradient manhole in 4th Street West, and the condition of the intersection remains unknown.

5.1.2.2 FORMER CENTRAL AVENUE LAUNDRY AND CLEANERS

Due to historic releases of PCE being associated with sewer piping, the sanitary sewer near former CAL was investigated. Sanitary sewer scoping was conducted on November 7, 2017. The sanitary sewer runs in the alley behind 1246 Central Avenue, connecting to a sanitary sewer main which transports waste north in Plainview Street, and then

connecting to the sewer main in Central Avenue (Figure B-3 in Appendix B-1). The sanitary sewer systems appeared to be between 4 and 6 ft bgs. Scoping began at manhole 46-35, approximately 100 ft west of former CAL, and proceeded east 360.2 ft to manhole 46-34, in South Plainview Avenue (Figure B-3 in Appendix B-1). Locations of notable features are measured from the entry point at manhole 46-35. The sanitary sewer piping was constructed of 8-inch VCP, installed in 4-foot sections. Each section appeared to be connected using a black rubber gasket. Gasket condition varied along the length of the sewer, and occasionally showed signs of intrusion from the subsurface (soil, insects, etc.) as well as signs of swelling and or warping (Photo CAL 1 in Appendix B-2). Other gaskets appeared to have experienced surface degradation resulting in small fragments of the gasket being deposited on the sidewalls of the piping (Photo CAL 2 in Appendix B-2). Crumbling degradation of the gasket material first begins to appear significantly around 106 ft and is significant for the next five joints. Service inlets connecting to the sewer main were located at 56.7, 75.1, 79.0, 137.4, 148.6, 209.9, 234.5, 270.3, and 291.3 ft from manhole 46-35. These inlets often appeared to be jointed to the sewer via fracturing of the sewer main and using a tar sealant to join the pipes, though some connections looked to be worn or in poor condition (Photo CAL 3 in Appendix B-2). Staining at the inlet was observed at 56.7 ft from the manhole. Hairline fractures were noted at 58.0, 94.4, and 188.6 ft from the manhole (Photo CAL 4 in Appendix B-2). Solid white deposits are also noted throughout the piping, intermittently at gaskets and on sidewalls. It is not clear if this is residue accumulating from sewage running through the piping (e.g. fats, oils, and grease deposition), or if it can be attributed to outside influences (i.e. deposition from groundwater intrusion) (Photo CAL 5 in Appendix B-2). The joint at 343.8 ft appears to be slightly more separated than most other joints, but could not be conclusively identified as a point of ingress/egress of the sewer line.

The sanitary sewer line in Plainview Street was scoped from manhole 46-34 northward towards the sewer main in Central Avenue (Figure B-3 in Appendix B-1). The sewer line appeared to be constructed of 12-inch VCP, connected in 4-foot sections. Gasketing material or sealants between individual pipe sections was not easily identified, though some appeared to contain tar in the seams. A significant quantity of the pipe joints appeared to have mineral deposition due to groundwater intrusion. This may suggest a conduit between the sewer piping and groundwater in the subsurface (Photo CAL 6 in Appendix B-2). The joint at 35.4 ft from manhole 46-34 appeared to be separated more than other joints, with minimal sealant and pervasive mineral deposition (Photo CAL 7 in Appendix B-2). The joint at 84.6 ft also appeared to be quite wide, though mineral deposition was not obvious along the joint. An obstruction was encountered below the sewage line at 96 ft and the scoping was terminated.

5.1.2.3 FORMER REX CLEANERS

Similar to other potential PCE release locations, the sewer conditions near former Rex Cleaners were investigated. Sanitary sewer line scoping was conducted at former Rex on November 7, 2017. Scoping was conducted in the alley

between 19 S. Broadway and 18 S. 27th Avenue (the east alley), as well as in the alley between 19 S. Broadway and 2720 Minnesota Avenue (the north alley). The sanitary sewer in the east alley was scoped from manhole 9-3 south towards 1st Avenue South (Figure B-4 in Appendix B-1). The sewer line was constructed of 8-inch VCP, connected in approximately 2-foot sections. The sanitary sewer systems appeared to be between 6 and 8 ft bgs. Gasketing material or sealants connecting the pipe sections were not readily apparent or appeared to have been degraded over time. The general condition of the VCP was poor, with significant cracking throughout the piping and signs of intrusion from the subsurface into the pipeline. Large cracks, typically greater than ¼-inch wide by 4-6 inches long, were observed throughout the piping (Photo REX 1 in Appendix B-2). Service inlets did not appear to consistently have a sealed connection to the sewer line (Photo REX 2 in Appendix B-2). Joints in the piping appeared to be quite separated at 19.0, 21.3, 27.5, 29.5, 56.7 ft (Photo REX 3 in Appendix B-2). Some dark staining appeared to be present on the ceiling of the piping at 27 ft (Photo REX 4 in Appendix B-2). At 28.2 ft, an active or formerly active sewer inlet connects to the system. It features a joint which appears to be separating, as well as a long crack which may pass through the body of the piping (Photo REX 5 in Appendix B-2). A large fracture is apparent in the pipe ceiling at roughly 39.7 ft, where service inlets were attached to the pipeline (Photo REX 6). Similar damage is also observed at the service line inlet at 48.5 ft, where a fracture from the service inlet extends all the way around the sewer main, passing below the water line (Photo REX 7 in Appendix B). Similar significant fracturing is also observed at the sewer inlet at 65.6 ft. At 78 ft, a service inlet appears to be obstructed, and possibly separated from the main sewer line, allowing solids and potentially liquids to enter/leave the sewer service line (Photo REX 8 in Appendix B-2). A solid obstruction at approximately 80 ft prevented further scoping of the sewer line.

On March 8, 2018, access to the sanitary sewer through manhole 9-2 in 1st Avenue South was coordinated with MDT. The sewer line was scoped from manhole 9-2 northwest towards manhole 9-3 (Figure B-4 in Appendix B-2). The sewer line was constructed of 8-inch VCP, connected in approximately 2-foot sections. Gasketing material or sealants connecting the pipe sections were not readily apparent or appeared to have been degraded over time. Some small, largely superficial cracking was observed in the pipe surface. At 41.0 ft, pipe discharges were observed at either side of the pipe, which appeared to be occluded with waste (Photo REX 9). Similar discharges at 82.8 ft were also obstructed with waste. The solid obstruction previously encountered was found at 87.0 ft. The obstruction was partially removed from the wall of the pipe by the scoping rover, but the scoping rover could not fully get past the obstruction. Scoping of the sewer line to the north was terminated. Scoping was then performed beginning at manhole 9-2, proceeding southeast towards Meadow Gold Dairy (Figure B-4 in Appendix B-1). At approximately 3.2 ft, a portion of the clay pipe appeared to be fractured below the sewage line (Photo REX 10 in Appendix B-2). At 22.6 ft, a long crack was observed along the ceiling of the VCP pipe (Photo REX 11). At 30.8 ft, a series of longitudinal and circumferential cracks appear in the piping, culminating in a break in the piping where soil was visible on the other side of the crack (Photo REX 12 in Appendix B-2). A fracture in the lip of a VCP pipe section was observed at

approximately 63 ft, just beyond a series of active pipe inlets. Piping inlets at 89.9 ft appeared to be occluded with waste. A potentially poorly connected pipe joint was observed at approximately 93 ft. At 98 ft, a fracture in the lip of a VCP pipe section was observed (Photo REX 13 in Appendix B-2). A potentially separated pipe inlet was observed at 114.5 ft. An actively flowing, and potentially damaged sewer inlet was observed at 139.7 ft (Photo REX 14 in Appendix B-2). Scoping was terminated at 150 ft.

The sanitary sewer line running in the north alley was scoped for 100 ft from manhole 9-83 towards manhole 9-82 to the southwest (Figure B-4 in Appendix B-1). The material of construction was identified as 12-inch ductile iron piping, with a grouted lining. The piping was connected in 16-foot sections. The general condition of the piping appeared to be good, with some degradation appearing near pipe joints and sewer service inlets. Gasketing or sealant at the joints was not readily identifiable in all cases, though a tar sealant appeared to be present on at least one set of joints. The joints within the pipe section scoped showed signs of rusting, though it is unclear if this deterioration is structural or superficial. Two sewer service inlets located approximately 2 ft and 3.6 ft from manhole 9-83 showed significant signs of deterioration of the grouted lining of the piping, with the ductile iron structure of the piping exposed and the presence of rust quite identifiable. No significant abnormalities or potential locations for discharge to the subsurface were identified.

Storm sewer scoping was conducted on November 8, 2017 in the vicinity of the former Rex Cleaners. Scoping began at manhole 9-79 in South 28th Street and proceeded southeast towards manhole 9-133 (Figure B-4 in Appendix B-1). Storm sewer piping was constructed of 18-inch polyvinyl chloride (PVC). The storm sewer systems appeared to be between 8 and 10 ft bgs. Piping appeared in very good condition. The PVC pipe was installed in 15-foot sections. Joints appeared to be tightly fitted, though no signs of sealant or gasket were visible on the interior of the piping. Scoping was conducted for 136 ft, and was terminated at manhole 9-133. No signs of abnormalities or defects in pipe integrity were noted.

5.1.3 UTILITY CLEARANCE

During the course of subsurface soil, groundwater, and vapor investigations, approximately 205 penetrations into the subsurface were performed, including MiHPT probes, groundwater screening probes, subsurface soil borings, alluvial monitoring well installations, bedrock well installations, and subslab soil vapor sample probes. To advance each of these investigation points safely and mitigate the risk associated with subsurface utility strikes, Trihydro and its subcontractors coordinated with the Montana One-call system and requested public-utility locates for each investigation location. As another layer of safety, a private utility locating service was secured to aid in tracing

potentially unmapped or mis-recorded utility corridors on private property, and which were located outside of the areas served by public utility companies.

In areas where utility locates indicated that proposed investigation areas were within 20 ft of an energized line and could be moved to still meet data objectives, the sample point was moved to a less encumbered location. On four occasions, when an investigation location could not be moved, or private records were too sparse to provide adequate knowledge of an investigation area, a vac-truck subcontractor was brought onsite to pothole excavations to a depth of about 8 ft prior to completing the investigation activity. At one location where the property owner was not sure of utility corridors potholing revealed a communications bundle on the property that was unmarked and unknown to the property owner. The proposed location of MW-135 was moved, potholing was performed again, and utility lines were avoided.

Investigation activities conducted during the winter of 2017-2018 were impacted at various times by inclement weather. When snow cover occluded utility marks, utilities were re-located and/or investigation activities were rescheduled to permit remarking of the utility location or observation of the utility markings.

5.2 GROUNDWATER MONITORING AND WELL INSTALLATION

The RI groundwater investigation was developed to address the data gaps identified in the DSR (Trihydro 2017a) specifically related to current plume delineation and residual source investigation. Prior to RI groundwater monitoring activities, wells in and near the Facility were evaluated during a monitoring well survey and inventory (Section 5.1), and a smaller number of the existing 280+ wells were selected to meet data gaps and objectives outlined in the RIWP (Trihydro 2017b). This included some existing wells based on their spatial location area, depths, and past historic PCE concentrations. However, additional areas were identified where there were no appropriate existing wells to meet data objectives. In areas without appropriate monitoring wells, the RIWP identified a direct push PCE screening plan to establish an optimal location for additional well installation. This section discusses the groundwater sampling events, the direct push screening activities, and the monitoring well installation. RI plume delineation activities involved sampling existing monitoring wells and installation/sampling of new monitoring wells to support evaluation of the footprint in which groundwater concentrations exceed applicable standards. Residual or unknown source characterization data gaps were addressed through installation/sampling of new monitoring wells in bedrock to evaluate the potential for vertical contaminant transport through overlying unconsolidated deposits.

Site-wide groundwater sampling from EPA-installed wells was last reported to DEQ from the 2015 sampling event, and no holistic groundwater monitoring events to date had been conducted to establish a CSM of contamination across

BSL, former CAL, and former Rex. EPA staff conducted groundwater monitoring on-site in August 2017, but data was not acquired at the time of this report release. Available EPA groundwater data was limited to the EPA wells and investigation areas; therefore, the ability to evaluate contaminant fate and transport, changes in plume shape and orientation, temporal/seasonal variations, and the effects of interim remedial actions at peripheral areas was limited. Furthermore, the EPA well network focused on highest concentration areas near BSL and within the 2008 identified plume area and did not look at distal areas where applicable SLs were likely exceeded, but not at the levels observed in the BSL area. To help address select data gaps (understanding contaminant fate and transport, changes in plume shape and orientation, temporal/seasonal variations, and the effects of interim remedial actions), three quarterly groundwater sampling and fluid-gauging events were conducted (July 2017, May 2018, and September 2018) during the RI. Results for the groundwater monitoring events are presented in Section 9. The individual monitoring events are explained in detail below.

5.2.1 INITIAL GROUNDWATER MONITORING EVENT (JULY 2017)

The objective of the initial groundwater sampling event in July 2017 was to evaluate the current nature and extent of groundwater contamination. Data from this sampling event was used to locate borings and monitoring wells needed to further delineate the extent of groundwater contamination exceeding standards as well as additional potential source zone evaluations. After the monitoring well survey and data gap evaluation, an initial groundwater sampling network was established to meet RIWP groundwater DQOs as described in the July 2017 Groundwater Sampling Memo (Appendix C). For the July 2017 monitoring event, groundwater samples were collected from 88 groundwater monitoring wells. The groundwater samples were analyzed for a range of constituents including VOCs, SVOCs, VPH/EPH, metals, and MNA parameters. A groundwater sampling memo, describing the sampling activities and the rationale for each sample, is included in Appendix C. Groundwater analytical results are included in groundwater analytical results tables in Section 9, organized by analyte type.

5.2.2 DIRECT PUSH GROUNDWATER SCREENING

The intent of the RI direct push groundwater screening sample activities was to provide a rapid-turnaround reading of PCE concentrations in the field, to allow step-out or step-in sampling and well installation decisions, while drilling subcontractors were on-site. To identity Facility areas that needed groundwater screening samples because the existing monitoring well network did not delineate the plume, Trihydro evaluated the analytical data from the initial RI groundwater monitoring event (July 2017) and developed a plan as detailed in the RIWP and shown on RIWP Figure 8-1 (Trihydro 2017b). The preliminary evaluation identified six regions of the groundwater plume where groundwater concentrations had not been investigated or delineated. Within these six regions, a total of 22 sub-areas were selected for direct-push groundwater screening, and potential placement of permanent groundwater monitoring

wells. At 19 of these locations, the PCE groundwater concentration in the nearest adjacent or upgradient monitoring well exceeded the DEQ-7 groundwater standard of 5 µg/L, and the target was to install wells that could help establish where the 5 µg/L groundwater concentrations exist. While the objective was to locate the 5 µg/L PCE boundary, PCE concentrations between approximately 0.1 and 10 µg/L were considered adequate for the purposes of plume delineation.

The analysis of the July 2017 groundwater data also aided in identifying four additional potential source areas: the former Rex; ALSCO Cleaners; HLS; and Wetzel's Cleaners, which needed additional groundwater screening in order to establish if they were potential contributing sources within the Facility. The screening samples associated with these potential source locations are described in Section 8 of the RIWP (Trihydro 2017b) and Section 8 of this RI Report.

Step-out sampling involved the collection of groundwater samples from temporary soil borings using Geoprobe® direct-push techniques, e.g., through use of an SP16 sampler or a temporary monitoring well with a screen. Groundwater samples were generally collected from two locations within each of the rectangular areas shown on Figure 8-1 of the RIWP with the two locations representing the opposite ends of the rectangular areas indicated for each step-out sample (i.e., inside and outside of the inferred plume boundary). Table 5-1 shows the number of samples per location and results of the PCE screening. In 13 of the 22 planned delineation sub-areas, 2 groundwater screening samples were collected as planned. In 5 of the 22 planned delineation sub-areas, one groundwater screening sample was collected since it met the criteria of delineating the plume at or near the 5 µg/L PCE SL, so no additional step-out was necessary. At the 4 remaining sub-areas of the 22 planned, more than 2 groundwater screening results were obtained since the PCE analytical results were above 10 µg/L PCE level for multiple step-outs. These four areas included the following:

- 2A and 2C regions, which are both upgradient of former CAL (grids -12,-6 to -7,-1)
- 2B region, which is along Central Avenue between the former CAL and BSL source areas (grids 6,-1 to 5,1)
- 4B region, which is on the south side of the rail corridor where State Avenue meets 1st Avenue South (grids -2,-3 to -2,1)

During field investigations, screening samples were also collected from three irrigation wells (REGAL-I-01, PAI-EAST and PAI-WEST) upgradient of CAL, four downgradient wells located at the Phillips 66 refinery (OR-4, R-1W, R-24 and R7-WC), and four monitoring wells installed during winter 2018 (MW-112, MW-113, MW-114, and MW-115) near former Rex. A screening sample was also collected from an existing monitoring well at SYSCO foods (SYSCO-1), which was later sampled during the groundwater sampling events as SYS-EMW-03. These samples were

collected to support further delineation of the groundwater PCE plume, and identify appropriate locations for permanent monitoring well installation, as necessary.

Direct-push groundwater screening was conducted from November 28 through December 21, 2017 and from February 6 through April 25, 2018. A 3-foot saturated interval, immediately below the water table, was targeted for the depth of the groundwater sampling to minimize influence of the open boring on VOC concentrations. Direct-push samples were collected by driving a well screen down to a point approximately 3 ft below the water table using a direct-push sampling rig or using a Geoprobe® SP16 sampler, to create a temporary monitoring well at each sub-area. Disposable ¼ in Teflon-lined low-density polyethylene (LDPE) tubing was then connected to a peristaltic pump with approximately 4 inches of silicone tubing in the peristaltic pump rotary head and the ¼ in Teflon LDPE tubing was lowered down to the well screen. The use of peristaltic pumps for low-flow sampling of VOCs is discouraged, however, DEQ allowed a peristaltic pump to be used because the data was used for field screening purposes to assist with placement of permanent monitoring wells. The screened interval was typically from 19 to 23 ft bgs, and the pump inlet was usually set approximately 1 foot above the bottom of the screen. Because the step-out samples were conducted at temporary points in order to identify more-permanent monitoring well installation locations, water quality parameters were not recorded; however, low-flow sampling protocols were followed to the extent practicable (i.e. groundwater pumping rates were kept below 300 milliliters per minute [ml/min]) and at least three boring/well volumes of groundwater were purged prior to sampling, typically around 1-2 gallons of purge water per well.

Groundwater screening samples were collected and hand-delivered to Pace Analytical Laboratory in Billings, Montana for analysis for PCE using a modified EPA method 8260, which reported only the PCE concentration, with limited field or laboratory quality assurance/quality control (QA/QC) protocols, to minimize turnaround time and sample cost. The limited QA/QC met the quality needed and intent of the screening samples to provide a rapid-turnaround reading of PCE concentrations in the field, which allowed step-out or step-in sampling or well placement while drilling subcontractors were on-site. These “rush” screening sample results were typically available within 24-36 hours. The rush turn-around-time allowed for quick field decisions so that in areas where groundwater screening samples contained PCE at concentrations greater than 10 µg/L, a step-out location was identified (to the extent practicable), utility locates were coordinated, and an additional sample was collected. In locations where screening samples did not contain detectable PCE (i.e. PCE concentrations less than the 1 µg/L reporting limit [RL]), a step-in location was identified (to the extent practicable), utility locates were coordinated, and an additional sample was collected.

Sixty-nine groundwater samples were collected for rapid PCE screening over the course of the direct-push investigation. In some identified locations, Trihydro was unable to access the property to collect samples or met

equipment refusal before reaching groundwater. Groundwater screening results are presented in Table 5-1, and locations along with PCE analytical results are shown on Figure 5-1.

5.2.3 MONITORING WELL INSTALLATION

5.2.3.1 ALLUVIAL MONITORING WELL INSTALLATION

Using analytical data from the July 2017 groundwater event and PCE screening data as described in Section 5.2.2, Trihydro identified locations to install additional permanent groundwater monitoring wells. The objective of these wells was to establish the approximate location of the <5 µg/L groundwater dissolved-phase PCE plume boundary, and/or to provide better delineation of potential source-area groundwater concentrations. Thirty-three alluvial groundwater monitoring wells were installed in general accordance with drilling, well construction, and development procedures outlined in Section 4.1 of the Sampling and Analysis Plan (SAP) (Appendix A of the RIWP) (Trihydro 2017b). In addition, two bedrock wells were installed near BSL in general accordance with drilling, well construction, and development procedures outlined in Section 4.1 of the SAP. Monitoring wells associated with the plume boundary were installed with the objectives of delineating the groundwater plume and providing permanent locations to monitor plume migration over time. Bedrock wells installed near BSL are intended to supplement existing monitoring wells with deeper screened intervals placed entirely in the underlying shale bedrock. Well logs with lithology and well construction details are included in Appendix A.

Alluvial wells were drilled by a truck-mounted drill rig using hollow-stem auger (HSA). Continuous soil sampling was performed by an auger-leading split spoon containing a disposable acetate sleeve. A geologist examined the soil samples and recorded observations on a field log (Appendix E). Once the borings were advanced to their desired depths, wells were constructed and completed as follows:

- Wells were constructed using 2-inch inside diameter, 10-foot long, 0.010-inch slotted), schedule 40 PVC screen coupled with 2-inch inside diameter, schedule 40 PVC riser in 10-foot lengths to achieve the desired well depth. The well was capped at the bottom with a schedule 40 PVC end sump and fitted with a 2-inch J-plug at the top to cap.
- The well was inserted within the HSA and placed at a target depth of approximately 3 ft above and 7 ft below the water table.
- Once the well was placed at the target depth the augers were retracted while the drillers placed a sand pack by slowly pouring sand bags (10/20 silica) into the annulus created by the interior of the auger and the 2-inch PVC well. The sand pack extended from the total depth (TD) of the boring to approximately 2 ft above the top of the screen interval.

- 3/8-inch bentonite chips were then added above the sand pack, and extended to the bottom of the flush-mount well cover, to create the bentonite seal. The bentonite chips were hydrated with potable water, in lifts, during placement.
- The well was fitted with a 2-inch J-plug at the top, and an 8-inch diameter, flush-mount surface completion (cover) was positioned so as to promote drainage away from the wellhead housing. The flush-mount well cover was set in place with concrete and labeled with the well designation.

Note: MW-113 was constructed with a hydrated bentonite seal having a thickness less than 2 ft and a sand pack extending only 1.5 ft over the top of screen. The well was construction to these specifications due to the shallow groundwater at that location.

5.2.3.2 BEDROCK MONITORING WELL INSTALLATION

Two borings were advanced into bedrock in the area of BSL to assess the competency of the alluvial deposit / bedrock interface, identify the presence or absence of DNAPL at the alluvial deposit / bedrock interface, and to identify the presence or absence of dissolved phase constituents in bedrock groundwater.

Bedrock monitoring wells were drilled by a truck-mounted drill rig using HSA adapted with air rotary capability. Continuous sampling through the alluvial deposits was performed using an auger-leading split spoon containing an acetate sleeve. Recovery of hammered lead split spoon samples at the bedrock surface was poor due to the competency of the bedrock. A field geologist examined the samples during drilling and recorded observations on field logs (Appendix E). In order to help ensure the borings did not provide a conduit for contaminants in the alluvial aquifer to migrate downward into the bedrock, an outer “conductor” casing was seated into the bedrock before further bedrock drilling was advanced and bedrock wells were installed. Installation of the borings, conductor casing, and bedrock wells were conducted as follows:

- A 12-inch outside diameter auger was advanced through the alluvial aquifer to a point approximately 2-ft below the bedrock surface. A 6-inch inner diameter, schedule 40 PVC conductor casing constructed in 10-ft threaded sections, was cut to the desired length for each well and was installed in the augers.
- The conductor casing was seated into the bedrock and grouted in place to seal the water-bearing alluvial aquifer from the underlying bedrock well. The grout was installed outside of the conductor casing, and consisted of 3/8-inch hydrated bentonite chips at the base of the conductor casing for approximately 3 linear ft followed by Type I/II mixed Portland cement slurry from the top of the bentonite seal to approximately 2 ft bgs. The casing

was left in place to cure for more than 72 hours before continuing drilling through the conductor casing into the bedrock below.

- Once the conductor casing seal was cured, water was removed from within the conductor casing and drilling into bedrock was continued using 5-inch augers to the desired well depths.
- Bedrock coring was performed using a 7.57 cm outside diameter and 4.76 cm inside diameter (NQ sized) wireline coring system with a diamond impregnated coring bit. The core barrel assembly consisted of the core barrel and an overshot component. The core barrel assembly was split barrel, 5 ft in length, 3.125-inch outside diameter/ 1.980-inch inside diameter, advanced in 5-foot intervals with rotation from the drill head and the borehole cleared using an air compressor. Upon completion of the 5-foot interval the wireline attached to the overshot assembly was used to retrieve the 5-foot core barrel assembly.
- Bedrock wells were constructed using 2-inch inside diameter, 5-foot long, 0.010-inch continuous wrap, Type 304 stainless steel screen coupled with 2-inch inside diameter, Type 304 stainless steel riser in 10-foot lengths to achieve the desired well depth. The well was capped at the bottom with a stainless steel end cap and fitted with a 2-inch J-plug at the top.
- The wells were inserted within the HSA and placed at a target depth below the bedrock surface. MW-126 and MW-127 were terminated 9.5 and 17.0 ft, respectively, into the bedrock.
- Once the well was placed at the target depth the augers were retracted while the drillers placed a sand pack by slowly pouring sand bags (10/20 silica) into the annulus created by the interior of the auger and the 2-inch stainless steel well. The sand pack extended from the TD of boring to approximately 2 to 5 ft above the screened interval, but did not extend to the alluvial deposit / bedrock interface.
- 3/8-inch bentonite chips were then added above the sand pack, and extended to the bottom of the flush-mount well cover, to create the bentonite seal. The bentonite chips were hydrated with potable water, in lifts, during placement.
- The well was fitted with a 2-inch J-plug at the top, and an 8-inch diameter, flush-mount surface completion (cover) was positioned so as to promote drainage away from the wellhead housing. The flush-mount well cover was set in place with concrete and labeled with the well designation.

Appendix A includes boring logs with well construction details for the bedrock wells MW-126 and MW-127.

5.2.4 MAY 2018 GROUNDWATER MONITORING EVENT

The second of the groundwater monitoring events was conducted in May 2018. Groundwater samples were collected from 105 groundwater monitoring wells, including previously existing wells and recently installed monitoring wells. Groundwater samples were analyzed for a range of constituents including VOCs, SVOCs, VPH/EPH, polychlorinated biphenyls (PCBs), metals, and MNA parameters. Fluid levels, potentiometric surface data, field parameters, and analytical groundwater results are presented in Section 9.

5.2.5 SEPTEMBER 2018 GROUNDWATER MONITORING EVENT

The third and final monitoring event was conducted in September 2018. Groundwater samples were collected from 106 groundwater monitoring wells, including older existing wells and recently installed monitoring wells. Groundwater samples were analyzed for a range of constituents including VOCs, SVOCs, VPH/EPH, metals, and MNA parameters. Fluid levels, potentiometric surface data, field parameters, and analytical groundwater results are presented in Section 9.

5.3 SOURCE AREA SOIL INVESTIGATION (DIRECT PUSH SOIL SAMPLE AND MIHPT)

The source area soil investigation was conducted to evaluate known and potential source areas via high-resolution data collection and corresponding soil sampling for laboratory analysis to assess if soils are a potential source of contamination at the Facility. The high-resolution techniques employed a tool that combines membrane interface probe (MIP) and HPT denoted as MiHPT. The combined MiHPT probe is advanced downward through the subsurface through a target interval to provide continuous data profiles related to contaminant distribution and aquifer permeability. At select locations, soil cores were collected for geologic logging and correlated soil sampling in conjunction with MiHPT data. A summary of MiHPT investigation locations and soil sample intervals is provided in Table 5-2. This section describes methods employed for MiHPT investigation, soil core collection, and related soil sampling activities. In addition, summaries of soil investigation activities for each known or potential source area, including deviations from the RIWP, are provided.

5.3.1 MIHPT METHODS

The MiHPT evaluation was conducted by Dakota Technologies (Dakota) between November 13 and December 20, 2017. The MiHPT system utilized a Geoprobe® direct push rig to advance the combined MIP and HPT device through the subsurface. The MiHPT also has an electrical conductivity (EC) detector to gather additional lithology/subsurface data. The MiHPT is advanced into the subsurface and provides continuous data on VOCs versus depth via the MIP detector. The MiHPT direct push logging tool consists of a subsurface probe and aboveground analytical system that

combines MIP, HPT, and EC data collection into one subsurface boring push. MiHPT methods and data analysis are provided in a technical memorandum (Appendix D).

5.3.2 KNOWN AND POTENTIAL SOURCE AREA SOIL SAMPLING

Surface and subsurface soil sampling was conducted to collect quantitative soil analytical data and aid in interpretation of MiHPT data. Confirmatory soil samples were obtained from soil cores, collected using direct push methods from locations as near as possible to the associated MiHPT point. Soil cores were inspected, logged, and sampled, as described in Section 3 of the SAP (Appendix A of the RIWP) (Trihydro 2017b). Standard confirmatory sampling was conducted at a target of 15% of locations; an additional 5% of locations were selected for high-resolution sampling. Standard confirmatory sample locations were selected to provide spatial variability and to provide data contaminant profile data specific to CVOCs. Standard confirmatory soil samples were typically collected from at least two depth intervals, including one surface (0 to 0.5 ft bgs) and one unsaturated-zone subsurface (location-specific depth intervals were determined based on MiHPT data) interval; additional depth intervals were sampled from select locations on an "opportunistic" basis where photoionization detector (PID) readings or visual observations consistent with contamination (i.e. staining, odor, etc.) were observed by the field personnel. Typically, standard confirmatory samples were analyzed for VOCs. To characterize a wider variety of analyte concentrations in the identified source areas high-resolution confirmatory samples were analyzed for a larger suite of analytes including VOCs, SVOCs, EPH, VPH, and metals. High resolution samples were also collected from at least six depth intervals per boring based on the lithology and saturation of the soil boring as follows:

- A surface soil sample at 0-0.5 ft bgs
- A surface soil sample at 1-2 ft bgs
- A low-concentration unsaturated subsurface soil zone interval
- A high-concentration unsaturated subsurface soil zone interval
- A low-concentration saturated subsurface soil zone interval
- A high-concentration saturated subsurface soil zone interval

The locations for standard and high-resolution confirmatory soil sampling were selected based on preliminary evaluation of the MiHPT field data. High-resolution analysis focused on locations with elevated MIP responses, particularly at or below the water table.

5.4 VAPOR INTRUSION SAMPLING

VI sampling was conducted during February and March 2018, which presented a 'worst-case' scenario for evaluating risks to building occupants from VI. VI samples were collected from indoor air, subslab air, crawlspace air, and ambient air.

VI samples were collected as described in Section 7 of the SAP (Appendix A of the RIWP) (Trihydro 2017b). Indoor and crawlspace air samples at residential locations were collected in individually clean-certified 6-liter (L) Summa® canisters with corresponding individually clean certified 24-hour flow controllers. Indoor air samples at commercial locations were also collected in individually certified 6-L Summa® canisters but with corresponding individually clean certified 8-hour flow controllers. Subslab air samples at both residential and commercial locations were collected in individually clean-certified 6-L Summa canister with corresponding individually clean certified 30-minute flow controllers. Ambient air samples were collected on the same days that VI samples were collected. Ambient air samples were collected in individually clean-certified 6-liter (L) Summa® canisters with corresponding individually clean certified 24-hour flow controllers. The starting and completion times, initial and final vacuum for each Summa® canister, sample IDs, and readings were recorded in the field documentation. The VI field documentation forms were acquired from the Montana VI Guide (DEQ 2011). VI Sample results were compared against EPA Regional Screening Level (RSL) Industrial and Residential Air Standards and DEQ Generic APH Fraction SLs.

The VI work plan addendum memo (Trihydro 2018), proposed 18 properties in phase I of the VI sampling, 16 properties in phase II, and 8 properties in phase III for 42 properties where other environmental data indicated potential for VI. During the sampling efforts, Trihydro and DEQ contacted additional property owners across the Facility to obtain access for VI sampling. The total number of VI sampling locations was expanded to 49 locations, to better evaluate the extent to which VI is occurring throughout the Facility.

5.5 STORMWATER/SURFACE WATER AND SEDIMENT SAMPLING

Two stormwater sewer utility systems intersect the Facility: the City/County Drain and the Suburban Ditch. The City/County Drain crosses the Facility from north to south as it runs under South Plainview Street east of former CAL. The Suburban Ditch enters the Facility from the south near BSL and flows north and east before joining the City of Billings storm sewer system at the intersection of Central Avenue and Montana Avenue. The sediments and water in both the Suburban Ditch and the City/County Drain were not previously characterized. Both upstream and downstream sediment samples were collected as part of the RI to identify the extent of potential sediment contamination and probable points of entry for the contaminants. Results and figures are presented in Section 11.

The stormwater system is comprised of irrigation ditches, underground drains, and streams. Water in the stormwater system is made up of surface water from sources such as the Yellowstone River and local irrigation ditches and streams, as well as precipitation runoff that travels overland to the ditches or is collected by the storm sewer system infrastructure. The City/County Drain travels at the surface in the form of a stream in a public park near sample location CC-1. The stream is accessible to the general public. The City/County Drain is an underground, concrete culvert and accessible only by utility workers near sample location CC-2. The Drain is underground for the majority of the distance from CC-1 to CC-3. At CC-3 the City/County Drain surfaces to an irrigation ditch. The irrigation ditch is lined by berms and is difficult to access but may be accessible to workers. The Suburban Ditch near sample location SD-3 flows through a park that is accessible to the general public. Between sample points SD-1 and SD-4, the Suburban Ditch is in the underground stormwater collection system for the City of Billings. Water in this portion of the Suburban Ditch is only accessible to workers. From SD-4 to the Yellowstone River, the Suburban Ditch is an open channel in an industrial area. Access to the public is limited, however the Ditch could be accessed by workers.

5.6 POST-INVESTIGATION EVALUATIONS OR REPAIRS

Direct-push investigation activities consisted of driving an approximately 2-inch outside diameter sampling rod through the ground surface into the subsurface. In unpaved locations, the sample probe was driven through the surface cover of grass or soil, and abandoned with hydrated bentonite chips. The bentonite was added in approximately 1-2 foot lifts, and extended from the bottom of the penetration to ground surface. In locations where the surface was completed with asphalt, the probe was driven through the asphalt.

Where direct-push investigations were conducted in asphalt surface completions, the boreholes were abandoned with hydrated bentonite chips from the bottom of the borehole to approximately 6 inches bgs. Bentonite chips were hydrated in 1-2 foot lifts. The final six inches of the borehole were backfilled using cold-patch asphalt. Hot-patch asphalt was not available during the November 2017-March 2018 investigation period, as the hot-patch asphalt plants shut down for the winter. Cold-patch repairs to the asphalt were used as an interim measure, until hot-patch repairs could be scheduled in summer 2018. Hot patch repairs took place on July 31, 2018. A total of 18 borehole locations were hot patched; 5 were patched at 711 Central Avenue and 13 locations were patched at former Rex. Patching of boreholes consisted of using a skid steer-mounted mill machine to remove asphalt in an approximately 1 foot by 1 foot square down to subgrade. In a few areas, a larger area was milled to patch 2 closely located boreholes. The milled locations were first treated with a tack coat binding emulsion, refilled with hot asphalt, and compacted using a gas-powered plate compactor. Seal coat is not added to asphalt patches for at least a year.

Monitoring wells were completed as flush-mount wells, in accordance with the monitoring well construction diagram included in Figure 2 of the Alluvial Well Rationale Memo (Trihydro 2017b). To create monitoring well surface completions in asphalt (typically in City of Billings rights-of-way), the installation subcontractor made a square cut in the asphalt, removed the asphalt square, and installed the well. The opening around the well was then backfilled with a concrete apron. Monitoring wells installed in surfaces not completed with asphalt, were also finished with a concrete apron sloping away from the well lid, to reduce the potential for standing water above the well vault.

Subsurface vapor sampling points were installed at 22 locations during the VI investigation. Each location was installed as a permanent monitoring point by drilling through the concrete floor with a ¾-inch hammer drill. The top ~1 inch of the hole was then widened using a 1 ¼-inch hammer drill to allow the sample fittings to sit mostly below the concrete surface, to minimize inconvenience and tripping hazards to building occupants. Teflon tubing was then used to create a sample probe that was attached to a brass or stainless-steel compression fitting. The fitting was inserted in the hole so that only the amount necessary to open and close the fitting was exposed. The sample port was completed by filling the bottom of the hole with 10/20 silica sand, up to the underside of the slab, followed by hydrated bentonite clay to approximately 2 inches below the surface of the concrete. The final 2 inches of the boring, including the space around the sample fitting, was finished with quick-set concrete, and levelled. The port was closed with a removable brass or stainless-steel cap or plug.

Monitoring well EMW-09 at Taylor's Choice Auto was observed to be missing its lid during the May 2018 sampling event. Trihydro attempted to procure a replacement lid from the drilling subcontractor; however, the contractor could not locate a lid that would fit the vault correctly. Several previously installed wells have non-traditional completion methods, such as a PVC cap set directly in asphalt with no apron or vault, a steel threaded plug tapped into a blank socket-weld cap, and a PVC cap loose-fit into a concrete sidewalk with no vault or apron. Trihydro did not modify or repair wells installed and operated by other entities.

5.7 DECONTAMINATION

Non-disposable drilling equipment, such as direct push rods, drill augers, and bits were decontaminated between each well or boring location. Initial steps for decontamination involved the removal of any bulk soil stuck to equipment. Equipment was then rinsed with an Alconox solution or pressure washed before being final rinsed with clean potable water.

Non-disposable sample equipment (bladder pumps) were decontaminated by washing disassembled parts in an Alconox solution. Pump parts were then double rinsed in distilled water before being reassembled with a new bladder for each well.

Decontamination water was collected and containerized as discussed in Section 5.10.3.

5.8 ADDITIONAL RECORDS REVIEW

Groundwater screening and analytical results obtained during the RI suggest there are potential additional contributions to the groundwater contaminant plume both upgradient of former CAL, and downgradient of former Rex. These locations are outside of the area previously evaluated during the DSR (Trihydro 2017a). Trihydro staff reviewed additional records from the EDR report, which can be found in Appendix A of the DSR. Trihydro also used DEQ's data mapping tool at http://svc.mt.gov/deq/wmadst/default.aspx to evaluate potential contaminant contributions from other CECRA sites, LUST facilities, and hazardous waste generators.

Trihydro reviewed potential source areas upgradient of former CAL and identified 25 potential sites or releases for further evaluation. Potential solvent storage was identified in a former UST at the SYSCO foods distribution facility at 1509 Monad Road. An existing monitoring well (SYS-MW-03) was identified and added to the groundwater sampling schedule, and a new monitoring well (MW-130) was installed in the presumed downgradient direction from SYSCO. The purpose of these wells was to identify potential contaminant contributions to the PCE groundwater plume upgradient of former CAL.

Trihydro also identified two additional locations for potential contributions to the CVOCs plumes downgradient of former Rex:

- Midland West Manufacturing at 2224 Minnesota Avenue – Potentially a former metal fabricator's location. According to the EDR, the operation may have used PCE. No violations or releases were reported. It is located adjacent to (and slightly downgradient of) MW-115, and was a RCRA conditionally exempt small quantity generator (ID 1001124339 or MTR000003053).
- Former Pacific Hide & Fur at 2517 Minnesota Avenue – A medium priority CECRA site, identified for potential metals and petroleum compound contaminants. This site is located between former Rex and MW-115, along the assumed groundwater gradient.

Other upgradient operations include Suhr Transport at 2302 Minnesota Avenue, Billings Pipe & Pump (former UST site, Facility ID 5607474) at 2424 Minnesota Avenue, Star Development Company at 2408 Minnesota Avenue,

American Appliance Company at 2417 Minnesota Avenue, and property owned by MRL. An unidentified cleaner was also identified on the 1923 Sanborn map, in the region of the former Pacific Hide & Fur operation. Three monitoring wells were installed downgradient of these potential sources (MW-132, MW-133, and MW-134), in addition to the originally planned downgradient former Rex property well (MW-115).

5.9 SURVEYING

The existing monitoring wells were surveyed by a licensed surveyor in September 2017. New RI monitoring wells were surveyed in May 2018. The top of casing (TOC), ground elevation, and easting/northing were established in relation to the nearest permanent benchmark (i.e., United States Coast and Geodetic Survey (USCGS), United States Geological Survey (USGS), or the National Geodetic Vertical Datum [NGVD]), and the vertical control datum used to determine the elevation of the well is the North American Vertical Datum of 1988 (NAVD 88). The survey results provide an accuracy of plus or minus 0.1 foot horizontally, and plus or minus 0.01 foot vertically. The horizontal well coordinates are established by surveying in reference to a permanent benchmark, and the latitude and longitude coordinates will reference the State Plane NAD83 High Accuracy Reference Network Coordinate System in ft.

5.10 INVESTIGATION DERIVED WASTE

IDW produced at the Facility during the RI included purge water from monitoring well sampling and development, decontamination water produced during sampling equipment decontamination, drill cuttings from monitoring well installation, residual soils from direct-push soil sampling investigations, disposable sampling equipment, and disposable personal protective equipment (PPE). DEQ performed a RCRA listed hazardous waste evaluation of the IDW to be produced during the RI, and determined that IDW would not be listed waste. A copy of DEQ's evaluation is included in Attachment A of the SAP (Trihydro 2017b). IDW generated during the RI was not expected to be listed or characteristic hazardous waste. Waste manifests are presented in Appendix E-7.

5.10.1 INVESTIGATION DERIVED WASTE STAGING AREA

An IDW staging area was established at the gravel lot behind the BSL property at 715 Central Avenue. Temporary security fencing was set up, which remained closed and locked except as normal operations required. Liquid IDW was staged on a secondary containment pad capable of holding the entirety of the liquid IDW stored on site.

5.10.2 SOLID MATRIX INVESTIGATION DERIVED WASTE

Drill cuttings and residual soils were collected in 55-gallon drums. Drums had labels affixed to the outside clearly identifying the source of the material, the contents, and the date of generation. IDW drums were stored on a secondary containment pad consisting of a manufactured containment system or a double layer of 6 mil polyethylene plastic. For disposal of the waste at the City of Billings landfill, solid phase IDW was characterized for:

- TCLP metals by EPA Method 6010
- Metals by EPA Method 6010
- TCLP mercury by EPA Method 7470
- TCLP SVOCs by EPA Method 8270
- VOCs by EPA Method 8260
- TCLP VOCs by EPA Method 8260
- EPH/VPH by the Montana Method
- Free liquids by EPA Method 9095

Analytical methods, holding times, and preservation methods are presented in Table 3-1 of the SAP, (Appendix A of the RIWP) (Trihydro 2017b). Wastes were found not to exceed characteristically hazardous levels and were disposed of at the City of Billings Landfill. Landfill waste criteria are provided in Attachment A-7 of the SAP (Trihydro 2017b).

Disposable sampling equipment and disposable PPE were cleaned of gross contamination, bagged, and placed in a dumpster for disposal as municipal solid waste.

5.10.3 LIQUID MATRIX INVESTIGATION DERIVED WASTE

Liquid IDW was primarily groundwater and decontamination water. NAPL, light non-aqueous phase (LNAPL) or DNAPL IDW was not encountered or generated during the RI.

Aqueous phase IDW generated from groundwater and stormwater/surface water investigations was collected in 330-gallon polyethylene tanks and 55-gallon drums onsite, and labels were affixed to the outside clearly identifying the source, contents, and the date of generation. The IDW tanks were stored on-site on a manufactured containment system capable of holding at least twice the volume of the IDW storage tank. Grab samples were collected from the tanks and drums and submitted for the following analyses to determine if the IDW could be disposed of at the City of Billings WWTP:

- VOCs by EPA Method 8260
- pH by Method SM 4500-H+B
- EPH/VPH by the Montana Method
- flashpoint by EPA Method 1010
- hexavalent chromium by SM 3500-Cr B
- TCLP metals by EPA Method 6010
- TCLP mercury by EPA Method 7470
- sulfide by method SM 4500-S2-D
- cyanide by SM-4500-CN-E

Analytical methods, holding times, and preservation methods are presented in Table 3 of the Preliminary Groundwater Sampling Memo (Trihydro 2017b). Liquid IDW characterization results were compared to the City of Billings WWTP non-hazardous waste characterization limits, as shown on the waste discharge authorization manifest included in Attachment A-8 of the SAP in the RIWP (Trihydro 2017b). Liquid IDW met the disposal requirements and was pumped from the tanks and hauled to the WWTP by a licensed waste hauler (Beartooth Environmental). Waste manifests were maintained by project staff to document final location and disposition of waste.

5.11 DATA VALIDATION

Analytical data gathered during RI activities was subjected to data validation procedures to evaluate data quality and usability. Trihydro's data validation team performed Tier II data validations on soil, groundwater, sediment from the stormwater system, and stormwater/surface water analytical laboratory data, and Tier III data validations on indoor air and soil vapor analytical data. Data were validated in accordance with EPA's Contract Laboratory Program National Functional Guidelines and DEQ's Data Validation Guidance (DEQ 2018a).

5.11.1 DATA VALIDATION SUMMARY

Accuracy, precision, method compliance, and completeness of these data packages were assessed during the data reviews. Accuracy is the degree of agreement between an analytical measurement and a known reference value. Laboratory accuracy was established by reviewing the demonstrated percent recoveries of matrix spike/matrix spike duplicate (MS/MSD) samples, laboratory control sample/laboratory control sample duplicate samples, and organic system monitoring compounds (surrogates) to verify that data were not biased. Field accuracy was established by

collecting and analyzing the trip blank, field blank, and equipment blank samples to monitor for possible ambient or cross contamination during sampling and transportation.

Precision is the degree of mutual agreement between individual measurements of the same property under similar conditions (analytical results are repeatable). Precision was determined by evaluating the calculated relative percent differences (RPD) for field duplicate pairs, laboratory duplicate pairs, MS and MSD pairs, and LCS and LCSD pairs.

Method compliance was established by reviewing sample integrity, holding times, detection limits, surrogate recoveries, laboratory blanks, and initial and continuing calibrations (where applicable) against method-specific and validation requirements.

5.11.2 DATA QUALITY AND USABILITY

The purpose of validating data and assigning qualifiers is to assist in proper data interpretation. Data that were not qualified meet the site DQOs. If values were assigned qualifiers other than an R (rejected, data not usable), the data may be used for site evaluation; however, consideration should be given to the reasons for qualification when interpreting sample concentrations. Data points that were assigned an R qualifier should not be used for site evaluation purposes.

Data may have been qualified with J data flags by the laboratory if the result was greater than or equal to the method detection limit (MDL) but less than the RL. These laboratory-applied J flags were preserved, if present, and included in the Data Qualification Summary tables at the end of the data validation reports. Data Qualification Summary tables were included in the data validation reports to identify the samples and analytes qualified. Data validation reports are included in Appendix G.

If data would be qualified with more than one flag, one qualifier was assigned based on the severity; however, all reasons for qualification were retained. Data that would be qualified with both J+ and J- flags were evaluated based on validation criteria and assigned the appropriate flag. The hierarchy of qualifiers from the most to least severe is as follows:

- R > JB/U > NJ > J+/J- > J/UJ

Data qualifiers used during the validations for this project included the following:

Qualifier	Definition
J	Estimated concentration
J+	The result is an estimated concentration, but may be biased high
J-	The result is an estimated concentration, but may be biased low
UJ	Estimated RL
U	Evaluated to be undetected at the RL
JB	Estimated concentration due to blank contamination
R	Rejected, data not usable

Of the 13,484 environmental and field duplicate sample results reported for the air samples collected in February and March 2018, 287 sample results were rejected as a result of the data validation review. The completeness measure for the data generated is 97.9%, which is greater than the RIWP required 90%.

Acetone and/or methylene chloride were detected in trip blanks in two of the groundwater data sets resulting in application of 19 qualifiers (1 JB qualifier and 18 U flags) to associated sample results. Of the 28,027 environmental and field duplicate sample results reported for the groundwater samples collected between July 2017 and September 2018, 267 sample results were rejected as a result of the data validation review. The completeness measure for the generated data is 99.05%; which is greater than the required 90%.

Individual total metals, VOC, and SVOC analytes were detected in 3 of the field blanks associated with soil samples. Qualification of sample data was not required based on the field blank detections. Equipment blanks were reported with detections of metals and methylene chloride that resulted in qualification of data. One U flag and 2 JB flags were applied as a result of target analyte detections in the equipment blanks. Of the 6,573 environmental and field duplicate sample results reported for the soil samples collected between November 2017 and May 2018, 5 sample results were rejected as a result of the data validation review. The completeness measure for the generated data is 99.92%, which is greater than the required 90%. An additional 10 equipment blank or field blank data points were rejected; however, the data points for the blank samples were not included in the completeness calculation.

Field blank and equipment blank samples associated with surface water and sediment were reported to have detections of chloroform, toluene, total EPH, and total metals that resulted in qualification of data. A total of 7 JB flags were applied as a result of target analyte detections in the field blank, 19 JB qualifiers and 2 U flags were applied as a result of target analyte detections in the equipment blank. Of the 1,965 environmental and field duplicate sample results reported for the sediment and surface water samples collected in June and July 2018, no sample results were rejected as

a result of the data validation review. The completeness measure for the generated data is 100%, greater than the required 90%.

Data qualifiers assigned to the analytical results are included in the associated RI tables and in the data validation reports in Appendix G.

6.0 FIELD OBSERVATIONS AND WORK PLAN COMPLIANCE

Field observations and activities were documented on field forms and in Field Direct digital forms. Deviations from the work plan were discussed with the DEQ Project Officer and Trihydro Project Manager prior to continuing the investigation work in the field, as practicable.

6.1 FIELD OBSERVATIONS

Field observations and field data for each phase of the investigations described in Section 5 were documented, where applicable, on dedicated field forms. Field observation forms are presented in Appendix E in subsections E-1 through E-7. Daily field observations were recorded digitally in the Field Direct report format and are provided in PDF format (Appendix E-1). Groundwater stabilization parameters, fluid levels, and sampling information are contained in groundwater sampling field forms (Appendix E-2). Digital logs of the stabilization parameters, as well as digital logs of daily groundwater meter field calibrations, are included as PDFs. PCE screening groundwater sampling information was also recorded on field forms and are also included in Appendix E-2. Field boring log forms from direct-push soil sampling and monitoring well installation are presented in Appendix E-3, and finalized boring logs are presented in Appendix A, as noted in Section 2.3. Direct-push soil sampling information was recorded on field sample forms (Appendix E-4). VI field data was recorded on field sampling forms, which are presented in Appendix E-5. Bedrock well hydraulic test results and analysis are presented in Appendix E-6. Videos of the storm and sanitary sewer scoping activities are presented in digital format in Appendix B, which is provided on a USB drive. IDW disposal records for the waste generated during the field activities are include as Appendix E-7.

6.1.1 NOTABLE FIELD OBSERVATIONS

6.1.1.1 VAPOR INTRUSION

During VI sampling at 342 Miles Avenue, a long, approximately 4” wide cracked and patched area was observed along the length of the furnace room (Photo IM_2065 in Appendix E-5). The occupant described that he had previously heard a loud noise from below the concrete and had felt the floor rumble. He noted that he had subsequently observed the floor to be damaged. Additionally, the subslab depressurization system was not operational during sampling. The occupant was not aware of when the system had ceased to function.

During VI sampling at 202 9th Street West, elevated PID readings were observed in the subslab sampling port. The PID recorded 226.8 parts per million (ppm), and readings on the 4-gas meter noted 16.7% oxygen and 7% lower explosive limit (LEL). The elevated subslab concentrations were reported to DEQ. PID readings in basement air were 0 parts per billion (ppb), and readings on the 4-gas meter were 20.9% oxygen, and 0% LEL. Review of EDR findings

indicates that an illicit substance investigation was conducted at an upgradient home on Cook Avenue. Additionally, a fuel-injector cleaner business was located in the adjacent structure to the north, and may use various solvents during the course of regular business.

During vapor-intrusion sampling at BSL, laundry carts were observed to bear the label of REX LAUNDRY. When discussing this information with site personnel, they noted to Trihydro staff that the former Rex Laundry was operated by a member of the Cline family, prior to establishing BSL. BSL staff also noted that a roofing business may have historically operated at or near the current Buck's Bar property at 1511 Central Avenue, and may have used solvents as part of their business operations. This location is upgradient of BSL by approximately 0.95 miles.

6.1.1.2 GROUNDWATER SAMPLING

During the July 2017 groundwater sampling event, several wells scheduled for sampling were unable to be sampled, as follows:

- BL-GW-5 – Located in BNSF railyard. Well could not be located using a metal detector. Discussion with BNSF personnel suggests the well has been abandoned. A replacement well, EMW-32, was located southwest of the railyard, and was sampled instead.
- D5, E1, & F3 – Wells not located. Discussion with BNSF personnel suggests that these may have been one-time direct-push groundwater samples, and that wells may never have been installed at these locations.
- BNMW-7 – Well contained 0.02 ft of LNAPL during sampling event. Well was not sampled, and BNMW-17 was sampled instead.
- BPGP39 – Unable to be located using a metal detector during well inventory. Presumed destroyed.
- BPGP73 – Unable to be located using a metal detector during well inventory. Destruction of well confirmed by EPA in August 2017.
- BPGW02 – Unable to be located using a metal detector during well inventory. A 4-inch well is located 60 yards east of the presumed location of BPGW02. Presumed destroyed.
- BPMW10 – Unable to be located using a metal detector during well inventory. Presumed destroyed.
- Weston-MW-2 – Unable to be located using a metal detector during well inventory. Discussion with DEQ personnel suggests that the former Weston's Repair LUST site was approved for closure and the well was abandoned.

During the May 2018 groundwater sampling event, several sidewalk corners north of Central Avenue were being repaired and updated with Americans with Disabilities Act-compliant ramps. Due to this construction work, monitoring well BPGP05 was destroyed.

During the July 2018 groundwater sampling event, asphalt road resurfacing was conducted on Central Avenue in the vicinity of and during some of the monitoring well sampling. Trihydro prepared field blanks in the vicinity of 711 Central Avenue while hot asphalt was being laid less than 10 ft away in order to rule out potential interference from ambient air VOCs. Additionally, a recent water main rupture had occurred near the intersection of S 8th Street West and Central Avenue. It is unknown how much water was released. Static water levels in nearby monitoring wells did not reflect changes due to the rupture.

During monitoring well installation, property access for permanent monitoring well installation was unable to be coordinated with Meadow Gold Dairy, and monitoring well MW-131 was not installed and therefore not included in the sampling.

6.1.1.3 STORMWATER/SURFACE WATER AND SEDIMENT SAMPLING

During stormwater/surface water and sediment sampling, the flow direction of the Suburban Ditch was found to be opposite that which was identified in the RIWP. The drainage flows from south to north, and is channelized near BSL, where it travels in the subsurface to the western edge of downtown Billings, before surfacing again. Sample locations were adjusted slightly to meet the RIWP objectives of sampling upgradient of BSL, nearest to the BSL source area, and downgradient of BSL (details in Section 11.0). This was discussed with DEQ prior to sampling stormwater/surface water and sediment and does not affect DQOs.

6.2 DEVIATIONS FROM WORK PLAN

Utility corridor investigation

The utility corridor investigation observations were not recorded completely in real time on a field form as stated in the RIWP. Instead, the investigations were recorded on video, and the most salient observations were noted during the investigation when apparent. The video was then reviewed, and the additional observations were noted in Section 5.1. This deviation does not impact attainment of DQOs, as the salient information was recorded and reviewed both in real-time and post-investigation.

Storm sewer scoping was originally planned for the section of storm sewer located southeast of the former Rex building. However, during storm sewer scoping activities, it was observed that the sewer piping had been replaced

with PVC piping. When discussing this with the City of Billings street traffic personnel, it was noted that this piping appeared to be quite recently installed, and was not likely to have been in use during the presumed period of operation of former Rex, believed to be prior to 1973. As this piping would not be able to provide information regarding historical releases from former Rex, this deviation does not impact the DQOs, and was discussed with DEQ.

VI Sampling

VI Addendum to the RIWP (Trihydro 2017b) identified 62 potential properties for sampling during the 2018 VI sampling event. Access was successfully arranged for 49 properties, but could not be coordinated with the remaining 13 property owners. This impacts DQO evaluations, as it limits the spatial coverage of VI samples at the Facility. The VI Addendum also calls for APH sampling at each location in the investigation. After review of the locations, DEQ determined that APH sampling was not necessary at properties where there was no reasonable expectation of petroleum hydrocarbons (i.e. groundwater detections, high field screening indications, etc.). Trihydro sampled for APH at a location if it was an UST facility, adjoined UST facilities, or was approximately one block directly downgradient of a LUST site. Therefore, APH sampling was removed from 24 sample locations after sample collection, but prior to analysis. This may reduce the ability to evaluate APH across the plume, but as the locations identified were not likely to contain APH contaminants, this does not significantly impact DQOs.

The properties at 632 St. John's Avenue #2 and 211 Terry Avenue were previously identified by EPA as having indoor air contaminant concentrations in excess of applicable SLs, and had mitigation systems installed. These properties were identified for resampling in 2018; however, access could not be coordinated with the property owners. This impacts DQO evaluations, as indoor air sampling was unable to be completed at these locations, and therefore the evaluation of EPA-installed vapor mitigation systems will only be performed on the 5 locations that were sampled. This was discussed with DEQ during the VI investigation, but despite considerable efforts to contact the owners, access was not able to be resolved by either Trihydro or DEQ.

The Bright Little Stars Daycare at 27 Custer Avenue was also identified for VI sampling, to evaluate risk to potentially sensitive receptors, but the business owner did not agree to sampling during the VI investigation. This may impact DQO evaluations for sensitive receptors. This was discussed with DEQ during the VI investigation, but despite considerable efforts to gain access, this was not able to be resolved by either Trihydro or DEQ.

On March 1, 2018, an ambient air canister was placed behind 125 Broadwater Avenue, chained to a utility pole. When sampling teams went to recover the canister the following day, it was discovered to be missing, presumed stolen. This affects DQO evaluations as indoor air comparisons to ambient air sample conditions are limited to one ambient air

sample for that day, which was cross-gradient for several locations. This was discussed with DEQ during the VI investigation and police and the lab were notified; however, the canister was not recovered.

The chain of custody for 104 Custer Avenue was incorrectly marked and excluded fixed gases analysis. Therefore, the laboratory used the carrier gas nitrogen for other chemical analytical methods that is incompatible with fixed gases analysis. This prevented fixed gas analysis on the sample after contaminant analysis. This limits the analysis of the subslab contaminant vapor concentrations for fixed gas concentration evaluation, but did not impact the ability of evaluating the potential for contaminant VI at the property.

Groundwater Sampling

During the July 2017 groundwater sampling event, well BPGP46b was purged at the lowest flow rate using the peristaltic pump. BPGP46b is a deeper well installed to approximately the top of bedrock, and was scheduled to be sampled for VOCs, SVOCs, EPH/VPH and metals, to gain a better understanding of deeper groundwater conditions. However, due to its slow recharge rate, sufficient sample volume was only obtained for VOCs, VPH, and EPH analyses. This impacts DQOs as it reduces the amount of information regarding groundwater toward the bottom of the alluvial aquifer.

During the May 2018 sampling event, VOC sample sets from 22 wells, as well as QC samples, were inadvertently left in a vehicle by the parcel delivery service while being shipped from Pace Analytical's Billings laboratory to their Minnesota laboratory, resulting in the samples being received significantly out of temperature. The affected wells were re-sampled on May 21 and 22, 2018 at the laboratory's cost. DQOs were not affected as the applicable samples were still collected within approximately two weeks of the remainder of the sampling event.

During the May 2018 sampling event, monitoring wells MW-101 and MW-102 were misidentified in the field, and were therefore sampled for different analytical suites than those described in the groundwater sampling plan. The VPH vials for MW-102 were submitted to the laboratory but were not evaluated within the allotted holding time. This impacts DQOs as a portion of the MW-101 sampling suite was not collected during the May sampling event. However, this error was rectified during the September sampling event, and a complete set of analytical data was collected.

The SVOC equipment blank for May 10, 2018, was inadvertently placed in hydrochloric acid-preserved 1-L amber bottles, instead of unpreserved bottles. SVOC analysis could not be performed on that sample. This is not expected to significantly impact DQOs, as SVOCs have not been observed in equipment or field blanks during the RI, and SVOCs have not been identified as ubiquitous COPCs at the Facility.

The very slow recoveries of the bedrock monitoring wells affected sample procedures. Bedrock monitoring well MW-126 contained approximately 1 foot of water during the May 2018 sampling event. The well purged dry completely before monitoring parameters could be logged. The monitoring well had been purged dry previously as part of development activities after installation. The well was direct-sampled the following day without collecting stabilization parameters, and only VOCs, VPH, and SVOCs could be collected, as inadequate sample volume was available for the remaining suite. MW-127 was purged dry, and also only produced minimal volumes of water, but due to high turbidity (>5,700 nephelometric turbidity units), field personnel determined that the well needed to be re-developed, and it was not sampled during the May 2018 event. These deviations affect the completeness of the data set and temporal evaluation of PCE concentrations at MW-127.

Direct-Push Investigation

During direct-push groundwater and soil sampling, the direct-push subcontractor could not complete a push to groundwater in the street in front of, nor in the alley behind, Wetzel's Cleaners due to refusal from cobbles or other material. A second direct-push subcontractor with a more powerful rig was able to complete direct-push borings in the street in front of Wetzel's as well as in the alley. Due to limited recovery, subsurface soil samples at WETZ-GW-01 and WETZ-GW-02 were collected over the 10-15 ft interval, which is greater than the targeted sampling intervals specified in the Quality Assurance Project Plan (QAPP). This impacts DQOs as contaminants in this interval may be interspersed over a wide range and the sampling resolution is poor; however, field observations and PID readings of the smaller intervals were consistent with the VOC analytical results. DEQ was notified of equipment and recovery limitations when these events occurred.

Direct-push access could not be arranged for HLS. The property owner at Scentry Biologicals, as well as the MDT, allowed sample points to be placed on their properties instead. These sample points are further from HLS than originally planned, however, due to the persistent nature of chlorinated solvent contamination, PCE concentrations indicative of a source area would still be able to be observed at these locations, and this deviation should not impact DQOs. Two locations, HLS-GW-01 and HLS-GW-02 were located on HLS property and access was not able to be coordinated with the property owner during the investigation. Screening samples were not collected from these locations. However, low PCE groundwater screening concentrations from slightly downgradient samples HLS-GW-03 and HLS-GW-04 suggest that a PCE source area is likely not located upgradient, and therefore this deviation should not impact DQOs. DEQ was notified of these changes in boring locations.

A field duplicate was collected at location REX-MIP-08; however, the sample interval was not adequately recorded on the field sampling form. Therefore, the field duplicate data was rejected, as it could not be adequately tied to a

location. This impacts DQOs by reducing the quantity of QA/QC samples collected during the subsurface soil investigation.

Monitoring Well Installation

Active utilities, property access, and several other site-specific factors necessitated deviations in the locations of several monitoring wells as follows:

- MW-105 – This well was moved approximately 350 ft northeast of its planned location due to overhead and underground utilities. Potential locations were also restricted due to the active rail lines. The well was intended to be installed closer to the plume perimeter, but still provides concentration and water elevation data for an area that was not previously investigated.
- MW-106 – This well was moved approximately 150 ft west of its proposed location due to utilities and property access. The well was installed closer to the plume perimeter, so the change in location does not affect DQOs.
- MW-117 – This well was originally intended for a City of Billings parking lot on N 27th Street. The City did not agree to allow well installation, so the well was installed in N 26th Street approximately 450 ft northeast. Based on direct push screening the leading edge of the plume appears to be between these two points, and the change does not affect DQOs.
- MW-128 through MW-135 – These well locations were discussed with and agreed to by DEQ during well installation activities due to groundwater and VI preliminary results indicating potential data gaps in plume delineation. These wells were installed to help address these potential data gaps and meet DQOs.
- MW-131 – This well was proposed to investigate the potential sewer line release at former Rex, but property access could not be arranged while the drill rig was onsite. The well would have provided a permanent groundwater monitoring point close to the possible release location, but soil and grab groundwater samples were previously collected from this area to allow for source investigation. Therefore, DQOs were met except those associated with temporal groundwater monitoring of potential source areas.

7.0 CONTAMINANTS OF POTENTIAL CONCERN

As part of the initial step to determine the COPCs for the Facility, historical use and analytical results were evaluated. The DSR provides a synopsis of historical uses and a summary of the analytical results from previous investigations (Trihydro 2017a). Previous investigations had identified solvents and petroleum hydrocarbons exceeding applicable SLs in soil, groundwater, and indoor air. This section describes the SL selection for current applicable SLs for each investigated media along with the criteria used to identify COPCs in subsequent Nature and Extent sections.

7.1 SCREENING LEVEL SELECTION

The applicable SLs for the Facility are based on DEQ guidance and regulations, EPA SLs, and background levels for inorganic constituents. The SLs are based on the analyte, the media sampled, and, if applicable, the depth of the sample and depth to groundwater. SLs for residential and commercial/industrial direct contact are included as well as leaching/migration to groundwater. The following list of SLs were used in data evaluation and specific SLs by analyte and media are detailed in Appendix I and on the data analytical tables presented in Sections 8, 9, 10, and 11.

Groundwater SLs:

- Montana DEQ-7 Water Quality Standards (DEQ 2017)
- Montana Tier 1 RBSLs (DEQ 2018b)
    - Residential direct contact
    - Commercial direct contact
    - Construction direct contact
    - Leaching to groundwater 0-10 ft
    - Leaching to groundwater 10-20 ft
    - Leaching to groundwater >20 ft
- EPA RSLs for Chemical Contaminants at Superfund Sites (EPA 2018b) with carcinogenic target risk (TR) SL of 1x10-6 (i.e. 1E-6) and non-carcinogenic SL hazard quotient (HQ) of 0.1 (EPA, November 2018)
- Maximum contaminant level (MCL)-based Protection of Groundwater soil screening levels (SSLs) (EPA, November 2018)
- EPA Tapwater RSLs, with TR SL of 1E-6 and non-carcinogenic SL HQ of 0.1 (EPA, November 2018)

Surface (less than 2 ft bgs) and Subsurface Soil (greater than 2 ft bgs) SLs:

- RSLs for soil results were modified based on DEQ's State Superfund Attachment C – Soil Screening Process (DEQ 2016)
- Residential and industrial soil RSLs (EPA, November 2018)
- Background Concentrations of Inorganic Constituents in Montana Surface Soils (Hydrometrics 2013)
- Montana DEQ Evaluating Lead in Soil SLs (DEQ 2018d)

Stormwater/Surface Water System and Sediment SLs (compared to surface water and sediment SLs due to interaction with upgradient irrigation surface water and downgradient outfalls to surface water systems):

- Sediment:
  - EPA Region 3 Biological Technical Assistance Group (BTAG) Freshwater Sediment Screening Benchmarks (EPA 2006)
- Stormwater System/Surface Water
  - EPA Region 3 BTAG Surface Water Screening Benchmarks (EPA 2006)
  - Montana DEQ-7 Water Quality Standards; Human Health Surface Water, Aquatic Life Standards - Acute and Aquatic Life Standards - Chronic (DEQ 2017)
  - 2018 November EPA Tap Water RSLs HQ 0.1 (EPA, November 2018)

VI/Air SLs:

- Air results were compared to generic residential and industrial RSLs with carcinogenic risk SL of 1E-6 and non-carcinogenic SL of HQ of 0.1
- Montana DEQ Typical Indoor Air Concentrations (TIACs) (DEQ 2012)
- Montana DEQ generic APH fraction SLs (DEQ 2018c)

The inclusion of these SLs is conservative to account for the wide range of land uses of the properties within the Facility. The nature and extent of contamination discussions in Sections 8 through 11 include specifics as to which SLs are exceeded based on the media sampled.

7.2 CONTAMINANTS OF POTENTIAL CONCERN SELECTION CRITERIA

The COPCs for the Facility are applied with the criteria that a detection of an analyte exceeding applicable SLs for that media and depth/depth to groundwater are considered to be a COPC for that particular media (i.e. surface soil, subsurface soil, groundwater, stormwater/surface water, or sediment). For indoor air, COPCs were selected based both on exceedance of an applicable SL, as well as evaluation of a complete or potentially complete VI pathway. COPC selection for VI pathway followed the DEQ VI guidance for determination of VI COPCs on a structure-by-structure basis based on multiple lines of evidence and analytical results above applicable indoor air SLs in indoor air (DEQ 2011). COPCs for the stormwater/surface water and sediment associated with the stormwater systems were determined based on exceedances of applicable SLs and the evaluation of concentration gradient evaluations between the upgradient (e.g. off-Facility) concentrations, Facility concentrations, and the downgradient (e.g. off-Facility) concentrations. The applicable SLs for each media were determined from the screening criteria outlined in DEQ's Frequently Asked Questions online guidance (DEQ 2018e), and are included by media in Appendix I.

Analytes with laboratory RLs above an applicable SL, for a particular medium are considered COPCs only if there is also a detection of that analyte above the laboratory RL in the same medium. If there are only RL exceedances of applicable SLs in that medium, but no detections of that analyte exceed applicable SLs, then those analytes are noted, but not deemed COPCs. Additionally, if an analyte was detected in fewer than 5% of the RI samples for a particular media, the analyte is noted but not considered to be a COPC except for VI COPC evaluation. COPC evaluation for VI is based on structure-by-structure COPCs and multiple lines of evidence, which did not include elimination of COPCs based on a Facility-wide dataset. Sections 8 through 11 include the COPC evaluation for each media and discuss the spatial (vertical and horizontal) distribution of analytical results, where appropriate.

8.0 NATURE AND EXTENT OF CONTAMINATION – KNOWN AND POTENTIAL SOURCE AREA SOILS

The soil investigation was conducted to evaluate known and potential source areas for contamination, and to provide high-resolution data for contaminant distribution and aquifer hydraulic characteristics. To accomplish these goals, the soil investigation included a MiHPT investigation and soil core collection and sampling. The MiHPT investigation provided high-resolution, depth-specific characterization data on organic constituents and hydrogeology. The results of the MiHPT investigation were used to help select soil sample locations and target depth intervals. Soil cores were collected from a subset of the MiHPT locations, and other locations as determined in the field. Soil analytical results were compared to applicable SLs listed in Section 7.1, as described in DEQ's soil screening flowchart (DEQ 2016). Soil screening was used as a basis for COPC selection.

This section presents COPC selection for soils, followed by a summary of investigation results. The MiHPT data support this section, and a detailed analysis and description of the MiHPT data analysis is provided in Appendix D. Surface (0-2 ft bgs) and subsurface (> 2 ft bgs) soil COPCs are addressed separately. Results are presented for each of the known or potential source areas evaluated with the direct push investigations. Detailed comparisons of MiHPT results to soil concentration data is provided in Appendix D, and is further described in Section 8.2.

8.1 CONTAMINANTS OF POTENTIAL CONCERN SELECTION

Historical soil data is limited in scope and spatial variation in addition to primarily being collected prior to interim actions; therefore, historical soil data is not applicable to describe current site conditions. Available historical analytical data for BSL may be indicative of site conditions prior to interim remedial actions conducted by EPA in 2008. Surface and subsurface soil data were not available for former CAL prior to the RI. A partial analytical data set is available for former Rex, but location information for the sampling points has not been found. Similar limitations on historical data for former CAL and former Rex also apply to the soil data's use for characterization of current COPCs. To assess current conditions, RI surface and subsurface soil investigations were conducted at BSL, former CAL, and former Rex properties to identify current Facility soil contaminant concentrations and distribution.

8.1.1 FACILITY-WIDE CONTAMINANTS OF POTENTIAL CONCERN

Fifteen surface soil samples and forty subsurface soil samples were collected to evaluate source-area contaminants at the Facility. Samples were evaluated at Pace Analytical Laboratories for VOCs, SVOCs, EPH/VPH and metals. Soil COPCs were identified by comparing soil analytical results to current applicable SLs, as noted in Section 7. Soil

analytical results were evaluated against SLs based on depth, where surface soils are defined as the 0-2 foot interval bgs, and subsurface soil is defined as greater than 2 ft bgs. Surface and subsurface soils were screened for direct-contact and leaching to groundwater exposure pathways. Soils were screened against the most conservative applicable SLs (i.e. residential direct contact and leaching to groundwater for groundwater 0-10 ft bgs) (DEQ 2018e). The following analytes were detected above applicable SLs and are considered COPCs for the Facility:

Surface Soil

Leaching to groundwater – PCE

Subsurface Soil

Direct contact –benzo(a)pyrene

Leaching to groundwater – 1,2,4-trimethylbenzene, PCE

Subsurface soil VOC analytical results for 1,2,4-trimethylbenzene, ethylbenzene, naphthalene, and PCE each exceeded their respective direct contact SLs in less than 5% of samples (1 in 40 samples). Subsurface soil VPH analytical results for C5-C8 aliphatic hydrocarbons and C9-C12 aliphatic hydrocarbons exceeded their respective direct contact SLs in 2 of 21 samples, and 1 of 21 samples, respectively. Furthermore, the exceeding samples for the aforementioned compounds were located at depths greater than 10 ft bgs, which is typically the depth at which the direct contact risk to construction/excavation workers may be limited depending on site conditions (DEQ 2018e). For leaching to groundwater SLs, 1,3,5-trimethylbenzene exceeded the leaching to groundwater SL in less than 5% of samples (1 in 21 samples).

Twenty-two compounds were identified in the QAPP whose MDL was greater than an applicable SL, and are shown in Table 3-1 of the QAPP in the RIWP (Trihydro 2017b). In addition to those compounds, n-nitrosodi-n-propylamine was not detected in any samples, and its detection limit was greater than applicable direct contact and leaching SLs for each sample. Nine additional compounds were not detected in samples, but their MDLs were greater than their respective leaching to groundwater SLs: 1,1-DCE, 2,4,6-dichlorophenol, 2,6-dinitrotoluene, 3,3-dichlorobenzidine, 4,6-dinitro-2-methylphenol, bis(2-chloroethyl)ether, hexachlorobenzene, hexachloroethane, and nitrobenzene.

In addition to the Facility-wide evaluation, COPCs were also evaluated based upon source area. Results are presented below.

8.1.2 BSL CONTAMINANTS OF POTENTIAL CONCERN

Five surface soil samples and ten subsurface soil samples were collected from four borings at BSL. Sample depths ranged from 0-25.5 ft bgs. COPCs specific to BSL are as follows:

Surface Soil

Leaching to groundwater – PCE

Subsurface Soil

Leaching to groundwater – 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, PCE

Additionally, 1,2,4-trimethylbenzene, C5-C8 aliphatics, ethylbenzene, naphthalene, and PCE each exceeded their respective direct-contact SLs in one sample each. However, each of these samples was located at 14 ft bgs or deeper, and thus are deeper than the 10 ft bgs typical depth at which the direct contact risk to construction/excavation workers is evaluated (DEQ 2018e).

8.1.3 FORMER CAL CONTAMINANTS OF POTENTIAL CONCERN

Five surface soil samples and nine subsurface soil samples were collected from four borings at the former CAL. Sample depths ranged from 0-23.5 ft bgs. COPCs specific to the former CAL are as follows:

Surface Soil

Leaching to groundwater – PCE

Subsurface Soil

Leaching to groundwater – PCE

No other detected compounds exceeded applicable SLs at the former CAL.

8.1.4 FORMER REX CLEANERS CONTAMINANTS OF POTENTIAL CONCERN

Five surface soil samples and twelve subsurface soil samples were collected from eight borings at the former Rex Cleaners. Sample depths ranged from 0-23.5 ft bgs. COPCs specific to the former Rex Cleaners are as follows:

Surface Soil

Leaching to groundwater – PCE

Subsurface Soil

Leaching to groundwater – 1,2,4-trimethylbenzene

Additionally, C5-C8 aliphatics and C9-C12 aliphatics each exceeded their respective direct-contact SLs in one sample each. However, each of these samples was located at 17 ft bgs and thus are deeper than the 10 ft bgs typical depth at which the direct contact risk to construction/excavation workers is evaluated (DEQ 2018e).

8.1.5 ALSCO CONTAMINANTS OF POTENTIAL CONCERN

Three subsurface soil samples were collected from three borings at ALSCO. Sample depths ranged from 2-15 ft bgs. No detected compounds at ALSCO exceeded direct contact or leaching to groundwater SLs.

8.1.6 HLS CONTAMINANTS OF POTENTIAL CONCERN

Two subsurface soil samples were collected from two borings downgradient of HLS at the Scentry Biologicals, Inc. property. Sample depths ranged from 3-8 ft bgs. COPCs specific to the area downgradient of HLS are as follows:

Subsurface Soil

Direct contact – benzo(a)pyrene

No other detected compounds exceeded applicable SLs at the site.

8.1.7 D7HRC CONTAMINANTS OF POTENTIAL CONCERN

One subsurface soil sample was collected downgradient of the District 7 Human Resources Council (D7HRC) property. Sample depth was 7-9 ft bgs. No detected compounds at D7HRC exceeded direct contact or leaching to groundwater SLs.

8.1.8 WETZEL'S CLEANERS CONTAMINANTS OF POTENTIAL CONCERN

Two subsurface soil samples were collected from two borings at Wetzel's Cleaners. Sample depths ranged from 10-15 ft bgs. No detected compounds at Wetzel's Cleaners exceeded direct contact or leaching to groundwater SLs.

8.2 MIHPT/DIRECT PUSH INVESTIGATION SUMMARY

The MiHPT portion of the soil investigation provided screening-level data at multiple locations, to enhance the fate and transport evaluation with high resolution data representing organic constituents and aquifer characteristics. This

subsection presents a summary of MiHPT results; a detailed description is provided in Appendix D, along with the investigation report provided by the MiHPT subcontractor (Dakota Technologies, Inc.).

The MiHPT uses direct-push techniques, coupled with MIP and HPT, to generate continuous data profiles. MIP data includes halogen specific detector (XSD), flame ionization detector (FID), and PID data. The XSD data are selective for halogenated organic compounds, and results are indicative of the presence of CVOCs. The FID and PID analyses provide results for most organic compounds, including hydrocarbons. The FID is more sensitive to a broader range of organics including lower molecular-weight compounds such as methane. HPT data provide information on the aquifer characteristics. The HPT involves injection of water as the tool is advanced through the formation; the injection pressure and flow rate provide information about the formation hydraulic conductivity. EC data are plotted along with HPT data, as these also provide information about the aquifer. Overall, HPT and EC data provide high-resolution characterization information on subsurface hydrogeology.

A tabulated list of MiHPT locations and soil sample depth intervals for each of the areas is shown in Table 5-2. MiHPT locations for each of the source areas are shown in Figures 8-1 through 8-4. A detailed description of MiHPT methods and results, including a project summary report provided by the MiHPT subcontractor (Dakota Technologies, Inc.), is presented in Appendix D. Appendix D also provides a detailed comparison of MiHPT results to soil data (as noted in Section 8.0). For each location where both MiHPT and confirmatory soil sampling were conducted, overlay plots are provided (Appendix D, Figure D-5) showing data-versus-depth profiles for MiHPT data and soil concentration data for key analytes (PCE, EPH, and VPH).

The following subsections present a summary of soil investigation results at BSL, former CAL, former Rex, and D7HRC. Additional details regarding the MiHPT data collection, including system calibration and QC testing, are provided in the MiHPT report provided by Dakota Technologies, Inc. (Appendix D).

8.3 SURFACE SOIL RESULTS SUMMARY

Surface soil samples were collected from known and potential source areas including BSL, former CAL property, and former Rex property. At each of these potential source areas, 5 surface soil samples were collected from 4 locations (total of 15 surface soil samples from 12 locations). Surface soil is considered to extend from 0 – 2 ft bgs, although subintervals within this depth range were collected. Surface soil samples were collected via direct-push soil coring as described above (Section 5.3.2). The sample rationale included (a) collection of quantitative site characterization soil data; (b) confirmatory samples to aid in interpretation of MiHPT results; (c) high-resolution sample locations to extensively characterize the local soil column; (d) MiHPT alternate locations, which were conducted at locations where

MiHPT was unable to be completed due to access issues at the time the equipment was on site; and (e) fate and transport parameter collection. Surface samples, except for fate and transport samples, were analyzed for VOCs; based upon sample rationale presented in the RIWP (Trihydro 2017b), select samples were also analyzed for SVOCs, EPH/VPH, and metals. Fate and transport soil samples were analyzed for *foc* and moisture content.

Tables 8-1 through 8-4 show the analytical results for surface samples collected in the RI from each of the known and potential source areas. Surface soil data are tabulated as follows: Table 8-1 shows VOC data, Table 8-2 shows SVOC data, Table 8-3 shows EPH/VPH data, and Table 8-4 shows data for metals.

A summary of the exceedances and/or detections for each of the analyte classes is as follows. Additional details regarding surface soil analytical data for each of the potential source-zone areas are presented subsequently.

- VOCs: PCE exceeded the 23 µg/kg leaching to groundwater SL calculated according to DEQ's soil screening flowchart (DEQ 2016) in nine samples collected from seven locations (exceedances occurred at multiple depths from two locations); exceedances were observed at BSL, CAL, and Rex. RLs exceeded one or more of the applicable surface-soil SLs for several analytes, including 1,2,3-trichloropropane, 1,2-dibromo-3-chloropropane, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichlorethane, 1,1-DCE, 1,2,3-trichloropropane, 1,2-dibromoethane, 1,2-dichloroethane (DCA), 1,2-dichlorpropane, 2-butanone, allyl chloride, bromomethane, carbon tetrachloride, dibromochloromethane, dibromomethane, methylene chloride, PCE, and VC.
- Petroleum: EPH and VPH analytical results were compared to DEQ's RBCA RBSLs. Petroleum hydrocarbons did not exceed applicable SLs, and RLs were also below applicable SLs.
- SVOCs: Analytical results did not exceed applicable direct contact or leaching to groundwater SLs. N-nitrosodi-n-propylamine and N-nitrosodimethylamine both had RLs exceeding the direct-contact SL. The SVOC analysis for sample CAL-MIP-04 (1-2) was diluted by a factor of 25 by the analytical laboratory due to analyte/matrix interference. Therefore, for the analytical results for CAL-MIP-04 (1-2), an additional 17 SVOC compounds had MDLs higher than applicable SLs, that did not exceed MDLs in other surface soil samples.

8.4 SUBSURFACE SOIL RESULTS SUMMARY

Subsurface soil samples, including confirmatory samples associated with the MiHPT investigation, were collected from known and potential source areas including BSL (10 samples from 4 locations), former CAL (9 samples from 4 locations), former Rex (8 samples from 4 locations, as well as 4 samples from 4 locations during a direct-push

investigation of a sanitary sewer line servicing the former Rex building), D7HRC (1 sample from 1 location), ALSCO Cleaners (3 samples from 3 locations), Wetzel's Cleaners (2 samples from 2 locations), and HLS (2 samples from 2 locations). An additional opportunistic subsurface soil sample was collected during the installation of MW-133. Subsurface soil is considered to occur greater than 2 ft bgs. Subsurface soil samples were collected from direct-push soil cores as described above (Section 5.3.2). The sample rationale included (a) collection of quantitative site characterization soil data; (b) confirmatory samples to aid in interpretation of MiHPT results; (c) high-resolution sample locations to extensively characterize the local soil column; (d) MiHPT tentative locations, which were conducted based upon primary evaluation of the results of fixed MiHPT locations, or at locations where MiHPT was unable to be completed due to access issues at the time the equipment was on site; and (e) fate and transport parameter collection. Subsurface samples, except for fate and transport samples, were analyzed for VOCs; based upon sample rationale presented in the RIWP (Trihydro 2017b), select samples were also analyzed for SVOCs, EPH/VPH, and metals. Fate and transport soil samples were analyzed for *foc* and moisture content.

Tables 8-5 through 8-8 show the analytical results for subsurface samples collected in the RI from each of the known and potential source-zone areas. Subsurface soil data are tabulated as follows: Table 8-5 shows VOC data, Table 8-6 shows SVOC data, Table 8-7 shows EPH/VPH data, and Table 8-8 shows data for metals.

A summary of the subsurface exceedances and/or detections for each of the analyte classes is as follows. Details regarding subsurface soil analytical data for potential source areas are presented by potential source area location in subsequent Sections 8.5 through 8.10.

- VOCs: PCE exceeded the leaching to groundwater SL (23 µg/kg) in eight samples at four locations at former CAL and BSL. PCE, ethylbenzene, 1,2,4-trimethylbenzene, and naphthalene each exceeded the residential direct contact RBSL in a single sample, but the sample depths were greater than 14 ft bgs. RLs exceeded one or more of the applicable subsurface-soil SLs for several analytes, including 1,2,3-trichloropropane, 1,2-dibromo-3-chloropropane, 1,1,1,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichlorethane, 1,1-DCE, 1,2,3-trichlorpropane, 1,2-dibromoethane, 1,2-DCA, 1,2-dichlorpropane, allyl chloride, bromodichloromethane, bromomethane, carbon tetrachloride, chloromethane, dibromochloromethane, dibromomethane, hexachlorobutadiene, methylene chloride, methyl tert-butyl ether (MTBE), PCE, TCE and VC.
- Petroleum: EPH and VPH analytical results were compared to DEQ's RBCA RBSLs. Petroleum hydrocarbons did not exceed applicable SLs, and RLs were also below applicable SLs.
- SVOCs: Benzo(a)pyrene exceeded residential direct contact RBSL in two samples at HLS. N-nitrosodi-n-propylamine and N-nitrosodimethylamine both had RLs exceeding the direct-contact SL. Sixteen

compounds had RLs greater than the leaching to groundwater SL, but did not have associated detected exceedances in subsurface soil samples.

8.5 BIG SKY LINEN INVESTIGATION RESULTS

This section presents surface soil and subsurface soil analytical results for BSL. Both a summary of MiHPT results and detailed data analysis of MiHPT results are presented in Appendix D.

8.5.1 MIHPT SUMMARY

MIHPT investigation was completed at 21 locations near BSL on November 16, 2017, and between November 28 and December 1, 2017 (Table 5-2). Of the 21 MiHPT locations identified for BSL in the RIWP, 19 were installed in the locations as planned. Two of the planned locations, BSL-MIP-09 and MIP-T18, were unable to be completed due to access limitations; both were proposed for BSL property. Two additional locations, MIP-T20 and MIP-T21, were added to the alley north of 711 Central Ave. MiHPT and related soil sampling locations associated with BSL are shown on Figure 8-1.

MiHPT data near BSL suggests that zones with potentially high concentrations exist, and the highest concentrations are apparent along the transect from BSL eastward, running south of the building at 711 Central Ave, and in locations MIP-T15 and MIP-T16 (located west of 711 Central Avenue). Elevated CVOCs concentrations are also apparent near the western sides of the 711 Central Avenue Building Area and Parking Area, but appear to decline moving east. Possible CVOCs impacts are also observed in the alley north of 711 Central Avenue, although at lower apparent levels than observed further south. South of Central Avenue, CVOCs may be present but at lower apparent concentrations (i.e., plume levels).

HPT results suggest similar trends across the BSL investigation points for estimated K based on depth. Each location indicates differing shallower and deeper water bearing zones. In the shallower water bearing zones, HPT and EC data suggest presence of some finer-grained, lower permeability materials. The shallow portion tends to be heterogeneous and typically extends from ground surface to approximately 15 to 20 ft bgs. HPT calculated K values in the shallow zone typically ranged from <1 to 10 ft/d. Despite the widespread heterogeneity, the HPT and EC data suggest little consistency in continuous layers within or between investigation locations across BSL suggesting that the low permeability layers are not connected horizontally. Conversely, the deeper zone (which underlies the shallow zone at transition depths of approximately 15 to 20 ft bgs) is more homogeneous, and has higher HPT calculated permeability. The higher permeability is indicted by low EC values (typically less than 1 mS/m) and low HPT injection pressures (approximately 1 psi, when corrected for hydrostatic head). The estimated HPT-calculated K values

are relatively uniform in the deeper zone, typically ranging from 60 to 80 ft/d. The transition from shallower to deeper water bearing zones generally occurs near the water table at the majority of the BSL MiHPT investigation locations (Appendix A).

8.5.2 SURFACE SOIL RESULTS

To assess the current conditions at BSL, five surface soil samples were collected from four locations during the RI. These included two MiHPT confirmatory sample locations and two MiHPT-alternate locations; one MiHPT alternate location was evaluated via high-resolution sampling. The sampled locations, with associated depth intervals and rationale, were as follows:

- BSL-MIP-01: 0 to 0.5 ft bgs (confirmatory)
- BSL-MIP-09: 0 to 0.5 ft bgs and 1 to 2 ft bgs (high resolution; MIP alternate location)
- BSL-MIP-T20: 0 to 0.5 ft bgs (confirmatory)
- BSL-MIP-T18: 0 to 0.5 ft bgs (MIP alternate location)

BSL surface soil samples were evaluated for VOCs, which included chlorinated solvents (e.g., PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and VC); one location (BSL-MIP-09) was also evaluated for SVOCs, EPH/VPH, and metals. Surface soil screening-level exceedances occurred for PCE only (Figure 8-5). Detected PCE concentrations exceeded the leaching to groundwater SL, calculated using DEQ's soil screening flow chart part 2 (23 µg/kg), at two BSL surface soil locations; in addition to the detected values, RLs for PCE in the remaining surface soil samples also exceeded the leaching SL.

Petroleum hydrocarbons (analyzed for EPH/VPH via the Montana-modified MADEP Methods), SVOCs (analyzed via EPA Method 8270) and metals (analyzed via EPA Methods 6010 and 7471) were compared to applicable SLs presented in Section 7.1 and were screened according to parts 1 and 2 of DEQ's soil screening flow chart. EPH/VPH hydrocarbons, SVOCs, and metals did not exceed applicable SLs in surface soils at BSL.

8.5.3 SUBSURFACE SOIL RESULTS

To assess the current conditions at BSL, eleven subsurface soil samples were collected from four locations during the RI. These included two confirmatory sample locations, one high-resolution location, and one MiHPT-alternate location. The sampled locations, with associated depth intervals and rationale, were as follows:

- BSL-MIP-01: 12 to 13 ft bgs and 17 to 18 ft bgs (confirmation)
  - Additional sample collected from 4 to 4.5 ft bgs (fate and transport)
- BSL-MIP-09: 8 to 8.5 ft bgs, 12 to 12.5 ft bgs (SPLP), 16 to 16.5 ft bgs, and 25 to 25.5 ft bgs (high resolution; MiHPT alternate location)
- BSL-MIP-T20: 12 to 13 ft bgs and 14 to 15 ft bgs (confirmation)
- BSL-MIP-T18: 9.5 to 10 ft bgs and 13 to 14 ft bgs (MiHPT alternate location)

Subsurface soil sample locations were evaluated for VOCs, which included chlorinated solvents (e.g., PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and VC). Detected PCE concentrations exceeded the leaching to groundwater SL in six samples from three BSL subsurface soil locations. 1,2,4- and 1,3,5-trimethylbenzenes exceeded the leaching SLs at BSL-MIP-T20 at a depth of 14 to 15 ft bgs. PCE concentrations also exceeded the direct-contact SL in one location, BSL-MIP-09, but at a depth of 16 to 16.5 ft bgs. Ethylbenzene, 1,2,4-trimethylbenzene, and naphthalene concentrations exceed direct contact SLs at BSL-MIP-20 at a depth of 14 to 15 ft bgs.

Samples from BSL-MIP-09 (all sample depths) and BSL-MIP-20 (14 to 15 ft bgs) were analyzed for EPH/VPH, SVOCs and metals. Analytes were compared to their applicable SLs as described in Section 7. Analytes from these analytical groups were not detected above applicable SLs.

Subsurface soil analytical data for chlorinated solvents, as well as summary EPH and VPH screening values, are presented on Figure 8-5.

8.6 FORMER CENTRAL AVENUE LAUNDRY AND CLEANERS INVESTIGATION RESULTS

This section presents surface soil and subsurface soil analytical results for former CAL area MiHPT and soil investigations. A summary of MiHPT results is also included, and full MiHPT results are presented in Appendix D.

8.6.1 MIHPT SUMMARY

MiHPT investigation was completed at 15 locations near former CAL between November 13 and 30, 2017 (Table 5-2). Four of the locations included in the RIWP, CAL-MIP-03, MIP-T01, MIP-T04, and MIP-T05, were not completed due to lack of detections in nearby locations (three of these locations were listed as “tentative” in the RIWP and were only intended to be monitored to assist in source delineation if local detections occurred in fixed MiHPT locations). MiHPT and related soil sampling locations associated with CAL are shown on Figure 8-2.

In comparison to BSL, the levels of detections at former CAL suggest a relatively minor source area. The MiHPT analytical for former CAL area suggests possible CVOCs detections occurring at low levels, in very few vertical intervals, and a few possible CVOCs detections in depth intervals associated with shallow groundwater.

Similar to the observations from BSL, HPT results for each former CAL location indicate shallow water bearing zones with lower permeability media, and deep water bearing zones with higher permeability media. In the shallow zones, HPT and EC data suggest relatively finer-grained, lower permeability media. The shallow portion also exhibits a higher degree of heterogeneity than the deep zone. Where K values were calculated in the shallow zone values typically ranged from <1 to 10 ft/d. The HPT and EC data do not suggest spatially extensive water bearing zones occurring in the shallow zone; the defining characteristic of the shallow zone appears to be lower permeability with moderate heterogeneity. The estimated K is more heterogenous and variable from approximately 10 to 15 ft bgs. Below 15 ft bgs, the estimated K is more uniform and considerably higher. This deeper zone appears to be homogeneous and exhibits higher permeability. Within the deep zone, EC values, HPT injection pressures, and estimated K values are consistent with the values reported above for BSL, which are relatively uniform in the deeper water bearing zone and typically range around 100 ft/d.

8.6.2 SURFACE SOIL RESULTS

To assess the current conditions at former CAL, six surface soil samples were collected from four locations during the RI. The sampled locations, with associated depth intervals and rationale, were as follows:

- CAL-MIP-02: 0 to 0.5 ft bgs (confirmation) and 0 to 1 ft bgs (fate and transport)
- CAL-MIP-04: 0 to 0.5 and 1 to 2 ft bgs (high resolution)
- CAL-MIP-09: 0 to 0.5 ft bgs (confirmation)
- CAL-MIP-T03: 0 to 0.5 ft bgs (confirmation)

Except for samples collected for fate and transport (described in Section 12), former CAL surface soil samples were evaluated for VOCs; one location (CAL-MIP-04) was also evaluated for SVOCs, EPH/VPH, and metals. Surface soil screening-level exceedances occurred for PCE (Figure 8-6). Detected PCE concentrations exceeded the leaching to groundwater SL in three samples at two former CAL surface soil locations; in addition to the detected values, RLs for PCE in surface soil samples also exceeded the leaching SL.

Petroleum hydrocarbons (analyzed for EPH/VPH via the Montana-modified MADEP Methods), SVOCs (analyzed via EPA Method 8270) and metals (analyzed via EPA Methods 6010 and 7471) were compared to applicable SLs

presented in Section 7.1 and were screened according to parts 1 and 2 of DEQ's soil screening flow chart. Petroleum hydrocarbons, SVOCs, and metals did not exceed applicable SLs in surface soils at CAL.

8.6.3 SUBSURFACE SOIL RESULTS

To assess the current soil conditions near the former CAL area, 16 subsurface soil samples were collected from four locations during the RI. The sampled locations, with associated depth intervals and rationale, were as follows:

- CAL-MIP-02: 8.5 to 9 ft bgs and 20 to 21 ft bgs (confirmation)
  - Additional samples collected from 8 to 9 ft bgs and 11 to 12 ft bgs (fate and transport)
- CAL-MIP-04: 3 to 3.5 ft bgs, 6 to 6.5 ft bgs, and 14 to 14.5 ft bgs, and 23 to 23.5 ft bgs (high resolution)
  - Additional sample collected from 3 to 5 ft bgs (SPLP)
- CAL-MIP-09: 5.5 to 6.5 ft bgs and 19 to 19.5 ft bgs (confirmation)
- CAL-MIP-T03: 4.5 to 5 ft bgs (confirmation)
  - Additional sample collected from 3.5 to 4.5 ft bgs (SPLP)
  - Additional samples collected from 5 to 7.5 ft bgs, 10 to 18.5 ft bgs, and 20 to 25 ft bgs (bulk soil properties)

Subsurface soil samples, aside from soil properties and fate-and-transport samples noted above, were analyzed for VOCs; one location was also analyzed for EPH/VPH, SVOCs, and metals. Detected PCE concentrations exceeded the leaching to groundwater SL at location CAL-MIP-04.

Four samples from one former CAL location were analyzed for EPH/VPH, SVOCs and metals. Analytes were compared to their applicable SLs as described in Section 7. No analytes from these analytical groups were detected above applicable SLs. Subsurface soil analytical data for chlorinated solvents, as well as summary EPH and VPH screening values, are shown on Figure 8-6.

8.7 REX CLEANERS INVESTIGATION RESULTS

This section presents surface and subsurface soil analytical results for former Rex along with a summary of MiHPT results. Detailed MiHPT results and analysis are presented in Appendix D.

8.7.1 MIHPT SUMMARY

A MiHPT investigation was completed at 10 locations near former Rex between December 2 and 20, 2017 (Table 5-2). Of the 17 MiHPT locations identified for Rex in the Work Plan, 10 were installed in the locations as planned. Of the eight locations identified as "tentative" in the Work Plan, seven were not probed; the exception was MIP-T27, which was included in the MiHPT investigation. Most of the tentative locations were excluded due to limited levels of contamination indicated via MiHPT data from fixed locations. MiHPT and related soil sampling locations associated with former Rex are shown on Figure 8-3.

The magnitude of XSD detections from the former Rex property does not suggest an onsite CVOCs source, although a potential PCE source area was identified outside the MiHPT investigation area (Section 8.7.3). However, moderately elevated PID and FID levels are apparent in some locations (REX-MIP-03 and REX-MIP-08). The PID/FID detections with lack of associated XSD readings suggests the presence of hydrocarbons in limited areas around former Rex.

HPT results at the former Rex area exhibit similar trends to BSL and former CAL. Most former Rex MiHPT investigation locations indicate shallow water bearing zones with lower permeability media and deep water bearing zones with higher permeability media. In the shallow water bearing zones, HPT and EC data suggest relatively finer-grained, lower permeability media. However, some locations exhibit low EC and low HPT injection pressure in the shallow zone, which suggests coarse-grained, high-permeability lenses. In general, the shallow portion also exhibits a higher degree of heterogeneity than the deeper water bearing zone. The HPT and EC data suggest little consistency in continuous layers within or between investigation locations across the former Rex investigation area suggesting that the low permeability layers are not connected horizontally in the shallower water bearing zone. The deeper water bearing zone appears to start around 15 ft bgs, is homogeneous, and exhibits higher permeability throughout. Within the deep zone, EC values, HPT injection pressures, and estimated K values are consistent with the values reported above for other MiHPT investigation areas from around 60 to 80 ft/d.

8.7.2 SURFACE SOIL RESULTS

To assess the current conditions at former Rex, five surface soil samples were collected from four locations during the RI. The sampled locations, with associated depth intervals and rationale, were as follows:

- Rex-MIP-03: 0 to 0.5 ft bgs (confirmation)
- Rex-MIP-04: 0 to 0.5 ft bgs (confirmation)
- Rex-MIP-07: 0 to 0.5 ft bgs (confirmation)
- Rex-MIP-08: 0 to 0.5 and 1 to 2 ft bgs (high resolution)

Former Rex surface soil samples were evaluated for VOCs and one location (REX-MIP-08) was also evaluated for SVOCs, EPH/VPH, and metals. Surface soil screening-level exceedances occurred for PCE (Figure 8-7). Detected PCE concentrations exceeded the leaching to groundwater SL in three samples at three former Rex surface soil locations; in addition to the detected values, RLs for PCE in surface soil samples also exceeded the leaching SL.

Petroleum hydrocarbons (analyzed for EPH/VPH via the Montana-modified MADEP Methods), SVOCs (analyzed via EPA Method 8270) and metals (analyzed via EPA Methods 6010 and 7471) were compared to applicable SLs presented in Section 7.1 and were screened according to parts 1 and 2 of DEQ's soil screening flow chart. Petroleum hydrocarbons, SVOCs, and metals did not exceed applicable SLs in surface soils at former Rex.

8.7.3 SUBSURFACE SOIL RESULTS

To assess the current conditions at former Rex, nine subsurface soil samples were collected from four locations during the RI. The sampled locations, with associated depth intervals and rationale, were as follows:

- REX-MIP-03: 10 to 10.5 ft bgs and 17 to 17.5 ft bgs (confirmation)
- REX-MIP-04: 12 to 12.5 ft bgs (confirmation)
- REX-MIP-07: 3.5 to 4 ft bgs (confirmation)
- REX-MIP-08: 5.0 to 5.5 ft bgs, 9.5 to 10.5 ft bgs, 15.0 to 15.5 ft bgs (SPLP), 17.0 to 17.5 ft bgs (high resolution), and 23-23.5 ft bgs

Subsurface soil samples were evaluated for VOCs; one location (REX-MIP-08) was also evaluated for SVOCs, EPH/VPH, and metals. The analyte 1,2,4-trimethylbenzene exceeded the leaching to groundwater SL in one location, at REX-MIP-08 (17-17.5).

Four samples from one former Rex location were analyzed for EPH/VPH, SVOCs and metals. Analytes were compared to their applicable SLs as described in Section 7. Analytes from these analytical groups were not detected above applicable SLs or were not identified as an exceedance due to the depth of the sample (REX-MIP-08 17-17.5 ft bgs exceeded the direct contact SL for two VPH fractions). Subsurface soil analytical data for chlorinated solvents, as well as summary EPH and VPH screening values, are shown on Figure 8-7.

Soil sample locations associated with the sanitary sewer, which was identified as a potential source, were also collected near former Rex. The sampled locations, with associated depth intervals, were as follows:

- Sewer-1: 5.5 to 6.0 ft bgs
- Sewer-2: 5.5 ft bgs
- Sewer-3: 17 ft bgs
- Sewer-4: 14.5 to 15.5 ft bgs

The samples associated with the sewer were analyzed for VOCs, which included chlorinated solvents. All constituents, including PCE, were below detection limits in sewer-area soil sample analytical results.

8.8 DISTRICT 7 HUMAN RESOURCES COUNCIL INVESTIGATION RESULTS

This section presents subsurface soil analytical results and a summary of MiHPT results for D7HRC. A detailed analysis of MiHPT results are presented in Appendix D.

8.8.1 MIHPT SUMMARY

The MiHPT investigation was completed at three locations near D7HRC on November 17, 2017 (Table 5-2). The MiHPT locations were located in accordance with the RIWP (Trihydro 2017b) except for D7HRC-MIP-03, which was relocated from the south side of 1st Avenue North, approximately 205 ft northwest, to the north side of 1st Avenue North, due to local traffic and utility corridors. MiHPT and related soil sampling locations associated with D7HRC are shown on Figure 8-4. The three locations surround the D7HRC potential release area with D7HRC-MIP-01 (upgradient/west), D7HRC-MIP-02 (downgradient/north), and D7HRC-MIP-03 (downgradient/east).

Minor fluctuations in XSD data, which correspond with FID/PID spikes, suggest that low levels of CVOCs may be present in the vadose zone, particularly at depth intervals of 5 to 10 ft bgs. The magnitude of XSD detections suggests that small levels of CVOCs may exist, but does not suggest a local CVOCs source zone. Based on potential XSD detections in the vadose zone, coupled with FID/PID spikes (both of which appear to be relatively minor in scale), small-scale CVOCs impacts in the vadose zone cannot be ruled out for this area.

The HPT and EC data suggest characteristic shallow and deep zones, which is consistent with observations at the other potential source areas included in the MiHPT evaluation. The transition depth interval at D7HRC is relatively shallow, occurring at about 12 ft bgs. The shallow zone is highly heterogeneous, with HPT injection pressures spanning multiple orders of magnitude and EC values that fluctuate substantially.

8.8.2 SUBSURFACE SOIL RESULTS

To assess the current conditions at D7HRC, in addition to field observations and MiHPT evaluation, one confirmatory subsurface soil sample was collected from D7HRC-MIP-01 at 7 to 9 ft bgs. The sample was evaluated for VOCs, SVOCs, EPH/VPH, and metals. The sample was screened against applicable SLs as described in Section 7. No analytes detected from these analytical groups exceeded applicable SLs. However, for several key analytes (including PCE and 1,2-DCA) the laboratory RLs exceeded DEQ Leaching SLs. Due to both screening-level exceedances for soil samples and potential XSD/FID/PID spikes noted in MiHPT data (as noted in the previous subsection), small-scale CVOCs impacts in the vadose zone cannot be ruled out for this area.

8.9 ALSCO INVESTIGATION RESULTS

To assess the current conditions at ALSCO, subsurface soil samples were collected from three locations during the RI. The sampled locations, with associated depth intervals and rationale, were as follows:

- ALSCO-GW-02: 9 to 10 ft bgs (confirmation)
- ALSCO-GW-03: 2.0 to 2.8 ft bgs (confirmation)
- ALSCO-GW-04: 14 to 15 ft bgs (confirmation)

The samples were evaluated for VOCs, SVOCs, EPH/VPH, and metals. The sample was screened against applicable SLs as described in Section 7. No detected analytes from these analytical groups exceeded applicable SLs. As described in Section 5.2, groundwater PCE screening samples were also collected in conjunction with subsurface soil sampling. Five groundwater screening samples were collected at ALSCO, none of which contained PCE above the RL.

8.10 WETZEL'S CLEANERS INVESTIGATION RESULTS

To assess current conditions at Wetzel's Cleaners, subsurface soil samples were collected from two Wetzel's Cleaners locations during the RI. The sampled locations, with associated depth intervals and rationale, were as follows:

- WETZ-GW-01: 10 to 15 ft bgs (confirmation)
- WETZ-GW-02: 10 to 15 ft bgs (confirmation)

Soil samples were collected over a 5 foot interval due to poor sample recovery. The samples were evaluated for VOCs, SVOCs, EPH/VPH, and metals. The samples were screened against applicable SLs as described in Section 7. No detected analytes from these analytical groups exceeded applicable SLs.

As described in Section 5.2, groundwater PCE screening samples were also collected in conjunction with subsurface soil sampling. Two groundwater screening samples were collected at Wetzel's. The upgradient sample, WETZ-GW-01, contained PCE at 79.7 µg/L, and the downgradient sample, WETZ-GW-02 contained PCE at 2.7 µg/L. As described in Section 9.9, these PCE results appear to be consistent with the plume originating at BSL.

It is unclear if hydrocarbon contamination near Wetzel's may be depressing the PCE results in WETZ-GW-02 which is located downgradient of WETZ-GW-01. A strong petroleum odor was observed while logging the soil boring and the soil samples were collected over a large interval (5 ft). Sample results for PCE were <21.2 µg/kg which is below the DEQ leaching to groundwater SL of 23 µg/kg. It is possible that lower level CVOCs soil contamination could be present in a thin soil horizon that was missed and/or co-mingled with petroleum contamination and was diluted over the sample collection interval. However, no other CVOCs, including daughter products, were detected which would support WETZ-GW-02 results not being depressed by hydrocarbon contamination.

8.11 HOSPITAL LAUNDRY SERVICE INVESTIGATION RESULTS

To assess current conditions at HLS, RI subsurface soil samples were collected from two locations downgradient of HLS, which were located in the MDT right-of-way. The sampled locations, with associated depth intervals and rationale, were as follows:

- HLS-GW-03: 7 to 8 ft bgs (confirmation).
- HLS-GW-04: 3 to 4 ft bgs (confirmation).
- Soil samples were evaluated for VOCs, SVOCs, EPH/VPH and metals. The samples were screened against applicable SLs as described in Section 7. Benzo(a)pyrene exceeded the direct-contact residential RBSL in both samples. No other detected analytes exceeded applicable SLs.

As described in Section 5.2, groundwater PCE screening samples were also collected in conjunction with subsurface soil sampling. Three groundwater screening samples were collected at HLS. PCE was detected in all three samples, but below the DEQ-7 standard of 5 µg/L and the required reporting value. PCE screening concentrations ranged from 0.28 to 0.39 µg/L.

8.12 NON-AQUEOUS PHASE LIQUID OCCURRENCE

An objective of the RI was to identify potential chlorinated solvent source areas, which could include surface or subsurface soils containing NAPL. Surface and subsurface soil investigations at the Facility did not encounter NAPL. Investigations conducted in known or suspected source areas did not encounter contaminant concentrations suggestive

of free-phase light or dense NAPL. Limited LNAPL was encountered during the groundwater investigation, and is discussed in Section 9.9. Contaminant concentrations encountered during the VI investigation may be indicative of residual, presently inaccessible source material located beneath occupied structures. Potential residual NAPL analysis is presented in the fate and transport discussion in Section 12.4

8.13 SPLP ANALYSIS

Soil samples were collected for SPLP analysis from select locations at BSL, CAL, and REX to estimate the site-specific adsorption-desorption potential of a COPC. SPLP extracts were analyzed for 11 VOCs; results are shown in Table 8-9. Analyte concentrations in SPLP extracts were below detection limits for 10 of the 11 analytes in each sample. PCE was detected in the extract in the following two samples:

- BSL-MIP-09 at a depth of 12 to 12.5 ft bgs (15 J µg/L)
- CAL-MIP-04 at a depth of 1 to 2 ft bgs (5.3 J µg/L)

The DEQ-7 SL for PCE is 5.0 µg/L. Thus, the estimated concentrations (as indicated by the J flag) at the two locations exceed applicable groundwater standards, which suggests that the potential exists for soil leachate to impact groundwater. Both of these exceedances occur at locations where total soil PCE concentrations were above the DEQ leaching to groundwater SL (23.18 µg/kg). The PCE concentrations in soil samples associated with the SPLP locations were 149 µg/kg at BSL-MIP-09 (12 to 12.5 ft bgs; Table 8-5) and 87.7 µg/kg at CAL-MIP-04 (1 to 2 ft bgs; Table 8-1).

9.0 NATURE AND EXTENT OF CONTAMINATION – GROUNDWATER

Historical groundwater sampling at the Facility has primarily focused on chlorinated solvent impacts downgradient of the BSL property. During the RI, three groundwater monitoring events were conducted to evaluate the nature and extent of contamination in groundwater at the Facility, including potential impacts from other known or potential sources. Groundwater monitoring was conducted in July 2017, May 2018, and September 2018. Groundwater samples were analyzed for VOCs, SVOCs, EPH/VPH, PCBs, dissolved metals, and MNA parameters as described in Section 4, and as shown in groundwater sampling schedule tables presented in Appendix D of the RIWP (Trihydro 2017b), and Tables 9-1 through 9-6 of this report. Groundwater analytical results were compared to Circular DEQ-7 human health standards (DEQ 2017), RBCA RBSLs (DEQ 2018b) or EPA Tapwater RSLs (2018b) as described in Section 7.1.1.

Chlorinated solvents are the most prevalently encountered, and widely distributed contaminants at the Facility. Based upon PCE groundwater concentrations observed during RI investigation activities, the PCE groundwater plume exceeding the 5 µg/L DEQ-7 groundwater standard covers approximately 600 acres in urban Billings. PCE concentrations exceeding 50 µg/L were generally observed over a 250 acre area at the Facility. Petroleum hydrocarbons and SVOCs were not found in excess of applicable standards site wide, and were observed only infrequently, typically adjacent to known or suspected petroleum hydrocarbon release areas.

Groundwater plume maps were drawn using kriging software, and manually adjusted as needed primarily to account for potentially reducing conditions associated with petroleum releases leading to localized reductive dechlorination. Since the size of the Facility and spacing of the monitoring well network do not typically allow fine enough resolution to map these localized areas of lower CVOCs concentrations, the wells with these conditions were included within the plume boundaries even if their associated CVOCs concentrations might place them slightly outside the plume. Petroleum compounds tend to be less mobile in groundwater than CVOCs, so the effects of a petroleum release are typically observed on a much smaller scale than the PCE plumes observed at the Facility. Monitoring wells associated with petroleum releases (e.g., LUST sites and the BNSF Railyard) are biased toward locations with petroleum contamination, and therefore the petroleum concentrations along with field parameters were used to evaluate whether these wells should be included within plume boundaries.

9.1 CONTAMINANTS OF POTENTIAL CONCERN SELECTION

9.1.1 HISTORICAL CONTAMINANTS OF POTENTIAL CONCERN

Prior to the RI activities, groundwater monitoring was performed periodically since 2006 by EPA as part of investigations into the BSL area and the BPCE Facility. Other investigation areas and LUST sites also have had previous groundwater monitoring activities. Historical groundwater analytical data from 1988 to 2016 contains results for 102 analytes, mostly VOCs in the vicinity of the Facility. Historical COPCs were identified by comparing groundwater analytical results to current applicable standards or SLs, as noted in Section 7 and in the Facility DSR (Trihydro 2017a). The following analytes were detected above applicable SLs and are considered historical COPCs for the Facility:

- Benzene
- cis-1,2-DCE
- PCE
- TCE
- VC

Benzene exceeded the DEQ-7 groundwater SL 43 times at 28 locations throughout the Facility, including 5 wells associated with current or former LUST sites at CENEX-2 (Facility grid -7,1), CENEX-3 (-7,1), PEP01 (6,3), PEP04 (6,3), and SMW07 (-1,-1) as detailed in the DSR (Trihydro 2017a). Other benzene exceedances were located across the Facility, from near the BSL source area (BPGP02 at grid 1,1) to more than a mile northeast of the BSL source area (BPGP89 at grid 11,6). PCE, TCE, *cis*-1,2-DCE, and VC exceeded their respective DEQ Circular 7 groundwater SLs across the Facility, and generally appeared to be associated with the BSL source area. However, historical data at the former Cenex service station, now the ZipTrip service station on Central Avenue (CENEX-1 through CENEX-8), have evidence of CVOCs contamination, which suggests an upgradient chlorinated solvent source apart from BSL. Additionally, analytical results from monitoring wells at the Riverstone Health Center (RH-MW-1 through RH-MW-8 in grid 17,8) also suggested an additional source area at the distal northeast edge of the plume based on historical data.

Historical investigations occasionally used a Hapsite GC/MS during select events to provide field analytical results for environmental samples. As noted in the DSR (Trihydro 2017a), much of the onsite laboratory data did not contain data validation information, and comparison split samples evaluated by both Hapsite methods and off-site analytical laboratories often resulted in significantly different analyte concentrations. Trihydro evaluated the available historical data in the DSR and determined the field laboratory data to be useful for order of magnitude evaluations and historical

comparisons, but did not consider it adequate to support quantitative evaluation of current conditions. Therefore, for compounds where historical exceedances are only observed in data sets considered inadequate for quantitative evaluation, and where exceedances are less than 5% of the samples, those analytes were not retained as historical groundwater COPCs at the Facility. However, this did not preclude the evaluation of those analytes as potential COPCs during the RI. Further discussion is presented below.

Eight additional compounds were detected above applicable SLs in historical samples in less than 5% of samples. These compounds are 1,1-DCE, chloroform, ethylbenzene, methylene chloride, MTBE, naphthalene, toluene, and *trans*-1,2-DCE. These analytes were not retained as historical COPCs at the Facility, but were still evaluated during screening for current COPCs at the Facility.

9.1.2 CURRENT CONTAMINANTS OF POTENTIAL CONCERN

To evaluate current groundwater conditions at the Facility, three groundwater sampling events were conducted, collecting groundwater samples from 88 wells during the July 2017 event, 105 wells during the May 2018 event, and 106 wells during the September 2018 event. A comparison of the analytical results from these three events to applicable SLs (as described in Section 7) resulted in 12 current COPCs identified for groundwater at the Facility. The following analytes are current COPCs for Facility groundwater:

- 1-methylnaphthalene
- Benzene
- C5-C8 aliphatic hydrocarbons
- C9-C10 aromatic hydrocarbons
- C9-C12 aliphatic hydrocarbons
- *cis*-1,2-DCE
- PCE
- TCE
- VC
- Cobalt
- Manganese
- Iron

9.2 ALLUVIAL AQUIFER GROUNDWATER RESULTS – JULY 2017

Historical groundwater sampling in and near the Facility has focused primarily on VOCs, specifically CVOCs, occasionally to the exclusion of other potential contaminants. To evaluate the nature and extent of other constituents, an expanded analyte list was used for the July 2017 groundwater sampling event, including SVOCs, EPH, VPH, dissolved metals, and MNA parameters. Sampling was conducted over two separate mobilizations, the first of which covered the main body of the plume and the majority of the wells, and the second to address 7 wells located on or adjacent to the BNSF railyard. Wells chosen for the expanded analyte list were selected to provide adequate spatial coverage of the Facility, and/or to account for other potential nearby sources of contamination (e.g., LUST sites, other hazardous waste facilities, or DEQ State Superfund Sites). Groundwater sampling and fluid level monitoring were conducted at 88 wells during the July 2017 sampling event. Groundwater in the shallow alluvial aquifer typically ranged between 7 and 16 bgs. The potentiometric surface of groundwater was generally to the east and slightly northeast, and is shown on Figure 9-1. Fluid level and water elevation/surface data is presented in Table 9-1.

Several wells were not sampled as proposed in the groundwater sampling memo for July 2017 (Appendix C-1). Wells BPGP39, BPGP73, F3, E1, D5, BL-GW-5, Weston-MW-2, and GWIC-281548 could not be located during the sampling event, and were not sampled. Well GSMW-6 was replaced with GSMW-5 due to access conditions in the field. BNMW-7 contained 0.02' of free product, and was replaced by BNMW-17. BPGW02 had an obstruction at depth and could not be sampled. Well EMW-32 was located and replaced F3. SD-I-02 was located and used to delineate potential upgradient impacts in the western portion of the plume. BPGP29 was sampled in replacement of BPGP39. These changes based on site conditions were communicated to DEQ during weekly status meetings.

The following subsections describe the analytical results for July 2017, Tables 9-1 through 9-6 contain analytical results compared to applicable SLs, and Figures 9-2 through 9-5 illustrate notable analytical results.

EPH/VPH

EPH/VPH concentrations were evaluated at 51 wells during the July 2017 sampling event. July 2017 petroleum hydrocarbon results are shown in Table 9-2, and detected exceedances are shown on Figure 9-2. Two petroleum hydrocarbon compounds were primarily detected in exceedance of applicable RBSLs or DEQ-7 human health standards: benzene, and adjusted C5-C8 aliphatic hydrocarbons. Ethylbenzene was detected at one location (GSMW-5) at 700J- µg/L which equals the applicable RBSL SL of 700 µg/L. Benzene was analyzed at 51 wells via the Montana-modified Massachusetts VPH method, and at 88 wells using EPA Method 8260. Benzene was detected in groundwater in excess of the RBSL (which is the same as the DEQ-7 standard of 5 µg/L) at four locations: BPGP02 (1,1), BPGP78 (1,1), BPGP89 (11,6), and GSMW-5 (3,-2). Of the 51 locations evaluated for VPH, C5-C8 aliphatics exceeded the RBSL of 650 µg/L at eight locations: BPGP02 (1,1), BPGP46 (1,1), BPGP59 (1,1), BPGP66 (1,1), BPGP80 (1,1),

BPGP89 (11,6), EMW-09 (-1.-1), and GSMW-5 (3,-2). Of the fifty-one wells screened for EPH, four were in excess of the 1,000 µg/L SL: BNMW-17 (13,7), EMW-09 (-1,-1), EMW-21 (16,11), and GSMW-5 (3,-2). EPH fractionation was performed on the samples from these wells, and none were found to contain EPH fractions in excess of an applicable RBSL. Additionally, two petroleum compounds evaluated using the VPH method (benzene and naphthalene) had MDLs above applicable SLs at EMW-09 (-1,-1), due to a higher dilution factor from elevated concentrations of other contaminants in the sample. Detection limits for these compounds using method EPA 8260 were below applicable SLs. Most petroleum fraction exceedances appear to be associated with existing or former LUST sites.

SVOCs

SVOC results are shown in Table 9-3, and exceedances are shown with EPH/VPH and SVOC groundwater results on Figure 9-2. Two SVOC analytes were detected in excess of applicable SLs out of 37 locations evaluated, at one well each. BPGP78 (1,1) contained 1-methylnaphthalene in excess of the 11 µg/L RBSL. Bis(2-ethylhexyl)-phthalate was detected in one well at 20 µg/L, which is in excess of the DEQ-7 standard of 6 µg/L at CENEX-5 (-7,-1). Ten SVOC compounds had non-detect RBSL or DEQ-7 exceedances; the majority of which are PAHs for which the generic SLs are often lower than the lowest achievable detection limits at analytical laboratories. The compounds were 1-methylnaphthalene, 2-methylnaphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, fluoranthene, hexachlorobutadiene, indeno(1,2,3-cd)pyrene, pentachlorophenol, and pyrene. With the exception of the lone exceedance of 1-methynaphthalene noted above, none of these other nine compounds were detected in exceedance of an applicable SL.

Dissolved Metals

Metals results are presented in Table 9-4. Detected concentrations of dissolved arsenic and selenium exceeded EPA Tapwater RSLs but were less than the DEQ-7 standard. Dissolved cobalt, iron, and manganese do not have DEQ-7 standards; however, DEQ has proposed standards for iron and manganese, but the rule is not final (DEQ 2018f). Dissolved cobalt exceeded the Tapwater RSL at 15 wells. Dissolved iron exceeded the Tapwater RSL at BNMW-17 (13,7). The detected concentrations of dissolved manganese exceeded the Tapwater RSL at 22 wells.

VOCs

Five VOCs were detected in excess of applicable DEQ-7 human health standards: PCE, TCE, *cis*-1,2-DCE, VC, and benzene (DEQ-7 standard is the same as its RBSL, also detected in VPH samples). The five compounds were evaluated at all 88 wells sampled in July 2017. PCE was detected in 75 samples and exceeded the DEQ-7 standard of 5 µg/L in 68 samples. Twenty-two wells contained PCE between 5 and 50 µg/L, 29 contained PCE between 50 and 500 µg/L, 13 wells contained PCE between 500 and 5000 µg/L, and 6 wells contained PCE at concentrations in excess

of 5,000 µg/L, with a peak concentration of 47,400 µg/L at BPGP49 (1,1). These six highest concentration wells are located within the known source area at BSL (1,1), and one of the wells, BPGP74, is located within the sheet pile wall installed during the EPA interim remedial action in 2008. July 2017 PCE concentrations are shown on Figure 9-3.

PCE degradation/daughter products had notable exceedances during July 2017. TCE exceeded the DEQ-7 standard of 5 µg/L in 49 wells and had a peak concentration of 444 (J-) µg/L at BPGP61. Of the exceedances, 61% were less than 50 µg/L. TCE concentrations and isocontours for the July 2017 sampling event are shown on Figure 9-4. C*is*-1,2-DCE exceeded the DEQ-7 standard of 70 µg/L in 6 locations: BPGP46 (1,1), BPGP74 (1,1), BPGP89 (11,6), BPGW01 (1,1), EMW-11 (3,3), and EMW-15 (6,2). TCE had a peak concentration of 175 µg/L at EMW-11 (3,3). The CVOC analyte VC exceeded the DEQ-7 standard of 0.2 µg/L in 5 locations: BPGP29 (9,7), BPGP74 (1,1), BPGP84 (5,2), BNMW-9 (14,6), and EMW-15 (6,3), with a peak concentration of 3.5 µg/L at BPGP84. *Cis*-1,2-DCE and VC exceedances are shown on Figure 9-5. July 2017 VOC results are presented in Table 9-5.

The highest PCE groundwater standard exceedances were typically between BSL and the adjacent building at 711 Central Avenue. In monitoring wells downgradient of the alley between BSL and 711 Central Avenue, PCE concentrations appeared to decline by an order of magnitude within approximately 200 ft to the northeast and east. Figure 9-3 shows groundwater PCE isocontours and concentration data for the July 2017 sampling event. PCE exceedances from the BSL area extended from the eastern edge of BSL and continued approximately 1.5 miles to the northeast. The apparent width of the plume, as indicated on Figure 9-3, was limited in delineation by the placement of the existing wells, which included only approximately 9 wells on the over 4.5 mile perimeter of the PCE plume with PCE concentrations less than the standard. To the west of BSL, PCE exceedances were observed north of the former CAL area and continued approximately 0.3 miles northeast to irrigation wells in Central Park along 10th Street West and north on Billings Public Schools property at the corner of St. Johns Avenue and 10th Street West. Similarly, another exceedance area is observed east of the former Rex area in wells at the northeast edge of the BSL plume.

Of the 88 monitoring wells sampled by Trihydro in 2017, 63 were also sampled in 2015 by EPA or other agencies investigating groundwater contamination in Billings (Trihydro 2017a). Compared to groundwater data from 2015, PCE concentrations in groundwater increased in 18 of the 63 wells (28.5%), decreased in 25 of the 63 wells (39.7%), and had no significant change in 20 of the 63 wells (31.7%). The largest changes in groundwater concentrations were in wells located near the BSL source area. Monitoring well BPGP49 had the largest increase, from 8,100 to 47,400 µg/L. Six additional wells contained PCE at concentrations greater than 1,000 µg/L in 2017: BPGP46, BPGP53, BPGP58, BPGP59, BPGP63, and BPGP63B. All seven of these wells are adjacent to or within 200 ft of the BSL source area and have higher concentrations in 2017 compared to those measured in 2015. Seven additional wells contained PCE at concentrations between 100 and 1000 µg/L, and had apparent concentration increases from 2015 to 2017. Four of

these monitoring wells, BPGP61, BPGP66, BPGP67, and BPGW01, are located within 200 ft of BSL; the remaining three, BPGP80, BPGP81, and BPGP87, are located within 800 ft of the BSL source area. TCE concentrations increased in 12 wells, decreased in 29 wells, and had no significant change in 22 wells. TCE concentration increases of over 100 µg/L occurred in two wells, BPGP46 (1,1) and BPGW01 (1,1), both of which are located near the BSL source area. Detections of other PCE degradation products are not easily comparable due to detection limit differences and fewer available historic detections.

In the 25 groundwater wells that had not been sampled in 2015, PCE concentrations ranged from non-detect (<1 µg/L) to 136 µg/L. Observations of elevated PCE concentrations in wells BMW-1 (124 µg/L), BMW07-1 (57.8 µg/L) and BMW-4 (55.9 µg/L) suggest that the groundwater plume concentrations south of the Montana Avenue/BNSF railroad corridor along 1st Avenue South have increased (Trihydro 2017a). When last sampled in 2012, groundwater PCE concentrations were observed at 69 µg/L for BMW-1 (9,3), 18 µg/L for BMW07-1 (10,3), and 34 µg/L for BMW-4 (10,3). Three wells are located downgradient of BSL, which were part of a petroleum investigation area and were not previously known to have been sampled for VOCs: EMW-18 (17,11), EMW-21 (16,11), EMW-26 (17,11). These wells had evidence of low levels of petroleum hydrocarbons, but did not have PCE or TCE detections. Two wells associated with LUST remediation activities at the Zip Trip/Cenex station at 1201 Central Avenue, located downgradient of former CAL, have analytical results for PCE at 24.9 µg/L at CENEX-5 (-7,1) and 42.8 µg/L for ZPMW-1(-7,1). Two irrigation wells, SD-I-01 (-4,1) and SD-I-02 (-5,2), located on Billings School District property also have PCE analytical results in exceedance of DEQ-7 groundwater standards, at 7.2 and 21.9 µg/L, respectively.

Groundwater sampling was conducted at a range of monitoring wells associated with former UST and/or LUST sites. The occurrence of petroleum hydrocarbons in conjunction with CVOCs can stimulate natural biodegradation of chlorinated solvents through reductive dechlorination. Comingled plumes of petroleum hydrocarbons and chlorinated solvents in anaerobic subsurface conditions typically have anaerobic bacteria that use the CVOCs as electron acceptors and the petroleum constituents as electron donors in lieu of or along with other organic carbon electron donors. Therefore, the anaerobic bacteria “respire” and degrade the chlorinated solvents, therefore depressing chlorinated solvent concentrations (ITRC, 2008).

Within the BPCE Facility groundwater plume, observations of elevated petroleum compounds, particularly hydrocarbons with higher solubility such as benzene, may be associated with depressed PCE and TCE concentrations. This is apparent at BPGP89 where surrounding wells indicate elevated PCE concentrations, but an elevated benzene concentration (250 µg/L) is observed while PCE concentrations are less than 1 µg/L. Additionally, *cis*-1,2-DCE concentrations are elevated compared to nearby wells, indicating that reductive dechlorination is occurring near the well. Wells BPGP94 and BPBP22 both had detections of C5-C8 aliphatics below the RBSL, but the presence of

petroleum hydrocarbons may indicate that reducing conditions could be present in groundwater in the area. This has the potential to result in chlorinated solvent concentration depression due to reductive dechlorination. The former Standard Battery LUST facility (Facility ID 5613510) is located upgradient of BPGP22 and BPGP94, and up- and slightly cross-gradient of BPGP88. Three wells were sampled at the northeastern edge of the plume (EMW-18, EMW-21, and EMW-26) that are associated with a petroleum release site response. Low levels of petroleum hydrocarbons and reducing conditions were detected in two of the three wells, and PCE was not detected above 1 µg/L, but later sampling indicates these wells may not have been impacted by PCE migration. TCE groundwater concentrations are depressed in well BPGP89, as well as in wells on the BNSF site, and wells associated with historical releases at service stations along 1st Avenue South.

Other wells within the plume, such as BPGP88, show depressed PCE concentrations compared to nearby wells, but did not contain petroleum hydrocarbons nor reducing conditions indicative of petroleum contaminants during the July 2017 sampling event. Benzene was detected in the well during EPA's 2015 sampling event, and PCE was elevated consistent with concentrations in other nearby wells. Local groundwater chemistry may also affect contaminant concentrations.

Five analytes from 88 analyzed locations do not have DEQ-7 standards or RBSLs, however, each compound was detected above its respective EPA Tapwater RSL: 1,2,4-trimethylbenzene, isopropylbenzene, n-propylbenzene, 1,3,5-trimethylbenzene, and 1,1,1,2-tetrachloroethane. 1,2,4-trimethylbenzene was detected above the Tapwater RSL of 56 µg/L at six wells. Isopropylbenzene and n-propylbenzene were each detected above their respective Tapwater RSL at three wells. 1,3,5-trimethylbenzene and 1,1,1,2-tetrachloroethane were each detected above their respective Tapwater RSLs at one well.

Thirteen VOCs had non-detect exceedances of DEQ-7 standards or RBSLs: 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, 1,2-DCA, bromomethane, carbon tetrachloride, dibromochloromethane, *cis*-1,3-dichloropropene, methylene chloride, PCE, *trans*-1,3-dichloropropene, and VC.

MNA Parameters & Field Parameters

MNA parameters are examined to evaluate subsurface degradation processes and the likelihood of an anaerobic or aerobic environment that is conducive to differing types of biotic transformations of COPCs. Chlorinated solvents, including PCE and TCE, typically degrade during anaerobic biodegradation by reductive dechlorination in the presence of a specific microbial community (EPA 2018a). However, fast-moving unconfined, shallow groundwater aquifers typically have aerobic conditions that are not as conducive to anaerobic biodegradation. Typically, a reducing environment is optimal for anaerobic biodegradation; however, alternate electron acceptors nitrate, manganese, iron,

and sulfate must be depleted, along with methanogenesis, before reductive dechlorination can occur (EPA 2018a). While these environments are progressively more reducing, they can occur simultaneously as plume conditions vary spatially, especially in a study area as large as this Facility. To evaluate the general alluvial aquifer conditions and to help in future evaluation of MNA, MNA parameters were analyzed at 29 wells across the Facility in July 2017. In addition to the indicator field parameters DO and ORP, the MNA parameters collected for the Facility wells included the following: chloride, sulfate, methane, ethane, ethene, nitrate, nitrite, and *toc*. MNA parameters and field parameter results for July 2017 are presented in Table 9-6.

Chloride can be introduced to an aquifer through many processes; however, during anaerobic biodegradation of PCE, chloride ions are sequentially removed during transition between degradation products (EPA 2018a). Chloride concentrations in July 2017 wells ranged from non-detect to 414 mg/L, with a median concentration of 85.6 mg/L. The highest chloride concentration of 414 mg/L was detected in well BPGP50 (14,10), which is located directly downgradient of Wetzel's Cleaners. However, BPGP50 also has over 2 mg/L DO and ORP of around 200 mV, which indicates an aerobic environment, but it is possible chloride is being advected to the area from an upgradient area with more strongly reducing conditions or from alternate environmental sources.

Sulfate concentrations were greater than 1,000 mg/L at nine MNA-sampled wells during the July 2017 groundwater event including the following: BPGP48, BPGP41, BPGP50, BPGP15, BPGP22, BMW-4, BPGP-42, BPGP92, BNMW-23 (Table 9-6). Sulfate levels less than 20 mg/L are desirable, but not necessary, to have anaerobic biodegradation of chlorinated solvents (EPA 2018b). For the July 2017 sampling event, no wells had sulfate lower than 20 mg/L. Sulfate concentrations ranged from 136 to 1,890 mg/L, with a median concentration of 1,040 mg/L.

Nitrogen or the combination of nitrate and nitrite are used as indicator parameters. If nitrate and nitrite are low compared to background concentrations, and other reducing conditions exist, the aquifer may be nearly reducing enough for reductive dechlorination (EPA 2018a). Typically, nitrogen less than 1.0 mg/L is ideal for reductive dechlorination. Nitrate and nitrite were detected in each sample, and concentrations ranged from 0.011 to 17 mg/L, with a median concentration of 2.65 mg/L. Nitrogen was below 1 mg/L for July 2017 MNA-sampled wells BPGP02, BPG66, EMW-21, and BPGP41.

Carbon sources available in the groundwater (colloidal or dissolved) can be evaluated with the *toc* parameter. The less carbon available, the more likely the microbes are to use other carbon sources such as COPCs (EPA 2018a). *Toc* ranged from non-detect to 11.3 mg/L, with a median concentration of 1.2 mg/L. Two locations contained elevated *toc* when compared to the rest of the plume: BPGP02 (6.8 mg/L) and EMW-21 (11.3 mg/L) are known to have petroleum hydrocarbon groundwater impacts which may be contributing to elevated *toc* concentrations.

A final end product of reductive dechlorination is ethene. Evaluating the ethane and ethene concentrations in known reductive dechlorination environments can help identify if the correct microbial community is present to convert VC (EPA 2018a). Elevated levels of ethane and ethene, compared to typical groundwater concentrations, are indicators of reductive dechlorination. Ethene and ethane were not detected above the detection limit in the July 2017 MNA-sampled wells. Methane is typically also sampled with ethane and ethene since elevated methane comes from methanogenesis processes and is also an indicator of a highly reduced groundwater environment (EPA 2018a). Methane was detected at 10 of 29 locations, with its highest concentration detected at EMW-21, which as previously noted, has petroleum hydrocarbon impacts which likely contribute to geochemical conditions in the subsurface.

Field parameters were collected during groundwater sampling, including ORP, DO, specific conductance, temperature, turbidity, and pH. Groundwater conditions indicate generally oxidizing environments; however, reducing conditions are routinely observed in areas where an additional carbon source is available as a terminal electron receptor (i.e. in locations with hydrocarbon contamination). This is commonly observed in wells near former LUST sites, or petroleum hydrocarbon releases, including a former UST behind BSL near the alley between BSL and St. John's Avenue (LUST Facility ID 5604214), the former Short Stop Exxon service station (LUST Facility ID 5606609) upgradient of BSL, current USTs at the Pepsi bottling plant (LUST Facility ID 5608323), an auto dealership and repair shop on 1st Avenue North (currently Steve's Auto Sales at 3520 1st Avenue North), UST release from Empire Motors on 2nd Avenue North (LUST Facility ID 5608351), the former Bair's Service Station (LUST Facility ID 5605757), and the BNSF railyard (DEQ Superfund CECRA Facility). Figure 9-2 includes locations that have identified LUST or UST sites nearby. Some petroleum impacts may emanate from UST facilities that are undocumented LUSTs.

Thirteen of the 88 wells sampled had reducing environments based on negative ORP and low DO (<1 mg/L) when sampled (BNMW-17, BNMW-23, BPGP02, BPGP17, BPGP46b, BPGP78, BPGP89, BPGP91, EMW-09, EMW-15, EMW-21, GSMW-5, and Whiteley MW-1). Ten of the wells are in or adjacent to known historical hydrocarbon releases. BPGP91 is not located in or near a known hydrocarbon release, and did not contain compounds above applicable SLs, and only one compound above detection limits (*cis*-1,2-DCE at 9.2 µg/L). BPGP46b (1,1) is a poorly producing deeper well where reducing conditions were observed, along with PCE and TCE in excess of applicable SLs. BPGP17 contained PCE and TCE at concentrations exceeding DEQ-7 standards, but at lower concentrations than nearby wells. However, BPGP17 also contained C5-C8 aliphatic hydrocarbons below applicable SLs, which may account for slightly depressed concentrations of chlorinated compounds compared to nearby wells. MNA general trends for the three groundwater sampling events are noted in Section 9.4.

9.3 ALLUVIAL AQUIFER GROUNDWATER RESULTS – MAY 2018

Groundwater sampling and fluid level monitoring was conducted at 105 wells during the May 2018 sampling event. Trihydro proposed a revised sampling suite, based on the July 2017 results. The new sampling schedule included 35 new wells installed during spring 2018, to further characterize the plume boundary and water within the bedrock near BSL. Fluid level data for the sampling event is presented in Table 9-1. Analytical results are presented in Tables 9-2 through 9-6. Groundwater in the shallow alluvial aquifer typically ranged between 6 and 17 ft bgs, with a mean depth to groundwater of 12.01 ft bgs. One monitoring well, MW-113 (20,9) had groundwater present at 2.76 ftZbgs. This set of fluid level data is not directly comparable to the July 2017 fluid level data as it includes 16% more wells in distal areas upgradient and down gradient of the July 2017 wells, and also is recorded during a different season. However, the data can be used to look at individual temporal trends in alluvial wells, which indicated that 75 of the 105 wells sampled (71%) were at a seasonal high groundwater elevation in May 2018. Two bedrock wells were gauged and contained groundwater at 32.73 (MW-126) (1,1) and 42.08 (MW-127) (1,1) ft bgs, although these levels do not appear to represent static water levels as measurements were taken soon after well installation and development. The shallow groundwater potentiometric surface was generally to the east and slightly northeast, and is shown on Figure 9-6.

EPH/VPH

Complete May 2018 petroleum hydrocarbon results are shown in Table 9-2, and EPH/VPH exceedances are shown on Figure 9-7. Twenty-one wells were evaluated for petroleum hydrocarbon compounds using the Montana-modified MADEP EPH and VPH methods (including newly installed wells and existing wells that had previously exceeded applicable SLs). Three compounds were detected in exceedance of applicable RBSLs or DEQ-7 human health standards: benzene, C5-C8 aliphatic hydrocarbons (adjusted), and C9-C10 aromatic hydrocarbons (unadjusted). Five wells contained EPH concentrations in excess of the 1,000 µg/L SL and EPH fractionation was performed on the samples from these wells. None of the samples contained EPH fractions in excess of an applicable RBSL. Of the 21 locations evaluated for VPH, C5-C8 aliphatics exceeded the RBSL (650 µg/L) at four locations (BPGP78 (1,1), BPGP89 (11,6), EMW-09 (-1,-1) and MW-117 (16,11)). Benzene was evaluated at each well sampled during the May 2018 sampling event via EPA Method 8260, and at 21 wells using the Montana-modified Massachusetts method for VPH. Benzene was detected in groundwater in excess of the RBSL (5 µg/L) at four locations (BPGP02 (1,1), BPGP78 (1,1), BPGP89 (11,6), and MW-117 (16,11)). The C9-C10 aromatic hydrocarbons concentration exceeded the 1,100 µg/L RBSL at MW-117. Additionally, two petroleum compounds had MDLs above applicable SLs, either due to practical limitations of the analytical method, or due to elevated concentrations of other contaminants in the sample. EPH/VPH compounds which had non-detect RBSL or DEQ-7 exceedances were benzene and MTBE.

SVOCs

SVOC results are shown in Table 9-3, and SVOC exceedances are shown with EPH/VPH results on Figure 9-7. Two SVOCs were detected in excess of applicable SLs, at one well each. MW-117 (16,11) contained 1-methylnaphthalene in excess of the 11 µg/L RBSL. Bis(2-ethylhexyl)phthalate was detected in well MW-111 (17,7) at a concentration in excess of the DEQ-7 standard of 6 µg/L MW-111 (17,7). Compounds which were not detected during the sampling event, but had RLs which exceeded applicable RBSL or DEQ-7 SLs were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene and pentachlorophenol.

PCBS

Two monitoring wells, MW-132 (18,10) and MW-133 (18,10), were evaluated for the presence of PCBs due to historical records indicating potential electrical transformer maintenance at nearby upgradient locations. PCBs were not detected in either sample, and detection limits did not exceed DEQ-7 human health standards. PCB results are also presented in Table 9-3, with SVOC results.

Dissolved Metals

Metals results are presented in Table 9-4. Detected concentrations of dissolved arsenic, selenium, and thallium exceeded EPA Tapwater RSLs, but were less that the DEQ-7 standard. Dissolved aluminum, cobalt, iron, manganese, and vanadium do not have DEQ-7 standards; however, DEQ has proposed standards for iron and manganese, but the rule is not final (DEQ 2018f). The detected concentrations of dissolved aluminum and vanadium exceeded the Tapwater RSLs at well EMW-03 (-8,-1). Dissolved cobalt exceeded the Tapwater RSL at 13 wells. Dissolved iron exceeded the Tapwater RSL at 4 wells out of 21 sampled; however, that is not indicative of the entire well network since metals analysis was removed from the majority of the wells in this sample period. The detected concentrations of dissolved manganese exceeded the Tapwater RSL at 20 wells.

VOCs

VOC sample results are shown in Table 9-5. Five VOCs were detected in excess of applicable DEQ-7 human health standards: PCE, TCE, *cis*-1,2-DCE, VC, and benzene. The five compounds were evaluated at each of the 105 wells sampled. PCE was detected in 94 samples and exceeded the DEQ-7 standard of 5 µg/L in 71 samples. As shown on Figure 9-8, 26 wells contained PCE between 5 and 50 µg/L, 27 contained PCE between 50 and 500 µg/L, 14 wells contained PCE between 500 and 5000 µg/L, and 4 wells contained PCE at concentrations in excess of 5,000 µg/L, with a peak concentration of 39,300 µg/L at BPGP51 (1,1). The four highest concentration wells are located within the known source area at BSL, and one of the wells (BPGP74 [1,1]) is located within the sheet pile wall installed during the EPA interim remedial action in 2008. TCE concentrations exceeded the DEQ-7 standard of 5 µg/L in 48 wells and had a peak concentration of 431 µg/L at BPGP59. For TCE 75% of exceedances were less than 50 µg/L. TCE

concentrations are shown on Figure 9-9 and in Table 9-5. C*is*-1,2-DCE concentrations exceeded the DEQ-7 standard of 70 µg/L in 6 locations (BPGP59, BPGP74, BPGP89, MW-105 [4,1], MW-114 [16,8], and MW-129 [8,3]). The CVOC analyte VC concentrations exceeded the DEQ-7 standard of 0.2 µg/L in 6 locations as well (BPGP29 [9,7], BPGP84 [5,2], MW-105, MW-108 [8,1], MW-114, and MW-129). *Cis*-1,2-DCE and VC exceedances are shown on Figure 9-10.

Sixty-nine wells that were sampled in July 2017 were resampled in May 2018. PCE concentrations in 22 of those wells changed by 10% or less between the two events; detected concentrations increased by more than 10% in 17 wells, and decreased by more than 10% in 30 wells. The largest temporal changes were in well BPGP49 (1,1) (decreased by 25,500 µg/L), BPGP46 (decreased by 16,832 µg/L), and BPGP51 (increased by 32,280 µg/L). These three wells are located within the BSL source area. Such large changes in contaminant concentrations are often indicative of chlorinated solvent source areas. Dissolution from finer grained zones or residual PCE NAPL trapped in pores from capillary flow (typical of vadose zone immobile NAPL) often account for notable changes in solubility and concentrations in source zone areas. PCE is hydrophobic, and therefore adsorbed, immiscible, immobile PCE can have considerable variability in dissolution and groundwater concentrations based on variations in soil wettability and contact between adsorbed PCE and groundwater (EPA 1991). The rate of dissolution is a function of the PCE NAPL solubility, groundwater flow conditions, differential between the actual and solubility concentrations, and the contact area between the NAPL and groundwater (EPA 1991). Dissolution becomes more variable in highly heterogeneous soils, such as is seen in the unsaturated zone in the BSL area. Dissolution and contact with PCE sorbed to soil can be enhanced at times based on groundwater depth and hydrogeology, and partitioning into air phase in pore space (EPA 1991).

In general, PCE isocontours in Figure 9-8 were drawn using PCE concentrations from wells sampled in May 2018. However, some PCE concentrations in monitoring wells where reducing conditions exist may be depressed compared to concentrations in nearby wells where reducing conditions do not exist. However, a negative ORP, which is typically associated with reduced conditions does not always indicate lower PCE concentrations. For example, in September 2018, 15 wells with negative ORP values and low DO had PCE analytical results below the 5 µg/L SL, but 9 wells had negative ORP and low DO and had PCE concentrations from just above 5 µg/L to >16,000 µg/L PCE. Since the scale of the PCE plume is large and covers over 500 acres of area that is above the SL for PCE, smaller areas where reducing conditions are present and reduced PCE across smaller localized zones of reducing aquifer conditions are not as easily captured in the general trends of groundwater. Despite not being able to use the current well network to see small pockets of reducing conditions, there are some areas with lower ORP, potential for petroleum carbon source, lower DO, and lower PCE concentrations within the plume boundary. For these areas where historical site knowledge and current analytical data point to lower PCE based on reducing conditions, select portions of the contours as well as the Facility

boundary were inferred based on the potential for higher PCE concentrations outside of localized areas of reducing conditions, typically associated with hydrocarbon impacts. Wells with observed reducing conditions include southern plume boundary wells MW-108 (8,1) and BNMW-23 (14,6), northern plume boundary wells BPGP31 (6,6) and MW-121 (4,4), well BPGP78 (1,1) near the BSL source area, and well BPGP91 (14,9) at the distal edge of the BSL plume. Where these wells may have been used to establish the PCE groundwater concentration exceedance boundary, the plume boundary may be shown as an inferred boundary.

The addition of newly installed monitoring wells to the monitoring well network has allowed better delineation of the plume boundary, including conditions cross-gradient or downgradient of wells where significantly reducing conditions exist. Therefore, the approximate plume boundary was revised from the boundary described during evaluation of the July 2017 data (Appendix C-2).

1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, isopropylbenzene, n-propylbenzene, and 1,1-DCA were analyzed at 105 locations but do not have DEQ-7 standards or RBSLs; however, these compounds were detected above their respective EPA Tapwater RSLs. 1,2,4-trimethylbenzene was detected above the Tapwater RSL of 56 µg/L at four wells. 1,3,5-trimethylbenzene and n-propylbenzene were detected above their respective Tapwater RSLs at three wells. Isopropylbenzene was detected above the Tapwater RSL at two wells, and 1,1-DCA was detected above the Tapwater RSL at one well.

Twenty-one VOCs were not detected during the sampling event, but had RLs which exceeded applicable DEQ-7 standards or RBSLs: 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-DCE, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, 1,2-DCA, 1,2-dichloropropane, benzene, bromodichloromethane, bromoform, bromomethane, carbon tetrachloride, chloromethane, dibromochloromethane, *cis*-1,3-dichloropropene, hexachlorobutadiene, methylene chloride, MTBE, *trans*-1,3-dichloropropene, TCE, and VC.

MNA Parameters & Field Parameters

As noted in Section 9.2, MNA parameters are examined to evaluate subsurface degradation processes and the likelihood of an anaerobic or aerobic environment that is conducive to differing types of biotic transformations of COPCs. Chlorinated solvents, including PCE and TCE, typically degrade during anaerobic biodegradation via reductive dechlorination in the presence of a specific microbial community (EPA 2018a). MNA and field parameters from May 2018 confirmed that much like other unconfined, shallow groundwater aquifers, the alluvial aquifer at the Facility typically has aerobic conditions that may not be conducive to anaerobic biodegradation. Section 9.2 discusses the aerobic to anaerobic environment transitions optimal for reductive dechlorination. To evaluate the general alluvial aquifer conditions and to help in future evaluation of MNA, MNA parameters were analyzed at 15 wells across the

Facility in May 2018. In addition to indicator field parameters DO and ORP, the MNA parameters collected for the Facility wells included chloride, sulfate, methane, ethane, ethene, nitrate, nitrite, and *toc*. MNA parameters and field parameter results for May 2018 are presented in Table 9-6.

Chloride can be introduced to an aquifer though many processes; however, during anaerobic biodegradation of PCE, chloride ions are sequentially removed during transition between degradation products (EPA 2018a). Chloride concentrations ranged from 50.3 to 567 mg/L, with a median concentration of 90.5. The highest chloride concentration of 567 mg/L was detected in well BPGP50, which is located directly downgradient of Wetzel's Cleaners.

Nitrogen or the combination of nitrate and nitrite are used as indicator parameters to evaluate if a nitrate-reducing environment has passed toward optimal anaerobic biodegradation for reductive dechlorination (EPA 2018a). Typically, nitrogen less than 1.0 mg/L is ideal for reductive dechlorination. Nitrogen (nitrate + nitrite) was detected in 14 samples, and parameter concentrations ranged from 0.005 to 13.3 mg/L, with a median concentration of 2.8 mg/L. Nitrogen was below 1.0 mg/L in six MNA-sampled wells during May 2018: BNMW-23, BPGP02, BPGP59, BPGP78, and RH-MW-3.

Sulfate concentrations ranged from 434 to 1250 mg/L, with a median concentration of 954 mg/L. Sulfate levels less than 20 mg/L are desirable, but not necessary, to have anaerobic biodegradation of chlorinated solvents (EPA 2018b).

Carbon sources available in the groundwater (colloidal or dissolved) are examined by looking at *toc*. The less naturally-occurring carbon is available, the more likely the microbes are to use other carbon sources such as COPCs (EPA 2018a). Carbon, as *toc*, did not vary significantly across the Facility, ranging from 0.39 to 2.0 with a median concentration of 1.4.

A final end product of reductive dechlorination is ethene. Evaluating ethane and ethene concentrations in known reductive dechlorination environments can help identify if the correct microbial community is present to convert VC (EPA 2018a). Elevated levels of ethane and ethene, compared to typical groundwater concentrations, are indicators of reductive dechlorination. Ethene was detected twice, at MW-102 near former CAL, and at MW-128 near the structure at 202 9th Street West where subslab soil vapor PID readings were significantly elevated. Ethane was detected at BPGP78 and at MW-128. Methane was detected at 12 of the 15 locations, and ranged from 1.4 to 484 µg/L, with a median concentration of 8.4 µg/L. The peak methane concentration was observed at BPGP78, which also contained petroleum hydrocarbons in excess of applicable SLs.

Field parameters were collected during groundwater sampling, including ORP, DO, specific conductance, temperature, turbidity, and pH. Groundwater conditions are a mixture of reducing and oxidizing environments. Reducing conditions are routinely observed in areas where an additional carbon source is available as a terminal electron receptor (i.e. in locations with hydrocarbon contamination). This is commonly observed in wells near former LUST sites, near former or current fueling facilities, and near the BNSF railyard.

9.4 ALLUVIAL AQUIFER GROUNDWATER RESULTS – SEPTEMBER 2018

Groundwater sampling and fluid level monitoring was conducted at 106 wells during the September 2018 sampling event. Trihydro proposed a revised sampling suite based on the May 2018 results, including the omission of PCBs from monitoring wells MW-132 (18,10) and MW-133 (18,10). Fluid level data for the sampling event is presented in Table 9-1. Analytical results are presented in Tables 9-2 through 9-6. Groundwater in the shallow alluvial aquifer typically ranged between 7 and 17.09 ft bgs, with a mean depth to groundwater of 12.49 ft bgs. These statistics are mostly comparable to the same sample well network as May 2018 sampling event. The individual well trend data can be used to look at temporal trends in alluvial wells, which indicated that 64 of the 106 wells sampled (60%) were at a seasonal low groundwater elevation in September 2018. One monitoring well, MW-113, had groundwater present at 3.55 ft bgs. The shallow groundwater potentiometric surface was generally to the east and slightly northeast (Figure 9-11).

EPH/VPH

Fourteen wells were evaluated for petroleum hydrocarbon compounds using the Montana-modified MADEP EPH and VPH methods. Complete petroleum hydrocarbon results are shown in Table 9-2, and EPH/VPH exceedances are shown on Figure 9-12. Two VPH compounds were detected in exceedance of applicable RBSLs or DEQ-7 human health standards: benzene and C5-C8 aliphatic hydrocarbons (adjusted). Two wells contained EPH in excess of the 1,000 µg/L SL and EPH fractionation was performed on the samples from these wells. BNMW-17 (13,7) contained C11-C22 aromatics in excess of its RBSL (1,100 µg/L). Of the 14 locations evaluated for VPH, C5-C8 aliphatics exceeded the RBSL (650 µg/L) at five locations (BPGP02 (1,1), BPGP46 (1,1), BPGP78 (1,1), BPGP89 (11,6), and EMW-09 (-1,1)). Benzene was evaluated at 106 wells sampled during the September 2018 sampling event via EPA Method 8260, and at 14 wells using the Montana-modified Massachusetts method for VPH. Benzene was detected in groundwater in excess of the RBSL (5 µg/L) at five locations (BPGP02, BPGP78, BPGP89, MW-117, and SYS-EMW-03. Groundwater samples did not have non-detect EPH/VPH analytical results where the detection limits exceeded applicable RBSLs or DEQ-7 standards during the September 2018 sampling event.

SVOCs

Five locations were evaluated for SVOCs during the September 2018 sampling event. SVOC results are shown in Table 9-3, and SVOC exceedances are shown with EPH/VPH results on Figure 9-12. Only 1-methylnaphthalene was detected in excess of applicable SLs. MW-117 and BPGP78 contained 1-methylnaphthalene in excess of the 11 µg/L RBSL. Compounds which were not detected during the sampling event, but had RLs which exceeded applicable RBSL or DEQ-7 exceedances were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, hexachlorobutadiene, indeno(1,2,3-cd)pyrene, and pentachlorophenol.

Dissolved Metals

Metals results are presented in Table 9-4. Detected concentrations of dissolved arsenic, barium, cadmium, selenium, and thallium exceeded EPA Tapwater RSLs but were less than the DEQ-7 standards. Dissolved cobalt, iron, manganese, and vanadium do not have DEQ-7 standards; however, DEQ has proposed standards for iron and manganese, but the rule is not final (DEQ 2018f). The detected concentration of dissolved cobalt exceeded the Tapwater RSL at 15 wells. The detected concentrations of dissolved manganese exceeded the Tapwater RSL at 17 wells, while dissolved iron and vanadium exceed the Tapwater RSLs at well BNMW-17 (13,7).

VOCs

Complete September 2018 VOC results are presented in Table 9-5. Six VOCs were detected in excess of applicable DEQ-7 human health standards: benzene (whose DEQ-7 standard is the same as its RBSL, and which was also detected in VPH samples), methylene chloride, PCE, TCE, *cis*-1,2-DCE, and VC. These compounds were evaluated at the 106 wells sampled. PCE was detected in 97 locations and exceeded the DEQ-7 standard of 5 µg/L in 66 wells. Twenty-two wells contained PCE between 5 and 50 µg/L, 29 contained PCE between 50 and 500 µg/L, 11 wells contained PCE between 500 and 5000 µg/L, and 4 wells contained PCE at concentrations in excess of 5,000 µg/L, with a peak concentration of 41,900 µg/L at BPGP49. The four highest concentration wells are located within the known source area at BSL, and one of the wells (BPGP74) is located within the sheet pile wall installed during the EPA interim remedial action in 2008. PCE concentrations are shown on Figure 9-13. TCE exceeded the DEQ-7 standard of 5 µg/L in 46 wells and had a peak concentration of 308 µg/L at BPGP74. 80% of TCE exceedances were less than 50 µg/L. TCE concentrations are shown on Figure 9-14 and in Table 9-5. C*is*-1,2-DCE exceeded the DEQ-7 standard of 70 µg/L in 6 locations (BPGP61, BPGP74, BPGP76, BPGP89, MW-114, and MW-129). VC exceeded the DEQ-7 standard of 0.2 µg/L in 4 locations (BPGP29, BPGP84, MW-105, and MW-114) and these were the only locations with detectable VC concentrations. *Cis*-1,2-DCE and VC exceedances are shown on Figure 9-15. Methylene chloride exceeded the DEQ-7 standard of 5 µg/L in one location, MW-115.

Ninety-five wells were sampled in May 2018 and resampled in September 2018 and had detectable concentrations of PCE during both sampling events. PCE concentrations changed by 10% or less between the two events in 19 of those wells, increased by more than 10% in 45 wells, and decreased by more than 10% in 31 wells. The largest temporal changes were in well BPGP49 (increased by 20,000 µg/L), BPGP51 (decreased by 10,000 µg/L), and BPGP74 (increased by 26,700 µg/L). These three wells are located within the BSL source area. Such large changes in contaminant concentrations are often indicative of source area dissolution and are discussed in more detail in section 9.3.

As previously mentioned, wells with reducing conditions may be subject to depressed concentrations of PCE due to reductive dechlorination, including southern plume boundary wells MW-108 and BNMW-23. Similarly, along the northern edge of the main plume, BPGP31 and MW-121 both have significantly reducing environments, as do wells BPGP78 near the BSL source area, and BPGP91 at the distal edge of the plume. The isocontours on Figures 9-13 and 9-14 were drawn using PCE/TCE concentrations from these wells, but the Facility boundary was inferred based on the potential for higher PCE/TCE concentrations outside of localized areas of reducing conditions.

PCE has a variety of degradation products that have been observed throughout the plume, the most prevalent of which is TCE. As PCE undergoes microbial degradation, TCE, *cis*- and *trans*-1,2-DCE, and VC may be formed, among others. Degradation product formation will be discontinuous throughout the PCE plume and will be highly dependent upon local conditions.

1,1,2,2-tetrachloroethane, 1,1-DCA, 1,2,4-trimethylbenzene, isopropylbenzene, and n-propylbenzene were analyzed at 106 locations but do not have DEQ-7 standards or RBSLs; however, these compounds were detected above their respective EPA Tapwater RSLs. 1,2,4-trimethylbenzene was detected above the Tapwater RSL at five wells. N-propylbenzene was detected above the Tapwater RSL at three wells. 1,1-DCA, and isopropylbenzene were detected above their respective Tapwater RSLs at two wells, and 1,1,2,2-tetrachloroethane was detected above the Tapwater RSL at one well.

Twenty-three VOCs were not detected during the sampling event, but had RLs which exceeded applicable DEQ-7 standards or RBSLs: 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-DCE, 1,2,4-trichlorobenzene, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, 1,2-DCA, 1,2-dichloropropane, benzene, bromodichloromethane, bromoform, bromomethane, carbon tetrachloride, chloroform, chloromethane, *cis*-1,2-DCE, dibromochloromethane, *cis*-1,3-dichloropropene, hexachlorobutadiene, methylene chloride, MTBE, naphthalene, *trans*-1,3-dichloropropene, TCE, and VC.

MNA Parameters & Field Parameters

As noted in Section 9.2, MNA parameters are used to evaluate subsurface degradation processes and the likelihood of an anaerobic or aerobic environment that is conducive to different types of biotic transformations of COPCs. Chlorinated solvents including PCE and TCE typically degrade during anaerobic biodegradation via reductive dechlorination in the presence of a specific microbial community (EPA 2018a). MNA and field parameters from September 2018 confirmed that much like other unconfined, shallow groundwater aquifers, the alluvial aquifer at the Facility typically has aerobic conditions that may not be conducive to anaerobic biodegradation. Section 9.2 discusses the aerobic to anaerobic environment transitions optimal for reductive dechlorination. To evaluate the general alluvial aquifer conditions and to help in future evaluation of MNA, MNA parameters were analyzed at 15 wells across the Facility in September 2018. In addition to indicator field parameters DO and ORP, the MNA parameters collected for the Facility wells included chloride, sulfate, methane, ethane, ethene, nitrate, nitrite, and *toc*. MNA parameters and field parameter results for September 2018 are presented in Table 9-6.

Chloride can be introduced to an aquifer though many processes; however, during anaerobic biodegradation of PCE, chloride ions are sequentially removed during transition between degradation products (EPA 2018a). Chloride concentrations ranged from 34 to 221 mg/L, with a median concentration of 97.8 mg/L. These values are generally slightly lower than those observed during the May 2018 sampling event. The highest chloride concentration of 221 mg/L was detected in well BPGP50, which is located directly downgradient of Wetzel's Cleaners. This well also had the highest chloride concentration during the July 2017 and May 2018 sampling events. Nitrogen or the combination of nitrate and nitrite are used as indicator parameters for evaluating if a nitrate-reducing environment has passed toward optimal anaerobic biodegradation for reductive dechlorination (EPA 2018a). Typically, nitrogen less than 1.0 mg/L is ideal for reductive dechlorination. Nitrogen (nitrate + nitrite) was detected in each well sampled, and parameter concentrations ranged from 0.006 to 12.4 mg/L, with a median concentration of 2.8 mg/L. Nitrogen was below 1.0 mg/L in six MNA-sampled wells during September 2018: BPGP02, BPGP59, BPGP78, BPGP92, and MW-108.

Sulfate concentrations ranged from 395 to 1,570 mg/L, with a median concentration of 1,050 mg/L. Sulfate levels less than 20 mg/L are desirable, but not necessary, to have anaerobic biodegradation of chlorinated solvents (EPA 2018b).

Toc evaluates carbon sources available in the groundwater (colloidal or dissolved). The less naturally occurring carbon available, the more likely the microbes are to use other carbon sources such as COPCs (EPA 2018a). Carbon, as *toc*, did not vary significantly across the Facility, ranging from 0.64 to 4.4 mg/L with a median concentration of 1.5 mg/L.

A final end product of reductive dechlorination is ethene. Evaluating ethane and ethene concentrations in known reductive dechlorination environments can help identify if the correct microbial community is present to degrade VC (EPA 2018a). Elevated levels of ethane and ethene, compared to typical groundwater concentrations, are indicators of reductive dechlorination. Ethene was not detected in groundwater during the September 2018 sampling event. Ethane was detected at BPGP02 and BPGP78. Methane was detected at 6 of the 15 locations, and ranged from 12.8 to 286 µg/L, with a median concentration of 53.4 µg/L. The peak methane concentration was observed at BPGP78, which also contained petroleum hydrocarbon concentrations in excess of applicable SLs.

Field parameters were collected during groundwater sampling, including ORP, DO, specific conductance, temperature, turbidity, and pH. Groundwater conditions are a mixture of reducing and oxidizing environments. Reducing conditions are routinely observed in areas where an additional carbon source is available as a terminal electron receptor (i.e. in locations with hydrocarbon contamination). This is commonly observed in wells near former LUST sites, near former or current fueling facilities, and near the BNSF railyard.

In general, the following wells exhibited reducing conditions in September 2018 based on field and MNA parameters:

- BPGP02 (1,1), which is located in the alley behind BSL source area immediately downgradient of a former UST location
- BPGP78 (1,1), which is located in the alley behind BSL source area immediately downgradient of a former UST location
- MW-108 (8,1), which is located along 1st Avenue South where known UST and LUST sites are adjacent
- BNMW-23 (14,6), which is located downgradient of BNSF railroad property and wells with known petroleum hydrocarbon impacts
- EMW-21 (16,11), which is located at the distal, northeast, end of the PCE plume and adjacent to known UST and LUST sites

9.5 BEDROCK GROUNDWATER RESULTS

Two monitoring wells, MW-126 and MW-127 were installed in May 2018 to characterize the bedrock surface, competency, bedrock composition, and groundwater occurrence in the underlying bedrock. MW-126 was sampled during the May and September 2018 sampling events, and MW-127 was sampled only during the September sampling event. Installation methods also allowed for geologists to evaluate the nature and extent of contamination immediately above or at the bedrock surface, as presented in Section 2. MW-126 is located in the parking lane along 7th Street West, downgradient of the known BSL source area, and just west of the utility corridor in 7th Street West. MW-127 is

located in the alley between BSL and 711 Central Avenue in an area that was previously excavated during interim EPA actions. These wells, MW-126 and MW-127, were cased-off from the alluvial aquifer above to prevent cross contamination through the annular space of the well between the alluvial aquifer and bedrock aquifer. The wells were installed with sand pack and screened intervals from 28 to 35.5 ft bgs (MW-126) and 34.5 to 45 ft bgs (MW-127), resulting in the top of screened and sand pack intervals which are approximately 2.5 and 6.5 ft into the shale beneath the alluvial formations (Section 2). The bedrock where the wells are completed was logged as intact, dry, and with no visible fractures or weathering that would indicate a fractured bedrock connection to the alluvial aquifer above. These observations were obtained by the geologists based on the difficulty of the air rotary drilling during each 5-foot sampler advancement, which was hammered into the top of the shale bedrock, along with the observations of the recovered shale rock material. While the recovered shale was fractured when recovered with the hammered sampler (as is typical of the sample method), the geologists examined the fractures and presence of water to evaluate competency of bedrock. Since the recovered rock fractures fit tightly together, the fracture surfaces were sharp, the surfaces did not exhibit weathering or degrading at the fracture surface (i.e. lack of coloring/staining associated with weathering, smooth surfaces, little to no rounded or pocked fracture surfaces, no evidence of intrusion of different materials into fracture areas, etc.) and the fractures and drill cuttings were dry from within a few inches of the alluvial material/rock interface to the termination of the deep well depth, the geologists evaluated the rock as competent based on experience with air rotary drilling methods and field observations. Furthermore, the PID was used to screen the recovered rock and there was no evidence of volatile contaminant occurrence in the recovered rock material.

To confirm competency and water presence observations, bedrock well hydraulic tests were performed from September through December 2018 and have measured K values of 4.23×10^{-5} ft/d (1.49×10^{-8} cm/s) for MW-126 and 2.88×10^{-4} ft/d (1.02×10^{-7} cm/s) for MW-127. These low K values are consistent with literature-reported ranges of unweathered shale that are typically on the order of less than 1×10^{-4} or 1×10^{-5} ft/d (Freeze and Cherry, 1979). Both wells are slow to recharge; therefore, groundwater sampling was performed as part of a slug-out test during the September 2018 groundwater sampling event. Slug test results and analysis are presented in Appendix E-6.

During the September 2018 sampling event, both wells were sampled using a modified low flow sampling approach. The wells were purged slowly (<200 ml/min) while recording stabilization parameters; however, due to their very slow recharge rates, both wells exceeded 0.3 ft of drawdown during sampling, and were eventually purged dry, to the extent practicable using a bladder pump. The wells were allowed to recharge overnight, and were sampled the next day, without purging, for VOCs by EPA Method 8260. Both wells had very low DO concentrations (less than 0.5 mg/L) and both displayed reducing conditions, with negative ORP values during attempted stabilization. PCE was detected in both wells, and was higher in MW-127 (2.2 µg/L) than MW-126 (0.53 µg/L). The PCE concentration in MW-126 is consistent with the May 2018 result of 1 µg/L. MW-127 is located less than 10 ft from BPGP51, which contained PCE

at 29,300 µg/L during the September 2018 sampling event, which suggests that groundwater in bedrock is not in good communication with the impacted groundwater in the overlying alluvial aquifer. MW-126 similarly is located less than 20 ft downgradient from BPGP60, which contained PCE at 2,270 µg/L during the September 2018 sampling event. Low PCE concentrations are also not indicative of DNAPL presence within the bedrock at MW-126 or MW-127, and confirm the observations that there was no visual, olfactory, or PID screening evidence of VOCs near the alluvial/bedrock interface.

Neither well contained analytes above an applicable SL. MW-126 contained detectable acetone, phenol, 2-butanone, and C9-C12 aliphatics, during the May 2018 sampling event, and acetone during the September 2018 sampling event. MW-127 contained no other detectable analytes.

9.6 PERISTALTIC PUMP COMPARISON

During the July 2017 event, six wells were sampled both with a 2-inch QED SamplePro bladder pump, as well as a GeoTech GeoPump peristaltic pump. The purpose of using different pumps to collect samples at the same location was to compare the effects of a peristaltic pump and a bladder pump on volatile sample results, as many of the previously installed wells were smaller than 2-inch inside diameter, necessitating the use of a peristaltic pump. The six wells were selected to target upgradient/low concentration PCE areas (BPGW04 and EMW-03), distal plume edge/PCE concentrations at or near the DEQ-7 standard (EMW-21 and RH-MW-3), and main plume body/elevated PCE concentrations (EMW-11 and EMW-15). Five of the wells were 2-inch PVC wells, and EMW-11 is a 4-inch PVC well.

During the sampling comparison, wells were purged with a bladder pump until water quality parameter stabilization was achieved. Then a groundwater sample for VOC analysis was collected from the bladder pump tubing. Peristaltic pump tubing was lowered into the well, prior to purging, to the approximate intake of the bladder pump, and the peristaltic pump sample collected immediately after the bladder pump sample. The peristaltic pump sample was distinguished from the bladder pump sample by adding “P” to the end of the sample ID (e.g. EMW-11P). Eleven analytes were detected in groundwater samples (Table 9-7), and the most commonly detected analyte was PCE, which was detected in 4 of the six wells. One well, EMW-21, did not contain detectable concentrations of VOCs by EPA Method 8260, but did contain C11-C22 aromatic hydrocarbons, which may have impacted low-level chlorinated solvent results due to reductive dechlorination.

Detectable concentrations of a contaminant in both the bladder and peristaltic pump sample occurred 15 times. The RPD was calculated for each of these pairs of detections as follows:

$$RPD = \frac{X_B - X_P}{\frac{(X_B + X_P)}{2}} * 100$$

Where X_B is the contaminant concentration in the bladder pump sample, and X_P is the contaminant concentration in the peristaltic pump sample. Typically, RPD is calculated using the absolute value of the difference between two samples. In this instance, the absolute value was not used, to allow identification of when the bladder pump sample concentration was higher (positive RPD) or lower (negative RPD) than the peristaltic pump concentration. Sample RPDs ranged from 34% to -85%, with a mean of -6% and a standard deviation of 30%. Six of the fifteen RPDs were within 10%, and twelve of the fifteen were within 30%, which is the target RPD threshold identified in the QAPP (Trihydro 2017b) for duplicate groundwater samples. The greatest disparity in concentrations were found in PCE in EMW-11, which had an RPD of -85%, acetone in EMW-15, which had an RPD of -47%, and *cis*-1,2-DCE in EMW-11, which had an RPD of 34%. Calculated RPDs are shown in Table 9-8. These results indicate that the analytical results from peristaltic pump and bladder pump sampling appear to be comparable for this investigation.

9.7 TEMPORAL GROUNDWATER ELEVATION CHANGES

Fluctuations in groundwater analyte concentrations and groundwater elevations were examined based on analytical and fluid level data collected during the three groundwater monitoring events from July 2017 through September 2018. These temporal changes in groundwater concentrations help identify aspects of plume stability, but more importantly in a plume with a large spatial extent, stemming from multiple sources, may indicate areas where the groundwater has higher influence from surface infiltration or groundwater elevation changes.

Groundwater fluid level monitoring data for the alluvial aquifer wells were collected in July 2017, May 2018, and September 2018 in order to evaluate temporal changes of groundwater elevations. The highest groundwater elevations were expected to be found in the May 2018 groundwater elevation data considering that this period is after winter melt infiltration and recharge typically observed in Montana, this was outlined in the RIWP (Trihydro 2017b). The lowest groundwater elevation data was expected to coincide with the September 2018 groundwater fluid level data since this is the end of higher temperature summers and typically before significant precipitation increases in Montana. This correlated with the observations of groundwater elevation in the wells sampled during the RI groundwater monitoring events. During the May 2018 event, 71% of the wells observed the highest groundwater elevation, and during the September 2018 groundwater event, 60% of the wells observed the lowest groundwater elevation observed between July 2017 and September 2018. Hydrographs of wells that were gauged during the RI are shown in Appendix C along with historical groundwater elevation data for each well, if available. In general, the fluctuations in groundwater elevations were reviewed upgradient of BSL, near BSL, in the general plume downgradient of BSL, and at the distal

areas of the plume. There were no discernable trends with the exception that there was a localized general groundwater elevation high at wells near BSL in July 2017, which may be attributed to higher infiltration at the upgradient Central Park area during irrigation, but does not seem significant. The other trend identified is that it appears that groundwater elevations in the downtown Billings area have increased slightly (by about a foot of elevation) from 2006 through 2018. Individual groundwater wells also had some higher fluctuations, but they did not seem to have patterns correlating with other nearby wells. However, the degree to which groundwater fluctuates in shallow unconfined aquifers is not directly dependent on surface infiltration of precipitation or potential downgradient recharge to surface water bodies, and may also be highly dependent on the properties of the aquifer. As Sections 2.5 and 2.6 note, the unconfined alluvial aquifer beneath the Facility lies along the middle quaternary terrace of three alluvial deposited terraces and is comprised primarily of sands and gravels in the saturated zone. These sands and gravels have high hydraulic conductivities and low relative gradients, and previous EPA evaluations of groundwater found less than 3-ft fluctuations annually in localized areas. There are also no significant surface water bodies within the Facility boundary. Therefore, with these hydraulic settings, the aquifer surface elevation was not expected to vary significantly with time.

Changes in groundwater elevation in the alluvial wells during the RI groundwater fluid level monitoring ranged from 0.02 to 5.65 ft, with median fluctuations of 0.59 ft and average fluctuations of 0.78 ft. The standard deviation of the groundwater fluctuation was 0.84 ft. During the RI, 7 monitoring wells experienced fluctuations of more than 2 ft. Two of those wells are the irrigation wells for the softball fields and playgrounds belonging to the school district, and their significant change over the course of a season of irrigation is expected. EMW-03 is located in proximity to the transition from the lower alluvial terrace to the upper alluvial terrace, and changes in groundwater elevation at this location may be affected by that transition. Two wells, BPGP27 and BPGP47, are located along the northern edge of the plume, towards the distal end of the plume. BPGP27 experienced a local maximum during the May sampling event, while BPGP47 may have experienced a low during the September sampling event. Both wells are located in residential boulevards and may be subject to local irrigation influences.

The largest groundwater elevation changes were in BPGP74 and BPGP76, both of which are located within the sheet pile wall around the source area at BSL. The groundwater elevation in July 2017 for both wells was 5-5.6 ft higher than during the 2018 sampling events. Furthermore, during the July event, the groundwater elevation in those two wells was between 4.2 and 6.1 ft higher than the nearest adjacent wells, BPGP51 and BPGP63, which are within 50 and 120 ft of the sheet-pile wells. The source of this excess groundwater is unknown, but the sheet pile area does extend into the lawn in front of 711 Central Avenue (which is irrigated), and EPA records show that water, sanitary sewer, and storm sewer utility lines pass through notches cut into the sheet piling wall on the east and west sides of the containment. However, the depth of the notches in the sheet pile area is unknown. During the May and September

2018 sampling events the groundwater elevation was within 1 foot of nearest adjacent wells and varied by less than 0.05 ft. The measured elevations were also within 0.4 ft of historically recorded fluid levels during EPA's 2014 groundwater monitoring event.

9.8 TEMPORAL GROUNDWATER CONCENTRATION EVALUATION

The following section presents contaminant trend evaluations of COPCs at the Facility. Contaminant trend data is organized by contaminant type, as applicable. Some contaminants, such as SVOCs and PCBs have not been documented as widespread contaminants at the Facility, and trend analysis for those compounds has not been conducted.

9.8.1 CVOCS

Due to the nature of the contamination at the Facility (chlorinated solvents and degradation products released as the result of dry cleaning and potentially other industrial activities), CVOCs are a primary focus at the Facility. PCE and TCE are the most ubiquitous contaminants exceeding DEQ-7 groundwater standards. Other PCE and TCE degradation products, such as *cis*- and *trans*-1,2-DCE and VC, are observed in excess of applicable standards on a less frequent basis.

RI groundwater PCE concentration data was evaluated for variations in wells near BSL, where the highest PCE concentrations typically occur. Historical PCE groundwater data was included in the analysis to evaluate long-term temporal changes in groundwater concentration and plume size. Due to the density of wells and potential for different plume behavior based on proximity to the source, two areas of wells were evaluated: BSL source area wells and BSL higher concentration plume wells just downgradient from the BSL source area. These two areas focus the analysis of PCE variation on areas of higher PCE concentrations, to address DQOs specific to source zone evaluations and mass transport evaluations.

9.8.1.1 BSL SOURCE AREA PCE

Eleven wells were identified for use in evaluation of the BSL source area. These wells were analyzed to evaluate the potential for residual source material to continue to contribute to groundwater PCE concentrations. Wells BPGP46, BPGP51, and BPGP49 are located in the alley between BSL and 711 Central Avenue and are located in close proximity to the areas excavated during the interim remedial actions. These three wells form an approximate north/south transect across the plume near the source area. Wells BPGP61 and BPGW01 are located in the parking lot north of 711 Central Avenue, and lie approximately 60 ft and 165 ft, respectively, downgradient from the alley. Finally, six wells, BPGP53,

BPGP59, BPGP60, BPGP63, BPGP65 and BPGP67, are located between approximately 190 to 270 ft downgradient of the alley. The locations of wells identified for temporal PCE trend analysis are shown on Figure 9-16.

The following wells in the near vicinity of the historic BSL release area were not included in the analysis. Deeper bedrock wells MW-126 and MW-127, although located in or downgradient of the BSL source area, do not contain the high concentrations indicative of the alluvial wells installed in the source area and were found to be disconnected from the alluvial aquifer, and were not included in the BSL source area analysis. Similarly, deeper EPA-installed wells (such as BPGP46b and BPGP51B) also indicate lower PCE concentrations compared to their paired alluvial well counterparts (BPGP46 and BPGP51), and were also not used to evaluate variation in PCE source area groundwater concentrations. Furthermore, BPGP74 and BPGP76 are located within the sheet-pile wall and are believed to be representative of groundwater impacted by residual PCE contamination contained within the sheet-piling. The eleven wells identified for evaluation are located in grid (1,1).

Temporal variation of PCE groundwater concentration in the BSL source area wells is shown on Figures 9-17a and 9-17b. Due to the wide range of concentrations observed in the source area, data are plotted on a logarithmic scale. Data were evaluated from 2009 to present, when available. Groundwater PCE concentration data collected prior to and during 2008 were not used, as site conditions were significantly altered due to interim remedial actions during that time period. Laboratory analytical data from 2009 were not available for some wells. However, onsite mobile-lab data were available for 6 wells, which is displayed as the 2009 PCE concentrations on Figures 9-17a and 9-17b.

Samples from wells BPGP51 and BPGP49 have had elevated PCE concentrations from 2009 to 2018, with BPGP49 showing a slight increase over time. These two wells consistently contain some of the highest groundwater PCE concentrations at the Facility. Elevated PCE concentrations, which have ranged from 7,020 to 47,400 µg/L over the reporting period, may be indicative of residual source area contamination, and may fluctuate based on enhanced dissolution of residual, immobile PCE in source areas during higher water elevation periods. BPGP46, which is located between BPGP51 to the south and BPGP49 to the north, is generally an order of magnitude lower in concentration than the other two wells in the alley. The PCE groundwater concentration at BPGP46 increased in July 2017 with its highest recorded concentration (17,200 µg/L), which was three times higher than previously recorded. The PCE concentration then decreased to the lowest recorded value (368 µg/L) in May 2018 before returning to a value consistent with previous measurements in September 2018 (2,680 µg/L). Several other wells displayed a similar local maximum in July 2017, followed by a minimum in May 2018: BPGP49, BPGP53, BPGP59, BPGP63, BPGP67 and BPGW01. These PCE groundwater concentration increases coincide with RI groundwater elevations localized near the BSL source area being generally at their highest during the July 2017 groundwater monitoring event, and at their lowest in May 2018. Therefore, the variations in groundwater concentrations at the BSL source area are likely

dependent on groundwater elevation and the enhanced dissolution of residual source material in the smear zone during higher groundwater elevations. The eleven wells evaluated during this source area analysis did not appear to show significant latent effects of emergency removal actions conducted in 2008.

While there are variations in RI data, these fluctuations are within the same order of magnitude for these high concentration wells, and PCE groundwater concentrations in the source area appear to be generally stable from 2009 through 2018. The exceptions are wells BPGP60 and BPGP65 where PCE concentrations gradually decreased, though concentrations still typically exceed 1,000 µg/L in both wells. The sustained elevated groundwater PCE concentrations, in the absence of an active primary release mechanism (i.e. a continuous source due to operations), suggests that residual, immobile PCE NAPL may be present in subsurface soil pore spaces, and is likely continuing to dissolve into groundwater. As the source area subsurface MiHPT and soil sample investigation did not find evidence of PCE NAPL or soil PCE concentrations approaching saturation, this contamination may be located in inaccessible areas below the BSL and 711 Central Avenue structures and/or within the sheet pile area, as is indicated by the elevated groundwater concentrations of >40,000 µg/L of BPGP74.

Two other wells with slightly decreasing groundwater PCE concentrations in the BSL source area are BPGP67 and BPGW01. BPGP67 and BPGW01 are both located in the northern portion of the BSL source area. Upgradient wells BPGP02 and BPGP78 both contain petroleum hydrocarbon contamination, likely originating from the former UST removed from the northern portion of the BSL property in 1998. PCE groundwater concentrations in BPGW01 and BPGP67 both display significant variation, often by more than an order of magnitude. This spike in concentration was also observed in wells BPGP46, BPGP49, BPGP53, and BPGP59 in July 2017. The PCE concentrations in these wells are consistently lower than other nearby wells included in this analysis. This may be partially attributable to heterogenous contaminant distribution along the northern portion of the BSL source area, but may also be affected by enhanced reductive dechlorination in the presence of additional carbon source (i.e. petroleum hydrocarbons). The lower concentration of PCE in BPGW01 in September 2018 also corresponds with the lowest DO, 0.27 mg/L, observed during the RI groundwater sampling events; however, ORP was at 127 mV. Similarly, the DO at BPGP67 was low at 0.09 mg/L in September 2018, and the ORP was 59.6 mV.

Generally, this temporal variation analysis of PCE concentration near the BSL source area illustrates that there is little change in long-term PCE concentrations in the groundwater plume beneath the BSL source area from 2009 through 2018. However, there are some shorter-term fluctuations, typically within the same order of magnitude, for PCE concentrations during the RI groundwater monitoring period from July 2017, through May 2018, and into September 2018. These results are discussed further in the source area fate and transport and CSM discussion in Section 12.

9.8.1.2 BSL PCE PLUME

Downgradient of the BSL source area, the PCE groundwater plume ranges in concentration from roughly 100 to 1,000 µg/L, with some exceptions. This higher-concentration portion of the plume immediately downgradient of the BSL source area wells that were analyzed in Section 9.8.1.1 were evaluated for dissolved phase PCE groundwater concentration changes for historic and RI data to examine changes after interim remedial actions conducted in 2008. Less data is available for downgradient wells from 2009 to 2014, as many of the wells in this area were installed in 2015 by EPA.

Ten wells were identified for analysis in the main plume. Three wells, BPGP80, BPGP81, and BPGP87, form a rough transect across the plume in grid 2,1, which is approximately 700 ft downgradient of the BSL source area. BPGP08 (4,2) and BPGP83 (4,1) form a north-south transect approximately 0.3 miles from the BSL source area. BPGP12 (5,3), BPGP84 (5,2), and PEP07 (6,3) form a cluster of wells approximately 0.5 miles from the BSL source area. Finally, BPGP22 (7,4) and BPGP92 (6,5) form a transect across the plume approximately 0.7 miles from the BSL source area. Well locations can be seen on Figure 9-16 and plume PCE concentration trends are shown on Figures 9-18a and 9-18b.

BPGP80, BPGP81, and BPGP87 have similar PCE groundwater concentration peaks during July 2017, followed by decreases during lower groundwater elevation periods in 2018, as discussed in Section 9.8.1. BPGP80 is located in the center of the plume, but slightly closer to the BSL source area, and is indicative of higher contaminant mass flow through the area, compared to BPGP81 and BPGP87, which are located on the northern and southern edges of the higher concentration portion of the plume, respectively. A consistent trend is not readily apparent along this transect, although looking at only BPGP80 and BPGP81, there may be evidence of decreasing groundwater concentrations from 2015 to 2018, although the localized high groundwater elevation, and corresponding higher PCE concentration, for May 2018 does confound the trend with a rise in concentrations prior to returning to lower concentrations in September 2018.

The PCE concentration in BPGP08 in 2009 was less than the DEQ-7 standard (4.22 µg/L) but increased by two orders of magnitude in 2010. Increases in PCE concentration may be related to the diffusion of contaminants into groundwater during emergency removal in 2008, and subsequent transport along the direction of groundwater flow. However, between 2011 and 2015 the PCE concentration at BPGP08 decreased by a factor of three. Since 2015, the PCE concentration at BPGP08 has remained mostly stable. Nearby well BPGP83 had consistently higher PCE concentrations than BPGP08, and PCE concentrations have increased from 2017 through 2018. Well BPGP83 lies more directly downgradient of the BSL source area, and groundwater potentiometric surface contours in the immediate area suggest a more easterly flow from BSL towards BPGP83, rather than towards the more northerly located BPGP08.

PCE concentrations in BPGP12 and PEP07 appear to be relatively stable and may be gradually decreasing. However, PCE concentrations increased slightly from the May to September 2018 sampling events, which may be associated with the increase in groundwater PCE contamination in the BSL source area observed in July 2017. During recent sampling events BPGP84 appears to be just south of the 500 µg/L PCE isocontour, and the PCE concentration has consistently decreased during each sampling event.

The PCE groundwater concentration in BPGP22 has remained relatively stable over the observation period from 2010 through 2018, with slightly more variation during the 2018 RI sampling events. It is located northeast of the 500 µg/L PCE isocontour. The relative stability of BPGP22 may indicate that variations in BSL source area mass transport are dampened with greater distance from BSL or localized increases observed in May 2018 at the BSL source area for PCE concentration have not yet reached the downgradient well areas. However, BPGP22 is located downgradient from the former Standard Battery LUST Facility (Facility ID 5613510). As noted in Section 9.2, low-level detections of petroleum hydrocarbons may be indicative of potentially reducing groundwater conditions near BPGP22. The presence of depressed oxygen concentrations and reducing conditions may result in locally depressed PCE and TCE concentrations.

Well BPGP92 is located just northwest of BPGP22 but has not been sampled as long as BPGP22. BPGP92 may be indicative of contaminant concentrations north of the 500 µg/L isocontour, and PCE concentrations have steadily declined from 2015 through 2018.

Generally, the PCE groundwater concentrations downgradient of the BSL source area are lower than source area BSL PCE concentrations, but remain up to three orders of magnitude greater than the PCE SL. There is not a clear trend for the wells within the 100 to 1,000 µg/L downgradient plume area of BSL, as a whole, but some PCE concentration trends can be inferred as follows:

- Nearer to the BSL source area, wells BPGP80 and BPGP81 may have a slightly decreasing trend, but BPGP87 appears stable.
- BPGP08, BPGP12, BPGP22, and PEP07 appear relatively stable in their PCE concentrations during the RI.
- Just south and north of the stable wells noted above, BPGP84 (south) and BPGP92 (north) appear to have a decreasing PCE concentration trend.
- Well BPGP83 had a recent increasing trend in PCE concentrations, which may be associated with potential mass transport downgradient of the BSL source area.

9.8.1.3 TCE

After PCE, TCE is the next most ubiquitous contaminant at the Facility. TCE is generally co-located with PCE contamination at the Facility. Specifically, the TCE plume appears to consistently mirror the higher concentration PCE groundwater plume (50 µg/L and higher). This trend is observable during the three RI groundwater sampling events (Figures 9-3 and 9-4; Figures 9-8 and 9-9; and Figures 9-13 and 9-14). Several additional temporal features for TCE are consistent across these sampling events:

- A lack of TCE exceedances in groundwater in the western plume associated with former CAL and other potential upgradient sources. This is consistent with the lower PCE concentrations in this region of the plume.
- TCE concentrations generally fall within the 50 ug/L PCE isocontour, but notably extend beyond this region within and downgradient of the BNSF railyard. This region of the Facility has both current and historical observations of petroleum hydrocarbon contamination, which may contribute to reductive dechlorination and the subsequently observed elevated TCE concentrations over multiple sampling events.
- TCE concentrations more than an order of magnitude above the DEQ-7 standard were observed consistently in known and potential source areas with elevated PCE (BSL and MW-115), and at two wells within the plume body (BPGP92 and MW-105).

9.8.1.4 CIS- AND TRANS-1,2-DCE, AND VC

As discussed in Section 9.2, 9.3, and 9.4, PCE degradation products *cis*- and *trans*-1,2-DCE and VC are not consistently observed across the Facility. *Cis*-1,2-DCE has been detected in analytical laboratory results above the DEQ-7 standard of 70 µg/L 37 times since 2008, more than half of which were observed during the RI groundwater sampling events. Similarly, VC (for which a detection is typically greater than the 0.2 µg/L DEQ-7 standard) has only 29 detections since 2008, 17 of which are from the RI groundwater sampling events. *Trans*-1,2-DCE has only been observed above the DEQ-7 standard once since 2008. Due to the small quantity of data, trend analysis of these compounds is not likely to yield significant statistical results. PCE degradation product concentrations can be used for evaluation of contaminant profiles for individual wells, and variations in degradation processes due to local conditions.

9.8.2 PETROLEUM HYDROCARBONS

As previously noted, petroleum hydrocarbons have not been of primary focus during historical investigations. EPH/VPH analyses have only been conducted during the RI, and EPH/VPH compounds were not found to exceed applicable SLs facility-wide. Exceedances of C5-C8 aliphatic hydrocarbons were observed at approximately 4 to 8 monitoring wells during each of the groundwater sampling events. This data is generally not of a large enough volume to perform temporal trend analyses. However, some historical analytical laboratory BTEX data is available for

the Facility, and benzene has been observed in groundwater samples during the RI in excess of its DEQ-7 standard. As benzene is the most ubiquitous petroleum hydrocarbon compound observed at the Facility, a limited temporal benzene analysis was performed. Eleven wells contained petroleum hydrocarbons exceeding an applicable SL during the RI: BNMW-17, BPGP02, BPGP46 BPGP59, BPGP66, BPGP78, BPGP80, BPGP89, EMW-09, GSMW-5, and MW-117. Analytical data for GSMW-5 is currently only available for the July 2017 sampling event, and analytical data for MW-117, EMW-09, and BNMW-17 are currently only available for the three RI sampling events.

Benzene groundwater trend analysis was performed for the remaining seven wells, and is shown in Figure 9-19. Historical laboratory analytical data for these wells is available from as early as 2006, and groundwater data was evaluated from 2006 to present. HAPSITE mobile laboratory data was not used in this analysis. Groundwater evaluation was not limited to 'post-remedial action' dates, as was done for PCE near BSL, as a petroleum hydrocarbon source zone was not the focus of EPA's interim remedial actions. Benzene concentrations at BPGP46, BPGP59, BPGP66, and BPGP80 were generally not detected above the RL. Non-detect sample results were charted as one-half the RL. Fluctuations in the charted concentrations at these wells are generally attributable to variations in historical RLs, and benzene was not detected above the DEQ-7 standard at these wells.

BPGP02 and BPGP78 are both located near the BSL source area, downgradient of the historical UST location at BSL. BPGP78 has been above the DEQ-7 benzene standard since sampling began in 2010. Linear trend analysis at this well does not suggest a consistent pattern, and Mann-Kendall analysis was also performed for this well, and no trend was identified. BPGP02 has exceeded the DEQ-7 standard during each sampling event since 2014. Linear trend analysis did not suggest a consistent pattern and Mann-Kendall analysis also did not identify a trend. BPGP89 is located in the boulevard east of North 35th Street, between 1st Avenue North and Montana Avenue. The nearest known upgradient UST Facility is located at the NaRa Restaurant (Facility ID 5613636), located on Division Street, approximately 600 ft to the southwest. Benzene concentrations have exceeded the DEQ-7 standard during each sampling event since 2015, and Mann-Kendall analysis of groundwater concentrations at this well suggest that the contaminant concentration is currently stable.

9.8.3 DISSOLVED METALS

Analytical data were evaluated for dissolved metals trend analysis at the Facility. Dissolved metals were not identified as historical COPCs at the Facility, and four historical dissolved metals samples are currently available as part of EPA's historical data set. Dissolved metals were evaluated at BPGP12, BPGP16, BPGP33, and BPGW02 in 2006. Cobalt, iron, and manganese were identified as COPCs at the Facility during the RI, but were not observed above applicable SLs in the historical samples. As previously noted, these analytes exceeded applicable EPA Tapwater RSLs,

but did not have applicable DEQ-7 standards. DEQ is currently evaluating proposed standards for manganese and iron, but the rule is not yet final. Ten wells were sampled for dissolved metals during the three RI sampling events at the Facility: BMW-1, BNMW-17, BNMW-23, BPGP22, BPGP46, BPGP59, BPGP78, BPGP80, EMW-03, and ZPMW-1. These wells were used to provide a limited trend analysis for dissolved metals COPCs at the Facility. Non-detect values were not used to calculate average dissolved metal concentrations.

Average concentrations of dissolved metals COPCs were evaluated across the ten previously identified wells during the RI. The average concentration of dissolved cobalt was highest in July 2017 at 1.9 µg/L, and was 1.6 µg/L during both May and September 2018. Dissolved iron was highest during May 2018 at 2,006 µg/L, and lowest in July 2017 at 638 µg/L, while the September 2018 average concentration was 1,457 µg/L. Dissolved manganese was highest during September 2018, with an average concentration of 999 µg/L, and lowest during May 2018, with an average concentration of 653 µg/L, while the July 2017 average concentration was 852 µg/L. No discernable trends in dissolved metals COPCs were identified during this analysis.

9.9 NON-AQUEOUS PHASE LIQUID OCCURRENCE

LNAPL was encountered once during groundwater sampling activities at the Facility. Monitoring well BNMW-7 in the BNSF railyard contained approximately 0.02 ft of LNAPL during the July 2017 event. The LNAPL coated the oil/water interface probe and was dark with a strong odor. Measurement of the LNAPL thickness is approximate due to the thin layer of LNAPL in the well. The well was not sampled, and BNMW-17 was selected as a replacement well.

EMW-21 contained a sorbent sock holder during the July 2017 event, and had a strong petroleum odor. The well did not contain measurable LNAPL during the event, but a slight sheen was noted on water purged from the well.

DNAPL was not encountered during groundwater monitoring events or during direct-push investigations. Potential residual NAPL analysis is presented in the fate and transport discussion in Section 12.3.

9.10 GROUNDWATER CONTAMINATION PLUME AND FACILITY BOUNDARY

Data from the three groundwater sampling events indicates that four chlorinated solvent source areas may be present and contributing to the PCE plume at the Facility, in the general areas of former CAL, BSL, former Rex, and MW-115. Groundwater analytical data, potentiometric surface results, direct-push PCE groundwater screening data, local hydrogeology, and site release histories have been used to interpret data and evaluate the extent and transport of groundwater contamination at the Facility. Due to their widespread nature, PCE and TCE groundwater contaminant

plumes are the most significant contributors to delineation of the Facility boundary. Discussion of individual factors used in plume analysis are presented in this section.

Former CAL

The westernmost plume extends from Regal Street, encompassing the former CAL source area and the residential area around Central Park, extending approximately 1.2 miles towards BSL and Broadwater Avenue. PCE concentrations measured in the former CAL plume are only slightly above the DEQ-7 standard, with the exception of MW-101, directly behind former CAL, which contained PCE at 185-191 µg/L. These results indicate that former CAL appears to be a source area, but low-level PCE concentrations also exist upgradient of former CAL. RI-installed wells MW-124 and MW-123, as well as PCE screening locations 1B-GW-02 and 3A-GW-01 aid in establishing the northern 5 µg/L plume boundary. The northeastern-most edge of the plume boundary is inferred based upon the PCE concentration at MW-123 as well as contaminant transport properties. MW-103, which has not contained PCE above 5 µg/L, is shown within the 5 µg/L plume boundary since detectable petroleum hydrocarbons observed in the well during the May 2018 sampling event may be leading to reducing conditions in the area. The southern boundary is largely inferred based upon PCE contaminant transport properties, the local potentiometric surface gradient, and upgradient well concentrations. Well REGAL-I-01 is the westernmost well exceeding the DEQ-7 PCE standard. Well MW-130 is upgradient and slightly cross gradient to the REGAL-I-01 irrigation well and contained PCE concentrations less than 1 µg/L. Historical dry cleaning operations are known to have existed west of former CAL along Central Avenue, as well as along 24th Street West (One Hour Valet at 71 25th Street West and Rimrock Cleaners at 2545 Central Avenue, both located in grid [-24,1]). Other commercial or industrial operations to the southwest may also contribute to the diffuse groundwater plume, though neither of the most upgradient monitoring wells (MW-130 and SYS-EMW-03) contained PCE above the DEQ-7 standard. Additionally, surface topography begins grading to the upper alluvial terrace approximately 750 ft west of former CAL. More lithologic evidence would be necessary to corroborate whether or not the basal sandy/gravel layer (more permeable unit) pinches out as the alluvial terrace transition (Qa2-Qa3) is approached. Basal narrowing of the sandy/gravel unit is shown on Gosling and Pashley 1973 A – A' cross section. A large, approximately 150-acre area (Mountain View Cemetery and Exchange City Golf Course) straddles the Qa3 – Qa2 terrace transition. This area is largely unencumbered by impermeable surface features such as buildings, roads, and parking lots and irrigated during the spring and summer months, potentially causing local groundwater mounding/gradient changes. Aforementioned site specific hydrogeologic recharge and boundary conditions may affect area hydrologic parameters and flow direction, which may in turn affect dissolved plume occurrence in the vicinity of CAL. Therefore, diffuse upgradient contributions to PCE contamination are not well understood, and the western edge of the plume is inferred.

BSL

The largest and most well-mapped groundwater chlorinated solvent plume extends from BSL to the northeast for more than 1.5 miles to North 27th Street and encompasses approximately 350 acres along the Montana Avenue corridor. The plume appears to expand laterally as it extends from the BSL source area, and appears to be more than 3,100 ft wide at its widest point during the September 2018 sampling event. The highest PCE groundwater concentrations are found in the source area near BSL within approximately 600 ft of the known release areas. The BSL plume consists of a central core of high concentration (greater than 500 µg/L) PCE contamination that extends from the BSL source area to the northeast along the groundwater gradient for approximately 0.6 miles. North of the BNSF railroad, groundwater gradients appear to run roughly parallel to the rail line, towards the northeast. However, south of the rail line, groundwater may have a more easterly flow from Underpass Avenue to approximately South 32nd Street.

Newly installed wells MW-122, MW-121, MW-119, and MW-118, along with existing monitoring well BPGP31 provide evidence of the northern extent of the 5 µg/L groundwater plume. Two northern edge monitoring locations, monitoring well BPGP48 and groundwater grab sample 3C-GW-02 (later to be completed as MW-120), did not contain PCE above the detection limit during the July 2017 sampling event or PCE screening investigation, respectively. However, during the May and September 2018 sampling events, both of these wells contained PCE above the 5 µg/L standard, and therefore the northern boundary of the plume is inferred in their proximity. The BSL plume extends through two other potential source area investigations at D7HRC and Wetzel Cleaners.

Along the southern plume edge, several wells have observed petroleum hydrocarbon impacts, though concentrations may not exceed applicable RBSLs, including MW-108, BNMW-9, MW-109, and BNMW-23. There are multiple petroleum hydrocarbon release sites, including LUST facilities, the BNSF Railyard, and various former service stations, operated near the 1st Avenue South corridor, as documented in the RI Report: Billings 1st Avenue South UST Field Site (HKM 2007). The presence of low-level petroleum hydrocarbons may result in depressed PCE concentrations due to reductive dechlorination. Therefore, the 5 µg/L contour is inferred in several locations along the southern plume edge, based upon the presence of petroleum hydrocarbons, the presence of PCE degradation products, field parameter conditions in the wells (depressed DO and negative oxidation/reduction potential), and proximal wells without hydrocarbon impacts and elevated solvent concentrations.

The distal edge of the BSL plume appears to be located near the North 27th Street corridor. However, both newly-installed (MW-117) and existing (EMW-18, EMW-21, and EMW-26) monitoring wells in this area have documented petroleum hydrocarbon contamination, which may result in reductive dechlorination of chlorinated solvents, as noted above. The distal plume edge is therefore inferred. The highest PCE concentrations in the BSL plume occur in monitoring wells within the source area and directly downgradient of BSL.

Former Rex

The former Rex plume is one of three smaller PCE groundwater plumes located in the northeastern portion of the larger Facility plume. The groundwater potentiometric surface grades more east than northeast in this portion of the Facility, and the PCE plume extends from the former Rex property, to approximately South 24th Street. Monitoring wells MW-132, MW-134, MW-113, and MW-112 provide cross- and downgradient boundaries for the 5 µg/L PCE plume. This plume is located downgradient and cross-gradient of the BSL plume and appears to have low level (less than 5 µg/L) PCE contamination from the BSL plume intermingling with source area contamination at former Rex, as indicated by upgradient well MW-116. Upgradient monitoring wells Whitely MW-1 and Whitely MW-2 may also provide evidence of separation of the 5 µg/L BSL plume; however, both wells contained evidence of petroleum hydrocarbons during the July 2017 sampling event. The highest PCE concentrations in monitoring wells at former Rex occur approximately 250 ft downgradient of the former Rex property at RH-MW-7, with concentrations ranging from 104-126 µg/L. The groundwater grab sample collected from soil boring SEWER-04, located nearest the observed sewer line fracture and approximately 150 ft upgradient of RH-MW-7, had a PCE concentration of 164 µg/L. Well MW-114 is the nearest well to the former Rex building and contained PCE at 24.9 and 45.3 µg/L during the 2018 sampling events. However, during both events, petroleum-based solvents sec-butylbenzene and tert-butylbenzene were detected in groundwater, (though below applicable SLs), DO was low (0.11 mg/L or less), and PCE degradation product concentrations were elevated. This may indicate the presence of reducing conditions in the area, potentially resulting in depressed PCE concentrations, and may warrant further evaluation.

MW-115

The groundwater PCE plume at MW-115 is not well understood. MW-115 was originally installed to help delineate distal plume edge for the Facility and provide additional hydraulic gradient information for this area and was intended for installation along South 22nd Street. However, due to utility obstruction, the location was moved in the field to South 23rd Street. A screening sample was collected from the well prior to development and found PCE at 260 µg/L, which was considerably higher than expected based on data from nearby wells. Subsequently, three monitoring wells (MW-132, MW-133, and MW-134) were installed upgradient of MW-115, adjacent to investigation areas at the former Pacific Hide and Fur and an electrical substation, but PCE exceeding the 5 µg/L standard was not observed in these three upgradient wells.

Subsequent sampling at MW-115 in May and September 2018 found PCE concentrations of 956 and 1,790 µg/L respectively. These elevated PCE concentrations, combined with the results from upgradient monitoring wells EMW-18, MW-113, MW-132, MW-133, and MW-134 where PCE concentrations do not exceed the 5 µg/L standard suggests that there is an unknown source for this plume area, distinct from sources for the former Rex and BSL plumes. The rapid increase in PCE concentrations at the well may indicate that the release is relatively recent or that the well

was not adequately developed and still contained some debris from drilling activities that could affect flow into the well or water quality. Four wells along the Phillips 66 Refinery's western boundary were sampled for PCE in February 2018 as part of the PCE screening investigation by Trihydro. Two of the wells lie downgradient and cross-gradient of MW-115. OR-4 contained PCE at 21.2 µg/L, and R-24 contained PCE at 2.1 µg/L. These wells may slightly bound the MW-115 plume, but they do not lie directly downgradient along the east-trending local potentiometric surface; therefore, the eastern plume edge is inferred. Additionally, the large concentration gradient between MW-115 and OR-4 in particular may indicate that an older, relatively low-level release impacted OR-4 while the more recent release observed at MW-115 has not yet reached OR-4 or diverges in groundwater direction.

10.0 NATURE AND EXTENT OF CONTAMINATION – VAPOR INTRUSION

Due to the volatile and persistent nature of the chlorinated solvents associated with the Facility and the potential for CVOCs in subslab vapor and indoor air, previous investigations into VI were conducted by EPA. Interim remedial actions conducted by EPA sought to reduce source area solvent mass, thereby decreasing continuing contributions to groundwater CVOCs, and subsequently alleviate impacts to indoor air. Over 150 properties were sampled by EPA before, during, and after interim actions conducted at the Facility, including 7 properties where mitigation systems were installed. During the RI, 49 properties were investigated to evaluate the current conditions and potential for indoor air VI after EPA interim actions, and to provide an updated CSM for the VI pathway. The 49 structures were selected based on structures that had previous EPA investigations, structures that were outside historical investigation areas near lower concentration areas of the groundwater plume, near different potential plume or CVOCs source areas, structures with known mitigation systems, structures with sensitive receptors, structures with varied building types or construction, and discussions with DEQ. The VI sampling memo has specific rationale for each proposed VI investigation structure (Trihydro 2018). VI sampling was conducted in two phases between February 7 and March 9, 2018. VI and subslab samples were analyzed for TO-15 VOCs, TO-15 APH, fixed gases by method 3C, and methane by TO-3, as described in Section 4, and as shown in the VI sampling results (Appendix H). Indoor air analytical results were compared to DEQ TIACs (DEQ 2012), DEQ generic APH fraction SLs (DEQ 2018c), EPA residential RSLs with HQ = 0.1, and EPA Industrial RSLs with HQ = 0.1, as described in Section 7.1.1. Complete RI results for indoor air, crawlspace air, and subslab vapor, delineated by property, are presented in Appendix H, but Table 10-1 includes each location and its property-specific VI evaluation. Structure details on properties sampled during the 2018 VI investigation are shown in Figure 10-1.

10.1 VAPOR INTRUSION DATA EVALUATION APPROACH

DEQ's Montana VI Guide (2011) recommends use of multiple lines of evidence when evaluating VI data. The multiple lines of evidence include the analytical data collected during VI sampling, other contaminated media, building construction, and sampling conditions to assemble a holistic picture of the potential for VI at the Facility. Trihydro used multiple lines of evidence to evaluate potential VI impacts at the 49 properties sampled at the Facility and determine if the VI pathway was completed or potentially complete. Using multiple lines of evidence presented in Sections 10.1.1 through 10.1.14 and detailed for each section on Table 10-1, Trihydro evaluated the VI pathway for contaminants exceeding applicable November 2018 EPA RSLs (EPA 2018b), DEQ's RBCA APH levels, and DEQ's TIACs (DEQ 2012). The VI evaluation is presented in Table 10-1. The remainder of this section describes specific

lines of evidence used during the VI investigation, and provides additional explanation of the rationale used during VI pathway completeness evaluations.

10.1.1 VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN VARIOUS MEDIA AND STRUCTURE PROXIMITY TO CONTAMINATED MEDIA

As described in Sections 8, 9, and 11, investigations were performed in soil, groundwater, surface water, stormwater, and sediment at the Facility. VI sample locations were selected to provide broad spatial coverage of the Facility in relation to the CVOCs groundwater plume. Due to the large areal extent of the chlorinated solvent groundwater plume, when compared to the much smaller source area locations, the majority of the VI sample locations are not located in proximity to potentially contaminated soil, sediment, or surface water. Therefore, when evaluating potential VI concerns at a property, the nearest groundwater monitoring well, and its May 2018 groundwater PCE concentration, were noted and included in the VI evaluation table.

The VI guidance also recommends investigation of all structures within 300 ft of known chlorinated solvent groundwater plumes. Due to the large areal extent of the facility (estimated at more than 855 acres, containing more than 1,000 structures), a subset of those properties was selected to provide spatial coverage throughout the known areas of historic and currently known groundwater impacts. Properties were evaluated in areas proximal to known contaminant sources, in areas of elevated groundwater concentrations within the plume body, and in structures located near the currently understood boundary of the groundwater plume. VI sample locations are shown on Figure 10-1.

10.1.2 RATIOS OF INDOOR AIR CONTAMINANTS TO SUBSTRUCTURE CONTAMINANTS

A variety of structures were sampled during the VI investigation, including structures with concrete basements, field stone foundations, slab-on-grade, crawlspaces, and combined basements and crawlspaces. For buildings with a concrete floor, including those with basements, indoor air contaminant concentrations were compared to subslab soil-vapor contaminant concentrations. For structures with a crawlspace, the crawlspace samples were considered a ‘lower level’ of the structure, and crawlspace concentrations were compared to indoor air concentrations. The results of these comparisons are shown in Table 10-1.

10.1.3 WORST-CASE SCENARIO SAMPLING

VI sampling was conducted between February 7 and March 9, 2018. Average air temperature was monitored throughout the sampling event and was recorded on field sampling forms during the sampling event. Field sampling forms are presented in Appendix E-5. Data from Weather Underground (2018) shows that the average maximum daily temperature during the sampling event was 27.7 °F, while the average daily temperature was 18.4 °F. This supports

worst-case scenario sampling, as the ground was likely to be frozen throughout the sampling period. Trihydro staff also used a soil probe to verify that the ground was frozen during sampling in the month of March, and reported this information to the sampling team. As directed by DEQ as an assurance of worst-case-VI-conditions of frozen ground, a test of frozen ground was performed by inserting a carbon steel probe into the ground surface and measuring inches of ground penetration starting in March 2018. For each sample day in March 2018, the ground was found to be frozen each day, as the sample probe could not be inserted into the ground beyond 1 inch during each test. The sampled structures, with the exception of the former Rex's Cleaners building and the property at 306 North 30th Street, were occupied during the time of sampling, and were being actively heated during sampling, increasing the chances of a chimney effect amplifying VI, and further supporting a worst-case scenario analysis. Trihydro personnel requested that building occupants leave doors and windows closed as much as possible during VI sample collection.

10.1.4 TEMPORAL VARIABILITY

Only one round of VI sampling was conducted by Trihydro during the RI, thus temporal analysis is not conducted based on RI data. Recommendations for additional sampling to provide temporal variation analysis of current site conditions is provided in Section 10.6. As previously noted, EPA conducted VI sampling as part of interim efforts to investigate impacts to potential receptors near the BSL groundwater impacts. This sampling was conducted throughout the year during interim action investigations, and therefore may not have been conducted during worst-case scenario conditions. Investigations regarding indoor air impacts due to VI from chlorinated VOCs began in 2000 with soil vapor sampling conducted by DEQ through EPA's 2011 groundwater and indoor air sampling event. EPA started indoor air sampling in 2006 at properties closest to BSL and continued indoor air sampling in 2007 and 2008 at many of the same properties (Trihydro 2017a). In 2010 and 2011, EPA expanded its indoor air sampling to include more downgradient properties and used that post-interim remedial action dataset to establish a risk-based interim action level to aid EPA in evaluating structures that may need mitigation systems (Trihydro 2017a). As the EPA's sampling appears to have been primarily conducted to evaluate the effectiveness of interim remedial actions, the resulting VI data was not used to evaluate temporal variability at previously sampled structures during the 2018 VI investigation. EPA's historical data is included in Appendix H results data tables by property.

10.1.5 TIME REQUIRED TO REMEDIATE CONTAMINANTS

Chlorinated solvents are known to be recalcitrant contaminants in the subsurface. Existing chlorinated solvent sources at the Facility are suspected to be on the order of 25 to 50 years old based on historical reports and data. Furthermore, as previously noted, groundwater CVOCs impacts are widespread and may require significant effort to remediate to current applicable SLs. Therefore, based on the DEQ Montana VI Guide (DEQ 2011), the recalcitrance and persistence

of underlying groundwater CVOCs concentrations above applicable SLs is one line of evidence that VI evaluation is required for the Facility.

10.1.6 INDICATIONS OF SIGNIFICANT CONTAMINANT SOURCES BELOW A STRUCTURE

The Facility has over 500 acres of area with groundwater concentrations above applicable SLs and approximately 41 of the 49 structures investigated for VI are above the Facility groundwater plume with 5 µg/L or higher concentrations, and the remaining 8 structures were within the guidance-recommended 300 ft of the PCE groundwater plume. This is another line of evidence for VI evaluation and the information was considered when performing the VI evaluation at each structure as presented in Table 10 (DEQ 2011). While many of these structures are not located over known source areas, they are located above areas of PCE groundwater impacts and therefore were included in the investigation. Elevated subsurface or indoor air concentrations above a known source may influence decisions about mitigation system installation or remedial activities to be conducted at those locations, but the absence of a significant known source did not preclude VI evaluation at the locations sampled. In Table 10-1, the third column notes the "Nearest Identified Potential PCE Source" and that is filtered to discuss the potential PCE source (i.e. chlorinated solvent user).

Additionally, several structures were specifically targeted for VI investigations at known and suspected source areas with significant sources. The likelihood of a nearby significant source was considered when designing the VI sample locations and when performing the VI evaluation to examine multiple lines of evidence as a significant contaminant source area – either historic or current. The three known source area structures were found to have elevated contaminant concentrations in both indoor air and subsurface vapors, with former Rex having the highest indoor air result for PCE of 223 micrograms per cubic meter (µg/m^3), BSL with a result of 85.1 µg/m^3, and former CAL at 4.7 µg/m^3 compared to the indoor air Industrial RSL for PCE of 18 µg/m^3. Source area properties are discussed further in Section 10.5 and Table 10-1.

10.1.7 BUILDING CONSTRUCTION AND CURRENT CONDITIONS

Another line of evidence to consider for VI pathway evaluation is building type and construction. As noted in Section 10.1.2, a range of building constructions were sampled during the investigation. As expected, buildings with crawlspaces typically contained lower contaminant concentrations in the crawlspace air than contaminant concentrations in subslab vapor in buildings with concrete slabs. This is because vapor becomes trapped under impermeable surfaces such as concrete slabs, whereas higher air exchange with indoor and outdoor air typically takes place in crawlspaces. Of the 49 properties sampled, 22 properties had basements, 8 properties had crawlspaces, 14 properties had both a basement and a crawlspace under some portion of the building, and 5 properties were slab on grade construction. For each property investigated, field sampling teams noted VI pathway concerns such as floor

drains or sumps, cracks, fissures or degradation of concrete slabs, and openings to crawlspace air. This information was recorded along with building construction details in the Property Information section of Table 10-1. Building construction information was collected via occupant questionnaires and field sample forms (which can be found in Appendix E-5 and from information contained on the Montana Secretary of State Cadastral database, at http://svc.mt.gov/msl/mtcadastral). Of the properties investigated, 28 were observed to have cracks or access to the subsurface that could affect VI pathway evaluation when looking at building construction.

10.1.8 BUILDING OWNER SURVEYS AND POTENTIAL INDOOR SOURCES

As previously noted, occupied dwelling questionnaires were completed for each property to the extent practicable. Where questionnaires could not be completed by occupants, field staff would record structure information based upon site visit observations, property records, and available information provided by occupants. Field staff noted if they observed containers for solvents, fuel, paints, cleaning products, deodorizers, aerosols, and other potential VOC sources on field sampling forms, but did not do a whole-structure inventory or remove any containers prior to sampling. Potential observed indoor air VOC sources are presented as part of the VI pathway evaluation for each property in Table 10-1. Occupied dwelling questionnaires can be found in Appendix E-5.

10.1.9 POTENTIAL OUTDOOR SOURCES

Ambient (outdoor) air samples were collected during each day of indoor air sampling at the Facility. Twenty-five ambient air samples were collected during the investigation. Due to the large area of the Facility, multiple ambient air samples were sometimes collected for adequate comparison to indoor air samples. In general, ambient air sample locations were selected to collect both upgradient and cross-gradient air samples during indoor air sample collection, based upon prevailing wind conditions during the time of sampling. Indoor air sample analyte concentrations were compared to the ambient air sample analyte concentrations for the ambient air samples collected for that day. Ambient air sample analytical results are presented in Appendix H.

For several compounds (e.g., benzene, chloroform, and carbon tetrachloride), ambient air concentrations were frequently observed in excess of their respective November 2018 EPA residential air RSLs. Where VI sampling results suggested a potentially complete pathway for a given contaminant, ambient air concentrations for that day were compared to indoor air concentrations to evaluate whether outdoor sources could potentially be contributing to indoor air concentrations. This evaluation is presented in Table 10-1 for each structure as part of the VI pathway evaluation.

10.1.10 REPORTING LIMIT COMPARISONS TO SCREENING LEVELS

Sample analytical results were compared to the November 2018 EPA RSLs for residential air with HQ = 0.1. As noted in the RIWP QAPP (Trihydro 2017b), the RLs for most compounds are below applicable SLs. However, some contaminant SLs are lower than achievable RLs. Those compounds are listed in the notes section of Table 10-1. Additionally, contaminant concentrations or other interferences may have resulted in elevated RLs for individual compounds in some samples. Those compounds for which the RL exceeded the SL are noted in the sample results column of Table 10-1 for each property. If RLs were greater than applicable SLs in a sample, and the compound was not detected in other media at the structure, then the VI pathway was not considered complete for that compound. However, if the compound was detected in other samples within the structure, additional site-specific information was used to evaluate the potential for complete VI pathways. Five compounds evaluated during the investigation had a DEQ TIAC that is higher than the applicable EPA Residential RSL (1,2-DCA, benzene, ethyl acetate, isopropanol, and naphthalene), and two compounds did not have an applicable EPA Residential RSL (ethanol and trichlorofluoromethane). The TIAC was used as the applicable residential air SL for these compounds. The TIAC for naphthalene is also higher than the EPA Industrial RSL, and was therefore also used for the applicable industrial air SL.

10.1.11 CONSTITUENT RATIOS IN VARIOUS MEDIA

VI pathway evaluation used comparison of contaminant concentrations in various media. Contaminant concentrations in indoor air on the main floor or upper floors were compared, where applicable, to lower level indoor air (such as main floor or basement air), to evaluate potential concentration gradients in indoor air, in support of a complete VI pathway. With respect to VI, a concentration gradient occurs when vapor diffuses from an area of high concentration to low concentration. This means that vapor typically moves upward through a structure from higher concentrations in the subslab and/or crawl space air (closer to source soil or groundwater contamination) to progressively lower concentrations in the basement, main level, and then upper levels of a structure. Contaminant concentrations in indoor air samples collected from the lowest level of a structure were compared to concentrations in the substrate (i.e., crawlspace air or subslab vapor) to evaluate the VI pathway from the substrate to indoor air. If a concentration gradient was observed from the substrate to lower level and main level indoor air, the VI pathway was considered complete. If concentration gradients could not be clearly established, but a gradient existed for a portion of the pathway (e.g., PCE concentrations in subslab vapor were greater than indoor air concentrations in the lower and main level, but the main level had higher PCE concentrations than the lower level), the VI pathway was considered either not complete, or potentially complete, depending on other structure information.

Due to the ubiquitous nature of PCE in groundwater at the Facility, the VI pathway was evaluated for PCE at each structure in the investigation. Other compounds were evaluated for individual structures when they exceeded indoor air

SLs for that location. Of the 49 properties sampled, 41 were located above or adjacent to known groundwater with PCE concentrations exceeding the DEQ-7 standard. Eight properties were sampled whose nearest groundwater monitoring well did not contain PCE above the standard, but were within the guidance-recommended 300 ft of the PCE groundwater plume. These properties were evaluated to have incomplete VI pathways for PCE, although two of the properties did have complete VI pathways for TCE.

10.1.12 SAMPLE RESULTS FROM NEARBY STRUCTURES

As previously noted, the Facility has a large areal extent, and sample locations were selected, as practicable, to allow for the broadest spatial coverage that would provide representative data for the Facility. Therefore, adjacent structures were typically not sampled, with the exception of several properties close to the BSL source area. Sampling was not impeded in these structures, and VI pathway evaluations were conducted without reliance upon adjacent structure information. Future evaluations may be able to utilize the 2018 VI investigation data to evaluate potential concerns for nearby structures, prior to conducting additional VI investigations.

10.1.13 EVIDENCE OF BIODEGRADATION

Subslab samples were analyzed for fixed gases (oxygen, nitrogen, helium, and carbon dioxide) as described in Section 7. PCE is typically resistant to degradation in aerobic environments, and where anaerobic conditions occur, can have a half-life on the order of ten years (Lawrence 2006). In general, aerobic conditions were observed in the groundwater monitoring wells sampled; therefore, significant subsurface evidence of solvent biodegradation is not expected to be observed for the general plume area. Oxygen in the subsurface was generally slightly depressed, and was approximately 19% v/v on average, which is indicative of oxygen-consuming microbial activity. However, this level of oxygen suggests that conditions are not conducive to anerobic PCE degradation immediately beneath structures' slabs. Carbon dioxide was only detected at measurable volumes in approximately 31% of samples. For those samples where it was detected, carbon dioxide constituted about 4.2% v/v of the sample volume, which is elevated compared to the typical 0.04% of carbon dioxide in ambient air. The highest carbon dioxide was observed in the subslab sample for 202 9th Street West, which coincided with high LEL and other field measurements during the VI investigation, and elevated carbon dioxide could be indicative of increased degradation below slab.

10.1.14 UNCERTAINTY

As previously noted, the Facility has a large areal extent, and contains more than 1,000 occupied structures, rendering complete sampling of all structures overlying the groundwater plume practically challenging. Sample locations were selected to sample a range of structures along cross-sections and transects of the known extent of the groundwater plume, but the data coverage may not be adequate to provide representative data for every property use or structure

type within the known groundwater plume. Additionally, VI sample locations were identified in the RIWP VI Addendum (Trihydro 2018), which was submitted in Winter 2018. Subsequently, additional monitoring wells were installed and sampled in May 2018, along with newly identified irrigation and existing monitoring wells in the northeastern and southwestern ends of the known contaminant plume. The groundwater PCE plume was found to be larger than previous sampling was able to identify, and may indicate previously unknown contaminant sources. VI sampling was completed prior to the identification of these potentially impacted areas, and may not adequately represent conditions in those areas.

EPA conducted significant VI investigations before, during, and after the interim remedial actions conducted in 2008 from 2006 through 2011; however, indoor air was not evaluated again until the 2018 RI. Therefore, uncertainty also exists in temporal variations in VI data post-interim actions, and recommendations regarding additional data collection are presented in Section 10.6.

10.2 CONTAMINANTS OF POTENTIAL CONCERN SELECTION

To evaluate current indoor air conditions at the Facility, 49 residential and commercial properties throughout the Facility were sampled. DEQ VI guidance requires determination of VI COPCs on a property-by-property basis (DEQ 2011). However, due to the large areal extent of the Facility, a list of site-wide COPCs based upon current conditions observed during the 2018 VI investigation has been developed. This approach is expected to support a conservative evaluation (i.e., include more than the minimum number of compounds), as not all compounds are expected to be COPCs for each structure at the Facility. Structure-specific VI pathway concerns are presented in Table 10-1. A summary evaluation of the COPCs is presented in Section 10.3.

10.3 2018 VAPOR INTRUSION INVESTIGATION RESULTS

During February and March 2018, 49 properties were evaluated for VI impacts, including 39 residential properties, 7 commercial or light industrial businesses, a pre-school daycare facility, an elementary school, and a high school. Three of the commercial structures are known or suspected source area buildings (BSL, former CAL, and former Rex). Based on the building properties of each structure, appropriate samples were collected from 2nd floor air, main floor air, basement air, crawlspace air, and subslab vapor. In locations where crawlspaces were isolated from indoor air, crawlspace air was not considered to be indoor air. However, where crawlspaces were open to basements that were or could become occupied, samples were labelled basement/crawlspace air, and were considered indoor air. Subslab samples were not considered indoor air, and were not included in the indoor air evaluation. A total of 115 indoor air samples were collected from occupied spaces at these properties. Analytical results for indoor air are presented below, and Figures 10-2 through 10-5 show spatial locations of VI analytical results exceedances. In general, there were

39 structures evaluated for VI, out of 49 structures, that had complete or potentially complete pathways for at least one analyte. Of these properties with complete or potentially complete VI pathways, the following structure types were observed:

- 17 structures with basements
- 11 structures with basement/crawlspace combinations
- 5 structures with crawlspaces
- 4 structures with slab on grade foundations
- 2 school structures (combination foundational structures)

TO-15 Volatile Organic Compounds

VI samples were evaluated for VOCs using the TO-15 method. Analytical results were compared to applicable SLs as noted in Section 7. Nine VOC compounds were detected in indoor air in excess of their EPA RSLs or applicable MT TIACs, and the VI pathway was determined complete or potentially complete. These compounds are considered indoor air COPCs for the Facility and include:

<u>Facility Indoor Air COPCs</u>

- 1,2-DCA – Exceeded DEQ's TIAC of 0.23 µg/m3 (which is higher than the residential air RSL) at 1 structure.
- 1,2,4-trimethylbenzene – Exceeded the residential air RSL of 6.3 µg/m3 in 1 structure.
- 1,3-butadiene – Exceeded the residential air RSL of 0.094 µg/m3 in 1 structure.
- Benzene – Exceeded DEQ's TIAC of 1.3 µg/m3 (which is higher than the residential air RSL) in 4 structures.
- Bromodichloromethane – Exceeded the residential air RSL of 0.076 µg/m3 in 4 structures.
- Carbon tetrachloride – Exceeded the residential air RSL of 0.47 µg/m3 in 6 structures.
- Chloroform – Exceeded the residential air RSL of 1.2 µg/m3 in 26 structures.
- PCE – Exceeded the residential air RSL of 4.2 µg/m3 in 14 structures.
- TCE – Exceeded the residential air RSL of 0.21 µg/m3 in 19 structures.

Seventeen additional compounds were detected in exceedance of their respective EPA RSLs for residential indoor air or applicable TIACs. The TO-15 method analytes with indoor air exceedances that were evaluated as not having complete VI pathways along with the number of structures that had those exceedances based on the RI investigation are listed below. Due to the incomplete nature of the VI pathway specific to these analytes, they have not been determined

to be Facility COPCs; however, due to the variable nature of VI investigations and the large spatial extent of the Facility, these analytes should be retained for future VI investigations specific to each structure. Contaminants exceeding indoor air concentrations are presented on a structure-by-structure basis in Table 10-1 and in Table 10-2. Table 10-2 includes the ranges of analyte exceedances for COPCs and other indoor air analytes with exceedances. Those analytes that exceeded indoor air SLs in structures, but were not found to have complete VI pathways are noted below:

Compounds Exceeding Applicable Indoor Air SLs Without Complete VI Pathways

- 1,1,2,2-tetrachloroethane (4 structures)
- 1,1,2-trichloroethane (1 structure)
- 1,2-dibromoethane (1 structure)
- 1,2-dichloropropane (1 structure)
- 1,3,5-trimethylbenzene (3 structures)
- 1,4-dichlorobenzene (3 structures)
- chloromethane (2 structures)
- dichlorodifluoromethane (1 structure)
- ethyl acetate (7 structures)
- ethylbenzene (9 structures)
- heptane (1 structure)
- hexachlorobutadiene (1 structure)
- isopropanol (16 structures)
- methylene chloride (4 structures)
- m,p-xylenes (4 structures)
- naphthalene (4 structures)
- o-xylenes (2 structures)

PCE VI results are shown on Figure 10-2, and TCE VI results are shown on Figure 10-3. VI result locations for indoor air exceedances for trihalomethanes (bromodichloromethane and chloroform) are presented spatially on Figure 10-4. Figure 10-5 shows other VOC analytical results exceedances: benzene, carbon tetrachloride, 1,2-DCA and

1,3-butadiene. The VI pathway was found complete at some locations for the analytes presented in Figures 10-4 and 10-5, and those locations are presented by property in Table 10-1. Chloroform (Figure 10-4) and benzene (Figure 10-5) were detected above applicable EPA residential RSL indoor air (chloroform) or TIAC (benzene) SLs in more than half of the structures sampled. Benzene was above the TIAC of 1.3 µg/m^3 in 26 of the 49 structures and in 57 samples collected from those structures. Similarly, chloroform was detected above the applicable RSL of 0.12 µg/m^3 in 47 structures with 93 indoor air samples (not including duplicates). While there is not a typical background indoor air concentration for chloroform, in some instances, use of chlorinated water in structures may make it difficult to assess if the VI pathway is complete or just one of several contributing sources to indoor air quality. The VI pathway was not determined complete for ethyl acetate, ethylbenzene, or isopropanol; therefore, VI results are not shown spatially for those samples.

Air Phase Petroleum Hydrocarbons

Of the 49 properties sampled during the RI, 23 were sampled for potential APH impacts. Therefore, a total of 62 indoor air samples were evaluated for APH at these properties using the TO-15 APH Method. The following compounds were detected in exceedance of DEQ's Generic APH Fraction SLs (DEQ 2018):

- C5-C8 aliphatic hydrocarbons
- C9-C10 aromatic hydrocarbons
- C9-C12 aliphatic hydrocarbons

C5-C8 aliphatics exceeded the 94 µg/m^3 generic SL at 8 properties, and in 14 of 62 samples, with exceedance concentrations ranging from 107 to 906 µg/m^3. C9-C12 aliphatics exceeded the 44 µg/m^3 generic SL at 10 properties, and in 11 of 62 samples, with concentrations ranging from 44.9 to 2,480 µg/m^3. The VI pathway was determined as complete in at least one property for these compounds; therefore, they are considered COPCs for the Facility.

C9-C10 aromatic hydrocarbons exceeded the 10 µg/m^3 SL at the BSL main office in a single sample, with a concentration of 2,750 µg/m^3. The VI pathway was not determined as complete at this location; therefore, C9-C10 aromatic hydrocarbons are not considered a COPC for the Facility.

Ambient Air

Twenty-five ambient air samples were collected during VI sampling at the Facility and were evaluated for TO-15 SIM VOCs and APH. Several analytes were detected in ambient air above applicable SLs in a significant (more than 5%) number of the ambient air samples. The most prevalent were benzene (which exceeded the EPA residential air RSL in each of the 25 ambient air samples, and the TIAC in 8 ambient air samples), chloroform (which exceeded the EPA

Residential RSL in 18 samples), and carbon tetrachloride (exceeding its EPA Residential RSL in 12 samples). This suggests that ambient air concentrations of these compounds may be impacting indoor air. Ambient air concentrations for samples collected on the same day as indoor air samples were compared to indoor air sample results as part of the multiple lines of evidence evaluation. Other compounds that exceeded EPA residential air RSLs included 1,2-DCA (4 samples, though it did not exceed the applicable TIAC), TCE (3 samples), methylene chloride (3 samples), 1,3-butadiene (2 samples), and ethylbenzene (2 samples). Benzene also exceeded the EPA industrial air RSL in 5 ambient air samples. Ambient air results are shown in Appendix H.

10.4 SOURCE AREA STRUCTURE EVALUATIONS

The VI pathway was evaluated for individual structures as described in Section 10.1 and Table 10-1. However, specific additional evaluation is presented below for source area properties at BSL, former CAL, and former Rex. Due to its proximity to BSL, elevated solvent concentrations (in spite of an operating mitigation system), and the potential for contaminant source material extending beneath the structure, an evaluation of the commercial building at 711 Central Avenue is also included in this section.

10.4.1 BIG SKY LINEN

As described in the DSR (Trihydro 2017), PCE use at BSL is believed to have terminated between 1992 and 1994, and the equipment associated with dry cleaning operations was removed from the site in 1997. The business currently offers wet-laundry services. Discussions with property owners suggests that chlorinated solvent use occurred primarily in the northeast corner of the building, which currently houses a laundry sorting area. A worn area on the floor shows the pathway that solvent overflows may have run to a floor drain during operations. The floor drain was a known release point of solvents to the subsurface, and was abandoned in 1975 (Lockheed Martin 2009). Historical VI sampling at BSL did not include indoor air sampling and was limited to subslab vapor sampling. Vapor samples were collected from subslab ports in June and July 2007, prior to interim remedial actions at the Facility. PCE concentrations ranged from approximately 160 to 970,000 µg/m^3. While these samples are assumed to have been collected from the commercial building, it is unknown which specific locations within the building these samples represent. No vapor mitigation system was installed by the EPA during interim actions. Structure observations and discussions with the owner indicate that there is no vapor mitigation system at this property.

The 2018 VI investigation data at BSL shows PCE subslab concentrations ranging from 209 to 3,310,000 µg/m^3, which is similar in magnitude to the 2007 concentration range. Sample locations within the structure are shown on the field sampling forms in Appendix E-5. Three subslab samples were collected in the process area from existing EPA sample ports. The two vapor samples from ports in the eastern portion of the process area contained PCE at more than

1,000,000 µg/m^3. This area is where chlorinated solvents were historically used in the building. The subslab concentrations suggest the continuing presence of source area contaminants beneath the slab of the BSL building. A third subslab sample was collected in the middle of the process area, and contained the lowest PCE concentration in subslab vapor, at 209 µg/m^3. The fourth sample was collected from a sample port installed in February 2018, in an office addition on the west side of the BSL building. This addition was constructed in approximately 2011. The subslab sample contained PCE at 833 µg/m^3. This addition was built over the area used to stockpile excavated soils during the interim remedial action.

Indoor air samples were collected in the office area, near the mid-process area, and in the eastern process area of the structure. The three samples contained PCE at concentrations exceeding the 18 µg/m^3 November 2018 EPA industrial air RSL. Concentrations in indoor air ranged from 26.1 to 85.1 µg/m^3, with the highest concentration found in the eastern processing area. The VI pathway was determined to be complete for PCE, C5-C8 aliphatic hydrocarbons, and C9-C12 aliphatic hydrocarbons. The VI pathway analysis for other compounds may have been obscured by elevated detection limits due to the high concentrations of PCE in the subslab samples. Other compounds with industrial air RSL exceedances included 1,2,4-trimethylbenzene, 1,2-dibromoethane, 1,3,5-trimethylbenzene, chloroform, ethylbenzene, o-xylenes, and TCE.

10.4.2 711 CENTRAL AVENUE

The commercial building at 711 Central Avenue has no recorded activity as a commercial solvent user or cleaning operation. However, its proximity (less than 30 ft) to BSL, location downgradient of BSL along the prevailing groundwater flow direction, and the known release areas in the alley separating BSL from 711 Central Avenue, suggest that PCE source material may exist below the building. This potential subsurface PCE source may continue to act as a source of contamination for indoor air and groundwater. The building currently houses several commercial and non-profit enterprises.

Prior to conducting interim remedial actions to address subsurface contamination adjacent to BSL and 711 Central Avenue, EPA determined that a heating, ventilation and air conditioning (HVAC) bypass system would be necessary to prevent solvent vapors generated during excavation from impacting indoor air at 711 Central Avenue. The system was installed with HVAC inlets above the roofline instead of near ground surface, where they were originally installed. In February and May 2008, EPA installed radon-style mitigation systems in three residential properties, as well as 711 Central Avenue. System design information is not available, but they are thought to consist of a subslab vapor-depressurization location beneath the slab that is connected to a pipe with a continuously operating blower(s), and vents and piping above/outside of the structure. Subslab vapor mitigation systems are typically designed to generate a

pressure gradient between the vapor below the subslab and indoor air that allows for subslab vapors to have a lower pressure pathway to ventilation that is not through the slab and into indoor air (i.e., to limit airflow from the subslab to the building). Although the system at 711 Central Avenue was believed to be operational during the sampling event, operation was unable to be verified, as access was not provided by the property owner to a locked storage room that had the piping with the manometer gauge. A DEQ site visit in March 2019 noted that the system was off or inoperable, as it was not showing a vacuum on the manometer at that time.

During the 2018 VI investigation, two subslab vapor samples (with one duplicate) and six indoor air samples (with one duplicate) were collected at 711 Central Avenue. Sample locations are shown on the field sampling forms in Appendix E-5. Subslab samples were collected from EPA-installed ports in the concrete slab in the H.O.M.E. Church located in the western end of the basement, and in the utility room, located in the central portion of the basement. Subslab vapor concentrations of PCE were elevated in both samples, with the highest concentration being found in the utility room, at 1,650,000 µg/m^3. The PCE concentration in the church subslab sample was significantly lower, at 26,200 µg/m^3. The subslab port in the church is located a short distance from the point where the mitigation system appears to pass through the slab. It appears that only a single mitigation system is installed in the structure, and it is unknown if there is only a single penetration through the slab for drawing vapor for the mitigation system. TCE was also detected in the subslab vapor, again at higher concentrations in the utility room (12,600 µg/m^3) than in the church (47.3 µg/m^3). *Cis*- and *trans*-1,2-DCE were only detected in the utility room sample, but these detectable concentrations support the observation that degradation of PCE may be occurring beneath 711 Central Avenue. VC was not detected in either sample. In addition to chlorinated solvents, C5-C8 aliphatic hydrocarbons were elevated in both subslab samples, at 673,000 µg/m^3 in the utility room and 3,850 µg/m^3 in the church.

Indoor air samples were collected in the basement level and the 1st floor (identified as the 'main' floor in field sampling forms) at 711 Central Avenue. Basement air samples were collected in the H.O.M.E. Church sanctuary, in an unoccupied office area in the east wing of the building, in the central hallway in the basement, and in the utility room. Main floor samples were collected in the east wing and west wing of the building. The VI pathway was determined as complete for chloroform, PCE, and TCE, and these compounds were observed in excess of commercial and residential indoor air SLs in basement air. PCE was detected in each indoor air sample, and concentrations in indoor air exceeded the 18 µg/m^3 EPA industrial RSL in 4 of the 5 basement air samples, and 1 of 2 main floor samples. The highest concentrations were found in the utility room (48.1 µg/m^3) and unoccupied east wing (46.6 µg/m^3). Indoor air concentrations were lower in the church sanctuary samples, though still exceeding the industrial RSL. The main floor indoor air samples were 3.9 µg/m^3 (east wing) and 7.5 µg/m^3 (west wing), which further suggests that the mitigation system may be effective in reducing VI impacts, though contaminant concentrations still exceed generic SLs. TCE exceeded the 0.88 µg/m^3 industrial RSL in the basement utility room and hallway samples only.

In general, contaminant concentrations appeared to be lower in samples collected proximal to the mitigation system. Elevated detection limits in subslab samples due to elevated PCE concentrations may have occluded evaluation of other potential VI contaminant pathways due to interference, although no other contaminants than those previously noted exceeded their respective EPA industrial RSLs.

10.4.3 FORMER CENTRAL AVENUE LAUNDRY AND CLEANERS

As noted in the DSR, the former CAL, located at 1246 Central Avenue, appears to have conducted dry cleaning operations for roughly 8 years, during which time chlorinated solvent waste was disposed of "…onsite in a sewer lagoon (MDHES 1993)." Former CAL was not evaluated for VI impacts during investigations prior to the RI. After serving as a dry-cleaner for several years, the building has housed a variety of businesses, including (most recently) the Cigarette Store, which continues to operate on the premises.

Groundwater sampling results indicate a potential source area may exist at former CAL. One suspected release mechanism involved discharge to the sanitary sewer running in the alley south of former CAL. However, sewer scoping did not reveal immediately apparent release locations, and groundwater sampling results from a newly installed well north of former CAL had PCE analytical results in September 2018 at 3.4 µg/L, which are low in the context of source-area investigation. However, a monitoring well in the alley behind former CAL, adjacent to the sanitary sewer line, MW-101, had analytical results for PCE at 191 µg/L in September 2018. This suggests that a residual source area may potentially be located towards the southern edge of the building close to where the sewer line is located in the alley.

One subslab vapor and one indoor air sample were collected at former CAL. Sample locations are shown on VI field forms in Appendix E-5. The VI pathway was determined as appearing complete for PCE and TCE. PCE was elevated in subslab vapor (74,800 µg/m^3), though indoor air only slightly exceeded the residential RSL at 4.7 µg/m^3. TCE was slightly elevated in the subslab vapor (13.4 µg/m^3), and did not exceed the industrial RSL in indoor air, but exceeded the residential RSL of 0.21 µg/m^3. The subslab port was located in the back portion of the structure, in an effort to identify potential source area contamination associated with sanitary sewer discharge. Four other compounds found in indoor air exceeded industrial RSLs, but were not detected in subslab vapor: 1,2-DCA, 1,3-butadiene, benzene, and chloroform. RLs were not significantly elevated in subslab vapor for 1,2-DCA and chloroform; however, the limits did exceed the detected concentration in indoor air for 1,2-DCA and chloroform so VI cannot be ruled out for these compounds.

10.4.4 FORMER REX CLEANERS

The former Rex appears to have operated as a laundry cleaning service in some capacity from as early as 1912, until approximately 1973. The structure, located at 19 S. Broadway, is currently unoccupied, though it previously housed an automobile dealership and repair shop. No equipment persists from the former cleaning activities, though floor drains are present in the eastern warehouse portion of the building, which appears to be an older portion of the structure. The building has been remodeled with new interior and exterior metal sheathing, though it appears some historical features such as the floor drains, concrete floors, and foundations may still be original. The structure had not been previously investigated for VI impacts from chlorinated solvents, though a partial Phase II investigation report is available for the Facility, indicating the presence of PCE in the subsurface (Maxim 2002).

A subslab port was installed in the eastern warehouse area, as it appeared to be the oldest portion of the concrete slab and contained multiple floor drains as well as cracked concrete floors. Sample locations are shown in the field forms in Appendix E-5. During VI sample collection, a PID was used to evaluate potential VOC impacts in floor cracks and drains. Elevated PID readings were observed throughout the eastern warehouse, with the highest concentrations in the southern portion of the room. The subslab sample port PID reading was 114.5 ppm.

One subslab vapor sample and one indoor air sample were collected at the property. The property was vacant at the time of sampling and the office and warehouse areas were heated. The indoor air sample was also collected from the eastern warehouse area. The PCE concentration was elevated in the subslab vapor, at 583,000 µg/m^3. Indoor air PCE concentrations exceeded the industrial RSL at 223 µg/m^3. These results appear to confirm the presence of chlorinated solvents on site. TCE was not detected in indoor air; however, the RL exceeded the industrial RSL, and TCE was detected in the subslab at 8,680 µg/m^3. PCE was the only compound detected in indoor air above the industrial RSL, while benzene also exceeded the residential RSL. C5-C8 aliphatic hydrocarbons were detected at 5,090 µg/m^3 in the subslab vapor which is higher than DEQ's generic APH SL of 94 µg/m^3, though they were not detected in indoor air with a detection limit less than the SL.

10.5 MITIGATION SYSTEM EVALUATIONS

During the 2008 interim remedial actions and subsequent investigations conducted by EPA, seven radon-style indoor air mitigation systems were installed at structures determined to be impacted by chlorinated solvent VI. The systems do not appear to have vapor/air treatment, and most are vented directly to the outside of the structures. Trihydro attempted to sample each property to evaluate the effectiveness of the systems to mitigate VI impacts. Trihydro was able to coordinate property access at 5 of the 7 properties:

- 311 Howard Avenue

- 317 Terry Avenue
- 342 Miles Avenue
- 527 St. John's Avenue
- 711 Central Avenue

Property owners at the remaining mitigation system properties (211 Terry Avenue and 632 Saint John's Avenue #02) were unable to be reached during the sampling event.

The following observations were recorded during sampling accessible EPA-installed mitigation systems. As previously noted, the mitigation system at 711 Central Avenue was believed to be operational during sampling, but was not confirmed. Analysis of mitigation system effectiveness will consider the system to be operational. The mitigation system at 527 St. John's Avenue was shut off during the preliminary VI site visit on February 6, 2018, but was able to be switched on and had adequate vacuum indicating that is was operating correctly during subsequent VI sampling on February 8-9, 2018. The property owner at 317 Terry Avenue noted that the motor burned out of the mitigation system shortly after EPA installation, and that he had replaced it himself, and the system had thereafter functioned correctly. Trihydro personnel confirmed that the mitigation system at 317 Terry Avenue was operational during sampling. The system at 311 Howard Avenue was verified to be operating. The mitigation system at 342 Miles Avenue was not functioning during the initial site visit. Attempts to restart the system were unsuccessful, and it appears that the motor may not be operational. Sampling was conducted at 342 Miles Avenue with the mitigation system off.

For each of the five properties, the VI pathway for PCE was determined to be complete or potentially complete. For the four properties with operating mitigation systems, only 711 Central Avenue contained PCE in indoor air in excess of SLs, though indoor air concentrations appeared to be lower on the western side of the building where the system was installed, despite being closer to a known source area. The property at 311 Howard did not appear to have a complete VI pathway for compounds exceeding SLs, though it did have several indoor air contaminants present in excess of applicable residential RSLs or generic APH SLs. The remaining properties with functioning mitigation systems appeared to have complete VI pathways for chloroform and carbon tetrachloride, in addition to other compounds in indoor air in excess of residential RSLs. Each of the four properties with functioning mitigation systems contained 1,2-DCA in indoor air in excess of the residential RSL. However, the property at 342 Miles Avenue, with the non-functioning mitigation system, appears to have a complete VI pathway for PCE, TCE, C5-C8 aliphatics, and chloroform. Additionally, the indoor air concentrations in the basement and in the main level all exceeded EPA RSLs for PCE and range from 13.5 $\mu g/m^3$ to 17.9 $\mu g/m^3$.

PCE analytical results in the subslab vapor at structures with a functioning system ranged from 6.3 µg/m^3 at 317 Terry Avenue, to 1,650,000 µg/m^3 at 711 Central Avenue (though as previously noted, the subslab concentration in the western area (church) sample closer to the mitigation system was two orders of magnitude lower at 26,200 µg/m^3. The structure at 527 St. John's Avenue contained PCE at 14,600 µg/m^3 in subslab vapor, but did not contain PCE above the SL in indoor air. The subslab concentration of PCE at 342 Miles with the non-functioning mitigation system is an order of magnitude larger than the highest concentrations observed at the working mitigation system locations with PCE at 143,000 µg/m^3.

10.6 CONCLUSIONS AND RECOMMENDATIONS

As noted in Section 10.1.4, previous indoor air sampling efforts may have been focused on interim remedial action evaluation, and may not have been designed to evaluate potential long-term VI exposure. Therefore, the data gathered during the 2018 VI investigation has been evaluated as the preliminary round of VI sampling, as described in DEQ's VI General Decision-Making Process flowchart (DEQ 2011). As site-specific background indoor and outdoor air levels have not been established for the Facility, and each of the 49 properties investigated contained at least one contaminant exceeding indoor air SLs, an additional round of VI sampling may be necessary at each property. Select properties may warrant evaluation for mitigation based upon VI sample results, and are discussed below.

Fourteen properties appear to have complete PCE VI pathways, where PCE concentrations exceed indoor air SLs. One of these properties, 342 Miles Avenue, has a non-operational mitigation system that, if repaired, may be able to address VI concerns raised during the 2018 RI. Of the thirteen other properties, four are associated with known source areas or immediately downgradient to known source areas: former Rex, former CAL, BSL, and 711 Central Avenue. These properties had elevated concentrations of PCE in subslab vapor, which suggests that indoor air concentrations may decrease with mitigation system installation/expansion and may also warrant additional evaluation for remediation of source area contamination. Three properties, 120 Wyoming Avenue, 408 Howard Avenue, and 44 6th Street West, contained PCE in subslab vapor at greater than 10,000 µg/m^3, which is more than 3 orders of magnitude greater than the SL, and one property, 308 Miles Avenue, contained PCE in subslab vapor at greater than 100,000 µg/m^3. These properties may warrant consideration for vapor mitigation systems.

Three additional properties, 112 South 33rd Street, 28 7th Street West, and 11 Custer Avenue, did not appear to have complete VI pathways for PCE, but did contain PCE in subslab vapor at 25,500, 13,200, and 108,000 µg/m^3, respectively, and may warrant additional consideration for mitigation.

The VI pathway was evaluated as complete for TCE at 17 properties, 10 of which have already been determined complete PCE pathways. Of the remaining 7 properties, the property at 104 Custer Avenue contained TCE in subslab vapor at more than 200 µg/m^3, which is more than three orders of magnitude greater than an indoor air residential SL, and may warrant consideration for a vapor mitigation system. Additionally, the property at 3 Broadwater Avenue is Billings Central High School, and the TCE pathway was evaluated as complete at this structure, though concentrations are within an order of magnitude of the TCE indoor air SL. While this property may not warrant a full mitigation system, it may require additional evaluation due to the presence of sensitive receptor occupants within the structure.

11.0 NATURE AND EXTENT OF CONTAMINATION – STORMWATER/SURFACE WATER AND SEDIMENT

The two stormwater systems that intersect the Facility, City/County Drain and Suburban Ditch, were sampled to evaluate CVOC and other Facility COPC impacts on stormwater/surface water and sediment. In addition, stormwater/surface water and sediment samples were collected from the outfall of the City of Billings stormwater collection system. As noted in Section 7, stormwater system samples are compared to surface water and sediment SLs since the stormwater system includes and discharges to surface water. Stormwater/surface water, and sediment had not been sampled during previous investigations for the Facility. The extent of interaction of groundwater with stormwater/surface water (if any) was unknown based on previous investigations. The City/County Drain crosses the Facility from north to south as it runs along S. Plainview Street east of former CAL. The Suburban Ditch enters the Facility from the south near BSL and flows north and east before joining the City of Billings storm sewer system at the intersection of Central Avenue and Montana Avenue. Stormwater/surface water and sediment sampling was conducted in June and July 2018 when water was present in the Suburban Ditch as the ditch does not have water year-round. Sample locations are shown on Figure 11-1.

Three co-located stormwater/surface water and sediment samples associated with the stormwater systems were collected from the City/County Drain, one sample only included stormwater/surface water sampling with no co-located sediment sample. The upstream samples of stormwater/surface water and sediment (CC-1) were collected at Spring Creek Park, (-10, 8), before the surface water enters the underground, concrete channel. This location is open to the surface in a park environment. A stormwater/surface water sample was collected from the City/County Drain within the Facility through a manhole into the subsurface pipe (CC-2), East of former CAL (-7, 1). CC-2 was collected by threading tubing through the access in the manhole and using a peristaltic pump to collect water. No sediment could be collected at this location. The downstream stormwater/surface water and sediment samples (CC-3) were collected south of Amend Park at the concrete channel outfall (-6, -11) where the underground stormwater system transitions to an open ditch on the south side of King Avenue East. Figure 11-1 shows the locations of CC-1, CC-2, and CC-3.

Four co-located stormwater/surface water and sediment samples were also collected from the Suburban Ditch drainage. Sample location SD-1 was located near the point where the Suburban Ditch enters the main stormwater collection system (2, -1). This location is nearest BSL and has the potential for impacts as result of stormwater runoff or shallow subsurface groundwater migration. SD-1 is open to the public in a drainage area near residential structures. The second sample location, SD-2, in the Suburban Ditch is near Montana Avenue (-1, -3) and is topographically downgradient from BSL, but upstream of SD-1 in the stormwater system. A third sample collection point, SD-3, for the Suburban Ditch was upstream at Amend Park (-2, -9). This location is also accessible to the public in a park

environment. A downstream co-located stormwater/surface water and sediment sample, SD-4, was collected at the outfall of the City of Billings' stormwater collection system (24, 14). This location is at the termination of the piping as the underground piping discharges toward the outfall. Figure 11-1 shows the sample points and the direction of stormwater system flow.

11.1 SUMMARY OF CONTAMINANT RESULTS

Stormwater/surface water and sediment samples were collected to evaluate conditions at the Facility. More specifically, stormwater/surface water and sediment samples were collected because these systems are connected to, convey from, or ultimately discharge to state waters (Yellowstone River). The stormwater collection system discharges stormwater/surface water just south of the HWY 87 bridge. Additionally, some of these canals or channels are potential ecological and human receptor pathways. Seven stormwater/surface water samples and one duplicate sample were collected from the stormwater drainage system, and six sediment samples and one duplicate sample were collected from sediment in the stormwater drainage system. Stormwater/surface water and stormwater system sediment analytical results were compared to freshwater surface water and sediment SLs (as described in Section 7) for initial RI screening. Aluminum and iron were found in stormwater/surface water at concentrations that exceeded BTAG surface water benchmarks. Aluminum, iron, and selenium were found in stormwater/surface water at concentrations that exceeded a DEQ-7 surface water standard. Arsenic and thallium were found at concentrations that exceeded EPA Tap Water RSLs. Arsenic, copper, iron, lead, nickel, and zinc were found in stormwater system sediment exceeding BTAG freshwater sediment benchmarks.

Samples were analyzed for VOCs, total metals, EPH, and VPH. As noted in Section 7, analytical results were compared against Montana DEQ-7 Standards, EPA Tapwater RSLs, or EPA Region 3 BTAG Freshwater Surface Water Screening Benchmarks as appropriate. Additionally, results were compared against aquatic life standards (both acute and chronic). Freshwater aquatic life standards for select metals are hardness-dependent (DEQ 2017), and were adjusted based upon the observed hardness in the samples. Total hardness for surface water at each sample location was calculated by the lab using method 2340B. Total hardness ranged from 203 mg/L $CaCO_3$ at SD-1 to 1,230 mg/L $CaCO_3$ at CC-1. The most conservative SL was used based upon the observed hardness (203 mg/L $CaCO_3$).

Detected concentrations of aluminum and iron exceeded the EPA Region 3 BTAG Freshwater Surface Water Screening Benchmarks in each of the collected stormwater/surface water samples. There are no DEQ-7 Human Health Standards for aluminum or iron. Detected concentrations of aluminum exceeded the chronic aquatic life standard at each sample location. Aluminum concentrations also exceeded the acute aquatic life standard at CC-1, SD-1, SD-2, and SD-3. The detected concentrations of iron exceeded the chronic aquatic life standard at sample locations SD-2 and SD-3. The

aquatic life standards are based on total metal concentrations with the exception of those for aluminum which are based on dissolved concentrations. At the time the samples were collected, it had not been determined that dissolved metals concentrations were necessary so only total metals were collected. However, comparing the total aluminum concentrations to the dissolved standards is a conservative approach. The detected concentrations of selenium exceeded the chronic aquatic life standard at sample locations CC-1, CC-2, and CC-3. PCE was detected at a concentration of 0.55 µg/L in sample SD-4 (the outfall for the City storm sewer system) which is an order of magnitude below the DEQ-7 groundwater standard. PCE and breakdown products were not detected above RLs in the other stormwater/surface water samples. Stormwater/surface water sample VOC analytical results are shown in Table 11-1, metals analytical results are shown in Table 11-2, and EPH/VPH analytical results are shown in Table 11-3.

Sediment samples were analyzed for VOCs, total metals, EPH, and VPH. Results were compared against EPA Region 3 BTAG Freshwater Sediment Screening Benchmarks. PCE and breakdown products were not detected above detection limits. Detected analytes that exceeded the SLs were metals. The most exceedances were detected at sample point SD-1 (Suburban Ditch inside the Facility): arsenic, iron, lead, nickel, and zinc exceeded the BTAG benchmarks in this sample. The second most exceedances occurred in the sample collected at sample point CC-3 (outfall of City/County Drain): copper, iron, and lead. Detected iron concentrations exceeded BTAG benchmarks at the most locations (SD-1, SD-1 Dup, SD-2, SD-3, and CC-3). The other detected analytes in stormwater/surface water and sediment were inorganic metal analytes. The following detected metals show a trend that the upgradient, off-Facility, stormwater/surface water locations have higher metals concentrations than stormwater/surface water results for downgradient locations: aluminum, iron, selenium, zinc, and manganese. Metals detected in sediment appear to be consistent with those detected in stormwater/surface water. Aluminum, arsenic, barium, chromium, cobalt, copper, iron, lead, manganese, nickel, mercury, vanadium, and zinc were consistently detected in both stormwater/surface water and sediment. Beryllium and cadmium were detected in sediment but not stormwater/surface water, while antimony was detected in stormwater/surface water and not sediment. Note that metals are naturally occurring in soils, and the sediment concentrations may be elevated due to contribution from surface soil erosion or possibly roadway surface water runoff. Many metals (including Zn, Pb, Cu, Na, Fe, Ba, Mg, Mn, and K) are associated with vehicular traffic or roadway treatments (Apeagyei et al. 2011). Al, As, Ba, Be, Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni, V, and Zn were detected in soil samples at both BSL and CAL. In addition, Sb, Hg, and Ag were also detected in soil samples at CAL. Sediment sample VOC analytical results are shown in Table 11-4, metals analytical results are shown in Table 11-5, and EPH/VPH results are shown in Table 11-6.

11.2 SOURCES TO STORMWATER/SURFACE WATER SYSTEMS

Analytical results indicate that Facility groundwater is not significantly impacting downgradient stormwater/surface water or sediment concentrations for VOCs, SVOCs, EPH, and VPH COPCs from other media, but stormwater/surface water may potentially be interacting with CVOCs impacted groundwater or sources. Visual inspections during a storm event did not show groundwater percolation or visible interactions between stormwater/surface water in drainages open to the surface. However, visual inspections of sanitary sewer systems upgradient of SD-4 (e.g. near former Rex) did indicate some groundwater infiltration into the sanitary sewer piping (Section 8), which may also be reasonably occurring in subsurface stormwater systems. The one detected PCE concentration of 0.55 µg/L at SD-4, which is below the applicable SLs, is in the stormwater system downgradient of the Facility, but is not statistically significantly higher than the RLs of other non-detect upgradient stormwater/surface water results (i.e. <1 µg/L). The PCE detection at SD-4, while well below the DEQ-7 standard, may indicate that there is a potential Facility source contributing PCE contamination to the stormwater system; however, upstream stormwater/surface water samples higher detection limits and inaccessibility for much of the underground stormwater system restricts the ability to confirm potential Facility impacts to stormwater systems associated with the Suburban Ditch to Yegen Ditch stormwater system.

As part of the evaluation of the potential COPCs for the stormwater system as it crosses the Facility, the upgradient, on Facility, and downgradient analyte concentrations were evaluated to see if the analyte concentration increases on the facility or downgradient as compared to upgradient sample points. The following two subsections note the analytes that exceeded applicable SLs and the evaluation of upgradient to downgradient concentration gradients.

11.2.1 CITY-COUNTY STORMWATER SYSTEM

A comparison of the analytical results from the stormwater/surface water and sediment to applicable SLs (as described in Section 7) resulted in the following analytes above SLs:

- <u>City-County Stormwater/Surface Water Exceedances</u>
  - Aluminum, arsenic, iron, selenium
- <u>City-County Sediment in Stormwater System Exceedances</u>
  - Copper, iron, lead

For the stormwater/surface water exceedances, aluminum, iron and selenium were highest upgradient of the Facility at CC-1 and lower on facility or downgradient at CC-2 and CC-3. Arsenic is higher downgradient at CC-2 and CC-3; however, the concentrations are of the same order of magnitude and exceed only the EPA Tapwater RSL. Arsenic is

also not a COPC for the soil or groundwater at the facility. Based on this evaluation, these analytes are not retained as Facility COPCs in stormwater/surface water.

For sediment copper, iron, and lead have higher concentrations downgradient; two orders of magnitude higher for copper and one order of magnitude higher for iron and lead. These are not COPCs in the associated stormwater/surface water system, and only iron is a Facility COPC for groundwater, but not for soil. These are not retained as COPCs for sediment based on the concentration gradients in stormwater/surface water system and based on not having associated Facility soil COPCs.

11.2.2 SUBURBAN DITCH STORMWATER SYSTEM

A comparison of the analytical results from the stormwater/surface water and sediment to applicable SLs (as described in Section 7) resulted in the following analytes above SLs:

- Suburban Ditch Stormwater/Surface Water Exceedances
  - Aluminum, arsenic, iron, thallium
- Suburban Sediment in Stormwater System Exceedances
  - Arsenic, iron, lead, nickel, zinc

For the stormwater/surface water exceedances, aluminum, arsenic, and iron were highest upgradient of the Facility at SD-3, SD-2, and SD-1 and lower downgradient at SD-4. Thallium was only detected upgradient at SD-2 and is only above the EPA RSL Tapwater SL. Based on this evaluation, these analytes are not retained as Facility COPCs in stormwater/surface water.

For sediment arsenic, iron, nickel, and zinc are highest upgradient and lowest downgradient after the stormwater collection system has traveled through the Facility and City of Billings. Lead is an order of magnitude higher downgradient at SD-4; however, the lead is not identified as a COPCs in the associated stormwater/surface water system or as a Facility COPC for soils or groundwater. Based on this analysis, these are not retained as COPCs for sediment.

12.0 CONTAMINANT FATE AND TRANSPORT

This section addresses the fate and transport information for the Facility including characteristics of the COPCs identified in Sections 8 through 11 (Section 12.1), general COPC toxicological information (Section 12.2), analyte specific fate and transport considerations (Section 12.3), and Facility-specific fate and transport CSM (Section 12.4).

12.1 CHARACTERISTICS OF CONTAMINANTS OF POTENTIAL CONCERN

COPCs have been identified on a media-specific basis for the Facility, as detailed in Sections 8 through 11 and summarized in Table 12-1. Due to the large areal extent of the Facility and multiple source areas, COPCs are not distributed uniformly throughout the Facility. COPCs may be unique to a given medium or may be present in multiple media. The physical and chemical characteristics of those COPCs are presented below. COPC characteristics were reviewed on the Agency for Toxic Substances & Disease Registry (ATSDR) Toxicological Profiles (ATSDR 1995, ATSDR 1996, ATSDR 1999, ATSDR 2001, ATSDR 2004, ATSDR 2005a, ATSDR 2005b, ATSDR 2006, ATSDR 2007, ATSDR 2012a, ATSDR 2012b, ATSDR 2014a, ATSDR 2014b, ATSDR 2018); the USGS Description, Properties, and Degradation of Selected VOCs Detected in Ground Water— A Review of Selected Literature; and EPA's Integrated Risk Information System (IRIS) Database at https://www.epa.gov/iris.

In the following section and Table 12-2, the relevant fate and transport chemical parameters for the Facility's COPCs are provided. During the RI, four groups of contaminants were evaluated, based upon site history and potential risk: VOCs, SVOCs, EPH/VPH, and metals. Therefore, the relevant fate and transport parameters are divided into the same analyte groups and then by COPC. These fate and transport parameters are based on the guidance documents cited above, but in conjunction with the CSM and site-specific data, they could be used to assess specific COPC transport for the Facility. Contaminants identified only in the sediment associated with the stormwater/surface water systems are not included in the fate and transport evaluation due to the lack of connection to a Facility source. The COPC fate and transport discussion includes the chemical parameters for qualitative evaluations of sorption, solubility, and volatility, which are presented in Table 12-3.

Henry's Law Constant: Henry's Law relates the concentration of a compound dissolved in a solution to its partial pressure in the vapor phase above the solution. It is a useful descriptor in dilute solutions (i.e. where the solute mass is much less than the solvent mass) to identify how a compound may partition between the gas phase and the aqueous phase (Hemond and Fechner 2000).

Octanol-water partitioning coefficient (K_{ow}): the ratio of the concentration of a compound dissolved in the octanol phase to the ratio of the molar concentration of the same compound dissolved in the aqueous phase, when the octanol and aqueous phases are in equilibrium. It is generally a measurement of how a compound will tend to partition (i.e. into an organic phase, or into an aqueous phase) and is a useful predictor of how a material in a NAPL may behave in the presence of groundwater, for instance (Hemond and Fechner 2000).

Soil organic carbon-water partitioning coefficient (K_{oc}): This value begins with the sorption coefficient (K_p) which is defined as the ratio of the concentration of a compound sorbed to soil (mg of compound per kg of soil), to the concentration dissolved in the aqueous phase (mg of compound per L of water). This K_{oc} value is then found by normalizing the K_p to the *foc* in the soils in question, by dividing the K_p by the *foc*. This partition coefficient will depend heavily on the type of soils in which it is measured, and therefore can vary significantly for the same compound. However, it can provide a useful predictor of the ability of a compound to sorb to organic matter or partition to groundwater in the subsurface. This value is often log-transformed to allow comparison across several orders of magnitude (Hemond and Fechner 2000).

Solubility: a measure of the maximum concentration of a substance in a given solute (in this instance, water) achieved by equilibrating the pure compound with the solute. Along with the K_{ow} and K_{oc}, the solubility provides a measure of the mass of contaminant that can be present in the aqueous phase. Concentrations of compounds observed at significant fractions of their solubility limits (e.g., greater than 10%) may be indicative of the presence of free-phase contaminants in the subsurface (Hemond and Fechner 2000).

Vapor pressure: the equilibrium pressure of substance in the vapor phase above its solid or liquid phase. While typically measured for pure substances, it is a useful metric to evaluate relative volatility, as compounds with higher vapor pressures will tend to leave the solid or liquid phases and partition to the vapor phase (Hemond and Fechner 2000).

12.1.1 VOLATILE ORGANIC COMPOUNDS

1,2-DCA

1,2-DCA is a clear, flammable liquid with a ‘pleasant’ odor and sweet taste. It was historically used as a lead scavenger in leaded gasoline, and as a chemical precursor in the synthesis of VC and other chemical compounds and as an industrial solvent. It is slightly denser than water, at 1.253 g/mL, which may cause it to sink in an aqueous environment. However, it is quite soluble in water (8.69 g/L) and has a high vapor pressure at ambient conditions (79.1 mmHg at 25°C), which typically results in 1,2-DCA either evaporating or dissolving rapidly rather than persisting

as a fluid in the environment. Its odor is detectable at 12 ppm in air. Its K_{ow} is 1.48 and K_{oc} is 1.52. Its Henry's Law constant is 0.14 kilopascals meters cubed per mole (kPa-m^3/mol) at 25°C.

1,2,4-trimethylbenzene (1,2,4-TMB)

1,2,4-TMB is a colorless liquid with a 'characteristic' odor. It is produced as a part of petroleum refining and is a constituent of gasoline. It is a common contaminant in motor vehicle exhaust. It is a flammable liquid, with a flash point of 44°C. Its density is 0.88 g/mL and is sparingly soluble in water (57 mg/L at 25°C). It is a somewhat volatile liquid, with a vapor pressure of 1 mmHg at 13.3°C. Its K_{ow} is 3.8 and its K_{oc} is 3.34. It has a Henry's Law constant of 0.524 kPa-m^3/mol.

1,3,5-trimethylbenzene (1,3,5-TMB)

1,3,5-TMB is a colorless, flammable liquid with a distinctive and aromatic odor and is used primarily to derive colorants. Its vapor pressure at 25°C is 2 mmHg. It is categorized as a Class II flammable liquid with a flash point of 50°C. It has a density of 0.874 g/mL and is not very soluble in water (48 mg/L). It has a Henry's Law constant of 0.889 kPa-m^3/mol (Williams, A).

1,3-butadiene

1,3-butadiene is a colorless, volatile gas which is produced primarily as part of steam cracking of petroleum hydrocarbons and is used as a chemical precursor for synthesis of polymeric materials in rubber manufacturing. Its vapor pressure at 25°C is 2.11 x 10^3 mmHg. It has a mild gasoline-like odor, and is highly flammable, with a flashpoint of -76°C. It is somewhat soluble in water (735 mg/L at 25°C) and has a K_{ow} of 1.99 and a K_{oc} of approximately 2.45.

Benzene

Benzene is a colorless, flammable liquid with a sweet odor. It is highly volatile (vapor pressure 75 mmHg at 20°C) and evaporates rapidly in ambient air. It is detectable in air at approximately 60 ppm. Benzene is widely used in chemical manufacturing as a precursor chemical for synthesis of other complex molecules, is a common component in gasoline and enters the atmosphere in small amounts from automobile exhaust. It has a density of 0.879 g/mL and is somewhat soluble in water (1.8 g/L). It has a flashpoint of -11°C, K_{ow} of 2.13, and K_{oc} of 1.5-1.7. It has a Henry's Law constant of 0.557 kPa m^3/mol at 25°C.

Bromodichloromethane

Bromodichloromethane is a colorless liquid and is part of the group of chemicals known as trihalomethanes. It is often formed as a byproduct of the chlorination of municipal drinking water supplies in the presence of bromine. It had

historical uses in fire suppression and as a solvent, but is primarily used as a chemical precursor in the manufacture of other organic compounds. It is soluble in water at 3.03 g/L at 30°C, and has a density of 1.98 g/ml at 20°C. It has a K_{ow} of 2.00, and a K_{oc} of 1.8. It is somewhat volatile, with a vapor pressure of 50 mmHg, and its Henry's Law constant is 0.223 kPa m^3/mol.

Carbon tetrachloride

Carbon tetrachloride, also called carbon tet, is a colorless, nonflammable, volatile liquid with a sweet odor. It can be detected in air at 10 ppm. It has historically been used as a dry cleaning solvent, blended with other dry cleaning solvents, to make refrigerant fluids and aerosol propellants, as well as in fire extinguishers, and as an industrial solvent (State Coalition for Remediation of Drycleaners 2019). Carbon tet was imported to the US in 1898, and was the first dry cleaning solvent used in commercial operations in the US. The use of carbon tet increased through the 1930s, and by 1940 US dry cleaners used approximately 45 million pounds of carbon tet, compared to the 12 million pounds of PCE and 5 million pounds of TCE (State Coalition for Remediation of Drycleaners 2019). Carbon tetrachloride was phased out as a primary dry cleaning solvent in the early 1950s due to its high toxicity and corrosion of machinery components (State Coalition for Remediation of Drycleaners 2019). Carbon tet was also used as a fumigant in grain storage bins to control insects. Its use as a fumigant was stopped in the 1960s, but its use as a pesticide was not discontinued until 1986 (ASTDR 2005a). It has been observed as a contaminant in the production of PCE (WHO 2006). Carbon tet has a density of 1.59 g/mL, and a solubility in water of 800 mg/L at 20°C. Its vapor pressure at 20°C is 90 mmHg, and its K_{ow} and K_{oc} are 2.64 and 2.04, respectively. Its Henry's Law constant is 2.98 kPa m^3/mol.

Chloroform

Also known as trichloromethane or methyltrichloride, chloroform is colorless liquid with a 'pleasant' odor and slightly sweet taste. It does not burn easily. It was historically used as an anesthetic and is primarily used as a chemical precursor for the manufacture of other chemicals. It is also noted as a historic dry cleaning solvent (State Coalition for Remediation of Drycleaners 2019). It is a common contaminant found in sodium hypochlorite, used to treat drinking water supplies, and also forms in minute quantities as a byproduct of chlorinated drinking water supplies. It is often present in municipal wastewater or where water has been discharged to the subsurface. It has a density of 1.485 g/mL, and a solubility in water of 7.43 g/L at 25°C. It is highly volatile, with a vapor pressure of 160 mmHg at 20°C. Its K_{ow} is 1.97 and its K_{oc} is 2.40. Its Henry's Law constant is 0.411 kPa m^3/mol.

***Cis*-1,2-DCE**

Cis-1,2-DCE, also called *cis*-1,2-dichloroethylene or *cis*-1,2-DCE, is one of two conformations of 1,2-DCE, the other being *trans*-1,2-DCE. It is typically used in chemical synthesis as an intermediary for the production of other organic solvents. It is a known degradation product of more complex chlorinated solvents (TCE and PCE) and is often found in

the environment as a result of their release. It is a colorless, flammable liquid (flashpoint of 6°C), with a sharp odor. It is detectable in air at about 17 ppm and is volatile (180 mmHg). It is relatively soluble in water (3.5 g/L at 20°C), and has K_{ow} of 1.86, and an estimated K_{oc} of 1.69. Its Henry's Law constant is 0.46 kPa m^3/mol.

PCE

PCE, also known as tetrachloroethene, PERC, tetrachloroethylene, or perchloroethylene, is a nonflammable, colorless liquid, detectable in air at concentrations of 1 ppm. It has been used historically in dry cleaning and metal degreasing as a solvent, as well as a chemical intermediary for the synthesis of more complex molecules. It has a density of 1.623 g/mL, which causes it to sink in groundwater aquifers. Its half-life in ambient air is estimated at approximately 100 days. It has a solubility of 206 mg/L in water at 25°C. Its K_{ow} is 3.4, and its K_{oc} is 2.2-2.54. It has a vapor pressure of 18.5 mmHg at 20°C. Its Henry's Law constant is 1.73 kPa m^3/mol.

TCE

TCE, also known as trichloroethene or trichloroethylene, is a colorless, nonflammable liquid with a sweet odor. It has been used as a degreasing solvent, in textile processing, and is a chemical precursor for the manufacture of R-134a refrigerant. It can also be present in the environment as a degradation product of PCE. It has a density of 1.464 g/mL, which causes it to sink in groundwater aquifers. It is detectable in air at concentrations of 21.4 ppm. It has a solubility 1,280 mg/L in water at 25°C. Its K_{ow} is 2.61, and K_{oc} is 2.00. It has a vapor pressure of 69 mmHg at 25°C. Its Henry's Law constant is 1.03 kPa m^3/mol.

VC

VC, also known as vinyl chloride, chloroethene, chloroethylene, or ethylene chloride, is a flammable, colorless gas with a sweet odor. Its primary use is in the synthesis of polymers, PVC being the largest end-use for polymer synthesis. It is also a product of the degradation of chlorinated solvents associated with dry cleaning activities (PCE and TCE). It is detectable in air at 3,000 ppm. It is somewhat soluble in water at 2.763 g/L at 20°C. Its flashpoint is -78°C, and it is highly volatile, with a vapor pressure at 20°C of 2,530 mmHg. Its K_{ow} is 1.36 and its K_{oc} is 1.99. Its Henry's Law constant is 2.68 kPa m^3/mol.

12.1.2 SEMI-VOLATILE ORGANIC COMPOUNDS

1-Methylnaphthalene

1-Methylnaphthalene is a colorless, sparingly volatile liquid (vapor pressure 0.054 mmHg). It is used as a chemical precursor in the synthesis of 1-methylnaphthoic acid. It is found in the environment as releases from the combustion of

petroleum fuels and atmospheric discharges from manufacturing processes. It is only slightly soluble in water (25.8 mg/L at 25°C). Its K_{ow} is 3.87 and its Henry's Law constant is 0.036 kPa m^3/mol.

Benzo(a)pyrene

Benzo(a)pyrene is a member of a family of chemicals known as PAHs. In a pure state it exists as a pale yellow solid. It is often found as a product of incomplete combustion of organic substances, and is present in tobacco smoke, combustion fumes from automobiles and wood burning stoves, and coal tar. It is sparingly soluble in water (2.3×10^{-3} mg/L). It is not a volatile compound, with a melting point of 179 °C, and a vapor pressure of 5.6×10^{-9} mmHg. Its Henry's Law constant is 4.9×10^{-7} atm-m^3/mol.

12.1.3 PETROLEUM HYDROCARBONS, EPH AND VPH

Petroleum hydrocarbon compounds cover a range of thousands of varieties of aliphatic and aromatic hydrocarbon chains. They can occur in a variety of petrochemical media, from crude oil to refined fuels, lubricants, and synthetic products. Petroleum hydrocarbons are a mixture of chemical compounds, rather than a single chemical structure. As such, they vary wildly in both structure, physical and chemical properties, and toxicity. They are ubiquitous in the environment due to their widespread use. As carbon chains get longer, the hydrocarbons typically decrease in solubility, vapor pressure (i.e., volatility), and tend to partition more towards organic environments than aqueous ones. When describing petroleum hydrocarbons, they are often split into 'fractions' of similar composition. Fractions of interest in this investigation include C5-C8 aliphatic, C9-C10 aromatic, and C9-C12 aliphatic hydrocarbons.

12.1.4 INORGANIC METALS

Cobalt

Cobalt is a naturally occurring inorganic element found in most rocks, soil, water, plants, and animals, and is used to produce alloys used in the manufacture of aircraft engines, magnets, grinding and cutting tools, and artificial hip and knee joints. Cobalt has an atomic mass of 58.93 g/mol and the melting point is 1,495 ˚C. Radioactive cobalt (cobalt-60 and cobalt-57) is used for commercial and medical purposes such as sterilizing medical equipment and consumer products, radiation therapy for treating cancer patients, manufacturing plastics, and irradiating food. Cobalt-60 has a half-life of about 5.27 years and cobalt-57 has a half-life of about 272 days (ATSDR 2004).

Cobalt enters the environment through natural sources and the burning of coal or oil, and production of cobalt alloys. Cobalt compounds are nonvolatile, and thus, cobalt is emitted to the atmosphere in particulate form. In the air, cobalt will be associated with particles that settle to the ground within a few days. The transport of cobalt in air depends on its particle size and density, and meteorological conditions; it can be returned to land or surface water by rain or it may

settle to the ground by dry deposition. In nonarid areas, wet deposition may exceed dry deposition (Arimoto et al. 1985; Erlandsson et al. 1983). Coarse particles, with aerodynamic diameters >2 µm (such as those obtained during ore processing), may deposit within 10 km from the point of emission; finer particles may travel longer distances. It is the larger particles that may be responsible for elevated local concentrations around emission sources. The mass median diameter of cobalt in the ambient atmosphere is about 2.6 µm (Milford and Davidson 1985).

Cobalt released into water or soil will stick to particles. Some cobalt compounds may dissolve to water depending on conditions (ATSDR 2004).

Manganese

Manganese is a naturally occurring metal found in many types of rocks. It combines with other substances such as oxygen, sulfur, or chlorine. Manganese occurs naturally in most foods and may be added to some foods. Manganese is an essential nutrient and eating a small amount is required daily for good health. Manganese has an atomic mass of 54.9380 g/mol and the melting point is 1,247 °C. Manganese is used principally in steel production to improve hardness, stiffness, and strength. It may also be used as an additive in gasoline to improve the octane rating (ATSDR 2012b).

Manganese can be released to the air, soil, and water from the manufacture, use, and disposal of manganese-based products and does not break down in the environment. Manganese compounds have negligible vapor pressures, but may exist in air as suspended particulate matter. Particles are mainly removed from the atmosphere by gravitational settling (EPA 1984). The transport of manganese in air is largely determined by its particle size. About 80% of the manganese in suspended particulate matter is associated with particles having a mass median aerodynamic diameter (MMAD) of <5 µm (WHO 1981). The compound's small particle size (approximately 80% with a MMAD <5 µm and approximately 50% with an MMAD <2 µm) favors widespread airborne distribution and is within the respirable range (WHO 1981).

In a study completed by Evans (1989), there were two mechanisms involved in explaining the retention of manganese and other metals in the environment by soil. First, through cation exchange reactions, manganese ions and the charged surface of soil particles form manganese oxides, hydroxides, and oxyhydroxides, which in turn form absorption sites for other metals. Secondly, manganese can be adsorbed to other oxides, hydroxides, and oxyhydroxides through ligand exchange reactions. When the soil solution becomes saturated, these manganese oxides, hydroxides, and oxyhydroxides can precipitate into a new mineral phase and act as a new surface to which other substances can absorb (Evans 1989).

The transport of manganese in water is controlled by the solubility of the specific chemical form present which is determined by pH, redox potential, and characteristics of available anions. Mn(II) is the most common oxidation state in most waters (pH 4-7), but may become oxidized under alkaline conditions at pH > 8. (EPA 1984). Manganese oxide (Mn(IV)) can be used as an anaerobic electron acceptor by many microbes in the biodegradation of petroleum hydrocarbons and other organic compounds, forming Mn(II) (Villatoro-Monzon, et al. 2003).

Iron

Iron is a lustrous, ductile, malleable metal and is the most used of all the metals thanks to its low cost and high strength. Steel is best known alloy of iron. Iron is a common constituent in soils and groundwater and readily participates in subsurface redox reactions. Iron has an atomic mass of 55.85 g/mol and a melting point of 1,536 ˚C (Lenntech). In groundwater systems, iron occurs in one of two oxidation states: reduced soluble divalent ferrous iron (Fe+2) or oxidized insoluble trivalent ferric iron (Fe^{+3}). Most iron in shallow subsurface soils will be in the oxidized ferric state. (Vance 1994). Ferric iron can be used as an anaerobic electron acceptor by many microbes in biodegradation of petroleum hydrocarbons and other organic compounds, forming ferrous iron (Villatoro-Monzon, et al. 2003).

12.2 GENERAL TOXICOLOGICAL INFORMATION

12.2.1 VOLATILE ORGANIC COMPOUNDS

1,2-DCA

The primary exposure pathways for 1,2-DCA are via inhalation of impacted ambient air near source area releases, and ingestion of contaminated drinking water (ATSDR 2001). The main systems affected by 1,2-DCA toxicity include the cardiovascular system, immune system, kidneys, liver, and neurological system. It is classified as a probable human carcinogen based upon sufficient evidence of carcinogenicity in animals and is associated with sarcomas forming in blood vessels (EPA 1987).

1,2,4-TMB

The primary exposure pathway for 1,2,4-TMB is through inhalation of vapors (EPA 2016). Animal studies have indicated that 1,2,4-TMB has toxicological effects on the nervous system, including cognitive effects and decreased pain sensitivity. Other effects have also been observed, including impacts to the respiratory and hematological systems. There is currently inadequate data to assess carcinogenic potential (EPA 2016).

1,3,5-TMB

The primary exposure pathways for 1,3,5-TMB include inhalation of vapors, ingestion, skin and/or eye contact. 1,3,5-TMB target organs include the respiratory system, the central nervous system and blood with effects to the eyes

and skin if there is direct contact. Major effects of 1,3,5-TMB include eye, skin, nose, and throat irritation, bronchitis, hypochromic anemia, and chemical pneumonitis (CDC 2018).

1,3-butadiene

The primary exposure pathway for 1,3-butadiene for the general population is via inhalation (ATSDR 2012a). Oral effects do not appear to have been assessed for 1,3-butadiene. Noncancer effects associated with 1,3-butadiene exposure include reproductive impacts (ovarian atrophy). Other target organs associated with 1,3-butadiene include neurological dysfunction, developmental effects, hematological effects, impacts to the lymphatic system, and death. 1,3-butadiene has been classified as carcinogenic to humans and is associated with hematologic cancers (EPA 2002).

Benzene

The primary exposure pathway for benzene is inhalation of contaminated air, which is especially prevalent in areas of high traffic, near petroleum service stations, and from cigarette smoke (ATSDR 2007). Health effects associated with benzene exposure include genotoxicity, chromosomal aberrations, decreased immune system function, decreased levels of blood cells, and anemia. Benzene is classified as a human carcinogen and is associated with hematologic cancers (EPA 2000a).

Bromodichloromethane

The primary exposure pathways for bromodichloromethane are through ingestion of chlorinated water supplies, inhalation of vapors during showering or bathing, and dermal absorption during contact with impacted water (ATSDR 2018). Target organ impacts of bromodichloromethane are liver damage, kidney damage, impaired immune response, and reproductive system effects including resorptions and decreased sperm velocity. It is currently classified as a probable human carcinogen and is associated with urinary cancers (EPA 1993).

Carbon tetrachloride

The primary exposure pathway for carbon tetrachloride is inhalation of contaminated air and from volatilization of carbon tetrachloride from contaminated water sources (ATSDR 2005a). Carbon tetrachloride acts as a central nervous system (CNS) depressant and can cause irritation of the gastrointestinal tract. Toxicological effects can also include impacts to the liver and kidneys due to metabolization products. It is classified as likely to be carcinogenic to humans and is associated with hepatic and endocrine system cancers (EPA 2010a).

Chloroform

The primary exposure pathways for chloroform are through ingestion of contaminated drinking water, and inhalation of air impacted by chloroform vapors or volatilization of chloroform from contaminated water (ATSDR 1997).

Chloroform toxicity has been associated with hepatic system impacts, including formation of cysts. It has also been associated with toxic effects to the kidneys and central nervous system effects. Chloroform is classified as a probable human carcinogen under high-exposure conditions but is classified as not likely to be carcinogenic to humans under exposure conditions that are less than high-exposure scenarios (EPA 2001).

***Cis*-1,2-DCE**

Primary exposure pathways for *cis*-1,2-DCE are via inhalation of contaminated air and ingestion of contaminated drinking water (ATSDR 1996). Target organ impacts for *cis*-1,2-DCE include kidney enlargement, decreased red blood cell count, and impacts to liver function. It is classified as having inadequate information to assess carcinogenic potential (EPA 2010b).

PCE

Primary exposure pathways for PCE are via inhalation in outdoor and indoor air, and ingestion of contaminated drinking water (ATSDR 2014a). Human and animal studies suggest that PCE targets the CNS. Acute exposure can result in CNS depression, unconsciousness, and death. Lower concentrations are associated with neurobehavioral effects and impacts to vision. It is characterized as likely to be carcinogenic to humans and is associated with hepatic (liver) cancer (EPA 2012).

TCE

Primary exposure pathways for TCE are via inhalation of impacted ambient and indoor air, and ingestion of contaminated drinking water (ATSDR 2014b). TCE targets the CNS, and similar to PCE, can cause CNS depression, unconsciousness, and death from acute exposure. TCE toxicity also appears to target the kidneys, liver, immune system, male reproductive system, and developing fetuses. Animal evidence suggests developmental immunotoxicity and potential fetal heart malformations have been linked to TCE oral exposure. TCE is characterized as carcinogenic to humans, and is associated with hematologic, hepatic, and urinary cancers (EPA 2011b).

VC

The primary exposure pathways for VC are via inhalation of impacted air or ingestion of contaminated water (ATSDR 2006). VC toxicity has been associated with narcotic effects, Raynaud's phenomenon, scleroderma, and hepatocellular alterations (liver cell polymorphism). Animal evidence also suggests developmental effects, and neurological effects. VC is currently classified as a human carcinogen and is associated with hepatic cancers (EPA 2000b).

12.2.2 SEMI-VOLATILE ORGANIC COMPOUNDS

1-Methylnaphthalene

Assessments of primary exposure pathways for 1-methylnaphthalene have not been identified by ATSDR as of 2005. Animal studies have shown potential toxicological effects to include pulmonary alveolar proteinosis after chronic oral exposure to 1-methylnaphthalene. Available data is classified as inadequate to assess human carcinogenic potential for 1-methylnaphthalene (ATSDR 2005b)

Benzo(a)pyrene

The primary exposure pathways for benzo(a)pyrene are via inhalation of impacted ambient air, wood smoke, vehicle exhaust, and tobacco smoke, and via consumption of benzo(a)pyrene in foods (ATSDR 1995). Animal studies have shown that benzo(a)pyrene is associated with birth defects, decreased birth weights, and suppressed immune system function. Benzo(a) pyrene is currently classified as carcinogenic to humans and is associated with gastrointestinal and respiratory system tumors (EPA 2005b).

12.2.3 PETROLEUM HYDROCARBONS, EPH AND VPH

Due to the ubiquitous nature of petroleum hydrocarbons, exposure pathways are likely to be correspondingly pervasive. Inhalation of contaminated air from petroleum releases, dermal absorption due to contact with contaminated soil or groundwater, and ingestion of water impacted with petroleum hydrocarbons are expected to be common exposure pathways (ATSDR 1999). Due to the complexity of mixtures in petroleum hydrocarbons, individual toxicological effects can be difficult to identify. Provisional Peer-Reviewed Toxicity Values (PPRTVs) have been derived to aid in quantifying risk associated with petroleum hydrocarbon mixtures. These PPRTVs and the data from which they are evaluated are based on hydrocarbon fractions that may differ from those investigated in this study and are used to the extent applicable (EPA 2009). These may be based off of human or animal studies. Toxicological effects associated with petroleum hydrocarbon fractions are:

- **C5-C8 aliphatic hydrocarbons** – peripheral neuropathy, reduced birth weight, decreased motor nerve conduction velocity, nasal epithelial cell hyperplasia, neurotoxicity, testicular atrophy, and suggestive evidence of carcinogenicity.
- **C9-C18 aliphatic hydrocarbons** – liver, kidney and hematologic effects, nasal goblet cell hypertrophy and adrenal hyperplasia, and suggestive evidence of carcinogenicity.
- **C9-C16 aromatic hydrocarbons –** increased kidney weight, decreased body weight, nasal lesions, liver and kidney toxicity, developmental toxicity, decreased clotting time, anemia, maternal body weight depression, and suggestive evidence of human carcinogenicity.

12.2.4 METALS

Cobalt

Cobalt is beneficial to humans as part of vitamin B12. The primary exposure pathway for cobalt at the Facility would be ingesting contaminated groundwater. Food and water are the largest sources of cobalt for the general population. The general population is rarely exposed to radioactive cobalt. Exposure to high levels of cobalt can result in lung and heart effects and dermatitis. Liver and kidney effects have also been observed in animals exposed to high levels of cobalt. Nonradioactive cobalt has not been found to cause cancer in humans or animals following exposure in food or water. However, cancer has been shown in animals that breathed cobalt or when cobalt was placed directly into the muscle or under the skin. Based on the laboratory animal data, the International Agency for Research on Cancer has determined that cobalt and cobalt compounds are possibly carcinogenic to humans. Exposure to high levels of cobalt radiation can cause changes in the genetic materials within cells and may result in the development of some types of cancer (ATSDR 2004).

Manganese

High levels of manganese may affect the nervous system, resulting in behavior changes and slow or clumsy movements. Slower hand movements have been observed in workers exposed to lower concentrations. Nervous system and reproductive effects have been observed in animals following high oral doses of manganese. High levels of manganese in air can cause lung irritation and reproductive effects. (ATSDR 2012b). The primary exposure pathway for manganese at the Facility would be ingesting contaminated groundwater.

Iron

Iron is an essential part of hemoglobin. Excessive iron may cause conjunctivitis, choroiditis, and retinitis. Chronic inhalation of excessive concentrations of iron oxide fumes or dusts may result in pneumoconiosis and may enhance the risk of lung cancer. Iron deficiency (anemia) is a more common problem than excessive iron exposure. (Lenntech 2018).

Iron can be released to the air, soil, and water from the manufacture, use, and disposal of iron-based products. Iron can enter the human body through inhalation of iron oxide or through eating meats, potatoes, and vegetables (Lenntech 2018). The primary exposure pathway for iron at the Facility would be ingesting contaminated groundwater or a construction worker exposed to subsurface soils.

12.3 CONTAMINANT FATE AND TRANSPORT PROCESSES

General fate and transport processes that may attenuate concentrations of contaminants present in environmental media include the nondestructive attenuation mechanisms dispersion, dilution, sorption, and volatilization, and destructive attenuation mechanisms abiotic degradation and biodegradation. These attenuation mechanisms are discussed in the following sections, with emphasis on the fate and transport processes that are applicable at the BPCE Groundwater Facility.

12.3.1 ATTENUATION MECHANISMS

Nondestructive attenuation mechanisms result in decreasing aqueous contaminant concentrations, but no destruction of contaminant mass. These processes include sorption of contaminants to the aquifer matrix, dispersion or spreading of the contaminant mass in the aquifer during transport, dilution of the contaminant mass by mixing with unimpacted water, and volatilization of dissolved contaminants to soil vapor.

Destructive attenuation mechanisms of organic contaminants result in the removal of contaminant mass by biological and abiotic processes.

Sorption: Sorption immobilizes contaminant mass by processes that fix or sorb compounds to the aquifer matrix. Organic carbon and clay minerals with large surface area-to-volume ratios generally act as sites of adsorption. Sorption slows or retards the contaminant mass relative to the bulk groundwater velocity. Sorption is quantified using the partitioning coefficient (K_d) or retardation factor (EPA 1999). A lower K_d value indicates that the soil has little or no ability to slow contaminant movement. A higher K_d value provides a maximum concentration of a contaminant sorbed to soil. Retardation factors for organic COPCs are displayed in Table 12-4.

Dispersion: Dispersion describes the longitudinal and transverse spreading of the contaminant plume. Dispersion is caused by variations in flow velocity during advective transport of contaminants. Dispersion results in the three-dimensional mixing of the contaminants but does not affect the total mass present in the plume.
The dominant dispersion process in relatively fast-moving groundwater systems such as at the BPCE Groundwater Facility is mechanical mixing along tortuous flow paths in the aquifer matrix. Measurements of dispersivity are extremely difficult, and estimates are often based on plume length (EPA 1999).

Dilution: Dilution of contaminant mass may occur along the flow path of plumes through infiltration of recharge from precipitation, resulting in dilution of contaminant concentrations along a flow path. Site-specific dilution rates of the contaminant mass have not been quantified at the Facility. In addition, dissolved chemicals leaching from

contaminated vadose zone soils may be diluted by unimpacted groundwater underlying the contaminated soils (EPA 1999). Contaminant mass may volatilize across the water table, resulting in loss of contaminant mass to the vapor phase in the vadose zone. Volatilization of COPCs from groundwater and through the vadose zone can result in intrusion of COPCs from soil gas to subsurface structures and indoor air. VI pathways have been confirmed to be complete at the Facility.

12.3.2 VOLATILE ORGANIC COMPOUNDS

1,2-DCA

Due to its moderately high Henry's Law constant and high vapor pressure, 1,2-DCA is expected to rapidly volatilize and undergo photochemically induced degradation via hydroxyl radicals if discharged to air or media in contact with air (ATSDR 2001). The half-life of this reaction is 73 days, and 1,2-DCA's lifetime in the atmosphere is expected to be on the order of 5 months. When released to groundwater, 1,2-DCA may be a more persistent contaminant, with a half-life on the order of 72 years in the absence of a biodegradation mechanism (USGS 2006). In groundwater and streams, the primary degradation process for 1,2-DCA is biodegradation. 1,2-DCA's K_{oc} and comparatively high water solubility suggest that it would be unlikely to sorb preferentially to soils and sediments in the subsurface or water column, and would be available for transport by, or leaching to, groundwater. Volatilization from groundwater to soil vapor is expected to occur more slowly than volatilization to the atmosphere (ATSDR 2001).

Under aerobic groundwater conditions, 1,2-DCA can be used by microorganisms as a carbon source, undergoing degradation to intermediary metabolites, which can then be mineralized to carbon dioxide and water (USGS 2006). Under anaerobic groundwater conditions, 1,2-DCA is reported to undergo biodegradation in aerobic water with a half-life of approximately 100 days and in anerobic water with a half-life of approximately 400 days (ASTR 2001). Abiotic degradation is not expected to be a significant degradation pathway for 1,2-DCA. When adsorbed to soil or sediment in the subsurface, both aerobic and anaerobic biodegradation pathways are expected to occur (ATSDR 2001). The degree to which these pathways will compete with the leaching to groundwater transport mechanism is unknown.

1,2,4-TMB

Fate and transport data specific to 1,2,4-TMB appear to be limited. 1,2,4-TMB has sparing water solubility and a very high K_{oc} and is therefore expected to sorb preferentially to soils, rather than partition to, and transport in, groundwater (USGS 2006). Its Henry's Law constant and vapor pressure suggest that it will likely volatilize into the atmosphere.

Degradation of 1,2,4-TMB in the atmosphere is expected to occur due to the presence of hydroxyl radicals (EPA 1994). The half-life of this reaction is on the order of 6-12 hours. Biodegradation in soils is expected to occur, though volatilization is expected to be the primary removal pathway.

1,3,5-TMB

Fate and transport data were not readily available for 1,3,5-TMB. However, it does have similar physical and chemical properties to 1,2,4-TMB and can be evaluated based upon fate and transport data given for 1,2,4-TMB. Its Henry's Law constant and vapor pressure also suggest that it will likely volatilize into the atmosphere.

Due to the physical and chemical similarities between 1,3,5-TMB and 1,2,4-TMB, sorbing to soils is a likely pathway for 1,3,5-TMB rather than groundwater transport. The primary removal pathway is expected to be volatilization.

1,3-butadiene

1,3-butadiene is very volatile and is expected to vaporize from surface water and soils into the atmosphere readily (ATSDR 2012a). It is moderately soluble in water and its K_{oc} suggests it would preferentially sorb to organic material in soil, and therefore volatilization is expected to be the dominant transport mechanism. Minimal soil and water transport data are available for 1,3-butadiene. Its K_{oc} value suggests it may be able to transport in soil and potentially leach to groundwater, however transport via volatilization is expected to heavily dominate both transport effects.

1,3-butadiene is expected to undergo degradation in the atmosphere via reactions with hydroxyl radicals generated photochemically. The half-life of 1,3-butadiene in the atmosphere is expected to be between 2 and 6 hours (ATSDR 2012a). Studies of degradation in aqueous and solid matrices representative of environmental conditions do not appear to have been conducted rigorously. Laboratory studies suggest that aerobic degradation pathways exist similar to other petroleum hydrocarbon compounds.

Benzene

Benzene is highly volatile and volatilization from soil and water to the atmosphere is expected to be the primary transport mechanism dominating its movement. Its Henry's Law constant further suggests that it will preferentially partition to the atmosphere from groundwater (USGS 2006). However, moderate aqueous solubility also indicates that dissolved-phase transport in groundwater is also a possible mechanism for benzene migration through the environment, though volatilization into soil gas is also expected to occur (ATSDR 2007). Its lower K_{oc} indicates that it may be relatively mobile in soil and sediment and may show a potential for leaching to groundwater. However, this will likely be highly site-specific, depending on soil type.

Benzene contaminant mass will predominantly present in the vapor phase, where it undergoes relatively rapid degradation via reaction with hydroxyl radicals. Benzene will also readily undergo aerobic biodegradation in aqueous environments. Half-lives of 16 days and 28 days have been reported for benzene biodegradation in surface water and groundwater, respectively (ATSDR 2007). Benzene biodegradation under anaerobic conditions is significantly slower, as alternative terminal electron receptors, as well as the microbes capable of using them, must be present for degradation to occur. Residence times of 120 weeks or more have been reported for benzene in anaerobic conditions. Some research suggests that degradation rates will decrease in more strongly reducing environments (USGS 2006).

Bromodichloromethane

Bromodichloromethane is readily soluble in groundwater though it may adsorb to the solid phase in the presence of organic carbon. Transport via the groundwater pathway is expected to be significant (ATSDR 2018). However, due to its relatively high vapor pressure, and comparable K_{oc} to other organic compounds, its primary transport mechanism is expected to be volatilization to the vapor phase. Surface water and surface soil deposition are likely to result in rapid volatilization to the atmosphere, while a slower transport from groundwater to soil vapor is expected, due to its solubility, and the tendency to adsorb to organic carbon.

Atmospheric pathways for degradation have not been well studied, but may involve hydroxyl radical degradation in similar fashions to other organic contaminants (ATSDR 2018). Atmospheric lifetimes of bromodichloromethane have been estimated on the order of 2-3 months. Abiotic degradation in groundwater is expected to be greater than 1,000 years. Aerobic microbial degradation does not appear to be a significant degradation pathway, however anaerobic microbial degradation has been demonstrated to occur rapidly, with reductions of >99% in 2 days in laboratory conditions.

Carbon tetrachloride

Carbon tetrachloride has a high Henry's law constant and vapor pressure, and is an exceedingly volatile compound, readily evaporating out of soil or groundwater into the atmosphere (ATSDR 2004). Based upon its K_{oc}, a fraction of the compound may adsorb to soil, where it could then leach to groundwater, due to its moderate aqueous solubility. However, due to its volatility, partitioning to soil vapor is expected to be a more significant transport pathway.

Carbon tetrachloride does not rapidly degrade in the atmosphere, and is relatively stable under most atmospheric conditions. It does not undergo degradation via hydroxyl radical reaction as most other organic contaminants do. Its atmospheric half-life in the troposphere may be greater than 330 years. Diffusion into the upper atmosphere where it can undergo ultraviolet and other degradation processes may be important in its degradation process, and its overall half-life in the atmosphere (on average) is estimated around 50 years. In groundwater, anaerobic degradation has been

found to be an important degradation pathway for carbon tetrachloride, with an average half-life of 47 days (USGS 2006). Anaerobic degradation of carbon tetrachloride can lead to the formation of chloroform, dichloromethane, methyl chloride and methane, before being mineralized to carbon dioxide and water. Due to its heavily oxidized state, it is not expected to undergo meaningful dechlorination under aerobic conditions (ATSDR 2004).

Chloroform

Chloroform is readily soluble in water, and transport via the groundwater pathway is expected to be a significant transport mechanism. However, chloroform is also highly volatile and its Henry's Law constant is similar to other VOCs, and therefore volatilization to the atmosphere is expected to be the primary transport pathway (ATSDR 1997). Some soil sorption is expected to occur, however, due to its elevated volatility, partitioning from both sorbed soil and dissolved aqueous phases to the vapor phase are expected to be the most significant transport pathways for those media.

Chloroform is relatively stable in the atmosphere, but can undergo degradation by hydroxyl radicals, with a half-life on the order of 80 days (ATSDR 1997). In groundwater, chloroform biodegradation appears to occur primarily under anaerobic conditions, following known biodegradation pathways, including those associated with the degradation of carbon tetrachloride as mentioned above (USGS 2006). Chloroform degradation is heavily site specific and will depend significantly on the presence of other contaminants that may inhibit microbial growth, the concentration of chloroform, and the presence of appropriate microbes capable of degradation. Some aerobic degradation of chloroform has been observed, but may be inhibited by the presence of solvents, chlorinated contaminants, or heavy metals.

***Cis*-1-2-DCE**

Cis-1,2-DCE is moderately soluble in water, and has a relatively low Henry's Law constant compared to other chlorinated solvents, which suggests it may be more readily transported in groundwater than PCE, TCE, or other chlorinated solvent degradation products (ATSDR 1996). Its K_{ow} is also low compared to other chlorinated solvents, and *cis*-1,2-DCE may be prone to leaching and transport to groundwater when sorbed to soil, though soil sorption is not expected to be a significant transport pathway, due to its comparatively lower K_{oc}. However, its high vapor pressure will likely dominate its transport pathway, and volatilization from surface water and soil will likely occur readily. Its Henry's Law constant suggests that it will partition to soil vapor from contaminated groundwater.

Cis-1,2-DCE degradation in air is expected to occur relatively rapidly by hydroxyl radical reactions, with an empirically observed half-life of 12 days. In groundwater, microbial degradation can occur under both aerobic and anaerobic conditions. Under aerobic conditions, microorganisms can utilize it as a primary carbon source, while anaerobic conditions may be less favorable for *cis*-1,2-DCE than for higher-order chlorinated VOCs such as TCE and PCE (USGS 2006). Reductive dechlorination appears to be a slow process for *cis*-1,2-DCE, and degradation via either

cometabolic pathways, especially under methanogenic conditions, or aerobic pathways appears to occur more readily (ATSDR 1996).

PCE

PCE is sparingly soluble in water, and has a high Henry's Law constant, and is therefore expected to partition to the atmosphere and soil gas preferentially. However, volatilization rates from soil are expected to be 10-100 times slower than those from water (ATSDR 2014). In instances where PCE is present in soil, leaching to groundwater is expected to occur rapidly due to its low tendency to sorb to soils, though this largely is a function of the type of soil and the presence of organic carbon. In groundwater, PCE transport does not appear to be impacted by sorption to soils or sediment in groundwater. Sorbed PCE may serve as a reservoir in the smear zone where PCE can be re-dissolved into groundwater as groundwater levels fluctuate. More prevalently, free phase PCE can be present as DNAPL, which tends to sink in groundwater and serve as a long-term source for dissolved phase contamination.

Although PCE undergoes degradation via hydroxyl radical reactions, it appears to be a relatively slow process, and long term atmospheric transport is expected to occur. In groundwater, PCE has been found to be resistant to aerobic biodegradation in the subsurface, with some studies suggesting no observable degradation when DO is greater than 1.5 mg/L (USGS 2006). Anaerobic microbes have been shown to be much more successful in degrading PCE, using nitrate, iron, sulfate, and carbon dioxide as terminal electron receptors for methanogenesis. The anaerobic PCE degradation pathway is known to include the formation of TCE, *cis*- and *trans*-1,2-DCE, and VC. The half-life for PCE via anaerobic biodegradation has been observed between 239 and 3,246 days. Due to its highly oxidized state, PCE is prone to reductive dechlorination in reducing environments (ATSDR 2014).

TCE

TCE is moderately soluble in water, however its Henry's Law constant suggests that TCE partitions rapidly to the atmosphere from surface water. The major route of removal of TCE from water is volatilization (ATSDR 2014). TCE is highly mobile in sandy soil. TCE is denser than water and what is not volatilized at the surface will submerge in water. The majority of TCE present on soil surfaces will volatilize to the atmosphere or leach into the subsurface. Experimentally measured K_{oc} values indicate medium to high mobility of TCE in soil.

The dominant process by which TCE degrades in the atmosphere is the reaction with hydroxyl radicals. These reactions are light and temperature dependent and can, therefore, vary with seasons (ATSDR 2014). Degradation of TCE by anaerobes via reductive dechlorination have been documented, but can be problematic, as a common product is VC, a known carcinogen. Under reducing conditions, dechlorination of TCE to DCE can occur relatively rapidly; however, the dechlorination of DCE to VC, and VC to ethane has been documented to be a much slower process

(USGS 2006). Aerobic degradation of TCE has been demonstrated in groundwater to a limited extent, however, the production of DCE and VC appears to be unique to anaerobic degradation. The effectiveness of chlorinated solvents to serve as electron acceptors is related to their oxidation state (i.e., the number of chlorine substitutions in the molecule).

VC

VC is more than twice as soluble in water as TCE, and is more than an order of magnitude more soluble in water than PCE, suggesting that dissolution in groundwater may be a significant transport mechanism. However, its high Henry's Law Constant, and exceedingly high vapor pressure, indicate that volatilization will be the most significant transport pathway (USGS 2006). It will likely partition to the atmosphere or soil vapor preferentially from groundwater or soil. Its moderate K_{oc} suggests that it may be mobile in soil and has the potential to migrate to groundwater. Most VC present on soil surfaces will volatilize to the atmosphere. The presence of other contaminants, such as organic solvents, can affect the mobility of VC in the soil (ATSDR 2006). PCE and TCE can partially degrade to form VC in aqueous environments.

The primary degradation mechanism for VC in the atmosphere is the reaction with the photochemically generated hydroxyl radicals (ATSDR 2006), and photolysis is not expected to occur. In groundwater, VC can undergo rapid microbial degradation under aerobic conditions. Degradation of VC under anaerobic conditions generally occurs much more slowly than under aerobic conditions. However, effective VC degradation can occur in situations where methanogenic or iron-reducing conditions are present, with mean half-lives on the order of 30 minutes (USGS 2006).

12.3.3 SEMI-VOLATILE ORGANIC COMPOUNDS

1-methylnaphthalene

Limited research is available for 1-methylnaphthalene transport and degradation characteristics; however, it shares many structural and chemical similarities to naphthalene, and may be expected to behave in a similar fashion. It is sparingly soluble in water, with a high K_{ow}, which indicates that transport via groundwater advection may be a less significant pathway than other transport mechanisms. It has a moderate vapor pressure and Henry's Law constant, which indicates that it will likely volatilize to the atmosphere under ambient conditions (ATSDR 2005b). Volatilization will depend strongly on temperature, wind speed, and the ability of 1-methynaphthalene to diffuse through water columns and soil. Due to both its low solubility and moderate volatility, 1-methynaphthalene has the potential to exist as a part of a more complex DNAPL in the subsurface, from which 1-methynaphthalene may be slow to dissolve.

Similar to other petroleum compounds, 1-methylnaphthalene is expected to react with hydroxyl radicals in ambient air, yielding half-lives on the order of 3.5 hours. 1-methylnaphthalene is expected to undergo biodegradation in groundwater systems under aerobic conditions. Biodegradation effects appear to coexist with photolysis in surface water systems, but groundwater system degradation pathways are less well documented, and may have contaminant half-lives ranging widely from 3 to 1,700 days (ATSDR 2005b). Biodegradation may also occur in subsurface soil in the presence of oxygen, but abiotic degradation is unlikely to occur.

Benzo(a)pyrene

Research into benzo(a)pyrene-specific transport properties is limited. Generally, PAHs are evaluated instead, and information from PAHs analyte evaluations has been used to evaluate fate and transport characteristics of benzo(a)pyrene in the RI. Benzo(a)pyrene has a very low water solubility, a very low vapor pressure, and a high K_{ow}, which typically results in preferential partitioning to sediment and soil, and minimal distribution to air and water in the environment. Benzo(a)pyrene in air tends to exist in the particulate phase, rather than as a vapor, due to its high molecular weight and high boiling point (ATSDR 1995).

In soils, microbial degradation is expected to be the primary process by which benzo(a)pyrene is degraded. Biodegradation is significantly longer for larger molecular weight PAHs such as benzo(a)pyrene, compared to smaller molecular weight PAHs such as naphthalene. Sorption of PAHs to organic matter in soil may affect the rate of biodegradation, due to reducing bioavailability of the compound. Microbial biodegradation is expected to be the primary degradation pathway for benzo(a)pyrene in water, as some evidence suggests higher molecular weight PAHs are less amenable to photooxidation. Photolysis is expected to be the primary degradation pathway for PAHs in air. However, due to benzo(a)pyrene's large molecular weight and high K_{ow}, it is expected to exist in air primarily sorbed to other solids. The surface character and chemical composition of the sorbing media has been demonstrated to affect the ability of the compound to undergo photolysis (ATSDR 1995).

12.3.4 PETROLEUM HYDROCARBONS, EPH AND VPH

Petroleum products released to the environment migrate through soil via two general pathways: (1) as bulk oil flow infiltrating the soil under the forces of gravity and capillary action (bulk migration), and (2) as individual compounds separating from the bulk petroleum mixture and dissolving in air or water (compound migration). As bulk free-phase petroleum hydrocarbons have not been observed extensively at the Facility, fate and transport analysis will focus upon dissolution of individual components into air or water.

Compound Migration

After a release of petroleum hydrocarbons to the soil column, individual compounds may separate from the mixture and migrate independently. Chemical transport properties such as volatility, solubility, and sorption potential are often used to evaluate and predict which compounds will likely separate from the mixture. The VPH fractions of petroleum hydrocarbons are most likely to separate from a free-phase hydrocarbon mixture.

Since petroleum products are complex mixtures of hundreds of compounds, the compounds characterized by relatively high vapor pressures tend to volatilize and enter the vapor phase. The exact composition of these vapors depends on the composition of the original product (ATSDR 1999). The rate of volatilization will depend upon the vapor pressure of the compound, as well as its Henry's Law constant, but will also be a function of air and soil temperature, humidity, wind speed, soil type, moisture content, oil composition, solar radiation, and thickness of the oil layer.

Solubility generally decreases with increasing molecular weight of the hydrocarbon compounds. For compounds having similar molecular weights, the aromatic hydrocarbons are more water soluble and mobile in water than the aliphatic hydrocarbons and branched aliphatics are less water soluble than straight-chained aliphatics. The compounds most likely to be measured in water when in contact with petroleum fuels are the light fraction, aromatic hydrocarbons such as benzene, toluene, ethylbenzene, and xylenes.

Lighter petroleum products such as gasoline make up the VPH fraction and contain constituents with higher water solubility and volatility and lower sorption potential than do heavier petroleum products such as fuel oil. The VPH-fraction hydrocarbons tend to migrate readily through soil, potentially threatening or affecting groundwater supplies. In contrast, EPH-fraction hydrocarbons, such as fuel oil, are generally more persistent in soils because of their relatively low water solubility and volatility and high sorption capacity. Hydrocarbon compounds identified at the BPCE Facility include C5-C8 aliphatic hydrocarbons, C9-C18 aliphatic hydrocarbons, and C9-C10 aromatic hydrocarbons.

Indigenous microbes found in many natural settings have been shown to be capable of degrading petroleum compounds. The final products of microbial degradation are carbon dioxide, water, and microbial biomass (ATSDR 1999). The rate of petroleum hydrocarbon degradation depends on the chemical composition of the product released to the environment as well as site-specific environmental factors. Generally, the straight chain hydrocarbons and the aromatics are degraded more readily than the highly branched aliphatic compounds (Havlicek 1988).

Bacteria that decompose petroleum products using oxygen as an electron acceptor are important in the degradation process. The rate of biodegradation will depend, in part, on the supply of oxygen to the contaminated area, because

aerobic metabolism is much faster than anaerobic metabolism. When there is an insufficient amount of DO available, organisms that can use other electron acceptors may degrade the contaminants, but at slower rates. The ideal pH range to promote biodegradation is close to neutral (6 to 8). The moisture content of the contaminated soil will affect biodegradation of oils through dissolution of the residual compounds, dispersive actions, and the need for microbial metabolism to sustain high activity. The moisture content in soil affects microbial locomotion, solute diffusion, substrate supply, and the removal of metabolic by-products (ATSDR 1999).

Excessive moisture will limit the gaseous supply of oxygen for enhanced decomposition of petroleum hydrocarbons. Generally, as the temperature increases, biological activity tends to increase up to a temperature where enzyme denaturation occurs. The optimal temperature for biodegradation to occur ranges from 18 ºC to 30 ºC. Nutrients must also be present in the proper amounts. Nitrogen is usually the limiting nutrient governing the rate of decomposition.

12.4 CONCEPTUAL SITE MODEL

The CSM provides a summary of how and where contaminants are expected to move and the impacts they may have. The CSM presents known and potential contaminant sources and contaminant release and migration mechanisms along with potential contaminant exposure pathways and routes with respect to human and ecological receptors. Figure 12-1 includes a pictorial CSM that illustrates known and potential contaminated media for the Facility based on the RI investigation results in addition to potential and known exposure pathways. Figure 12-1 focuses on existing contaminant sources, and not historical primary sources that appear to have been addressed or no longer exist. The following subsections describe the release sources and mechanisms at each identified source area, as well as media impacted by that source area.

12.4.1 BIG SKY LINEN

BSL is a commercial cleaning facility located at 715 Central Avenue. The structure it occupies was built in 1955, and BSL has operated at its current location since 1965 or before. BSL offered dry cleaning services using PCE as a dry cleaning solvent until as late as 1994. Since the early 1990s BSL has provided commercial wet laundry services. Site contamination is known to be related to the release of PCE to the subsurface during commercial operations at BSL that were detailed by EPA during the interim emergency response. While contaminant releases initially occurred at the place of business and associated utilities adjacent to BSL, the chlorinated solvent releases resulted in widespread contamination extending for more than 1.6 miles to the northeast of the property. The following subsections describe the known primary releases discovered during EPA’s interim emergency actions, and also detail the current source and release mechanisms evaluated based on the RI results.

12.4.1.1 PRIMARY SOURCES AND RELEASE MECHANISMS

BSL's primary source of chlorinated solvents was PCE from dry cleaning activities prior to 1995. The PCE at BSL was collected in the building in a floor drain connected to a French drain system and dry well located in the alley east of BSL that discharged directly to the subsurface prior to 1970. In 1970, the French drain was connected to the city storm sewer system; however, in 1975 BSL was directed to abandon all drains and properly dispose of PCE waste and wastewater (Lockheed Martin 2009). Additional primary releases likely occurred after 1975 since EPA observed and replaced degraded sanitary sewer system piping during EPA interim remedial actions in 2008. Releases appeared to have occurred from sanitary and storm sewer service lines as well as main lines in Central Avenue, based on heavily contaminated soil excavated from underneath these lines by EPA during the interim emergency actions. Although carbon tetrachloride was only detected in subslab vapor and indoor air during the RI, it may have been released along with PCE (carbon tetrachloride is a known contaminant in PCE); however, carbon tetrachloride was not detected above DEQ-7 groundwater standards (3 µg/L) across the Facility. Most of the RLs for carbon tetrachloride in groundwater were between < 1 µg/L and < 2 µg/L. Historically, carbon tetrachloride was also used as a solvent, pre-dating the use of PCE, as discussed in Section 12.1 (though there is no documentation of its use at BSL as a solvent). Carbon tetrachloride was consistently detected in ambient air samples at the Facility during the RI. Detected concentrations in ambient air samples were at magnitudes similar to indoor air samples, indicating that carbon tetrachloride in indoor air may not be attributable to VI. Detected carbon tetrachloride concentrations were generally lower in subslab vapor samples than corresponding indoor air samples, although RLs for subslab vapor samples were generally higher than detected concentrations in indoor air or ambient air.

Separate from the chlorinated solvent source identification, a gasoline UST was formerly located on the north side of BSL property, which was found in 1998 to have released petroleum to the subsurface. The UST was removed, and subsurface soil excavated in 1998 (DEQ, 1998). These releases have resulted in sources of PCE and VPH contamination of subsurface soil, groundwater, and soil vapor at BSL. The trihalomethanes bromodichloromethane and chloroform are often associated with chlorination of municipal water since they are formed when naturally occurring organic matter reacts with chlorine released to the environment, but are also present in wastewater processes, and rinse water from domestic and commercial cleaning and laundry operations (USGS 2018). Low levels of trihalomethane compounds are ubiquitous at the Facility.

As primary chlorinated solvent sources and releases were identified by DEQ and EPA prior to 2008, interim remedial actions were taken starting in 2008 to excavate impacted subsurface soil from the alley between BSL and the building at 711 Central Avenue, as well as along the stormwater and sanitary sewer utility corridor in Central Avenue. Additional remedial actions including vapor mitigation at select locations, in situ chemical oxidation along utility

corridors, and sheet pile wall installation were employed near BSL. Dry cleaning is no longer conducted on site, and no other USTs are known to be present on site.

Based upon site visits, historical records, and RI analytical results, these primary release mechanisms (with the exception of drinking water releases to the subsurface) no longer appear to be a continuing source of contamination at the Facility. Ongoing contaminant sources are attributable to media that remains impacted by these primary release mechanisms. The remaining contaminated media (i.e., soil and groundwater) are discussed as secondary sources below.

12.4.1.2 SECONDARY SOURCES AND RELEASE MECHANISMS

In addition to the primary sources discussed above, the secondary sources (media that became contaminated as a result of the original releases) included in the CSM at BSL are as follows.

Soil

The upper alluvial zone, approximately the top 13 to 20 ft, is comprised of heterogeneous sandy clay, sandy silt, clayey sand, silt, or clay interspersed with smaller sand layers. The upper alluvial material is present in smaller, disconnected alluvial lenses rather than continuous layers, and the water table is typically present near the bottom of this zone, approximately 13-15 ft bgs. HPT-estimated K values ranged from less than 1 to 10 ft/day in this zone. Beneath that layer of lenticular upper alluvium is a coarser, more homogenous sand or gravel alluvial layer that is approximately 10 to 20 ft thick. Hydraulic conductivity values of this saturated zone were reported to range from 7.7 to 71.5 ft/day (URS Operating Services, Inc. 2010).

As noted above, subsurface soil and groundwater contamination was observed during interim EPA remedial actions starting in 2008. Releases of PCE from degraded sewer piping and direct discharge to the subsurface resulted in solvent contamination of subsurface soils beneath and adjacent to BSL in the alley east of BSL and in the Central Avenue utility corridor. Soil excavation was conducted, to the limits of practicality, due to the presence of occupied structures (BSL and 711 Central Avenue) and utilities in close proximity to the BSL investigation area. Results of soil sampling and MiHPT investigation indicate that soil near the smear zone is likely acting as a secondary source for groundwater and soil vapor contamination. PCE discharged to the subsurface may have traveled horizontally along the fine-grained layers, and there was likely DNAPL present in the vadose and smear zone at the time of release. Free-phase PCE would have diffused into fine-grained lenses, which is likely where the most PCE mass remains. The RI did not identify DNAPL at BSL or 711 Central Avenue, although the respective building footprints were not included in the investigation. The highest concentrations of PCE in subsurface soil were observed in the smear zone adjacent to

BSL at approximately 90 mg/kg, while PCE saturation concentrations for the soils observed in the area are approximately 480 mg/kg. Surface soil PCE concentrations identified in the RI were approximately one order of magnitude less than subsurface PCE concentrations.

Data from RI sampling provides evidence that ongoing source material may exist beneath building footprints. Soil vapor data from subslab samples at BSL and 711 Central Avenue show elevated PCE concentrations, possibly indicative of PCE-saturated soil or DNAPL. Additionally, groundwater PCE concentrations at monitoring wells located near known primary release areas are close to 20% of the aqueous solubility of PCE. However, groundwater PCE concentrations in bedrock monitoring wells are less than the standard, and are several orders of magnitude less than the solubility limit. This suggests that residual DNAPL may exist near BSL, but it does not appear to be mobile or to have penetrated downward to bedrock. Subsurface soil sampling did not identify a petroleum hydrocarbon LNAPL plume or significant sitewide petroleum hydrocarbon plume. However, ongoing petroleum hydrocarbon impacts in excess of generic SLs in BPGP02 and BPGP78 along the northern portion of the properties, present 20 years after removal of the UST, suggest there may be residual petroleum contaminants in the soil as well.

Solvents may leach from subsurface soil to groundwater, acting as a long-term source of groundwater contamination. Furthermore, heterogeneous soil distributions can provide a secondary source of COPCs to groundwater via back diffusion from fine-grained layers. Solvents may also volatilize from soil into soil vapor, which has the potential to migrate through the subsurface (both vertically and horizontally) and impact indoor air at structures above or adjacent to contaminated soils at the Facility. Natural biodegradation processes may convert PCE into other chlorinated ethenes such as TCE, 1,2-DCE (*cis* and *trans*), and VC. Physical/chemical properties of these degradation products (discussed previously) suggest they may be more likely than PCE to volatilize from soil to enter soil gas, or partition to groundwater and be transported along the groundwater plume.

Groundwater

The PCE releases described above have resulted in impacted groundwater. A dissolved phase solvent plume extends from beneath known release areas and has migrated northeast of the BSL property along the predominant groundwater flow direction for more than 1.6 miles. Groundwater PCE concentrations in monitoring wells are highest near the eastern end of the BSL building, where historical dry cleaning operations occurred, and the French drain and sewer lines were located. Four wells in this area consistently contain PCE concentrations greater than 10,000 µg/L. DNAPL appears to not exist on top of bedrock in part because the saturated zone appears to be homogeneous, coarse-grained material, and groundwater velocity is high enough that the dissolved phase PCE concentration is less than the solubility limit. Petroleum hydrocarbon concentrations are highest in wells on the northern edge of the BSL and 711 Central

Avenue properties, downgradient of the former UST location, but do not appear to extend off of the properties to the extent observed for PCE.

Darcy seepage velocities were calculated using site-specific parameters (Appendix A) to compare a possible transport scenario to current observed conditions at the facility. Seepage velocities range from 340 ft/yr to 1,355 ft/yr based upon varying hydraulic conductivities, gradients, and estimated effective porosity. Based on a potential early release date of 1955 at BSL, and using the calculated Darcy seepage velocities above, an un-retarded plume could potentially extend 4-16 miles from BSL to the current date. When the retardation factor for PCE (16.3) calculated in Table 12-4 is applied to the Darcy seepage velocities, an estimated plume length of 0.25-1.0 miles from BSL for PCE is derived. The RI documented that PCE concentrations exceeding 5 µg/L are estimated to extend approximately 1.6 miles from the BSL source area. Given the uncertainties in the start of the release, the potential for some volume of contaminant transport via sewer lines, the range of hydraulic conductivities, the estimated effective porosities, and the large extent of the plume leading to the likelihood of heterogeneity, these predicted plume migration results appear to indicate that the various parameters measured and estimated for Facility conditions are reasonable.

Residents, business owners/operators, and local government may also use the contaminated groundwater for irrigation, and filling of swimming pools or other water features, which may also result in volatilization of chlorinated solvents to the ambient air, and incidental ingestion or direct contact with contaminated groundwater.

Soil Vapor

PCE releases from primary and secondary sources appear to be causing soil vapor solvent impacts. VOCs in groundwater have migrated an extended distance from the source, and dissolved phase chlorinated solvents may volatilize and enter soil gas above the groundwater plume. Volatile contaminants may subsequently impact indoor air in overlying structures above the groundwater plume through VI pathways. Soil vapor can be approximated at BSL and 711 Central Avenue near the known primary release areas with subslab vapor analytical results of PCE greater than 1,390,000 µg/m^3 in samples without mitigation systems. VI sampling in residential and commercial structures above the dissolved phase PCE plume (i.e., not adjacent to the known release areas) had analytical results in subslab and indoor air concentrations in excess of applicable generic SLs (Section 10 and Appendix H).

12.4.1.3 TERTIARY SOURCES AND RELEASE MECHANISMS

In addition to the primary and secondary sources discussed above, the tertiary sources (i.e., media that became contaminated as a result of the secondary source releases) included in the CSM at BSL are as follows.

Groundwater impacts, as a result of dissolution of residual PCE in soil including back-diffusion from fine-grained soils, continue to be a tertiary source. Changes in water elevation may influence dissolution rates, as well as infiltration of water through the vadose zone in source areas. Soil vapor impacts above the contaminated groundwater plume also continue to impact potential receptors through VI pathways.

Groundwater analytical results demonstrate that dissolved phase PCE extends to the upgradient (western) vicinity of BSL from upgradient sources. The BSL property is located downgradient of a known historical dry cleaning operation at former CAL. The groundwater PCE plumes are observed to intermingle, though at concentrations less than the DEQ-7 Standard (5 µg/L).

During the EPA interim actions, sheet piling was installed in Central Avenue to allow deeper excavation of impacted soil near occupied structures. Free-phase PCE was observed to extend below the groundwater surface, and excavation was conducted below the water table within the sheet piling area with dewatering operations to maximize source removal. However, the practical limits of excavation likely did not permit complete recovery of contaminated material. Monitoring wells BPGP74 and BPGP76 are believed to lie within the sheet pile area, and are therefore indicative of groundwater conditions within the sheet pile enclosure. The sheet pile area may not serve as a complete barrier to groundwater flow, as groundwater may potentially seep through joints and is likely connected to groundwater during higher water elevations. The sheet piling was left in place and notched to permit reinstallation of repaired utility lines. The depth of the sewer pipelines observed during sewer scoping suggests that the bottom of the sheet pile notches may be below the water table during periods of high groundwater levels. Additionally, infiltration captured within the sheet pile (from irrigation activities, municipal water discharge, or precipitation) may discharge through the notches as fluid levels within the sheet pile area rise. This discharge may serve as a tertiary source of contamination for groundwater, subsurface soil, and soil vapor.

12.4.2 FORMER CENTRAL AVENUE LAUNDRY AND CLEANERS

Chlorinated solvent use is believed to have occurred between 1982 and 1990 at former CAL. DEQ RCRA-program records indicate that solvent waste may have been disposed of on-site in a ‘lagoon’, but no other information exists to identify a disposal location or waste handling practices at the Facility. No lagoon is currently present or identifiable in the shopping center property in which former CAL was located. A building containing a salon is now present in the gravel lot historically located at the eastern edge of the property. Since former CAL’s closure in 1990, the former dry cleaning portion of the building has been occupied by a number of non-dry cleaning related businesses and is currently occupied by a commercial tobacco retailer. Chlorinated solvent releases at the site are believed to have impacted soil,

groundwater, and soil vapor on the former CAL property. An upgradient dissolved phase groundwater PCE plume extends from Industrial Avenue and Regal Street, to the northeast for approximately 1.1 miles.

12.4.2.1 PRIMARY SOURCES AND RELEASE MECHANISMS

Primary release mechanisms at the former CAL are currently not well understood. Historical release mechanisms common to dry cleaning solvent releases include sanitary and storm sewer discharge, on site surface discharge, subsurface discharge via dry wells or French drains, spills, leaks, dripping from process residuals, solvent recovery system overflow, and improper chemical storage. RI activities attempted to identify potential primary release mechanisms and locations, and included sanitary sewer scoping, MiHPT direct-push investigation, direct-push soil sampling, temporary groundwater screening sampling, permanent monitoring well installation, property manager surveys, groundwater sampling, and VI sampling. As previously noted, solvent use has been discontinued at the site, and based upon site visits and investigation results, primary release mechanisms do not appear to be contributing to contamination at the Facility at this time. Ongoing sources to groundwater may be attributable to other media impacted by historical primary release mechanisms and are presented in secondary sources.

12.4.2.2 SECONDARY SOURCES AND RELEASE MECHANISMS

Secondary sources at former CAL are media that may have become contaminated as a result of historic primary source contaminant releases. The following are considered secondary sources at the former CAL property.

Soil

Direct-push soil sampling and MiHPT did not find evidence of saturated solvent contamination or DNAPL in soils outside of the shopping center building footprint. Both MiHPT and soil analytical results indicate peak soil PCE concentrations occurred at approximately 3 ft bgs and 13-15 ft bgs in boring CAL-MIP-04, with the highest PCE concentration observed at the site of 0.17 mg/kg at a depth of 14-14.5 ft bgs. These concentrations are consistent with release mechanisms which could include surface spills (CAL-MIP-04 is near the back door of the former CAL) and/or releases from a floor drain and/or shallow sanitary sewer service line. For monitoring wells with historical data available, solvent contamination appears to be persistent despite cessation of solvent use (and potential release to the environment) in 1990. This suggests that secondary sources are sustaining groundwater concentrations. Additionally, subslab vapor samples collected during the RI showed elevated concentrations of PCE (74,800 $\mu g/m^3$) beneath the concrete slab of the former CAL building, which are indicative of a residual secondary source beneath the building footprint.

Solvents may leach from subsurface soil to groundwater, acting as a long-term source of groundwater contamination. Furthermore, heterogeneous soil distributions can provide a secondary source of COPCs to groundwater via back diffusion from lower permeable layers with residual contamination in the pores. Solvents may also volatilize from soil into soil vapor, which has the potential to migrate through the subsurface (both vertically and horizontally) and impact indoor air at structures above or adjacent to contaminated soils at the Facility. Natural biodegradation processes may convert PCE into other chlorinated ethenes such as TCE, 1,2-DCE (*cis* and *trans*), and VC. Physical/chemical properties of these degradation products (discussed previously) suggest they may be more likely than PCE to volatilize from soil to enter soil gas, or partition to groundwater and be transported along the groundwater plume.

Groundwater

A dissolved phase groundwater plume of PCE exceeding the DEQ-7 standard extends from the former CAL property at 1246 Central Avenue offsite in the general direction of groundwater flow (to the northeast) for approximately 0.7 miles (additional upgradient contributions to the dissolved phase plume are presented in Tertiary Sources and Release Mechanisms in Section 12.4.2.3). PCE concentrations at former CAL are highest on the south side of the building in newly installed well MW-101, adjacent to the sanitary sewer system that may have received discharge from the former dry cleaning operations, and are on the order of 200 µg/L. This is less than 0.1% of the aqueous solubility for PCE in groundwater. Groundwater screening samples for PCE were collected adjacent to the eastern edge of the shopping center plaza. PCE concentrations were slightly above the DEQ-7 standard, but lower than concentrations observed in MW-101. Groundwater contamination is present beneath occupied structures downgradient of former CAL.

Darcy seepage velocities were calculated using site-specific parameters (Appendix A) to compare a possible transport scenario to current observed conditions at the facility. Seepage velocities range from 340 ft/yr to 1,355 ft/yr based upon varying hydraulic conductivities, gradients, and estimated effective porosity. Based on a potential early release date of 1982 at former CAL, an un-retarded plume could extend 2.3-9.2 miles using the calculated Darcy seepage velocities above. When the retardation factor for PCE (16.3) calculated in Table 12-4 is applied to the Darcy seepage velocities, an estimated plume length of 0.1-0.6 miles from CAL for PCE is derived. The RI documented that PCE concentrations exceeding 5 µg/L are estimated to extend approximately 0.75 miles from the former CAL source area. Given the uncertainties in the start of the release, the range of hydraulic conductivities, the estimated effective porosities, and the large extent of the plume leading to the likelihood of heterogeneity, these predicted plume migration results appear to indicate that the parameters measured and estimated for Facility conditions are reasonable.

Residents, business owners/operators, and local government may also use the contaminated groundwater for irrigation, and filling of swimming pools or other water features, which may also result in volatilization of chlorinated solvents to the ambient air, and incidental ingestion or direct contact with contaminated groundwater.

Soil Vapor

PCE releases from primary and secondary sources appear to be causing soil vapor solvent impacts. Soil vapor sampling in the former CAL location found a subslab vapor PCE concentration of 74,800 µg/m^3, and an indoor air PCE concentration of 4.7 µg/m^3. VOCs in groundwater appear to have migrated an extended distance from the source, and dissolved phase chlorinated solvents may volatilize and enter soil gas above the groundwater plume. Volatile contaminants may subsequently impact indoor air in overlying structures above the groundwater plume. VI sampling in eight residential and commercial structures above the dissolved phase PCE plume downgradient of former CAL did not find PCE concentrations in excess of generic SLs, though PCE was present above detection limits in properties as far as 2,000 ft downgradient (northeast) of former CAL.

12.4.2.3 TERTIARY SOURCES AND RELEASE MECHANISMS

In addition to the primary and secondary sources discussed above, the tertiary sources (i.e., media that became contaminated as a result of the secondary source releases) included in the CSM at Former CAL are as follows.

Groundwater impacts, as a result of dissolution of residual PCE in soil including back-diffusion from fine-grained soils, continue to be a tertiary source. Changes in water elevation may influence dissolution rates, as well as infiltration of water through the vadose zone in source areas. Soil vapor impacts above the contaminated groundwater plume also continue to impact potential receptors through VI pathways.

The former CAL property is located within the footprint of a low-level groundwater PCE plume on the western edge of the Facility, to which contamination from former CAL appears to contribute an order of magnitude higher PCE than the low-level plume to the west. Groundwater analytical results demonstrate that upgradient PCE contamination is present at the Facility and likely intermingles with impacts from the former CAL area. The source of upgradient PCE impacts are not known, though historical dry cleaners are known to have operated along 24th Street West and Central Avenue west and south of former CAL. Light industrial facilities have been, and continue to be, located upgradient of former CAL as well.

12.4.3 FORMER REX CLEANERS

Laundry services at the former Rex location began as early as 1912. Sanborn fire insurance maps note the existence of former Rex as early as 1949, and Montana Secretary of State records note that the cleaning service was in good standing until 1973. The period during which chlorinated solvents may have been used on site is unknown, though site analytical results suggest that former Rex may be a source area contributing to groundwater and soil vapor contaminant concentrations at the Facility. The property is no longer used for dry cleaning activities, and is currently vacant, after

previously hosting an automobile repair and sales business through 2017. Available information indicates that chlorinated solvents are currently not used at the property.

12.4.3.1 PRIMARY SOURCES AND RELEASE MECHANISMS

Primary release mechanisms at former Rex are not well understood. Historical release mechanisms common to dry cleaning solvent releases include sanitary and storm sewer discharge, on site surface discharge, subsurface discharge via dry wells or French drains, spills, leaks, dripping from process residuals, solvent recovery system overflow, and improper chemical storage. A single commercial structure occupies the former Rex property, which encompasses both original and newer structural additions to the building. The easternmost portion of the building is currently a commercial garage, and has numerous floor drains, cracks, and fissures in the concrete floor. During VI sampling, a crack adjacent to the southernmost floor drain in this portion of the property had a PID reading of 91.46 ppm, and the subslab sample port had a PID reading of 114.5 ppm, indicating the presence of VOCs, possibly including PCE, underneath the building slab. RI activities included sanitary and storm sewer scoping, MiHPT direct-push investigation, direct-push soil sampling, temporary screening well installation, permanent monitoring well installation, property owner surveys, groundwater sampling, and VI sampling. During sanitary sewer scoping, multiple large cracks and fissures in the sewer pipeline servicing the former Rex property were located, including a large fracture underneath 1st Avenue South near the Meadow Gold Dairy. Direct-push groundwater grab samples downgradient of the sewer fracture found PCE groundwater contamination ranging from 74.1 to 164 µg/L, with the boring closest to the sewer line (SEWER-04) having the highest PCE groundwater concentration reported for the former Rex plume. PCE concentrations in four subsurface soil samples downgradient of the sewer fracture were below detection limits. MiHPT and direct push soil sampling indicated the presence of PCE at relatively low levels (peaking at 0.083 mg/kg) in surface soil surrounding the former Rex building. Subsurface soil samples from the former Rex property did not indicate the presence of PCE, although RLs for the smear zone were elevated in some samples due to hydrocarbons. These results along with sampling results from monitoring wells installed on the property indicate there may have been some relatively minor surface discharge of PCE.

As previously noted, known solvent use has been discontinued at the site, and based upon site visits and investigation results, primary release mechanisms do not appear to be contributing to subsurface impacts at the Facility at this time. Ongoing sources to groundwater may be attributable to other media impacted by historical primary release mechanisms and are discussed in secondary sources.

12.4.3.2 SECONDARY SOURCES AND RELEASE MECHANISMS

Secondary sources at former Rex are media that may have become contaminated due to primary release mechanisms at the Facility. The following are considered secondary sources at former Rex.

Soil

Direct-push soil sampling and MiHPT did not find evidence of saturated solvent contamination or DNAPL in soils outside of the former Rex building footprint. PCE was detected in surface soil samples in 3 of 4 locations at the former Rex property and was not detected below 0.5 ft bgs. Due to utility clearance issues, soil sampling was not conducted in the alleyway where the suspected leaking sanitary sewer is located. PCE concentrations in surface soil ranged from 42.1 to 83 µg/kg. Subsurface soil samples collected downgradient of the sewer line fraction also did not contain PCE above the RL. Monitoring well data in the area is relatively recent, with the earliest available solvent data from 2009. The highest concentrations observed are typically at RH-MW-7, ranging from 104 to 210 µg/L. This suggests that an ongoing contaminated soil source may be leaching PCE to groundwater. The level of soil contamination required to sustain observed groundwater PCE concentrations may be less than analytical RLs and may be located in fine-grained soils that may be present in thin and discontinuous layers, so they may not have been sampled during the RI. Subslab vapor samples collected during the RI showed elevated concentrations of PCE (583,000 ug/m^3) beneath the concrete slab of the former Rex building.

Solvents may leach from subsurface soil to groundwater, acting as a long-term source of groundwater contamination. Furthermore, heterogeneous soil distributions can provide a secondary source of COPCs to groundwater via back diffusion. Solvents may also volatilize from soil into soil vapor, which has the potential to migrate through the subsurface (both vertically and horizontally) and impact indoor air at structures above or adjacent to contaminated soils at the Facility. Natural biodegradation processes may convert PCE into other chlorinated ethenes such as TCE, 1,2-DCE (*cis* and *trans*), and VC. Physical/chemical properties of these degradation products (discussed previously) suggest they may be more likely than PCE to volatilize from soil to enter soil gas, or partition to groundwater and be transported along the groundwater plume.

Groundwater

A dissolved phase groundwater plume of PCE contamination exceeding the DEQ-7 standard extends from the general area around the former Rex property at 19 South Broadway, offsite in the general direction of groundwater flow (to the east, and slightly northeast) for approximately 1,000 ft (additional upgradient contributions to the dissolved phase plume are presented in Tertiary Sources and Release Mechanisms in Section 12.4.3.2). Dissolved phase PCE concentrations are highest at RH-MW-7, which is located downgradient of the sewer line fracture, northeast of the Meadow Gold Dairy, and are on the order of 100 µg/L. PCE concentrations at MW-114, which is the nearest well to

the former Rex property, has typically contained PCE on the order of 25 to 50 µg/L. Four groundwater screening samples for PCE were collected downgradient of the sewer line fracture. PCE concentrations were higher (164 and 110 µg/L) nearer to the former Rex property and the sewer line, than those further away (74.1 and 84.5 µg/L). Groundwater contamination is present beneath occupied structures downgradient of former Rex.

Darcy seepage velocities were calculated using site-specific parameters (Appendix A) to compare a possible transport scenario to current observed conditions at the facility. Seepage velocities range from 340 ft/yr to 1,355 ft/yr based upon varying hydraulic conductivities, gradients, and estimated effective porosity. Based on an early release date of 1948 at former Rex, an un-retarded plume could extend 4.5-18 miles using the calculated Darcy seepage velocities above. When the retardation factor for PCE (16.3) calculated in Table 12-4 is applied to the Darcy seepage velocities, an estimated plume length of 0.3-1.1 miles from Rex for PCE is derived. The RI documented that PCE concentrations exceeding 5 µg/L are estimated to extend approximately 0.25 miles from the former Rex source area. Given the uncertainties in the start of the release, the range of hydraulic conductivities, the estimated effective porosities, and the large extent of the plume leading to the likelihood of heterogeneity, these predicted plume migration results appear to indicate that the parameters measured and estimated for Facility conditions are reasonable. If discharge did cease in or prior to 1973, it is likely that the plume is in its late stage and is receding in area, leading to a smaller plume than calculated. However, the limited sampling data collected to date does not allow for evaluation of plume stability.

Residents, business owners/operators, and local government may also use the contaminated groundwater for irrigation, and filling of swimming pools or other water features, which may also result in volatilization of chlorinated solvents to the ambient air, and incidental ingestion or direct contact with contaminated groundwater.

Soil Vapor

PCE releases from potential primary and secondary source appear to be causing soil vapor solvent impacts. Soil vapor sampling in the former Rex building found a subslab vapor concentration of PCE of 583,000 µg/m^3, and indoor air PCE at 223 µg/m^3, which was the highest PCE concentration observed in indoor air during the VI investigation. VOCs in groundwater appear to have migrated an extended distance from the source, and dissolved phase chlorinated solvents may volatilize and enter soil gas above the groundwater plume. Volatile contaminants may subsequently impact indoor air in overlying structures above the groundwater plume. VI sampling in one commercial structure above the dissolved phase PCE plume downgradient of former Rex did not find PCE concentrations in excess of generic SLs, though PCE was present above detection limits in properties as far as 1,000 ft downgradient (East/Northeast) of former Rex.

12.4.3.3 TERTIARY SOURCES AND RELEASE MECHANISMS

In addition to the primary and secondary sources discussed above, the tertiary sources (i.e., media that became contaminated as a result of the secondary source releases) included in the CSM at former Rex are as follows.

Groundwater impacts, as a result of dissolution of residual PCE in soil including back-diffusion from fine-grained soils, continue to be a tertiary source. Changes in water elevation or infiltration from deteriorating utility systems may influence dissolution rates, as well as infiltration of water through the vadose zone or affected utility bedding in source areas. Soil vapor impacts above a contaminated groundwater plume may also continue to impact potential receptors through VI pathways.

Low-level PCE concentrations are present in groundwater upgradient of former Rex, although at levels less than DEQ-7 standards. These concentrations appear to originate from the BSL groundwater plume.

12.4.4 NORTHEASTERN FACILITY AREA NEAR MW-115

During direct-push investigation activities conducted as part of the RI, groundwater PCE screening samples were collected northeast of former Rex to help delineate the distal edge of the groundwater PCE plume. A PCE screening sample collected from MW-115 found PCE at 260 µg/L, which is the highest concentration observed outside of the BSL source area, more than 1.3 miles to the southwest. Subsequent groundwater monitoring events in May and September 2018 found PCE concentrations of 956 and 1,790 µg/L, respectively. The increasing concentrations may be indicative of a relatively recent release. However, the CSM for PCE contamination in this area is incomplete, as release sources have not been identified. Figure 12-1 depicts a pictorial representation of this PCE contamination around MW-115 on the far right of the figure.

12.4.5 PATHWAYS FOR EXPOSURE

Facility-specific exposure pathways have been updated and identified as part of RI evaluations conducted. Figure 12-1 includes a pictorial evaluation of known COPC areas and potential pathways for exposure for the CSM. The subsections below discuss the ecological and human receptors that may be affected by the pathways identified in the CSM.

12.4.5.1 ECOLOGICAL RECEPTORS

Due to the urban location of the Facility, and the extent of development in the region, sensitive ecological receptors are expected to be limited at the Facility. The Facility is less than a mile from the Yellowstone River at one end and the

urban area could be a habitat or migration corridor for birds and mammals. Surface soil contamination was limited, and primarily identified under pavement, so is not anticipated to affect ecological receptors.

The Montana Fish, Wildlife, & Parks (FWP) designates crucial habitat areas that assess risks to fish, wildlife, wildlife corridors, and their habitats. These crucial areas are mapped by FWP as hexagonal land areas with designations that help create management guidelines for development, energy projects, and transportation projects. These crucial areas are classified in a Crucial Areas Planning System (CAPS) that can be used to manage development and transportation projects with respect to the habitat risks to fish and wildlife (FWP 2008). The FWP assigns a class number to the areas, which can be used to evaluate the risk to fish and wildlife in that area during development activities. The higher the number the more crucial the area, which may require additional evaluation of risks for fish and wildlife or their habitat in that area. The higher ranked areas are important for wildlife corridor maintenance or may incur greater expense and more issues if developed. The northeastern portion of the Facility is located in a Class 2 ranked area. At the northeast edge of the investigation areas is a Class 1 (highest) ranked crucial habitat, which coincides with the part of the Facility that is closest to the Yellowstone River. The Class 1 ranking indicates that the leading end of the Facility plume may be under a crucial habitat corridor and have higher occurrence of local wildlife, based on Montana Fish Wildlife and Parks habitat evaluations. However, because groundwater was not identified to be impacting surface water, effects on ecological receptors are expected to be minimal.

12.4.5.2 HUMAN RECEPTORS

Groundwater

Potential human resident and worker exposure through direct contact, consumption, and inhalation of contaminated groundwater are considered primary exposure pathways. Groundwater pathways are typically evaluated for ingestion/consumption, inhalation, and direct contact when using groundwater for a drinking water supply or in bathing. In addition, direct contact is typically evaluated for workers who encounter groundwater through excavation or subsurface utility work.

The City of Billings provides potable water through a public surface water supply drawn from the Yellowstone River; therefore, groundwater is not generally used for drinking or bathing at the Facility. However, many residences, businesses, schools, and parks throughout the Facility have irrigation wells completed in the shallow aquifer. Residents, business owners/operators, and local government may use the Facility groundwater for irrigation, and filling of swimming pools or other water features. While the use of this water is restricted to irrigation purposes, receptors could potentially be exposed to COPCs through incidental direct contact, ingestion, or inhalation of vapors. Additionally, previous reports have identified potential exposure through the possibility of residents filling swimming

pools from irrigation wells (URS Operating Services, Inc. 2010). As the city provides water from other sources, groundwater contact and ingestion are likely an incidental pathway.

Soils

Surface soils impacts exceeding the most restrictive direct contact SL have not been identified at the Facility. Subsurface soil impacts exceeding the direct contact SL were identified in one sample from BSL at 16-16.5 ft bgs (smear zone). Construction workers within portions of the BSL and adjacent 711 Central Avenue properties may potentially be exposed to COPCs in open excavations near source areas or groundwater smear zones. Therefore, exposure to humans through direct contact, consumption, and inhalation of contaminated soils are considered primary exposure pathways for construction workers.

Indoor Air

Volatile compounds in DNAPL, groundwater, and subsurface soil have the potential to partition to soil gas at the Facility. This soil gas has the potential to migrate along utility corridors and through the subsurface (vertically and horizontally), accumulating beneath the concrete slabs or crawlspaces of overlying structures. These VOCs may then migrate into indoor air and affect building occupants. Therefore, potential exposure to humans through inhalation of indoor air is considered a primary exposure pathway.

Stormwater/Surface Water and Sediment

Facility-related impacts to stormwater/surface water and sediment from the stormwater system were not identified, so these media are not considered potential exposure pathways to human receptors.

13.0 CONCLUSIONS AND RECOMMENDATIONS

This section contains the conclusions drawn from the RI activities conducted at the BPCE Groundwater Facility, as well as recommendations for additional actions and investigations.

13.1 CONCLUSIONS

The primary objective of the RI was to assess the current nature and extent of contamination in groundwater, subslab or crawlspace vapor and indoor air, known and potential source area soils, stormwater/surface water, and sediment associated with the stormwater systems at the Facility using observations and data collected under this RI. Additional objectives of the RI are to provide data to support human health and ecological risk assessments and provide preliminary data to support feasibility analysis of cleanup alternatives. These objectives have been achieved, as the RI has provided a robust data set for evaluation of current conditions at the Facility.

Historical investigations were part of the interim response at the Facility and focused primarily on PCE and the areas of higher impact. Therefore, the RI evaluated a more expansive list of analytes to identify and describe COPCs for each medium at the Facility. Identified COPCs exceeding applicable SLs at the Facility include chlorinated solvents and their degradation products, trihalomethanes, and petroleum hydrocarbons. LNAPL was observed once at the Facility at BNMW-7, at a thickness of 0.02 ft, and is believed to only exist in isolated areas near petroleum release sources at the Facility. DNAPL was not observed at the Facility, including within and beneath known and suspected source areas.

As a part of known and potential source area investigations, sanitary and storm sewer scoping investigations were completed. Sewer pipeline fractures, cracks, and compromised joints were identified during these scoping investigations. These may have served as historical release mechanisms and may still serve as secondary release mechanisms.

Soil investigations were primarily conducted at known or suspected chlorinated solvent source areas at the Facility. Surface and subsurface soil samples were collected outside the building footprints in locations where chlorinated solvents were known or suspected to be used. PCE exceeding the leaching to groundwater SL was observed in surface soil at BSL, former CAL, and former Rex. Observations of other contaminants exceeding direct-contact or leaching to groundwater SLs in surface soil were limited. In subsurface soil, PCE was observed above the direct-contact SL at one location at BSL. Benzo(a)pyrene was observed above the direct-contact SL near HLS. PCE concentrations in subsurface soil exceeding leaching to groundwater SLs were observed at BSL, former CAL, and former Rex. The highest PCE concentrations in subsurface soil were observed at BSL, on the order of 90 mg/kg. Evidence of DNAPL

on bedrock was not identified during the RI; however, there may be small areas where DNAPL is present in fine-grained soils at or above the smear zone at BSL as well as beneath the BSL, 711 Central Avenue, and to lesser extents former CAL and former Rex building footprints, which act as a continuing secondary source to groundwater and soil vapor. Chlorinated solvent concentrations in soils were below detection limits at investigation areas near ALSCO, Wetzel's Cleaners, D7HRC, and HLS.

PCE is the most frequently encountered COPC in groundwater at the Facility, and PCE contamination exceeding 1 µg/L is observed Facility-wide over approximately 855 acres. The alluvial aquifer appears to be relatively high-velocity and homogeneous in the saturated zone, leading to large-scale plume migration. There are four identified co-mingled PCE groundwater plume areas within the Facility. The highest concentrations are observed near BSL, exceeding DEQ-7 standards by up to four orders of magnitude. Low levels of dissolved-phase PCE may be entering the Facility from upgradient sources, located west of the currently estimated Facility boundary. Lower level PCE contamination, on the order of 100 µg/L, has been observed near the former Rex and former CAL source areas, which are indicative of smaller source areas contributing to the greater chlorinated solvent plume. An unidentified source of PCE contamination appears to exist near MW-115 in the northeastern portion of the Facility. PCE concentrations as high as 1,790 µg/L have been observed in MW-115. PCE degradation products have also been observed in groundwater Facility-wide, though their distribution is less extensive than PCE. TCE exceeding groundwater SLs is present in the main body of the plume stretching from BSL to the northeast, and is also observed near former Rex and MW-115, but was not observed in exceedance of SLs in the western portion of the Facility associated with former CAL. TCE appears to be the most prevalent COPC in indoor air. VC was infrequently observed above the SL and did not appear to be a ubiquitous contaminant in groundwater. The alluvial aquifer is generally an aerobic environment, which is not conducive to chlorinated solvent biodegradation. However, conditions conducive to reductive dechlorination of CVOCs appear to be occurring in several wells at the Facility. Five wells have parameters consistent with reducing conditions as well as lower PCE concentrations compared to nearby wells, likely as a result of nearby petroleum hydrocarbon contamination.

DNAPL was not encountered in the alluvial materials above the bedrock, and DNAPL did not migrate into bedrock adjacent to or immediately downgradient of BSL. PCE concentrations in both bedrock wells were less than DEQ-7 groundwater standards. Since nearby monitoring wells screened at the top and bottom of the alluvial aquifer had PCE concentrations exceeding the SLs by 3-4 orders of magnitude, groundwater concentrations suggest that the bedrock acts as an effective vertical barrier to PCE migration. Additional evaluation of hydraulic conductivity in the bedrock wells noted hydraulic conductivities 8 to 9 orders of magnitude lower than measured in the alluvial aquifer, confirming that the bedrock appears to be minimally hydraulically connected to the alluvial aquifer, and is functioning as an aquitard.

The RI investigation included areas where groundwater chlorinated solvent and petroleum hydrocarbon constituents exceed applicable SLs, which includes more than 1,600 overlying residential and commercial structures based on the properties within the September 2018 5 µg/L groundwater contour. Due to the limitations associated with examining every property in a Facility of this size, VI impacts were evaluated and quantified at 49 properties across the Facility to include areas not previously investigated and areas that had historically high VI results. A total of 23 properties were evaluated as having complete or potentially complete VI pathways for PCE, TCE, or both, with indoor air exceedances of an applicable SL. Additionally, trihalomethanes (chloroform and bromodichloromethane), carbon tetrachloride, and compounds associated with petroleum contaminants (1,2-DCA, 1,3-butadiene, benzene, and aliphatic and aromatic hydrocarbon compounds) were found in indoor air exceeding applicable SLs, and were evaluated as having completed VI pathways in other properties. Five properties with subslab vapor mitigation systems previously installed during interim remedial actions were sampled during the VI investigation. At two of the properties, 711 Central Avenue and 342 Miles Avenue, the PCE VI pathway was evaluated to be complete, and PCE indoor air concentrations exceeded applicable indoor air SLs. The mitigation system at 342 Miles Avenue was confirmed to be nonfunctional during the sampling event, and the mitigation system was found to be non-operational at 711 Central Avenue during a DEQ site visit in March 2019. The PCE VI pathway was evaluated as potentially complete though indoor air concentrations did not exceed applicable SLs at the remaining three properties with mitigation systems. Elevated subslab vapor concentrations appear to be widespread as a result of VI pathways, and were highest in structures above or adjacent to potential PCE sources. Of the 49 structures evaluated, 39 were evaluated to have completed or potentially completed VI pathways with indoor air concentrations exceeding SLs for one or more COPCs as identified in Section 10. Mitigation, additional monitoring, and sampling of additional structures should be performed as recommended in Section 13.2 due to the potential for exposure of receptors.

Surface water bodies are not located within the Facility. However, stormwater collection and transportation systems may convey comingled surface water and stormwater to receiving surface water bodies. These systems were sampled to evaluate potential impacts from Facility contaminants. PCE was observed in one stormwater/surface water location downgradient of the Facility, at concentrations below the DEQ-7 standard, and was not observed in sediment collected from the stormwater system. In lieu of stormwater- and sediment-specific SLs, freshwater surface water and sediment benchmarks and DEQ-7 surface water and aquatic life standards were used to evaluate samples collected from the stormwater system. Metals concentrations observed in these samples exceeded those benchmarks. Based upon the relatively small data set collected, and the lack of Facility COPC observations above applicable SLs in stormwater/surface water, stormwater/surface water and sediment do not appear to be impacted by Facility-related contaminant migration.

13.2 RECOMMENDATIONS

Based upon the data collected and observations made during the RI, Trihydro makes the following recommendations:

Source Area Recommendations

- Investigate elevated PCE concentrations that appear to be present beneath the building footprints of BSL and 711 Central Avenue, and to lesser extents at former CAL and former Rex. Identify whether DNAPL may be present in soil underneath these buildings.
- Evaluate potential interim remedial alternatives for addressing residual sources of contamination at BSL, former Rex, and former CAL.
- Once the potential source area is evaluated for MW-115, investigate both soil and groundwater to determine the source characteristics and potential for interim actions to address the source and dissolved plume.

Soil Recommendations

- Conduct additional soil and groundwater investigation near MW-115 to evaluate potential source areas.

VI Recommendations

- Perform VI sampling in the salon at 1220 Central Avenue near former CAL to evaluate if the reported 'lagoon' was in this location.
- Repair the non-functional mitigation system at 342 Miles Avenue.
- Inspect the mitigation system at 711 Central Avenue to confirm it is operating properly and evaluate for appropriate sizing based upon building footprint and layout.
- Inspect the mitigation systems at 211 Terry Avenue and 632 St. John's Avenue #8 for proper operation and collect VI samples from these properties to evaluate mitigation system effectiveness.
- Install source-area vapor mitigation systems at BSL, former CAL, and former Rex to address completed pathways with indoor air concentrations greater than SLs.
- Evaluate utility and feasibility of vapor mitigation systems at the residential properties within the plume described in Section 10.6 with elevated subslab PCE and TCE concentrations.
- Based upon DEQ's VI guidance, sample each property again to evaluate whether VI may be occurring.
- Evaluate VI in a larger subset of potentially affected properties within the Facility with emphasis on the following:

- Collect VI samples from additional structures with potential sensitive receptors above the groundwater plume to provide a more extensive evaluation of VI pathways above the plume.
- Collect VI samples from other properties nearby those with elevated subslab/crawlspace and indoor air concentrations.

Groundwater Recommendations

- Evaluate potential groundwater investigation cross-gradient and upgradient of CAL, beginning near the corner of Central Avenue and 15th Street West and continuing up the terrace step in a westerly direction, as well as along Monad Road to identify source(s) of low-level PCE concentrations observed upgradient of former CAL.
- Conduct routine (i.e., quarterly or semiannual) groundwater sampling of MW-115 and nearby wells to evaluate changes in contaminant concentrations.
- Conduct additional groundwater screening investigation and install additional groundwater monitoring wells near MW-115 to evaluate nature and extent of contamination, including identification of source area. Once source area is identified, perform site visit and owner interviews with adjacent property owners to investigate possible release mechanisms.
- Conduct routine (i.e., annual) groundwater sampling of BPGP50, MW-117, and potentially other nearby wells to evaluate plume migration at the distal end of the BSL plume.
- Install a monitoring well on Meadow Gold Dairy property and/or MDT right-of-way closer to the sewer line fracture identified at former Rex to evaluate groundwater conditions near the potential release location.
- Perform additional investigations near BPGP89 to evaluate if an unknown or undocumented release source is contributing to elevated benzene levels in groundwater.

Stormwater/Surface Water and Sediment Recommendations

- Coordinate with City of Billings Street Traffic division to identify potential locations upstream of SD-4 for additional stormwater/surface water sampling to verify that low-level CVOCs concentrations observed in SD-4 are not indicative of higher-level contamination upstream.
- Coordinate with City of Billings Engineering division, environmental affairs, or DEQ to sample surface water during storm events or high peak flow to represent a broader range of flow conditions and thus water quality to verify contaminant observations during the RI.

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TABLES

TABLE 5-1. PCE SCREEN RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Easting	Northing	Tetrachloro- ethene (ug/L)
1A-GW-01	12/02/17	2211768.27	556451.91	1.5
1A-GW-02	12/04/17	2211970.19	556797.26	0.25
1B-GW-01	12/02/17	2213779.94	557158.51	8.9
1B-GW-02	12/04/17	2213776.02	557445.64	ND(1)
2A-GW-01	12/02/17	2211534.72	555488.45	4.3
2A-GW-02	12/03/17	2211456.95	555507.88	7
2A-GW-03	12/05/17	2211472.27	555252.2	8.8
2A-GW-04	12/18/17	2211104.88	555320.54	8.8
2A-GW-05	12/18/17	2211352.58	555025.66	13.1
2B-GW-02	12/05/17	2214411.79	556137.41	3.2
2B-GW-03	03/27/18	2214598.87	555417.94	0.21
2B-GW-04	03/27/18	2214272.48	554667.94	0.37
2C-GW-01	03/26/18	2208911.37	552841.55	ND(1)
2C-GW-02	04/04/18	2209912.48	554286.04	5.4
2C-GW-04	03/26/18	2210043.31	555011.69	ND(1)
2C-GW-05	03/26/18	2210609.29	555022.1	10.7
3A-GW-01	12/02/17	2215633.65	556500.44	0.83
3B-GW-01	12/02/17	2216508.15	557275.98	0.72
3B-GW-02	12/05/17	2216186.99	557608	ND(1)
3C-GW-01	12/04/17	2219010.27	559550.49	ND(1)
3C-GW-02	12/18/17	2219230.2	559492.14	ND(1)
3D-GW-01	12/05/17	2220257.61	559469.78	67.7
3D-GW-02	12/07/17	2220078.67	560441.16	ND(1)
3E-GW-01	12/02/17	2221052.65	560471.69	51.9
3E-GW-02	12/07/17	2221049.86	560981.27	ND(1)
4B-GW-01	12/04/17	2217456.86	555783.92	18.5
4B-GW-02	12/04/17	2217304.71	555937.36	39.3
4B-GW-03	02/06/18	2217772.97	555559.03	ND(1)
4C-GW-01	11/30/17	2218503.26	556165.93	ND(1)
4C-GW-03	12/06/17	2218935.15	556364.32	0.36
4D-GW-01	11/30/17	2220369.07	557164.95	15.4
4D-GW-02	12/06/17	2220835.47	556610.79	1.1
	02/06/18	2220835.47	556610.79	ND(1)
4E-GW-01	12/06/17	2221341.29	557852.48	22
4E-GW-02	12/06/17	2221550.27	557579.52	4
5A-GW-01	12/01/17	2223733.81	559902.82	1.2

Notes:
Location coordinates in State Plan NAD83

TABLE 5-1. PCE SCREEN RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Easting	Northing	Tetrachloro- ethene (ug/L)
5A-GW-02	12/18/17	2223559.79	559395.88	33.6
5B-GW-01	12/01/17	2222855.81	559164.24	0.87
5C-GW-01	03/27/18	2222810.35	559636.14	2.6
5C-GW-02	12/20/17	2222897.81	559518.05	7.5
5D-GW-02	03/27/18	2224356.36	559670	8.2
6A-GW-01	12/01/17	2222208.01	559338.63	0.69
6B-GW-01	12/20/17	2222179.94	560594.3	13.7
6B-GW-02	12/06/17	2222515.42	561548.28	1.5
6C-GW-01	12/07/17	2223339.51	561044.11	ND(1)
6C-GW-02	12/06/17	2224002	561416.97	ND(1)
ALSCO-GW-01	11/29/17	2215795.35	553080.92	ND(1)
ALSCO-GW-02	11/29/17	2215788.21	553157.5	ND(1)
ALSCO-GW-03	11/30/17	2215869.19	553196.46	ND(1)
ALSCO-GW-04	11/29/17	2215462.82	553050.98	ND(1)
ALSCO-GW-05	11/29/17	2215459.68	553146.57	ND(1)
HLS-GW-03	12/01/17	2215637.24	555412.95	0.39
HLS-GW-04	12/01/17	2215637.31	555488.25	0.28
HLS-GW-05	12/02/17	2215627.48	555615.08	0.29
MW-112	03/30/18	2224065.14	558897.66	0.4
MW-113	03/30/18	2224439.13	560051.01	0.086
MW-114	03/30/18	2222899.47	559514.23	12.3
MW-115	03/30/18	2224114.28	560669.05	260
PAI-EAST	04/25/18	2211440.55	554549.49	0.31
PAI-WEST	04/25/18	2210745.96	554420.5	1.3
R-1W	02/06/18	2224976.26	558681.01	ND(1)
R-24	02/06/18	2224957.1	560173.38	2.1
R7-WC	02/06/18	2224893.45	559612.58	ND(1)
SEWER-01 (5.5-6 ft)	03/30/18	2222958.53	559460.46	110
SEWER-02 (5.5 ft)	03/30/18	2222981.45	559434.62	81.5
SEWER-03 (17 ft)	03/30/18	2222945.2	559415.87	74.1
SEWER-04 (14.5-15.5 ft)	03/30/18	2222903.11	559419.62	164
WETZ-GW-01	03/27/18	2221335.52	559980.33	79.7
WETZ-GW-02	03/27/18	2221463.56	560086.66	2.7

Notes:
Location coordinates in State Plan NAD83

TABLE 5-2. MiHPT DIRECT PUSH INVESTIGATION LOCATION SUMMARY
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Source Area	Location	Probing Date	Total Probed Depth (ft bgs)	Preprobed Depth (ft bgs)	Sample Depths (ft bgs)
BSL	BSL-MIP-01	11/29/2017	28.5	4	0-0.5*, 4-4.5, 12-13, 17-18
BSL	BSL-MIP-02	12/1/2017	30.3	4	
BSL	BSL-MIP-03	11/29/2017	19.3	4	
BSL	BSL-MIP-04	11/30/2017	24.0	4	
BSL	BSL-MIP-05	11/30/2017	24.8	4	
BSL	BSL-MIP-06	11/28/2017	30.3	4	
BSL	BSL-MIP-07	11/28/2017	27.2	4	
BSL	BSL-MIP-08	11/28/2017	29.5	4	
BSL	BSL-MIP-09	NA			0-0.5*, 1-2*, 8-8.5, 12-12.5, 16-16.5, 25-25.5
BSL	BSL-MIP-10	11/28/2017	30.3	4	
BSL	BSL-MIP-11	11/16/2017	30.3	4	
BSL	MIP-T10	12/1/2017	30.2	4	
BSL	MIP-T11	11/30/2017	28.8	4	
BSL	MIP-T12	11/29/2017	33.0	4	
BSL	MIP-T13	11/30/2017	23.4	4	
BSL	MIP-T14	11/30/2017	26.2	4	
BSL	MIP-T15	11/28/2017	28.4	4	
BSL	MIP-T16	11/29/2017	27.4	4	
BSL	MIP-T17	11/29/2017	28.0	4	
BSL	MIP-T18	NA			0-0.5*, 9.5-10, 13-14
BSL	MIP-T19	11/29/2017	30.1	4	
BSL	MIP-T20	12/1/2017	31.1	4	0-0.5*, 12-13, 14-15
BSL	MIP-T21	12/1/2017	28.3	4	
BSL Total locations: 21 (23 planned)					
CAL	CAL-MIP-01	11/13/2017	34.5	4	
CAL	CAL-MIP-02	11/30/2017	38.4	4	0-0.5*, 8-9, 8.5-9, 11-12, 20-21
CAL	CAL-MIP-03	NA			
CAL	CAL-MIP-04	11/14/2017	28.1	4	0-0.5*, 1-2*, 3-3.5, 6-6.5, 14-14.5, 23-23.5
CAL	CAL-MIP-05	11/29/2017	27.6	4	
CAL	CAL-MIP-06	11/14/2017	21.2	4	
CAL	CAL-MIP-07	11/14/2017	28.0	4	
CAL	CAL-MIP-08	11/15/2017	28.8	4	
CAL	CAL-MIP-09	11/15/2017	30.4	4	0-0.5*, 5.5-6.5, 19-19.5
CAL	CAL-MIP-10	11/13/2017	34.2	4	
CAL	MIP-T01	NA			
CAL	MIP-T02	11/14/2017	31.8	4	

TABLE 5-2. MiHPT DIRECT PUSH INVESTIGATION LOCATION SUMMARY
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Source Area	Location	Probing Date	Total Probed Depth (ft bgs)	Preprobed Depth (ft bgs)	Sample Depths (ft bgs)
CAL	MIP-T03	11/14/2017	27.2	4	0-0.5*, 3.5-4.5, 4.5-5, 5-7.5, 10-18.5, 20-25
CAL	MIP-T04	NA			
CAL	MIP-T05	NA			
CAL	MIP-T06	11/16/2017	31.3	4	
CAL	MIP-T07	11/16/2017	29.5	4	
CAL	MIP-T08	11/16/2017	29.5	4	
CAL	MIP-T09	11/16/2017	31.0	4	
CAL Total locations: 15 (19 planned)					
Rex	REX-MIP-01	12/20/2017	24.4	4	
Rex	REX-MIP-02	12/19/2017	29.5	4	
Rex	REX-MIP-03	12/20/2017	30.7	4	0-0.5*, 10-10.5, 17-17.5
Rex	REX-MIP-04	12/19/2017	27.1	4	0-0.5*, 12-12.5
Rex	REX-MIP-05	12/19/2017	26.7	4	
Rex	REX-MIP-06	12/20/2017	27.2	4	
Rex	REX-MIP-07	12/19/2017	15.1	4	0-0.5*, 3.5-4
Rex	REX-MIP-08	12/2/2017	26.4	4	0-0.5*, 1-2*, 5-5.5, 9.5-10, 15-15.5, 17-17.5, 23-23.5
Rex	REX-MIP-09	12/2/2017	12.1	4	
Rex	MIP-T27	12/2/2017	25.7	4	
REX Total locations: 10 (10 planned)					
D7HRC	D7HRC-MIP-01	11/17/2017	20.4	4	7-9
D7HRC	D7HRC-MIP-02	11/17/2017	20.0	4	
D7HRC	D7HRC-MIP-03	11/17/2017	20.2	4	
D7HRC Total locations: 3 (3 planned)					

Notes:
* indicates surface sample, defined as being collected from the upper 2 feet
ft bgs: feet below ground surface
NA - not applicable
BSL: Big Sky Linen
CAL: Central Avenue Laundry
REX: Former Rex's Cleaners
D7HRC: District 7 Human Resource Council
NA - location excluded: not evaluated during the MiHPT survey due to accessibility issues while the MiHPT equipment was on site.
For excluded locations near BSL soil cores were collected for sampling at a later time.

TABLE 8-1. SURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,1,1,2-Tetrachloro-ethane (εg/kg)	1,1,1-Trichloro-ethane (εg/kg)	1,1,2,2-Tetrachloro-ethane (εg/kg)	1,1,2-Trichloro-ethane (εg/kg)	1,1,2-Trichloro-trifluoro-ethane (εg/kg)	1,1-Dichloro-ethane (εg/kg)	1,1-Dichloro-ethene (εg/kg)	1,1-Dichloro-propene (εg/kg)	1,2,3-Trichloro-benzene (εg/kg)	1,2,3-Trichloro-propane (εg/kg)	1,2,4-Trichloro-benzene (εg/kg)	1,2,4-Trimethyl-benzene (εg/kg)	1,2-Dibromo 3-chloro-propane (εg/kg)	1,2-Dibromo-ethane (εg/kg)
BSL-MIP-01 (0-0.5 ft)	12/03/17	**<54.8**	<219	**<54.8**	**<54.8**	<219	**<54.8**	**<219**	<219	<54.8	**<219**	<54.8	<54.8	**<1370**	**<54.8**
BSL-MIP-09 (0-0.5 ft)	03/29/18	**<51**	<51	**<51 UJ**	**<51**	<204	**<51**	**<51**	<51	<51	**<204**	<51	<51	**<510**	**<51**
BSL-MIP-09 (1-2 ft)	03/29/18	**<50.3**	<50.3	**<50.3 UJ**	**<50.3**	<201	**<50.3**	**<50.3**	<50.3	<50.3	**<201**	<50.3	<50.3	**<503**	**<50.3**
BSL-MIP-20 (0-0.5 ft)	12/04/17	**<53.2**	<213	**<53.2**	**<53.2**	<213	**<53.2**	**<213**	<213	<53.2	**<213**	<53.2	<53.2	**<1330**	**<53.2**
BSL-MIP-T18 (0-0.5 ft)	03/28/18	**<52**	<52	**<52 UJ**	**<52**	<208	**<52**	**<52**	<52	<52	**<208**	<52	<52	**<520**	**<52**
CAL-MIP-02 (0-0.5 ft)	11/28/17	**<222**	<55.4	**<55.4**	**<55.4**	<222	**<55.4**	**<55.4**	<55.4	<55.4	**<222**	<55.4	<55.4	**<1390**	**<55.4**
CAL-MIP-04 (0-0.5 ft)	11/28/17	**<219**	<54.7	**<54.7**	**<54.7**	<219	**<54.7**	**<54.7**	<54.7	<54.7	**<219**	<54.7	<54.7	**<1370**	**<54.7**
CAL-MIP-04 (1-2 ft)	11/28/17	**<234**	<58.5	**<58.5**	**<58.5**	<234	**<58.5**	**<58.5**	<58.5	<58.5	**<234**	<58.5	<58.5	**<1460**	**<58.5**
CAL-MIP-09 (0-0.5 ft)	11/15/17	**<227**	<568	**<56.8**	**<56.8**	<568	**<56.8**	**<56.8**	<227	<56.8	**<227**	<56.8	<56.8	**<568**	**<56.8**
CAL-MIP-T03 (0-0.5 ft)	11/28/17	**<219**	<54.7	**<54.7**	**<54.7**	<219	**<54.7**	**<54.7**	<54.7	<54.7	**<219**	<54.7	<54.7	**<1370**	**<54.7**
REX-MIP-03 (0-0.5 ft)	03/28/18	**<64.4**	<64.4	**<64.4 UJ**	**<64.4**	<257	**<64.4**	**<64.4**	<64.4	<64.4	**<257**	<64.4	<64.4	**<644**	**<64.4**
REX-MIP-04 (0-0.5 ft)	03/28/18	**<55.1**	<55.1	**<55.1 UJ**	**<55.1**	<221	**<55.1**	**<55.1**	<55.1	<55.1	**<221**	<55.1	<55.1	**<551**	**<55.1**
REX-MIP-07 (0-0.5 ft)	03/28/18	**<59.7**	<59.7	**<59.7 UJ**	**<59.7**	<239	**<59.7**	**<59.7**	<59.7	<59.7	**<239**	<59.7	<59.7	**<597**	**<59.7**
REX-MIP-08 (0-0.5 ft)	12/21/17	**<49.3**	<49.3	**<49.3**	**<49.3**	<197	**<49.3**	**<49.3**	<49.3	<49.3	**<197**	<49.3	<49.3	**<493**	**<49.3**
REX-MIP-08 (0-0.5 ft)	03/28/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
REX-MIP-08 (1-2 ft)	12/21/17	**<51.3**	<51.3	**<51.3**	**<51.3**	<205	**<51.3**	**<51.3**	<51.3	<51.3	**<205**	<51.3	<51.3	**<513**	**<51.3**
Screening Levels:															
DEQ DC Screening Level		2,000	810,000	600	1,100	670,000	3,600	23,000	NA	6,300	5.1	24,000	30,000	5.3	40
DEQ Leaching Screening Level		2.2	700	7.89	9.54	260,000	7.8	25	NA	210	0.0032	2,000	810	0.86	0.086

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-1. SURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Di-chloro-benzene (εg/kg)	1,2-Dichloro-ethane (εg/kg)	1,2-Dichloro-propane (εg/kg)	1,3,5-Trimethyl-benzene (εg/kg)	1,3-Di-chloro-benzene (εg/kg)	1,3-Dichloro-propane (εg/kg)	1,4-Di-chloro-benzene (εg/kg)	2,2-Dichloro-propane (εg/kg)	2-Butanone (εg/kg)	2-Chloro-toluene (εg/kg)	4-Chloro-toluene (εg/kg)	4-Methyl-2-Pentanone (εg/kg)	Acetone (εg/kg)	Allyl Chloride (εg/kg)
BSL-MIP-01 (0-0.5 ft)	12/03/17	<54.8	**<54.8**	**<54.8**	<54.8	<54.8	<54.8	<54.8	<219	346	<54.8	<54.8	<274	<1100	**<219**
BSL-MIP-09 (0-0.5 ft)	03/29/18	<51	**<51**	**<51**	<51	<51	<51	<51	<204	<255 UJ	<51	<51	<255	<1020	**<204**
BSL-MIP-09 (1-2 ft)	03/29/18	<50.3	**<50.3**	**<50.3**	<50.3	<50.3	<50.3	<50.3	<201	<252 UJ	<50.3	<50.3	<252	<1010	**<201**
BSL-MIP-20 (0-0.5 ft)	12/04/17	<53.2	**<53.2**	**<53.2**	<53.2	<53.2	<53.2	<53.2	<213	320	<53.2	<53.2	<266	<1060	**<213**
BSL-MIP-T18 (0-0.5 ft)	03/28/18	<52	**<52**	**<52**	<52	<52	<52	<52	<208	<260 UJ	<52	<52	<260	<1040	**<208**
CAL-MIP-02 (0-0.5 ft)	11/28/17	<55.4	**<55.4**	**<55.4**	<55.4	<55.4	<55.4	<55.4	<222	<277	<55.4	<55.4	<277	<1110	**<222**
CAL-MIP-04 (0-0.5 ft)	11/28/17	<54.7	**<54.7**	**<54.7**	<54.7	<54.7	<54.7	<54.7	<219	<273	<54.7	<54.7	<273	<1090	**<219**
CAL-MIP-04 (1-2 ft)	11/28/17	<58.5	**<58.5**	**<58.5**	<58.5	<58.5	<58.5	<58.5	<234	<293	<58.5	<58.5	<293	<1170	**<234**
CAL-MIP-09 (0-0.5 ft)	11/15/17	<56.8	**<56.8**	**<56.8**	<56.8	<56.8	<56.8	<56.8	<568	<284	<56.8	<56.8	<284	<1140	**<227**
CAL-MIP-T03 (0-0.5 ft)	11/28/17	<54.7	**<54.7**	**<54.7**	<54.7	<54.7	<54.7	<54.7	<219	<274	<54.7	<54.7	<274	<1090	**<219**
REX-MIP-03 (0-0.5 ft)	03/28/18	<64.4	**<64.4**	**<64.4**	<64.4	<64.4	<64.4	<64.4	<257	<322 UJ	<64.4	<64.4	<322	<1290	**<257**
REX-MIP-04 (0-0.5 ft)	03/28/18	<55.1	**<55.1**	**<55.1**	<55.1	<55.1	<55.1	<55.1	<221	<276 UJ	<55.1	<55.1	<276	<1100	**<221**
REX-MIP-07 (0-0.5 ft)	03/28/18	<59.7	**<59.7**	**<59.7**	<59.7	<59.7	<59.7	<59.7	<239	<298 UJ	<59.7	<59.7	<298	<1190	**<239**
REX-MIP-08 (0-0.5 ft)	12/21/17	<49.3	**<49.3**	**<49.3**	<49.3	<49.3	<49.3	<49.3	<197	<246	<49.3	<49.3	<246	<986	**<197**
REX-MIP-08 (0-0.5 ft)	03/28/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
REX-MIP-08 (1-2 ft)	12/21/17	<51.3	**<51.3**	**<51.3**	<51.3	<51.3	<51.3	<51.3	<205	179 J	<51.3	<51.3	<256	<1030	**<205**
Screening Levels:															
DEQ DC Screening Level		180,000	520	2,500	27,000	NA	160,000	2,600	NA	2,700,000	160,000	160,000	3,300,000	6,100,000	720
DEQ Leaching Screening Level		5,800	19	17	870	NA	1,300	720	NA	12,000	2,300	2,400	14,000	29,000	2.3

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-1. SURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Benzene (εg/kg)	Bromo-benzene (εg/kg)	Bromo-chloro-methane (εg/kg)	Bromo-dichloro-methane (εg/kg)	Bromoform (εg/kg)	Bromo-methane (εg/kg)	Carbon tetrachloride (εg/kg)	Chloro-benzene (εg/kg)	Chloroethane (εg/kg)	Chloroform (εg/kg)	Chloro-methane (εg/kg)	cis-1,2-Dichloro-ethene (εg/kg)	Cis-1,3-dichloro-propene (εg/kg)	Dibromo-chloromethane (εg/kg)
BSL-MIP-01 (0-0.5 ft)	12/03/17	<21.9	<54.8	<54.8	**<54.8**	**<548**	**<548**	**<219**	<54.8	<548	<54.8	**<219**	<54.8	<54.8	**<219**
BSL-MIP-09 (0-0.5 ft)	03/29/18	<24	<51	<51	**<51**	<204	**<510**	**<51**	<51	<510	<51	**<204**	<51	<51	**<204**
BSL-MIP-09 (1-2 ft)	03/29/18	<24	<50.3	<50.3	**<50.3**	<201	**<503**	**<50.3**	<50.3	<503	<50.3	**<201**	<50.3	<50.3	**<201**
BSL-MIP-20 (0-0.5 ft)	12/04/17	<21.3	<53.2	<53.2	**<53.2**	**<532**	**<532**	**<213**	<53.2	<532	<53.2	**<213**	<53.2	<53.2	**<213**
BSL-MIP-T18 (0-0.5 ft)	03/28/18	<20.8	<52	<52	**<52**	<208	**<520**	**<52**	<52	<520	<52	**<208**	<52	<52	**<208**
CAL-MIP-02 (0-0.5 ft)	11/28/17	<22.2	<55.4	<55.4	**<55.4**	**<554**	**<554 UJ**	**<222**	<55.4	<554	<55.4	**<222**	<55.4	<222	**<222**
CAL-MIP-04 (0-0.5 ft)	11/28/17	50	<54.7	<54.7	**<54.7**	**<547**	**<547 UJ**	**<219**	<54.7	<547	<54.7	**<219**	<54.7	<219	**<219**
CAL-MIP-04 (1-2 ft)	11/28/17	<27	<58.5	<58.5	**<58.5**	**<585**	**<585 UJ**	**<234**	<58.5	<585	<58.5	**<234**	<58.5	<234	**<234**
CAL-MIP-09 (0-0.5 ft)	11/15/17	<22.7	<56.8	<56.8	**<56.8**	**<568**	**<568**	**<227**	<56.8	<568	**<227**	**<227**	<56.8	<568	**<227**
CAL-MIP-T03 (0-0.5 ft)	11/28/17	<21.9	<54.7	<54.7	**<54.7**	**<547**	**<547 UJ**	**<219**	<54.7	<547	<54.7	**<219**	<54.7	<219	**<219**
REX-MIP-03 (0-0.5 ft)	03/28/18	<25.7	<64.4	<64.4	**<64.4**	**<257**	**<644**	**<64.4**	<64.4	<644	<64.4	**<257**	<64.4	<64.4	**<257**
REX-MIP-04 (0-0.5 ft)	03/28/18	<22.1	<55.1	<55.1	**<55.1**	**<221**	**<551**	**<55.1**	<55.1	<551	<55.1	**<221**	<55.1	<55.1	**<221**
REX-MIP-07 (0-0.5 ft)	03/28/18	<23.9	<59.7	<59.7	**<59.7**	**<239**	**<597**	**<59.7**	<59.7	<597	<59.7	**<239**	<59.7	<59.7	**<239**
REX-MIP-08 (0-0.5 ft)	12/21/17	23 J	<49.3	<49.3	**<49.3**	<197	**<493**	**<49.3**	<49.3	<493	**<197**	**<197**	<49.3	<49.3	**<197**
REX-MIP-08 (0-0.5 ft)	03/28/18	**<130**	--	--	--	--	--	--	--	--	--	--	--	--	--
REX-MIP-08 (1-2 ft)	12/21/17	<25	<51.3	<51.3	**<51.3**	<205	**<513**	**<51.3**	<51.3	<513	**<205**	**<205**	<51.3	<51.3	**<205**
Screening Levels:															
DEQ DC Screening Level		1,300	29,000	15,000	290	19,000	680	650	28,000	1,400,000	320	11,000	16,000	NA	8,300
DEQ Leaching Screening Level		70	420	210	27.7	210	25.3	11.7	680	59,000	194	77	210	NA	10.6

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-1. SURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Dibromo-methane (εg/kg)	Dichloro-difluoro-methane (εg/kg)	Dichlorofluoro-methane (εg/kg)	Diethyl ether (εg/kg)	Ethyl-benzene (εg/kg)	Hexachloro-butadiene (εg/kg)	Isopropyl-benzene (εg/kg)	m,p-Xylene (εg/kg)	Methylene Chloride (εg/kg)	MTBE (εg/kg)	Naphthalene (εg/kg)	n-Butyl-benzene (εg/kg)	n-Propyl-benzene (εg/kg)	o-Xylene (εg/kg)
BSL-MIP-01 (0-0.5 ft)	12/03/17	**<54.8**	<548	<548	<219	<54.8	**<274**	<54.8	--	**<219**	<54.8	<219	<54.8	<54.8	--
BSL-MIP-09 (0-0.5 ft)	03/29/18	**<51 UJ**	<204	<510	<204 UJ	<51	**<255**	<51	<97	**<204**	<51	<580	<51	<51	<97
BSL-MIP-09 (1-2 ft)	03/29/18	**<50.3 UJ**	<201	<503	<201 UJ	<50.3	**<252**	<50.3	<98	**<201**	<50.3	<590	<50.3	<50.3	<98
BSL-MIP-20 (0-0.5 ft)	12/04/17	**<53.2**	<532	<532	<213	<53.2	**<266**	<53.2	--	**<213**	<53.2	<213	<53.2	<53.2	--
BSL-MIP-T18 (0-0.5 ft)	03/28/18	**<52 UJ**	<208	<520	<208 UJ	<52	**<260**	<52	--	**<208**	<52	<208	<52	<52	--
CAL-MIP-02 (0-0.5 ft)	11/28/17	**<55.4**	<222	<554	<222	<55.4	**<277 UJ**	<55.4	--	**<222**	<55.4	<222	<55.4	<55.4	--
CAL-MIP-04 (0-0.5 ft)	11/28/17	**<54.7**	<219	<547	<219	47 J	**<273 UJ**	<54.7	100 J	**<219**	<54.7	59J/ND(630) U*	<54.7	<54.7	46 J
CAL-MIP-04 (1-2 ft)	11/28/17	**<58.5**	<234	<585	<234	<58.5	**<293 UJ**	<58.5	<110	**<234**	<58.5	13J/ND(640) U*	<58.5	<58.5	<110
CAL-MIP-09 (0-0.5 ft)	11/15/17	**<56.8**	<227	<568	<227	<56.8	**<284**	<56.8	--	**<227**	<56.8	<227	<56.8	<56.8	--
CAL-MIP-T03 (0-0.5 ft)	11/28/17	**<54.7**	<219	<547	<219	<54.7	**<274 UJ**	<54.7	--	**<219**	<54.7	<219	<54.7	<54.7	--
REX-MIP-03 (0-0.5 ft)	03/28/18	**<64.4 UJ**	<257	<644	<257 UJ	<64.4	**<322**	<64.4	--	**<257**	<64.4	<257	<64.4	<64.4	--
REX-MIP-04 (0-0.5 ft)	03/28/18	**<55.1 UJ**	<221	<551	<221 UJ	<55.1	**<276**	<55.1	--	**<221**	<55.1	<221	<55.1	<55.1	--
REX-MIP-07 (0-0.5 ft)	03/28/18	**<59.7 UJ**	<239	<597	<239 UJ	<59.7	**<298**	<59.7	--	**<239**	<59.7	<239	<59.7	<59.7	--
REX-MIP-08 (0-0.5 ft)	12/21/17	**<49.3**	<197	<493	<197	<51	**<246**	<49.3	26 J	**30.3J/ND (197)U***	<51	170 J	<49.3	<49.3	<100
REX-MIP-08 (0-0.5 ft)	03/28/18	--	--	--	--	<250	--	--	<510	--	**<250**	<3000	--	--	<510
REX-MIP-08 (1-2 ft)	12/21/17	**<51.3**	<205	<513	<205	<51.3	**<256**	<51.3	<99	**<205**	<51.3	16 J	<51.3	<51.3	<99
Screening Levels:															
DEQ DC Screening Level		2,400	8,700	NA	1,600,000	6,400	1,200	190,000	NA	57,000	52,000	4,300	390,000	380,000	65,000
DEQ Leaching Screening Level		21	15,000	NA	8,800	26,000	96.4	7,400	NA	13	78	12,000	32,000	12,000	100,000

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-1. SURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	p-Isopropyl-toluene (εg/kg)	sec-Butylbenzene (εg/kg)	Styrene (εg/kg)	tert-Butyl-benzene (εg/kg)	Tetrachloro-ethene (εg/kg)	Tetrahydro-furan (εg/kg)	Toluene (εg/kg)	trans-1,2-Dichloro-ethene (εg/kg)	trans-1,3-Dichloro-propene (εg/kg)	Trichloro-ethene (εg/kg)	Trichloro-fluoromethane (εg/kg)	Vinyl Chloride (εg/kg)	Xylenes, Total (εg/kg)
BSL-MIP-01 (0-0.5 ft)	12/03/17	<54.8	<54.8	21.4 J	<54.8	**<54.8**	<2190	91	<54.8	<54.8	**<54.8**	<219	**<21.9**	<164
BSL-MIP-09 (0-0.5 ft)	03/29/18	<51	<51	<51	<51	**1010**	<2040	<51	<51	<51	**<51**	<204	**<20.4**	<190
BSL-MIP-09 (1-2 ft)	03/29/18	<50.3	<50.3	<50.3	<50.3	**174**	<2010	<50.3	<50.3	<50.3	**<50.3**	<201	**<20.1**	<200
BSL-MIP-20 (0-0.5 ft)	12/04/17	<53.2	<53.2	23.6	<53.2	**<53.2**	<2130	79.7	<53.2	<53.2	**<53.2**	<213	**<21.3**	<160
BSL-MIP-T18 (0-0.5 ft)	03/28/18	<52	<52	<52	<52	**126**	<2080	<52	<52	<52	**<52**	<208	**<20.8**	<156
CAL-MIP-02 (0-0.5 ft)	11/28/17	<55.4	<55.4	<55.4	<55.4	**<55.4**	<2220	241	<55.4	<222	**<55.4**	<222	**<22.2**	<166
CAL-MIP-04 (0-0.5 ft)	11/28/17	<54.7	<54.7	<54.7	<54.7	**101**	<2190	45 J	<54.7	<219	**<54.7**	<219	**<21.9**	<210
CAL-MIP-04 (1-2 ft)	11/28/17	<58.5	<58.5	<58.5	<58.5	**87.7**	<2340	<58.5	<58.5	<234	**<58.5**	<234	**<23.4**	<210
CAL-MIP-09 (0-0.5 ft)	11/15/17	<56.8	<56.8	<56.8	<56.8	**71.3**	<2270	19.4 J	<227	<568	**<56.8**	<227	**<56.8**	<170
CAL-MIP-T03 (0-0.5 ft)	11/28/17	<54.7	<54.7	<54.7	<54.7	**<54.7**	<2190	76	<54.7	<219	**<54.7**	<219	**<21.9**	<164
REX-MIP-03 (0-0.5 ft)	03/28/18	<64.4	<64.4	<64.4	<64.4	**42.1 J**	<2570	<64.4	<64.4	<64.4	**<64.4**	<257	**<25.7**	<193
REX-MIP-04 (0-0.5 ft)	03/28/18	<55.1	<55.1	<55.1	<55.1	**83**	<2210	<55.1	<55.1	<55.1	**<55.1**	<221	**<22.1**	<165
REX-MIP-07 (0-0.5 ft)	03/28/18	<59.7	<59.7	<59.7	<59.7	**51.9 J**	<2390	<59.7	<59.7	<59.7	**<59.7**	<239	**<23.9**	<179
REX-MIP-08 (0-0.5 ft)	12/21/17	<49.3	<49.3	<49.3	<49.3	**<49.3**	<1970	<51	<49.3	<49.3	**<49.3**	<197	**<19.7**	<200
REX-MIP-08 (0-0.5 ft)	03/28/18	--	--	--	--	--	--	<250	--	--	--	--	--	<1000
REX-MIP-08 (1-2 ft)	12/21/17	<51.3	<51.3	<51.3	<51.3	**<51.3**	<2050	102	<51.3	<51.3	**<51.3**	<205	**<20.5**	<200
Screening Levels:														
DEQ DC Screening Level		NA	780,000	600,000	780,000	24,000	1,800,000	610,000	160,000	NA	940	2,300,000	59	72,000
DEQ Leaching Screening Level		NA	59,000	1,100	16,000	23	7,500	21,000	310	NA	18	63,500	0.684	320,000

Notes:
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ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-2. SURFACE SOIL - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acenaph-thene (εg/kg)	Acenaph-thylene (εg/kg)	Anthracene (εg/kg)	Benzo(a)-anthracene (εg/kg)	Benzo(a)-pyrene (εg/kg)	Benzo(b)-fluor-anthene (εg/kg)	Benzo(ghi)-perylene (εg/kg)	Benzo(k) fluor-anthene (εg/kg)	Bis(2chloro ethoxy)-methane (εg/kg)	Bis(2-chloro ethyl)ether (εg/kg)	Bis(2-ethyl hexyl)-phthalate (εg/kg)	4-Bromo-phenyl-phenylether (εg/kg)	Benzyl Butyl Phthalate (εg/kg)	Car-bazole (εg/kg)
BSL-MIP-09 (0-0.5 ft)	03/29/18	<348	<348	<348	<348	**<348**	<348	<348	<348	**<348**	**<348**	<348	<348	<348	<348
BSL-MIP-09 (1-2 ft)	03/29/18	<345	<345	<345	<345	**<345**	<345	<345	<345	**<345**	**<345**	<345	<345	<345	<345
CAL-MIP-04 (0-0.5 ft)	11/28/17	<361	<361	<361	5.3 J-	**7.3 J-**	10.8 J-	20.3 J-	3.9 J-	**<361**	**<361**	298 J	<361	125 J	<361
CAL-MIP-04 (1-2 ft)	11/28/17	<9660	<9660	<9660	**<9660**	**<9660**	**<9660**	<9660	<9660	**<9660**	**<9660**	<9660 UJ	<9660	**<9660 UJ**	<9660
REX-MIP-08 (0-0.5 ft)	03/28/18	<338	<338	<338	<338	**3.3 J**	4.3 J	8 J	1.6 J	**<338**	**<338**	<338	<338	<338	<338
REX-MIP-08 (1-2 ft)	12/21/17	<21.1	<21.1	<21.1	<21.1	<21.1	4.7 J	5.3 J	<21.1	--	--	--	--	--	--
REX-MIP-08 (1-2 ft)	03/28/18	<12	<12	<12	<12	<12	<12	<12	<12	--	--	--	--	--	--
Screening Levels:															
DEQ DC Screening Level		450,000	NA	2,200,000	1,300	130	1,300	NA	13,000	19,000	230	39,000	NA	290,000	NA
DEQ Leaching Screening Level		27,000	NA	2,600,000	6,800	2,300	23,000	NA	230,000	130	0.036	13,000	NA	2,400	NA

Notes:
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J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - Tetrachloroethene
SVOC ï semi-volatile organic compound
εg/kg - micrograms per kilogram

TABLE 8-2. SURFACE SOIL - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	4-Chloro-3-Methyl phenol (εg/kg)	4-Chloro-aniline (εg/kg)	2-Chloro-naphthalene (εg/kg)	2-Chloro-phenol (εg/kg)	4-Chloro-phenyl-phenylether (εg/kg)	Chrysene (εg/kg)	Dibenz (a,h) anthracene (εg/kg)	Dibenzo-furan (εg/kg)	1,2-Di-chloro-benzene (εg/kg)	1,3-Di-chloro-benzene (εg/kg)	1,4-Di-chloro-benzene (εg/kg)	3,3'-Di-chloro-benzidine (εg/kg)	2,4-Dichloro-phenol (εg/kg)	Diethyl-phthalate (εg/kg)
BSL-MIP-09 (0-0.5 ft)	03/29/18	<348	**<348**	<348	<348	<348	<348	**<348**	<348	<348	<348	<348	**<348**	**<348**	<348
BSL-MIP-09 (1-2 ft)	03/29/18	<345	**<345**	<345	<345 UJ	<345	<345	**<345**	<345	<345	<345	<345	**<345**	**<345 UJ**	<345
CAL-MIP-04 (0-0.5 ft)	11/28/17	<361	**<361**	<361	<361	<361	14.5 J-	**2.4 J-**	<361	<361	<361	<361	**<361**	**<361**	<361
CAL-MIP-04 (1-2 ft)	11/28/17	<9660	**<9660**	<9660	**<9660**	<9660	<9660	**<9660**	**<9660**	**<9660**	<9660	**<9660**	**<9660**	**<9660**	<9660
REX-MIP-08 (0-0.5 ft)	03/28/18	<338	**<338**	<338	<338	<338	<338	**2.1 J**	<338	<338	<338	<338	**<338**	**<338**	<338
REX-MIP-08 (1-2 ft)	12/21/17	--	--	--	--	--	<21.1	<21.1	--	--	--	--	--	--	--
REX-MIP-08 (1-2 ft)	03/28/18	--	--	--	--	--	<12	<12	--	--	--	--	--	--	--
Screening Levels:															
DEQ DC Screening Level		630,000	2,700	480,000	39,000	NA	130,000	130	7,300	180,000	NA	2,600	1,200	19,000	5,100,000
DEQ Leaching Screening Level		17,000	1.6	39,000	890	NA	690,000	7,500	1,500	5,800	NA	720	8.2	230	61,000

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
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ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - Tetrachloroethene
SVOC ï semi-volatile organic compound
εg/kg - micrograms per kilogram

TABLE 8-2. SURFACE SOIL - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	2,4-Dimethyl-phenol (εg/kg)	Dimethyl Phthalate (εg/kg)	Di-n-butyl-phthalate (εg/kg)	2-Methyl-4,6-dinitro phenol (εg/kg)	2,4-Dinitro-phenol (εg/kg)	2,4-Dinitro Toluene (εg/kg)	2,6-Dinitro Toluene (εg/kg)	Di-n-octyl-phthalate (εg/kg)	1,2-Diphenyl hydrazine (εg/kg)	Fluor-anthene (εg/kg)	Fluorene (εg/kg)	Hexachloro Benzene (εg/kg)	Hexachloro-butadiene (εg/kg)	Hexachloro-ethane (εg/kg)
BSL-MIP-09 (0-0.5 ft)	03/29/18	<348	<348	<348	**<1790 UJ**	<348 UJ	**<348**	**<348**	<348	**<348**	<348	<348	**<348**	**<348**	**<348**
BSL-MIP-09 (1-2 ft)	03/29/18	<345 UJ	<345	<345	**<1780 UJ**	<345 UJ	**<345**	**<345**	<345	**<345**	<345	<345	**<345**	**<345**	**<345**
CAL-MIP-04 (0-0.5 ft)	11/28/17	<361	<361	<361	**<1860**	<361	**<361**	**<361**	<361 UJ	**<361 UJ**	10.3 J-	<361	**<361**	**<361**	**<361**
CAL-MIP-04 (1-2 ft)	11/28/17	**<9660**	<9660	<9660	**<49700**	**<9660**	**<9660**	**<9660**	<9660 UJ	**<9660 UJ**	<9660	<9660	**<9660**	**<9660**	**<9660**
REX-MIP-08 (0-0.5 ft)	03/28/18	<338	<338	<338	**<1740 UJ**	<338 UJ	**<338**	**<338**	<338	**<338**	1.3 J	<338	**<338**	**<338**	**<338**
REX-MIP-08 (1-2 ft)	12/21/17	--	--	--	--	--	--	--	--	--	<21.1	<21.1	--	--	--
REX-MIP-08 (1-2 ft)	03/28/18	--	--	--	--	--	--	--	--	--	<12	<12	--	--	--
Screening Levels:															
DEQ DC Screening Level		130,000	NA	630,000	510	13,000	1,700	360	63,000	680	300,000	300,000	210	1,200	1,800
DEQ Leaching Screening Level		4,200	NA	23,000	26	440	3.2	0.67	570,000	2.5	85,000	35,000	1.2	96.4	2

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - Tetrachloroethene
SVOC ï semi-volatile organic compound
εg/kg - micrograms per kilogram

TABLE 8-2. SURFACE SOIL - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Indeno-(1,2,3-cd) pyrene (εg/kg)	Isophorone (εg/kg)	1-Methyl-naphthalene (εg/kg)	2-Methyl-naphthalene (εg/kg)	2-Methyl phenol (εg/kg)	3,4-Methyl phenol (εg/kg)	Naphthalene (εg/kg)	2-Nitro-aniline (εg/kg)	3-Nitro-aniline (εg/kg)	4-Nitro-aniline (εg/kg)	Nitro-benzene (εg/kg)	2-Nitro-phenol (εg/kg)	4-Nitro-phenol (εg/kg)	N-Nitroso-dimethyl-amine (εg/kg)
BSL-MIP-09 (0-0.5 ft)	03/29/18	<348	**<348**	<348	<348	<348	<697	<348	<348	<348	**<348**	**<348**	<348	<348	**<348**
BSL-MIP-09 (1-2 ft)	03/29/18	<345	**<345**	<345	<345	<345 UJ	<689 UJ	<345	<345	<345	**<345**	**<345**	<345 UJ	<345	**<345**
CAL-MIP-04 (0-0.5 ft)	11/28/17	5.5 J-	**<361**	<361	<361	<361	<722	16.6 J-	<361 UJ	<361	**<361**	**<361**	<361	<361 UJ	**<361**
CAL-MIP-04 (1-2 ft)	11/28/17	**<9660**	**<9660**	**<9660**	**<9660**	**<9660**	<19300	**<9660**	**<9660 UJ**	<9660	**<9660**	**<9660**	<9660	<9660 UJ	**<9660**
REX-MIP-08 (0-0.5 ft)	03/28/18	2.7 J	**<338**	<338	<338	<338	<675	<338	<338	<338	**<338**	**<338**	<338	<338	**<338**
REX-MIP-08 (1-2 ft)	12/21/17	<21.1	--	--	--	--	--	<21.1	--	--	--	--	--	--	--
REX-MIP-08 (1-2 ft)	03/28/18	<12	--	--	--	--	--	<12	--	--	--	--	--	--	--
Screening Levels:															
DEQ DC Screening Level		1,300	570,000	20,000	30,000	320,000	NA	4,300	63,000	NA	27,000	5,100	NA	NA	2
DEQ Leaching Screening Level		77,000	260	2,100	6,900	7,500	NA	12,000	800	NA	16	0.92	NA	NA	0.00027

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - Tetrachloroethene
SVOC ï semi-volatile organic compound
εg/kg - micrograms per kilogram

TABLE 8-2. SURFACE SOIL - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	N-Nitrosodi-n-propyl-amine (εg/kg)	N-Nitroso-diphenyl-amine (εg/kg)	2,2'-oxybis(1-Chloropropane) (εg/kg)	Penta-chloro-phenol (εg/kg)	Phen-anthrene (εg/kg)	Phenol (εg/kg)	Pyrene (εg/kg)	1,2,4-Trichloro-benzene (εg/kg)	2,4,5-Tri-chloro-phenol (εg/kg)	2,4,6-Tri-chloro-phenol (εg/kg)
BSL-MIP-09 (0-0.5 ft)	03/29/18	**<348**	<348	<348 UJ	**<707**	<348	<348	<348	<348	<348	**<348**
BSL-MIP-09 (1-2 ft)	03/29/18	**<345**	<345	<345 UJ	**<700**	<345	<345 UJ	<345	<345	<345	**<345**
CAL-MIP-04 (0-0.5 ft)	11/28/17	**<361**	<361	<361	**<733**	7.9 J-	<361	11 J-	<361	<361	**<361**
CAL-MIP-04 (1-2 ft)	11/28/17	**<9660**	**<9660**	**<9660**	**<19600**	<9660	<9660	<9660	**<9660**	<9660	**<9660**
REX-MIP-08 (0-0.5 ft)	03/28/18	**<338**	<338	<338 UJ	**<685**	<338	<338	3.2 J	<338	<338	**<338**
REX-MIP-08 (1-2 ft)	12/21/17	--	--	--	--	<21.1	--	2.5 J	--	--	--
REX-MIP-08 (1-2 ft)	03/28/18	--	--	--	--	<12	--	<12	--	--	--
Screening Levels:											
DEQ DC Screening Level		78	110,000	310,000	1,000	NA	1,900,000	220,000	24,000	630,000	49,000
DEQ Leaching Screening Level		0.081	670	2,600	14	NA	33,000	83,000	2,000	40,000	40

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - Tetrachloroethene
SVOC ï semi-volatile organic compound
εg/kg - micrograms per kilogram

TABLE 8-3. SURFACE SOIL - PETROLEUM ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	C5-C8, Aliphatic, Adjusted (mg/kg)	C9-C10, Aromatic, Unadjusted (mg/kg)	C9-C12, Aliphatic, Adjusted (mg/kg)	C9-C18, Aliphatic, Unadjusted (mg/kg)	C11-C22, Aromatic, Unadjusted (mg/kg)	C19-C36, Aliphatic, Unadjusted (mg/kg)	Total Extractable Hydrocarbon (mg/kg)	Total Purgeable Hydrocarbon (mg/kg)	Benzene (mg/kg)
BSL-MIP-09 (0-0.5 ft)	03/29/18	1.6 J	<0.97	<4.9	--	--	--	96.2 J+	1.4 J	<0.024
BSL-MIP-09 (1-2 ft)	03/29/18	0.27 J	<0.98	<4.9	--	--	--	12.6 J+	0.25 J	<0.024
CAL-MIP-04 (0-0.5 ft)	11/28/17	<5.2	0.049 J	<5.2	18 J	259	1270	1520	0.5 J	0.05
CAL-MIP-04 (1-2 ft)	11/28/17	0.39 J	<1.1	<5.3	--	--	--	<11.6	0.34 J	<0.027
REX-MIP-08 (0-0.5 ft)	12/21/17	3.5 J	2.8 J-	4.4 J	--	--	--	--	11.7	0.023 J
REX-MIP-08 (0-0.5 ft)	03/28/18	<25.3	2.1 J	<25.3	**<120**	173 J-	1240	1420 J-	2.9 J	**<0.13**
REX-MIP-08 (1-2 ft)	12/21/17	<5	<0.99 UJ	<5	<62	145	447	593	<9.9	<0.025
Screening Levels:										
DEQ Leaching Screening Level		220	130	11,000	53,000	370	NA	NA	NA	0.07
DEQ DC Screening Level		52	130	77	110	490	24,000	NA	NA	1.3

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
mg/kg - milligrams per kilogram
C## - Indicates petroleum compound size range, in terms of the number of carbons per molecule
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-3. SURFACE SOIL - PETROLEUM ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Ethyl- benzene (mg/kg)	MTBE (mg/kg)	Naphthalene (mg/kg)	Toluene (mg/kg)	m,p-Xylene (mg/kg)	o-Xylene (mg/kg)	Xylenes, Total (mg/kg)
BSL-MIP-09 (0-0.5 ft)	03/29/18	<0.049	<0.049	<0.58	<0.049	<0.097	<0.097	<0.19
BSL-MIP-09 (1-2 ft)	03/29/18	<0.049	<0.049	<0.59	<0.049	<0.098	<0.098	<0.2
CAL-MIP-04 (0-0.5 ft)	11/28/17	0.047 J	<0.052	0.059J/ND(0.63)U*	0.045 J	0.1 J	0.046 J	<0.21
CAL-MIP-04 (1-2 ft)	11/28/17	<0.053	<0.053	0.013J/ND(0.64)U*	<0.053	<0.11	<0.11	<0.21
REX-MIP-08 (0-0.5 ft)	12/21/17	<0.051	<0.051	0.17 J	<0.051	0.026 J	<0.1	<0.2
REX-MIP-08 (0-0.5 ft)	03/28/18	<0.25	**<0.25**	<3	<0.25	<0.51	<0.51	<1
REX-MIP-08 (1-2 ft)	12/21/17	<0.05	<0.05	0.016 J	<0.05	<0.099	<0.099	<0.2
Screening Levels:								
DEQ Leaching Screening Level		26	0.078	12	21	NA	100	320
DEQ DC Screening Level		6.4	52	4.3	610	NA	65	72

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
mg/kg - milligrams per kilogram
C## - Indicates petroleum compound size range, in terms of the number of carbons per molecule
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-4. SURFACE SOIL - METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Aluminum, Total (mg/kg)	Antimony, Total (mg/kg)	Arsenic, Total (mg/kg)	Barium, Total (mg/kg)	Beryllium, Total (mg/kg)	Cadmium, Total (mg/kg)	Chromium, Total (mg/kg)	Cobalt, Total (mg/kg)	Copper, Total (mg/kg)	Iron, Total (mg/kg)	Lead, Total (mg/kg)	Manganese, Total (mg/kg)	Mercury, Total (mg/kg)	Nickel, Total (mg/kg)
BSL-MIP-09 (0-0.5 ft)	03/29/18	5490	<1 UJ	4	109 J+	0.081 J	0.018 J	11	4	12.3	12700	5.4	303	<0.018	9.4
BSL-MIP-09 (1-2 ft)	03/29/18	5940	<1 UJ	3.3	92.7 J+	0.067 J	<0.16	11.7	4.6	11.5	12400	5.4	239	<0.018	9.9
CAL-MIP-04 (0-0.5 ft)	11/28/17	7800	0.16 J-	3	112 J+	0.1 J	0.36	18.2	4.3	28.5	13000	90 J-	213 J+	0.036	10.3
CAL-MIP-04 (1-2 ft)	11/28/17	7300	<1.1 UJ	3.1	95.6 J+	0.085 J	1	12.6	4.5	16.8	13100	12.1 J-	220 J+	0.14	9.5
REX-MIP-08 (0-0.5 ft)	03/28/18	6190	<0.94 UJ	1.9	117 J+	0.052 J	<0.14	10.2	6.6	15.8	15000	4.7	316	<0.02	12
REX-MIP-08 (1-2 ft)	03/28/18	16000	0.22 J-	7.6	139 J+	0.34	0.16 J	16.6	6	17.4	21100	12	251	0.015 J	15.1
Screening Levels:															
DEQ DC Screening Level		25,900	3.1	22.5	1,500	16	7.1	120,000	10	310	24,400	154	1,800	1.1	150
DEQ Leaching Screening Level		300,000	2.7	22.5	429	32	3.8	1,800,000	10	460	24,400	140	880	1	66.7

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
MT Background Threshold Values based DEQ/Hydrometrics Site Response Section Report (September 2013), and also reflected in the soil screening calculations.
Lead screening values for EPA residential and industrial RSLs revised to use DEQ's Blood Lead Guidance values (DEQ 2018).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
mg/kg - milligrams per kilogram

TABLE 8-4. SURFACE SOIL - METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Selenium, Total (mg/kg)	Silver, Total (mg/kg)	Thallium, Total (mg/kg)	Vanadium, Total (mg/kg)	Zinc, Total (mg/kg)
BSL-MIP-09 (0-0.5 ft)	03/29/18	<1	<0.51	**<1**	22.8	23
BSL-MIP-09 (1-2 ft)	03/29/18	<1	<0.52	**<1**	22.9	24.1
CAL-MIP-04 (0-0.5 ft)	11/28/17	<1.1	0.054 J	**<1.1**	24.3	112 J-
CAL-MIP-04 (1-2 ft)	11/28/17	<1.1	0.072 J	**<1.1**	24.7	271 J-
REX-MIP-08 (0-0.5 ft)	03/28/18	<0.94	<0.47	**<0.94**	24.9	22.5
REX-MIP-08 (1-2 ft)	03/28/18	<1.1	0.073 J	**<1.1**	33.4	60.3
Screening Levels:						
DEQ DC Screening Level		39	39	0.41	52.6	2,300
DEQ Leaching Screening Level		2.6	8.51	1.4	860	1,230

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
MT Background Threshold Values based DEQ/Hydrometrics Site Response Section Report (September 2013), and also reflected in the soil screening calculations.
Lead screening values for EPA residential and industrial RSLs revised to use DEQ's Blood Lead Guidance values (DEQ 2018).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
mg/kg - milligrams per kilogram

TABLE 8-5. SUBSURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,1,1,2-Tetrachloro-ethane (εg/kg)	1,1,1-Trichloro-ethane (εg/kg)	1,1,2,2-Tetrachloro-ethane (εg/kg)	1,1,2-Trichloro-ethane (εg/kg)	1,1,2-Trichloro-trifluoro-ethane (εg/kg)	1,1-Dichloro-ethane (εg/kg)	1,1-Dichloro-ethene (εg/kg)	1,1-Dichloro-propene (εg/kg)	1,2,3-Trichloro-benzene (εg/kg)	1,2,3-Trichloro-propane (εg/kg)	1,2,4-Trichloro-benzene (εg/kg)	1,2,4-Trimethyl-benzene (εg/kg)	1,2-Dibromo 3-chloro-propane (εg/kg)	1,2-Dibromo-ethane (εg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	**<225**	<56.3	**<56.3**	**<56.3**	<225	**<56.3**	**<56.3**	<56.3	<56.3	**<225**	<56.3	<56.3	**<1410**	**<56.3**
ALSCO-GW-03 (2-2.8 ft)	11/30/17	**<55.3**	<221	**<55.3**	**<55.3**	<221	**<55.3**	**<221**	<221	<55.3	**<221**	<55.3	<55.3	**<1380**	**<55.3**
ALSCO-GW-04 (14-15 ft)	11/29/17	**<241**	<60.2	**<60.2**	**<60.2**	<241	**<60.2**	**<60.2**	<60.2	<60.2	**<241**	<60.2	<60.2	**<1510**	**<60.2**
BSL-MIP-01 (12-13 ft)	12/03/17	**<59.7**	<239	**<59.7**	**<59.7**	<239	**<59.7**	**<239**	<239	<59.7	**<239**	<59.7	<59.7	**<1490**	**<59.7**
BSL-MIP-01 (12-13 ft) Dup	12/03/17	**<59.9**	<240	**<59.9**	**<59.9**	<240	**<59.9**	**<240**	<240	<59.9	**<240**	<59.9	<59.9	**<1500**	**<59.9**
BSL-MIP-01 (17-18 ft)	12/03/17	**<67.4**	<270	**<67.4**	**<67.4**	<270	**<67.4**	**<270**	<270	<67.4	**<270**	<67.4	<67.4	**<1680**	**<67.4**
BSL-MIP-09 (12-12.5 ft)	03/29/18	**<52.9**	<52.9	**<52.9 UJ**	**<52.9**	<212	**<52.9**	**<52.9**	<52.9	<52.9	**<212**	<52.9	<52.9	**<529**	**<52.9**
BSL-MIP-09 (16-16.5 ft)	03/29/18	**<268**	<268	**<268 UJ**	**<268**	<1070	**<268**	**<268**	<268	**<268**	**<1070**	<268	<268	**<2680**	**<268**
BSL-MIP-09 (25-25.5 ft)	03/29/18	**<53.5**	<53.5	**<53.5 UJ**	**<53.5**	<214	**<53.5**	**<53.5**	<53.5	<53.5	**<214**	<53.5	<53.5	**<535**	**<53.5**
BSL-MIP-09 (8-8.5 ft)	03/29/18	**<50.7**	<50.7	**<50.7 UJ**	**<50.7**	<203	**<50.7**	**<50.7**	<50.7	<50.7	**<203**	<50.7	<50.7	**<507**	**<50.7**
BSL-MIP-20 (12-13 ft)	12/04/17	**<59.4**	<238	**<59.4**	**<59.4**	<238	**<59.4**	**<238**	<238	<59.4	**<238**	<59.4	<59.4	**<1480**	**<59.4**
BSL-MIP-20 (14-15 ft)	12/04/17	**<60.2**	<241	**<60.2**	**<60.2**	<241	**<60.2**	**<241**	<241	<60.2	**<241**	<60.2	**49500**	**<1510**	**<60.2**
BSL-MIP-T18 (13-14 ft)	03/28/18	**<61.1**	<61.1	**<61.1 UJ**	**<61.1**	<245	**<61.1**	**<61.1**	<61.1	<61.1	**<245**	<61.1	<61.1	**<611**	**<61.1**
BSL-MIP-T18 (9.5-10 ft)	03/28/18	**<58**	<58	**<58 UJ**	**<58**	<232	**<58**	**<58**	<58	<58	**<232**	<58	<58	**<580**	**<58**
CAL-MIP-02 (20-21 ft)	11/28/17	**<253**	<63.3	**<63.3**	**<63.3**	<253	**<63.3**	**<63.3**	<63.3	<63.3	**<253**	<63.3	<63.3	**<1580**	**<63.3**
CAL-MIP-02 (8.5-9 ft)	11/28/17	**<243**	<60.8	**<60.8**	**<60.8**	<243	**<60.8**	**<60.8**	<60.8	<60.8	**<243**	<60.8	<60.8	**<1520**	**<60.8**
CAL-MIP-04 (14-14.5 ft)	11/28/17	**<248**	<61.9	**<61.9**	**<61.9**	<248	**<61.9**	**<61.9**	<61.9	<61.9	**<248**	<61.9	<61.9	**<1550**	**<61.9**
CAL-MIP-04 (23-23.5 ft)	11/28/17	**<222**	<55.6	**<55.6**	**<55.6**	<222	**<55.6**	**<55.6**	<55.6	<55.6	**<222**	<55.6	<55.6	**<1390**	**<55.6**
CAL-MIP-04 (3-3.5 ft)	11/28/17	**<241**	<60.2	**<60.2**	**<60.2**	<241	**<60.2**	**<60.2**	<60.2	<60.2	**<241**	<60.2	<60.2	**<1500**	**<60.2**
CAL-MIP-04 (6-6.5 ft)	11/28/17	**<243**	<60.7	**<60.7**	**<60.7**	<243	**<60.7**	**<60.7**	<60.7	<60.7	**<243**	<60.7	<60.7	**<1520**	**<60.7**
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	**<256**	<64.1	**<64.1**	**<64.1**	<256	**<64.1**	**<64.1**	<64.1	<64.1	**<256**	<64.1	<64.1	**<1600**	**<64.1**
CAL-MIP-09 (19-19.5 ft)	11/15/17	**<221**	<553	**<55.3**	**<55.3**	<553	**<55.3**	**<55.3**	<221	<55.3	**<221**	<55.3	<55.3	**<553**	**<55.3**
CAL-MIP-09 (5.5-6.5 ft)	11/15/17	**<236**	<590	**<59**	**<59**	<590	**<59**	**<59**	<236	<59	**<236**	<59	<59	**<590**	**<59**
CAL-MIP-T03 (4.5-5 ft)	11/28/17	**<234**	<58.6	**<58.6**	**<58.6**	<234	**<58.6**	**<58.6**	<58.6	<58.6	**<234**	<58.6	<58.6	**<1460**	**<58.6**
D7HRC-MIP-01 (7-9 ft)	11/17/17	**<232**	<581	**<58.1**	**<58.1**	<581	**<58.1**	**<58.1**	<232	<58.1	**<232**	<58.1	<58.1	**<581**	**<58.1**
HLS-GW-03 (7-8 ft)	12/01/17	**<59.2**	<237	**<59.2**	**<59.2**	<237	**<59.2**	**<237**	<237	<59.2	**<237**	<59.2	<59.2	**<1480**	**<59.2**
HLS-GW-04 (3-4 ft)	12/01/17	**<57.5**	<230	**<57.5**	**<57.5**	<230	**<57.5**	**<230**	<230	<57.5	**<230**	<57.5	<57.5	**<1440**	**<57.5**
MW-133 (11.5-12 ft)	05/15/18	**<53.8 UJ**	<53.8 UJ	**<53.8 UJ**	**<53.8 UJ**	<215 UJ	**<53.8 UJ**	**<53.8 UJ**	<53.8 UJ	<53.8 UJ	**<215 UJ**	<53.8 UJ	<53.8 UJ	**<1340 UJ**	**<53.8 UJ**
REX-MIP-03 (10-10.5 ft)	03/28/18	**<60.2**	<60.2	**<60.2 UJ**	**<60.2**	<241	**<60.2**	**<60.2**	<60.2	<60.2	**<241**	<60.2	<60.2	**<602**	**<60.2**
REX-MIP-03 (17-17.5 ft)	03/28/18	**<55.2**	<55.2	**<55.2 UJ**	**<55.2**	<221	**<55.2**	**<55.2**	<55.2	<55.2	**<221**	<55.2	<55.2	**<552**	**<55.2**
REX-MIP-04 (12-12.5 ft)	03/28/18	**<52.2**	<52.2	**<52.2 UJ**	**<52.2**	<209	**<52.2**	**<52.2**	<52.2	<52.2	**<209**	<52.2	<52.2	**<522**	**<52.2**
REX-MIP-07 (3.5-4 ft)	03/28/18	**<62.3**	<62.3	**<62.3 UJ**	**<62.3**	<249	**<62.3**	**<62.3**	<62.3	<62.3	**<249**	<62.3	<62.3	**<623**	**<62.3**
REX-MIP-08 (17-17.5 ft)	12/21/17	**<272 UJ**	<272 UJ	**<272 UJ**	**<272 UJ**	<1090 UJ	**<272 UJ**	**<272 UJ**	<272 UJ	**<272 UJ**	**<1090 UJ**	<272 UJ	**13900 J-**	**<2720 UJ**	**<272 UJ**
REX-MIP-08 (23-23.5 ft)	12/21/17	**<55.1**	<55.1	**<55.1**	**<55.1**	<220	**<55.1**	**<55.1**	<55.1	<55.1	**<220**	<55.1	<55.1	**<551**	**<55.1**
Screening Levels:															
DEQ DC Screening Level		2,000	810,000	600	1,100	670,000	3,600	23,000	NA	6,300	5.1	24,000	30,000	5.3	40
DEQ Leaching Screening Level		2.2	700	7.89	9.54	260,000	7.8	25	NA	210	0.0032	2,000	810	0.86	0.086

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-5. SUBSURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Di-chloro-benzene (εg/kg)	1,2-Dichloro-ethane (εg/kg)	1,2-Dichloro-propane (εg/kg)	1,3,5-Trimethyl-benzene (εg/kg)	1,3-Di-chloro-benzene (εg/kg)	1,3-Dichloro-propane (εg/kg)	1,4-Di-chloro-benzene (εg/kg)	2,2-Dichloro-propane (εg/kg)	2-Butanone (εg/kg)	2-Chloro-toluene (εg/kg)	4-Chloro-toluene (εg/kg)	4-Methyl-2-Pentanone (εg/kg)	Acetone (εg/kg)	Allyl Chloride (εg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	<56.3	**<56.3**	**<56.3**	<56.3	<56.3	<56.3	<56.3	<225	<281	<56.3	<56.3	<281	<1130	**<225**
ALSCO-GW-03 (2-2.8 ft)	11/30/17	<55.3	**<55.3**	**<55.3**	<55.3	<55.3	<55.3	<55.3	<221	204 J	<55.3	<55.3	<277	<1110	**<221**
ALSCO-GW-04 (14-15 ft)	11/29/17	<60.2	**<60.2**	**<60.2**	<60.2	<60.2	<60.2	<60.2	<241	<301	<60.2	<60.2	<301	<1200	**<241**
BSL-MIP-01 (12-13 ft)	12/03/17	<59.7	**<59.7**	**<59.7**	<59.7	<59.7	<59.7	<59.7	<239	<298	<59.7	<59.7	<298	<1190	**<239**
BSL-MIP-01 (12-13 ft) Dup	12/03/17	<59.9	**<59.9**	**<59.9**	<59.9	<59.9	<59.9	<59.9	<240	<300	<59.9	<59.9	<300	<1200	**<240**
BSL-MIP-01 (17-18 ft)	12/03/17	<67.4	**<67.4**	**<67.4**	<67.4	<67.4	<67.4	<67.4	<270	<337	<67.4	<67.4	<337	<1350	**<270**
BSL-MIP-09 (12-12.5 ft)	03/29/18	<52.9	**<52.9**	**<52.9**	<52.9	<52.9	<52.9	<52.9	<212	<265 UJ	<52.9	<52.9	<265	<1060	**<212**
BSL-MIP-09 (16-16.5 ft)	03/29/18	<268	**<268**	**<268**	<268	<268	<268	<268	<1070	<1340 UJ	<268	<268	<1340	<5350	**<1070**
BSL-MIP-09 (25-25.5 ft)	03/29/18	<53.5	**<53.5**	**<53.5**	<53.5	<53.5	<53.5	<53.5	<214	<268 UJ	<53.5	<53.5	<268	<1070	**<214**
BSL-MIP-09 (8-8.5 ft)	03/29/18	<50.7	**<50.7**	**<50.7**	<50.7	<50.7	<50.7	<50.7	<203	<253 UJ	<50.7	<50.7	<253	<1010	**<203**
BSL-MIP-20 (12-13 ft)	12/04/17	<59.4	**<59.4**	**<59.4**	<59.4	<59.4	<59.4	<59.4	<238	611	<59.4	<59.4	<297	<1190	**<238**
BSL-MIP-20 (14-15 ft)	12/04/17	<60.2	**<60.2**	**<60.2**	**10400**	<60.2	<60.2	<60.2	<241	<301	<60.2	<60.2	<301	<1200	**<241**
BSL-MIP-T18 (13-14 ft)	03/28/18	<61.1	**<61.1**	**<61.1**	<61.1	<61.1	<61.1	<61.1	<245	<306 UJ	<61.1	<61.1	<306	<1220	**<245**
BSL-MIP-T18 (9.5-10 ft)	03/28/18	<58	**<58**	**<58**	<58	<58	<58	<58	<232	<290 UJ	<58	<58	<290	<1160	**<232**
CAL-MIP-02 (20-21 ft)	11/28/17	<63.3	**<63.3**	**<63.3**	<63.3	<63.3	<63.3	<63.3	<253	<317	<63.3	<63.3	<317	<1270	**<253**
CAL-MIP-02 (8.5-9 ft)	11/28/17	<60.8	**<60.8**	**<60.8**	<60.8	<60.8	<60.8	<60.8	<243	<304	<60.8	<60.8	<304	<1220	**<243**
CAL-MIP-04 (14-14.5 ft)	11/28/17	<61.9	**<61.9**	**<61.9**	<61.9	<61.9	<61.9	<61.9	<248	<309	<61.9	<61.9	<309	<1240	**<248**
CAL-MIP-04 (23-23.5 ft)	11/28/17	<55.6	**<55.6**	**<55.6**	<55.6	<55.6	<55.6	<55.6	<222	<278	<55.6	<55.6	<278	<1110	**<222**
CAL-MIP-04 (3-3.5 ft)	11/28/17	<60.2	**<60.2**	**<60.2**	<60.2	<60.2	<60.2	<60.2	<241	<301	<60.2	<60.2	<301	<1200	**<241**
CAL-MIP-04 (6-6.5 ft)	11/28/17	<60.7	**<60.7**	**<60.7**	<60.7	<60.7	<60.7	<60.7	<243	<304	<60.7	<60.7	<304	<1210	**<243**
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	<64.1	**<64.1**	**<64.1**	<64.1	<64.1	<64.1	<64.1	<256	<321	<64.1	<64.1	<321	<1280	**<256**
CAL-MIP-09 (19-19.5 ft)	11/15/17	<55.3	**<55.3**	**<55.3**	<55.3	<55.3	<55.3	<55.3	<553	<276	<55.3	<55.3	<276	<1110	**<221**
CAL-MIP-09 (5.5-6.5 ft)	11/15/17	<59	**<59**	**<59**	<59	<59	<59	<59	<590	<295	<59	<59	<295	<1180	**<236**
CAL-MIP-T03 (4.5-5 ft)	11/28/17	<58.6	**<58.6**	**<58.6**	<58.6	<58.6	<58.6	<58.6	<234	<293	<58.6	<58.6	<293	<1170	**<234**
D7HRC-MIP-01 (7-9 ft)	11/17/17	<58.1	**<58.1**	**<58.1**	<58.1	<58.1	<58.1	<58.1	<581	<290	<58.1	<58.1	<290	<1160	**<232**
HLS-GW-03 (7-8 ft)	12/01/17	<59.2	**<59.2**	**<59.2**	<59.2	<59.2	<59.2	<59.2	<237	<296	<59.2	<59.2	<296	<1180	**<237**
HLS-GW-04 (3-4 ft)	12/01/17	<57.5	**<57.5**	**<57.5**	<57.5	<57.5	<57.5	<57.5	<230	<287	<57.5	<57.5	<287	<1150	**<230**
MW-133 (11.5-12 ft)	05/15/18	<53.8 UJ	**<53.8 UJ**	**<53.8 UJ**	<53.8 UJ	<53.8 UJ	<53.8 UJ	<53.8 UJ	<215 UJ	759 J-	<53.8 UJ	<53.8 UJ	<269 UJ	<1080 UJ	**<215 UJ**
REX-MIP-03 (10-10.5 ft)	03/28/18	<60.2	**<60.2**	**<60.2**	<60.2	<60.2	<60.2	<60.2	<241	<301 UJ	<60.2	<60.2	<301	<1200	**<241**
REX-MIP-03 (17-17.5 ft)	03/28/18	<55.2	**<55.2**	**<55.2**	<55.2	<55.2	<55.2	<55.2	<221	<276 UJ	<55.2	<55.2	<276	<1100	**<221**
REX-MIP-04 (12-12.5 ft)	03/28/18	<52.2	**<52.2**	**<52.2**	<52.2	<52.2	<52.2	<52.2	<209	<261 UJ	<52.2	<52.2	<261	<1040	**<209**
REX-MIP-07 (3.5-4 ft)	03/28/18	<62.3	**<62.3**	**<62.3**	<62.3	<62.3	<62.3	<62.3	<249	<311 UJ	<62.3	<62.3	<311	<1250	**<249**
REX-MIP-08 (17-17.5 ft)	12/21/17	<272 UJ	**<272 UJ**	**<272 UJ**	627 J-	<272 UJ	<272 UJ	<272 UJ	<1090 UJ	<1360 UJ	<272 UJ	<272 UJ	<1360 UJ	<5440 UJ	**<1090 UJ**
REX-MIP-08 (23-23.5 ft)	12/21/17	<55.1	**<55.1**	**<55.1**	<55.1	<55.1	<55.1	<55.1	<220	<275	<55.1	<55.1	<275	<1100	**<220**
Screening Levels:															
DEQ DC Screening Level		180,000	520	2,500	27,000	NA	160,000	2,600	NA	2,700,000	160,000	160,000	3,300,000	6,100,000	720
DEQ Leaching Screening Level		5,800	19	17	870	NA	1,300	720	NA	12,000	2,300	2,400	14,000	29,000	2.3

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-5. SUBSURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Benzene (mg/kg)	Bromo-benzene (εg/kg)	Bromo-chloro-methane (εg/kg)	Bromo-dichloro-methane (εg/kg)	Bromoform (εg/kg)	Bromo-methane (εg/kg)	Carbon tetrachloride (εg/kg)	Chloro-benzene (εg/kg)	Chloroethane (εg/kg)	Chloroform (εg/kg)	Chloro-methane (εg/kg)	cis-1,2-Dichloro-ethene (εg/kg)	Cis-1,3-dichloro-propene (εg/kg)	Dibromo-chloromethane (εg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	<0.028	<56.3	<56.3	**<56.3**	**<563**	**<563**	**<225**	<56.3	<563	<56.3	**<225**	<56.3	<225	**<225**
ALSCO-GW-03 (2-2.8 ft)	11/30/17	<0.027	<55.3	<55.3	**<55.3**	**<553**	**<553**	**<221**	<55.3	<553	<55.3	**<221**	<55.3	<55.3	**<221**
ALSCO-GW-04 (14-15 ft)	11/29/17	<0.03	<60.2	<60.2	**<60.2**	**<602**	**<602**	**<241**	<60.2	<602	<60.2	**<241**	<60.2	<241	**<241**
BSL-MIP-01 (12-13 ft)	12/03/17	<0.0239	<59.7	<59.7	**<59.7**	**<597**	**<597**	**<239**	<59.7	<597	24.6 J	**<239**	<59.7	<59.7	**<239**
BSL-MIP-01 (12-13 ft) Dup	12/03/17	<0.024	<59.9	<59.9	**<59.9**	**<599**	**<599**	**<240**	<59.9	<599	<59.9	**<240**	<59.9	<59.9	**<240**
BSL-MIP-01 (17-18 ft)	12/03/17	<0.027	<67.4	<67.4	**<67.4**	**<674**	**<674**	**<270**	<67.4	<674	<67.4	**<270**	<67.4	<67.4	**<270**
BSL-MIP-09 (12-12.5 ft)	03/29/18	<0.026	<52.9	<52.9	**<52.9**	**<212**	**<529**	**<52.9**	<52.9	<529	<52.9	**<212**	<52.9	<52.9	**<212**
BSL-MIP-09 (16-16.5 ft)	03/29/18	**<0.107**	<268	**<268**	**<268**	**<1070**	**<2680**	**<268**	<268	<2680	**<268**	**<1070**	**<268**	<268	**<1070**
BSL-MIP-09 (25-25.5 ft)	03/29/18	<0.026	<53.5	<53.5	**<53.5**	**<214**	**<535**	**<53.5**	<53.5	<535	<53.5	**<214**	<53.5	<53.5	**<214**
BSL-MIP-09 (8-8.5 ft)	03/29/18	<0.026	<50.7	<50.7	**<50.7**	<203	**<507**	**<50.7**	<50.7	<507	<50.7	**<203**	<50.7	<50.7	**<203**
BSL-MIP-20 (12-13 ft)	12/04/17	<0.0238	<59.4	<59.4	**<59.4**	**<594**	**<594**	**<238**	<59.4	<594	<59.4	**<238**	<59.4	<59.4	**<238**
BSL-MIP-20 (14-15 ft)	12/04/17	0.0274	<60.2	<60.2	**<60.2**	**<602**	**<602**	**<241**	<60.2	<602	<60.2	**<241**	<60.2	<60.2	**<241**
BSL-MIP-T18 (13-14 ft)	03/28/18	<0.0245	<61.1	<61.1	**<61.1**	**<245**	**<611**	**<61.1**	<61.1	<611	<61.1	**<245**	<61.1	<61.1	**<245**
BSL-MIP-T18 (9.5-10 ft)	03/28/18	<0.0232	<58	<58	**<58**	**<232**	**<580**	**<58**	<58	<580	<58	**<232**	<58	<58	**<232**
CAL-MIP-02 (20-21 ft)	11/28/17	<0.0253	<63.3	<63.3	**<63.3**	**<633**	**<633 UJ**	**<253**	<63.3	<633	<63.3	**<253**	<63.3	<253	**<253**
CAL-MIP-02 (8.5-9 ft)	11/28/17	<0.0243	<60.8	<60.8	**<60.8**	**<608**	**<608 UJ**	**<243**	<60.8	<608	<60.8	**<243**	<60.8	<243	**<243**
CAL-MIP-04 (14-14.5 ft)	11/28/17	<0.03	<61.9	<61.9	**<61.9**	**<619**	**<619 UJ**	**<248**	<61.9	<619	<61.9	**<248**	<61.9	<248	**<248**
CAL-MIP-04 (23-23.5 ft)	11/28/17	<0.025	<55.6	<55.6	**<55.6**	**<556**	**<556 UJ**	**<222**	<55.6	<556	<55.6	**<222**	<55.6	<222	**<222**
CAL-MIP-04 (3-3.5 ft)	11/28/17	<0.028	<60.2	<60.2	**<60.2**	**<602**	**<602 UJ**	**<241**	<60.2	<602	<60.2	**<241**	<60.2	<241	**<241**
CAL-MIP-04 (6-6.5 ft)	11/28/17	<0.03	<60.7	<60.7	**<60.7**	**<607**	**<607 UJ**	**<243**	<60.7	<607	<60.7	**<243**	<60.7	<243	**<243**
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	<0.03	<64.1	<64.1	**<64.1**	**<641**	**<641 UJ**	**<256**	<64.1	<641	<64.1	**<256**	<64.1	<256	**<256**
CAL-MIP-09 (19-19.5 ft)	11/15/17	<0.0221	<55.3	<55.3	**<55.3**	**<553**	**<553**	**<221**	<55.3	<553	**<221**	**<221**	<55.3	<553	**<221**
CAL-MIP-09 (5.5-6.5 ft)	11/15/17	<0.0236	<59	<59	**<59**	**<590**	**<590**	**<236**	<59	<590	**<236**	**<236**	<59	<590	**<236**
CAL-MIP-T03 (4.5-5 ft)	11/28/17	<0.0234	<58.6	<58.6	**<58.6**	**<586**	**<586 UJ**	**<234**	<58.6	<586	<58.6	**<234**	<58.6	<234	**<234**
D7HRC-MIP-01 (7-9 ft)	11/17/17	<0.029	<58.1	<58.1	**<58.1**	**<581**	**<581**	**<232**	<58.1	<581	**<232**	**<232**	<58.1	<581	**<232**
HLS-GW-03 (7-8 ft)	12/01/17	<0.029	<59.2	<59.2	**<59.2**	**<592**	**<592**	**<237**	<59.2	<592	<59.2	**<237**	<59.2	<59.2	**<237**
HLS-GW-04 (3-4 ft)	12/01/17	<0.029	<57.5	<57.5	**<57.5**	**<575**	**<575**	**<230**	<57.5	<575	<57.5	**<230**	<57.5	<57.5	**<230**
MW-133 (11.5-12 ft)	05/15/18	<0.0215 UJ	<53.8 UJ	<53.8 UJ	**<53.8 UJ**	**<538 UJ**	**<538 UJ**	**<53.8 UJ**	<53.8 UJ	<538 UJ	<53.8 UJ	**<215 UJ**	<53.8 UJ	<53.8 UJ	**<215 UJ**
REX-MIP-03 (10-10.5 ft)	03/28/18	<0.0241	<60.2	<60.2	**<60.2**	**<241**	**<602**	**<60.2**	<60.2	<602	<60.2	**<241**	<60.2	<60.2	**<241**
REX-MIP-03 (17-17.5 ft)	03/28/18	<0.0221	<55.2	<55.2	**<55.2**	**<221**	**<552**	**<55.2**	<55.2	<552	<55.2	**<221**	<55.2	<55.2	**<221**
REX-MIP-04 (12-12.5 ft)	03/28/18	<0.0209	<52.2	<52.2	**<52.2**	<209	**<522**	**<52.2**	<52.2	<522	<52.2	**<209**	<52.2	<52.2	**<209**
REX-MIP-07 (3.5-4 ft)	03/28/18	<0.0249	<62.3	<62.3	**<62.3**	**<249**	**<623**	**<62.3**	<62.3	<623	<62.3	**<249**	<62.3	<62.3	**<249**
REX-MIP-08 (17-17.5 ft)	12/21/17	**<0.13**	<272 UJ	**<272 UJ**	**<272 UJ**	**<1090 UJ**	**<2720 UJ**	**<272 UJ**	<272 UJ	<2720 UJ	**<1090 UJ**	**<1090 UJ**	**<272 UJ**	<272 UJ	**<1090 UJ**
REX-MIP-08 (23-23.5 ft)	12/21/17	<0.027	<55.1	<55.1	**<55.1**	**<220**	**<551**	**<55.1**	<55.1	<551	**<220**	**<220**	<55.1	<55.1	**<220**
Screening Levels:															
DEQ DC Screening Level		1.3	29,000	15,000	290	19,000	680	650	28,000	1,400,000	320	11,000	16,000	NA	8,300
DEQ Leaching Screening Level		0.07	420	210	27.7	210	25.3	11.7	680	59,000	194	77	210	NA	10.6

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-5. SUBSURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Dibromo-methane (εg/kg)	Dichloro-difluoro-methane (εg/kg)	Dichloro-fluoromethane (εg/kg)	Diethyl ether (εg/kg)	Ethyl-benzene (mg/kg)	Hexachloro-butadiene (εg/kg)	Isopropyl-benzene (εg/kg)	m,p-Xylene (mg/kg)	Methylene Chloride (εg/kg)	MTBE (mg/kg)	Naphthalene (mg/kg)	n-Butyl-benzene (εg/kg)	n-Propyl-benzene (εg/kg)	o-Xylene (mg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	**<56.3**	<225	<563	<225	<0.0563	**<281**	<56.3	<0.11	**<225**	<0.0563	0.021J/ND (0.68)U*	<56.3	<56.3	<0.11
ALSCO-GW-03 (2-2.8 ft)	11/30/17	**<55.3**	<553	<553	<221	<0.0553	**<277**	<55.3	<0.11	**<221**	<0.0553	<0.64	<55.3	<55.3	<0.11
ALSCO-GW-04 (14-15 ft)	11/29/17	**<60.2**	<241	<602	<241	<0.0602	**<301**	<60.2	<0.12	**<241**	<0.0602	<0.71	<60.2	<60.2	<0.12
BSL-MIP-01 (12-13 ft)	12/03/17	**<59.7**	<597	<597	<239	<0.0597	**<298**	<59.7	--	**<239**	<0.0597	<0.239	<59.7	<59.7	--
BSL-MIP-01 (12-13 ft) Dup	12/03/17	**<59.9**	<599	<599	<240	<0.0599	**<300**	<59.9	--	**<240**	<0.0599	<0.24	<59.9	<59.9	--
BSL-MIP-01 (17-18 ft)	12/03/17	**<67.4**	<674	<674	<270	<0.0674	**<337**	<67.4	--	**<270**	<0.0674	<0.27	<67.4	<67.4	--
BSL-MIP-09 (12-12.5 ft)	03/29/18	**<52.9 UJ**	<212	<529	<212 UJ	<0.053	**<265**	<52.9	<0.11	**<212**	<0.053	<0.63	<52.9	<52.9	<0.11
BSL-MIP-09 (16-16.5 ft)	03/29/18	**<268 UJ**	<1070	<2680	<1070 UJ	<0.268	**<1340**	<268	<0.1	**<1070**	**<0.268**	<1.07	<268	<268	<0.1
BSL-MIP-09 (25-25.5 ft)	03/29/18	**<53.5 UJ**	<214	<535	<214 UJ	<0.0535	**<268**	19.7 J	<0.1	**<214**	<0.0535	<0.62	<53.5	48.5 J	<0.1
BSL-MIP-09 (8-8.5 ft)	03/29/18	**<50.7 UJ**	<203	<507	<203 UJ	<0.052	**<253**	<50.7	<0.1	**<203**	<0.052	<0.63	<50.7	<50.7	<0.1
BSL-MIP-20 (12-13 ft)	12/04/17	**<59.4**	<594	<594	<238	<0.0594	**<297**	<59.4	--	**<238**	<0.0594	<0.238	<59.4	<59.4	--
BSL-MIP-20 (14-15 ft)	12/04/17	**<60.2**	<602	<602	<241	**4.5**	**<301**	2070	2.6	**<241**	<0.61	**5.55**	2380	7660	<1.2
BSL-MIP-T18 (13-14 ft)	03/28/18	**<61.1 UJ**	<245	<611	<245 UJ	<0.0611	**<306**	<61.1	--	**<245**	<0.0611	<0.245	<61.1	<61.1	--
BSL-MIP-T18 (9.5-10 ft)	03/28/18	**<58 UJ**	<232	<580	<232 UJ	<0.058	**<290**	<58	--	**<232**	<0.058	<0.232	<58	<58	--
CAL-MIP-02 (20-21 ft)	11/28/17	**<63.3**	<253	<633	<253	<0.0633	**<317 UJ**	<63.3	--	**<253**	<0.0633	<0.253	<63.3	<63.3	--
CAL-MIP-02 (8.5-9 ft)	11/28/17	**<60.8**	<243	<608	<243	<0.0608	**<304 UJ**	<60.8	--	**<243**	<0.0608	<0.243	<60.8	<60.8	--
CAL-MIP-04 (14-14.5 ft)	11/28/17	**<61.9**	<248	<619	<248	<0.0619	**<309 UJ**	<61.9	<0.12	**<248**	<0.0619	<0.73	<61.9	<61.9	<0.12
CAL-MIP-04 (23-23.5 ft)	11/28/17	**<55.6**	<222	<556	<222	<0.0556	**<278 UJ**	<55.6	<0.1	**<222**	<0.0556	<0.61	<55.6	<55.6	<0.1
CAL-MIP-04 (3-3.5 ft)	11/28/17	**<60.2**	<241	<602	<241	<0.0602	**<301 UJ**	<60.2	<0.11	**<241**	<0.0602	<0.68	<60.2	<60.2	<0.11
CAL-MIP-04 (6-6.5 ft)	11/28/17	**<60.7**	<243	<607	<243	<0.0607	**<304 UJ**	<60.7	<0.12	**<243**	<0.0607	<0.72	<60.7	<60.7	<0.12
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	**<64.1**	<256	<641	<256	<0.0641	**<321 UJ**	<64.1	<0.12	**<256**	<0.0641	<0.73	<64.1	<64.1	<0.12
CAL-MIP-09 (19-19.5 ft)	11/15/17	**<55.3**	<221	<553	<221	<0.0553	**<276**	<55.3	--	**<221**	<0.0553	<0.221	<55.3	<55.3	--
CAL-MIP-09 (5.5-6.5 ft)	11/15/17	**<59**	<236	<590	<236	<0.059	**<295**	<59	--	**<236**	<0.059	<0.236	<59	<59	--
CAL-MIP-T03 (4.5-5 ft)	11/28/17	**<58.6**	<234	<586	<234	<0.0586	**<293 UJ**	<58.6	--	**<234**	<0.0586	<0.234	<58.6	<58.6	--
D7HRC-MIP-01 (7-9 ft)	11/17/17	**<58.1**	<232	<581	<232	<0.0581	**<290**	<58.1	<0.11	**<232**	<0.0581	0.03J/ND (0.69)U*	<58.1	<58.1	<0.11
HLS-GW-03 (7-8 ft)	12/01/17	**<59.2**	<592	<592	<237	<0.0592	**<296**	<59.2	<0.12	**<237**	<0.0592	<0.7	<59.2	<59.2	<0.12
HLS-GW-04 (3-4 ft)	12/01/17	**<57.5**	<575	<575	<230	<0.0575	**<287**	<57.5	<0.11	**<230**	<0.0575	<0.69	<57.5	<57.5	<0.11
MW-133 (11.5-12 ft)	05/15/18	**<53.8 UJ**	<215 UJ	<538 UJ	<215 UJ	<0.0538 UJ	**<269 UJ**	<53.8 UJ	--	**<215 UJ**	<0.0538 UJ	<0.215 UJ	<53.8 UJ	<53.8 UJ	--
REX-MIP-03 (10-10.5 ft)	03/28/18	**<60.2 UJ**	<241	<602	<241 UJ	<0.0602	**<301**	<60.2	--	**<241**	<0.0602	<0.241	<60.2	<60.2	--
REX-MIP-03 (17-17.5 ft)	03/28/18	**<55.2 UJ**	<221	<552	<221 UJ	<0.0552	**<276**	<55.2	--	**<221**	<0.0552	<0.221	<55.2	<55.2	--
REX-MIP-04 (12-12.5 ft)	03/28/18	**<52.2 UJ**	<209	<522	<209 UJ	<0.0522	**<261**	<52.2	--	**<209**	<0.0522	<0.209	<52.2	<52.2	--
REX-MIP-07 (3.5-4 ft)	03/28/18	**<62.3 UJ**	<249	<623	<249 UJ	<0.0623	**<311**	<62.3	--	**<249**	<0.0623	<0.249	<62.3	<62.3	--
REX-MIP-08 (17-17.5 ft)	12/21/17	**<272 UJ**	<1090 UJ	<2720 UJ	<1090 UJ	2 J	**<1360 UJ**	765 J-	0.51 J	**<1090 UJ**	**<0.272 UJ**	1.6 J	982 J-	2330 J-	<0.52
REX-MIP-08 (23-23.5 ft)	12/21/17	**<55.1**	<220	<551	<220	<0.0551	**<275**	<55.1	<0.11	**<220**	<0.0551	<0.64	<55.1	<55.1	<0.11
Screening Levels:															
DEQ DC Screening Level		2,400	8,700	NA	1,600,000	6.4	1,200	190,000	NA	57,000	52	4.3	390,000	380,000	65
DEQ Leaching Screening Level		21	15,000	NA	8,800	26	96.4	7,400	NA	13	0.078	12	32,000	12,000	100

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-5. SUBSURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	p-Isopropyl-toluene (εg/kg)	sec-Butylbenzene (εg/kg)	Styrene (εg/kg)	tert-Butyl-benzene (εg/kg)	Tetrachloro-ethene (εg/kg)	Tetrahydro-furan (εg/kg)	Toluene (mg/kg)	trans-1,2-Dichloro-ethene (εg/kg)	trans-1,3-Dichloro-propene (εg/kg)	Trichloro-ethene (εg/kg)	Trichloro-fluoromethane (εg/kg)	Vinyl Chloride (εg/kg)	Xylenes, Total (mg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	<56.3	<56.3	<56.3	<56.3	**<56.3**	<2250	<0.0563	<56.3	<225	**<56.3**	<225	**<22.5**	<0.23
ALSCO-GW-03 (2-2.8 ft)	11/30/17	<55.3	<55.3	16 J	<55.3	**<55.3**	<2210	0.229 J	<55.3	<55.3	**<55.3**	<221	**<22.1**	<0.21
ALSCO-GW-04 (14-15 ft)	11/29/17	<60.2	<60.2	<60.2	<60.2	**<60.2**	<2410	<0.0602	<60.2	<241	**<60.2**	<241	**<24.1**	<0.24
BSL-MIP-01 (12-13 ft)	12/03/17	<59.7	<59.7	<59.7	<59.7	**<59.7**	<2390	<0.0597	<59.7	<59.7	**<59.7**	<239	**<23.9**	<0.179
BSL-MIP-01 (12-13 ft) Dup	12/03/17	<59.9	<59.9	<59.9	<59.9	**<59.9**	<2400	<0.0599	<59.9	<59.9	**<59.9**	<240	**<24**	<0.18
BSL-MIP-01 (17-18 ft)	12/03/17	<67.4	<67.4	<67.4	<67.4	**37.4 J**	<2700	<0.0674	<67.4	<67.4	**<67.4**	<270	**<27**	<0.202
BSL-MIP-09 (12-12.5 ft)	03/29/18	<52.9	<52.9	<52.9	<52.9	**149**	<2120	<0.053	<52.9	<52.9	**<52.9**	<212	**<21.2**	<0.21
BSL-MIP-09 (16-16.5 ft)	03/29/18	<268	<268	<268	<268	**89700**	**<10700**	<0.268	<268	<268	**<268**	<1070	**<107**	<0.803
BSL-MIP-09 (25-25.5 ft)	03/29/18	<53.5	17 J	<53.5	<53.5	**267**	<2140	<0.0535	<53.5	<53.5	**<53.5**	<214	**<21.4**	<0.21
BSL-MIP-09 (8-8.5 ft)	03/29/18	<50.7	<50.7	<50.7	<50.7	**62.6**	<2030	<0.052	<50.7	<50.7	**<50.7**	<203	**<20.3**	<0.21
BSL-MIP-20 (12-13 ft)	12/04/17	<59.4	<59.4	<59.4	<59.4	**<59.4**	<2380	<0.0594	<59.4	<59.4	**<59.4**	<238	**<23.8**	<0.178
BSL-MIP-20 (14-15 ft)	12/04/17	626	1020	<60.2	<60.2	**48.7**	<2410	0.0296	<60.2	<60.2	**<60.2**	<241	**<24.1**	2.6
BSL-MIP-T18 (13-14 ft)	03/28/18	<61.1	<61.1	<61.1	<61.1	**<61.1**	<2450	<0.0611	<61.1	<61.1	**<61.1**	<245	**<24.5**	<0.183
BSL-MIP-T18 (9.5-10 ft)	03/28/18	<58	<58	<58	<58	**<58**	<2320	<0.058	<58	<58	**<58**	<232	**<23.2**	<0.174
CAL-MIP-02 (20-21 ft)	11/28/17	<63.3	<63.3	<63.3	<63.3	**<63.3**	<2530	<0.0633	<63.3	<253	**<63.3**	<253	**<25.3**	<0.19
CAL-MIP-02 (8.5-9 ft)	11/28/17	<60.8	<60.8	<60.8	<60.8	**<60.8**	<2430	<0.0608	<60.8	<243	**<60.8**	<243	**<24.3**	<0.182
CAL-MIP-04 (14-14.5 ft)	11/28/17	<61.9	<61.9	<61.9	<61.9	**170**	<2480	<0.0619	<61.9	<248	**<61.9**	<248	**<24.8**	<0.24
CAL-MIP-04 (23-23.5 ft)	11/28/17	<55.6	<55.6	<55.6	<55.6	**<55.6**	<2220	<0.0556	<55.6	<222	**<55.6**	<222	**<22.2**	<0.2
CAL-MIP-04 (3-3.5 ft)	11/28/17	<60.2	<60.2	<60.2	<60.2	**<60.2**	<2410	0.0221 J	<60.2	<241	**<60.2**	<241	**<24.1**	<0.23
CAL-MIP-04 (6-6.5 ft)	11/28/17	<60.7	<60.7	<60.7	<60.7	**<60.7**	<2430	0.0224 J	<60.7	<243	**<60.7**	<243	**<24.3**	<0.24
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	<64.1	<64.1	<64.1	<64.1	**42.2 J**	<2560	<0.0641	<64.1	<256	**<64.1**	<256	**<25.6**	<0.24
CAL-MIP-09 (19-19.5 ft)	11/15/17	<55.3	<55.3	<55.3	<55.3	**<55.3**	<2210	0.0289 J	<221	<553	**<55.3**	<221	**<55.3**	<0.166
CAL-MIP-09 (5.5-6.5 ft)	11/15/17	<59	<59	<59	<59	**<59**	<2360	0.0367 J	<236	<590	**<59**	<236	**<59**	<0.177
CAL-MIP-T03 (4.5-5 ft)	11/28/17	<58.6	<58.6	<58.6	<58.6	**<58.6**	<2340	<0.0586	<58.6	<234	**<58.6**	<234	**<23.4**	<0.176
D7HRC-MIP-01 (7-9 ft)	11/17/17	<58.1	<58.1	<58.1	<58.1	**<58.1**	<2320	<0.0581	<232	<581	**<58.1**	<232	**<58.1**	<0.23
HLS-GW-03 (7-8 ft)	12/01/17	<59.2	<59.2	<59.2	<59.2	**<59.2**	<2370	<0.0592	<59.2	<59.2	**<59.2**	<237	**<23.7**	<0.23
HLS-GW-04 (3-4 ft)	12/01/17	<57.5	<57.5	<57.5	<57.5	**<57.5**	<2300	0.028 J	<57.5	<57.5	**<57.5**	<230	**<23**	<0.23
MW-133 (11.5-12 ft)	05/15/18	<53.8 UJ	<53.8 UJ	<53.8 UJ	<53.8 UJ	**<53.8 UJ**	<2150 UJ	0.0267 J-	<53.8 UJ	<53.8 UJ	**<53.8 UJ**	<215 UJ	**<21.5 UJ**	<0.161 UJ
REX-MIP-03 (10-10.5 ft)	03/28/18	<60.2	<60.2	<60.2	<60.2	**<60.2**	<2410	<0.0602	<60.2	<60.2	**<60.2**	<241	**<24.1**	<0.18
REX-MIP-03 (17-17.5 ft)	03/28/18	<55.2	<55.2	<55.2	<55.2	**<55.2**	<2210	<0.0552	<55.2	<55.2	**<55.2**	<221	**<22.1**	<0.166
REX-MIP-04 (12-12.5 ft)	03/28/18	<52.2	<52.2	<52.2	<52.2	**<52.2**	<2090	<0.0522	<52.2	<52.2	**<52.2**	<209	**<20.9**	<0.157
REX-MIP-07 (3.5-4 ft)	03/28/18	<62.3	<62.3	<62.3	<62.3	**<62.3**	<2490	<0.0623	<62.3	<62.3	**<62.3**	<249	**<24.9**	<0.187
REX-MIP-08 (17-17.5 ft)	12/21/17	717 J-	1080 J-	<272 UJ	<272 UJ	**<272 UJ**	**<10900 UJ**	<0.272 UJ	<272 UJ	<272 UJ	**<272 UJ**	<1090 UJ	**<109 UJ**	1.05 J-
REX-MIP-08 (23-23.5 ft)	12/21/17	<55.1	<55.1	<55.1	<55.1	**<55.1**	<2200	<0.0551	<55.1	<55.1	**<55.1**	<220	**<22**	<0.21
Screening Levels:														
DEQ DC Screening Level		NA	780,000	600,000	780,000	24,000	1,800,000	610	160,000	NA	940	2,300,000	59	72
DEQ Leaching Screening Level		NA	59,000	1,100	16,000	23	7,500	21	310	NA	18	63,500	0.684	320

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-5. SUBSURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,1,1,2-Tetrachloro-ethane (εg/kg)	1,1,1-Trichloro-ethane (εg/kg)	1,1,2,2-Tetrachloro-ethane (εg/kg)	1,1,2-Trichloro-ethane (εg/kg)	1,1,2-Trichloro-trifluoro-ethane (εg/kg)	1,1-Dichloro-ethane (εg/kg)	1,1-Dichloro-ethene (εg/kg)	1,1-Dichloro-propene (εg/kg)	1,2,3-Trichloro-benzene (εg/kg)	1,2,3-Trichloro-propane (εg/kg)	1,2,4-Trichloro-benzene (εg/kg)	1,2,4-Trimethyl-benzene (εg/kg)	1,2-Dibromo 3-chloro-propane (εg/kg)	1,2-Dibromo-ethane (εg/kg)
REX-MIP-08 (5-5.5 ft)	12/21/17	**<56.5**	<56.5	**<56.5**	**<56.5**	<226	**<56.5**	**<56.5**	<56.5	<56.5	**<226**	<56.5	<56.5	**<565**	**<56.5**
REX-MIP-08 (9.5-10 ft)	12/21/17	**<59.3**	<59.3	**<59.3**	**<59.3**	<237	**<59.3**	**<59.3**	<59.3	<59.3	**<237**	<59.3	<59.3	**<593**	**<59.3**
SEWER-01 (5.5-6 ft)	03/30/18	**<59.2**	<59.2	**<59.2 UJ**	**<59.2**	<237	**<59.2**	**<59.2**	<59.2	<59.2	**<237**	<59.2	<59.2	**<592**	**<59.2**
SEWER-02 (5.5 ft)	03/30/18	**<56.8**	<56.8	**<56.8 UJ**	**<56.8**	<227	**<56.8**	**<56.8**	<56.8	<56.8	**<227**	<56.8	<56.8	**<568**	**<56.8**
SEWER-03 (17 ft)	03/30/18	**<51.3**	<51.3	**<51.3**	**<51.3**	<205	**<51.3**	**<51.3**	<51.3	<51.3	**<205**	<51.3	<51.3	**<513**	**<51.3**
SEWER-04 (14.5-15.5 ft)	03/30/18	**<52.7**	<52.7	**<52.7**	**<52.7**	<211	**<52.7**	**<52.7**	<52.7	<52.7	**<211**	<52.7	<52.7	**<527**	**<52.7**
WETZ-GW-01 (10-15 ft)	03/27/18	**<49 UJ**	<49 UJ	**<49 UJ**	**<49 UJ**	<196 UJ	**<49 UJ**	**<49 UJ**	<49 UJ	<49 UJ	**<196 UJ**	<49 UJ	<49 UJ	**<490 UJ**	**<49 UJ**
WETZ-GW-02 (10-15 ft)	03/27/18	**<50.6 UJ**	<50.6 UJ	**<50.6 UJ**	**<50.6 UJ**	<203 UJ	**<50.6 UJ**	**<50.6 UJ**	<50.6 UJ	<50.6 UJ	**<203 UJ**	<50.6 UJ	<50.6 UJ	**<506 UJ**	**<50.6 UJ**
Screening Levels:															
DEQ DC Screening Level		2,000	810,000	600	1,100	670,000	3,600	23,000	NA	6,300	5.1	24,000	30,000	5.3	40
DEQ Leaching Screening Level		2.2	700	7.89	9.54	260,000	7.8	25	NA	210	0.0032	2,000	810	0.86	0.086

Notes:
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ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-5. SUBSURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Di-chloro-benzene (εg/kg)	1,2-Dichloro-ethane (εg/kg)	1,2-Dichloro-propane (εg/kg)	1,3,5-Trimethyl-benzene (εg/kg)	1,3-Di-chloro-benzene (εg/kg)	1,3-Dichloro-propane (εg/kg)	1,4-Di-chloro-benzene (εg/kg)	2,2-Dichloro-propane (εg/kg)	2-Butanone (εg/kg)	2-Chloro-toluene (εg/kg)	4-Chloro-toluene (εg/kg)	4-Methyl-2-Pentanone (εg/kg)	Acetone (εg/kg)	Allyl Chloride (εg/kg)
REX-MIP-08 (5-5.5 ft)	12/21/17	<56.5	**<56.5**	**<56.5**	<56.5	<56.5	<56.5	<56.5	<226	<282	<56.5	<56.5	<282	<1130	**<226**
REX-MIP-08 (9.5-10 ft)	12/21/17	<59.3	**<59.3**	**<59.3**	<59.3	<59.3	<59.3	<59.3	<237	<296	<59.3	<59.3	<296	<1190	**<237**
SEWER-01 (5.5-6 ft)	03/30/18	<59.2	**<59.2**	**<59.2**	<59.2	<59.2	<59.2	<59.2	<237	<296 UJ	<59.2	<59.2	<296	<1180	**<237**
SEWER-02 (5.5 ft)	03/30/18	<56.8	**<56.8**	**<56.8**	<56.8	<56.8	<56.8	<56.8	<227	<284 UJ	<56.8	<56.8	<284	<1140	**<227**
SEWER-03 (17 ft)	03/30/18	<51.3	**<51.3**	**<51.3**	<51.3	<51.3	<51.3	<51.3	<205	114 J	<51.3	<51.3	<257	<1030	**<205**
SEWER-04 (14.5-15.5 ft)	03/30/18	<52.7	**<52.7**	**<52.7**	<52.7	<52.7	<52.7	<52.7	<211	<264	<52.7	<52.7	<264	<1050	**<211**
WETZ-GW-01 (10-15 ft)	03/27/18	<49 UJ	**<49 UJ**	**<49 UJ**	<49 UJ	<49 UJ	<49 UJ	<49 UJ	<196 UJ	<245 UJ	<49 UJ	<49 UJ	<245 UJ	<980 UJ	**<196 UJ**
WETZ-GW-02 (10-15 ft)	03/27/18	<50.6 UJ	**<50.6 UJ**	**<50.6 UJ**	<50.6 UJ	<50.6 UJ	<50.6 UJ	<50.6 UJ	<203 UJ	<253 UJ	<50.6 UJ	<50.6 UJ	<253 UJ	<1010 UJ	**<203 UJ**
Screening Levels:															
DEQ DC Screening Level		180,000	520	2,500	27,000	NA	160,000	2,600	NA	2,700,000	160,000	160,000	3,300,000	6,100,000	720
DEQ Leaching Screening Level		5,800	19	17	870	NA	1,300	720	NA	12,000	2,300	2,400	14,000	29,000	2.3

Notes:
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ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-5. SUBSURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Benzene (mg/kg)	Bromo-benzene (εg/kg)	Bromo-chloro-methane (εg/kg)	Bromo-dichloro-methane (εg/kg)	Bromoform (εg/kg)	Bromo-methane (εg/kg)	Carbon tetrachloride (εg/kg)	Chloro-benzene (εg/kg)	Chloroethane (εg/kg)	Chloroform (εg/kg)	Chloro-methane (εg/kg)	cis-1,2-Dichloro-ethene (εg/kg)	Cis-1,3-dichloro-propene (εg/kg)	Dibromo-chloromethane (εg/kg)
REX-MIP-08 (5-5.5 ft)	12/21/17	0.02 J	<56.5	<56.5	**<56.5**	**<226**	**<565**	**<56.5**	<56.5	<565	**<226**	**<226**	<56.5	<56.5	**<226**
REX-MIP-08 (9.5-10 ft)	12/21/17	<0.028	<59.3	<59.3	**<59.3**	**<237**	**<593**	**<59.3**	<59.3	<593	**<237**	**<237**	<59.3	<59.3	**<237**
SEWER-01 (5.5-6 ft)	03/30/18	<0.0237	<59.2	<59.2	**<59.2**	**<237**	**<592**	**<59.2**	<59.2	<592	<59.2	**<237**	<59.2	<59.2	**<237**
SEWER-02 (5.5 ft)	03/30/18	<0.0227	<56.8	<56.8	**<56.8**	**<227**	**<568**	**<56.8**	<56.8	<568	<56.8	**<227**	<56.8	<56.8	**<227**
SEWER-03 (17 ft)	03/30/18	<0.0205	<51.3	<51.3	**<51.3**	<205	**<513**	**<51.3**	<51.3	<513	<51.3	**<205**	<51.3	<51.3	**<205**
SEWER-04 (14.5-15.5 ft)	03/30/18	<0.0211	<52.7	<52.7	**<52.7**	**<211**	**<527**	**<52.7**	<52.7	<527	<52.7	**<211**	<52.7	<52.7	**<211**
WETZ-GW-01 (10-15 ft)	03/27/18	<0.025	<49 UJ	<49 UJ	**<49 UJ**	<196 UJ	**<490 UJ**	**<49 UJ**	<49 UJ	<490 UJ	<49 UJ	**<196 UJ**	<49 UJ	<49 UJ	**<196 UJ**
WETZ-GW-02 (10-15 ft)	03/27/18	<0.26	<50.6 UJ	<50.6 UJ	**<50.6 UJ**	<203 UJ	**<506 UJ**	**<50.6 UJ**	<50.6 UJ	<506 UJ	<50.6 UJ	**<203 UJ**	<50.6 UJ	<50.6 UJ	**<203 UJ**
Screening Levels:															
DEQ DC Screening Level		1.3	29,000	15,000	290	19,000	680	650	28,000	1,400,000	320	11,000	16,000	NA	8,300
DEQ Leaching Screening Level		0.07	420	210	27.7	210	25.3	11.7	680	59,000	194	77	210	NA	10.6

Notes:
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J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-5. SUBSURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Dibromo-methane (εg/kg)	Dichloro-difluoro-methane (εg/kg)	Dichloro-fluoromethane (εg/kg)	Diethyl ether (εg/kg)	Ethyl-benzene (mg/kg)	Hexachloro-butadiene (εg/kg)	Isopropyl-benzene (εg/kg)	m,p-Xylene (mg/kg)	Methylene Chloride (εg/kg)	MTBE (mg/kg)	Naphthalene (mg/kg)	n-Butyl-benzene (εg/kg)	n-Propyl-benzene (εg/kg)	o-Xylene (mg/kg)
REX-MIP-08 (5-5.5 ft)	12/21/17	**<56.5**	<226	<565	<226	<0.0565	**<282**	<56.5	<0.1	**<226**	<0.0565	0.046 J	<56.5	<56.5	<0.1
REX-MIP-08 (9.5-10 ft)	12/21/17	**<59.3**	<237	<593	<237	<0.0593	**<296**	<59.3	<0.11	**<237**	<0.0593	<0.66	<59.3	<59.3	<0.11
SEWER-01 (5.5-6 ft)	03/30/18	**<59.2 UJ**	<237	<592	<237 UJ	<0.0592	**<296**	<59.2	--	**<237**	<0.0592	<0.237	<59.2	<59.2	--
SEWER-02 (5.5 ft)	03/30/18	**<56.8 UJ**	<227	<568	<227 UJ	<0.0568	**<284**	<56.8	--	**<227**	<0.0568	<0.227	<56.8	<56.8	--
SEWER-03 (17 ft)	03/30/18	**<51.3**	<205	<513	<205 UJ	<0.0513	**<257**	<51.3	--	**<205**	<0.0513	<0.205	<51.3	<51.3	--
SEWER-04 (14.5-15.5 ft)	03/30/18	**<52.7**	<211	<527	<211 UJ	<0.0527	**<264**	<52.7	--	**<211**	<0.0527	<0.211	<52.7	<52.7	--
WETZ-GW-01 (10-15 ft)	03/27/18	**<49 UJ**	<196 UJ	<490 UJ	<196 UJ	<0.05	**<245 UJ**	<49 UJ	<0.099	**<196 UJ**	<0.05	0.029 J	<49 UJ	<49 UJ	<0.099
WETZ-GW-02 (10-15 ft)	03/27/18	**<50.6 UJ**	<203 UJ	<506 UJ	<203 UJ	<0.51	**<253 UJ**	<50.6 UJ	<1	**<203 UJ**	<0.51	1.2 J	<50.6 UJ	<50.6 UJ	<1
Screening Levels:															
DEQ DC Screening Level		2,400	8,700	NA	1,600,000	6.4	1,200	190,000	NA	57,000	52	4.3	390,000	380,000	65
DEQ Leaching Screening Level		21	15,000	NA	8,800	26	96.4	7,400	NA	13	0.078	12	32,000	12,000	100

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J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-5. SUBSURFACE SOIL - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	p-Isopropyl-toluene (εg/kg)	sec-Butylbenzene (εg/kg)	Styrene (εg/kg)	tert-Butyl-benzene (εg/kg)	Tetrachloro-ethene (εg/kg)	Tetrahydro-furan (εg/kg)	Toluene (mg/kg)	trans-1,2-Dichloro-ethene (εg/kg)	trans-1,3-Dichloro-propene (εg/kg)	Trichloro-ethene (εg/kg)	Trichloro-fluoromethane (εg/kg)	Vinyl Chloride (εg/kg)	Xylenes, Total (mg/kg)
REX-MIP-08 (5-5.5 ft)	12/21/17	<56.5	<56.5	<56.5	<56.5	**<56.5**	<2260	<0.0565	<56.5	<56.5	**<56.5**	<226	**<22.6**	<0.21
REX-MIP-08 (9.5-10 ft)	12/21/17	<59.3	<59.3	<59.3	<59.3	**<59.3**	<2370	<0.0593	<59.3	<59.3	**<59.3**	<237	**<23.7**	<0.22
SEWER-01 (5.5-6 ft)	03/30/18	<59.2	<59.2	<59.2	<59.2	**<59.2**	<2370	<0.0592	<59.2	<59.2	**<59.2**	<237	**<23.7**	<0.178
SEWER-02 (5.5 ft)	03/30/18	<56.8	<56.8	<56.8	<56.8	**<56.8**	<2270	<0.0568	<56.8	<56.8	**<56.8**	<227	**<22.7**	<0.17
SEWER-03 (17 ft)	03/30/18	<51.3	<51.3	<51.3	<51.3	**<51.3**	<2050	0.169	<51.3	<51.3	**<51.3**	<205	**<20.5**	<0.154
SEWER-04 (14.5-15.5 ft)	03/30/18	<52.7	<52.7	<52.7	<52.7	**<52.7**	<2110	<0.0527	<52.7	<52.7	**<52.7**	<211	**<21.1**	<0.158
WETZ-GW-01 (10-15 ft)	03/27/18	<49 UJ	<49 UJ	<49 UJ	<49 UJ	**<49 UJ**	<1960 UJ	<0.05	<49 UJ	<49 UJ	**<49 UJ**	<196 UJ	**<19.6 UJ**	<0.2
WETZ-GW-02 (10-15 ft)	03/27/18	<50.6 UJ	<50.6 UJ	<50.6 UJ	<50.6 UJ	**<50.6 UJ**	<2030 UJ	<0.51	<50.6 UJ	<50.6 UJ	**<50.6 UJ**	<203 UJ	**<20.3 UJ**	<2
Screening Levels:														
DEQ DC Screening Level	NA	780,000	600,000	780,000	24,000	1,800,000	610	160,000	NA	940	2,300,000	59	72	
DEQ Leaching Screening Level	NA	59,000	1,100	16,000	23	7,500	21	310	NA	18	63,500	0.684	320	

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
VOC ï volatile organic compound
εg/kg - micrograms per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-6. SUBSURFACE SOIL - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acenaph-thene (εg/kg)	Acenaph-thylene (εg/kg)	Anthracene (εg/kg)	Benzo(a)-anthracene (εg/kg)	Benzo(a)-pyrene (εg/kg)	Benzo(b)-fluor-anthene (εg/kg)	Benzo(ghi)-perylene (εg/kg)	Benzo(k) fluor-anthene (εg/kg)	Bis(2chloro ethoxy)-methane (εg/kg)	Bis(2-chloro ethyl)ether (εg/kg)	Bis(2-ethyl hexyl)-phthalate (εg/kg)	4-Bromo-phenyl-phenylether (εg/kg)	Benzyl Butyl Phthalate (εg/kg)	Car-bazole (εg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	<384	<384	<384	<384	**<384**	<384	<384	<384	**<384**	**<384**	<384 UJ	<384	<384 UJ	<384
ALSCO-GW-03 (2-2.8 ft)	11/30/17	<365	<365	<365	<365	**<365**	<365	<365	<365	**<365**	**<365**	<365 UJ	<365	<365 UJ	<365
ALSCO-GW-04 (14-15 ft)	11/29/17	<403	<403	<403	<403	**<403**	<403	<403	<403	**<403**	**<403**	<403 UJ	<403	<403 UJ	<403
BSL-MIP-09 (12-12.5 ft)	03/29/18	<352	<352	<352	<352	**<352**	<352	<352	<352	**<352**	**<352**	<352	<352	<352	<352
BSL-MIP-09 (16-16.5 ft)	03/29/18	<363	<363	<363	<363	**<363**	<363	<363	<363	**<363 UJ**	**<363**	<363	<363	<363	<363
BSL-MIP-09 (25-25.5 ft)	03/29/18	<355	<355	<355	<355	**<355**	<355	<355	<355	**<355**	**<355**	103 J	<355	<355	<355
BSL-MIP-09 (8-8.5 ft)	03/29/18	<346	<346	<346	<346	**<346**	<346	<346	<346	**<346**	**<346**	<346	<346	<346	<346
BSL-MIP-20 (14-15 ft)	12/04/17	<407	<407	<407	<407	**<407**	<407	<407	<407	**<407**	**<407**	<407	<407	<407	<407
CAL-MIP-04 (14-14.5 ft)	11/28/17	<407	<407	<407	<407	**<407**	<407	<407	<407	**<407**	**<407**	<407 UJ	<407	<407 UJ	<407
CAL-MIP-04 (23-23.5 ft)	11/28/17	<366	<366	<366	<366	**<366**	<366	<366	<366	**<366**	**<366**	<366 UJ	<366	<366 UJ	<366
CAL-MIP-04 (3-3.5 ft)	11/28/17	<398	<398	<398	<398	**<398**	<398	<398	<398	**<398**	**<398**	407 J	<398	<398 UJ	<398
CAL-MIP-04 (6-6.5 ft)	11/28/17	<400	<400	<400	<400	**<400**	<400	<400	<400	**<400**	**<400**	<400 UJ	<400	<400 UJ	<400
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	<422	<422	<422	<422	**<422**	<422	<422	<422	**<422**	**<422**	<422 UJ	<422	<422 UJ	<422
D7HRC-MIP-01 (7-9 ft)	11/17/17	<398	<398	<398	<398	**<398**	<398	<398	<398	**<398**	**<398**	<398	<398	<398	<398
HLS-GW-03 (7-8 ft)	12/01/17	<390	<390	56.3 J	152 J	**141 J**	218 J	113 J	87.7 J	**<390**	**<390**	<390 UJ	<390	<390 UJ	<390
HLS-GW-04 (3-4 ft)	12/01/17	<378	<378	<378	152 J	**137 J**	132 J	84.6 J	75.1 J	**<378**	**<378**	<378 UJ	<378	<378 UJ	<378
REX-MIP-08 (17-17.5 ft)	12/21/17	<365	<365	<365	<365	**<365**	<365	<365 UJ	<365	**<365**	**<365**	<365	<365	<365	<365
REX-MIP-08 (23-23.5 ft)	03/28/18	<381	<381	<381	<381	**<381**	<381	<381	<381	**<381**	**<381**	<381	<381	<381	<381
REX-MIP-08 (5-5.5 ft)	12/21/17	<374	<374	<374	<374	**<374**	<374	<374 UJ	<374	**<374**	**<374**	<374	<374	<374	<374
REX-MIP-08 (9.5-10 ft)	12/21/17	<399	<399	<399	<399	**<399**	<399	<399 UJ	<399	**<399**	**<399**	223 J	<399	<399	<399
WETZ-GW-01 (10-15 ft)	03/27/18	<337	<337	<337	<337	**<337**	<337	<337	<337	**<337**	**<337**	<337	<337	<337	<337
WETZ-GW-02 (10-15 ft)	03/27/18	<343	<343	<343	<343	**<343**	<343	<343	<343	**<343**	**<343**	<343	<343	<343	<343
Screening Levels:															
DEQ DC Screening Level		450,000	NA	2,200,000	1,300	130	1,300	NA	13,000	19,000	230	39,000	NA	290,000	NA
DEQ Leaching Screening Level		27,000	NA	2,600,000	6,800	2,300	23,000	NA	230,000	130	0.036	13,000	NA	2,400	NA

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
SVOC ï semi-volatile organic compound
εg/kg - micrograms per kilogram

TABLE 8-6. SUBSURFACE SOIL - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	4-Chloro-3-Methyl phenol (εg/kg)	4-Chloro-aniline (εg/kg)	2-Chloro-naphthalene (εg/kg)	2-Chloro-phenol (εg/kg)	4-Chloro-phenyl-phenylether (εg/kg)	Chrysene (εg/kg)	Dibenz (a,h) anthracene (εg/kg)	Dibenzo-furan (εg/kg)	1,2-Di-chloro-benzene (εg/kg)	1,3-Di-chloro-benzene (εg/kg)	1,4-Di-chloro-benzene (εg/kg)	3,3'-Di-chloro-benzidine (εg/kg)	2,4-Dichloro-phenol (εg/kg)	Diethyl-phthalate (εg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	<384	**<384**	<384	<384	<384	<384	**<384**	<384	<384	<384	<384	**<384**	**<384**	<384
ALSCO-GW-03 (2-2.8 ft)	11/30/17	<365	**<365**	<365	<365	<365	51.1 J	**<365**	<365	<365	<365	<365	**<365**	**<365**	<365
ALSCO-GW-04 (14-15 ft)	11/29/17	<403	**<403**	<403	<403	<403	<403	**<403**	<403	<403	<403	<403	**<403**	**<403**	<403
BSL-MIP-09 (12-12.5 ft)	03/29/18	<352	**<352**	<352	<352	<352	<352	**<352**	<352	<352	<352	<352	**<352**	**<352**	<352
BSL-MIP-09 (16-16.5 ft)	03/29/18	<363	**<363 UJ**	<363	<363	<363	<363	**<363**	<363	<363	<363	<363	**<363**	**<363**	<363
BSL-MIP-09 (25-25.5 ft)	03/29/18	<355	**<355**	<355	<355	<355	<355	**<355**	<355	<355	<355	<355	**<355**	**<355**	<355
BSL-MIP-09 (8-8.5 ft)	03/29/18	<346	**<346**	<346	<346	<346	<346	**<346**	<346	<346	<346	<346	**<346**	**<346**	<346
BSL-MIP-20 (14-15 ft)	12/04/17	<407	**<407**	<407	<407	<407	<407	**<407**	<407	<407	<407	<407	**<407**	**<407**	<407
CAL-MIP-04 (14-14.5 ft)	11/28/17	<407	**<407**	<407	<407	<407	<407	**<407**	<407	<407	<407	<407	**<407**	**<407**	<407
CAL-MIP-04 (23-23.5 ft)	11/28/17	<366	**<366**	<366	<366	<366	<366	**<366**	<366	<366	<366	<366	**<366**	**<366**	<366
CAL-MIP-04 (3-3.5 ft)	11/28/17	<398	**<398**	<398	<398	<398	<398	**<398**	<398	<398	<398	<398	**<398**	**<398**	<398
CAL-MIP-04 (6-6.5 ft)	11/28/17	<400	**<400**	<400	<400	<400	<400	**<400**	<400	<400	<400	<400	**<400**	**<400**	<400
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	<422	**<422**	<422	<422	<422	<422	**<422**	<422	<422	<422	<422	**<422**	**<422**	<422
D7HRC-MIP-01 (7-9 ft)	11/17/17	<398	**<398 UJ**	<398	<398	<398	<398	**<398**	<398	<398	<398	<398	**<398**	**<398**	<398
HLS-GW-03 (7-8 ft)	12/01/17	<390	**<390**	<390	<390	<390	162 J	**<390**	<390	<390	<390	<390	**<390**	**<390**	<390
HLS-GW-04 (3-4 ft)	12/01/17	<378	**<378**	<378	<378	<378	127 J	**<378**	<378	<378	<378	<378	**<378**	**<378**	<378
REX-MIP-08 (17-17.5 ft)	12/21/17	<365	**<365**	<365	<365	<365	<365	**<365**	<365	<365	<365	<365	**<365**	**<365**	<365
REX-MIP-08 (23-23.5 ft)	03/28/18	<381	**<381**	<381	<381	<381	<381	**<381**	<381	<381	<381	<381	**<381**	**<381**	<381
REX-MIP-08 (5-5.5 ft)	12/21/17	<374	**<374**	<374	<374	<374	<374	**<374**	<374	<374	<374	<374	**<374**	**<374**	<374
REX-MIP-08 (9.5-10 ft)	12/21/17	<399	**<399**	<399	<399	<399	<399	**<399**	<399	<399	<399	<399	**<399**	**<399**	<399
WETZ-GW-01 (10-15 ft)	03/27/18	<337	**<337**	<337	<337	<337	<337	**<337**	<337	<337	<337	<337	**<337**	**<337**	<337
WETZ-GW-02 (10-15 ft)	03/27/18	<343	**<343**	<343	<343	<343	<343	**<343**	<343	<343	<343	<343	**<343**	**<343**	<343
Screening Levels:															
DEQ DC Screening Level		630,000	2,700	480,000	39,000	NA	130,000	130	7,300	180,000	NA	2,600	1,200	19,000	5,100,000
DEQ Leaching Screening Level		17,000	1.6	39,000	890	NA	690,000	7,500	1,500	5,800	NA	720	8.2	230	61,000

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
SVOC ï semi-volatile organic compound
εg/kg - micrograms per kilogram

TABLE 8-6. SUBSURFACE SOIL - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	2,4-Dimethyl-phenol (εg/kg)	Dimethyl Phthalate (εg/kg)	Di-n-butyl-phthalate (εg/kg)	2-Methyl-4,6-dinitro phenol (εg/kg)	2,4-Dinitro-phenol (εg/kg)	2,4-Dinitro Toluene (εg/kg)	2,6-Dinitro Toluene (εg/kg)	Di-n-octyl-phthalate (εg/kg)	1,2-Diphenyl hydrazine (εg/kg)	Fluor-anthene (εg/kg)	Fluorene (εg/kg)	Hexachloro Benzene (εg/kg)	Hexachloro-butadiene (εg/kg)	Hexachloro-ethane (εg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	<384	<384	<384	**<1980 UJ**	<384 UJ	**<384**	**<384**	<384 UJ	**<384 UJ**	<384	<384	**<384**	**<384**	**<384**
ALSCO-GW-03 (2-2.8 ft)	11/30/17	<365	<365	<365	**<1880 UJ**	<365 UJ	**<365**	**<365**	<365 UJ	**<365 UJ**	<365	<365	**<365**	**<365**	**<365**
ALSCO-GW-04 (14-15 ft)	11/29/17	<403	<403	<403	**<2080 UJ**	<403 UJ	**<403**	**<403**	<403 UJ	**<403 UJ**	<403	<403	**<403**	**<403**	**<403**
BSL-MIP-09 (12-12.5 ft)	03/29/18	<352	<352	<352	**<1810 UJ**	<352 UJ	**<352**	**<352**	<352	**<352**	<352	<352	**<352**	**<352**	**<352**
BSL-MIP-09 (16-16.5 ft)	03/29/18	<363	<363	<363	**<1870 UJ**	<363 UJ	**<363**	**<363**	<363	**<363**	<363	<363	**<363**	**<363 UJ**	**<363**
BSL-MIP-09 (25-25.5 ft)	03/29/18	<355	<355	<355	**<1830 UJ**	<355 UJ	**<355**	**<355**	<355	**<355**	<355	<355	**<355**	**<355**	**<355**
BSL-MIP-09 (8-8.5 ft)	03/29/18	<346	<346	<346	**<1780 UJ**	<346 UJ	**<346**	**<346**	<346	**<346**	<346	<346	**<346**	**<346**	**<346**
BSL-MIP-20 (14-15 ft)	12/04/17	<407	<407	<407	**<2100**	<407	**<407**	**<407**	<407	**<407**	<407	<407	**<407**	**<407**	**<407**
CAL-MIP-04 (14-14.5 ft)	11/28/17	<407	<407	<407	**<2100**	<407	**<407**	**<407**	<407 UJ	**<407 UJ**	<407	<407	**<407**	**<407**	**<407**
CAL-MIP-04 (23-23.5 ft)	11/28/17	<366	<366	<366	**<1890**	<366	**<366**	**<366**	<366 UJ	**<366 UJ**	<366	<366	**<366**	**<366**	**<366**
CAL-MIP-04 (3-3.5 ft)	11/28/17	<398	<398	<398	**<2050**	<398	**<398**	**<398**	<398 UJ	**<398 UJ**	<398	<398	**<398**	**<398**	**<398**
CAL-MIP-04 (6-6.5 ft)	11/28/17	<400	<400	<400	**<2060**	<400	**<400**	**<400**	<400 UJ	**<400 UJ**	<400	<400	**<400**	**<400**	**<400**
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	<422	<422	<422	**<2170**	<422	**<422**	**<422**	<422 UJ	**<422 UJ**	<422	<422	**<422**	**<422**	**<422**
D7HRC-MIP-01 (7-9 ft)	11/17/17	<398	<398	<398	**<2050**	<398	**<398**	**<398**	<398	**<398**	<398	<398	**<398**	**<398**	**<398**
HLS-GW-03 (7-8 ft)	12/01/17	<390	<390	<390	**<2010 UJ**	<390 UJ	**<390**	**<390**	<390 UJ	**<390 UJ**	292 J	<390	**<390**	**<390**	**<390**
HLS-GW-04 (3-4 ft)	12/01/17	<378	<378	<378	**<1950 UJ**	<378 UJ	**<378**	**<378**	<378 UJ	**<378 UJ**	274 J	<378	**<378**	**<378**	**<378**
REX-MIP-08 (17-17.5 ft)	12/21/17	<365	<365	<365	**<1880 UJ**	<365 UJ	**<365**	**<365**	<365	**<365**	<365 UJ	<365	**<365 UJ**	**<365**	**<365 UJ**
REX-MIP-08 (23-23.5 ft)	03/28/18	<381	<381	<381	**<1960 UJ**	<381 UJ	**<381**	**<381**	<381	**<381**	<381	<381	**<381**	**<381**	**<381**
REX-MIP-08 (5-5.5 ft)	12/21/17	<374	<374	<374	**<1930 UJ**	<374 R	**<374**	**<374**	<374	**<374**	<374 UJ	<374	**<374 UJ**	**<374**	**<374 UJ**
REX-MIP-08 (9.5-10 ft)	12/21/17	<399	<399	<399	**<2060 UJ**	<399 UJ	**<399**	**<399**	<399	**<399**	<399 UJ	<399	**<399 UJ**	**<399**	**<399 UJ**
WETZ-GW-01 (10-15 ft)	03/27/18	<337	<337	<337	**<1730 UJ**	<337 UJ	**<337**	**<337**	<337	**<337**	<337	<337	**<337**	**<337**	**<337**
WETZ-GW-02 (10-15 ft)	03/27/18	<343	<343	<343	**<1770 UJ**	<343 UJ	**<343**	**<343**	<343	**<343**	<343	<343	**<343**	**<343**	**<343**
Screening Levels:															
DEQ DC Screening Level		130,000	NA	630,000	510	13,000	1,700	360	63,000	680	300,000	300,000	210	1,200	1,800
DEQ Leaching Screening Level		4,200	NA	23,000	26	440	3.2	0.67	570,000	2.5	85,000	35,000	1.2	96.4	2

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
SVOC ï semi-volatile organic compound
εg/kg - micrograms per kilogram

TABLE 8-6. SUBSURFACE SOIL - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Indeno-(1,2,3-cd) pyrene (εg/kg)	Isophorone (εg/kg)	1-Methyl-naphthalene (εg/kg)	2-Methyl-naphthalene (εg/kg)	2-Methyl phenol (εg/kg)	3,4-Methyl phenol (εg/kg)	Naphthalene (εg/kg)	2-Nitro-aniline (εg/kg)	3-Nitro-aniline (εg/kg)	4-Nitro-aniline (εg/kg)	Nitro-benzene (εg/kg)	2-Nitro-phenol (εg/kg)	4-Nitro-phenol (εg/kg)	N-Nitroso-dimethyl-amine (εg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	<384	**<384**	<384	<384	<384	<767	<384	<384 UJ	<384	**<384**	**<384**	<384	<384 UJ	**<384**
ALSCO-GW-03 (2-2.8 ft)	11/30/17	<365	**<365**	<365	<365	<365	<730	<365	<365 UJ	<365	**<365**	**<365**	<365	<365 UJ	**<365**
ALSCO-GW-04 (14-15 ft)	11/29/17	<403	**<403**	<403	<403	<403	<807	<403	<403 UJ	<403	**<403**	**<403**	<403	<403 UJ	**<403**
BSL-MIP-09 (12-12.5 ft)	03/29/18	<352	**<352**	<352	<352	<352	<704	<352	<352	<352	**<352**	**<352**	<352	<352	**<352**
BSL-MIP-09 (16-16.5 ft)	03/29/18	<363	**<363 UJ**	<363	<363 UJ	<363	<727	<363 UJ	<363	<363	**<363**	**<363 UJ**	<363	<363	**<363**
BSL-MIP-09 (25-25.5 ft)	03/29/18	<355	**<355**	<355	<355	<355	<709	<355	<355	<355	**<355**	**<355**	<355	<355	**<355**
BSL-MIP-09 (8-8.5 ft)	03/29/18	<346	**<346**	<346	<346	<346	<691	<346	<346	<346	**<346**	**<346**	<346	<346	**<346**
BSL-MIP-20 (14-15 ft)	12/04/17	<407	**<407**	400	72.1	<407	<814	<407	<407	<407	**<407**	**<407**	<407	<407	**<407**
CAL-MIP-04 (14-14.5 ft)	11/28/17	<407	**<407**	<407	<407	<407	<814	<407	<407 UJ	<407	**<407**	**<407**	<407	<407 UJ	**<407**
CAL-MIP-04 (23-23.5 ft)	11/28/17	<366	**<366**	<366	<366	<366	<733	<366	<366 UJ	<366	**<366**	**<366**	<366	<366 UJ	**<366**
CAL-MIP-04 (3-3.5 ft)	11/28/17	<398	**<398**	<398	<398	<398	<796	<398	<398 UJ	<398	**<398**	**<398**	<398	<398 UJ	**<398**
CAL-MIP-04 (6-6.5 ft)	11/28/17	<400	**<400**	<400	<400	<400	<801	<400	<400 UJ	<400	**<400**	**<400**	<400	<400 UJ	**<400**
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	<422	**<422**	<422	<422	<422	<844	<422	<422 UJ	<422	**<422**	**<422**	<422	<422 UJ	**<422**
D7HRC-MIP-01 (7-9 ft)	11/17/17	<398	**<398**	<398	<398	<398	<795	<398	<398	<398	**<398**	**<398**	<398	<398	**<398**
HLS-GW-03 (7-8 ft)	12/01/17	102 J	**<390**	<390	<390	<390	<781	<390	<390 UJ	<390	**<390**	**<390**	<390	<390 UJ	**<390**
HLS-GW-04 (3-4 ft)	12/01/17	79.9 J	**<378**	<378	<378	<378	<756	<378	<378 UJ	<378	**<378**	**<378**	<378	<378 UJ	**<378**
REX-MIP-08 (17-17.5 ft)	12/21/17	<365 UJ	**<365**	268 J	<365	<365	<730	<365 UJ	<365	<365	**<365**	**<365**	<365	<365	**<365**
REX-MIP-08 (23-23.5 ft)	03/28/18	<381	**<381**	<381	<381	<381	<761	<381	<381	<381	**<381**	**<381**	<381	<381	**<381**
REX-MIP-08 (5-5.5 ft)	12/21/17	<374 UJ	**<374**	<374	<374	<374	<748	<374	<374	<374	**<374**	**<374**	<374	<374	**<374**
REX-MIP-08 (9.5-10 ft)	12/21/17	<399 UJ	**<399**	<399	<399	<399	<798	<399	<399	<399	**<399**	**<399**	<399	<399	**<399**
WETZ-GW-01 (10-15 ft)	03/27/18	<337	**<337**	<337	<337	<337	<673	<337	<337	<337	**<337**	**<337**	<337	<337	**<337**
WETZ-GW-02 (10-15 ft)	03/27/18	<343	**<343**	<343	<343	<343	<686	<343 UJ	<343	<343	**<343**	**<343**	<343	<343	**<343**
Screening Levels:															
DEQ DC Screening Level		1,300	570,000	20,000	30,000	320,000	NA	4,300	63,000	NA	27,000	5,100	NA	NA	2
DEQ Leaching Screening Level		77,000	260	2,100	6,900	7,500	NA	12,000	800	NA	16	0.92	NA	NA	0.00027

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
SVOC ï semi-volatile organic compound
εg/kg - micrograms per kilogram

TABLE 8-6. SUBSURFACE SOIL - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	N-Nitrosodi-n-propyl-amine (εg/kg)	N-Nitroso-diphenyl-amine (εg/kg)	2,2'-oxybis(1-Chloropropane) (εg/kg)	Penta-chloro-phenol (εg/kg)	Phen-anthrene (εg/kg)	Phenol (εg/kg)	Pyrene (εg/kg)	1,2,4-Trichloro-benzene (εg/kg)	2,4,5-Tri-chloro-phenol (εg/kg)	2,4,6-Tri-chloro-phenol (εg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	**<384**	<384	<384	**<779**	<384	<384	<384	<384	<384	**<384**
ALSCO-GW-03 (2-2.8 ft)	11/30/17	**<365**	<365	<365	**<741 UJ**	<365	<365	76.7 J	<365	<365 UJ	**<365 UJ**
ALSCO-GW-04 (14-15 ft)	11/29/17	**<403**	<403	<403	**<819**	<403	<403	<403	<403	<403	**<403**
BSL-MIP-09 (12-12.5 ft)	03/29/18	**<352**	<352	<352 UJ	**<715**	<352	<352	<352	<352	<352	**<352**
BSL-MIP-09 (16-16.5 ft)	03/29/18	**<363**	<363	<363 UJ	**<738**	<363	<363	<363	<363 UJ	<363	**<363**
BSL-MIP-09 (25-25.5 ft)	03/29/18	**<355**	<355	<355 UJ	**<720**	<355	<355	<355	<355	<355	**<355**
BSL-MIP-09 (8-8.5 ft)	03/29/18	**<346**	<346	<346 UJ	**<702**	<346	<346	<346	<346	<346	**<346**
BSL-MIP-20 (14-15 ft)	12/04/17	**<407**	<407	<407	**<826**	<407	<407	<407	<407	<407	**<407**
CAL-MIP-04 (14-14.5 ft)	11/28/17	**<407**	<407	<407	**<827**	<407	<407	<407	<407	<407	**<407**
CAL-MIP-04 (23-23.5 ft)	11/28/17	**<366**	<366	<366	**<744**	<366	<366	<366	<366	<366	**<366**
CAL-MIP-04 (3-3.5 ft)	11/28/17	**<398**	<398	<398	**<808**	<398	<398	<398	<398	<398	**<398**
CAL-MIP-04 (6-6.5 ft)	11/28/17	**<400**	<400	<400	**<813**	<400	<400	<400	<400	<400	**<400**
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	**<422**	<422	<422	**<857**	<422	<422	<422	<422	<422	**<422**
D7HRC-MIP-01 (7-9 ft)	11/17/17	**<398**	<398	<398	**<807**	<398	<398	<398	<398	<398	**<398**
HLS-GW-03 (7-8 ft)	12/01/17	**<390**	<390	<390	**<793**	191 J	<390	266 J	<390	<390	**<390**
HLS-GW-04 (3-4 ft)	12/01/17	**<378**	<378	<378	**<768**	170 J	<378	262 J	<378	<378	**<378**
REX-MIP-08 (17-17.5 ft)	12/21/17	**<365**	<365	<365	**<741**	<365	<365	<365	<365	<365	**<365**
REX-MIP-08 (23-23.5 ft)	03/28/18	**<381**	<381	<381 UJ	**<773**	<381	<381	<381	<381	<381	**<381**
REX-MIP-08 (5-5.5 ft)	12/21/17	**<374**	<374	<374	**<759**	<374	<374	<374	<374	<374	**<374**
REX-MIP-08 (9.5-10 ft)	12/21/17	**<399**	<399	<399	**<810**	<399	<399	<399	<399	<399	**<399**
WETZ-GW-01 (10-15 ft)	03/27/18	**<337**	<337	<337	**<683**	<337	<337	<337	<337	<337	**<337**
WETZ-GW-02 (10-15 ft)	03/27/18	**<343**	<343	<343	**<696**	<343	<343	<343	<343	<343	**<343**
Screening Levels:											
DEQ DC Screening Level		78	110,000	310,000	1,000	NA	1,900,000	220,000	24,000	630,000	49,000
DEQ Leaching Screening Level		0.081	670	2,600	14	NA	33,000	83,000	2,000	40,000	40

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
SVOC ï semi-volatile organic compound
εg/kg - micrograms per kilogram

TABLE 8-7. SUBSURFACE SOIL - PETROLEUM ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	C5-C8, Aliphatic, Adjusted (mg/kg)	C9-C10, Aromatic, Unadjusted (mg/kg)	C9-C12, Aliphatic, Adjusted (mg/kg)	C11-C22, Aromatic, Unadjusted (mg/kg)	C9-C18, Aliphatic, Unadjusted (mg/kg)	C19-C36, Aliphatic, Unadjusted (mg/kg)	Total Extractable Hydrocarbon (mg/kg)	Total Purgeable Hydrocarbon (mg/kg)	Benzene (mg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	<5.6	<1.1	<5.6	--	--	--	27.9	<11.3	<0.028
ALSCO-GW-03 (2-2.8 ft)	11/30/17	<5.3	<1.1	<5.3	41.4 J	**<120**	96J/ND(120)U*	<360	<10.7	<0.027
ALSCO-GW-04 (14-15 ft)	11/29/17	<6	<1.2	<6	--	--	--	11.3 J	<11.9	<0.03
BSL-MIP-09 (12-12.5 ft)	03/29/18	<5.3	<1.1	<5.3	--	--	--	58.5 J+	<10.5	<0.026
BSL-MIP-09 (16-16.5 ft)	03/29/18	2.4 J	<1	<5.2	--	--	--	19.1 J+	2.2 J	<0.026
BSL-MIP-09 (25-25.5 ft)	03/29/18	<5.1	<1	<5.1	--	--	--	13.7 J+	<10.3	<0.026
BSL-MIP-09 (8-8.5 ft)	03/29/18	1.1 J	<1	<5.2	--	--	--	56.5 J+	0.99 J	<0.026
BSL-MIP-20 (14-15 ft)	12/04/17	**105**	51.4	42.3	--	--	--	28.5	211	**<0.3**
CAL-MIP-04 (14-14.5 ft)	11/28/17	<6.1	<1.2	<6.1	--	--	--	<12.1	<12.2	<0.03
CAL-MIP-04 (23-23.5 ft)	11/28/17	<5.1	<1	<5.1	--	--	--	--	<10.2	<0.025
CAL-MIP-04 (3-3.5 ft)	11/28/17	<5.6	<1.1	<5.6	--	--	--	<11.7	<11.3	<0.028
CAL-MIP-04 (6-6.5 ft)	11/28/17	<6	<1.2	<6	--	--	--	<12.1	<11.9	<0.03
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	<6.1	<1.2	<6.1	--	--	--	3.9 J	<12.2	<0.03
D7HRC-MIP-01 (7-9 ft)	11/17/17	<5.7	<1.1	<5.7	--	--	--	<11.7	<11.4	<0.029
HLS-GW-03 (7-8 ft)	12/01/17	<5.8	<1.2	<5.8	--	--	--	4.5 J	<11.7	<0.029
HLS-GW-04 (3-4 ft)	12/01/17	<5.7	<1.1	<5.7	--	--	--	9.1 J	<11.4	<0.029
REX-MIP-08 (17-17.5 ft)	12/21/17	**98.7**	47.2 J-	**81.4**	--	--	--	--	241	**<0.13**
REX-MIP-08 (17-17.5 ft)	03/28/18	--	--	--	--	--	--	54.5 J+	--	--
REX-MIP-08 (23-23.5 ft)	12/21/17	<5.3	0.03 J-	<5.3	--	--	--	--	<10.7	<0.027
REX-MIP-08 (23-23.5 ft)	03/28/18	--	--	--	--	--	--	11.6 J+	--	--
REX-MIP-08 (5-5.5 ft)	12/21/17	3.3 J	5.8 J-	14.2	--	--	--	--	26.6	0.02 J
REX-MIP-08 (5-5.5 ft)	03/28/18	--	--	--	--	--	--	58.7 J+	--	--
REX-MIP-08 (9.5-10 ft)	12/21/17	<5.5	<1.1 UJ	<5.5	--	--	--	--	<11	<0.028
REX-MIP-08 (9.5-10 ft)	03/28/18	--	--	--	--	--	--	15.4 J+	--	--
WETZ-GW-01 (10-15 ft)	03/27/18	<5	<0.99	<5	--	--	--	<20.1	<9.9	<0.025
WETZ-GW-02 (10-15 ft)	03/27/18	<51.2	35.8	70.5	--	--	--	4.5 J	126	**<0.26**
Screening Levels:										
DEQ Leaching Screening Level		220	130	11,000	370	53,000	NA	NA	NA	0.07
DEQ DC Screening Level		52	130	77	490	110	24,000	NA	NA	1.3

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
mg/kg - milligrams per kilogram
C## - Indicates petroleum compound size range, in terms of the number of carbons per molecule
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-7. SUBSURFACE SOIL - PETROLEUM ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Ethyl- benzene (mg/kg)	MTBE (mg/kg)	Naphthalene (mg/kg)	Toluene (mg/kg)	m,p-Xylene (mg/kg)	o-Xylene (mg/kg)	Xylenes, Total (mg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	<0.056	<0.056	0.021J/ND(0.68)U*	<0.056	<0.11	<0.11	<0.23
ALSCO-GW-03 (2-2.8 ft)	11/30/17	<0.053	<0.053	<0.64	<0.053 UJ	<0.11	<0.11	<0.21
ALSCO-GW-04 (14-15 ft)	11/29/17	<0.06	<0.06	<0.71	<0.06	<0.12	<0.12	<0.24
BSL-MIP-09 (12-12.5 ft)	03/29/18	<0.053	<0.053	<0.63	<0.053	<0.11	<0.11	<0.21
BSL-MIP-09 (16-16.5 ft)	03/29/18	<0.052	<0.052	<0.62	<0.052	<0.1	<0.1	<0.21
BSL-MIP-09 (25-25.5 ft)	03/29/18	<0.051	<0.051	<0.62	<0.051	<0.1	<0.1	<0.21
BSL-MIP-09 (8-8.5 ft)	03/29/18	<0.052	<0.052	<0.63	<0.052	<0.1	<0.1	<0.21
BSL-MIP-20 (14-15 ft)	12/04/17	4.5	**<0.61**	4.1	<0.61	2.6	<1.2	2.6
CAL-MIP-04 (14-14.5 ft)	11/28/17	<0.061	<0.061	<0.73	<0.061	<0.12	<0.12	<0.24
CAL-MIP-04 (23-23.5 ft)	11/28/17	<0.051	<0.051	<0.61	<0.051	<0.1	<0.1	<0.2
CAL-MIP-04 (3-3.5 ft)	11/28/17	<0.056	<0.056	<0.68	<0.056	<0.11	<0.11	<0.23
CAL-MIP-04 (6-6.5 ft)	11/28/17	<0.06	<0.06	<0.72	<0.06	<0.12	<0.12	<0.24
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	<0.061	<0.061	<0.73	<0.061	<0.12	<0.12	<0.24
D7HRC-MIP-01 (7-9 ft)	11/17/17	<0.057	<0.057	0.03J/ND(0.69)U*	<0.057	<0.11	<0.11	<0.23
HLS-GW-03 (7-8 ft)	12/01/17	<0.058	<0.058	<0.7	<0.058	<0.12	<0.12	<0.23
HLS-GW-04 (3-4 ft)	12/01/17	<0.057	<0.057	<0.69	<0.057	<0.11	<0.11	<0.23
REX-MIP-08 (17-17.5 ft)	12/21/17	2 J	**<0.26**	1.6 J	<0.26	0.51 J	<0.52	<1
REX-MIP-08 (17-17.5 ft)	03/28/18	--	--	--	--	--	--	--
REX-MIP-08 (23-23.5 ft)	12/21/17	<0.053	<0.053	<0.64	<0.053	<0.11	<0.11	<0.21
REX-MIP-08 (23-23.5 ft)	03/28/18	--	--	--	--	--	--	--
REX-MIP-08 (5-5.5 ft)	12/21/17	<0.052	<0.052	0.046 J	<0.052	<0.1	<0.1	<0.21
REX-MIP-08 (5-5.5 ft)	03/28/18	--	--	--	--	--	--	--
REX-MIP-08 (9.5-10 ft)	12/21/17	<0.055	<0.055	<0.66	<0.055	<0.11	<0.11	<0.22
REX-MIP-08 (9.5-10 ft)	03/28/18	--	--	--	--	--	--	--
WETZ-GW-01 (10-15 ft)	03/27/18	<0.05	<0.05	0.029 J	<0.05	<0.099	<0.099	<0.2
WETZ-GW-02 (10-15 ft)	03/27/18	<0.51	**<0.51**	1.2 J	<0.51	<1	<1	<2
Screening Levels:								
DEQ Leaching Screening Level		26	0.078	12	21	NA	100	320
DEQ DC Screening Level		6.4	52	4.3	610	NA	65	72

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
mg/kg - milligrams per kilogram
C## - Indicates petroleum compound size range, in terms of the number of carbons per molecule
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-8. SUBSURFACE SOIL - METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Aluminum, Total (mg/kg)	Antimony, Total (mg/kg)	Arsenic, Total (mg/kg)	Barium, Total (mg/kg)	Beryllium, Total (mg/kg)	Cadmium, Total (mg/kg)	Chromium, Total (mg/kg)	Cobalt, Total (mg/kg)	Copper, Total (mg/kg)	Iron, Total (mg/kg)	Lead, Total (mg/kg)	Manganese, Total (mg/kg)	Mercury, Total (mg/kg)	Nickel, Total (mg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	13500	<1.1 UJ	5.9	108 J+	0.23 J	0.12 J	17.4	6.3	15.3	21400	10.9 J-	301 J+	0.014 J	15.1
ALSCO-GW-03 (2-2.8 ft)	11/30/17	5140	<1.1 UJ	2.5	98.4	0.053 J	0.069 J	9.2	3.7	10.3	7400	7.3 J-	243	0.0095 J	8.4
ALSCO-GW-04 (14-15 ft)	11/29/17	6460	<1.2 UJ	6.3	110 J+	0.054 J	0.03 J	16.8	5.4	9.3	14100	5.5 J-	273 J+	0.01 J	12.3
BSL-MIP-09 (12-12.5 ft)	03/29/18	4980	<1 UJ	2.4	87.4 J+	0.045 J	<0.16	8.8	3.6	9.4	7840	5.8	168	<0.02	7.7
BSL-MIP-09 (16-16.5 ft)	03/29/18	6100	<1 UJ	2.1	88 J+	0.067 J	<0.15	8.5	4	10.1	7700	5.4	226	<0.019	8.2
BSL-MIP-09 (25-25.5 ft)	03/29/18	4790	<1 UJ	3	135 J+	0.033 J	0.027 J	8.9	4	10	8560	4.9	158	<0.021	8.8
BSL-MIP-09 (8-8.5 ft)	03/29/18	3640	<1 UJ	1.6	62 J+	0.035 J	<0.15	6.8	2.7	6	5470	4.1	157	<0.018	5.8
BSL-MIP-20 (14-15 ft)	12/04/17	8050	<1.2	5.3	145	0.15	0.082	17.4	7	14.9	12000	9	248	0.018	17.2
CAL-MIP-04 (14-14.5 ft)	11/28/17	15300	<1.2 UJ	7.6	131 J+	0.28 J	0.15 J	17.2	6.7	18.9	23200	13.9 J-	241 J+	0.038	16.6
CAL-MIP-04 (23-23.5 ft)	11/28/17	6680	<1.1 UJ	11	146 J+	0.11 J	<0.16	14.1	4.9	12.9	11700	15.7 J-	665 J+	0.011 J	12.6
CAL-MIP-04 (3-3.5 ft)	11/28/17	11200	<1.2 UJ	6.5	126 J+	0.21 J	0.1 J	12.3	4.8	12.2	17000	10.2 J-	171 J+	0.022	11.1
CAL-MIP-04 (6-6.5 ft)	11/28/17	10300	<1.1 UJ	5	111 J+	0.18 J	0.07 J	11.9	4.9	9.8	16200	8.1 J-	256 J+	0.014 J	11.2
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	9420	<1.2 UJ	6.3	97.7 J+	0.14 J	0.098 J	11.3	5.1	11.2	17300	10.1 J-	230 J+	0.016 J	11.1
D7HRC-MIP-01 (7-9 ft)	11/17/17	7780	<1.2 UJ	5.8	103	0.15 J	0.099 J	10.1	5.1	10.9	14400	9	228	<0.024	11.1
HLS-GW-03 (7-8 ft)	12/01/17	7000	<1.1 UJ	6.6	131	0.14 J	0.18	8.8 JB	5.3	12.5	16000	10.5 J-	210	0.024	11.8
HLS-GW-04 (3-4 ft)	12/01/17	8540	<1.1 UJ	5.1	99.2	0.16 J	0.21	11.3 JB	5	11.5	14800	82.6 J-	280	0.028	11
REX-MIP-08 (17-17.5 ft)	12/21/17	2700	0.14 J-	1.6	52.1	<0.27	<0.16	9.2	2.8	5.9	5720	6.2	93.6	<0.019	4.6
REX-MIP-08 (23-23.5 ft)	03/28/18	5730	<1.1 UJ	4.3	91.5 J+	0.089 J	<0.16	13.5	4.2	9.9	9410	5.8	247	0.012 J	8.2
REX-MIP-08 (5-5.5 ft)	12/21/17	7950	<1.1 UJ	5.6	133	0.1 J	0.16 J	10.6	4.7	14.4	14900	20.3	311	0.12	11.1
REX-MIP-08 (9.5-10 ft)	12/21/17	7350	<1.2 UJ	5.5	111	0.11 J	0.091 J	9.9	5	11.7	15700	9.4	239	0.024	11.7
WETZ-GW-01 (10-15 ft)	03/27/18	6480	<0.97 UJ	3.4	139 J-	0.051 J	0.052J/ND (0.15)U*	14.8	4.4	10.9	10400	6.5	204	<0.02	8.8
WETZ-GW-02 (10-15 ft)	03/27/18	4950	<0.96 UJ	3.2	100 J-	0.068 J	0.022J/ND (0.14)U*	7.7	3.7	7.9	9630	4.7	248	<0.02	6.6
Screening Levels:															
DEQ DC Screening Level		25,900	3.1	22.5	1,500	16	7.1	120,000	10	310	24,400	154	1,800	1.1	150
DEQ Leaching Screening Level		300,000	2.7	22.5	429	32	3.8	1,800,000	10	460	24,400	140	880	1	66.7

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
Lead screening values for EPA residential and industrial RSLs revised to use DEQ's Blood Lead Guidance values (DEQ 2018)
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
mg/kg - milligrams per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-8. SUBSURFACE SOIL - METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Selenium, Total (mg/kg)	Silver, Total (mg/kg)	Thallium, Total (mg/kg)	Vanadium, Total (mg/kg)	Zinc, Total (mg/kg)
ALSCO-GW-02 (9-10 ft)	11/29/17	<1.1	<0.57	**<1.1**	30.6	59.9 J-
ALSCO-GW-03 (2-2.8 ft)	11/30/17	<1.1	<0.54	**<1.1 UJ**	18.6	25.5 J-
ALSCO-GW-04 (14-15 ft)	11/29/17	<1.2	<0.61	**<1.2**	31.1	26.7 J-
BSL-MIP-09 (12-12.5 ft)	03/29/18	<1	<0.52	**<1**	15.5	18.6
BSL-MIP-09 (16-16.5 ft)	03/29/18	<1	<0.51	**<1**	16.7	17.5
BSL-MIP-09 (25-25.5 ft)	03/29/18	<1	<0.52	**<1**	14.8	17.6
BSL-MIP-09 (8-8.5 ft)	03/29/18	<1	<0.5	**<1**	11.2	12.7
BSL-MIP-20 (14-15 ft)	12/04/17	<1.2	<0.62	**<1.2**	25.8	35.2
CAL-MIP-04 (14-14.5 ft)	11/28/17	<1.2	0.074 J	**<1.2**	31	69.7 J-
CAL-MIP-04 (23-23.5 ft)	11/28/17	<1.1	<0.54	**<1.1**	21.4	22.4 J-
CAL-MIP-04 (3-3.5 ft)	11/28/17	0.75 J	0.048 J	**<1.2**	24.9	45.3 J-
CAL-MIP-04 (6-6.5 ft)	11/28/17	<1.1	<0.57	**<1.1**	23.4	42.1 J-
CAL-MIP-04 (6-6.5 ft) Dup	11/28/17	<1.2	<0.6	**<1.2**	21.9	45.9 J-
D7HRC-MIP-01 (7-9 ft)	11/17/17	<1.2	<0.6	**<1.2**	19.2	42.4
HLS-GW-03 (7-8 ft)	12/01/17	<1.1	0.055 J	**<1.1 UJ**	17.5	47 J-
HLS-GW-04 (3-4 ft)	12/01/17	<1.1	0.056 J	**<1.1 UJ**	20.2	69 J-
REX-MIP-08 (17-17.5 ft)	12/21/17	<1.1 UJ	<0.53	**<1.1 UJ**	10.3	12.1 J-
REX-MIP-08 (23-23.5 ft)	03/28/18	<1.1	<0.54	**<1.1**	19.4	22.6
REX-MIP-08 (5-5.5 ft)	12/21/17	<1.1 UJ	0.09 J	**<1.1 UJ**	20	57.8 J-
REX-MIP-08 (9.5-10 ft)	12/21/17	<1.2 UJ	<0.6	**<1.2 UJ**	18.4	45.3 J-
WETZ-GW-01 (10-15 ft)	03/27/18	<0.97	<0.49	**<0.97**	21.5	19.9
WETZ-GW-02 (10-15 ft)	03/27/18	<0.96	<0.48	**<0.96**	18.8	21.6
Screening Levels:						
DEQ DC Screening Level		39	39	0.41	52.6	2,300
DEQ Leaching Screening Level		2.6	8.51	1.4	860	1,230

Notes:
Bold values exceed applicable screening levels, which were calculated using Montana Department of Environmental Quality (DEQ) Soil Screening Guidance (2016).
Lead screening values for EPA residential and industrial RSLs revised to use DEQ's Blood Lead Guidance values (DEQ 2018)
< - Analyte below the detection limit
ND - Non-detect samples with no reported detection limit
NA - Not applicable
J - Estimated concentration
J+/J- indicates estimated concentration possibly biased high/low, respectively
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concentration
JB - Estimated concentration due to blank contamination
ft - feet
PCE - tetrachloroethene
mg/kg - milligrams per kilogram
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 8-9. SURFACE AND SUBSURFACE SOILS - ANALYTICAL RESULTS FOR SPLP
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Matrix	1,1-Dichloro-ethene, SPLP (εg/L)	1,2-Dichloro-ethane, SPLP (εg/L)	1,4-Di-chloro-benzene, SPLP (εg/L)	2-Butanone, SPLP (εg/L)	Benzene, SPLP (εg/L)	Carbon tetrachloride, SPLP (εg/L)	Chloro-benzene, SPLP (εg/L)	Chloroform, SPLP (εg/L)	Tetrachloro-ethene, SPLP (εg/L)	Trichloro-ethene, SPLP (εg/L)	Vinyl Chloride, SPLP (εg/L)
BSL-MIP-09 (12-12.5 ft)	03/29/18	Subsurface Soil	<25	<25	<25	<125	<25	<25	<25	<25	15 J	<10	<5
CAL-MIP-04 (1-2 ft)	11/28/17	Surface Soil	<25	<25	<25	<125	<25	<25	<25	<25	5.3 J	<10	<5
CAL-MIP-04 (3-5 ft)	11/28/17	Subsurface Soil	<25	<25	<25	<125	<25	<25	<25	<25	<25	<10	<5
CAL-MIP-T03 (3.5-4.5 ft)	11/28/17	Subsurface Soil	<25	<25	<25	<125	<25	<25	<25	<25	<25	<10	<5
REX-MIP-08 (15-15.5 ft)	03/28/18	Subsurface Soil	<25	<25	<25	<125	<25	<25	<25	<25	<25	<10	<5

Notes:
< - Analyte below the detection limit
J - Estimated concentration
ft - feet
SPLP - Synthetic precipitation leaching procedure
εg/L - micrograms per liter

TABLE 9-1 THIRD QUARTER 2017 THROUGH THIRD QUARTER 2018 FLUID LEVELS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Location	Date Measured	Depth to Water (ft-bmp)	Water Elevation (ft-msl)	Depth Gauged (ft-bmp)
BMW07-1	7/25/2017	15.73	3123.50	23.50
BMW07-1	5/10/2018	15.00	3124.23	23.50
BMW07-1	9/14/2018	15.42	3123.81	23.50
BMW-1	7/25/2017	12.95	3125.76	20.15
BMW-1	5/10/2018	12.20	3126.51	20.15
BMW-1	9/14/2018	12.80	3125.91	20.15
BMW-4	7/25/2017	15.60	3123.36	19.85
BMW-4	5/10/2018	14.92	3124.04	19.85
BMW-4	9/14/2018	15.33	3123.63	19.85
BNMW-17	8/30/2017	15.46	3119.54	19.29
BNMW-17	5/08/2018	14.61	3120.39	19.29
BNMW-17	9/13/2018	15.50	3119.50	19.29
BNMW-20	8/30/2017	14.04	3120.36	NA
BNMW-20	5/08/2018	13.18	3121.22	NA
BNMW-20	9/13/2018	13.78	3120.62	22.58
BNMW-21	8/31/2017	14.50	3119.20	18.30
BNMW-21	5/08/2018	13.58	3120.12	18.30
BNMW-21	9/13/2018	14.17	3119.53	18.30
BNMW-23	7/25/2017	12.64	3117.84	19.69
BNMW-23	8/31/2017	12.99	3117.49	19.68
BNMW-23	5/08/2018	12.49	3117.99	19.68
BNMW-23	9/13/2018	12.95	3117.53	19.46
BNMW-24	8/30/2017	13.72	3117.93	NA
BNMW-7	8/30/2017	15.57	3119.70	19.97
BNMW-8	8/30/2017	14.93	3118.75	19.90
BNMW-8	5/08/2018	14.13	3119.55	19.90
BNMW-8	9/13/2018	14.69	3118.99	19.90
BNMW-9	8/30/2017	14.35	3118.03	20.80
BNMW-9	5/08/2018	13.59	3118.79	20.80
BNMW-9	9/13/2018	14.19	3118.19	20.80
BPGP02	8/31/2017	12.90	3136.53	19.98
BPGP02	5/11/2018	11.64	3137.79	19.98
BPGP02	9/14/2018	11.65	3137.78	19.76
BPGP04	7/25/2017	13.14	3136.73	21.52
BPGP05	7/25/2017	11.12	3135.30	21.90
BPGP08	7/25/2017	11.76	3132.74	20.69
BPGP08	5/10/2018	11.31	3133.19	20.69
BPGP08	9/12/2018	11.61	3132.89	20.48
BPGP12	7/25/2017	11.94	3131.45	23.67
BPGP12	5/09/2018	11.27	3132.12	23.67

TABLE 9-1 THIRD QUARTER 2017 THROUGH THIRD QUARTER 2018 FLUID LEVELS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Location	Date Measured	Depth to Water (ft-bmp)	Water Elevation (ft-msl)	Depth Gauged (ft-bmp)
BPGP12	5/21/2018	11.12	3132.27	23.67
BPGP12	9/12/2018	11.72	3131.67	23.45
BPGP15	7/25/2017	11.33	3130.57	19.57
BPGP15	5/08/2018	10.54	3131.36	19.57
BPGP15	9/11/2018	11.01	3130.89	19.34
BPGP16	7/25/2017	12.21	3126.90	19.39
BPGP16	5/08/2018	11.12	3127.99	19.39
BPGP16	9/11/2018	12.64	3126.47	19.38
BPGP17	7/25/2017	11.77	3127.97	22.28
BPGP17	5/08/2018	10.47	3129.27	22.28
BPGP17	9/11/2018	11.66	3128.08	22.04
BPGP22	7/25/2017	11.21	3128.65	21.99
BPGP22	5/08/2018	10.49	3129.37	21.99
BPGP22	9/14/2018	11.32	3128.54	21.77
BPGP24B	7/25/2017	13.05	3137.84	34.92
BPGP25	7/25/2017	11.93	3125.91	21.47
BPGP25	5/07/2018	10.10	3127.74	21.47
BPGP25	9/11/2018	12.00	3125.84	21.13
BPGP27	7/25/2017	11.31	3125.74	21.44
BPGP27	5/07/2018	8.49	3128.56	21.44
BPGP27	9/11/2018	11.38	3125.67	21.22
BPGP28	7/25/2017	11.23	3124.47	20.35
BPGP29	7/28/2017	11.95	3124.35	21.67
BPGP29	5/07/2018	10.81	3125.49	21.67
BPGP29	9/11/2018	11.90	3124.40	21.33
BPGP31	7/25/2017	12.00	3127.31	21.44
BPGP31	5/07/2018	10.38	3128.93	21.44
BPGP31	9/11/2018	11.91	3127.40	21.19
BPGP32	7/25/2017	13.22	3136.86	19.41
BPGP41	7/25/2017	11.73	3123.31	13.62
BPGP41	5/07/2018	10.68	3124.36	13.62
BPGP41	9/10/2018	11.96	3123.08	14.19
BPGP42	7/25/2017	13.29	3122.42	20.75
BPGP42	5/08/2018	12.52	3123.19	20.75
BPGP42	9/10/2018	11.47	3124.24	20.57
BPGP44	7/31/2017	12.79	3119.76	21.23
BPGP44	5/08/2018	12.58	3119.97	21.23
BPGP44	9/10/2018	12.89	3119.66	21.70
BPGP46	7/25/2017	12.92	3137.96	21.54
BPGP46	5/11/2018	13.57	3137.31	21.54

TABLE 9-1 THIRD QUARTER 2017 THROUGH THIRD QUARTER 2018 FLUID LEVELS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Location	Date Measured	Depth to Water (ft-bmp)	Water Elevation (ft-msl)	Depth Gauged (ft-bmp)
BPGP46	9/15/2018	13.69	3137.19	21.80
BPGP46b	7/25/2017	12.92	3137.94	34.64
BPGP46b	5/11/2018	13.54	3137.32	34.64
BPGP47	7/25/2017	10.20	3124.73	20.96
BPGP47	5/07/2018	9.41	3125.52	20.96
BPGP47	9/10/2018	12.02	3122.91	20.55
BPGP48	7/25/2017	10.63	3125.29	21.74
BPGP48	5/07/2018	8.99	3126.93	21.74
BPGP48	9/11/2018	10.70	3125.22	21.51
BPGP49	7/25/2017	13.01	3138.00	21.61
BPGP49	5/11/2018	13.58	3137.43	21.61
BPGP49	9/14/2018	13.76	3137.25	21.38
BPGP50	7/25/2017	14.37	3114.72	19.59
BPGP50	5/09/2018	14.43	3114.66	19.59
BPGP50	5/21/2018	14.29	3114.80	19.59
BPGP50	9/10/2018	14.47	3114.62	19.56
BPGP51	7/25/2017	12.92	3138.01	21.83
BPGP51	5/11/2018	13.66	3137.27	21.83
BPGP51	9/15/2018	13.73	3137.20	21.83
BPGP51B	7/25/2017	12.96	3137.99	27.57
BPGP51B	5/11/2018	13.66	3137.29	27.57
BPGP51B	9/14/2018	13.20	3137.75	27.57
BPGP52	7/25/2017	13.48	3136.39	27.32
BPGP53	7/25/2017	13.28	3136.80	27.20
BPGP53	5/10/2018	13.61	3136.47	27.20
BPGP53	9/14/2018	13.60	3136.48	27.01
BPGP54	7/25/2017	12.89	3136.81	27.30
BPGP58	7/25/2017	13.84	3137.57	22.21
BPGP59	7/25/2017	13.01	3136.73	22.25
BPGP59	5/10/2018	13.41	3136.33	22.25
BPGP59	9/14/2018	13.36	3136.38	22.07
BPGP60	7/25/2017	13.37	3136.70	22.33
BPGP60	5/10/2018	13.75	3136.32	22.33
BPGP60	9/14/2018	13.70	3136.37	22.11
BPGP61	7/25/2017	13.36	3137.48	17.63
BPGP61	5/11/2018	13.85	3136.99	17.63
BPGP61	9/14/2018	13.94	3136.90	17.00
BPGP63	7/25/2017	13.83	3136.73	19.96
BPGP63	5/11/2018	14.23	3136.33	19.96
BPGP63	9/14/2018	14.25	3136.31	19.96

TABLE 9-1 THIRD QUARTER 2017 THROUGH THIRD QUARTER 2018 FLUID LEVELS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Location	Date Measured	Depth to Water (ft-bmp)	Water Elevation (ft-msl)	Depth Gauged (ft-bmp)
BPGP63B	7/25/2017	13.97	3136.75	20.75
BPGP65	7/25/2017	12.81	3136.78	18.81
BPGP65	5/12/2018	13.25	3136.34	18.81
BPGP65	9/14/2018	12.32	3137.27	18.81
BPGP65B	7/25/2017	13.01	3136.80	29.89
BPGP65B	5/10/2018	13.39	3136.42	29.89
BPGP65B	9/14/2018	13.37	3136.44	29.62
BPGP66	7/25/2017	12.68	3136.77	19.52
BPGP67	7/25/2017	12.69	3136.68	25.91
BPGP67	5/10/2018	13.02	3136.35	25.91
BPGP67	9/14/2018	13.04	3136.33	25.65
BPGP72B	7/25/2017	12.11	NA	21.51
BPGP74	7/25/2017	7.86	3142.20	21.56
BPGP74	5/11/2018	12.92	3137.14	21.56
BPGP74	9/15/2018	12.89	3137.17	12.85
BPGP76	7/25/2017	7.00	3142.81	21.55
BPGP76	5/11/2018	12.61	3137.20	21.55
BPGP76	9/15/2018	12.65	3137.16	12.65
BPGP78	7/25/2017	12.60	3137.53	22.17
BPGP78	5/11/2018	12.91	3137.22	22.17
BPGP78	9/14/2018	12.77	3137.36	21.98
BPGP80	7/25/2017	11.98	3136.02	20.02
BPGP80	5/10/2018	12.02	3135.98	20.02
BPGP80	9/13/2018	12.13	3135.87	19.84
BPGP81	7/25/2017	11.86	3135.58	18.42
BPGP81	5/09/2018	11.87	3135.57	18.42
BPGP81	5/21/2018	11.64	3135.80	18.42
BPGP81	9/13/2018	11.93	3135.51	18.20
BPGP83	7/25/2017	12.59	3133.01	22.65
BPGP83	5/09/2018	12.45	3133.15	22.65
BPGP83	5/21/2018	12.28	3133.32	22.65
BPGP83	9/14/2018	12.62	3132.98	22.49
BPGP84	7/31/2017	11.77	3131.13	20.89
BPGP84	5/09/2018	10.95	3131.95	20.89
BPGP84	5/21/2018	11.09	3131.81	20.89
BPGP84	9/12/2018	11.66	3131.24	20.73
BPGP85	7/25/2017	11.34	3132.33	19.88
BPGP85	5/08/2018	10.78	3132.89	19.88
BPGP85	9/12/2018	11.09	3132.58	19.64
BPGP86	7/25/2017	11.84	3124.88	22.44

TABLE 9-1 THIRD QUARTER 2017 THROUGH THIRD QUARTER 2018 FLUID LEVELS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Location	Date Measured	Depth to Water (ft-bmp)	Water Elevation (ft-msl)	Depth Gauged (ft-bmp)
BPGP86	5/07/2018	10.82	3125.90	22.44
BPGP86	9/11/2018	11.88	3124.84	22.23
BPGP87	7/25/2017	12.92	3135.69	21.62
BPGP87	5/10/2018	13.83	3134.78	21.62
BPGP87	9/13/2018	13.01	3135.60	21.49
BPGP88	7/25/2017	11.29	3127.99	17.59
BPGP89	7/25/2017	13.97	3122.92	20.86
BPGP89	5/08/2018	13.12	3123.77	20.86
BPGP89	9/10/2018	13.86	3123.03	20.63
BPGP90	7/25/2017	12.68	3120.98	20.97
BPGP91	7/25/2017	14.35	3115.88	24.72
BPGP91	5/09/2018	14.44	3115.79	24.72
BPGP91	5/21/2018	14.30	3115.93	24.72
BPGP91	9/10/2018	14.46	3115.77	24.54
BPGP92	7/25/2017	11.09	3128.93	20.68
BPGP92	5/08/2018	9.98	3130.04	20.68
BPGP92	9/11/2018	10.90	3129.12	20.85
BPGP93	7/31/2017	11.68	3134.93	22.05
BPGP93	5/09/2018	11.75	3134.86	22.05
BPGP93	5/21/2018	11.51	3135.10	22.05
BPGP93	9/13/2018	11.85	3134.76	21.96
BPGP94	7/25/2017	12.69	3125.27	21.62
BPGP94	5/09/2018	11.69	3126.27	21.62
BPGP94	5/21/2018	11.43	3126.53	21.62
BPGP94	9/11/2018	12.70	3125.26	21.43
BPGW01	7/25/2017	13.12	3136.88	18.95
BPGW01	5/11/2018	13.42	3136.58	18.95
BPGW01	8/15/2018	13.30	3136.70	18.95
BPGW01	8/21/2018	13.30	3136.70	18.95
BPGW01	9/15/2018	13.55	3136.45	18.95
BPGW04	7/25/2017	10.75	3140.69	20.26
BPGW04	5/11/2018	11.37	3140.07	20.26
BPGW04	9/11/2018	11.64	3139.80	20.26
CENEX-5	7/24/2017	11.60	3147.16	20.22
EMW-03	7/24/2017	12.66	3148.97	20.00
EMW-03	5/07/2018	10.48	3151.15	20.00
EMW-03	9/12/2018	11.03	3150.60	20.00
EMW-09	7/25/2017	10.38	3140.48	22.83
EMW-09	5/11/2018	11.28	3139.58	22.83
EMW-09	9/11/2018	11.49	3139.37	22.83

TABLE 9-1 THIRD QUARTER 2017 THROUGH THIRD QUARTER 2018 FLUID LEVELS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Location	Date Measured	Depth to Water (ft-bmp)	Water Elevation (ft-msl)	Depth Gauged (ft-bmp)
EMW-11	7/25/2017	12.12	3132.53	26.07
EMW-15	7/25/2017	11.41	3130.76	18.55
EMW-18	7/25/2017	10.65	3111.46	21.22
EMW-18	5/10/2018	10.46	3111.65	21.22
EMW-18	9/14/2018	10.37	3111.74	21.22
EMW-21	7/25/2017	11.13	3111.63	24.11
EMW-26	7/25/2017	10.83	3110.94	17.19
EMW-28	7/25/2017	15.35	3122.13	20.85
EMW-28	5/09/2018	14.52	3122.96	20.85
EMW-28	5/21/2018	14.40	3123.08	20.85
EMW-28	9/13/2018	15.01	3122.47	16.40
EMW-32	8/31/2017	16.25	3121.83	20.03
EMW-32	5/10/2018	15.09	3122.99	20.03
EMW-32	9/13/2018	15.62	3122.46	20.03
GSMW-5	7/25/2017	12.80	3133.26	16.87
MW-100	5/07/2018	8.74	3151.28	NA
MW-100	9/14/2018	9.24	3150.78	NA
MW-101	5/07/2018	8.74	3151.57	NA
MW-101	9/12/2018	9.92	3150.39	NA
MW-102	5/07/2018	9.20	3150.69	NA
MW-102	9/11/2018	9.12	3150.77	NA
MW-103	5/11/2018	10.67	3139.78	NA
MW-103	9/11/2018	11.13	3139.32	NA
MW-104	5/10/2018	12.99	3134.24	NA
MW-104	9/11/2018	12.83	3134.40	23.61
MW-105	5/08/2018	11.75	NA	NA
MW-105	9/13/2018	11.99	NA	NA
MW-106	5/08/2018	14.80	3132.64	NA
MW-106	9/13/2018	14.74	3132.70	27.35
MW-107	5/10/2018	15.10	3130.08	NA
MW-107	9/12/2018	15.49	3129.69	NA
MW-108	5/10/2018	13.60	3128.34	NA
MW-108	9/12/2018	14.13	3127.81	NA
MW-109	5/09/2018	16.70	3121.19	NA
MW-109	5/22/2018	16.63	3121.26	NA
MW-109	9/14/2018	17.09	3120.80	28.70
MW-110	5/09/2018	16.07	3118.50	NA
MW-110	5/22/2018	16.01	3118.56	NA
MW-110	9/13/2018	16.03	3118.54	NA
MW-111	5/10/2018	13.52	3113.81	NA

TABLE 9-1 THIRD QUARTER 2017 THROUGH THIRD QUARTER 2018 FLUID LEVELS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Location	Date Measured	Depth to Water (ft-bmp)	Water Elevation (ft-msl)	Depth Gauged (ft-bmp)
MW-111	9/12/2018	14.11	3113.22	23.70
MW-112	5/09/2018	6.21	3109.19	NA
MW-112	5/22/2018	6.02	3109.38	NA
MW-112	9/12/2018	6.90	3108.50	18.15
MW-113	5/09/2018	2.76	3109.05	NA
MW-113	5/22/2018	2.48	3109.33	NA
MW-113	9/13/2018	3.55	3108.26	13.85
MW-114	5/09/2018	14.12	3113.57	NA
MW-114	5/22/2018	13.98	3113.71	NA
MW-114	9/12/2018	14.61	3113.08	24.15
MW-115	5/09/2018	9.32	3109.33	NA
MW-115	5/22/2018	9.14	3109.51	NA
MW-115	9/13/2018	9.62	3109.03	23.60
MW-116	5/08/2018	12.99	3115.23	NA
MW-116	9/12/2018	12.65	3115.57	23.10
MW-117	5/10/2018	11.82	3111.70	NA
MW-117	9/14/2018	11.87	3111.65	22.34
MW-118	5/10/2018	15.58	3112.92	NA
MW-118	9/14/2018	15.63	3112.87	23.77
MW-119	5/10/2018	14.20	3116.38	NA
MW-119	9/14/2018	14.49	3116.09	NA
MW-120	5/07/2018	9.54	3123.69	NA
MW-120	9/14/2018	10.24	3122.99	21.67
MW-121	5/10/2018	10.76	3132.44	NA
MW-121	9/14/2018	11.29	3131.91	NA
MW-122	5/11/2018	11.19	3134.93	NA
MW-122	9/14/2018	11.56	3134.56	NA
MW-123	5/08/2018	11.17	3141.21	NA
MW-123	9/11/2018	12.41	3139.97	NA
MW-124	5/07/2018	8.65	3149.04	NA
MW-124	9/12/2018	9.73	3147.96	23.64
MW-125	5/10/2018	12.18	3135.28	NA
MW-125	9/11/2018	11.89	3135.57	NA
MW-126	5/11/2018	32.73	3116.08	NA
MW-126	5/12/2018	32.64	3116.17	NA
MW-126	6/20/2018	17.05	3131.76	NA
MW-126	6/25/2018	16.19	3132.62	NA
MW-126	7/09/2018	16.57	3132.24	NA
MW-126	7/16/2018	14.14	3134.67	NA
MW-126	8/15/2018	13.37	3135.44	NA

TABLE 9-1 THIRD QUARTER 2017 THROUGH THIRD QUARTER 2018 FLUID LEVELS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Location	Date Measured	Depth to Water (ft-bmp)	Water Elevation (ft-msl)	Depth Gauged (ft-bmp)
MW-126	8/21/2018	13.31	3135.50	NA
MW-126	9/11/2018	32.98	3115.83	NA
MW-127	5/12/2018	42.08	3108.57	NA
MW-127	6/14/2018	42.55	3108.10	NA
MW-127	6/20/2018	26.45	3124.20	NA
MW-127	6/25/2018	21.39	3129.26	NA
MW-127	7/09/2018	18.25	3132.40	NA
MW-127	7/16/2018	16.19	3134.46	NA
MW-127	8/13/2018	15.24	3135.41	NA
MW-127	8/15/2018	14.89	3135.76	NA
MW-127	8/21/2018	14.45	3136.20	NA
MW-127	9/11/2018	40.63	3110.02	NA
MW-128	5/09/2018	8.10	3142.77	NA
MW-128	5/22/2018	7.59	3143.28	NA
MW-128	9/11/2018	8.89	3141.98	23.42
MW-129	5/23/2018	12.70	3129.24	NA
MW-129	9/14/2018	13.56	3128.38	26.01
MW-130	5/23/2018	11.42	3158.08	NA
MW-130	9/12/2018	11.25	3158.25	NA
MW-132	5/23/2018	10.88	3111.83	NA
MW-132	9/13/2018	11.31	3111.40	22.11
MW-133	5/23/2018	10.28	3111.54	NA
MW-133	9/13/2018	10.71	3111.11	20.50
MW-134	5/23/2018	7.80	3110.17	NA
MW-134	9/13/2018	7.58	3110.39	18.82
MW-135	5/23/2018	11.36	3126.79	NA
MW-135	9/14/2018	13.14	3125.01	26.25
PAI-WEST	9/15/2018	10.01	NA	23.12
PEP07	7/25/2017	11.56	3130.20	23.25
PEP07	5/11/2018	10.81	3130.95	23.25
PEP07	9/14/2018	11.54	3130.22	23.25
REGAL-I-01	5/09/2018	14.45	3156.77	NA
REGAL-I-01	5/21/2018	15.24	3155.98	NA
REGAL-I-01	9/13/2018	13.38	3157.84	NA
RH-MW-1	7/25/2017	14.21	3112.46	20.15
RH-MW-1	5/09/2018	13.73	3112.94	20.15
RH-MW-1	5/22/2018	13.68	3112.99	20.15
RH-MW-1	9/12/2018	14.21	3112.46	20.15
RH-MW-3	7/25/2017	14.62	3112.50	19.90
RH-MW-3	5/09/2018	14.15	3112.97	19.90

TABLE 9-1 THIRD QUARTER 2017 THROUGH THIRD QUARTER 2018 FLUID LEVELS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Location	Date Measured	Depth to Water (ft-bmp)	Water Elevation (ft-msl)	Depth Gauged (ft-bmp)
RH-MW-3	5/22/2018	14.03	3113.09	19.90
RH-MW-3	9/12/2018	14.63	3112.49	19.90
RH-MW-7	7/25/2017	13.65	3112.70	20.07
RH-MW-7	5/09/2018	13.17	3113.18	20.07
RH-MW-7	5/22/2018	13.05	3113.30	20.07
RH-MW-7	9/12/2018	13.65	3112.70	20.07
SD-I-01	8/01/2017	14.54	3141.98	25.40
SD-I-01	5/08/2018	12.45	3144.07	25.40
SD-I-01	9/12/2018	12.93	3143.59	26.12
SD-I-02	8/01/2017	11.96	3142.80	NA
SD-I-02	5/08/2018	8.84	3145.92	NA
SD-I-02	9/12/2018	9.70	3145.06	NA
SMW12	7/31/2017	12.89	3136.87	22.71
SMW12	5/11/2018	13.31	3136.45	22.71
SMW12	9/11/2018	13.25	3136.51	22.71
SYS-EMW-03	5/09/2018	9.33	3157.85	NA
SYS-EMW-03	5/22/2018	8.91	3158.27	NA
SYS-EMW-03	9/12/2018	8.29	3158.89	13.80
Whiteley MW-1	7/25/2017	14.56	3113.63	19.50
Whiteley MW-2	7/25/2017	15.32	3113.45	17.09
ZPMW-1	7/24/2017	11.60	3146.80	20.07
ZPMW-1	5/09/2018	9.71	3148.69	20.07
ZPMW-1	5/22/2018	9.06	3149.34	20.07
ZPMW-1	9/12/2018	10.15	3148.25	20.07

TABLE 9-2. GROUNDWATER - EPH/VPH ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Benzene (εg/L)	Naphthalene (εg/L)	C5-C8, Aliphatic, Adjusted (εg/L)	C9-C10, Aromatic, Unadjusted (εg/L)	C9-C12, Aliphatic, Adjusted (εg/L)	Ethyl-benzene (εg/L)	m,p-Xylene (εg/L)	MTBE (εg/L)	o-Xylene (εg/L)	Toluene (εg/L)	Total Purgeable Hydrocarbon (εg/L)	Xylenes, Total (εg/L)	C9-C18, Aliphatic, Unadjusted (εg/L)	C11-C22, Aromatic, Unadjusted (εg/L)
BMW07-1	07/29/17	**<0.5**	**<5**	35.8 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	31.7 J+	<2	--	--
BMW-1	07/29/17	**<0.5**	**<5**	45.4 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	40.4 J+	<2	--	--
BMW-4	07/28/17	**1.4**	**<5**	35	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	34	<2	--	--
BNMW-17	08/30/17	**<0.5**	**6.5 J-**	<20	22.1	37.9	<0.5	<0.5	<1	<0.5	<0.5	104 JB	<2	469	495
	05/08/18	**<0.5**	**<5**	<20	18.2 J	7.6 J	<0.5	<0.5	<1	<0.5	<0.5	39	<2	684	121 J
	09/13/18	**<0.5**	**4 J**	5.5 J	42.5	38.9	<0.5	<0.5	<1	<0.5	<0.5	107	<2	71.4 J	**1500 J**
BNMW-20	08/30/17	**<0.5**	**<5 UJ**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
BNMW-21	08/31/17	**<0.5**	**<5**	21.2	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
BNMW-23	08/31/17	**<0.5**	**<5**	298 J+	202 J+	71.4 J+	**6.8 J+**	<0.5	<1	<0.5	<0.5	587 J+	<2	--	--
BNMW-24	08/30/17	**<0.5**	**<5 UJ**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
BNMW-8	08/30/17	**<0.5**	**<5 UJ**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
BNMW-8 Dup	08/30/17	**<0.5**	**<5 UJ**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
BNMW-9	08/30/17	**<0.5**	**<5 UJ**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
BPGP02	08/31/17	**140**	**35.7**	**1510**	819	244	**263**	94.1	<5	6.8	12.7	3110	**101**	--	--
	05/11/18	**49.9**	**21.9**	505	240	107	**154**	132	<1	4	8.8	1270	**136**	--	--
	09/14/18	**148 J-**	**20.2 J-**	**1210**	434 J-	407	**207**	109 J-	<1	7.9 J-	15.9 J-	2630 J-	**117 J-**	--	--
BPGP05	07/26/17	**<0.5**	**<5**	176 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	157 J+	<2	--	--
BPGP12	07/28/17	**<0.5**	**<5**	208 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	184 J+	<2	--	--
BPGP15	07/28/17	**<0.5**	**<5**	21.6	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
BPGP16	07/30/17	**<0.5**	**<5**	160 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	142 J+	<2	--	--
BPGP17	07/30/17	**<0.5**	**<5**	42 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	37.1 J+	<2	--	--
BPGP22	07/30/17	**<0.5**	**<5**	92 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	81.7 J+	<2	--	--
BPGP32	07/26/17	**<0.5**	**<5**	27.3	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	24.2	<2	--	--
BPGP41	07/28/17	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
BPGP42	07/28/17	**<0.5**	**<5**	87.8 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	77.6 J+	<2	--	--
BPGP44	07/31/17	**<0.5**	**<5**	57.7 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	51.4 J+	<2	--	--
BPGP46	07/27/17	**<0.5**	**<5**	**1930**	63.3	<20	<0.5	<0.5	**14.1 J**	<0.5	<0.5	1720	<2	--	--
	05/11/18	**1.6**	**<5**	401	66	27.3	<0.5	<0.5	<1	<0.5	<0.5	466	<2	--	--
	09/15/18	**0.74 J-**	**<5 UJ**	**863**	13.3 J-	14 J	<0.5	<0.5 UJ	<1	<0.5 UJ	<0.5 UJ	830 J-	<2 UJ	--	--
BPGP46b	07/27/17	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
BPGP48	07/28/17	**<0.5**	**<5**	34.4	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	30.4	<2	--	--
BPGP50	07/30/17	**<0.5**	**<5**	26.8 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	24 J+	<2	--	--
BPGP59	07/26/17	**0.55 J+**	**<5**	**1190 J+**	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	1060 J+	<2	--	--
	05/10/18	**2.9 J+**	**<5**	574 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	508 J+	<2	--	--
DEQ RBCA RBSLs GROUNDWATER		5	100	650	1,100	1,400	700	NA	30	NA	1,000	NA	10,000	1,400	1,100
DEQ-7 GROUNDWATER STANDARD		5	100	NA	NA	NA	700	10,000	30	10,000	1,000	NA	10,000	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.46	0.17	NA	NA	NA	1.5	NA	14	19	110	NA	19	NA	NA

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
EPH - Extractable petroleum hydrocarbon
VPH - Volatile petroleum hydrocarbon
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-2. GROUNDWATER - EPH/VPH ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	C19-C36, Aliphatic, Unadjusted (εg/L)	Total Extractable Hydrocarbon (εg/L)
BMW07-1	07/29/17	--	<221
BMW-1	07/29/17	--	<214
BMW-4	07/28/17	--	<237
BNMW-17	08/30/17	471	1440
	05/08/18	194 JB	684 JB
	09/13/18	134J/ND(202) U*	1500 J
BNMW-20	08/30/17	--	<208
BNMW-21	08/31/17	--	<416
BNMW-23	08/31/17	--	306
BNMW-24	08/30/17	--	409
BNMW-8	08/30/17	--	<204
BNMW-8 Dup	08/30/17	--	225
BNMW-9	08/30/17	--	703
BPGP02	08/31/17	--	690
	05/11/18	--	181 J
	09/14/18	--	856 JB
BPGP05	07/26/17	--	<199
BPGP12	07/28/17	--	<209
BPGP15	07/28/17	--	<205
BPGP16	07/30/17	--	<190
BPGP17	07/30/17	--	<191
BPGP22	07/30/17	--	<209
BPGP32	07/26/17	--	<199
BPGP41	07/28/17	--	<206
BPGP42	07/28/17	--	<217
BPGP44	07/31/17	--	<212
BPGP46	07/27/17	--	<198
	05/11/18	--	114 J
	09/15/18	--	90.3J/ND(211) U*
BPGP46b	07/27/17	--	<227
BPGP48	07/28/17	--	<208
BPGP50	07/30/17	--	<203
BPGP59	07/26/17	--	<201
	05/10/18	--	110 J
DEQ RBCA RBSLs GROUNDWATER		1,000	NA
DEQ-7 GROUNDWATER STANDARD		NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
EPH - Extractable petroleum hydrocarbon
VPH - Volatile petroleum hydrocarbon
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-2. GROUNDWATER - EPH/VPH ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Benzene (εg/L)	Naphthalene (εg/L)	C5-C8, Aliphatic, Adjusted (εg/L)	C9-C10, Aromatic, Unadjusted (εg/L)	C9-C12, Aliphatic, Adjusted (εg/L)	Ethyl-benzene (εg/L)	m,p-Xylene (εg/L)	MTBE (εg/L)	o-Xylene (εg/L)	Toluene (εg/L)	Total Purgeable Hydrocarbon (εg/L)	Xylenes, Total (εg/L)	C9-C18, Aliphatic, Unadjusted (εg/L)	C11-C22, Aromatic, Unadjusted (εg/L)
BPGP59	09/14/18	**1.1 J**	**<5 UJ**	214 J+	<20 UJ	<20	<0.5	<0.5 UJ	<1	<0.5 UJ	<0.5 UJ	200 J	<2 UJ	--	--
BPGP65B	07/27/17	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
BPGP66	07/26/17	**<2.5**	**<25**	**920 J+**	<100	<100	**<2.5**	<2.5	<5	<2.5	<2.5	850 J+	<10	--	--
BPGP78	07/27/17	**10**	**<25**	534	193	<100	**69**	<2.5	<5	<2.5	<2.5	890	<10	--	--
	05/11/18	**186**	**11.9**	**1060**	336	310	**368**	<0.5 UJ	<1	0.53	4.4	2540	0.53 J	--	--
	09/14/18	**113 J-**	**1.7 J-**	**943**	347 J-	162	**199**	<0.5 UJ	<1	<0.5 UJ	2.6 J-	1800 J-	<2 UJ	--	--
BPGP80	07/26/17	**<0.5**	**<5**	**784 J+**	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	698 J+	<2	--	--
	05/10/18	0.46 J+	**<5**	371 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	327 J+	<2	--	--
	09/13/18	0.44 J+	**<5**	210 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	194 J+	<2	--	--
BPGP80 Dup	05/10/18	0.44 J+	**<5**	382 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	337 J+	<2	--	--
BPGP83	07/28/17	**<0.5**	**<5**	264 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	234 J+	<2	--	--
BPGP84	07/31/17	**<0.5 UJ**	**<5 UJ**	151 J	<20 UJ	<20 UJ	<0.5 UJ	<0.5 UJ	<1 UJ	<0.5 UJ	<0.5 UJ	134 J	<2 UJ	--	--
BPGP89	07/30/17	**250 J-**	**<5 UJ**	**810 J-**	140 J-	81 J-	**180 J-**	<0.5 UJ	<1 UJ	1.2 J-	6.5 J-	1850 J-	<2 UJ	--	--
	05/08/18	**305 J+**	**1.9 J+**	**1180 J+**	93.8 J+	63.5 J+	**151 J+**	<0.5	<1	1.1 J+	5.7 J+	1980 J+	1.1 J+	<209	<209
	09/10/18	**195 J**	**5.7**	**1380**	185	143 J+	**167**	<0.5	<1	<0.5	5.6	2770 J+	<2	--	--
BPGP92	07/30/17	**<0.5**	**<5**	160 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	142 J+	<2	--	--
BPGP92 Dup	07/30/17	**<0.5**	**<5**	171 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	151 J+	<2	--	--
BPGP93	07/31/17	**<0.5**	**<5**	27.3 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	24.2 J+	<2	--	--
BPGP94	07/30/17	**<0.5**	**<5**	36.9 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	32.7 J+	<2	--	--
BPGW04	07/27/17	**<0.5**	**<5**	50.6	25.1	<20	<0.5	<0.5	<1	<0.5	<0.5	87.1	<2	--	--
CENEX-5	07/28/17	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
EMW-03	07/28/17	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
EMW-09	08/01/17	**<12.5**	**<125**	**857**	856	<500	**176 J**	40.7	**<25**	<12.5	<12.5	2540	**<50**	<195	286
	05/11/18	**<0.5**	**7.1**	**1440**	977	293	**248**	<0.5	**21.7 J**	2.6	<0.5	3110	2.6	104 J	286
	09/11/18	**<0.5**	**<5**	**2000**	988	323 J+	**68.2**	<0.5	<1	1.6	<0.5	2960 J+	1.6 J	42.3 J	288 J
EMW-15	07/31/17	**3.8 J**	**<5 UJ**	212 J	<20 UJ	<20 UJ	<0.5 UJ	<0.5 UJ	<1 UJ	<0.5 UJ	<0.5 UJ	222 J	<2 UJ	--	--
EMW-18	07/29/17	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
EMW-21	07/28/17	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	<210	237
EMW-26	07/29/17	**<0.5 UJ**	**<5 UJ**	<20 UJ	<20 UJ	<20 UJ	<0.5 UJ	<0.5 UJ	<1 UJ	<0.5 UJ	<0.5 UJ	<20 UJ	<2 UJ	--	--
EMW-28	07/29/17	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
EMW-32	08/31/17	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
GSMW-5	07/31/17	**5.3 J-**	**57 J-**	**708 J-**	846 J-	<200 UJ	**634 J-**	43.3 J-	4.4 J-	2.4 J-	2.1 J-	3220 J-	**45.7 J-**	<206	<206
MW-102	05/07/18	<0.5 R	<5 R	<20 R	<20 R	<20 R	<0.5 R	<0.5 R	<1 R	<0.5 R	<0.5 R	<20 R	<2 R	--	--
DEQ RBCA RBSLs GROUNDWATER		5	100	650	1,100	1,400	700	NA	30	NA	1,000	NA	10,000	1,400	1,100
DEQ-7 GROUNDWATER STANDARD		5	100	NA	NA	NA	700	10,000	30	10,000	1,000	NA	10,000	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.46	0.17	NA	NA	NA	1.5	NA	14	19	110	NA	19	NA	NA

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
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RSL - Regional Screening Level
EPH - Extractable petroleum hydrocarbon
VPH - Volatile petroleum hydrocarbon
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TABLE 9-2. GROUNDWATER - EPH/VPH ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	C19-C36, Aliphatic, Unadjusted (εg/L)	Total Extractable Hydrocarbon (εg/L)
BPGP59	09/14/18	--	139J/ND(203) U*
BPGP65B	07/27/17	--	<197
BPGP66	07/26/17	--	<214
BPGP78	07/27/17	--	259
	05/11/18	--	756
	09/14/18	--	936 JB
BPGP80	07/26/17	--	<213
	05/10/18	--	127 J
	09/13/18	--	86.7J/ND(203) U*
BPGP80 Dup	05/10/18	--	73.5 J
BPGP83	07/28/17	--	<203
BPGP84	07/31/17	--	<207
BPGP89	07/30/17	--	317
	05/08/18	76.4J/ND(209) U*	<626
	09/10/18	--	750
BPGP92	07/30/17	--	<223
BPGP92 Dup	07/30/17	--	<215
BPGP93	07/31/17	--	<204
BPGP94	07/30/17	--	<220
BPGW04	07/27/17	--	<196
CENEX-5	07/28/17	--	<209
EMW-03	07/28/17	--	<212
EMW-09	08/01/17	<195	<584
	05/11/18	22.4 J	286 J
	09/11/18	<203 UJ	288 J
EMW-15	07/31/17	--	<209
EMW-18	07/29/17	--	<204
EMW-21	07/28/17	<210	<629
EMW-26	07/29/17	--	286
EMW-28	07/29/17	--	<261
EMW-32	08/31/17	--	<237
GSMW-5	07/31/17	<206	<617
MW-102	05/07/18	--	231 JB
DEQ RBCA RBSLs GROUNDWATER		1,000	NA
DEQ-7 GROUNDWATER STANDARD		NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA

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TABLE 9-2. GROUNDWATER - EPH/VPH ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Benzene (εg/L)	Naphthalene (εg/L)	C5-C8, Aliphatic, Adjusted (εg/L)	C9-C10, Aromatic, Unadjusted (εg/L)	C9-C12, Aliphatic, Adjusted (εg/L)	Ethyl-benzene (εg/L)	m,p-Xylene (εg/L)	MTBE (εg/L)	o-Xylene (εg/L)	Toluene (εg/L)	Total Purgeable Hydrocarbon (εg/L)	Xylenes, Total (εg/L)	C9-C18, Aliphatic, Unadjusted (εg/L)	C11-C22, Aromatic, Unadjusted (εg/L)
MW-103	05/11/18	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
MW-104	05/10/18	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
MW-105	05/08/18	**3.7 J+**	**1.5 J+**	302 J+	65 J+	33.6 J+	1.3 J+	<0.5	<1	<0.5	<0.5	390 J+	<2	--	--
	09/13/18	**<0.5 UJ**	**<5 UJ**	95.7 J	<20 UJ	<20 UJ	<0.5 UJ	<0.5 UJ	<1 UJ	<0.5 UJ	<0.5 UJ	90.3 J	<2 UJ	--	--
MW-108	05/10/18	**<0.5**	**5.1**	268	99.3	112	<0.5	<0.5	<1	1.7	<0.5	502	1.7 J	113 J	56.8 J
	09/12/18	**<0.5**	**2.4 J**	249	82.6	74.5	<0.5	<0.5	<1	<0.5	<0.5	417	<2	--	--
MW-109	05/09/18	**<0.5**	**<5**	28.6	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	25.2	<2	--	--
	09/14/18	**<0.5 UJ**	**<5 UJ**	<20	<20 UJ	<20	<0.5	<0.5 UJ	<1	<0.5 UJ	<0.5 UJ	<20 UJ	<2 UJ	--	--
MW-111	05/10/18	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
MW-117	05/10/18	**33.9 J**	**12.9**	**2390**	**1950**	582	**195**	142	<1	13.6	<0.5	5610	**156**	330	177 J
MW-119	05/10/18	**<0.5**	**<5**	<20	9.7 J	8.5 J	0.18 J	<0.5	<1	<0.5	0.18 J	25.3	<2	--	--
	09/14/18	**<0.5 UJ**	**<5 UJ**	<20	<20 UJ	<20	<0.5	<0.5 UJ	<1	<0.5 UJ	<0.5 UJ	<20 UJ	<2 UJ	--	--
MW-122	05/11/18	**<0.5**	**<5**	6.2 J	8.7 J	11.6 J	<0.5	<0.5	<1	<0.5	<0.5	31	<2	--	--
	09/14/18	**<0.5 UJ**	**<5 UJ**	<20	<20 UJ	<20	<0.5	<0.5 UJ	<1	<0.5 UJ	<0.5 UJ	<20 UJ	<2 UJ	--	--
MW-126	05/12/18	**<0.5**	**<5**	<20	<20	1.1 J	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
MW-128	05/09/18	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
	09/11/18	**<0.5**	**<5**	4.7 J	4.1 J	1.4 J+	<0.5	<0.5	<1	<0.5	<0.5	10.8 J+	<2	--	--
MW-128 Dup	05/09/18	**<0.5**	**<5**	5.1 J	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
	09/11/18	**<0.5**	**<5**	4.9 J	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
MW-129	05/23/18	**<0.5**	**<5**	300 J+	33.7 J+	70.9 J+	<0.5	<0.5	<1	<0.5	<0.5	392 J+	<2	--	--
PEP07	07/31/17	**<0.5**	**<5**	207 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	183 J+	<2	--	--
RH-MW-3	07/28/17	**<0.5**	**<5**	28.8 J+	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	25.5 J+	<2	--	--
SD-I-01	08/01/17	**<0.5**	**<5**	<20	<20	<20	<0.5	<0.5	<1	<0.5	<0.5	<20	<2	--	--
SMW12	07/31/17	**<2.5**	**<25**	<100	<100	<100	**<2.5**	<2.5	<5	<2.5	<2.5	<100	<10	--	--
DEQ RBCA RBSLs GROUNDWATER		5	100	650	1,100	1,400	700	NA	30	NA	1,000	NA	10,000	1,400	1,100
DEQ-7 GROUNDWATER STANDARD		5	100	NA	NA	NA	700	10,000	30	10,000	1,000	NA	10,000	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.46	0.17	NA	NA	NA	1.5	NA	14	19	110	NA	19	NA	NA

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TABLE 9-2. GROUNDWATER - EPH/VPH ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	C19-C36, Aliphatic, Unadjusted (εg/L)	Total Extractable Hydrocarbon (εg/L)
MW-103	05/11/18	--	104 J
MW-104	05/10/18	--	96.2 J
MW-105	05/08/18	--	615 JB
	09/13/18	--	167J/ND(217) U*
MW-108	05/10/18	39.4J/ND(194) U*	<582
	09/12/18	--	648 JB
MW-109	05/09/18	--	206/ND(206) U*
	09/14/18	--	121J/ND(200) U*
MW-111	05/10/18	--	188 J
MW-117	05/10/18	63.4J/ND(205) U*	330 J
MW-119	05/10/18	--	115 J
	09/14/18	--	79.1J/ND(219) U*
MW-122	05/11/18	--	134 J
	09/14/18	--	134J/ND(214) U*
MW-126	05/12/18	--	--
MW-128	05/09/18	--	103J/ND(197) U*
	09/11/18	--	124 J
MW-128 Dup	05/09/18	--	161J/ND(206) U*
	09/11/18	--	65.3 J
MW-129	05/23/18	--	224/ND(224) U*
PEP07	07/31/17	--	<212
RH-MW-3	07/28/17	--	<205
SD-I-01	08/01/17	--	<208
SMW12	07/31/17	--	<205
DEQ RBCA RBSLs GROUNDWATER		1,000	NA
DEQ-7 GROUNDWATER STANDARD		NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA

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TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acenaph-thene (εg/L)	Acenaph-thylene (εg/L)	Anthracene (εg/L)	Benzo(a)-anthracene (εg/L)	Benzo(a)-pyrene (εg/L)	Benzo(b)-fluor-anthene (εg/L)	Benzo(ghi)-perylene (εg/L)	Benzo(k) fluor-anthene (εg/L)	Bis(2chloro ethoxy)-methane (εg/L)	Bis(2-chloro ethyl)ether (εg/L)	Bis(2-ethyl hexyl)-phthalate (εg/L)	4-Bromo-phenyl-phenylether (εg/L)	Benzyl Butyl Phthalate (εg/L)	Car-bazole (εg/L)
BMW-1	07/29/17	<10.3	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	<10.3
BMW-4	07/28/17	<11.1	<11.1	<11.1	**<11.1**	**<11.1**	**<11.1**	<11.1	**<11.1**	**<11.1**	**<11.1**	**<11.1**	<11.1	**<11.1**	<11.1
BNMW-21	08/31/17	<11.5	<11.5	<11.5	**<11.5**	**<11.5**	**<11.5**	<11.5	**<11.5**	**<11.5**	**<11.5**	**<11.5**	<11.5	**<11.5**	<11.5
BNMW-23	08/31/17	<11.2	<11.2	<11.2	**<11.2**	**<11.2**	**<11.2**	<11.2	**<11.2**	**<11.2**	**<11.2**	**<11.2**	<11.2	**<11.2**	<11.2
BPGP02	08/31/17	<10.8	<10.8	<10.8	**<10.8**	**<10.8**	**<10.8**	<10.8	**<10.8**	**<10.8**	**<10.8**	**<10.8**	<10.8	**<10.8**	<10.8
BPGP04	07/31/17	<11.4	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	**<11.4 UJ**	**<11.4**	**<11.4**	<11.4	**<11.4**	<11.4
BPGP05	07/26/17	<10.4	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4
BPGP12	07/28/17	<10.2	<10.2	<10.2	**<10.2**	**<10.2**	**<10.2**	<10.2	**<10.2**	**<10.2**	**<10.2**	**<10.2**	<10.2	**<10.2**	<10.2
BPGP15	07/28/17	<10.4	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4
BPGP22	07/30/17	<11.4	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	<11.4
BPGP31	07/31/17	<10.9	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	**<10.9 UJ**	**<10.9**	**<10.9**	<10.9	**<10.9**	<10.9
BPGP32	07/26/17	<42.6	<42.6	<42.6	**<42.6**	**<42.6**	**<42.6**	<42.6	**<42.6**	**<42.6**	**<42.6**	**<42.6**	<42.6	**<42.6**	<42.6
BPGP41	07/28/17	<11.2	<11.2	<11.2	**<11.2**	**<11.2**	**<11.2**	<11.2	**<11.2**	**<11.2**	**<11.2**	**<11.2**	<11.2	**<11.2**	<11.2
BPGP42	07/28/17	<10.9	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	<10.9
BPGP44	07/31/17	<10.4	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	**<10.4 UJ**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4
BPGP46	07/27/17	<10.4	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4
BPGP48	07/28/17	<10.8	<10.8	<10.8	**<10.8**	**<10.8**	**<10.8**	<10.8	**<10.8**	**<10.8**	**<10.8**	**<10.8**	<10.8	**<10.8**	<10.8
BPGP50	07/30/17	<10.9	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	<10.9
BPGP58	07/31/17	<11.4	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	**<11.4 UJ**	**<11.4**	**<11.4**	<11.4	**<11.4**	<11.4
BPGP59	07/26/17	<10.5	<10.5	<10.5	**<10.5**	**<10.5**	**<10.5**	<10.5	**<10.5**	**<10.5**	**<10.5**	**<10.5**	<10.5	**<10.5**	<10.5
BPGP65B	07/27/17	<11.1	<11.1	<11.1	**<11.1**	**<11.1**	**<11.1**	<11.1	**<11.1**	**<11.1**	**<11.1**	**<11.1**	<11.1	**<11.1**	<11.1
BPGP66	07/26/17	<11.4	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	<11.4
BPGP67	07/31/17	<11	<11	<11	**<11**	**<11**	**<11**	<11	**<11**	**<11 UJ**	**<11**	**<11**	<11	**<11**	<11
BPGP76	07/31/17	<11	<11	<11	**<11**	**<11**	**<11**	<11	**<11**	**<11 UJ**	**<11**	**<11**	<11	**<11**	<11
BPGP78	07/27/17	<10.3	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	<10.3
	05/11/18	<10.6	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	<10.6
	09/14/18	<10	<10	<10	**<10**	**<10**	**<10**	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10
BPGP80	07/26/17	<11.2	<11.2	<11.2	**<11.2**	**<11.2**	**<11.2**	<11.2	**<11.2**	**<11.2**	**<11.2**	**<11.2**	<11.2	**<11.2**	<11.2
BPGP83	07/28/17	<10.9	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	<10.9
BPGP92	07/30/17	<11.5	<11.5	<11.5	**<11.5**	**<11.5**	**<11.5**	<11.5	**<11.5**	**<11.5**	**<11.5**	**<11.5**	<11.5	**<11.5**	<11.5
BPGP92 Dup	07/30/17	<12	<12	<12	**<12**	**<12**	**<12**	<12	**<12**	**<12**	**<12**	**<12**	<12	**<12**	<12
BPGP94	07/30/17	<11.6	<11.6	<11.6	**<11.6**	**<11.6**	**<11.6**	<11.6	**<11.6**	**<11.6**	**<11.6**	**<11.6**	<11.6	**<11.6**	<11.6
BPGW04	07/27/17	<10.4	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4
CENEX-5	07/28/17	<10.3	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	**<10.3**	**<10.3**	**20**	<10.3	**<10.3**	<10.3
EMW-03	07/28/17	<11.4	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	<11.4
EMW-21	07/28/17	<10.6	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	<10.6
EMW-26	07/29/17	<10.9	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	<10.9
MW-102	05/07/18	<10	<10	<10	**<10**	**<10**	**<10**	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10
DEQ-7 GROUNDWATER STANDARD		70	NA	2,100	0.5	0.05	0.5	NA	5	NA	0.3	6	NA	1	NA
DEQ RBCA RBSLs GROUNDWATER		70	NA	2,100	0.5	0.05	0.5	NA	5	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		53	NA	180	0.03	0.025	0.25	NA	2.5	5.9	0.014	5.6	NA	16	NA

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	4-Chloro-3-Methyl phenol (εg/L)	4-Chloro-aniline (εg/L)	2-Chloro-naphthalene (εg/L)	2-Chloro-phenol (εg/L)	4-Chloro-phenyl-phenylether (εg/L)	Chrysene (εg/L)	Dibenz (a,h) anthracene (εg/L)	Dibenzo-furan (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	3,3'-Di-chloro-benzidine (εg/L)	2,4-Dichloro-phenol (εg/L)	Diethyl-phthalate (εg/L)
BMW-1	07/29/17	<10.3	**<51.5**	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**	**<51.5**	**<10.3**	<10.3
BMW-4	07/28/17	<11.1	**<55.6**	<11.1	**<11.1**	<11.1	<11.1	**<11.1**	**<11.1**	<11.1	<11.1	**<11.1**	**<55.6**	**<11.1**	<11.1
BNMW-21	08/31/17	<11.5	**<57.5**	<11.5	**<11.5**	<11.5	<11.5	**<11.5**	**<11.5**	<11.5	<11.5	**<11.5**	**<57.5**	**<11.5**	<11.5
BNMW-23	08/31/17	<11.2	**<56.2**	<11.2	**<11.2**	<11.2	<11.2	**<11.2**	**<11.2**	<11.2	<11.2	**<11.2**	**<56.2**	**<11.2**	<11.2
BPGP02	08/31/17	<10.8	**<53.8**	<10.8	**<10.8**	<10.8	<10.8	**<10.8**	**<10.8**	<10.8	<10.8	**<10.8**	**<53.8**	**<10.8**	<10.8
BPGP04	07/31/17	<11.4	**<56.8 UJ**	<11.4	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	<11.4	<11.4	**<11.4**	**<56.8**	**<11.4**	<11.4
BPGP05	07/26/17	<10.4	**<52.1**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**	**<52.1**	**<10.4**	<10.4
BPGP12	07/28/17	<10.2	**<51**	<10.2	**<10.2**	<10.2	<10.2	**<10.2**	**<10.2**	<10.2	<10.2	**<10.2**	**<51**	**<10.2**	<10.2
BPGP15	07/28/17	<10.4	**<52.1**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**	**<52.1**	**<10.4**	<10.4
BPGP22	07/30/17	<11.4	**<56.8**	<11.4	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	<11.4	<11.4	**<11.4**	**<56.8**	**<11.4**	<11.4
BPGP31	07/31/17	<10.9	**<54.3 UJ**	<10.9	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	<10.9	<10.9	**<10.9**	**<54.3**	**<10.9**	<10.9
BPGP32	07/26/17	<42.6	**<213**	<42.6	**<42.6**	<42.6	**<42.6**	**<42.6**	**<42.6**	**<42.6**	<42.6	**<42.6**	**<213**	**<42.6**	<42.6
BPGP41	07/28/17	<11.2	**<56.2**	<11.2	**<11.2**	<11.2	<11.2	**<11.2**	**<11.2**	<11.2	<11.2	**<11.2**	**<56.2**	**<11.2**	<11.2
BPGP42	07/28/17	<10.9	**<54.3**	<10.9	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	<10.9 UJ	<10.9 UJ	**<10.9 UJ**	**<54.3**	**<10.9**	<10.9
BPGP44	07/31/17	<10.4	**<52.1 UJ**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**	**<52.1**	**<10.4**	<10.4
BPGP46	07/27/17	<10.4	**<52.1**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**	**<52.1**	**<10.4**	<10.4
BPGP48	07/28/17	<10.8	**<53.8**	<10.8	**<10.8**	<10.8	<10.8	**<10.8**	**<10.8**	<10.8 UJ	<10.8 UJ	**<10.8 UJ**	**<53.8**	**<10.8**	<10.8
BPGP50	07/30/17	<10.9	**<54.3**	<10.9	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	<10.9	<10.9	**<10.9**	**<54.3**	**<10.9**	<10.9
BPGP58	07/31/17	<11.4	**<56.8 UJ**	<11.4	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	<11.4	<11.4	**<11.4**	**<56.8**	**<11.4**	<11.4
BPGP59	07/26/17	<10.5	**<52.6**	<10.5	**<10.5**	<10.5	<10.5	**<10.5**	**<10.5**	<10.5	<10.5	**<10.5**	**<52.6**	**<10.5**	<10.5
BPGP65B	07/27/17	<11.1	**<55.6**	<11.1	**<11.1**	<11.1	<11.1	**<11.1**	**<11.1**	<11.1	<11.1	**<11.1**	**<55.6**	**<11.1**	<11.1
BPGP66	07/26/17	<11.4	**<56.8**	<11.4	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	<11.4	<11.4	**<11.4**	**<56.8**	**<11.4**	<11.4
BPGP67	07/31/17	<11	**<54.9 UJ**	<11	**<11**	<11	<11	**<11**	**<11**	<11	<11	**<11**	**<54.9**	**<11**	<11
BPGP76	07/31/17	<11	**<54.9 UJ**	<11	**<11**	<11	<11	**<11**	**<11**	<11	<11	**<11**	**<54.9**	**<11**	<11
BPGP78	07/27/17	<10.3	**<51.5**	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**	**<51.5**	**<10.3**	<10.3
	05/11/18	<10.6	**<53.2**	<10.6	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6**	<10.6	<10.6	**<10.6**	**<53.2**	**<10.6**	<10.6
	09/14/18	<10	**<10**	<10	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**	**<50**	**<10**	<10
BPGP80	07/26/17	<11.2	**<56.2**	<11.2	**<11.2**	<11.2	<11.2	**<11.2**	**<11.2**	<11.2	<11.2	**<11.2**	**<56.2**	**<11.2**	<11.2
BPGP83	07/28/17	<10.9	**<54.3**	<10.9	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	<10.9	<10.9	**<10.9**	**<54.3**	**<10.9**	<10.9
BPGP92	07/30/17	<11.5	**<57.5**	<11.5	**<11.5**	<11.5	<11.5	**<11.5**	**<11.5**	<11.5	<11.5	**<11.5**	**<57.5**	**<11.5**	<11.5
BPGP92 Dup	07/30/17	<12	**<60.2**	<12	**<12**	<12	<12	**<12**	**<12**	<12	<12	**<12**	**<60.2**	**<12**	<12
BPGP94	07/30/17	<11.6	**<58.1**	<11.6	**<11.6**	<11.6	<11.6	**<11.6**	**<11.6**	<11.6	<11.6	**<11.6**	**<58.1**	**<11.6**	<11.6
BPGW04	07/27/17	<10.4	**<52.1**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**	**<52.1**	**<10.4**	<10.4
CENEX-5	07/28/17	<10.3	**<51.5**	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**	**<51.5**	**<10.3**	<10.3
EMW-03	07/28/17	<11.4	**<56.8**	<11.4	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	<11.4	<11.4	**<11.4**	**<56.8**	**<11.4**	<11.4
EMW-21	07/28/17	<10.6	**<53.2**	<10.6	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6**	<10.6	<10.6	**<10.6**	**<53.2**	**<10.6**	<10.6
EMW-26	07/29/17	<10.9	**<54.3**	<10.9	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	<10.9	<10.9	**<10.9**	**<54.3**	**<10.9**	<10.9
MW-102	05/07/18	<10	**<50**	<10	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**	**<50**	**<10**	<10
DEQ-7 GROUNDWATER STANDARD		500	NA	800	30	NA	50	0.05	0.000002	600	600	75	0.49	10	600
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	50	0.05	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		140	0.37	75	9.1	NA	25	0.025	0.79	30	NA	0.48	0.13	4.6	1,500

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	2,4-Dimethyl-phenol (εg/L)	Dimethyl Phthalate (εg/L)	Di-n-butyl-phthalate (εg/L)	2-Methyl-4,6-dinitro phenol (εg/L)	2,4-Dinitro-phenol (εg/L)	2,4-Dinitro Toluene (εg/L)	2,6-Dinitro Toluene (εg/L)	Di-n-octyl-phthalate (εg/L)	1,2-Diphenyl hydrazine (εg/L)	Fluor-anthene (εg/L)	Fluorene (εg/L)	Hexachloro Benzene (εg/L)	Hexachloro-butadiene (εg/L)	Hexachloro-ethane (εg/L)
BMW-1	07/29/17	**<51.5**	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**
BMW-4	07/28/17	**<55.6**	<11.1	<11.1	**<11.1**	**<11.1**	**<11.1**	**<11.1**	<11.1	**<11.1**	<11.1	<11.1	**<11.1**	**<11.1**	**<11.1**
BNMW-21	08/31/17	**<57.5**	<11.5	<11.5	**<11.5**	**<11.5**	**<11.5**	**<11.5**	<11.5	**<11.5**	<11.5	<11.5	**<11.5**	**<11.5**	**<11.5**
BNMW-23	08/31/17	**<56.2**	<11.2	<11.2	**<11.2**	**<11.2**	**<11.2**	**<11.2**	<11.2	**<11.2**	<11.2	<11.2	**<11.2**	**<11.2**	**<11.2**
BPGP02	08/31/17	**<53.8**	<10.8	<10.8	**<10.8**	**<10.8**	**<10.8**	**<10.8**	<10.8	**<10.8**	<10.8	<10.8	**<10.8**	**<10.8**	**<10.8**
BPGP04	07/31/17	**<56.8**	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4 UJ**	**<11.4**
BPGP05	07/26/17	**<52.1**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**
BPGP12	07/28/17	**<51**	<10.2	<10.2	**<10.2**	**<10.2**	**<10.2**	**<10.2**	<10.2	**<10.2**	<10.2	<10.2	**<10.2**	**<10.2**	**<10.2**
BPGP15	07/28/17	**<52.1**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**
BPGP22	07/30/17	**<56.8**	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**
BPGP31	07/31/17	**<54.3**	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9 UJ**	**<10.9**
BPGP32	07/26/17	**<213**	<42.6	**<42.6**	**<42.6**	**<42.6**	**<42.6**	**<42.6**	**<42.6**	**<42.6**	**<42.6**	**<42.6**	**<42.6**	**<42.6**	**<42.6**
BPGP41	07/28/17	**<56.2**	<11.2	<11.2	**<11.2**	**<11.2**	**<11.2**	**<11.2**	<11.2	**<11.2**	<11.2	<11.2	**<11.2**	**<11.2**	**<11.2**
BPGP42	07/28/17	**<54.3**	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**
BPGP44	07/31/17	**<52.1**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4 UJ**	**<10.4**
BPGP46	07/27/17	**<52.1**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4 UJ**
BPGP48	07/28/17	**<53.8**	<10.8	<10.8	**<10.8**	**<10.8**	**<10.8**	**<10.8**	<10.8	**<10.8**	<10.8	<10.8	**<10.8**	**<10.8**	**<10.8**
BPGP50	07/30/17	**<54.3**	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**
BPGP58	07/31/17	**<56.8**	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4 UJ**	**<11.4**
BPGP59	07/26/17	**<52.6**	<10.5	<10.5	**<10.5**	**<10.5**	**<10.5**	**<10.5**	<10.5	**<10.5**	<10.5	<10.5	**<10.5**	**<10.5**	**<10.5**
BPGP65B	07/27/17	**<55.6**	<11.1	<11.1	**<11.1**	**<11.1**	**<11.1**	**<11.1**	<11.1	**<11.1**	<11.1	<11.1	**<11.1**	**<11.1**	**<11.1 UJ**
BPGP66	07/26/17	**<56.8**	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**
BPGP67	07/31/17	**<54.9**	<11	<11	**<11**	**<11**	**<11**	**<11**	<11	**<11**	<11	<11	**<11**	**<11 UJ**	**<11**
BPGP76	07/31/17	**<54.9**	<11	<11	**<11**	**<11**	**<11**	**<11**	<11	**<11**	<11	<11	**<11**	**<11 UJ**	**<11**
BPGP78	07/27/17	**<51.5**	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3 UJ**
	05/11/18	**<53.2**	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6 UJ**	**<10.6**
	09/14/18	<10	<10	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10	<10	**<10**	**<10**	**<10**
BPGP80	07/26/17	**<56.2**	<11.2	<11.2	**<11.2**	**<11.2**	**<11.2**	**<11.2**	<11.2	**<11.2**	<11.2	<11.2	**<11.2**	**<11.2**	**<11.2**
BPGP83	07/28/17	**<54.3**	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**
BPGP92	07/30/17	**<57.5**	<11.5	<11.5	**<11.5**	**<11.5**	**<11.5**	**<11.5**	<11.5	**<11.5**	<11.5	<11.5	**<11.5**	**<11.5**	**<11.5**
BPGP92 Dup	07/30/17	**<60.2**	<12	<12	**<12**	**<12**	**<12**	**<12**	<12	**<12**	<12	<12	**<12**	**<12**	**<12**
BPGP94	07/30/17	**<58.1**	<11.6	<11.6	**<11.6**	**<11.6**	**<11.6**	**<11.6**	<11.6	**<11.6**	<11.6	<11.6	**<11.6**	**<11.6**	**<11.6**
BPGW04	07/27/17	**<52.1**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4 UJ**
CENEX-5	07/28/17	**<51.5**	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**
EMW-03	07/28/17	**<56.8**	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**	**<11.4**	<11.4	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	**<11.4**
EMW-21	07/28/17	**<53.2**	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**
EMW-26	07/29/17	**<54.3**	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**	**<10.9**	<10.9	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	**<10.9**
MW-102	05/07/18	**<50**	<10	<10	**<10**	**<10 UJ**	**<10**	**<10**	<10	**<10**	<10	<10	**<10**	**<10**	**<10**
DEQ-7 GROUNDWATER STANDARD		100	2,000	20	2	10	0.49	0.5	NA	0.3	20	50	0.2	5	30
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	20	50	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		36	NA	90	0.15	3.9	0.24	0.049	20	0.078	80	29	0.0098	0.14	0.33

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Indeno-(1,2,3-cd) pyrene (εg/L)	Isophorone (εg/L)	1-Methyl-naphthalene (εg/L)	2-Methyl-naphthalene (εg/L)	2-Methyl phenol (εg/L)	3,4-Methyl phenol (εg/L)	Naphthalene (εg/L)	2-Nitro-aniline (εg/L)	3-Nitro-aniline (εg/L)	4-Nitro-aniline (εg/L)	Nitro-benzene (εg/L)	2-Nitro-phenol (εg/L)	4-Nitro-phenol (εg/L)	N-Nitroso-dimethyl-amine (εg/L)
BMW-1	07/29/17	**<10.3**	<10.3	**<10.3**	**<10.3**	<10.3	<20.6	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**
BMW-4	07/28/17	**<11.1**	<11.1	**<11.1**	**<11.1**	<11.1	<22.2	**<11.1**	<11.1	<11.1	**<11.1**	**<11.1**	<11.1	<11.1	**<11.1**
BNMW-21	08/31/17	**<11.5**	<11.5	**<11.5**	**<11.5**	<11.5	<23	**<11.5**	<11.5	<11.5	**<11.5**	**<11.5**	<11.5	<11.5	**<11.5**
BNMW-23	08/31/17	**<11.2**	<11.2	**<11.2**	**<11.2**	<11.2	<22.5	**<11.2**	<11.2	<11.2	**<11.2**	**<11.2**	<11.2	<11.2	**<11.2**
BPGP02	08/31/17	**<10.8**	<10.8	**<10.8**	**<10.8**	<10.8	<21.5	**22.4**	<10.8	<10.8	**<10.8**	**<10.8**	<10.8	<10.8	**<10.8**
BPGP04	07/31/17	**<11.4**	<11.4 UJ	**<11.4 UJ**	**<11.4 UJ**	<11.4	<22.7	**<11.4 UJ**	<11.4	<11.4	**<11.4**	**<11.4 UJ**	<11.4	<11.4	**<11.4**
BPGP05	07/26/17	**<10.4**	<10.4	**<10.4**	**<10.4**	<10.4	<20.8	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**
BPGP12	07/28/17	**<10.2**	<10.2	**<10.2**	**<10.2**	<10.2	<20.4	**<10.2**	<10.2	<10.2	**<10.2**	**<10.2**	<10.2	<10.2	**<10.2**
BPGP15	07/28/17	**<10.4**	<10.4	**<10.4**	**<10.4**	<10.4	<20.8	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**
BPGP22	07/30/17	**<11.4**	<11.4	**<11.4**	**<11.4**	<11.4	<22.7	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	<11.4	<11.4	**<11.4**
BPGP31	07/31/17	**<10.9**	<10.9 UJ	**<10.9 UJ**	**<10.9 UJ**	<10.9	<21.7	**<10.9 UJ**	<10.9	<10.9	**<10.9**	**<10.9 UJ**	<10.9	<10.9	**<10.9**
BPGP32	07/26/17	**<42.6**	<42.6	**<42.6**	**<42.6**	<42.6	<85.1	**<42.6**	**<42.6**	<42.6	**<42.6**	**<42.6**	<42.6	<42.6	**<42.6**
BPGP41	07/28/17	**<11.2**	<11.2	**<11.2**	**<11.2**	<11.2	<22.5	**<11.2**	<11.2	<11.2	**<11.2**	**<11.2**	<11.2	<11.2	**<11.2**
BPGP42	07/28/17	**<10.9**	<10.9	**<10.9**	**<10.9**	<10.9	<21.7	**<10.9 UJ**	<10.9	<10.9	**<10.9**	**<10.9**	<10.9	<10.9	**<10.9**
BPGP44	07/31/17	**<10.4**	<10.4 UJ	**<10.4 UJ**	**<10.4 UJ**	<10.4	<20.8	**<10.4 UJ**	<10.4	<10.4	**<10.4**	**<10.4 UJ**	<10.4	<10.4	**<10.4**
BPGP46	07/27/17	**<10.4**	<10.4	**<10.4**	**<10.4**	<10.4	<20.8	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**
BPGP48	07/28/17	**<10.8**	<10.8	**<10.8**	**<10.8**	<10.8	<21.5	**<10.8 UJ**	<10.8	<10.8	**<10.8**	**<10.8**	<10.8	<10.8	**<10.8**
BPGP50	07/30/17	**<10.9**	<10.9	**<10.9**	**<10.9**	<10.9	<21.7	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	<10.9	<10.9	**<10.9**
BPGP58	07/31/17	**<11.4**	<11.4 UJ	**<11.4 UJ**	**<11.4 UJ**	<11.4	<22.7	**<11.4 UJ**	<11.4	<11.4	**<11.4**	**<11.4 UJ**	<11.4	<11.4	**<11.4**
BPGP59	07/26/17	**<10.5**	<10.5	**<10.5**	**<10.5**	<10.5	<21.1	**<10.5**	<10.5	<10.5	**<10.5**	**<10.5**	<10.5	<10.5	**<10.5**
BPGP65B	07/27/17	**<11.1**	<11.1	**<11.1**	**<11.1**	<11.1	<22.2	**<11.1**	<11.1	<11.1	**<11.1**	**<11.1**	<11.1	<11.1	**<11.1**
BPGP66	07/26/17	**<11.4**	<11.4	**<11.4**	**<11.4**	<11.4	<22.7	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	<11.4	<11.4	**<11.4**
BPGP67	07/31/17	**<11**	<11 UJ	**<11 UJ**	**<11 UJ**	<11	<22	**<11 UJ**	<11	<11	**<11**	**<11 UJ**	<11	<11	**<11**
BPGP76	07/31/17	**<11**	<11 UJ	**<11 UJ**	**<11 UJ**	<11	<22	**<11 UJ**	<11	<11	**<11**	**<11 UJ**	<11	<11	**<11**
BPGP78	07/27/17	**<10.3**	<10.3	**11.4**	**<10.3**	<10.3	<20.6	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**
	05/11/18	**<10.6**	<10.6	**4.6 J**	**<10.6**	<10.6	<21.3	**6.1 J**	<10.6	<10.6	**<10.6**	**<10.6**	<10.6	<10.6	**<10.6**
	09/14/18	**<10**	<10	**12.8**	**<10**	<10	<10	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**
BPGP80	07/26/17	**<11.2**	<11.2	**<11.2**	**<11.2**	<11.2	<22.5	**<11.2**	<11.2	<11.2	**<11.2**	**<11.2**	<11.2	<11.2	**<11.2**
BPGP83	07/28/17	**<10.9**	<10.9	**<10.9**	**<10.9**	<10.9	<21.7	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	<10.9	<10.9	**<10.9**
BPGP92	07/30/17	**<11.5**	<11.5	**<11.5**	**<11.5**	<11.5	<23	**<11.5**	<11.5	<11.5	**<11.5**	**<11.5**	<11.5	<11.5	**<11.5**
BPGP92 Dup	07/30/17	**<12**	<12	**<12**	**<12**	<12	<24.1	**<12**	<12	<12	**<12**	**<12**	<12	<12	**<12**
BPGP94	07/30/17	**<11.6**	<11.6	**<11.6**	**<11.6**	<11.6	<23.3	**<11.6**	<11.6	<11.6	**<11.6**	**<11.6**	<11.6	<11.6	**<11.6**
BPGW04	07/27/17	**<10.4**	<10.4	**<10.4**	**<10.4**	<10.4	<20.8	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**
CENEX-5	07/28/17	**<10.3**	<10.3	**<10.3**	**<10.3**	<10.3	<20.6	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**
EMW-03	07/28/17	**<11.4**	<11.4	**<11.4**	**<11.4**	<11.4	<22.7	**<11.4**	<11.4	<11.4	**<11.4**	**<11.4**	<11.4	<11.4	**<11.4**
EMW-21	07/28/17	**<10.6**	<10.6	**<10.6**	**<10.6**	<10.6	<21.3	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6**	<10.6	<10.6	**<10.6**
EMW-26	07/29/17	**<10.9**	<10.9	**<10.9**	**<10.9**	<10.9	<21.7	**<10.9**	<10.9	<10.9	**<10.9**	**<10.9**	<10.9	<10.9	**<10.9**
MW-102	05/07/18	**<10**	<10	**<10**	**<10**	<10	<20	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**
DEQ-7 GROUNDWATER STANDARD		0.5	400	NA	NA	NA	NA	100	NA	NA	NA	10	NA	50	0.0069
DEQ RBCA RBSLs GROUNDWATER		0.5	NA	11	36	NA	NA	100	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.25	78	1.1	3.6	93	NA	0.17	19	NA	3.8	0.14	NA	NA	0.00011

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	N-Nitrosodi-n-propyl-amine (εg/L)	N-Nitroso-diphenyl-amine (εg/L)	2,2'-oxybis(1-Chloropropane) (εg/L)	Penta-chloro-phenol (εg/L)	Phen-anthrene (εg/L)	Phenol (εg/L)	Pyrene (εg/L)	1,2,4-Trichloro-benzene (εg/L)	2,4,5-Tri-chloro-phenol (εg/L)	2,4,6-Tri-chloro-phenol (εg/L)	Aroclor-1016 (εg/L)	Aroclor-1221 (εg/L)	Aroclor-1232 (εg/L)	Aroclor-1242 (εg/L)
BMW-1	07/29/17	**<10.3**	<10.3	<10.3	**<20.6**	<10.3	<10.3	<10.3	**<10.3**	<10.3	**<10.3**	--	--	--	--
BMW-4	07/28/17	**<11.1**	<11.1	<11.1	**<22.2**	<11.1	<11.1	<11.1	**<11.1**	<11.1	**<11.1**	--	--	--	--
BNMW-21	08/31/17	**<11.5**	<11.5	<11.5	**<23**	<11.5	<11.5	<11.5	**<11.5**	<11.5	**<11.5**	--	--	--	--
BNMW-23	08/31/17	**<11.2**	<11.2	<11.2	**<22.5**	<11.2	<11.2	<11.2	**<11.2**	<11.2	**<11.2**	--	--	--	--
BPGP02	08/31/17	**<10.8**	<10.8	<10.8	**<21.5**	<10.8	<10.8	<10.8	**<10.8**	<10.8	**<10.8**	--	--	--	--
BPGP04	07/31/17	**<11.4**	<11.4	<11.4	**<22.7**	<11.4	<11.4	<11.4	**<11.4 UJ**	<11.4	**<11.4**	--	--	--	--
BPGP05	07/26/17	**<10.4**	<10.4	<10.4	**<20.8**	<10.4	<10.4	<10.4	**<10.4**	<10.4	**<10.4**	--	--	--	--
BPGP12	07/28/17	**<10.2**	<10.2	<10.2	**<20.4**	<10.2	<10.2	<10.2	**<10.2**	<10.2	**<10.2**	--	--	--	--
BPGP15	07/28/17	**<10.4**	<10.4	<10.4	**<20.8**	<10.4	<10.4	<10.4	**<10.4**	<10.4	**<10.4**	--	--	--	--
BPGP22	07/30/17	**<11.4**	<11.4	<11.4	**<22.7**	<11.4	<11.4	<11.4	**<11.4**	<11.4	**<11.4**	--	--	--	--
BPGP31	07/31/17	**<10.9**	<10.9	<10.9	**<21.7**	<10.9	<10.9	<10.9	**<10.9 UJ**	<10.9	**<10.9**	--	--	--	--
BPGP32	07/26/17	**<42.6**	**<42.6**	<42.6	**<85.1**	<42.6	<42.6	**<42.6**	**<42.6**	<42.6	**<42.6**	--	--	--	--
BPGP41	07/28/17	**<11.2**	<11.2	<11.2	**<22.5**	<11.2	<11.2	<11.2	**<11.2**	<11.2	**<11.2**	--	--	--	--
BPGP42	07/28/17	**<10.9**	<10.9	<10.9	**<21.7**	<10.9	<10.9	<10.9	**<10.9**	<10.9	**<10.9**	--	--	--	--
BPGP44	07/31/17	**<10.4**	<10.4	<10.4	**<20.8**	<10.4	<10.4	<10.4	**<10.4 UJ**	<10.4	**<10.4**	--	--	--	--
BPGP46	07/27/17	**<10.4**	<10.4	<10.4	**<20.8**	<10.4	<10.4	<10.4	**<10.4**	<10.4	**<10.4**	--	--	--	--
BPGP48	07/28/17	**<10.8**	<10.8	<10.8	**<21.5**	<10.8	<10.8	<10.8	**<10.8**	<10.8	**<10.8**	--	--	--	--
BPGP50	07/30/17	**<10.9**	<10.9	<10.9	**<21.7**	<10.9	<10.9	<10.9	**<10.9**	<10.9	**<10.9**	--	--	--	--
BPGP58	07/31/17	**<11.4**	<11.4	<11.4	**<22.7**	<11.4	<11.4	<11.4	**<11.4 UJ**	<11.4	**<11.4**	--	--	--	--
BPGP59	07/26/17	**<10.5**	<10.5	<10.5	**<21.1**	<10.5	<10.5	<10.5	**<10.5**	<10.5	**<10.5**	--	--	--	--
BPGP65B	07/27/17	**<11.1**	<11.1	<11.1	**<22.2**	<11.1	<11.1	<11.1	**<11.1**	<11.1	**<11.1**	--	--	--	--
BPGP66	07/26/17	**<11.4**	<11.4	<11.4	**<22.7**	<11.4	<11.4	<11.4	**<11.4**	<11.4	**<11.4**	--	--	--	--
BPGP67	07/31/17	**<11**	<11	<11	**<22**	<11	<11	<11	**<11 UJ**	<11	**<11**	--	--	--	--
BPGP76	07/31/17	**<11**	<11	<11	**<22**	<11	<11	<11	**<11 UJ**	<11	**<11**	--	--	--	--
BPGP78	07/27/17	**<10.3**	<10.3	<10.3	**<20.6**	<10.3	<10.3	<10.3	**<10.3**	<10.3	**<10.3**	--	--	--	--
	05/11/18	**<10.6**	<10.6	<10.6	**<21.3**	<10.6	11.3	<10.6	**<10.6**	<10.6	**<10.6 UJ**	--	--	--	--
	09/14/18	**<10**	<10	<10	**<20**	<10	1.4 J	<10	**<10**	<10	**<10**	--	--	--	--
BPGP80	07/26/17	**<11.2**	<11.2	<11.2	**<22.5**	<11.2	<11.2	<11.2	**<11.2**	<11.2	**<11.2**	--	--	--	--
BPGP83	07/28/17	**<10.9**	<10.9	<10.9	**<21.7**	<10.9	<10.9	<10.9	**<10.9**	<10.9	**<10.9**	--	--	--	--
BPGP92	07/30/17	**<11.5**	<11.5	<11.5	**<23**	<11.5	<11.5	<11.5	**<11.5**	<11.5	**<11.5**	--	--	--	--
BPGP92 Dup	07/30/17	**<12**	<12	<12	**<24.1**	<12	<12	<12	**<12**	<12	**<12**	--	--	--	--
BPGP94	07/30/17	**<11.6**	<11.6	<11.6	**<23.3**	<11.6	<11.6	<11.6	**<11.6**	<11.6	**<11.6**	--	--	--	--
BPGW04	07/27/17	**<10.4**	<10.4	<10.4	**<20.8**	<10.4	<10.4	<10.4	**<10.4**	<10.4	**<10.4**	--	--	--	--
CENEX-5	07/28/17	**<10.3**	<10.3	<10.3	**<20.6**	<10.3	<10.3	<10.3	**<10.3**	<10.3	**<10.3**	--	--	--	--
EMW-03	07/28/17	**<11.4**	<11.4	<11.4	**<22.7**	<11.4	<11.4	<11.4	**<11.4**	<11.4	**<11.4**	--	--	--	--
EMW-21	07/28/17	**<10.6**	<10.6	<10.6	**<21.3**	<10.6	<10.6	<10.6	**<10.6**	<10.6	**<10.6**	--	--	--	--
EMW-26	07/29/17	**<10.9**	<10.9	<10.9	**<21.7**	<10.9	<10.9	<10.9	**<10.9**	<10.9	**<10.9**	--	--	--	--
MW-102	05/07/18	**<10**	<10	<10	**<20 UJ**	<10	<10	<10	**<10**	<10	**<10**	--	--	--	--
DEQ-7 GROUNDWATER STANDARD		0.05	33	NA	1	NA	4,000	20	70	300	30	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	20	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.011	12	71	0.041	NA	580	12	0.4	120	1.2	0.14	0.0047	0.0047	0.0078

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Aroclor-1248 (εg/L)	Aroclor-1254 (εg/L)	Aroclor-1260 (εg/L)	Aroclor-1262 (εg/L)	Aroclor-1268 (εg/L)
BMW-1	07/29/17	--	--	--	--	--
BMW-4	07/28/17	--	--	--	--	--
BNMW-21	08/31/17	--	--	--	--	--
BNMW-23	08/31/17	--	--	--	--	--
BPGP02	08/31/17	--	--	--	--	--
BPGP04	07/31/17	--	--	--	--	--
BPGP05	07/26/17	--	--	--	--	--
BPGP12	07/28/17	--	--	--	--	--
BPGP15	07/28/17	--	--	--	--	--
BPGP22	07/30/17	--	--	--	--	--
BPGP31	07/31/17	--	--	--	--	--
BPGP32	07/26/17	--	--	--	--	--
BPGP41	07/28/17	--	--	--	--	--
BPGP42	07/28/17	--	--	--	--	--
BPGP44	07/31/17	--	--	--	--	--
BPGP46	07/27/17	--	--	--	--	--
BPGP48	07/28/17	--	--	--	--	--
BPGP50	07/30/17	--	--	--	--	--
BPGP58	07/31/17	--	--	--	--	--
BPGP59	07/26/17	--	--	--	--	--
BPGP65B	07/27/17	--	--	--	--	--
BPGP66	07/26/17	--	--	--	--	--
BPGP67	07/31/17	--	--	--	--	--
BPGP76	07/31/17	--	--	--	--	--
BPGP78	07/27/17	--	--	--	--	--
	05/11/18	--	--	--	--	--
	09/14/18	--	--	--	--	--
BPGP80	07/26/17	--	--	--	--	--
BPGP83	07/28/17	--	--	--	--	--
BPGP92	07/30/17	--	--	--	--	--
BPGP92 Dup	07/30/17	--	--	--	--	--
BPGP94	07/30/17	--	--	--	--	--
BPGW04	07/27/17	--	--	--	--	--
CENEX-5	07/28/17	--	--	--	--	--
EMW-03	07/28/17	--	--	--	--	--
EMW-21	07/28/17	--	--	--	--	--
EMW-26	07/29/17	--	--	--	--	--
MW-102	05/07/18	--	--	--	--	--
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.0078	0.0078	0.0078	NA	NA

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acenaph-thene (εg/L)	Acenaph-thylene (εg/L)	Anthracene (εg/L)	Benzo(a)-anthracene (εg/L)	Benzo(a)-pyrene (εg/L)	Benzo(b)-fluor-anthene (εg/L)	Benzo(ghi)-perylene (εg/L)	Benzo(k) fluor-anthene (εg/L)	Bis(2chloro ethoxy)-methane (εg/L)	Bis(2-chloro ethyl)ether (εg/L)	Bis(2-ethyl hexyl)-phthalate (εg/L)	4-Bromo-phenyl-phenylether (εg/L)	Benzyl Butyl Phthalate (εg/L)	Car-bazole (εg/L)
MW-103	05/11/18	<10.3	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	<10.3
MW-104	05/10/18	<10	<10	<10	**<10**	**<10**	**<10**	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10
MW-105	05/08/18	<9.9	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	<9.9
MW-108	05/10/18	<9.8	<9.8	<9.8	**<9.8**	**<9.8**	**<9.8**	<9.8	**<9.8**	**<9.8**	**<9.8**	**<9.8**	<9.8	**<9.8**	<9.8
	09/12/18	<10.2	<10.2	<10.2	**<10.2**	**<10.2**	**<10.2**	<10.2	**<10.2**	**<10.2**	**<10.2**	**<10.2**	<10.2	**<10.2**	<10.2
MW-109	05/09/18	<9.9	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	<9.9
MW-111	05/10/18	<10.4	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	**<10.4**	**<10.4**	**16.2**	<10.4	**<10.4**	<10.4
	09/12/18	<10.3	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	<10.3
MW-115	09/13/18	<10	<10	<10	**<10**	**<10**	**<10**	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10
MW-117	05/10/18	<10	<10	<10	**<10**	**<10**	**<10**	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10
	09/14/18	<9.9	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	<9.9
MW-119	05/10/18	<10	<10	<10	**<10**	**<10**	**<10**	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10
MW-122	05/11/18	<10.6	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	<10.6
MW-126	05/12/18	<11.8	<11.8	<11.8	**<11.8**	**<11.8**	**<11.8**	<11.8	**<11.8**	**<11.8**	**<11.8**	**<11.8**	<11.8	**<11.8**	<11.8
MW-128	05/09/18	<9.9	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	<9.9
MW-128 Dup	05/09/18	<10.1	<10.1	<10.1	**<10.1**	**<10.1**	**<10.1**	<10.1	**<10.1**	**<10.1**	**<10.1**	**<10.1**	<10.1	**<10.1**	<10.1
MW-132	05/23/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-133	05/23/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEP07	07/31/17	<10.6	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	**<10.6 UJ**	**<10.6**	**<10.6**	<10.6	**<10.6**	<10.6
RH-MW-3	07/28/17	<10.6	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	<10.6
SD-I-01	08/01/17	<11.1	<11.1	<11.1	**<11.1**	**<11.1**	**<11.1**	<11.1	**<11.1**	**<11.1 UJ**	**<11.1**	**<11.1**	<11.1	**<11.1**	<11.1
DEQ-7 GROUNDWATER STANDARD		70	NA	2,100	0.5	0.05	0.5	NA	5	NA	0.3	6	NA	1	NA
DEQ RBCA RBSLs GROUNDWATER		70	NA	2,100	0.5	0.05	0.5	NA	5	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		53	NA	180	0.03	0.025	0.25	NA	2.5	5.9	0.014	5.6	NA	16	NA

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	4-Chloro-3-Methyl phenol (εg/L)	4-Chloro-aniline (εg/L)	2-Chloro-naphthalene (εg/L)	2-Chloro-phenol (εg/L)	4-Chloro-phenyl-phenylether (εg/L)	Chrysene (εg/L)	Dibenz (a,h) anthracene (εg/L)	Dibenzo-furan (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	3,3'-Di-chloro-benzidine (εg/L)	2,4-Dichloro-phenol (εg/L)	Diethyl-phthalate (εg/L)
MW-103	05/11/18	<10.3	**<51.5**	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**	**<51.5**	**<10.3**	<10.3
MW-104	05/10/18	<10	**<50**	<10	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**	**<50**	**<10**	<10
MW-105	05/08/18	<9.9	**<49.5**	<9.9	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	<9.9	<9.9	**<9.9**	**<49.5**	**<9.9**	<9.9
MW-108	05/10/18	<9.8	**<49**	<9.8	**<9.8**	<9.8	<9.8	**<9.8**	**<9.8**	<9.8	<9.8	**<9.8**	**<49**	**<9.8**	<9.8
	09/12/18	<10.2	**<10.2**	<10.2	**<10.2**	<10.2	<10.2	**<10.2**	**<10.2**	<10.2	<10.2	**<10.2**	**<51**	**<10.2**	<10.2
MW-109	05/09/18	<9.9	**<49.5**	<9.9	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	<9.9	<9.9	**<9.9**	**<49.5**	**<9.9**	<9.9
MW-111	05/10/18	<10.4	**<52.1**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**	**<52.1**	**<10.4**	<10.4
	09/12/18	<10.3	**<10.3**	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**	**<51.5**	**<10.3**	<10.3
MW-115	09/13/18	<10	**<10**	<10	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**	**<50**	**<10**	<10
MW-117	05/10/18	<10	**<50**	<10	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**	**<50**	**<10**	<10
	09/14/18	<9.9	**<9.9**	<9.9	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	<9.9	<9.9	**<9.9**	**<49.5**	**<9.9**	<9.9
MW-119	05/10/18	<10	**<50**	<10	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**	**<50**	**<10**	<10
MW-122	05/11/18	<10.6	**<53.2**	<10.6	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6**	<10.6	<10.6	**<10.6**	**<53.2**	**<10.6**	<10.6
MW-126	05/12/18	<11.8	**<58.8**	<11.8	**<11.8**	<11.8	<11.8	**<11.8**	**<11.8**	<11.8	<11.8	**<11.8**	**<58.8**	**<11.8**	<11.8
MW-128	05/09/18	<9.9	**<49.5**	<9.9	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	<9.9	<9.9	**<9.9**	**<49.5**	**<9.9**	<9.9
MW-128 Dup	05/09/18	<10.1	**<50.5**	<10.1	**<10.1**	<10.1	<10.1	**<10.1**	**<10.1**	<10.1	<10.1	**<10.1**	**<50.5**	**<10.1**	<10.1
MW-132	05/23/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-133	05/23/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEP07	07/31/17	<10.6	**<53.2 UJ**	<10.6	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6**	<10.6	<10.6	**<10.6**	**<53.2**	**<10.6**	<10.6
RH-MW-3	07/28/17	<10.6	**<53.2**	<10.6	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6**	<10.6	<10.6	**<10.6**	**<53.2**	**<10.6**	<10.6
SD-I-01	08/01/17	<11.1	**<55.6 UJ**	<11.1	**<11.1**	<11.1	<11.1	**<11.1**	**<11.1**	<11.1	<11.1	**<11.1**	**<55.6**	**<11.1**	<11.1
DEQ-7 GROUNDWATER STANDARD		500	NA	800	30	NA	50	0.05	0.000002	600	600	75	0.49	10	600
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	50	0.05	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		140	0.37	75	9.1	NA	25	0.025	0.79	30	NA	0.48	0.13	4.6	1,500

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	2,4-Dimethyl-phenol (εg/L)	Dimethyl Phthalate (εg/L)	Di-n-butyl-phthalate (εg/L)	2-Methyl-4,6-dinitro phenol (εg/L)	2,4-Dinitro-phenol (εg/L)	2,4-Dinitro Toluene (εg/L)	2,6-Dinitro Toluene (εg/L)	Di-n-octyl-phthalate (εg/L)	1,2-Diphenyl hydrazine (εg/L)	Fluor-anthene (εg/L)	Fluorene (εg/L)	Hexachloro Benzene (εg/L)	Hexachloro-butadiene (εg/L)	Hexachloro-ethane (εg/L)
MW-103	05/11/18	**<51.5**	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3 UJ**	**<10.3**
MW-104	05/10/18	**<50**	<10	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10	<10	**<10**	**<10**	**<10**
MW-105	05/08/18	**<49.5**	<9.9	<9.9	**<9.9**	**<9.9 UJ**	**<9.9**	**<9.9**	<9.9	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**
MW-108	05/10/18	**<49**	<9.8	<9.8	**<9.8**	**<9.8**	**<9.8**	**<9.8**	<9.8	**<9.8**	<9.8	3.1 J	**<9.8**	**<9.8**	**<9.8**
	09/12/18	<10.2	<10.2	<10.2	**<10.2**	**<10.2**	**<10.2**	**<10.2**	<10.2	**<10.2**	<10.2	1.7 J	**<10.2**	**<10.2**	**<10.2**
MW-109	05/09/18	**<49.5**	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**
MW-111	05/10/18	**<52.1**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**	**<10.4**	<10.4	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	**<10.4**
	09/12/18	<10.3	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**	**<10.3**	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	**<10.3**
MW-115	09/13/18	<10	<10	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10	<10	**<10**	**<10**	**<10**
MW-117	05/10/18	**<50**	<10	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10	<10	**<10**	**<10**	**<10**
	09/14/18	<9.9	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**
MW-119	05/10/18	**<50**	<10	<10	**<10**	**<10**	**<10**	**<10**	<10	**<10**	<10	<10	**<10**	**<10**	**<10**
MW-122	05/11/18	**<53.2**	<10.6	<10.6	**<10.6 UJ**	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6 UJ**	**<10.6**
MW-126	05/12/18	**<58.8**	<11.8	<11.8	**<11.8**	**<11.8**	**<11.8**	**<11.8**	<11.8	**<11.8**	<11.8	<11.8	**<11.8**	**<11.8 UJ**	**<11.8**
MW-128	05/09/18	**<49.5**	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**	**<9.9**	<9.9	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	**<9.9**
MW-128 Dup	05/09/18	**<50.5**	<10.1	<10.1	**<10.1**	**<10.1**	**<10.1**	**<10.1**	<10.1	**<10.1**	<10.1	<10.1	**<10.1**	**<10.1**	**<10.1**
MW-132	05/23/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-133	05/23/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEP07	07/31/17	**<53.2**	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6 UJ**	**<10.6**
RH-MW-3	07/28/17	**<53.2**	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**	**<10.6**	<10.6	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6**	**<10.6**
SD-I-01	08/01/17	**<55.6**	<11.1	<11.1	**<11.1**	**<11.1**	**<11.1**	**<11.1**	<11.1	**<11.1**	<11.1	<11.1	**<11.1**	**<11.1 UJ**	**<11.1**
DEQ-7 GROUNDWATER STANDARD	100	2,000	20	2	10	0.49	0.5	NA	0.3	20	50	0.2	5	30
DEQ RBCA RBSLs GROUNDWATER	NA	NA	NA	NA	NA	NA	NA	NA	NA	20	50	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1	36	NA	90	0.15	3.9	0.24	0.049	20	0.078	80	29	0.0098	0.14	0.33

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Indeno-(1,2,3-cd) pyrene (εg/L)	Isophorone (εg/L)	1-Methyl-naphthalene (εg/L)	2-Methyl-naphthalene (εg/L)	2-Methyl phenol (εg/L)	3,4-Methyl phenol (εg/L)	Naphthalene (εg/L)	2-Nitro-aniline (εg/L)	3-Nitro-aniline (εg/L)	4-Nitro-aniline (εg/L)	Nitro-benzene (εg/L)	2-Nitro-phenol (εg/L)	4-Nitro-phenol (εg/L)	N-Nitroso-dimethyl-amine (εg/L)
MW-103	05/11/18	**<10.3**	<10.3	**<10.3**	**<10.3**	<10.3	<20.6	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**
MW-104	05/10/18	**<10**	<10	**<10**	**<10**	<10	<20	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**
MW-105	05/08/18	**<9.9**	<9.9	**<9.9**	**<9.9**	<9.9	<19.8	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	<9.9	<9.9	**<9.9**
MW-108	05/10/18	**<9.8**	<9.8	**<9.8**	**<9.8**	<9.8	<19.6	**<9.8**	<9.8	<9.8	**<9.8**	**<9.8**	<9.8	<9.8	**<9.8**
	09/12/18	**<10.2**	<10.2	**<10.2**	**<10.2**	<10.2	<10.2	**<10.2**	<10.2	<10.2	**<10.2**	**<10.2**	<10.2	<10.2	**<10.2**
MW-109	05/09/18	**<9.9**	<9.9	**<9.9**	**<9.9**	<9.9	<19.8	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	<9.9	<9.9	**<9.9**
MW-111	05/10/18	**<10.4**	<10.4	**<10.4**	**<10.4**	<10.4	<20.8	**<10.4**	<10.4	<10.4	**<10.4**	**<10.4**	<10.4	<10.4	**<10.4**
	09/12/18	**<10.3**	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**	<10.3	<10.3	**<10.3**	**<10.3**	<10.3	<10.3	**<10.3**
MW-115	09/13/18	**<10**	<10	**<10**	**<10**	<10	<10	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**
MW-117	05/10/18	**<10**	<10	**22.6**	**<10**	<10	<20	**5.9 J**	<10	<10	**<10**	**<10**	<10	<10	**<10**
	09/14/18	**<9.9**	<9.9	**14.8**	**<9.9**	<9.9	<9.9	**5.2 J**	<9.9	<9.9	**<9.9**	**<9.9**	<9.9	<9.9	**<9.9**
MW-119	05/10/18	**<10**	<10	**<10**	**<10**	<10	<20	**<10**	<10	<10	**<10**	**<10**	<10	<10	**<10**
MW-122	05/11/18	**<10.6**	<10.6	**<10.6**	**<10.6**	<10.6	<21.3	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6**	<10.6	<10.6	**<10.6**
MW-126	05/12/18	**<11.8**	<11.8	**<11.8**	**<11.8**	<11.8	<23.5	**<11.8**	<11.8	<11.8	**<11.8**	**<11.8**	<11.8	<11.8	**<11.8**
MW-128	05/09/18	**<9.9**	<9.9	**<9.9**	**<9.9**	<9.9	<19.8	**<9.9**	<9.9	<9.9	**<9.9**	**<9.9**	<9.9	<9.9	**<9.9**
MW-128 Dup	05/09/18	**<10.1**	<10.1	**<10.1**	**<10.1**	<10.1	<20.2	**<10.1**	<10.1	<10.1	**<10.1**	**<10.1**	<10.1	<10.1	**<10.1**
MW-132	05/23/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-133	05/23/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEP07	07/31/17	**<10.6**	<10.6 UJ	**<10.6 UJ**	**<10.6 UJ**	<10.6	<21.3	**<10.6 UJ**	<10.6	<10.6	**<10.6**	**<10.6 UJ**	<10.6	<10.6	**<10.6**
RH-MW-3	07/28/17	**<10.6**	<10.6	**<10.6**	**<10.6**	<10.6	<21.3	**<10.6**	<10.6	<10.6	**<10.6**	**<10.6**	<10.6	<10.6	**<10.6**
SD-I-01	08/01/17	**<11.1**	<11.1 UJ	**<11.1 UJ**	**<11.1 UJ**	<11.1	<22.2	**<11.1 UJ**	<11.1	<11.1	**<11.1**	**<11.1 UJ**	<11.1	<11.1	**<11.1**
DEQ-7 GROUNDWATER STANDARD		0.5	400	NA	NA	NA	NA	100	NA	NA	NA	10	NA	50	0.0069
DEQ RBCA RBSLs GROUNDWATER		0.5	NA	11	36	NA	NA	100	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.25	78	1.1	3.6	93	NA	0.17	19	NA	3.8	0.14	NA	NA	0.00011

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	N-Nitrosodi-n-propyl-amine (εg/L)	N-Nitroso-diphenyl-amine (εg/L)	2,2'-oxybis(1-Chloropropane) (εg/L)	Penta-chloro-phenol (εg/L)	Phen-anthrene (εg/L)	Phenol (εg/L)	Pyrene (εg/L)	1,2,4-Trichloro-benzene (εg/L)	2,4,5-Tri-chloro-phenol (εg/L)	2,4,6-Tri-chloro-phenol (εg/L)	Aroclor-1016 (εg/L)	Aroclor-1221 (εg/L)	Aroclor-1232 (εg/L)	Aroclor-1242 (εg/L)
MW-103	05/11/18	**<10.3**	<10.3	<10.3	**<20.6**	<10.3	<10.3	<10.3	**<10.3**	<10.3	**<10.3 UJ**	--	--	--	--
MW-104	05/10/18	**<10**	<10	<10	**<20**	<10	<10	<10	**<10**	<10	**<10**	--	--	--	--
MW-105	05/08/18	**<9.9**	<9.9	<9.9	**<19.8 UJ**	<9.9	<9.9	<9.9	**<9.9**	<9.9	**<9.9**	--	--	--	--
MW-108	05/10/18	**<9.8**	<9.8	<9.8	**<19.6**	<9.8	<9.8	<9.8	**<9.8**	<9.8	**<9.8**	--	--	--	--
	09/12/18	**<10.2**	<10.2	<10.2	**<20.4**	<10.2	<10.2	<10.2	**<10.2**	<10.2	**<10.2**	--	--	--	--
MW-109	05/09/18	**<9.9**	<9.9	<9.9	**<19.8**	<9.9	<9.9	<9.9	**<9.9**	<9.9	**<9.9**	--	--	--	--
MW-111	05/10/18	**<10.4**	<10.4	<10.4	**<20.8**	<10.4	<10.4	<10.4	**<10.4**	<10.4	**<10.4**	--	--	--	--
	09/12/18	**<10.3**	<10.3	<10.3	**<20.6**	<10.3	<10.3	<10.3	**<10.3**	<10.3	**<10.3**	--	--	--	--
MW-115	09/13/18	**<10**	<10	<10	**<20**	<10	<10	<10	**<10**	<10	**<10**	--	--	--	--
MW-117	05/10/18	**<10**	<10	<10	**<20**	<10	<10	<10	**<10**	<10	**<10**	--	--	--	--
	09/14/18	**<9.9**	<9.9	<9.9	**<19.8**	<9.9	<9.9	<9.9	**<9.9**	<9.9	**<9.9**	--	--	--	--
MW-119	05/10/18	**<10**	<10	<10	**<20**	<10	<10	<10	**<10**	<10	**<10**	--	--	--	--
MW-122	05/11/18	**<10.6**	<10.6	<10.6	**<21.3 UJ**	<10.6	<10.6	<10.6	**<10.6**	<10.6	**<10.6 UJ**	--	--	--	--
MW-126	05/12/18	**<11.8**	<11.8	<11.8	**<23.5**	<11.8	2.1 J	<11.8	**<11.8**	<11.8	**<11.8 UJ**	--	--	--	--
MW-128	05/09/18	**<9.9**	<9.9	<9.9	**<19.8**	<9.9	<9.9	<9.9	**<9.9**	<9.9	**<9.9**	--	--	--	--
MW-128 Dup	05/09/18	**<10.1**	<10.1	<10.1	**<20.2**	<10.1	<10.1	<10.1	**<10.1**	<10.1	**<10.1**	--	--	--	--
MW-132	05/23/18	--	--	--	--	--	--	--	--	--	--	<0.11	**<0.11**	**<0.11**	**<0.11**
MW-133	05/23/18	--	--	--	--	--	--	--	--	--	--	<0.095	**<0.095**	**<0.095**	**<0.095**
PEP07	07/31/17	**<10.6**	<10.6	<10.6	**<21.3**	<10.6	<10.6	<10.6	**<10.6 UJ**	<10.6	**<10.6**	--	--	--	--
RH-MW-3	07/28/17	**<10.6**	<10.6	<10.6	**<21.3**	<10.6	<10.6	<10.6	**<10.6**	<10.6	**<10.6**	--	--	--	--
SD-I-01	08/01/17	**<11.1**	<11.1	<11.1	**<22.2**	<11.1	<11.1	<11.1	**<11.1 UJ**	<11.1	**<11.1**	--	--	--	--
DEQ-7 GROUNDWATER STANDARD		0.05	33	NA	1	NA	4,000	20	70	300	30	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	20	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.011	12	71	0.041	NA	580	12	0.4	120	1.2	0.14	0.0047	0.0047	0.0078

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-3. GROUNDWATER - SVOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Aroclor-1248 (εg/L)	Aroclor-1254 (εg/L)	Aroclor-1260 (εg/L)	Aroclor-1262 (εg/L)	Aroclor-1268 (εg/L)
MW-103	05/11/18	--	--	--	--	--
MW-104	05/10/18	--	--	--	--	--
MW-105	05/08/18	--	--	--	--	--
MW-108	05/10/18	--	--	--	--	--
	09/12/18	--	--	--	--	--
MW-109	05/09/18	--	--	--	--	--
MW-111	05/10/18	--	--	--	--	--
	09/12/18	--	--	--	--	--
MW-115	09/13/18	--	--	--	--	--
MW-117	05/10/18	--	--	--	--	--
	09/14/18	--	--	--	--	--
MW-119	05/10/18	--	--	--	--	--
MW-122	05/11/18	--	--	--	--	--
MW-126	05/12/18	--	--	--	--	--
MW-128	05/09/18	--	--	--	--	--
MW-128 Dup	05/09/18	--	--	--	--	--
MW-132	05/23/18	**<0.11**	**<0.11**	**<0.11**	<0.11	<0.11
MW-133	05/23/18	**<0.095**	**<0.095**	**<0.095**	<0.095	<0.095
PEP07	07/31/17	--	--	--	--	--
RH-MW-3	07/28/17	--	--	--	--	--
SD-I-01	08/01/17	--	--	--	--	--
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.0078	0.0078	0.0078	NA	NA

Notes:
Bolded values exceed one or more applicable screening levels
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
SVOC - Semi-volatile organic compound

TABLE 9-4. GROUNDWATER – METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Aluminum, Dissolved (εg/L)	Antimony, Dissolved (εg/L)	Arsenic, Dissolved (εg/L)	Barium, Dissolved (εg/L)	Beryllium, Dissolved (εg/L)	Cadmium, Dissolved (εg/L)	Chromium, Dissolved (εg/L)	Cobalt, Dissolved (εg/L)	Copper, Dissolved (εg/L)	Iron, Dissolved (εg/L)
BMW-1	07/29/17	11.5/ND(11.5)U*	<0.5	**2.5**	10	<0.2	0.099	<0.5	**1**	2.2	<50
	05/10/18	17.4 JB	0.16 J	**2.4**	8.9	<0.2	0.076J/ND(0.08)U*	0.15J/ND(0.5)U*	**0.8**	2.4 JB	21.4J/ND(50)U*
	09/14/18	<20	0.15 J	**2.4**	9.7	<0.2	0.12	0.26J/ND(0.5)U*	**0.72**	1.8	13.9J/ND(50)U*
BMW-4	07/28/17	<10	<0.5	**2.8**	11.6	<0.2	<0.08	<0.5	<0.5	2.2	<50
BNMW-17	08/30/17	39.9 JB	<0.5	**7.4**	227	<0.2	<0.08	1.3	<0.5	<1	**1610**
	05/08/18	13 JB	<0.5	**6.9**	219	<0.2	<0.08	0.77 JB	0.46 J	0.31 J	**5350**
	09/13/18	91.3 JB	0.18 J	**9.9**	**557**	0.2 J	0.21	2.3 JB	0.42 J	1.1 JB	**9750**
BNMW-20	08/30/17	29.2 JB	<0.5	**2.1**	11	<0.2	<0.08	1.7	<0.5	1.5	<50
BNMW-21	08/31/17	11.6	<0.5	**1.9**	14	<0.2	<0.08	1.4	<0.5	2.7	<50
BNMW-23	08/31/17	<10	<0.5	**1.8**	28.6	<0.2	<0.08	<0.5	**2.3**	<1	71.3
	05/08/18	4J/ND(10)U*	<0.5	**2.1**	43.8	<0.2	<0.08	0.3J/ND(0.5)U*	**0.91**	0.7 J	251
	09/13/18	14.7J/ND(20)U*	0.15 J	**2**	48.7	<0.2	0.055 J	0.31J/ND(0.5)U*	**2.9**	0.62J/ND(1)U*	52.1 JB
BNMW-24	08/30/17	60.2 JB	<0.5	**1.8**	30.6	<0.2	<0.08	<0.5	<0.5	2	<50
BNMW-8	08/30/17	22.3 JB	<0.5	**1.9**	12.6	<0.2	<0.08	<0.5	<0.5	1.4	<50
BNMW-8 Dup	08/30/17	32.7 JB	<0.5	**2**	13	<0.2	<0.08	<0.5	<0.5	1.1	<50
BNMW-9	08/30/17	<10 UJ	<0.5	**2.2**	14.7	<0.2	0.15	<0.5	**1.2**	1.8	<50
BPGP02	08/31/17	<10	<0.5	**5.9**	123	<0.2	<0.08	<0.5	<0.5	<1	339
BPGP05	07/26/17	<10	<0.5	**1.5**	30.2	<0.2	<0.08	0.75	<0.5	1.5	<50
BPGP12	07/28/17	<10	<0.5	**2.1**	15.8	<0.2	<0.08	0.69	<0.5	1.9	<50
BPGP15	07/28/17	<10	<0.5	**1.6**	11.2	<0.2	<0.08	<0.5	<0.5	1.7	<50
BPGP22	07/30/17	<10	<0.5	**2.6**	13.1	<0.2	<0.08	<0.5	**2.1**	1.9	<50
	05/08/18	3.9J/ND(10)U*	<0.5	**2**	13.8	<0.2	<0.08	0.53 JB	<0.5	1.5	<50
	09/14/18	<20	0.095 J	**2.4**	17.2	<0.2	0.059 J	0.71 JB	0.31 J	1.6	<50
BPGP22 Dup	05/08/18	3.4J/ND(10)U*	<0.5	**1.9**	13	<0.2	<0.08	0.47J/ND(0.5)U*	<0.5	1.4	<50
BPGP32	07/26/17	<10	<0.5	**2.1**	12.2	<0.2	<0.08	1.2	<0.5	1.4	<50
BPGP41	07/28/17	50.6 JB	<0.5	**1.5**	10.8	<0.2	<0.08	0.63	<0.5	2.4	70.2
BPGP42	07/28/17	18.2	<0.5	**2.1**	8.8	<0.2	<0.08	<0.5	**0.69**	2.2	<50
BPGP46	07/27/17	<10	<0.5	**3.1**	19	<0.2	<0.08	<0.5	**1**	<1	<50
	05/11/18	<10	<0.5	**0.82**	5 JB	<0.2	<0.08	<0.5	0.15 J	<1	<50 UJ
	09/15/18	<20	<0.5	**4.6**	54.7	0.069 J	0.1	0.22J/ND(0.5)U*	**1.7**	0.67 J	54.8 JB
BPGP48	07/28/17	14.2	<0.5	**1.8**	11.4	<0.2	<0.08	<0.5	<0.5	2.6	<50
BPGP50	07/30/17	11.8/ND(11.8)U*	<0.5	**2.5**	25.9	<0.2	<0.08	<0.5	<0.5	1.9	<50
BPGP59	07/26/17	15.1	<0.5	**1.9**	22.9	<0.2	<0.08	<0.5	**3.6**	1.9	<50
	05/10/18	4.9J/ND(10)U*	0.16 J	**2.1**	26.5	<0.2	0.034J/ND(0.08)U*	0.6 JB	**1.7**	1.6 JB	8.4J/ND(50)U*
	09/14/18	<20	0.12 J	**2**	52.2	<0.2	0.053 J	0.36J/ND(0.5)U*	**1.4**	1.9	<50
BPGP65B	07/27/17	<10	<0.5	**1.7**	10.8	<0.2	<0.08	<0.5	<0.5	1.7	<50
BPGP66	07/26/17	<10	<0.5	**2**	16.6	<0.2	<0.08	<0.5	**1.7**	1.6	<50
BPGP78	07/27/17	<10	<0.5	**4.4**	22.1	<0.2	<0.08	<0.5	**1.1**	<1	791
	05/11/18	2.7 J	<0.5	**1.1**	21.2	<0.2	<0.08	<0.5	0.15 J	<1	96.5 J-
	09/14/18	<20	0.18 J	**3.9**	45.6	<0.2	<0.08	0.19J/ND(0.5)U*	**2.3**	0.47 J	289
DEQ-7 GROUNDWATER STANDARD		NA	6	10	1,000	4	5	100	NA	1,300	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,000	0.78	0.052	380	2.5	0.92	NA	0.6	80	1,400

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-4. GROUNDWATER – METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Lead, Dissolved (εg/L)	Manganese, Dissolved (εg/L)	Mercury, Dissolved (εg/L)	Nickel, Dissolved (εg/L)	Selenium, Dissolved (εg/L)	Silver, Dissolved (εg/L)	Thallium, Dissolved (εg/L)	Vanadium, Dissolved (εg/L)	Zinc, Dissolved (εg/L)
BMW-1	07/29/17	<0.1	**544**	<0.01	7.8	7.6	<0.5	**<0.1**	2.3	<5
	05/10/18	0.05J/ND(0.1)U*	**390**	<0.01	6.7	7.8	<0.5	**<0.1**	2.1	8.1 JB
	09/14/18	0.047 J	**356**	<0.01	6	7.3	0.42 J	**0.082 J**	2.2	2.9J/ND(5)U*
BMW-4	07/28/17	<0.1	1	<0.01	4.2	3.1	<0.5	**<0.1**	2.3	<5
BNMW-17	08/30/17	<0.1	**1520**	<0.01	1.9	1.2	<0.5	**<0.1 UJ**	6	<5
	05/08/18	0.055 J	**1340**	<0.01	2.3	0.43 J	<0.5	**<0.1**	3.9	3.1J/ND(5)U*
	09/13/18	0.54 JB	**1770**	<0.01	4	2	<0.5	**0.15**	**12.7**	10.1 JB
BNMW-20	08/30/17	<0.1	<0.5	<0.01	1.9	7.6	<0.5	**<0.1 UJ**	2.4	<5
BNMW-21	08/31/17	0.24	0.61	<0.01	3.7	7.5	<0.5	**<0.1**	1.8	<5
BNMW-23	08/31/17	<0.1	**1540**	<0.01	8.8	0.56	<0.5	**<0.1**	2.6	<5
	05/08/18	0.076 J	**1250**	<0.01	3.4	0.2 J	<0.5	**<0.1**	1.3	1J/ND(5)U*
	09/13/18	0.2 JB	**1880**	<0.01	9.4	0.99	0.54	**0.075 J**	2.7	2.8J/ND(5)U*
BNMW-24	08/30/17	<0.1	1.8	<0.01	2	4.9	<0.5	**<0.1 UJ**	1.7	<5
BNMW-8	08/30/17	<0.1	4.3	<0.01	2.6	**13.1**	<0.5	**<0.1 UJ**	2	<5
BNMW-8 Dup	08/30/17	<0.1	4.5	<0.01	2.5	**12.8**	<0.5	**<0.1 UJ**	2.1	<5
BNMW-9	08/30/17	<0.1	**989**	<0.01	10.4	4.2	<0.5	**<0.1 UJ**	1.9	<5
BPGP02	08/31/17	0.28	**366**	<0.01	1.3	<0.5	<0.5	**<0.1**	1.4	<5
BPGP05	07/26/17	<0.1	24.9 J-	<0.01	1.6	2.5	<0.5	**<0.1**	1.2	<5
BPGP12	07/28/17	<0.1	0.53/ND(0.53)U*	<0.01	2.9	**10.8**	<0.5	**<0.1**	1.7	<5
BPGP15	07/28/17	<0.1	<0.5	<0.01	4.1	7.9	<0.5	**<0.1**	1.3	<5
BPGP22	07/30/17	<0.1	**629**	<0.01	7.4	6.2	<0.5	**<0.1**	1.9	<5
	05/08/18	<0.1	19.1	<0.01	2.2	9.7	<0.5	**<0.1**	1	<5
	09/14/18	<0.1	**185**	<0.01	4.1	**15.4**	<0.5	**0.041 J**	1.4	4.4J/ND(5)U*
BPGP22 Dup	05/08/18	<0.1	18.4	<0.01	2.2	**12.4**	<0.5	**<0.1**	1 J	1.3J/ND(5)U*
BPGP32	07/26/17	<0.1	<0.5 UJ	<0.01	2.3	2.8	<0.5	**<0.1**	1.6	<5
BPGP41	07/28/17	<0.1	0.87	<0.01	2.5	**10.3**	<0.5	**<0.1**	1.2	<5
BPGP42	07/28/17	<0.1	**51.9**	<0.01	5.9	9.1	<0.5	**<0.1**	1.6	<5
BPGP46	07/27/17	<0.1	**885 J-**	<0.01	3.3	2.6	<0.5	**<0.1**	1.3	<5
	05/11/18	<0.1	**203**	<0.01	0.56	<0.5	<0.5	**<0.1**	<1	1.1 J
	09/15/18	0.087 J	**1990**	<0.01	4.8	0.21 J	<0.5	**0.1**	0.52 J	3J/ND(5)U*
BPGP48	07/28/17	<0.1	<0.5	<0.01	12.2	**21.5**	<0.5	**<0.1**	1.7	<5
BPGP50	07/30/17	<0.1	<0.5	<0.01	5.3	9.5	<0.5	**<0.1**	2.8	<5
BPGP59	07/26/17	<0.1	**530 J-**	<0.01	6	5.7	<0.5	**<0.1**	1.8	<5
	05/10/18	0.036J/ND(0.1)U*	**558**	<0.01	5.2	5.2	<0.5	**<0.1**	2.1	1.4J/ND(5)U*
	09/14/18	<0.1	**676**	<0.01	5.8	3.7	<0.5	**<0.1**	2.1	3.1J/ND(5)U*
BPGP65B	07/27/17	<0.1	**57.2 J-**	<0.01	3.9	4.5	<0.5	**<0.1**	1.3	<5
BPGP66	07/26/17	<0.1	**596 J-**	<0.01	4.5	3.8	<0.5	**<0.1**	1.6	<5
BPGP78	07/27/17	<0.1	**724 J-**	<0.01	4.1	1.7	<0.5	**<0.1**	1.5	<5
	05/11/18	<0.1	**117**	<0.01	0.76	0.58	<0.5	**<0.1**	0.47 J	3.4 J
	09/14/18	<0.1	**1340**	<0.01	5.9	0.9	<0.5	**0.036 J**	2.1	5J/ND(5)U*
DEQ-7 GROUNDWATER STANDARD		15	NA	2	100	50	100	2	NA	2,000
2018 November EPA Tap Water RSLs HQ 0.1		15	43	0.063	39	10	9.4	0.02	8.6	600

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-4. GROUNDWATER – METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Aluminum, Dissolved (εg/L)	Antimony, Dissolved (εg/L)	Arsenic, Dissolved (εg/L)	Barium, Dissolved (εg/L)	Beryllium, Dissolved (εg/L)	Cadmium, Dissolved (εg/L)	Chromium, Dissolved (εg/L)	Cobalt, Dissolved (εg/L)	Copper, Dissolved (εg/L)	Iron, Dissolved (εg/L)
BPGP80	07/26/17	<10	<0.5	**2**	14	<0.2	<0.08	<0.5	**3.1**	2.2	<50
	05/10/18	5J/ND(10)U*	0.12 J	**2.2**	16.7	<0.2	0.068J/ND(0.08)U*	0.7 JB	**2.2**	2.3 JB	<50
	09/13/18	31 JB	0.11 J	**3.7**	17.7	1.2	**1.2**	1.8 JB	**3.6**	2.6	24.6J/ND(50)U*
BPGP80 Dup	05/10/18	3.4J/ND(10)U*	<0.5	**2.3**	17.3	<0.2	0.029J/ND(0.08)U*	0.71 JB	**2.2**	1.4 JB	<50
BPGP83	07/28/17	11	<0.5	**2**	11.4	<0.2	<0.08	<0.5	<0.5	1.4	<50
BPGP87	07/31/17	15.4/ND(15.4)U*	<0.5	**2**	19.4	<0.2	<0.08	1.2	<0.5	1.6	<50
BPGP92	07/30/17	15/ND(15)U*	<0.5	**2.2**	12.5	<0.2	<0.08	<0.5	**0.95**	1.9	<50
BPGP92 Dup	07/30/17	<10	<0.5	**2.2**	12.7	<0.2	<0.08	<0.5	**0.98**	1.4	<50
BPGP94	07/30/17	20.2/ND(20.2)U*	<0.5	**2.5**	12	<0.2	<0.08	0.68	<0.5	1.4	<50
BPGW04	07/27/17	<10	<0.5	**1.9**	69.6	<0.2	<0.08	1.7	<0.5	1.3	<50
CENEX-5	07/28/17	114	<0.5	**1.6**	28.7	<0.2	0.096	<0.5	<0.5	2.6	124
EMW-03	07/28/17	18.5	<0.5	**3**	26.4	<0.2	<0.08	<0.5	**1.1**	1.5	<50
	05/07/18	**6420**	0.4 J	**5.4**	146	0.21	0.061 J	8.4	**7.6**	7	**6310**
	09/12/18	14.7J/ND(20)U*	0.21 J	**3.1**	34.9	<0.2	<0.08	0.33J/ND(0.5)U*	**1.4**	1.5 JB	16.3J/ND(50)U*
EMW-21	07/28/17	15.9	<0.5	**5.2**	42.5	<0.2	<0.08	0.56	**2.5**	<1	258
EMW-32	08/31/17	<10	<0.5	**1.2**	40.8	<0.2	<0.08	1.4	<0.5	1.3	<50
GSMW-5	07/31/17	54.3/ND(54.3)U*	<0.5	**4.9**	139	<0.2	<0.08	<0.5	0.57	<1	1130
MW-101	09/12/18	<20	0.18 J	**2.1**	55.5	<0.2	0.042J/ND(0.08)U*	0.46J/ND(0.5)U*	<0.5	1.2 JB	<50
MW-102	05/07/18	249	0.16 J	**0.97**	32.6	<0.2	0.049 J	0.48 J	0.39 J	1.6	261
MW-103	05/11/18	12	0.13J/ND(0.5)U*	**1.2**	17.6	<0.2	0.079 J	1.4	**1.3**	2.5	21.1 J-
	09/11/18	<20	0.12 J	**1.6**	14.4	<0.2	0.073 J	<0.5	**0.81**	2.7 JB	<50
MW-104	05/10/18	90.4	<0.5	**1.8**	30.9	<0.2	0.037J/ND(0.08)U*	0.29J/ND(0.5)U*	0.42 J	1.7 JB	133
	09/11/18	<20	0.12 J	**1.4 JB**	16.3	<0.2	0.051 J	0.22J/ND(0.5)U*	0.28 J	1.5 JB	<50
MW-105	05/08/18	5.7J/ND(10)U*	0.68	**3.6**	44.8	<0.2	0.033 J	<0.5	**1.2**	1.1	19 J
	09/13/18	18.1J/ND(20)U*	0.46 J	**5.2**	80	<0.2	0.031 J	0.21J/ND(0.5)U*	**1.6**	0.81J/ND(1)U*	468
MW-108	05/10/18	82.8	<0.5	**0.83**	20.5	<0.2	<0.08	0.41J/ND(0.5)U*	<0.5	0.41J/ND(1)U*	**3440**
MW-109	05/09/18	5.2 J	0.28 J	**0.75**	21.2	<0.2	0.034 J	<0.5	**10.3**	0.99 J	24.4 J
	09/14/18	<20	0.12 J	**0.88**	18.4	0.095 J	0.16	0.31J/ND(0.5)U*	**5.2**	1.4	7.3J/ND(50)U*
MW-111	05/10/18	35.4	0.28 J	**0.94**	16.9	<0.2	0.052J/ND(0.08)U*	0.29J/ND(0.5)U*	**1.6**	3.3	52.8 JB
	09/12/18	337	0.23 J	**1.6**	22.9	<0.2	0.065J/ND(0.08)U*	1.1 JB	**1.1**	2.8 JB	476
MW-117	05/10/18	124	0.12 J	**2.5**	45.2	<1	<0.08	0.35J/ND(0.5)U*	0.17 J	1.1 JB	**1650**
MW-119	05/10/18	114	0.19 J	**1.1**	19.9	<0.2	0.081/ND(0.081)U*	0.34J/ND(0.5)U*	**4.8**	2.6 JB	138
	09/14/18	20.8	0.19 J	**1.4**	16.8	<0.2	0.097	<0.5	**6.4**	2.8	41.9J/ND(50)U*
MW-122	05/11/18	3.6 J	0.12J/ND(0.5)U*	**1**	14.2	<0.2	0.029 J	0.18 J	**1.8**	2.2	7.2 J-
	09/14/18	<20	0.12 J	**1.7**	13.4	<0.2	0.043 J	0.35J/ND(0.5)U*	**0.72**	2.6	5.9J/ND(50)U*
MW-128	05/09/18	11	0.19 J	**0.91**	18.4	<0.2	0.052 J	0.19J/ND(0.5)U*	**8.7**	2.5	26.3 J
	09/11/18	<20	0.12 J	**1.1 JB**	16.4	<0.2	0.039 J	0.32J/ND(0.5)U*	**3.9**	2.7 JB	<50
MW-128 Dup	05/09/18	9.8 J	0.19 J	**0.91**	17.8	<0.2	0.066 J	0.25J/ND(0.5)U*	**8.6**	2.4	26 J
	09/11/18	11.6 J	0.12 J	**1.1 JB**	16.1	<0.2	0.032 J	0.16J/ND(0.5)U*	**4**	2.7 JB	6 J
RH-MW-3	07/28/17	<10	<0.5	**1.1**	43.3	<0.2	0.11	<0.5	<0.5	2.5	<50
DEQ-7 GROUNDWATER STANDARD		NA	6	10	1,000	4	5	100	NA	1,300	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,000	0.78	0.052	380	2.5	0.92	NA	0.6	80	1,400

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
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TABLE 9-4. GROUNDWATER – METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Lead, Dissolved (εg/L)	Manganese, Dissolved (εg/L)	Mercury, Dissolved (εg/L)	Nickel, Dissolved (εg/L)	Selenium, Dissolved (εg/L)	Silver, Dissolved (εg/L)	Thallium, Dissolved (εg/L)	Vanadium, Dissolved (εg/L)	Zinc, Dissolved (εg/L)
BPGP80	07/26/17	<0.1	**627 J-**	<0.01	5.1	7.6	<0.5	**<0.1**	2.1	<5
	05/10/18	0.029J/ND(0.1)U*	**430**	<0.01	4.2	9	<0.5	**0.029 J**	2.3	1.8J/ND(5)U*
	09/13/18	1.3	**431**	<0.01	5.6	**11.3**	0.17 J	**1.1**	3.9	5.6 JB
BPGP80 Dup	05/10/18	<0.1	**446**	0.004 J	4.2	9.1	<0.5	**<0.1**	2.3	1.3J/ND(5)U*
BPGP83	07/28/17	<0.1	<0.5	<0.01	2.3	6.7	<0.5	**<0.1**	1.9	<5
BPGP87	07/31/17	<0.1	<0.5	<0.01	1.7	5.2	<0.5	**<0.1**	1.8	<5
BPGP92	07/30/17	<0.1	**129**	<0.01	5.2	9.4	<0.5	**<0.1**	1.2	<5
BPGP92 Dup	07/30/17	<0.1	**140**	<0.01	5.4	9.4	<0.5	**<0.1**	1.2	<5
BPGP94	07/30/17	<0.1	<0.5	<0.01	3.7	5	<0.5	**<0.1**	1.8	<5
BPGW04	07/27/17	<0.1	**44.9 J-**	<0.01	1.3	**15.2**	<0.5	**<0.1**	1.1	<5
CENEX-5	07/28/17	<0.1	**550**	<0.01	5.1	**11**	<0.5	**<0.1**	2.3	<5
EMW-03	07/28/17	<0.1	**1060**	<0.01	5.7	**11.3**	<0.5	**<0.1**	4.4	<5
	05/07/18	3.8	**2050**	0.011	14.4	7.5	<0.5	**0.08 J**	**16**	17.7/ND(17.7)U*
	09/12/18	<0.1	**999**	<0.01	5.8	**14.3**	<0.5	**<0.1**	4.2	3 J
EMW-21	07/28/17	<0.1	**242**	<0.01	5	2.4	<0.5	**<0.1**	3.7	<5
EMW-32	08/31/17	<0.1	<0.5	<0.01	1	9.4	<0.5	**<0.1**	1.3	<5
GSMW-5	07/31/17	<0.1	**2140**	<0.01	1.9	1.1	<0.5	**<0.1**	1.5	<5
MW-101	09/12/18	<0.1	26.3	<0.01	1.1	**11.7**	<0.5	**0.038J/ND(0.1)U***	2.7	2.9 J
MW-102	05/07/18	0.22	**271**	<0.01	4.5	**15.9**	<0.5	**<0.1**	1.9	2.6J/ND(5)U*
MW-103	05/11/18	<0.1	**177**	<0.01	9.4	**11.5**	<0.5	**<0.1**	1.3	1.3 J
	09/11/18	<0.1	**116**	<0.01	6.7	**10.8**	<0.5	**0.031 J**	1.8	21.8 JB
MW-104	05/10/18	0.1 JB	**164**	<0.01	4.6	8	<0.5	**<0.1**	1.7	1.9J/ND(5)U*
	09/11/18	<0.1	**256**	<0.01	5.8	4.2	<0.5	**0.04 J**	1.4	2.7J/ND(5)U*
MW-105	05/08/18	1.6	**1630**	<0.01	9.7	1.1	<0.5	**<0.1**	2.3	3.2J/ND(5)U*
	09/13/18	0.53 JB	**736**	<0.01	11.1	0.95	0.46 J	**0.051 J**	0.6 J	164
MW-108	05/10/18	0.095J/ND(0.1)U*	**1270**	<0.01	2.3	0.19 J	<0.5	**<0.1**	0.91 J	1.2J/ND(5)U*
MW-109	05/09/18	<0.1	**2460**	<0.01	20.5	3.8	<0.5	**<0.1**	0.69 J	1.9 J
	09/14/18	0.15	**1160**	<0.01	18	4.4	<0.5	**0.13**	0.63 J	4.2J/ND(5)U*
MW-111	05/10/18	0.063J/ND(0.1)U*	**888**	<0.01	6.4	7.7	<0.5	**0.03 J**	0.86 J	5.8 JB
	09/12/18	0.55 JB	**531**	<0.01	4.4	7.4	<0.5	**0.057J/ND(0.1)U***	2.4	4.5 J
MW-117	05/10/18	1.5	**812**	<0.01	2.3	<2.5	<0.5	**<0.1**	0.67 J	5.4 JB
MW-119	05/10/18	0.15 JB	**68.3**	<0.01	12.5	**10.5**	<0.5	**<0.1**	1.8	2.8J/ND(5)U*
	09/14/18	0.098 J	12.5	<0.01	10.9	**13.5**	<0.5	**0.042 J**	2.2	4.4J/ND(5)U*
MW-122	05/11/18	<0.1	**714**	<0.01	12.9	9.2	<0.5	**<0.1**	1	1.9 J
	09/14/18	0.052 J	**268**	<0.01	10.7	**13.9**	<0.5	**0.055 J**	1.8	3.6J/ND(5)U*
MW-128	05/09/18	0.032 J	**1650**	<0.01	10.4	**19.1**	<0.5	**<0.1**	1.1	2 J
	09/11/18	<0.1	**833**	<0.01	6.9	**20.1**	<0.5	**0.033 J**	1.4	2.6J/ND(5)U*
MW-128 Dup	05/09/18	<0.1	**1570**	<0.01	10.2	**18.8**	<0.5	**<0.1**	1.1	1.3 J
	09/11/18	<0.1	**805**	<0.01	6.9	**20.8**	<0.5	**<0.1**	1.4	2.6J/ND(5)U*
RH-MW-3	07/28/17	<0.1	**67**	<0.01	3.3	**12.9**	<0.5	**<0.1**	4.3	<5
DEQ-7 GROUNDWATER STANDARD		15	NA	2	100	50	100	2	NA	2,000
2018 November EPA Tap Water RSLs HQ 0.1		15	43	0.063	39	10	9.4	0.02	8.6	600

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
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TABLE 9-4. GROUNDWATER – METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Aluminum, Dissolved (εg/L)	Antimony, Dissolved (εg/L)	Arsenic, Dissolved (εg/L)	Barium, Dissolved (εg/L)	Beryllium, Dissolved (εg/L)	Cadmium, Dissolved (εg/L)	Chromium, Dissolved (εg/L)	Cobalt, Dissolved (εg/L)	Copper, Dissolved (εg/L)	Iron, Dissolved (εg/L)
SD-I-01	08/01/17	<10	<0.5	**1.4**	16.6	<0.2	<0.08	0.56	**1.1**	2.7	64.9
ZPMW-1	08/01/17	15.4	<0.5	**1.4**	24.5	<0.2	<0.08	<0.5	**1.8**	1.2	80.3
	05/09/18	5.1 J	0.14 J	**1.2**	21.3	<0.2	<0.08	<0.5	**0.61**	1.3	<50
	09/12/18	<20	0.16 J	**1.5**	24	<0.2	0.1 JB	<0.5	**0.94**	1.3 JB	<50
DEQ-7 GROUNDWATER STANDARD		NA	6	10	1,000	4	5	100	NA	1,300	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,000	0.78	0.052	380	2.5	0.92	NA	0.6	80	1,400

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
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TABLE 9-4. GROUNDWATER – METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Lead, Dissolved (εg/L)	Manganese, Dissolved (εg/L)	Mercury, Dissolved (εg/L)	Nickel, Dissolved (εg/L)	Selenium, Dissolved (εg/L)	Silver, Dissolved (εg/L)	Thallium, Dissolved (εg/L)	Vanadium, Dissolved (εg/L)	Zinc, Dissolved (εg/L)
SD-I-01	08/01/17	<0.1	**70.8**	<0.01	5.1	9.6	<0.5	**<0.1**	1.4	69.6
ZPMW-1	08/01/17	<0.1	**462**	<0.01	3.4	**15.2**	<0.5	**<0.1**	2	<5
	05/09/18	<0.1	**172**	<0.01	3	**14**	<0.5	**<0.1**	1.8	7.2
	09/12/18	<0.1	**363**	<0.01	3.3	**15.7**	<0.5	**0.039J/ND(0.1)U***	2.6	4.9 J
DEQ-7 GROUNDWATER STANDARD		15	NA	2	100	50	100	2	NA	2,000
2018 November EPA Tap Water RSLs HQ 0.1		15	43	0.063	39	10	9.4	0.02	8.6	600

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
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RBSL - Risk-based Screening Level
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RSL - Regional Screening Level
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
BMW07-1	07/29/17	70.3 JB	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<20 UJ	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/14/18	<20	**<4**	0.2 J	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
BMW-1	07/29/17	44.4/ND(44.4) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/14/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
BMW-4	07/28/17	<20	**<4**	**1.4**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<20 UJ	**<4 UJ**	**1.2 J-**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/14/18	<20	**<4**	0.36 J	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
BNMW-17	08/30/17	24/ND(24)U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	0.29 J	<1	**<1**	<1
	09/13/18	<20	**<4**	**0.12 J**	<1	<1	**<1**	**<4**	**<4**	3.7 J	<1	0.37 J	<1	**<1**	<1
BNMW-20	08/30/17	40.5 JB	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BNMW-21	08/31/17	29.6/ND(29.6) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BNMW-23	08/31/17	32.9/ND(32.9) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	1.6	2.6	<1	**<1**	<1
	05/08/18	<20	**<4**	**0.53 J**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	2.5	4	0.38 J	**<1**	<1
	09/13/18	16J/ND(20)U*	**<4**	0.3 J	<1	<1	**<1**	**<4**	**<4**	<5	2.3	3.5	0.52 J	**<1**	<1
BNMW-24	08/30/17	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BNMW-8	08/30/17	<20 UJ	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BNMW-8 Dup	08/30/17	52.1 JB	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BNMW-9	08/30/17	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP02	08/31/17	29.4/ND(29.4) U*	**<4**	**147**	<1	<1	**<1**	**<4**	**<4**	<5	3.4	8.1	<1	**<1**	<1
	05/11/18	<40 UJ	**<8**	**53.6**	<2	<2	**<2**	**<8**	**<8**	<10	0.92 J	0.95 J	<2	**<2**	<2
	09/14/18	<20	**<4**	**156**	<1	<1	**<1**	**<4**	**<4**	<5	2.9	3.4	0.37 J	**<1**	<1
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

Notes:
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J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
BMW07-1	07/29/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BMW-1	07/29/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
BMW-4	07/28/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BNMW-17	08/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BNMW-20	08/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.3 J
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BNMW-21	08/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BNMW-23	08/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BNMW-24	08/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BNMW-8	08/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.35 J
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BNMW-8 Dup	08/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BNMW-9	08/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP02	08/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/11/18	<2	**<2**	<8	<2	<2	**<8**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
BMW07-1	07/29/17	**<1**	<1	**29.9**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	**<1**	<1	**43.5**	0.24 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/14/18	**<1**	<1	**30.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BMW-1	07/29/17	**<1**	<1	**15.2**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	**<1**	<1	**19.1**	0.27 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/14/18	**<1 UJ**	<1 UJ	**20.9 J-**	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
BMW-4	07/28/17	**<1 UJ**	<1	**20**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
	05/10/18	**<1 UJ**	<1 UJ	**26.7 J-**	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	09/14/18	**<1**	<1	**26**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BNMW-17	08/30/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/08/18	**<1**	<1	0.26 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/13/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BNMW-20	08/30/17	**<1**	<1	**8.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/08/18	**<1**	<1	**9.5**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/13/18	**<1**	<1	**5.9**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BNMW-21	08/31/17	**<1**	<1	**12.6**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/08/18	**<1**	<1	**13.9**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/13/18	**<1**	<1	**13.8**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BNMW-23	08/31/17	**<1**	<1	**6.4**	1.5	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**6.8 J+**	**<1**
	05/08/18	**<1**	<1	**10**	0.7 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**9.8**	**<1**
	09/13/18	**<1**	<1	**12.7**	0.53 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**10.5**	**<1**
BNMW-24	08/30/17	**<1**	<1	3.2	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BNMW-8	08/30/17	**<1**	<1	**7.1**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/08/18	**<1**	<1	**11**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/13/18	**<1**	<1	**12.3**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BNMW-8 Dup	08/30/17	**<1**	<1	**7.5**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BNMW-9	08/30/17	**<1**	<1	**4.5**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/08/18	**<1**	<1	**4.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/13/18	**<1**	<1	**4.2**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP02	08/31/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**320**	**<1**
	05/11/18	**<2**	<2	<2	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**173**	**<2**
	09/14/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**280**	**<1**
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

Notes:
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U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
BMW07-1	07/29/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**57.8**	<10 UJ	<1	**<1**
	05/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**48.1 J-**	<40	<1	**<1**
	09/14/18	<1	<1	<5	0.99J/ND(4)U*	<1	**<4**	<1	<1	**<1**	**<1**	**69.7**	<10	<1	**<1**
BMW-1	07/29/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**124**	<10	<1	**<1**
	05/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**131**	<40	<1	**<1**
	09/14/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**154 J-**	<10 UJ	<1 UJ	**<1 UJ**
BMW-4	07/28/17	<1	<1	<5	<4	<1	**<5**	<1	<4	**<1**	**<1**	**55.9**	<10	<1	**<1**
	05/10/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**54.4 J-**	<40 UJ	<1 UJ	**<1 UJ**
	09/14/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**51.7**	<10	<1	**<1**
BNMW-17	08/30/17	<1	<1	<5	<4	<1	**6.5 J-**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**0.99 J**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
	09/13/18	<1	<1	0.82 J	<4	<1	**4 J**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
BNMW-20	08/30/17	<1	<1	<5	<4	<1	**<5 UJ**	<1	<1	**<1**	**<1**	**25.8**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**33.2**	<10	<1	**<1**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**24.8**	<10	<1	**<1**
BNMW-21	08/31/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**20.2**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**20.9**	<10	<1	**<1**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**20.9**	<10	<1	**<1**
BNMW-23	08/31/17	2.7	<1	<5	<4	<1	**<5**	8.4	<1	**<1**	**<1**	**4.9**	<10	<1	**<1**
	05/08/18	6.6	0.69 J	<5	<4	<1	**1.2 J**	12.9	<1	**<1**	**<1**	3.2	<10	0.22J/ND(1)U*	**<1**
	09/13/18	3	0.57 J	<5	<4	<1	**<4**	10.2	<1	**<1**	**<1**	3	<10	0.22 J	**<1**
BNMW-24	08/30/17	<1	<1	<5	<4	<1	**<5 UJ**	<1	<1	**<1**	**<1**	**5.9**	<10	<1	**<1**
BNMW-8	08/30/17	<1	<1	<5	<4	<1	**<5 UJ**	<1	<1	**<1**	**<1**	**8.2**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**14.3**	<10	<1	**<1**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**18.2**	<10	<1	**<1**
BNMW-8 Dup	08/30/17	<1	<1	<5	<4	<1	**<5 UJ**	<1	<1	**<1**	**<1**	**8.6**	<10	<1	**<1**
BNMW-9	08/30/17	<1	<1	<5	<4	<1	**<5 UJ**	<1	<1	**<1**	**<1**	**5.4**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**6**	<10	<1	**<1**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**5.5**	<10	<1	**<1**
BPGP02	08/31/17	**55.8**	1.2	<5	<4	<5	**38.9**	**132**	<1	**<1**	**<1**	2.3	<10	12.7	**<1**
	05/11/18	5.5	0.43 J	<10	**<8**	<2	**21.9**	13.2	<2	**<2**	**<2**	1.4 J	<80	8.8	**<2**
	09/14/18	15.7	1.6	<5	2.7J/ND(4)U*	<1	**21.2**	42.3	0.75 J	**<1**	**<1**	0.9 J	<10	15.9 J-	**<1**
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

Notes:
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J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
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REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
BMW07-1	07/29/17	**<1**	<1	**<1**	**26.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<1**	<1	**<1**	**34.8**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/14/18	**<1**	<1	**<1**	**26.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BMW-1	07/29/17	**<1**	<1	**<1**	**17**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<1**	<1	**<1**	**19.5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/14/18	**<1 UJ**	<1 UJ	**<1 UJ**	**18.5 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
BMW-4	07/28/17	**<1**	<1	**<1**	**13.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<1 UJ**	<1 UJ	**<1 UJ**	**15.6 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2**	<2 UJ	<1 UJ	<3 UJ
	09/14/18	**<1**	<1	**<1**	**16.7**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BNMW-17	08/30/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BNMW-20	08/30/17	**<1**	<1	**<1**	**6.5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	0.16 J	**<1**	**8.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	<1	**<1**	**5.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BNMW-21	08/31/17	**<1**	<1	**<1**	**5.8**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	0.18 J	**<1**	**6.5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	<1	**<1**	**6.5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BNMW-23	08/31/17	**<1**	<1	**<1**	**16.6**	<1	**<4**	<1	**8.3**	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	<1	**<1**	**7**	<1	**<4**	<1	4.5	<1	**<0.2**	0.3 J	<1	<3
	09/13/18	**<1**	<1	**<1**	**13.6**	<1	**<4**	<1	**11.2**	<1	**<0.2**	<2	<1	<3
BNMW-24	08/30/17	**<1**	<1	**<1**	**2.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BNMW-8	08/30/17	**<1**	<1	**<1**	**4.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	0.16 J	**<1**	**6.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	0.39 J	**<1**	**7.1**	<1	**<4**	<1	0.43 J	<1	**<0.2**	<2	<1	<3
BNMW-8 Dup	08/30/17	**<1**	<1	**<1**	**4.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BNMW-9	08/30/17	**<1**	<1	**<1**	**3.4**	<1	**<4**	<1	<1	<1	**0.24**	<2	<1	<3
	05/08/18	**<1**	<1	**<1**	**3.7**	<1	**<4**	<1	<1	<1	**0.17 J**	<2	<1	<3
	09/13/18	**<1**	<1	**<1**	**3.4**	<1	**<4**	<1	<1	<1	**0.21**	<2	<1	<3
BPGP02	08/31/17	**<1**	<1	**<1**	**1.7**	<1	**<4**	<1	**122**	**50.1**	**<0.2**	94.1	6.8	**130**
	05/11/18	**<2**	<2	**<2**	**0.92**	<2	**<8**	<2	**97**	**6.6**	**<0.4**	153	4	**157**
	09/14/18	**<1**	<1	**<1**	**2.4**	<1	**<4**	<1	**161**	3.4	**<0.2**	114	7.9 J-	**121**
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

Notes:
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J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
BPGP04	07/31/17	74	**<4**	**<1**	<1	<1	**4.4**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP05	07/26/17	<80	**<4**	**<1**	<1	<1	**2.1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP08	07/26/17	<80	**<4**	**<1**	<1	<1	**2.1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<40	**<8**	**<2**	<2	<2	**<2**	**<8**	**<8**	<10	<2	<2	<2	**<2**	<2
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
BPGP12	07/28/17	78.7/ND(78.7) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/21/18	<40	**<8**	**<2**	<2	<2	**<2**	**<8**	**<8**	<10	<2	<2	<2	**<2**	<2
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
BPGP15	07/28/17	32.1/ND(32.1) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**0.59 J**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**0.56 J**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP16	07/30/17	62.5/ND(62.5) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**6.2**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**6.6**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP16 Dup	09/11/18	<20	**<4**	**<1**	<1	<1	**6.6**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP17	07/30/17	33.3/ND(33.3) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP22	07/30/17	59.8/ND(59.8) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**4.9**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/14/18	<20	**<4**	**<1**	<1	<1	**3.4**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP22 Dup	05/08/18	<20	**<4**	**<1**	<1	<1	**4.4**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP25	07/28/17	26.2/ND(26.2) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	05/07/18	<20	**<4**	**<1**	<1	<1	**2**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**3.3**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP27	07/28/17	56.8/ND(56.8) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	05/07/18	<20	**<4**	**<1**	<1	<1	**3.3**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
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VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
BPGP04	07/31/17	<1	**32.8**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP05	07/26/17	<1	**17.7**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP08	07/26/17	<1	**10.9**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<2	**3.5 JB**	<8	<2	<2	**<8**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP12	07/28/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/21/18	<2	**3.4 JB**	<8	<2	<2	**<20**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	1 J
	09/12/18	<1	**2.5**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	1.1
BPGP15	07/28/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**3.5**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**1.4**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP16	07/30/17	<1	**7.4**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**23.4**	<4	<1	<1	**<4**	**1.2**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**29.5**	<4	<1	<1	**<10**	**1.1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP16 Dup	09/11/18	<1	**30**	<4	<1	<1	**<10**	**0.94 J**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP17	07/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.54 J
	09/11/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.36 J
BPGP22	07/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**27.7**	<4	<1	<1	**<4**	**0.93 J**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1	**14.8**	<4	<1	<1	**<10**	0.7 J	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP22 Dup	05/08/18	<1	**27.4**	<4	<1	<1	**<4**	0.58 J	**<1**	**<4**	<1	<1	**<1**	<1 UJ	<1
BPGP25	07/28/17	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/07/18	<1	**10.9**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**22.8**	<4	<1	<1	**<10**	0.64 J	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP27	07/28/17	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/07/18	<1	**19.7**	<4	<1	<1	**<4**	0.52 J	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**6.4**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
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REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
BPGP04	07/31/17	**<1**	<1	1.2	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP05	07/26/17	**<1**	<1	**4.7 J+**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP08	07/26/17	**<1**	<1	**23 J+**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	**0.86 J**	<2	**24.7**	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**<2**	**<2**
	09/12/18	**0.47 J**	<1	**44**	0.18 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP12	07/28/17	**<1**	<1	**4.5**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/21/18	**<2**	<2	**6.1**	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**<2**	**<2**
	09/12/18	**<1**	<1	**5.9**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP15	07/28/17	**<1**	<1	1.6	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/08/18	**<1**	<1	3.3	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	2.2	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP16	07/30/17	**<1**	<1	**6.5**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/08/18	**<1**	<1	0.65 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	1.2	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP16 Dup	09/11/18	**<1**	<1	1.3	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP17	07/30/17	**<1 UJ**	<1	**11.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
	05/08/18	**<1**	<1	**40.3**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	**49.7**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP22	07/30/17	**<1 UJ**	<1	**65.6**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
	05/08/18	**<1**	<1	1.9	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/14/18	**<1**	<1	**12.9**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP22 Dup	05/08/18	**<1**	<1	1.4	<1	<1	**<4**	<1	<4 UJ	<1	<4	**<4**	<4	<1	**<1**
BPGP25	07/28/17	**<1 UJ**	<1 UJ	**5.2 J**	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/07/18	**<1**	<1	3	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	**7.3**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP27	07/28/17	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/07/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	0.93 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
BPGP04	07/31/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**219**	<10	<1	**<1**
BPGP05	07/26/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**460**	<10	<1	**<1**
BPGP08	07/26/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**330**	<10	<1	**<1**
	05/10/18	<2	<2	<10	**<8**	<2	**<8**	<2	<2	**<2**	**<2**	**361**	<80	<2	**<2**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**348**	<10	<1	**<1**
BPGP12	07/28/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**632**	<10	<1	**<1**
	05/21/18	<2	<2	<10	**<8**	<2	**<8**	<2	<2	**<2**	**<2**	**593**	<20	<2	**<2**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**653**	<10	<1	**<1**
BPGP15	07/28/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**34.1**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**42.3**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**40.3**	<10	<1	**<1**
BPGP16	07/30/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**492**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**155**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**76.6**	<10	<1	**<1**
BPGP16 Dup	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**78.1**	<10	<1	**<1**
BPGP17	07/30/17	<1	<1	<5	<4	<1	**<5**	<1	<4	**<1**	**<1**	**115**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**123**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**73.6**	<10	<1	**<1**
BPGP22	07/30/17	<1	<1	<5	<4	<1	**<5**	<1	<4	**<1**	**<1**	**214**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**65**	<10	<1	**<1**
	09/14/18	<1	<1	<5	1.6J/ND(4)U*	<1	**<4**	<1	<1	**<1**	**<1**	**116**	<10	<1	**<1**
BPGP22 Dup	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**59.1**	<10	<1	**<1**
BPGP25	07/28/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**173**	<10 UJ	<1 UJ	**<1 UJ**
	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**172 J-**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**98.3**	<10	<1	**<1**
BPGP27	07/28/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**10.7**	<10 UJ	<1 UJ	**<1 UJ**
	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**18.3**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**27**	<10	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
BPGP04	07/31/17	**<1**	<1	**<1**	**2.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP05	07/26/17	**<1**	<1	**<1**	**29**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP08	07/26/17	**<1**	<1	**<1**	**34.7**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<2**	0.63 J	**<2**	**32.1**	<2	**<8**	<2	<2	<2	**<0.4**	<4	<2	<6
	09/12/18	**<1**	0.77 J	**<1**	**49**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP12	07/28/17	**<1**	<1	**<1**	**35.8**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/21/18	**<2**	1.8 J	**<2**	**24.2**	<2	**<8**	<2	<2	<2	**<0.4**	<4	<2	<6
	09/12/18	**<1**	2.2	**<1**	**35.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP15	07/28/17	**<1**	<1	**<1**	**4.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	<1	**<1**	**10.1**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	<1	**<1**	**8**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP16	07/30/17	**<1**	<1	**<1**	**26.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	<1	**<1**	**4.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	<1	**<1**	**3.5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP16 Dup	09/11/18	**<1**	<1	**<1**	**3.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP17	07/30/17	**<1**	<1	**<1**	**22.1**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	0.56 J	**<1**	**41.1**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	0.53 J	**<1**	**37.7**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP22	07/30/17	**<1**	<1	**<1**	**75.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	<1	**<1**	**7**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/14/18	**<1**	0.37 J	**<1**	**23.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP22 Dup	05/08/18	**<1**	<1	**<1**	**5.7**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP25	07/28/17	**<1 UJ**	<1 UJ	**<1 UJ**	**19.4**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	05/07/18	**<1**	0.29 J	**<1**	**14**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	0.49 J	**<1**	**11.1**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP27	07/28/17	**<1 UJ**	<1 UJ	**<1 UJ**	**1.1**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	05/07/18	**<1**	<1	**<1**	**1.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	<1	**<1**	**3.5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
BPGP27 Dup	07/28/17	20.6/ND(20.6) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
BPGP28	07/28/17	49.7/ND(49.7) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
BPGP29	07/28/17	54.5/ND(54.5) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/07/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	0.11 J	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP31	07/31/17	30.5 J-	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	05/07/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
BPGP32	07/26/17	<80	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP41	07/28/17	60.1/ND(60.1) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/07/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP41 Dup	09/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP42	07/28/17	40.1/ND(40.1) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP44	07/31/17	55	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP46	07/27/17	<80	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	2.9 J+	7.6 J+	<1	**<1**	<1
	05/11/18	<40	**<8**	**1.6**	<2	<2	**<2**	**<8**	**<8**	<10	0.56 J	4.4	<2	**<2**	<2
	09/15/18	<20	**<4**	**1.2**	<1	<1	**<1**	**<4**	**<4**	<5	0.97 J+	1.2 J+	<1	**<1**	<1
BPGP46b	07/27/17	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	05/11/18	<20 UJ	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP47	07/28/17	36.8/ND(36.8) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	05/07/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP48	07/28/17	38.9/ND(38.9) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
BPGP27 Dup	07/28/17	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
BPGP28	07/28/17	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
BPGP29	07/28/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/07/18	<1	**12.5**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**2.4**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.44 J
BPGP31	07/31/17	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/07/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
BPGP32	07/26/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP41	07/28/17	<1	**2.7**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/07/18	<1	**4.3**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/10/18	<1	**8.6**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP41 Dup	09/10/18	<1	**8.7**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP42	07/28/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**0.97 J**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.64 J
	09/10/18	<1	**1.1**	0.16 J	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.49 J
BPGP44	07/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**1.3**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.48 J
	09/10/18	<1	**3**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.5 J
BPGP46	07/27/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	1.7 J+	<1	**<1**	<1	<1
	05/11/18	<2	**<2**	<8	<2	<2	**<8**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
	09/15/18	<1	**<4**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	0.47 J	<1	**<1**	<1	<1
BPGP46b	07/27/17	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/11/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP47	07/28/17	<1 UJ	**3 JB**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/07/18	<1	**4.2**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/10/18	<1	**14**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP48	07/28/17	<1 UJ	**1.2/ND(1.2)U***	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

Notes:
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U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
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VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
BPGP27 Dup	07/28/17	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
BPGP28	07/28/17	**<1 UJ**	<1 UJ	3.2 J	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
BPGP29	07/28/17	**<1**	<1	**18.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/07/18	**<1**	<1	**10.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	**16.7**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP31	07/31/17	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/07/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
BPGP32	07/26/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP41	07/28/17	**<1 UJ**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
	05/07/18	**<1**	<1	1.7	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/10/18	**<1**	<1	1.5	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP41 Dup	09/10/18	**<1**	<1	1.5	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP42	07/28/17	**<1**	<1	**21.7**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/08/18	**<1**	<1	**23.2**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/10/18	**<1**	<1	**18**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP44	07/31/17	**<1 UJ**	<1	**12.1**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
	05/08/18	**<1**	<1	**11.9**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/10/18	**<1**	<1	**11.9**	0.19 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP46	07/27/17	**<1**	<1	**118 J+**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/11/18	**<2**	<2	<2	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	<2	**<2**
	09/15/18	**<1**	<1 UJ	**7.1**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP46b	07/27/17	**<1 UJ**	<1 UJ	1 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/11/18	**<1**	<1	1.4	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP47	07/28/17	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/07/18	**<1**	<1	3	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/10/18	**<1**	<1	1.5	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP48	07/28/17	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

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REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
BPGP27 Dup	07/28/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**12.8**	<10 UJ	<1 UJ	**<1 UJ**
BPGP28	07/28/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**144**	<10 UJ	<1 UJ	**<1 UJ**
BPGP29	07/28/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**141**	<10	<1	**<1**
	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**37.2 J-**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**143**	<10	<1	**<1**
BPGP31	07/31/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	<4 UJ	<10 UJ	<1 UJ	**<1 UJ**
	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.42 J	<10	<1	**<1**
	09/11/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	<1 UJ	<10 UJ	<1 UJ	**<1 UJ**
BPGP32	07/26/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	1.8	<10	<1	**<1**
BPGP41	07/28/17	<1	<1	<5	<4	<1	**<5**	<1	<4	**<1**	**<1**	**37.2**	<10	<1	**<1**
	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**42.4**	<10	<1	**<1**
	09/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**65.7**	<10	<1	**<1**
BPGP41 Dup	09/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**63.8**	<10	<1	**<1**
BPGP42	07/28/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**247**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**231**	<10	<1	**<1**
	09/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**227**	<10	<1	**<1**
BPGP44	07/31/17	<1	<1	<5	<4	<1	**<5**	<1	<4	**<1**	**<1**	**170**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**152**	<10	<1	**<1**
	09/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**155**	<10	<1	**<1**
BPGP46	07/27/17	2.4 J+	<1	<5	<4	**14.1 J**	**<5**	1.7 J+	<1	**1.4 J+**	**<1**	**17200**	<10	<1	**<1**
	05/11/18	9.3	<2	<10	**<8**	<2	**<8**	9.1	<2	**<2**	**<2**	**368**	<20	<2	**<2**
	09/15/18	0.3 J	0.19 J+	<5	2J/ND(4)U*	<1	**<5 UJ**	0.37 J+	<1	**<1**	**<1**	**2680 J-**	<10	<1	**<1**
BPGP46b	07/27/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<5**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**183**	<10 UJ	<1 UJ	**<1 UJ**
	05/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**1980**	<40	<1	**<1**
BPGP47	07/28/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**41.7**	<10 UJ	<1 UJ	**<1 UJ**
	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**67.5**	<10	<1	**<1**
	09/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**56.8**	<10	<1	**<1**
BPGP48	07/28/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<5**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	<4	<10 UJ	<1 UJ	**<1 UJ**
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
BPGP27 Dup	07/28/17	**<1 UJ**	<1 UJ	**<1 UJ**	**1.3**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
BPGP28	07/28/17	**<1 UJ**	<1 UJ	**<1 UJ**	**14.8**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
BPGP29	07/28/17	**<1**	<1	**<1**	**40.5**	<1	**<4**	<1	<1	<1	**3.1 J+**	<2	<1	<3
	05/07/18	**<1**	<1	**<1**	**19.8**	<1	**<4**	<1	<1	<1	**0.46**	<2	<1	<3
	09/11/18	**<1**	0.46 J	**<1**	**40**	<1	**<4**	<1	<1	<1	**1.7**	<2	<1	<3
BPGP31	07/31/17	**<1 UJ**	<1 UJ	**<1 UJ**	**<0.4 UJ**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	05/07/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1 UJ**	<1 UJ	**<1 UJ**	**<0.4 UJ**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
BPGP32	07/26/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP41	07/28/17	**<1**	<1	**<1**	**2.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/07/18	**<1**	<1	**<1**	**4.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/10/18	**<1**	<1	**<1**	**6.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP41 Dup	09/10/18	**<1**	<1	**<1**	**6.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP42	07/28/17	**<1**	<1	**<1**	**36.7**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	0.61 J	**<1**	**42.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/10/18	**<1**	0.59 J	**<1**	**37.7**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP44	07/31/17	**<1**	<1	**<1**	**29.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	0.51 J	**<1**	**25.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/10/18	**<1**	0.73 J	**<1**	**27.8**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP46	07/27/17	**<1**	<1	**<1**	**232**	<1	**<4**	<1	2.4 J+	1 J+	**<0.2**	<2	<1	<3
	05/11/18	**<2**	<2	**<2**	**2.8**	<2	**<8**	<2	<2	<2	**<0.4**	<4	<2	<6
	09/15/18	**<1**	<1	**<1**	**17.4**	<1	**<4**	<1	1.4 J+	0.53 J	**<0.2**	<2	<1	<3
BPGP46b	07/27/17	**<1 UJ**	<1 UJ	**<1 UJ**	**66.4 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	05/11/18	**<1**	<1	**<1**	**246**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP47	07/28/17	**<1 UJ**	<1 UJ	**<1 UJ**	**3.9**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	05/07/18	**<1**	<1	**<1**	**7.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/10/18	**<1**	<1	**<1**	**5.7**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP48	07/28/17	**<1 UJ**	<1 UJ	**<1 UJ**	**<0.4**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

Notes:
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J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
BPGP48	05/07/18	<20	**<4**	**<1**	<1	<1	**1.1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**0.86 J**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP49	07/27/17	55/ND(55)U*	**<4 UJ**	**1.6 J-**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	18.8 J-	1.4 J-	3.5 J-	<1 UJ	**<1 UJ**	<1 UJ
	05/11/18	**<2000 UJ**	**<400**	**<100**	**<100**	**<100**	**<100**	**<400**	**<400**	<500	<100	<100	**<100**	**<100**	**<100**
	09/14/18	<100	**<20**	**1 J**	<5	<5	**<5**	**<20**	**<20**	<25	<5	<5	<5	**<5**	<5
BPGP50	07/30/17	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/21/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP50 Dup	05/21/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP51	07/27/17	26.7/ND(26.7) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	05/11/18	<1000 UJ	**<200**	**<50**	**<50**	**<50**	**<50**	**<200**	**<200**	<250	<50	<50	<50	**<50**	**<50**
	09/15/18	**<2000**	**<400**	**<100**	**<100**	**<100**	**<100**	**<400**	**<400 UJ**	<500	<100	<100	**<100**	**<100**	**<100**
BPGP51B	07/27/17	32.2/ND(32.2) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	2.7 J	<1 UJ	**<1 UJ**	<1 UJ
	05/11/18	<20	**<4**	**0.76 J**	<1	<1	**<1**	**<4**	**<4**	<5	<1	1.5	<1	**<1**	<1
	09/14/18	<20	**<4**	0.19 J	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
BPGP53	07/27/17	<100 UJ	**<20 UJ**	**<5 UJ**	<5 UJ	<5 UJ	**<5 UJ**	**<20 UJ**	**<20 UJ**	<25 UJ	<5 UJ	<5 UJ	<5 UJ	**<5 UJ**	<5 UJ
	05/10/18	<100	**<20**	**<5**	<5	<5	**<5**	**<20**	**<20**	<25	<5	<5	<5	**<5**	<5
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	0.39 J	<1	<1	**<1**	<1
BPGP54	07/26/17	<80	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP58	07/31/17	44.3	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	4.5	<1	**<1**	<1
BPGP59	07/26/17	<80	**<4**	**0.55 J+**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<200 UJ	**<40**	**2.9 J+**	**<10**	**<10**	**<10**	**<40**	**<40**	<50	<10	<10	<10	**<10**	**<10**
	09/14/18	<40	**<8**	**1.1 J**	<2	<2	**<2**	**<8**	**<8 UJ**	<10	<2	<2	<2	**<2**	<2
BPGP60	07/26/17	<80	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<400	**<80**	**<20**	**<20**	**<20**	**<20**	**<80**	**<80**	<100	<20	<20	<20	**<20**	**<20**
	09/14/18	<100	**<20**	**<5**	<5	<5	**<5**	**<20**	**<20 UJ**	<25	<5	<5	<5	**<5**	<5
BPGP60 Dup	07/26/17	84.7 J+	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP61	07/27/17	64.8/ND(64.8) U*	**<4 UJ**	**1.8 J-**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	63.9 J-	17.8 J-	16.7 J-	<1 UJ	**<1 UJ**	<1 UJ
	05/11/18	**<2000**	**<400**	**<100**	**<100**	**<100**	**<100 UJ**	**<400**	**<400**	<500	<100	<100	**<100**	**<100**	**<100**
	09/14/18	22.5 JB	**<4**	**1.6**	<1	<1	**<1**	**<4**	**<4**	<5	40.1	28.5	0.67 J	**<1**	<1
BPGP63	07/27/17	37.6/ND(37.6) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**2.8 J-**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	05/11/18	<200	**<40**	**<10**	**<10**	**<10**	**<10**	**<40**	**<40**	<50	<10	<10	<10	**<10**	**<10**
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
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RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
BPGP48	05/07/18	<1	**10**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**15.4**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP49	07/27/17	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	9.1 J-	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/11/18	<100	**<100**	**<400**	**<100**	**<100**	**<400**	**<100**	**<100**	**<400**	**<100**	<100	**<100**	**<100**	**<100**
	09/14/18	<5	**<5**	**<20**	<5	<5	**<50**	**<5**	**<5**	**<20**	5.5	<5	**<5**	<5	**<5**
BPGP50	07/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/21/18	<1	**0.59J/ND(1)U***	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/10/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.39 J
BPGP50 Dup	05/21/18	<1	**0.59J/ND(1)U***	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP51	07/27/17	<1 UJ	**11.1 J-**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/11/18	<50	**<50**	**<200**	**<50**	**<50**	**<200**	**<50**	**<50**	**<200**	**<50**	<50	**<50**	**<50**	**<50**
	09/15/18	<100	**<100**	**<400**	**<100**	**<100**	**<1000**	**<100**	**<100**	**<400**	**<100**	<100	**<100**	**<100**	**<100**
BPGP51B	07/27/17	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/11/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP53	07/27/17	<5 UJ	**28 J**	**<20 UJ**	<5 UJ	<5 UJ	**<20 UJ**	**<5 UJ**	**<5 UJ**	**<20 UJ**	<5 UJ	<5 UJ	**<5 UJ**	<5 UJ	**<5 UJ**
	05/10/18	<5	**<5**	**<20**	<5	<5	**<20**	**<5**	**<5**	**<20**	<5	<5	**<5**	<5	**<5**
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP54	07/26/17	<1	**3**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP58	07/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	1.1	<1	**<1**	<1	<1
BPGP59	07/26/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<10	**<10**	**<40**	<10	<10	**<40**	**<10**	**<10**	**<40**	<10	<10	**<10**	<10	**<10**
	09/14/18	<2	**<2**	<8	<2	<2	**<20**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
BPGP60	07/26/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<20	**<20**	**<80**	<20	<20	**<80**	**<20**	**<20**	**<80**	<20	<20	**<20**	<20	**<20**
	09/14/18	<5	**<5**	**<20**	<5	<5	**<50**	**<5**	**<5**	**<20**	<5	<5	**<5**	<5	**<5**
BPGP60 Dup	07/26/17	<1	**<1**	6.6 J+	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP61	07/27/17	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/11/18	<100	**<100**	**<400**	**<100**	**<100**	**<400**	**<100**	**<100**	**<400**	**<100**	<100	**<100**	**<100**	**<100**
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP63	07/27/17	<1 UJ	**25.3 J-**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/11/18	<10	**<10**	**<40**	<10	<10	**<40**	**<10**	**<10**	**<40**	<10	<10	**<10**	<10	**<10**
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
BPGP48	05/07/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	0.29 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP49	07/27/17	**<1 UJ**	<1 UJ	**8.4 J-**	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	**59.3 J-**	**<1 UJ**
	05/11/18	**<100**	**<100**	**<100**	**<100**	<100	**<400**	**<100**	<400	<100	**<400**	**<400**	**<400**	**<100**	**<100**
	09/14/18	**<5**	<5	**10**	<5	<5	**<20**	<5	<20	<5	**<20**	**<20**	<20	**<5**	**<5**
BPGP50	07/30/17	**<1**	<1	**10.8**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/21/18	**<1**	<1	**11**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/10/18	**<1**	<1	**14.8**	0.24J/ND(1)U*	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP50 Dup	05/21/18	**<1**	<1	**10.8**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP51	07/27/17	**<1 UJ**	<1 UJ	1.3 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/11/18	**<50**	**<50**	**<50**	**<50**	<50	**<200**	**<50**	<200	<50	**<200**	**<200**	<200	**<50**	**<50**
	09/15/18	**<100**	**<100**	**<100**	**<100**	<100	**<400**	**<100**	<400	<100	**<400**	**<400**	**<400**	**<100**	**<100**
BPGP51B	07/27/17	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	0.14 J	**<1**
	09/14/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP53	07/27/17	**<5 UJ**	<5 UJ	**<5 UJ**	<5 UJ	<5 UJ	**<20 UJ**	<5 UJ	<20 UJ	<5 UJ	**<20 UJ**	**<20 UJ**	<20 UJ	**<5 UJ**	**<5 UJ**
	05/10/18	**<5**	<5	1 J	<5	<5	**<20**	<5	<20	<5	**<20**	**<20**	<20	**<5**	**<5**
	09/14/18	**<1**	<1	1.3	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP54	07/26/17	**<1**	<1	2.5 J+	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP58	07/31/17	**<1**	<1	**25**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP59	07/26/17	**<1**	<1	**11.6 J+**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	**<10**	**<10**	**88.6**	<10	<10	**<40**	<10	<40	<10	**<40**	**<40**	<40	<10	**<10**
	09/14/18	**<2**	<2	**61.6**	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	<2	**<2**
BPGP60	07/26/17	**<1**	<1	**5.1 J+**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	**<20**	**<20**	**4.6 J**	<20	<20	**<80**	<20	<80	<20	**<80**	**<80**	<80	**<20**	**<20**
	09/14/18	**<5**	<5	**8.1**	<5	<5	**<20**	<5	<20	<5	**<20**	**<20**	<20	**<5**	**<5**
BPGP60 Dup	07/26/17	**<1**	<1	**4.9 J+**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP61	07/27/17	**<1 UJ**	<1 UJ	**65 J-**	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/11/18	**<100**	**<100**	**41.6 J**	**<100**	<100	**<400**	**<100**	<400	<100	**<400**	**<400**	**<400**	**<100**	**<100**
	09/14/18	**<1**	0.17 J	**90.7**	0.38 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**7.2**	**<1**
BPGP63	07/27/17	**<1 UJ**	<1 UJ	**14 J-**	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/11/18	**<10**	**<10**	**<10**	<10	<10	**<40**	<10	<40	<10	**<40**	**<40**	<40	**<10**	**<10**
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

Notes:
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U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
BPGP48	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**23.7 J-**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**17.6**	<10	<1	**<1**
BPGP49	07/27/17	18.5 J-	3.2 J-	<5 UJ	<4 UJ	<1 UJ	**7.6 J-**	44.5 J-	<4 UJ	**<1 UJ**	**<1 UJ**	**47400**	<10 UJ	1.5/ND(1.5)U*	**<1 UJ**
	05/11/18	**<100**	<100	<500	**<400**	**<100**	**<400**	**<100**	<100	**<100**	**<100**	**21900**	**<4000 UJ**	<100	**<100**
	09/14/18	<5	<5	<25	**<20**	<5	**<20**	<5	<5	**4.6 J**	**<5**	**41900**	<50	<5	**<5**
BPGP50	07/30/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**87.6**	<10	<1	**<1**
	05/21/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**61.7**	<10	<1	**<1**
	09/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**77.9**	<10	<1	**<1**
BPGP50 Dup	05/21/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**59.6**	<10	<1	**<1**
BPGP51	07/27/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**7020**	<10 UJ	<1 UJ	**<1 UJ**
	05/11/18	**<50**	<50	<250	**<200**	**<50**	**<200**	<50	<50	**<50**	**<50**	**39300**	**<2000**	<50	**<50**
	09/15/18	**<100**	<100	<500	**<400**	**<100**	**<400**	**<100**	<100	**<100**	**<100**	**29300**	**<1000**	<100	**<100**
BPGP51B	07/27/17	1.8 J	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	4.6 J	<4 UJ	**<1 UJ**	**<1 UJ**	**121**	<10 UJ	<1 UJ	**<1 UJ**
	05/11/18	2.6	<1	<5	<4	<1	**<4**	0.74 J	<1	**<1**	**<1**	**80.6**	<10	<1	**<1**
	09/14/18	0.6 J	<1	<5	1.7J/ND(4)U*	<1	**<4**	<1	<1	**<1**	**<1**	**112**	<10	<1	**<1**
BPGP53	07/27/17	<5 UJ	<5 UJ	<25 UJ	**<20 UJ**	<5 UJ	**<20 UJ**	<5 UJ	<20 UJ	**<5 UJ**	**<5 UJ**	**1060**	<50 UJ	<5 UJ	**<5 UJ**
	05/10/18	<5	<5	<25	**<20**	<5	**<20**	<5	<5	**<5**	**<5**	**521**	<200	<5	**<5**
	09/14/18	<1	<1	<5	1.7J/ND(4)U*	<1	**<4**	<1	<1	**<1**	**<1**	**249**	<10	<1	**<1**
BPGP54	07/26/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**1210**	<10	<1	**<1**
BPGP58	07/31/17	4.7	<1	<5	<4	<1	**<4**	2.5	<1	**<1**	**<1**	**9020**	<10	<1	**<1**
BPGP59	07/26/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**3460**	<10	<1	**<1**
	05/10/18	<10	<10	<50	**<40**	<10	**<5**	<10	<10	**<10**	**<10**	**1520**	**<400**	<10	**<10**
	09/14/18	<2	<2	<10	**3.3J/ND(8)U***	<2	**<8**	<2	<2	**<2**	**<2**	**730**	<20	<2	**<2**
BPGP60	07/26/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**2470**	<10	<1	**<1**
	05/10/18	<20	<20	<100	**<80**	**<20**	**<80**	<20	<20	**<20**	**<20**	**2690**	**<800**	<20	**<20**
	09/14/18	<5	<5	<25	**<20**	<5	**<20**	<5	<5	**<5**	**<5**	**2270**	<50	<5	**<5**
BPGP60 Dup	07/26/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**2230**	<10	<1	**<1**
BPGP61	07/27/17	**60.7 J-**	8.2 J-	<5 UJ	<4 UJ	<1 UJ	**11.4 J-**	7 J-	<4 UJ	**<1 UJ**	**<1 UJ**	**22100**	<10 UJ	<1 UJ	**<1 UJ**
	05/11/18	33.4 J	<100	<500	**<400**	**<100**	**<400**	**<100**	<100	**<100**	**<100**	**15500**	**<1000**	<100	**<100**
	09/14/18	**84.3**	16.8	<5	<4	<1	**8**	7.8	<1	**<1**	**<1**	**16300**	<10	0.11 J	**<1**
BPGP63	07/27/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**3570**	<10 UJ	<1 UJ	**<1 UJ**
	05/11/18	<10	<10	<50	**<40**	<10	**<40**	<10	<10	**<10**	**<10**	**991**	<100	<10	**<10**
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

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J - Estimated concentration
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U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
BPGP48	05/07/18	**<1**	<1	**<1**	**1.8**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	<1	**<1**	**1.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP49	07/27/17	**<1 UJ**	2.1 J-	**<1 UJ**	**22.3 J-**	<1 UJ	**<4 UJ**	<1 UJ	3.3 J-	<1 UJ	**<0.2 UJ**	<2 UJ	2.2 J-	<3 UJ
	05/11/18	**<100**	<100	**<100**	**<40**	<100	**<400**	<100	**<100**	**<100**	**<20**	<200	**<100**	**<300**
	09/14/18	**<5**	<5	**<5**	**14**	<5	**<20**	<5	<5	<5	**<1**	<10	<5	<15
BPGP50	07/30/17	**<1**	<1	**<1**	**17.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/21/18	**<1**	<1	**<1**	**16.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/10/18	**<1**	<1	**<1**	**19.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP50 Dup	05/21/18	**<1**	<1	**<1**	**15.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP51	07/27/17	**<1 UJ**	<1 UJ	**<1 UJ**	**4.3 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	05/11/18	**<50**	<50	**<50**	**<20**	<50	**<200**	<50	**<50**	**<50**	**<10**	<100	**<50**	**<150**
	09/15/18	**<100**	<100	**<100**	**<40**	<100	**<400**	<100	**<100**	**<100**	**<20**	<200	**<100**	**<300**
BPGP51B	07/27/17	**<1 UJ**	<1 UJ	**<1 UJ**	**1.4**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	05/11/18	**<1**	<1	**<1**	**0.99**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/14/18	**<1**	<1	**<1**	**2.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP53	07/27/17	**<5 UJ**	<5 UJ	**<5 UJ**	**4.1**	<5 UJ	**<20 UJ**	<5 UJ	<5 UJ	<5 UJ	**<1 UJ**	<10 UJ	<5 UJ	<15 UJ
	05/10/18	**<5**	<5	**<5**	**2.1**	<5	**<20**	<5	<5	<5	**<1**	<10	<5	<15
	09/14/18	**<1**	<1	**<1**	**1.7**	<1	**<4**	<1	0.4 J	<1	**<0.2**	<2	<1	<3
BPGP54	07/26/17	**<1**	<1	**<1**	**15.5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP58	07/31/17	**<1**	<1	**<1**	**228**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP59	07/26/17	**<1**	<1	**<1**	**185**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<10**	<10	**<10**	**431**	<10	**<40**	<10	**<10**	**<10**	**<2**	<20	<10	<30
	09/14/18	**<2**	<2	**<2**	**231**	<2	**<8**	<2	<2	<2	**<0.4**	<4	<2	<6
BPGP60	07/26/17	**<1**	<1	**<1**	**42.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<20**	<20	**<20**	**66.3**	<20	**<80**	<20	**<20**	**<20**	**<4**	<40	**<20**	**<60**
	09/14/18	**<5**	<5	**<5**	**79.9**	<5	**<20**	<5	<5	<5	**<1**	<10	<5	<15
BPGP60 Dup	07/26/17	**<1**	<1	**<1**	**43**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP61	07/27/17	**<1 UJ**	<1 UJ	**<1 UJ**	**444 J-**	<1 UJ	**<4 UJ**	<1 UJ	**34.9 J-**	<1 UJ	**<0.2 UJ**	6.9 J-	<1 UJ	6.9 J-
	05/11/18	**<100**	<100	**<100**	**131**	<100	**<400**	<100	**<100**	**<100**	**<20**	<200	**<100**	**<300**
	09/14/18	**<1**	<1	**<1**	**251**	<1	**<4**	<1	**18.7**	0.47 J	**<0.2**	3	0.75 J	3
BPGP63	07/27/17	**<1 UJ**	<1 UJ	**<1 UJ**	**24.6 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	05/11/18	**<10**	<10	**<10**	**10**	<10	**<40**	<10	**<10**	**<10**	**<2**	<20	<10	**<30**
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

Notes:
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J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
BPGP63	09/14/18	<100	**<20**	**1.3 J**	<5	<5	**<5**	**<20**	**<20 UJ**	<25	<5	<5	<5	**<5**	<5
BPGP63B	07/27/17	39.9/ND(39.9) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**3.2 J-**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
BPGP65	07/27/17	30.7/ND(30.7) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**1.9 J-**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	05/12/18	<200 UJ	**<40**	**<10**	**<10**	**<10**	**<10**	**<40**	**<40**	<50	<10	<10	<10	**<10**	**<10**
	09/14/18	<100	**<20**	**<5**	<5	<5	**<5**	**<20**	**<20 UJ**	<25	<5	<5	<5	**<5**	<5
BPGP65B	07/27/17	<80	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/14/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
BPGP66	07/26/17	<80	**<4**	**<2.5**	<1	<1	**<1**	**<4**	**<4**	<5	<1	1.4 J+	<1	**<1**	<1
BPGP67	07/31/17	73.6	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	05/10/18	21.9 J-	<4 R	**0.9 J-**	<1 R	<1 R	<1 R	<4 R	<4 R	11.1 J-	<1 R	<1 R	<1 R	<1 R	<1 R
	09/14/18	<20	**<4**	**4.4**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
BPGP74	07/27/17	20.2/ND(20.2) U*	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**2.9 J-**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	05/11/18	**<2000**	**<400**	**<100**	**<100**	**<100**	**<100 UJ**	**<400**	**<400**	<500	<100	<100	**<100**	**<100**	**<100**
	09/15/18	<1000	**<200**	**<50**	**<50**	**<50**	**<50**	**<200**	**<200 UJ**	<250	<50	<50	<50	**<50**	**<50**
BPGP76	07/31/17	52.2	**<4**	**<1**	<1	<1	**5.7**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/11/18	<20	**<4**	**<1**	<1	<1	**1.3 J-**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/15/18	<100	**<20**	**<5**	<5	<5	**<5**	**<20**	**<20 UJ**	<25	<5	<5	<5	**<5**	<5
BPGP78	07/27/17	69/ND(69)U*	**<4**	**8.7**	<1	<1	**<1**	**<4**	**<4 UJ**	22.5	2.3	6	<1	**<1**	<1
	05/11/18	<20 UJ	**<4**	**231**	<1	<1	**<1**	**<4**	**<4**	<5	1.5	4.6	0.16 J	**<1**	<1
	09/14/18	<20	**<4**	**119**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	3.3	6.1	<1	**<1**	<1
BPGP80	07/26/17	<80	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<200 UJ	**<40**	0.46 J+	**<10**	**<10**	**<10**	**<40**	**<40**	<50	<10	<10	<10	**<10**	**<10**
	09/13/18	<40	**<8**	0.49 J	<2	<2	**<2**	**<8**	**<8**	<10	<2	<2	<2	**<2**	<2
BPGP80 Dup	05/10/18	<20 UJ	**<4**	0.67 J	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP81	07/31/17	55.4	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/21/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP81 Dup	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP83	07/28/17	94/ND(94)U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/21/18	<40	**<8**	**<2**	<2	<2	**<2**	**<8**	**<8**	<10	<2	<2	<2	**<2**	<2
	09/14/18	<40	**<8**	**<2**	<2	<2	**<2**	**<8**	**<8 UJ**	<10	<2	<2	<2	**<2**	<2
BPGP84	07/31/17	47.8	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
BPGP63	09/14/18	<5	**<5**	**<20**	<5	<5	**<50**	**<5**	**<5**	**<20**	<5	<5	**<5**	<5	**<5**
BPGP63B	07/27/17	<1 UJ	**28.9 J-**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
BPGP65	07/27/17	<1 UJ	**18.3 J-**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/12/18	<10	**8.3J/ND(10)U***	**<40**	<10	<10	**<40**	**<10**	**<10**	**<40**	<10	<10	**<10**	<10	**<10**
	09/14/18	<5	**4.5 J**	**<20**	<5	<5	**<50**	**<5**	**<5**	**<20**	<5	<5	**<5**	<5	**<5**
BPGP65B	07/27/17	<1	**8.1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
BPGP66	07/26/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP67	07/31/17	<1 UJ	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<1 R	<1 R	<4 R	<1 R	<1 R	<10 R	<1 R	<1 R	<4 R	<1 R	<1 R	<1 R	<1 R	<1 R
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP74	07/27/17	<1 UJ	**31.6 J-**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	05/11/18	<100	**<100**	**<400**	**<100**	**<100**	**<400**	**<100**	**<100**	**<400**	**<100**	<100	**<100**	**<100**	**<100**
	09/15/18	<50	**37.9 J**	**<200**	**<50**	**<50**	**<500**	**<50**	**<50**	**<200**	**<50**	<50	**<50**	**<50**	**<50**
BPGP76	07/31/17	<1	**40.1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/11/18	<1	**27.9**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/15/18	<5	**24.8**	**<20**	<5	<5	**<50**	**<5**	**<5**	**<20**	<5	<5	**<5**	<5	**<5**
BPGP78	07/27/17	<1	**<1**	<4 UJ	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/11/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP80	07/26/17	<1	**1.2**	5.9 J+	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<10	**<10**	**<40**	<10	<10	**<40**	**<10**	**<10**	**<40**	<10	<10	**<10**	<10	**<10**
	09/13/18	<2	**<2**	<8	<2	<2	**<20**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
BPGP80 Dup	05/10/18	<1	**1.1 JB**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP81	07/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/21/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP81 Dup	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP83	07/28/17	<1	**6.9 JB**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/21/18	<2	**6.7 JB**	<8	<2	<2	**<20**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
	09/14/18	<2	**3**	<8	<2	<2	**<20**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
BPGP84	07/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
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VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
BPGP63	09/14/18	**<5**	<5	**6.7**	<5	<5	**<20**	<5	<20	<5	**<20**	**<20**	<20	**<5**	**<5**
BPGP63B	07/27/17	**<1 UJ**	<1 UJ	**4.9 J-**	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
BPGP65	07/27/17	**<1 UJ**	<1 UJ	3.1 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/12/18	**<10**	**<10**	**<10**	<10	<10	**<40**	<10	<40	<10	**<40**	**<40**	<40	**<10**	**<10**
	09/14/18	**<5**	<5	**12.7**	<5	<5	**<20**	<5	<20	<5	**<20**	**<20**	<20	**<5**	**<5**
BPGP65B	07/27/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	**<1**	<1	0.65 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/14/18	**<1 UJ**	<1 UJ	0.54 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
BPGP66	07/26/17	**<1**	<1	**8.6 J+**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**<2.5**	**<1**
BPGP67	07/31/17	**<1**	<1	**34.1**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	<1 R	<1 R	**10.9 J-**	<1 R	<1 R	<4 R	<1 R	<4 R	<1 R	<4 R	<4 R	<4 R	0.25 J-	<1 R
	09/14/18	**<1**	<1	**7.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP74	07/27/17	**<1 UJ**	1.9 J-	**108 J-**	1.2 J-	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	05/11/18	**<100**	**<100**	**196**	**<100**	<100	**<400**	**<100**	<400	<100	**<400**	**<400**	**<400**	**<100**	**<100**
	09/15/18	**<50**	**<50**	**244**	**<50**	<50	**<200**	**<50**	<200	<50	**<200**	**<200**	<200	**<50**	**<50**
BPGP76	07/31/17	**<1**	<1	**4.9**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/11/18	**<1**	<1	**62.3**	0.47 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/15/18	**<5**	<5	**94.8**	<5	<5	**<20**	<5	<20	<5	**<20**	**<20**	<20	**<5**	**<5**
BPGP78	07/27/17	**<1**	<1	**22.1**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**81.5**	**<1**
	05/11/18	**0.57 J**	<1	1.8	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**490**	**<1**
	09/14/18	**<1**	<1	2.3	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**235**	**<1**
BPGP80	07/26/17	**<1**	<1	**29.8 J+**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	**<10**	**<10**	**15.2 J**	<10	<10	**<40**	<10	<40	<10	**<40**	**<40**	<40	<10	**<10**
	09/13/18	**<2**	<2	**12.2**	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	<2	**<2**
BPGP80 Dup	05/10/18	**<1**	<1	**23.2 J**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP81	07/31/17	**<1**	<1	**12.7**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/21/18	**<1 UJ**	<1 UJ	0.73 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	09/13/18	**<1**	<1	**4.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP81 Dup	09/13/18	**<1**	<1	**4.3**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP83	07/28/17	**<1**	<1	**6.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/21/18	**<2**	<2	**6**	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**<2**	**<2**
	09/14/18	**<2**	<2	**6.5**	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**<2**	**<2**
BPGP84	07/31/17	**<1 UJ**	<1	**38.2**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
BPGP63	09/14/18	<5	<5	<25	**<20**	<5	**<20**	<5	<5	**<5**	**<5**	**2010**	<50	<5	**<5**
BPGP63B	07/27/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**2260**	<10 UJ	<1 UJ	**<1 UJ**
BPGP65	07/27/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**853**	<10 UJ	<1 UJ	**<1 UJ**
	05/12/18	<10	<10	<50	**<40**	<10	**<40**	<10	<10	**<10**	**<10**	**1690**	**<400**	<10	**<10**
	09/14/18	<5	<5	<25	**<20**	<5	**<20**	<5	<5	**<5**	**<5**	**1660**	<50	<5	**<5**
BPGP65B	07/27/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**11.2**	<10	<1	**<1**
	05/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**4.2**	<40	<1	**<1**
	09/14/18	<1 UJ	<1 UJ	<5 UJ	1.5J/ND(4)U*	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	1.9 J-	<10 UJ	<1 UJ	**<1 UJ**
BPGP66	07/26/17	<1	<1	<5	<4	<5	**<4**	<1	<1	**<1**	**<1**	**4290**	<10	<2.5	**<1**
BPGP67	07/31/17	<1	<1	<5	<4	<1	**<4**	<1	<4	**<1**	**<1**	**1020**	<10	<1	**<1**
	05/10/18	9.2 J-	<1 R	<5 R	<4 R	<1 R	<4 R	0.64 J-	<1 R	<1 R	<1 R	**118 J-**	<10 R	<1 R	<1 R
	09/14/18	2.8	<1	<5	2.4J/ND(4)U*	<1	**<4**	0.53 J	<1	**<1**	**<1**	**38.9**	<10	<1	**<1**
BPGP74	07/27/17	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	**<1 UJ**	**<1 UJ**	**11800**	<10 UJ	<1 UJ	**<1 UJ**
	05/11/18	**<100**	<100	<500	**<400**	**<100**	**<400**	**<100**	<100	**<100**	**<100**	**14400**	**<1000**	<100	**<100**
	09/15/18	**<50**	<50	<250	**<200**	**<50**	**<200**	<50	<50	**<50**	**<50**	**41100**	**<500**	<50	**<50**
BPGP76	07/31/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**127**	<10	<1	**<1**
	05/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**1720**	<10	<1	**<1**
	09/15/18	<5	<5	<25	**<20**	<5	**<20**	<5	<5	**<5**	**<5**	**4030**	<50	<5	**<5**
BPGP78	07/27/17	15.1	1	<5	<4	<5	**<4**	38	<4	**<1**	**<1**	<4	<10	<2.5	**<1**
	05/11/18	**46.6**	1.4	<5	<4	<1	**14.5**	**115**	<1	**<1**	**<1**	1.3	<40	4.4	**<1**
	09/14/18	30.5	1.9	<5	3.2J/ND(4)U*	<1	**2 J**	**110 J-**	<1	**<1**	**<1**	<1	<10	2.6 J-	**<1**
BPGP80	07/26/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**2140**	<10	<1	**<1**
	05/10/18	<10	<10	<50	**<40**	<10	**<5**	<10	<10	**<10**	**<10**	**1190 J-**	**<400**	<10	**<10**
	09/13/18	<2	<2	<10	**<8**	<2	**<8**	<2	<2	**<2**	**<2**	**772**	<20	<2	**<2**
BPGP80 Dup	05/10/18	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**1340 J-**	<40	<1	**<1**
BPGP81	07/31/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**385**	<10	<1	**<1**
	05/21/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**94.6 J-**	<10 UJ	<1 UJ	**<1 UJ**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**69.9**	<10	<1	**<1**
BPGP81 Dup	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**75.9**	<10	<1	**<1**
BPGP83	07/28/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**687**	<10	<1	**<1**
	05/21/18	<2	<2	<10	**<8**	<2	**<8**	<2	<2	**<2**	**<2**	**852**	<20	<2	**<2**
	09/14/18	<2	<2	<10	**2.2J/ND(8)U***	<2	**<8**	<2	<2	**<2**	**<2**	**1020**	<20	<2	**<2**
BPGP84	07/31/17	<1	<1	<5	<4	<1 UJ	**<5 UJ**	<1	<4	**<1**	**<1**	**440 J-**	<10	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
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RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
BPGP63	09/14/18	**<5**	<5	**<5**	**19.9**	<5	**<20**	<5	<5	<5	**<1**	<10	<5	<15
BPGP63B	07/27/17	**<1 UJ**	<1 UJ	**<1 UJ**	**9.9 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
BPGP65	07/27/17	**<1 UJ**	<1 UJ	**<1 UJ**	**8.2 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	05/12/18	**<10**	<10	**<10**	**10.1**	<10	**<40**	<10	**<10**	**<10**	**<2**	<20	<10	**<30**
	09/14/18	**<5**	<5	**<5**	**26.7**	<5	**<20**	<5	<5	<5	**<1**	<10	<5	<15
BPGP65B	07/27/17	**<1**	<1	**<1**	**0.57**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<1**	<1	**<1**	0.24 J	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/14/18	**<1 UJ**	<1 UJ	**<1 UJ**	**<0.4 UJ**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
BPGP66	07/26/17	**<1**	<1	**<1**	**94.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2.5	<2.5	<3
BPGP67	07/31/17	**<1**	<1	**<1**	**174**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	<1 R	<1 R	<1 R	**15.6 J-**	<1 R	<4 R	<1 R	0.45 J-	0.36 J-	<0.2 R	<2 R	0.48 J-	<3 R
	09/14/18	**<1**	<1	**<1**	**13.1**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP74	07/27/17	**<1 UJ**	<1 UJ	**<1 UJ**	**126 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**0.83 J-**	<2 UJ	<1 UJ	<3 UJ
	05/11/18	**<100**	<100	**<100**	**186**	<100	**<400**	<100	**<100**	**<100**	**<20**	<200	**<100**	**<300**
	09/15/18	**<50**	<50	**<50**	**308**	<50	**<200**	<50	**<50**	**<50**	**<10**	<100	**<50**	**<150**
BPGP76	07/31/17	**<1**	<1	**<1**	**7.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/11/18	**<1**	<1	**<1**	**67.1**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/15/18	**<5**	<5	**<5**	**124**	<5	**<20**	<5	<5	<5	**<1**	<10	<5	<15
BPGP78	07/27/17	**<1**	<1	**1.6**	**1.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2.5	<2.5	<3
	05/11/18	**<1**	<1	**<1**	**0.7**	<1	**<4**	<1	**47.2**	**12**	**<0.2**	13.4 J	0.53	13.4 J
	09/14/18	**<1**	<1	**<1**	**0.78**	<1	**<4**	<1	0.66 J	<1	**<0.2**	1.3 J	<1	<3
BPGP80	07/26/17	**<1**	<1	**<1**	**161**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<10**	<10	**<10**	**92.5**	<10	**<40**	<10	**<10**	**<10**	**<2**	<20	<10	<30
	09/13/18	**<2**	<2	**<2**	**57.4**	<2	**<8**	<2	<2	<2	**<0.4**	<4	<2	<6
BPGP80 Dup	05/10/18	**<1**	<1	**<1**	**124**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP81	07/31/17	**<1**	<1	**<1**	**50.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/21/18	**<1 UJ**	<1 UJ	**<1 UJ**	**4.7 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	09/13/18	**<1**	<1	**<1**	**4.5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP81 Dup	09/13/18	**<1**	<1	**<1**	**4.7**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP83	07/28/17	**<1**	<1	**<1**	**22**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/21/18	**<2**	<2	**<2**	**26.3**	<2	**<8**	<2	<2	<2	**<0.4**	<4	<2	<6
	09/14/18	**<2**	<2	**<2**	**36**	<2	**<8**	<2	<2	<2	**<0.4**	<4	<2	<6
BPGP84	07/31/17	**<1**	<1	**<1**	**35.2**	<1	**<4**	<1	<1	<1	**3.5**	<2	<1	<3
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

Notes:
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J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
BPGP84	05/21/18	<100	**<20**	**<5**	<5	<5	**<5**	**<20**	**<20**	<25	<5	<5	<5	**<5**	<5
	09/12/18	<20	**<4**	0.24 J	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	0.46 J	**<1**	<1
BPGP85	07/26/17	<80	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
BPGP85 Dup	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP86	07/28/17	23.3/ND(23.3) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/07/18	<40	**<8**	**<2**	<2	<2	**2.8**	**<8**	**<8**	<10	<2	<2	<2	**<2**	<2
	09/11/18	<20	**<4**	**<1**	<1	<1	**2.1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP87	07/31/17	23.7	**<4**	**<1**	<1	<1	**2**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<40	**<8**	**<2**	<2	<2	**<2**	**<8**	**<8**	<10	<2	<2	<2	**<2**	<2
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP88	07/26/17	24.3/ND(24.3) U*	**<4**	**<1**	<1	<1	**5.3**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP89	07/30/17	178 JB	**<4**	**250 J-**	<1	<1	**<1**	**<4**	**<4**	<5	<1	3.3	<1	**<1**	<1
	05/08/18	<40	**<8**	**380**	<2	<2	**<2**	**<8**	**<8**	<10	1.1 J	2.8	<2	**<2**	<2
	09/10/18	<40	**<8**	**297 J**	<2	<2	**<2**	**<8**	**<8**	<10	1.9 J	5.3	0.93 J	**<2**	<2
BPGP90	07/30/17	37.6/ND(37.6) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP91	07/29/17	35.5/ND(35.5) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/21/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP92	07/30/17	33.4/ND(33.4) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<40 UJ	**<8 UJ**	**<2 UJ**	<2 UJ	<2 UJ	**<2 UJ**	**<8 UJ**	**<8 UJ**	<10 UJ	<2 UJ	<2 UJ	<2 UJ	**<2 UJ**	<2 UJ
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
BPGP92 Dup	07/30/17	74.5 JB	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP93	07/31/17	49.4	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/21/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
BPGP94	07/30/17	22.2/ND(22.2) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/21/18	<20	**<4**	**<1**	<1	<1	**1.7**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
BPGP84	05/21/18	<5	**<5**	**<20**	<5	<5	**<50**	**<5**	**<5**	**<20**	<5	<5	**<5**	<5	**<5**
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP85	07/26/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP85 Dup	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP86	07/28/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/07/18	<2	**13.9**	<8	<2	<2	**<8**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
	09/11/18	<1	**11.4**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP87	07/31/17	<1	**14**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<2	**2 JB**	<8	<2	<2	**<8**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP88	07/26/17	<1	**39**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP89	07/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<2	**<2**	<8	<2	<2	**<8**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	0.41 J
	09/10/18	<2	**<2**	<8	<2	<2	**<20**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
BPGP90	07/30/17	<1	**1.6**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP91	07/29/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/21/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/10/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP92	07/30/17	<1	**1.5**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<2 UJ	**1 J-**	<8 UJ	<2 UJ	<2 UJ	**<8 UJ**	**<2 UJ**	**<2 UJ**	**<8 UJ**	<2 UJ	<2 UJ	**<2 UJ**	<2 UJ	0.9 J-
	09/11/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	1.2
BPGP92 Dup	07/30/17	<1	**1.6**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP93	07/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/21/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGP94	07/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/21/18	<1	**9.8**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**1.1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.52 J
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

Notes:
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J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
BPGP84	05/21/18	**<5**	<5	**20.5**	<5	<5	**<20**	<5	<20	<5	**<20**	**<20**	<20	**<5**	**<5**
	09/12/18	**<1**	0.77 J	**29.3**	0.22 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP85	07/26/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/08/18	**<1**	<1	0.92 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/12/18	**<1**	<1	0.82 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP85 Dup	09/12/18	**<1**	<1	0.75 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP86	07/28/17	**<1**	<1	**8.5**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/07/18	**<2**	<2	**5.8**	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**<2**	**<2**
	09/11/18	**<1**	<1	**7.2**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP87	07/31/17	**<1**	<1	1.2	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	**<2**	<2	<2	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**<2**	**<2**
	09/13/18	**<1**	<1	0.71 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP88	07/26/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP89	07/30/17	**<1**	<1	**120**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**196**	**<1**
	05/08/18	**<2**	<2	**78.4**	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**151 J+**	**<2**
	09/10/18	**<2**	<2	**87**	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**186**	**<2**
BPGP90	07/30/17	**<1**	<1	**10.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP91	07/29/17	**<1**	<1	**9.2**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/21/18	**0.48 J-**	<1 UJ	**12.9 J-**	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	09/10/18	**<1**	<1	**11.6**	0.3J/ND(1)U*	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP92	07/30/17	**<1 UJ**	<1	**6.9**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
	05/08/18	**<2 UJ**	<2 UJ	**9.8 J-**	<2 UJ	<2 UJ	**<8 UJ**	<2 UJ	<8 UJ	<2 UJ	**<8 UJ**	**<8 UJ**	<8 UJ	**<2 UJ**	**<2 UJ**
	09/11/18	**<1**	0.36 J	**25.6**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP92 Dup	07/30/17	**<1**	<1	**6.6**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP93	07/31/17	**1.5**	<1	**6.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/21/18	**1.7 J-**	<1 UJ	3.3 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	09/13/18	**1.4**	<1	2	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGP94	07/30/17	**<1 UJ**	<1	**32.6**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
	05/21/18	**<1**	<1	**20.2**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**0.27 J**	<1	**34.7**	0.39 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

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J - Estimated concentration
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U - Evaluated to be undetected at the reported concent
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DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
BPGP84	05/21/18	<5	<5	<25	**<20**	<5	**<20**	<5	<5	**<5**	**<5**	**387**	<50	<5	**<5**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**350**	<10	<1	**<1**
BPGP85	07/26/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**10**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**10.2**	<10	<1	**<1**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**11.7**	<10	<1	**<1**
BPGP85 Dup	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**10.4**	<10	<1	**<1**
BPGP86	07/28/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**341**	<10	<1	**<1**
	05/07/18	<2	<2	<10	**<8**	<2	**<8**	<2	<2	**<2**	**<2**	**258**	<20	<2	**<2**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**231**	<10	<1	**<1**
BPGP87	07/31/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**318**	<10	<1	**<1**
	05/10/18	<2	<2	<10	**<8**	<2	**<8**	<2	<2	**<2**	**<2**	**142**	<80	<2	**<2**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**124**	<10	<1	**<1**
BPGP88	07/26/17	<1	<1	<5	<4	<1	**<4**	<1	<4	**<1**	**<1**	**12.1**	<10	<1	**<1**
BPGP89	07/30/17	17.8	<1	<5	<4	<1 UJ	**<5 UJ**	25.2	<1	**<1**	**<1**	<1	<10	6.5 J-	**<1**
	05/08/18	10.6	<2	<10	**<8**	<2	**1.9 J+**	14.8	<2	**<2**	**<2**	<2	<20	5.7 J+	**<2**
	09/10/18	23.8	0.93 J	<10	3.2 J	<2	**5.7**	36.6	<2	**<2**	**<2**	0.35J/ND(2)U*	<20	5.6	**<2**
BPGP90	07/30/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**156**	<10	<1	**<1**
BPGP91	07/29/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
	05/21/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	1.4 J-	<10 UJ	<1 UJ	**<1 UJ**
	09/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.9 JB	<10	<1	**<1**
BPGP92	07/30/17	<1	<1	<5	<4	<1	**<5**	<1	<4	**<1**	**<1**	**466**	<10	<1	**<1**
	05/08/18	<2 UJ	<2 UJ	<10 UJ	**<8 UJ**	<2 UJ	**<8 UJ**	<2 UJ	<2 UJ	**<2 UJ**	**<2 UJ**	**429 J-**	<20 UJ	<2 UJ	**<2 UJ**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**259**	<10	<1	**<1**
BPGP92 Dup	07/30/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**478**	<10	<1	**<1**
BPGP93	07/31/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**76.1**	<10	<1	**<1**
	05/21/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**27.6 J-**	<10 UJ	<1 UJ	**<1 UJ**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**19.2**	<10	<1	**<1**
BPGP94	07/30/17	<1	<1	<5	<4	<1	**<5**	<1	<4	**<1**	**<1**	**30.4**	<10	<1	**<1**
	05/21/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**90.2**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**51.6**	<10	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
BPGP84	05/21/18	**<5**	<5	**<5**	**19**	<5	**<20**	<5	<5	<5	**5.5**	<10	<5	<15
	09/12/18	**<1**	<1	**<1**	**35.7**	<1	**<4**	<1	<1	<1	**6**	<2	<1	<3
BPGP85	07/26/17	**<1**	<1	**<1**	**2.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	<1	**<1**	**2.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**2.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP85 Dup	09/12/18	**<1**	<1	**<1**	**2.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP86	07/28/17	**<1**	1.1	**<1**	**31.1**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/07/18	**<2**	<2	**<2**	**18.8**	<2	**<8**	<2	<2	<2	**<0.4**	<4	<2	<6
	09/11/18	**<1**	0.76 J	**<1**	**20.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP87	07/31/17	**<1**	<1	**<1**	**3.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<2**	<2	**<2**	**1.8**	<2	**<8**	<2	<2	<2	**<0.4**	<4	<2	<6
	09/13/18	**<1**	<1	**<1**	**1.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP88	07/26/17	**<1**	<1	**<1**	**1**	<1 UJ	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP89	07/30/17	**<1**	<1	**<1**	**2.1**	<1	**<4**	<1	5.5	<1	**<0.2**	8.9	1.2 J-	8.9
	05/08/18	**<2**	<2	**<2**	**78.5**	<2	**<8**	<2	3	<2	**<0.4**	3.8 J	1.1 J+	1.1 J+
	09/10/18	**<2**	<2	**<2**	**13**	<2	**<8**	<2	3	0.55 J	**<0.4**	3.2 J	<2	<6
BPGP90	07/30/17	**<1**	<1	**<1**	**21.8**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP91	07/29/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/21/18	**<1 UJ**	<1 UJ	**<1 UJ**	0.27 J-	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	09/10/18	**<1**	<1	**<1**	**0.48**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP92	07/30/17	**<1**	<1	**<1**	**50.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<2 UJ**	1.1 J-	**<2 UJ**	**104 J-**	<2 UJ	**<8 UJ**	<2 UJ	<2 UJ	<2 UJ	**<0.4 UJ**	<4 UJ	<2 UJ	<6 UJ
	09/11/18	**<1**	1	**<1**	**172**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP92 Dup	07/30/17	**<1**	1.6	**<1**	**48**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP93	07/31/17	**<1**	<1	**<1**	**9.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/21/18	**<1 UJ**	<1 UJ	**<1 UJ**	**4 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	09/13/18	**<1**	<1	**<1**	**3.1**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGP94	07/30/17	**<1**	<1	**<1**	**13.5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/21/18	**<1**	<1	**<1**	**23.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	0.55 J	**<1**	**22.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

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J - Estimated concentration
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U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
BPGW01	07/26/17	<80	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/11/18	<20 UJ	**<4 UJ**	**3.2 J-**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	1.1 J-	<1 UJ	**<1 UJ**	<1 UJ
	09/15/18	<20	**<4**	**0.78 J**	<1	<1	**<1**	**<4**	**<4**	<5	<1	2 J+	0.15 J+	**<1**	<1
BPGW04	07/27/17	21.8/ND(21.8) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	05/11/18	<20	**<4**	**<1**	<1	<1	**0.55 J-**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**0.84 J**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
CENEX-5	07/28/17	50.1/ND(50.1) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
EMW-03	07/28/17	92.5/ND(92.5) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/07/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
EMW-09	08/01/17	<40	**<8**	**<2**	<2	<2	**<2**	**<8**	**<8**	36.3	8.6	20.4	<2	**<2**	<2
	05/11/18	<40	**<8**	**<2**	<2	<2	**<2 UJ**	**<8**	**<8**	<10	8.1	30.4	0.71 J	**<2**	<2
	09/11/18	<20	**<4**	**0.63 J**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	7.4	28.6	1	**<1**	<1
EMW-11	07/26/17	65.8	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
EMW-15	07/31/17	72.1	**<4**	**3.8 J**	<1	<1	**<1**	**<4**	**<4**	<5	<1	1.7	<1	**<1**	<1
EMW-18	07/29/17	31.7/ND(31.7) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
EMW-21	07/28/17	62.5/ND(62.5) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
EMW-26	07/29/17	85.3 JB	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
EMW-28	07/29/17	23.2/ND(23.2) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/21/18	<20	**<4**	**<1**	<1	<1	**5.9**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**7.2**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
EMW-28 Dup	09/13/18	<20	**<4**	**<1**	<1	<1	**7.3**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
EMW-32	08/31/17	20.6/ND(20.6) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/10/18	<20 UJ	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
GSMW-5	07/31/17	<100 UJ	**<20 UJ**	**5.3 J-**	<5 UJ	<5 UJ	**<5 UJ**	**<20 UJ**	**<20 UJ**	<25 UJ	<5 UJ	<5 UJ	<5 UJ	**<5 UJ**	<5 UJ
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

Notes:
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J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
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VOC - Volatile organic compound
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REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
BPGW01	07/26/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/11/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/15/18	<1	**<4**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
BPGW04	07/27/17	<1	**4.5**	<4 UJ	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/11/18	<1	**6.7 JB**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**5.6**	0.59 J	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
CENEX-5	07/28/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
EMW-03	07/28/17	<1	**<1**	4.7	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/07/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
EMW-09	08/01/17	<2	**<2**	<8	<2	<2	**<8**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
	05/11/18	<2	**<2**	<8	<2	<2	**<8**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
	09/11/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
EMW-11	07/26/17	<1	**<1**	<4 UJ	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
EMW-15	07/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
EMW-18	07/29/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
EMW-21	07/28/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
EMW-26	07/29/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
EMW-28	07/29/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/21/18	<1	**57.4**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/13/18	<1	**32.7**	<4	<1	<1	**<10**	**1.3**	**<1**	**<4**	<1	<1	**<1**	<1	<1
EMW-28 Dup	09/13/18	<1	**32.8**	<4	<1	<1	**<10**	**1.3**	**<1**	**<4**	<1	<1	**<1**	<1	<1
EMW-32	08/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/10/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
GSMW-5	07/31/17	<5 UJ	**<5 UJ**	**<20 UJ**	<5 UJ	<5 UJ	**<20 UJ**	**<5 UJ**	**<5 UJ**	**<20 UJ**	<5 UJ	<5 UJ	**<5 UJ**	<5 UJ	**<5 UJ**
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

Notes:
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J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
BPGW01	07/26/17	**<1**	<1	**120 J+**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/11/18	**<1 UJ**	<1 UJ	3.4 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	**6 J-**	**<1 UJ**
	09/15/18	**<1**	<1 UJ	3.6	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
BPGW04	07/27/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
CENEX-5	07/28/17	**<1**	<1	1.7	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
EMW-03	07/28/17	**<1 UJ**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
	05/07/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
EMW-09	08/01/17	**<2**	<2	<2	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**264 J**	**<2**
	05/11/18	**<2**	<2	<2	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	**254**	**<2**
	09/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**76.3**	**<1**
EMW-11	07/26/17	**<1**	<1	**175**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
EMW-15	07/31/17	**<1 UJ**	<1	**119**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
EMW-18	07/29/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/14/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
EMW-21	07/28/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
EMW-26	07/29/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
EMW-28	07/29/17	**<1**	<1	**5.2**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/21/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/13/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
EMW-28 Dup	09/13/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
EMW-32	08/31/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/10/18	**<1**	<1	0.58 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/13/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
GSMW-5	07/31/17	**<5 UJ**	<5 UJ	**<5 UJ**	<5 UJ	<5 UJ	**<20 UJ**	<5 UJ	<20 UJ	<5 UJ	**<20 UJ**	**<20 UJ**	<20 UJ	**700 J-**	**<5 UJ**
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

Notes:
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U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
BPGW01	07/26/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**215**	<10	<1	**<1**
	05/11/18	3.4 J-	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	2.6 J-	<1 UJ	**<1 UJ**	**<1 UJ**	**17 J-**	<10 UJ	<1 UJ	**<1 UJ**
	09/15/18	0.5 J	<1	<5	1.7J/ND(4)U*	<1	**<4**	<1	<1	**<1**	**<1**	**25.5**	<10	<1	**<1**
BPGW04	07/27/17	<1	<1	<5	<4	<1	**<5**	1.3	<4	**<1**	**<1**	4.1	<10	<1	**<1**
	05/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**5.6**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**7**	<10	<1	**<1**
CENEX-5	07/28/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**24.9**	<10	<1	**<1**
EMW-03	07/28/17	<1	<1	<5	<4	<1	**<5**	<1	<4	**<1**	**<1**	<4	<10	<1	**<1**
	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
EMW-09	08/01/17	**79.9**	<2	<10	**<8**	**<25**	**45.6**	**209**	<8	**<2**	**<2**	**<8**	<20	<2	**<2**
	05/11/18	**107**	1.4 J	<10	**<8**	**21.7 J**	**7.1**	**363**	<2	**<2**	**<2**	0.6 J	<20	0.53 J	**<2**
	09/11/18	**102**	1.2	<5	<4	<1	**1.6 J**	**332**	<1	**<1**	**<1**	0.44J/ND(1)U*	<10	0.64 J	**<1**
EMW-11	07/26/17	<1	<1	<5	<4	<1	**<4**	<1	<4	**<1**	**<1**	**14.2**	<10	<1	**<1**
EMW-15	07/31/17	<1	<1	<5	<4	<1 UJ	**<5 UJ**	<1	<4	**<1**	**<1**	**136**	<10	<1	**<1**
EMW-18	07/29/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
	05/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.74 J	<40	<1	**<1**
	09/14/18	<1	<1	<5	1.3J/ND(4)U*	<1	**<4**	<1	<1	**<1**	**<1**	0.4 J	<10	<1	**<1**
EMW-21	07/28/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
EMW-26	07/29/17	<1	<1	<5	<4	<1 UJ	**<5 UJ**	<1	<1	**<1**	**<1**	<1	<10 UJ	<1	**<1**
EMW-28	07/29/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**12.3**	<10 UJ	<1	**<1**
	05/21/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.23 J	<10	<1	**<1**
EMW-28 Dup	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.21 J	<10	<1	**<1**
EMW-32	08/31/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	2.4	<10	<1	**<1**
	05/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	3.9 J-	<40	<1	**<1**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	2.5	<10	<1	**<1**
GSMW-5	07/31/17	26.6 J-	<5 UJ	<25 UJ	**<20 UJ**	4.4 J-	**57 J-**	**77.5 J-**	<5 UJ	**<5 UJ**	**<5 UJ**	**<5 UJ**	<50 UJ	2.1 J-	**<5 UJ**
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

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BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
BPGW01	07/26/17	**<1**	<1	**<1**	**117**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/11/18	**<1 UJ**	<1 UJ	**<1 UJ**	**2.7 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	0.3 J-	<1 UJ	<3 UJ
	09/15/18	**<1**	<1	**<1**	**5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
BPGW04	07/27/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/11/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
CENEX-5	07/28/17	**<1**	<1	**<1**	**3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
EMW-03	07/28/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/07/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
EMW-09	08/01/17	**<2**	<2	**<2**	**<0.8**	<2	**<8**	<2	**128**	<2	**<0.4**	42.4	4.9	**47.2**
	05/11/18	**<2**	<2	**<2**	**<0.8**	<2	**<8**	<2	3.6	<2	**<0.4**	3.4 J	2.6	2.6
	09/11/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	0.69 J	<1	**<0.2**	1.5 J	1.6	1.6 J
EMW-11	07/26/17	**<1**	<1	**<1**	**126**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
EMW-15	07/31/17	**<1**	<1	**<1**	**107**	<1	**<4**	<1	<1	<1	**0.54**	<2	<1	<3
EMW-18	07/29/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<1**	<1	**<1**	**0.36 J**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/14/18	**<1**	<1	**<1**	**0.39 J**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
EMW-21	07/28/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
EMW-26	07/29/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
EMW-28	07/29/17	**<1**	<1	**<1**	**2.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/21/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
EMW-28 Dup	09/13/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
EMW-32	08/31/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/10/18	**<1**	<1	**<1**	**0.65**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
GSMW-5	07/31/17	**<5 UJ**	<5 UJ	**<5 UJ**	**<2 UJ**	<5 UJ	**<20 UJ**	<5 UJ	**274 J-**	<5 UJ	**<1 UJ**	43.7 J-	2.4 J-	**45.7 J-**
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
MW-100	05/07/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-101	05/07/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-102	05/07/18	<20	**<4**	<1	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-103	05/11/18	<20	**<4**	**<1**	<1	<1	**<1 UJ**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-104	05/10/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-105	05/08/18	22.1/ND(22.1) U*	**<4**	**3.7 J+**	<1	<1	**<1**	**<4**	**<4 UJ**	23.5 J+	1.4	1.8	0.19 J	**<1**	<1
	09/13/18	<40	**<8**	**0.3 J**	<2	<2	**<2**	**<8**	**<8**	<10	<2	0.84 J	<2	**<2**	<2
MW-106	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
MW-107	05/10/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-108	05/10/18	<20 R	<4 R	**<1 R**	<1 R	<1 R	<1 R	<4 R	<4 R	<5 R	<1 R	1.6 J-	1.6 J-	<1 R	<1 R
	09/12/18	<20	**<4**	**0.25 J**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	0.8 J	1.3	**<1**	<1
MW-109	05/09/18	--	--	**<0.5**	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-110	05/22/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
MW-111	05/10/18	<20 UJ	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-112	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-113	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
MW-113 Dup	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-114	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	0.45 J-	0.25 J-	**<1 UJ**	<1 UJ
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	0.62 J	0.52 J	**<1**	<1
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

Notes:
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J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
MW-100	05/07/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-101	05/07/18	<1	**0.74 J**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-102	05/07/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**<1**	0.51 J	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-103	05/11/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-104	05/10/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/11/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-105	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/13/18	<2	**<2**	<8	<2	<2	**<20**	**<2**	**<2**	**<8**	<2	<2	**<2**	<2	<2
MW-106	05/08/18	<1	**1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-107	05/10/18	<1 UJ	**3.3 JB**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/12/18	<1	**2**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-108	05/10/18	<1 R	<1 R	<4 R	<1 R	<1 R	<4 R	<1 R	<1 R	<4 R	<1 R	<1 R	<1 R	<1 R	<1 R
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-109	05/09/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<1	**3.5 JB**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1	**2.4**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-110	05/22/18	<1	**1.5 JB**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-111	05/10/18	<1	**7.3 JB**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**5.1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-112	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-113	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	**4.9 J-**
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	**5.6**
MW-113 Dup	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	**5.4**
MW-114	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
MW-100	05/07/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/14/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-101	05/07/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-102	05/07/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1 UJ**
	09/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-103	05/11/18	**<1**	<1	0.22 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	0.24 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-104	05/10/18	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	09/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-105	05/08/18	**<1**	<1	**93**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	1.3 J+	**<1**
	09/13/18	**<2**	<2	**61.2**	<2	<2	**<8**	<2	<8	<2	**<8**	**<8**	<8	<2	**<2**
MW-106	05/08/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/13/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-107	05/10/18	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	09/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-108	05/10/18	<1 R	<1 R	**48.3 J-**	0.4 J-	<1 R	<4 R	<1 R	<4 R	<1 R	<4 R	<4 R	<4 R	<1 R	<1 R
	09/12/18	**<1**	<1	**82.3**	1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-109	05/09/18	--	--	--	--	--	--	--	--	--	--	--	--	<0.5	--
	05/22/18	**<1**	<1	1.8	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1 UJ**
	09/14/18	**<1**	<1	2.1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-110	05/22/18	**<1**	<1	**6.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1 UJ**
	09/13/18	**<1**	<1	**5.3**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-111	05/10/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-112	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	**<1 UJ**	<1 UJ	0.94 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	09/12/18	**<1**	<1	1.4	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-113	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	**<1 UJ**	<1 UJ	0.51 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<4 UJ**
	09/13/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-113 Dup	09/13/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-114	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	**0.28 J-**	<1 UJ	**85.1 J-**	1.8 J-	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<4 UJ**
	09/12/18	**<1**	<1	**85.2**	1.5	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
MW-100	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**8.4**	<10	<1	**<1**
	09/14/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**11.7**	<10	<1	**<1**
MW-101	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**185**	<10	<1	**<1**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**191**	<10	<1	**<1**
MW-102	05/07/18	<1	<1	<5	<4	<1 R	<5 R	<1	<1	**<1**	**<1**	2.7	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	3.4	<10	<1	**<1**
MW-103	05/11/18	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	2.5	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	3.3	<10	<1	**<1**
MW-104	05/10/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<5**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	3 J-	<40 UJ	<1 UJ	**<1 UJ**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.7 JB	<10	<1	**<1**
MW-105	05/08/18	2.4	<1	<5	<4	<1	**1.5 J+**	5	<1	**<1**	**<1**	**164**	<10	<1	**<1**
	09/13/18	<2	<2	<10	**<8**	<2	**<8**	<2	<2	**<2**	**<2**	**274**	<20	<2	**<2**
MW-106	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	4.1	<10	<1	**<1**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**4.9**	<10	<1	**<1**
MW-107	05/10/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	<1 UJ	<40 UJ	<1 UJ	**<1 UJ**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.55J/ND(1)U*	<10	<1	**<1**
MW-108	05/10/18	<1 R	<1 R	<5 R	<4 R	<1 R	**5.1**	<1 R	<1 R	<1 R	<1 R	<1 R	<10 R	<1 R	<1 R
	09/12/18	<1	<1	<5	<4	<1	**2.4 J**	<1	<1	**<1**	**<1**	0.27J/ND(1)U*	<10	<1	**<1**
MW-109	05/09/18	--	--	--	--	<1	**<5**	--	--	--	--	--	--	<0.5	--
	05/22/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	2.3	<10	<1	**<1 UJ**
	09/14/18	<1	<1	<5	<4	<1	**<5 UJ**	<1	<1	**<1**	**<1**	3.5	<10	<1	**<1**
MW-110	05/22/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**4.2**	<10	<1	**<1 UJ**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	4.1	<10	<1	**<1**
MW-111	05/10/18	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	0.79 J-	<40	<1	**<1**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.6 JB	<10	<1	**<1**
MW-112	03/30/18	--	--	--	--	--	--	--	--	--	--	0.4	--	--	--
	05/22/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	1.8 J-	<10 UJ	<1 UJ	**<1 UJ**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.4 JB	<10	<1	**<1**
MW-113	03/30/18	--	--	--	--	--	--	--	--	--	--	0.086	--	--	--
	05/22/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	<1 UJ	<10 UJ	0.2 J-	**<1 UJ**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
MW-113 Dup	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
MW-114	03/30/18	--	--	--	--	--	--	--	--	--	--	**12.3**	--	--	--
	05/22/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**24.9 J-**	<10 UJ	<1 UJ	**<1 UJ**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**45.3**	<10	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
MW-100	05/07/18	**<1**	<1	**<1**	**0.79**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/14/18	**<1**	<1	**<1**	**0.93**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-101	05/07/18	**<1**	<1	**<1**	**3.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**4.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-102	05/07/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-103	05/11/18	**<1**	<1	**<1**	**0.64**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	<1	**<1**	**0.8**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-104	05/10/18	**<1 UJ**	<1 UJ	**<1 UJ**	0.2 J-	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2**	<2 UJ	<1 UJ	<3 UJ
	09/11/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-105	05/08/18	**<1**	<1	**<1**	**76.8**	<1	**<4**	<1	<1	<1	**1.1**	<2	<1	<3
	09/13/18	**<2**	<2	**<2**	**58.6**	<2	**<8**	<2	<2	<2	**0.5**	<4	<2	<6
MW-106	05/08/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	<1	**<1**	**0.33 J**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-107	05/10/18	**<1 UJ**	<1 UJ	**<1 UJ**	**<0.4 UJ**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2**	<2 UJ	<1 UJ	<3 UJ
	09/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-108	05/10/18	<1 R	<1 R	<1 R	<0.4 R	<1 R	<4 R	<1 R	<1 R	<1 R	**0.36 J-**	<2 R	1.7	1.7 J
	09/12/18	**<1**	<1	**<1**	**0.38 J**	<1	**<4**	<1	<1	<1	**0.77**	<2	<1	<3
MW-109	05/09/18	--	--	--	--	--	--	--	--	--	--	<0.5	<0.5	<2
	05/22/18	**<1 UJ**	<1	**<1**	**0.88**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/14/18	**<1**	<1	**<1**	**1.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-110	05/22/18	**<1 UJ**	<1	**<1**	**2.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	<1	**<1**	**2.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-111	05/10/18	**<1**	<1	**<1**	**0.49**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**0.78**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-112	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	**<1 UJ**	<1 UJ	**<1 UJ**	**0.84 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	09/12/18	**<1**	<1	**<1**	**0.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-113	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	**<1 UJ**	1.6 J-	**<1 UJ**	**<0.4 UJ**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	09/13/18	**<1**	1.5	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-113 Dup	09/13/18	**<1**	1.5	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-114	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	**<1 UJ**	<1 UJ	**<1 UJ**	**13.3 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**0.48 J-**	<2 UJ	<1 UJ	<3 UJ
	09/12/18	**<1**	<1	**<1**	**16.8**	<1	**<4**	<1	<1	<1	**0.23**	<2	<1	<3
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
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VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
MW-114 Dup	05/22/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	0.46 J	0.28 J	**<1**	<1
MW-115	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/13/18	<100	**<20**	**<5**	<5	<5	**<5**	**<20**	**<20 UJ**	<25	<5	<5	<5	**<5**	<5
MW-116	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-116 Dup	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-117	05/10/18	11.1 J	**<4**	**4.9 J**	<1	<1	**<1**	**<4**	**<4**	<5	13.6	9.2	0.55 J	**<1**	<1
	09/14/18	<100	**<20**	**5.6**	<5	<5	**<5**	**<20**	**<20 UJ**	<25	10.8	8	1.9 J	**<5**	<5
MW-118	05/10/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-119	05/10/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-120	05/07/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-121	05/10/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-121 Dup	05/10/18	<20 UJ	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
MW-122	05/11/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-123	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-124	05/07/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-125	05/10/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-125 Dup	05/10/18	<20 UJ	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
MW-126	05/12/18	11.3J/ND(20) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	4.3 J	<1	<1	<1	**<1**	<1
	09/11/18	11.1J/ND(20) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-127	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-128	05/09/18	--	--	**<0.5**	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-128 Dup	05/09/18	--	--	**<0.5**	--	--	--	--	--	--	--	--	--	--	--
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
MW-114 Dup	05/22/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-115	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/13/18	<5	**<5**	**<20**	<5	<5	**<50**	**<5**	**<5**	**<20**	<5	<5	**<5**	<5	**<5**
MW-116	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.44 J
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-116 Dup	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-117	05/10/18	<1	**<1**	<4	<1	0.21 J	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<5	**<5**	**<20**	<5	<5	**<50**	**<5**	**<5**	**<20**	<5	<5	**<5**	<5	**<5**
MW-118	05/10/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-119	05/10/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-120	05/07/18	<1	**5.2**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1	**13**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-121	05/10/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-121 Dup	05/10/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-122	05/11/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-123	05/08/18	<1	**0.62 J**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**1.9**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-124	05/07/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-125	05/10/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<4 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/11/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-125 Dup	05/10/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-126	05/12/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-127	09/11/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-128	05/09/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/11/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-128 Dup	05/09/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
MW-114 Dup	05/22/18	**0.26 J**	<1	**84.7**	1.7	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<4**
MW-115	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	**<1 UJ**	<1 UJ	**7.8 J-**	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<4 UJ**
	09/13/18	**<5**	<5	**10.4**	<5	<5	**<20**	<5	<20	<5	**<20**	**<20**	<20	**<5**	**<5**
MW-116	05/08/18	**<1**	<1	2	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/12/18	**<1**	<1	1.6	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-116 Dup	09/12/18	**<1**	<1	1.4	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-117	05/10/18	**0.93 J**	<1	**7.7**	1.4	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**229**	**<1**
	09/14/18	**<5**	<5	**7.6**	<5	<5	**<20**	<5	<20	<5	**<20**	**<20**	<20	**206**	**<5**
MW-118	05/10/18	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	09/14/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-119	05/10/18	**<1 UJ**	<1 UJ	0.43 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	0.18 J	**<1 UJ**
	09/14/18	**<1**	<1	0.54 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-120	05/07/18	**<1**	<1	2	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/14/18	**<1**	<1	1.7	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-121	05/10/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/14/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-121 Dup	05/10/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-122	05/11/18	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	09/14/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-123	05/08/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-124	05/07/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-125	05/10/18	**<1 UJ**	<1 UJ	<1 UJ	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
	09/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-125 Dup	05/10/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-126	05/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-127	09/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-128	05/09/18	--	--	--	--	--	--	--	--	--	--	--	--	<0.5	--
	05/22/18	**<1 UJ**	<1 UJ	0.5 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<4 UJ**
	09/11/18	**<1**	<1	0.22 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-128 Dup	05/09/18	--	--	--	--	--	--	--	--	--	--	--	--	<0.5	--
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

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J- - Estimated concentration, possibly biased low
J - Estimated concentration
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U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
MW-114 Dup	05/22/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**25.6**	<10	<1	**<1**
MW-115	03/30/18	--	--	--	--	--	--	--	--	--	--	**260**	--	--	--
	05/22/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**956 J-**	<10 UJ	<1 UJ	**<1 UJ**
	09/13/18	<5	<5	<25	**5.2 J**	<5	**<20**	<5	<5	**<5**	**<5**	**1790**	<50	<5	**<5**
MW-116	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.91 J	<10	<1	**<1**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.2 JB	<10	<1	**<1**
MW-116 Dup	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.3 JB	<10	<1	**<1**
MW-117	05/10/18	36.5	10.4	<5	<4	<1	**12.9**	**93.7**	<1	**<1**	**<1**	0.25 J	<40	1.6	**<1**
	09/14/18	26.6	6.1	<25	**<20**	<5	**10.5 J**	**84.2**	<5	**<5**	**<5**	**<5**	<50	1 J	**<5**
MW-118	05/10/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	<1 UJ	<40 UJ	<1 UJ	**<1 UJ**
	09/14/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
MW-119	05/10/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<5**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	1.7 J-	<40 UJ	0.18 J	**<1 UJ**
	09/14/18	<1	<1	<5	<4	<1	**<5 UJ**	<1	<1	**<1**	**<1**	3.2	<10	<1	**<1**
MW-120	05/07/18	<1	<1	<5	<4	<1	**<4**	0.25 J	<1	**<1**	**<1**	**42.9**	<10	<1	**<1**
	09/14/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**59**	<10	<1	**<1**
MW-121	05/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.4	<40	<1	**<1**
	09/14/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	2.2	<10	<1	**<1**
MW-121 Dup	05/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.4 J-	<40	<1	**<1**
MW-122	05/11/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<5**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	0.69 J-	<10 UJ	<1 UJ	**<1 UJ**
	09/14/18	<1	<1	<5	1.2J/ND(4)U*	<1	**<5 UJ**	<1	<1	**<1**	**<1**	0.48 J	<10	<1	**<1**
MW-123	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**7.8**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**9.3**	<10	<1	**<1**
MW-124	05/07/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1	<10	<1	**<1**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.7 JB	<10	<1	**<1**
MW-125	05/10/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	0.58 J-	<40 UJ	<1 UJ	**<1 UJ**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.71J/ND(1)U*	<10	<1	**<1**
MW-125 Dup	05/10/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.62 J-	<40	<1	**<1**
MW-126	05/12/18	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	1	<40 UJ	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.53J/ND(1)U*	<10	<1	**<1**
MW-127	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	2.2 JB	<10	<1	**<1**
MW-128	05/09/18	--	--	--	--	<1	**<5**	--	--	--	--	--	--	<0.5	--
	05/22/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**13 J-**	<10 UJ	0.095 J-	**<1 UJ**
	09/11/18	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**18.2**	<10	<1	**<1**
MW-128 Dup	05/09/18	--	--	--	--	<1	**<5**	--	--	--	--	--	--	<0.5	--
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
MW-114 Dup	05/22/18	**<1**	<1	**<1**	**13.7**	<1	**<4**	<1	<1	<1	**0.47**	<2	<1	<3
MW-115	03/30/18	--	--	--	--	--	--	--	--	--	--	--	--	--
	05/22/18	**<1 UJ**	<1 UJ	**<1 UJ**	**57.7 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	09/13/18	**<5**	<5	**<5**	**72.1**	<5	**<20**	<5	<5	<5	**<1**	<10	<5	<15
MW-116	05/08/18	**<1**	<1	**<1**	**1.8**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**1.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-116 Dup	09/12/18	**<1**	<1	**<1**	**1.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-117	05/10/18	**<1**	<1	**<1**	**1.7**	<1	**<4**	<1	**1010 J-**	**8.2**	**<0.2**	182	14.1	**196**
	09/14/18	**<5**	<5	**<5**	**<2**	<5	**<20**	<5	**691**	2.4 J	**<1**	94.8	8	**103**
MW-118	05/10/18	**<1 UJ**	<1 UJ	**<1 UJ**	**<0.4 UJ**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2**	<2 UJ	<1 UJ	<3 UJ
	09/14/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-119	05/10/18	**<1 UJ**	<1 UJ	**<1 UJ**	**1.7 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2**	<2 UJ	<1 UJ	<3 UJ
	09/14/18	**<1**	<1	**<1**	**2.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-120	05/07/18	**<1**	<1	**<1**	**5.3**	<1	**<4**	<1	2.7	<1	**<0.2**	<2	<1	<3
	09/14/18	**<1**	<1	**<1**	**6.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-121	05/10/18	**<1**	<1	**<1**	0.21 J	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/14/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-121 Dup	05/10/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-122	05/11/18	**<1 UJ**	<1 UJ	**<1 UJ**	**<0.4 UJ**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	09/14/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-123	05/08/18	**<1**	<1	**<1**	**0.35 J**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	<1	**<1**	0.26 J	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-124	05/07/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-125	05/10/18	**<1 UJ**	<1 UJ	**<1 UJ**	**<0.4 UJ**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2**	<2 UJ	<1 UJ	<3 UJ
	09/11/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-125 Dup	05/10/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-126	05/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-127	09/11/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-128	05/09/18	--	--	--	--	--	--	--	--	--	--	<0.5	<0.5	<2
	05/22/18	**<1 UJ**	<1 UJ	**<1 UJ**	**1.2 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	09/11/18	**<1**	<1	**<1**	**1.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-128 Dup	05/09/18	--	--	--	--	--	--	--	--	--	--	<0.5	<0.5	<2
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
MW-128 Dup	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-129	05/23/18	<20 UJ	**<4 UJ**	**0.4 J-**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	0.49 J-	<1 UJ	**<1 UJ**	<1 UJ
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	1 J	0.38 J	**<1**	<1
MW-130	05/23/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-130 Dup	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-132	05/23/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
MW-133	05/23/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
MW-134	05/23/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/13/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
MW-135	05/23/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
MW-135 Dup	09/14/18	<20 UJ	**<4 UJ**	**<1 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
PAI-EAST	04/25/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PAI-WEST	04/25/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/15/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
PEP07	07/31/17	27.5	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	05/11/18	<100	**<20**	**<5**	<5	<5	**<5**	**<20**	**<20**	<25	<5	<5	<5	**<5**	<5
	09/14/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
PEP07 Dup	05/11/18	<20 UJ	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
RH-MW-1	07/30/17	38.3/ND(38.3) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/22/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
RH-MW-3	07/28/17	59.1/ND(59.1) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/22/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
RH-MW-7	07/30/17	52.6/ND(52.6) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/22/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
RH-MW-7 Dup	07/30/17	<20 UJ	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
SD-I-01	08/01/17	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
MW-128 Dup	09/11/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-129	05/23/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-130	05/23/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-130 Dup	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-132	05/23/18	<1	**0.78J/ND(1)U***	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-133	05/23/18	<1	**0.63J/ND(1)U***	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.43 J
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-134	05/23/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.51 J
	09/13/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.7 J
MW-135	05/23/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
MW-135 Dup	09/14/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
PAI-EAST	04/25/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PAI-WEST	04/25/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/15/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
PEP07	07/31/17	<1 UJ	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/11/18	<5	**<5**	**<20**	<5	<5	**<20**	**<5**	**<5**	**<20**	<5	<5	**<5**	<5	**<5**
	09/14/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.52 J
PEP07 Dup	05/11/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	0.47 J
RH-MW-1	07/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/22/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
RH-MW-3	07/28/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/22/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
RH-MW-7	07/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/22/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
RH-MW-7 Dup	07/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
SD-I-01	08/01/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
MW-128 Dup	09/11/18	**<1**	<1	0.23 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-129	05/23/18	**<1 UJ**	<1 UJ	**92.3 J-**	0.24 J-	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<4 UJ**
	09/14/18	**<1**	<1	**90.5**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-130	05/23/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<4**
	09/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-130 Dup	09/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-132	05/23/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<4**
	09/13/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-133	05/23/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<4**
	09/13/18	**<1**	<1	0.29 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-134	05/23/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<4**
	09/13/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-135	05/23/18	**0.75 J-**	<1 UJ	**23.6 J-**	0.13 J-	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<4 UJ**
	09/14/18	**1**	<1	**26.3**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
MW-135 Dup	09/14/18	**1 J-**	<1 UJ	**26.6 J-**	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<1 UJ**
PAI-EAST	04/25/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PAI-WEST	04/25/18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/15/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
PEP07	07/31/17	**<1**	<1	**6.2**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/11/18	**<5**	<5	**3.9 J**	<5	<5	**<20**	<5	<20	<5	**<20**	**<20**	<20	**<5**	**<5**
	09/14/18	**<1**	<1	**3.8**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
PEP07 Dup	05/11/18	**<1**	<1	**4.5**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	0.56 J	**<1**
RH-MW-1	07/30/17	**<1**	<1	**36.6**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/22/18	**<1**	<1	3.1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1 UJ**
	09/12/18	**<1**	<1	**12.7**	0.51 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
RH-MW-3	07/28/17	**<1 UJ**	<1	**31.6**	1.1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
	05/22/18	**<1**	<1	**19.2**	0.79 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1 UJ**
	09/12/18	**<1**	<1	**26.4**	1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
RH-MW-7	07/30/17	**<1**	<1	**30.4**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/22/18	**<1**	<1	**31.9**	0.79 J	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<4**
	09/12/18	**<1**	<1	**29.7**	1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
RH-MW-7 Dup	07/30/17	**<1**	<1	**33**	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
SD-I-01	08/01/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
MW-128 Dup	09/11/18	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**17.9**	<10	<1	**<1**
MW-129	05/23/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<5**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**80.2 J-**	<10 UJ	0.23 J-	**<1 UJ**
	09/14/18	<1	<1	0.96 J	<4	<1	**<4**	<1	<1	**<1**	**<1**	**33.5**	<10	<1	**<1**
MW-130	05/23/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.37J/ND(1)U*	<10	<1	**<1**
MW-130 Dup	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.42J/ND(1)U*	<10	<1	**<1**
MW-132	05/23/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.1	<10	<1	**<1**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	0.85 J	<10	<1	**<1**
MW-133	05/23/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	1.2	<10	<1	**<1**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	2.1	<10	<1	**<1**
MW-134	05/23/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
	09/13/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
MW-135	05/23/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**71.6 J-**	<10 UJ	<1 UJ	**<1 UJ**
	09/14/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**83**	<10	<1	**<1**
MW-135 Dup	09/14/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**80.5 J-**	<10 UJ	<1 UJ	**<1 UJ**
PAI-EAST	04/25/18	--	--	--	--	--	--	--	--	--	--	0.31	--	--	--
PAI-WEST	04/25/18	--	--	--	--	--	--	--	--	--	--	1.3	--	--	--
	09/15/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	2.1	<10	<1	**<1**
PEP07	07/31/17	<1	<1	<5	<4	<1	**<5**	<1	<4	**<1**	**<1**	**589**	<10	<1	**<1**
	05/11/18	<5	<5	<25	**<20**	<5	**<20**	<5	<5	**<5**	**<5**	**520**	<50	<5	**<5**
	09/14/18	<1	<1	<5	1.2J/ND(4)U*	<1	**<4**	<1	<1	**<1**	**<1**	**644**	<10	<1	**<1**
PEP07 Dup	05/11/18	<1	<1	<5	<4	<1	**<4**	0.22 J	<1	**<1**	**<1**	**596**	<40	<1	**<1**
RH-MW-1	07/30/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**130**	<10	<1	**<1**
	05/22/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**29.5**	<10	<1	**<1 UJ**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**56.3**	<10	<1	**<1**
RH-MW-3	07/28/17	<1	<1	<5	<4	<1	**<5**	<1	<4	**<1**	**<1**	**29.2**	<10	<1	**<1**
	05/22/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**13.8**	<10	<1	**<1 UJ**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**29.6**	<10	<1	**<1**
RH-MW-7	07/30/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**114**	<10	<1	**<1**
	05/22/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**126**	<10	<1	**<1**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**104**	<10	<1	**<1**
RH-MW-7 Dup	07/30/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**116**	<10	<1	**<1**
SD-I-01	08/01/17	<1	<1	<5	<4	<1	**<5**	<1	<1	**<1**	**<1**	**7.2**	<10	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

Notes:
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J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
MW-128 Dup	09/11/18	**<1**	<1	**<1**	**1.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-129	05/23/18	**<1 UJ**	<1 UJ	**<1 UJ**	**28.3 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**1.1 J-**	<2 UJ	<1 UJ	<3 UJ
	09/14/18	**<1**	<1	**<1**	**20.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-130	05/23/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-130 Dup	09/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-132	05/23/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-133	05/23/18	**<1**	0.59 J	**<1**	**0.35 J**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	0.52 J	**<1**	**0.53**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-134	05/23/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/13/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-135	05/23/18	**<1 UJ**	<1 UJ	**<1 UJ**	**9 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	09/14/18	**<1**	<1	**<1**	**11.1**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
MW-135 Dup	09/14/18	**<1 UJ**	<1 UJ	**<1 UJ**	**11.2 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
PAI-EAST	04/25/18	--	--	--	--	--	--	--	--	--	--	--	--	--
PAI-WEST	04/25/18	--	--	--	--	--	--	--	--	--	--	--	--	--
	09/15/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
PEP07	07/31/17	**<1**	1	**<1**	**18**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/11/18	**<5**	<5	**<5**	**10.9 J**	<5	**<20**	<5	<5	<5	**<1**	<10	<5	<15
	09/14/18	**<1**	1.3	**<1**	**19.5**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
PEP07 Dup	05/11/18	**<1**	0.9 J	**<1**	**18.1 J**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
RH-MW-1	07/30/17	**<1**	<1	**<1**	**21.9**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/22/18	**<1 UJ**	<1	**<1**	**3.7**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**9.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
RH-MW-3	07/28/17	**<1**	<1	**<1**	**11.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/22/18	**<1 UJ**	<1	**<1**	**6.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**9.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
RH-MW-7	07/30/17	**<1**	<1	**<1**	**21.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/22/18	**<1**	<1	**<1**	**20.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**21.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
RH-MW-7 Dup	07/30/17	**<1**	<1	**<1**	**20.6**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
SD-I-01	08/01/17	**<1**	<1	**<1**	**1.2**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

Notes:
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JB - Estimated concentration due to blank contamination
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RSL - Regional Screening Level
VOC - Volatile organic compound
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (εg/L)	Allyl Chloride (εg/L)	Benzene (εg/L)	Bromo-benzene (εg/L)	Bromo-chloro-methane (εg/L)	Bromo-dichloro-methane (εg/L)	Bromoform (εg/L)	Bromo-methane (εg/L)	2-Butanone (εg/L)	n-Butyl-benzene (εg/L)	sec-Butylbenzene (εg/L)	tert-Butyl-benzene (εg/L)	Carbon tetrachloride (εg/L)	Chlorobenzene (εg/L)
SD-I-01	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
SD-I-02	08/01/17	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/08/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	<1	<1	**<1**	<1
	09/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
SD-I-02 Dup	08/01/17	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
SMW12	07/31/17	<20	**<4**	**<2.5**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/11/18	<20	**<4**	**<1**	<1	<1	**<1 UJ**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	09/11/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
SYS-EMW-03	05/22/18	17.7J/ND(20) U*	**<4**	**2.1**	<1	<1	**<1**	**<4**	**<4**	<5	0.6 J	1.1	<1	**<1**	<1
	09/12/18	<20	**<4**	**42.6**	<1	<1	**<1**	**<4**	**<4**	<5	0.7 J	0.76 J	<1	**<1**	<1
Whiteley MW-1	07/30/17	41.9/ND(41.9) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	1.9	10.1	1.2	**<1**	<1
Whiteley MW-2	07/30/17	57.9/ND(57.9) U*	**<4**	**<1**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
ZPMW-1	08/01/17	39.7	**<4**	**2.3**	<1	<1	**<1**	**<4**	**<4**	<5	<1	<1	<1	**<1**	<1
	05/22/18	<20 UJ	**<4 UJ**	**1.1 J-**	<1 UJ	<1 UJ	**<1 UJ**	**<4 UJ**	**<4 UJ**	<5 UJ	<1 UJ	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ
	09/12/18	<20	**<4**	**1.8**	<1	<1	**<1**	**<4**	**<4 UJ**	<5	<1	0.66 J	<1	**<1**	<1
DEQ-7 GROUNDWATER STANDARD		NA	NA	5	NA	NA	10	80	10	NA	NA	NA	NA	3	100
DEQ RBCA RBSLs GROUNDWATER		NA	NA	5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3	0.75	560	100	200	69	0.46	7.8

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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (εg/L)	Chloroform (εg/L)	Chloromethane (εg/L)	2-Chloro-toluene (εg/L)	4-Chloro-toluene (εg/L)	1,2-Dibromo 3-chloro-propane (εg/L)	Dibromo-chloromethane (εg/L)	1,2-Dibromo-ethane (εg/L)	Dibromomethane (εg/L)	1,2-Di-chloro-benzene (εg/L)	1,3-Di-chloro-benzene (εg/L)	1,4-Di-chloro-benzene (εg/L)	Dichloro-difluoro-methane (εg/L)	1,1-Dichloro-ethane (εg/L)
SD-I-01	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1 UJ	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
SD-I-02	08/01/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/08/18	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
SD-I-02 Dup	08/01/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
SMW12	07/31/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/11/18	<1	**0.86J/ND(1)U***	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/11/18	<1	**<1**	0.22 J	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
SYS-EMW-03	05/22/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
Whiteley MW-1	07/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
Whiteley MW-2	07/30/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
ZPMW-1	08/01/17	<1	**<1**	<4	<1	<1	**<4**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
	05/22/18	<1 UJ	**<1 UJ**	<4 UJ	<1 UJ	<1 UJ	**<10 UJ**	**<1 UJ**	**<1 UJ**	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	<1 UJ	<1 UJ
	09/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**	**<1**	**<4**	<1	<1	**<1**	<1	<1
DEQ-7 GROUNDWATER STANDARD		NA	70	600	NA	NA	0.2	8	0.017	NA	600	600	75	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	0.017	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87	0.0075	0.83	30	NA	0.48	20	2.8

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U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
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RBSL - Risk-based Screening Level
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TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2-Dichloro-ethane (εg/L)	1,1-Dichloro-ethene (εg/L)	cis-1,2-Dichloro-ethene (εg/L)	trans-1,2-Dichloro-ethene (εg/L)	Dichlorofluoro methane (εg/L)	1,2-Dichloro-propane (εg/L)	1,3-Dichloro-propane (εg/L)	2,2-Dichloro-propane (εg/L)	1,1-Dichloro-propene (εg/L)	Cis-1,3-dichloro-propene (εg/L)	trans-1,3-Dichloro-propene (εg/L)	Diethyl ether (εg/L)	Ethyl-benzene (εg/L)	Hexachloro-butadiene (εg/L)
SD-I-01	05/08/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4 UJ	<1	<4	**<4**	<4	<1	**<1**
	09/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
SD-I-02	08/01/17	**<1 UJ**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4 UJ	<1	**<1**
	05/08/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
SD-I-02 Dup	08/01/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
SMW12	07/31/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**<2.5**	**<1**
	05/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	09/11/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
SYS-EMW-03	05/22/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**1.9**	**<4**
	09/12/18	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**9.6**	**<1**
Whiteley MW-1	07/30/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	**203**	**<1**
Whiteley MW-2	07/30/17	**<1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
ZPMW-1	08/01/17	**1**	<1	<1	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
	05/22/18	**0.66 J-**	<1 UJ	0.75 J-	<1 UJ	<1 UJ	**<4 UJ**	<1 UJ	<4 UJ	<1 UJ	<4 UJ	**<4 UJ**	<4 UJ	<1 UJ	**<4 UJ**
	09/12/18	**0.69 J**	<1	0.79 J	<1	<1	**<4**	<1	<4	<1	<4	**<4**	<4	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		4	7	70	100	NA	5	NA	NA	NA	4	2	NA	700	5
DEQ RBCA RBSLs GROUNDWATER		4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37	NA	NA	NA	NA	390	1.5	0.14

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J - Estimated concentration
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RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (εg/L)	p-Isopropyl-toluene (εg/L)	4-Methyl-2-Pentanone (εg/L)	Methylene Chloride (εg/L)	MTBE (εg/L)	Naphthalene (εg/L)	n-Propyl-benzene (εg/L)	Styrene (εg/L)	1,1,1,2-Tetrachloro-ethane (εg/L)	1,1,2,2-Tetrachloro-ethane (εg/L)	Tetrachloro-ethene (εg/L)	Tetrahydrofuran (εg/L)	Toluene (εg/L)	1,2,3-Trichloro-benzene (εg/L)
SD-I-01	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**5.9**	<10	<1	**<1**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**6.1**	<10	<1	**<1**
SD-I-02	08/01/17	<1	<1	<5	<4	<1	**<4**	<1	<4	**<1**	**<1**	**18.5**	<10	<1	**<1**
	05/08/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**7**	<10	<1	**<1**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**20.7**	<10	<1	**<1**
SD-I-02 Dup	08/01/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**21.9**	<10	<1	**<1**
SMW12	07/31/17	<1	<1	<5	<4	<5	**<4**	<1	<4	**<1**	**<1**	**4.4**	<10	<2.5	**<1**
	05/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**4.5**	<10	<1	**<1**
	09/11/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**5.9**	<10	<1	**<1**
SYS-EMW-03	05/22/18	0.2 J	1.1	1.8 J	<4	<1	**4.7**	0.45 J	<1	**<1**	**<1**	<1	<10	<1	**<1**
	09/12/18	0.68 J	1.1	1.3 J	<4	<1	**6.2**	0.69 J	0.6 J	**<1**	**<1**	<1	<10	0.54 J	**<1**
Whiteley MW-1	07/30/17	39.1	<1	<5	<4	<1	**<4**	43.7	<1	**<1**	**<1**	<1	<10	1.8	**<1**
Whiteley MW-2	07/30/17	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	<1	<10	<1	**<1**
ZPMW-1	08/01/17	<1	<1	<5	<4	<1	**<4**	<1	<4	**<1**	**<1**	**42.8**	<10	<1	**<1**
	05/22/18	<1 UJ	<1 UJ	<5 UJ	<4 UJ	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	**<1 UJ**	**<1 UJ**	**44.4 J-**	<10 UJ	<1 UJ	**<1 UJ**
	09/12/18	<1	<1	<5	<4	<1	**<4**	<1	<1	**<1**	**<1**	**59.8**	<10	<1	**<1**
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	5	30	100	NA	100	NA	2	5	NA	1,000	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	30	100	NA	NA	NA	NA	NA	NA	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66	120	0.57	0.076	4.1	340	110	0.7

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-5. GROUNDWATER – VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4-Trichloro-benzene (εg/L)	1,1,1-Trichloro-ethane (εg/L)	1,1,2-Trichloro-ethane (εg/L)	Trichloro-ethene (εg/L)	Trichloro-fluoromethane (εg/L)	1,2,3-Trichloro-propane (εg/L)	1,1,2-Trichloro-trifluoro-ethane (εg/L)	1,2,4-Trimethyl-benzene (εg/L)	1,3,5-Trimethyl-benzene (εg/L)	Vinyl Chloride (εg/L)	m,p-Xylene (εg/L)	o-Xylene (εg/L)	Xylenes, Total (εg/L)
SD-I-01	05/08/18	**<1**	<1	**<1**	**0.82**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**1**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
SD-I-02	08/01/17	**<1**	<1	**<1**	**0.79**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/08/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/12/18	**<1**	<1	**<1**	**0.57**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
SD-I-02 Dup	08/01/17	**<1**	<1	**<1**	**0.72**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
SMW12	07/31/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2.5	<2.5	<3
	05/11/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	09/11/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
SYS-EMW-03	05/22/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	**42.5**	0.33 J	**<0.2**	15.6	4.2	**19.8**
	09/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	**40.2**	<1	**<0.2**	6	5.4	11.4
Whiteley MW-1	07/30/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	**18.1**	<1	**<0.2**	4.4	11.4	15.8
Whiteley MW-2	07/30/17	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
ZPMW-1	08/01/17	**<1**	<1	**<1**	**4**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
	05/22/18	**<1 UJ**	<1 UJ	**<1 UJ**	**3.3 J-**	<1 UJ	**<4 UJ**	<1 UJ	<1 UJ	<1 UJ	**<0.2 UJ**	<2 UJ	<1 UJ	<3 UJ
	09/12/18	**<1**	<1	**<1**	**4.3**	<1	**<4**	<1	<1	<1	**<0.2**	<2	<1	<3
DEQ-7 GROUNDWATER STANDARD		70	200	3	5	2,000	NA	NA	NA	NA	0.2	10,000	10,000	10,000
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000	5.6	6	0.019	NA	19	19

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
VOC - Volatile organic compound
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-6. GROUNDWATER – MNA ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Carbon (mg/L)	Chloride (mg/L)	Specific Conductance Fi (mS/cm)	Ethane (εg/L)	Ethylene (εg/L)	Methane (εg/L)	Nitrogen, Nitrate & Nitrite (mg/L)	Oxygen, Dissolved (mg/L)	pH (Std Units)	Oxidation-Reduction Pote (mV)	Sulfate (mg/L)	Temperature (oC)	Turbidity (NTU)
BMW07-1	07/29/17	--	--	2.84	--	--	--	--	1.03	6.98	117	--	15.28	4.72
	05/10/18	--	--	3.14	--	--	--	--	0.25	7.01	191.3	--	13.67	3.11
	09/14/18	--	--	3.73	--	--	--	--	0.06	6.64	83.4	--	15.32	16.94
BMW-1	07/29/17	1.2	136	2.32	<10	<10	<10	9.3	0.09	6.96	107.3	1050	15.61	618.01
	05/10/18	--	73.7	2.49	<10	<10	1.4J/ND(10)U*	9.7	0.2	7.06	227	834	12.96	56.74
	09/14/18	--	76.9	2.75	<10	<10	<10	7.9	0.09	6.71	76	798	15.49	6.13
BMW-4	07/28/17	2.1	95	3.3	<10	<10	34.2	7.8	0.27	6.92	105.9	1240	15	12.15
	05/10/18	--	--	3.32	--	--	--	--	0.2	6.85	192.6	--	12.02	3.42
	09/14/18	--	--	3.9	--	--	--	--	0.18	6.74	93.3	--	13.31	4.72
BNMW-17	08/30/17	--	--	2.95	--	--	--	--	2.97	7.25	(60.60)	--	17.16	224.02
	05/08/18	--	--	3.19	--	--	--	--	0.14	7.1	(182.70)	--	13.38	401.53
	09/13/18	--	--	3.71	--	--	--	--	0.16	6.85	(166.00)	--	14.8	101.94
BNMW-20	08/30/17	--	--	3.31	--	--	--	--	2	7.06	190.7	--	14.92	6.28
	05/08/18	--	--	3.59	--	--	--	--	2.22	7	181.3	--	15.79	1.96
	09/13/18	--	--	3.21	--	--	--	--	1.98	6.97	219.1	--	14.16	8.34
BNMW-21	08/31/17	1.1	85.4	3.1	<10	<10	<10	17	2.46	6.87	183.75	1140	15.4203	1.46
	05/08/18	--	--	3.08	--	--	--	--	1.58	6.94	166.5	--	16.24	485.97
	09/13/18	--	--	3.32	--	--	--	--	1.01	6.92	229.9	--	14.46	7.42
BNMW-23	08/31/17	3	89.5	3.22	<10	<10	11.1	2.5	0.04	7.08	(161.10)	1130	17.86	7.14
	05/08/18	--	61.6	2.16	<10	<10	8.4J/ND(10)U*	<0.01	0.21	7.21	(215.50)	653	14.44	19.06
	09/13/18	--	96.9	3.33	<10	<10	12.8	2.1	0.19	6.88	(75.60)	1060	15.73	0.13
BNMW-24	08/30/17	--	--	2.13	--	--	--	--	0.37	7.39	34.29	--	14.9171	1.88
BNMW-8	08/30/17	--	--	3.26	--	--	--	--	1.97	7.08	212	--	15.83	3.59
	05/08/18	--	--	3.44	--	--	--	--	2.54	6.89	229.9	--	13.8	6.72
	09/12/18	--	--	3.71	--	--	--	--	0.88	6.85	244.1	--	14.63	1.69
BNMW-9	08/30/17	--	--	3.04	--	--	--	--	0.92	7.16	83.1	--	16.42	9.23
	08/31/17	--	--	1.64	--	--	--	--	7.56	7.22	224.5	--	14.68	9.01
	05/08/18	--	--	3.17	--	--	--	--	0.21	6.8	191	--	14.27	5.48
	09/13/18	--	--	3.73	--	--	--	--	0.04	6.98	(15.50)	--	14.97	0.65
BPGP02	08/31/17	6.8	53.7	1.42	<10	<10	397	0.011	0	7.21	(164.56)	146	17.125	2.36
	05/11/18	--	171	2.47	<10	<10	64.8	0.13	0.35	6.96	(102.50)	551	11.61	0.52
	09/14/18	--	97.8	2.97	4.2 J	<10	163	0.65	0.18	7.07	(147.10)	815	15.61	2.42
BPGP04	07/31/17	--	--	0.78	--	--	--	--	3.53	7.59	83.1	--	17.86	13.41
BPGP05	07/26/17	0.91	78.6 J+	1.42	<10	<10	<10	1.8	4.22	7.15	122.8	388 J+	16.16	8.69
BPGP08	07/26/17	--	--	1.95	--	--	--	--	0.62	7.07	161.9	--	18.46	0.91
	05/10/18	--	--	2.73	--	--	--	--	0.23	7.07	237.7	--	11.87	59.83
	09/12/18	--	--	3.5	--	--	--	--	0.2	6.98	203.2	--	16.26	0.22
BPGP12	07/26/17	--	--	2.96	--	--	--	--	0.76	7.02	105.3	--	16.8	10.29
	07/28/17	1.1	92.7	--	<10	<10	<10	4	--	--	--	1170	--	--
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
MNA - Monitored natural attenuation
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
RSL - Regional Screening Level
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-6. GROUNDWATER – MNA ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Carbon (mg/L)	Chloride (mg/L)	Specific Conductance Fi (mS/cm)	Ethane (εg/L)	Ethylene (εg/L)	Methane (εg/L)	Nitrogen, Nitrate & Nitrite (mg/L)	Oxygen, Dissolved (mg/L)	pH (Std Units)	Oxidation-Reduction Pote (mV)	Sulfate (mg/L)	Temperature (oC)	Turbidity (NTU)
BPGP12	05/09/18	--	83.4	2.86	<10 UJ	<10 UJ	1.4J/ND(10)U*	2.6 J+	0.32	7.18	55.9	1130	11.67	0.36
	05/21/18	--	--	3	--	--	--	--	0.43	7.1	68.4	--	12.51	1.78
	09/12/18	--	170	3.61	<10	<10	<10	2.1	0.58	6.99	226	1370	14.71	0.05
BPGP15	07/28/17	1.6	<100	3.46	<10	<10	<10	4.6	1.64	6.81	105.4	1500	15.63	15.12
	05/08/18	--	--	3.71	--	--	--	--	0.85	7.04	28.2	--	12.27	0.66
	09/11/18	--	--	3.77	--	--	--	--	2.09	6.86	92.9	--	15.26	0.11
BPGP16	07/30/17	--	--	2.53	--	--	--	--	2	6.9	152.7	--	14.99	0.53
	05/08/18	--	--	0	--	--	--	--	7.78	7.85	(27.00)	--	12.82	9.34
	09/11/18	--	--	1.6	--	--	--	--	4	7.58	161.5	--	17.43	7.37
BPGP17	07/30/17	--	--	3.63	--	--	--	--	0.97	6.92	(20.10)	--	14.39	278.14
	05/08/18	--	--	3.69	--	--	--	--	0.22	6.95	(172.70)	--	12.52	9.93
	09/11/18	--	--	7.33	--	--	--	--	0.33	6.98	(104.80)	--	18.47	3.5
BPGP22	07/30/17	1.5	68	2.45	<10	<10	<10	2.4	0.37	6.9	148.7	1290	15.56	75.01
	05/08/18	--	--	3.11	--	--	--	--	0.85	7.02	45.3	--	13.79	4.25
	09/14/18	--	--	3.65	--	--	--	--	1.54	6.88	247.6	--	14.71	0.09
BPGP25	07/28/17	--	--	2.87	--	--	--	--	1.74	6.94	119.6	--	16.08	15.29
	05/07/18	--	--	3.92	--	--	--	--	4.42	7.06	237.9	--	12.28	18.92
	09/11/18	--	--	3.3	--	--	--	--	1.31	7.22	181.3	--	14.95	0.88
BPGP27	07/28/17	--	--	3.25	--	--	--	--	0.45	7.1	213.5	--	16.19	494.9
	05/07/18	--	--	2.31	--	--	--	--	3.55	6.95	240.4	--	10.52	2.22
	09/11/18	--	--	3.75	--	--	--	--	0.44	7.09	180.8	--	16.06	0.19
BPGP28	07/28/17	--	--	3.01	--	--	--	--	1.64	6.87	187.7	--	15.82	0.43
BPGP29	07/28/17	--	--	2.8	--	--	--	--	0.56	7.18	179.5	--	17.93	2.45
	05/07/18	--	--	2.22	--	--	--	--	2.4	7.17	235.78	--	13.09	5.82
BPGP31	07/31/17	--	--	3.93	--	--	--	--	0.9	6.91	107.3	--	15.07	39.11
	05/07/18	--	--	4.43	--	--	--	--	0.15	6.84	(136.20)	--	14.04	110.07
	09/11/18	--	--	4.77	--	--	--	--	0.21	7	183.4	--	16.18	5.26
BPGP32	07/26/17	1.2	69.2 J+	1.81	<10	<10	<10	1.9	0.31	7.25	128.6	862 J+	17.16	66.53
BPGP41	07/28/17	1.8	80.1	3.3	<10	<10	<10	0.78	5.11	6.92	177.7	1600	16.48	0.69
	05/07/18	--	--	3.96	--	--	--	--	3.56	6.88	238.5	--	12.84	2.68
	09/10/18	--	--	8.47	--	--	--	--	2.99	6.99	85	--	--	0.23
BPGP42	07/28/17	1.1	85.8	2.66	<10	<10	<10	3.7	0.8	7.18	165.2	1230	17.08	0.44
	05/08/18	--	71.9	2.89	<10	<10	<10	2.8 J+	0.24	7.16	229.1	1030	14.36	0.42
	09/10/18	--	91.8	5.56	<10	<10	<10	2.2	0.11	7.1	82.5	868	--	0.09
BPGP44	07/31/17	--	--	3.07	--	--	--	--	2.6	7.04	113.4	--	16.3	4.53
	05/08/18	--	--	2.3	--	--	--	--	3.98	7.19	242.4	--	12.76	0.57
	09/10/18	--	--	6.1	--	--	--	--	2.7	7.2	74.3	--	--	0.3
BPGP46	07/27/17	1.1	71.9	1.6	<10	<10	16	2	0.13	7.09	73.8	403	18	7.26
	05/11/18	--	--	1.63	--	--	--	--	0.16	7.23	133.2	--	14.15	2.26
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
MNA - Monitored natural attenuation
RBCA - Risk-based Corrective Action
RBSL - Risk-based Screening Level
EPA - United States Environmental Protection Agency
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TABLE 9-6. GROUNDWATER – MNA ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Carbon (mg/L)	Chloride (mg/L)	Specific Conductance Fi (mS/cm)	Ethane (εg/L)	Ethylene (εg/L)	Methane (εg/L)	Nitrogen, Nitrate & Nitrite (mg/L)	Oxygen, Dissolved (mg/L)	pH (Std Units)	Oxidation-Reduction Pote (mV)	Sulfate (mg/L)	Temperature (oC)	Turbidity (NTU)
BPGP46	09/15/18	--	--	2	--	--	--	--	0.16	7.15	(89.80)	--	16.37	70.61
BPGP46b	07/27/17	--	--	2.98	--	--	--	--	1.41	7.05	(44.00)	--	23.02	51.37
	05/11/18	--	--	3.09	--	--	--	--	0.39	7.3	(18.70)	--	13.93	0.53
BPGP47	07/28/17	--	--	3.12	--	--	--	--	2.42	7.04	179	--	19.79	0.91
	05/07/18	--	--	3.26	--	--	--	--	1.99	7.07	79.2	--	12.35	97.08
	09/10/18	--	--	5.81	--	--	--	--	2.62	7.1	104.6	--	--	0.39
BPGP48	07/28/17	3.3	94.1	3.63	<10	<10	<10	1.8	2.19	7.05	200.6	1890	16.75	4.39
	05/07/18	--	--	3.1	--	--	--	--	2.47	7.01	214	--	13.76	50.76
	09/10/18	--	--	3.88	--	--	--	--	1.53	7.08	200.1	--	16.42	0.22
	09/11/18	--	--	3.88	--	--	--	--	1.53	7.08	200.1	--	16.42	0.22
BPGP49	07/27/17	--	--	2.11	--	--	--	--	1.53	6.95	124.7	--	17.54	2.71
	05/11/18	--	--	2.27	--	--	--	--	1.02	7.15	37.9	--	13.1	3.3
	09/14/18	--	--	2.73	--	--	--	--	0.87	7.06	(29.60)	--	17.26	13.57
BPGP50	07/30/17	<0.84	414	3.38	<10	<10	<10	3.3	2.14	6.91	232.2	1080	18.22	1.73
	05/09/18	--	567	4.46	<10 UJ	<10 UJ	3.1J/ND(10)U*	2.8 J+	2.24	7.1	238	1160	14.03	0.57
	05/21/18	--	--	4.51	--	--	--	--	2.38	7.06	237.3	--	14.22	2.93
	09/10/18	--	221	7.28	<10	<10	<10	2.2	1	7.14	194.7	1080	--	0.19
BPGP51	07/27/17	--	--	1.47	--	--	--	--	2.84	6.86	163.3	--	18.82	7.1
	05/11/18	--	--	1.68	--	--	--	--	0.89	7.37	25.9	--	12.65	0.66
	09/15/18	--	--	2.14	--	--	--	--	0.76	7.2	175.5	--	16.52	1.78
BPGP51B	07/27/17	--	--	0.47	--	--	--	--	0.23	7.41	62.5	--	19.33	28.46
	05/11/18	--	--	1.38	--	--	--	--	0.3	7.35	154.3	--	13.74	0.89
	09/14/18	--	--	1.8	--	--	--	--	0.12	7.19	55.7	--	15.83	18.35
BPGP53	07/27/17	--	--	0.85	--	--	--	--	3.86	7.39	126.1	--	18.11	3.56
	05/10/18	--	--	2.43	--	--	--	--	0.63	7.22	240.3	--	13.11	2.83
	09/14/18	--	--	2.69	--	--	--	--	0.28	7.09	34.1	--	16.05	0.68
BPGP54	07/26/17	--	--	1.82	--	--	--	--	3.45	6.91	227.6	--	18.39	2.36
BPGP58	07/31/17	--	--	1.22	--	--	--	--	0.21	6.99	112.7	--	19.36	31.67
BPGP59	07/26/17	1.3	72.4 J+	0.37	<10	<10	55.9	1.1	1	7.32	99.4	542 J+	18.52	5.86
	05/10/18	--	62.6	1.88	<10	<10	98.3	0.46	0.71	7.03	297.7	561	15.36	26.33
	09/14/18	--	79.5	2.27	<10	<10	29.8	0.26	0.86	7.03	73.6	604	16.71	1.14
BPGP60	07/26/17	--	--	1.77	--	--	--	--	3.03	6.91	230.1	--	17.58	7.66
	05/10/18	--	--	2.3	--	--	--	--	3.5	6.74	224.5	--	13.45	18.99
	09/14/18	--	--	2.13	--	--	--	--	2.75	6.85	102.3	--	16.03	4.75
BPGP61	07/26/17	--	--	4.13	--	--	--	--	0.44	6.81	23.6	--	16.43	68.61
	05/11/18	--	--	0	--	--	--	--	9.07	6.85	225.5	--	14.5	0.76
	09/14/18	--	--	4.68	--	--	--	--	0.09	6.93	(84.60)	--	16.27	1.02
BPGP63	07/27/17	--	--	0.64	--	--	--	--	4.69	7.42	136.5	--	14.69	34.87
	05/11/18	--	--	1.37	--	--	--	--	0.17	7.44	14.6	--	13.81	17
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
MNA - Monitored natural attenuation
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REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Carbon (mg/L)	Chloride (mg/L)	Specific Conductance Fi (mS/cm)	Ethane (εg/L)	Ethylene (εg/L)	Methane (εg/L)	Nitrogen, Nitrate & Nitrite (mg/L)	Oxygen, Dissolved (mg/L)	pH (Std Units)	Oxidation-Reduction Pote (mV)	Sulfate (mg/L)	Temperature (oC)	Turbidity (NTU)
BPGP63	09/14/18	--	--	1.58	--	--	--	--	0.18	7.26	160.1	--	14.99	12.05
BPGP63B	07/27/17	--	--	0.7	--	--	--	--	2.98	7.43	137	--	16.58	0.4
BPGP65	07/27/17	--	--	0.77	--	--	--	--	7.24	7.45	126.3	--	15.86	8.31
	05/12/18	--	--	6.98	--	--	--	--	2.62	7.22	239	--	10.34	38.55
	09/14/18	--	--	2.25	--	--	--	--	3.39	7.15	185.2	--	14.72	19.66
BPGP65B	07/27/17	1.3	47.6	1.84	<10	<10	<10	1.6	0.92	6.97	151.4	746	17.37	119.61
	05/10/18	--	--	2.5	--	--	--	--	0.13	7.17	73.4	--	14.52	27.88
BPGP66	07/26/17	1.3	38.7 J+	0.19	<10	<10	40.1	0.5	0.9	7.47	100.5	337 J+	17.17	32.22
BPGP67	07/31/17	--	--	2.04	--	--	--	--	0.09	7.04	96.4	--	17.37	136.79
	05/10/18	--	--	1.61	--	--	--	--	0.12	7.24	153.5	--	16.96	36.7
	09/14/18	--	--	2.38	--	--	--	--	0.09	7.03	59.6	--	17.35	9.8
BPGP74	07/27/17	--	--	1.26	--	--	--	--	0.35	6.88	172.4	--	18.63	3.72
	05/11/18	--	--	1.29	--	--	--	--	0.2	7.36	36.2	--	12.1	2.27
	09/15/18	--	--	1.5	--	--	--	--	0.11	7.28	164.2	--	14.1	38.91
BPGP76	07/31/17	--	--	0.4	--	--	--	--	3.1	7.91	70.4	--	21.28	0
	05/11/18	--	--	1.09	--	--	--	--	5.08	7.32	68.15	--	11.05	2.16
	09/15/18	--	--	1.6	--	--	--	--	2.48	7	181	--	15.96	1.35
BPGP78	07/27/17	1.7	121 J+	2.64	<10	<10	309	0.033 JB	0.3	6.91	(69.70)	1190 J+	16.12	5.84
	05/11/18	--	100	2.79	11	<10	484	0.11	1.09	7.08	(43.70)	787	12.12	3.52
	09/14/18	--	143	3.32	7.5 J	<10	286	0.18	0.18	6.92	(115.70)	994	17.5	27.12
BPGP80	07/26/17	1.2	81.2 J+	2.54	<10	<10	51	4	0.32	7.21	121.2	962 J+	17	19.45
	05/10/18	--	--	2.81	--	--	--	--	0.37	7.09	236.2	--	13.35	0.4
	09/13/18	--	--	2.98	--	--	--	--	0.28	6.97	100.1	--	17	19.11
BPGP81	07/31/17	--	--	1.56	--	--	--	--	0.26	6.99	140.3	--	20.51	3.34
	05/09/18	--	--	1.62	--	--	--	--	1.97	7.08	154.7	--	12.16	1.62
	05/21/18	--	--	1.98	--	--	--	--	2.84	6.82	123	--	12.11	6.8
	09/13/18	--	--	2.06	--	--	--	--	0.93	7	92.8	--	16.34	13.86
BPGP83	07/28/17	0.9	63.2	1.91	<10	<10	<10	4.9	1.52	6.87	115.6	633	16.83	12.61
	05/09/18	--	--	1.97	--	--	--	--	0.34	7.12	162.7	--	15.76	5.66
	05/21/18	--	--	1.99	--	--	--	--	0.47	7.11	82.3	--	17.09	11.21
	09/14/18	--	--	1.95	--	--	--	--	1.13	6.92	228.4	--	15.67	0.13
BPGP84	07/31/17	--	--	0.08	--	--	--	--	0.37	7.07	92.5	--	18.08	0.79
	05/09/18	--	--	2.8	--	--	--	--	0.09	7.22	110.8	--	15.38	0.72
	05/21/18	--	--	2.86	--	--	--	--	0.09	7.1	89.6	--	16	7.59
	09/12/18	--	--	3.02	--	--	--	--	0.17	7.02	248.2	--	14.88	0.02
BPGP85	07/26/17	--	--	3.39	--	--	--	--	0.73	6.92	171.8	--	15.97	0.93
	05/08/18	--	--	3.69	--	--	--	--	0.67	6.89	86.1	--	12.43	1.13
	09/12/18	--	--	3.87	--	--	--	--	0.3	6.95	195.9	--	15.02	0.5
BPGP86	07/28/17	--	--	2.52	--	--	--	--	1.22	7.11	174.6	--	18.53	2.16
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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J - Estimated concentration
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Location ID	Date Sampled	Carbon (mg/L)	Chloride (mg/L)	Specific Conductance Fi (mS/cm)	Ethane (εg/L)	Ethylene (εg/L)	Methane (εg/L)	Nitrogen, Nitrate & Nitrite (mg/L)	Oxygen, Dissolved (mg/L)	pH (Std Units)	Oxidation-Reduction Pote (mV)	Sulfate (mg/L)	Temperature (oC)	Turbidity (NTU)
BPGP86	05/07/18	--	--	2.03	--	--	--	--	2.64	7.2	205.6	--	15.82	10.62
	09/11/18	--	--	2.66	--	--	--	--	1.99	7.2	210	--	15.56	0.47
BPGP87	07/31/17	--	--	1.43	--	--	--	--	3.67	7.12	122.1	--	19.21	1.33
	05/10/18	--	--	2.15	--	--	--	--	2.88	7.17	244.9	--	12.79	0.72
BPGP88	07/26/17	--	--	0.59	--	--	--	--	5.24	7.61	139.4	--	17.39	0.81
BPGP89	07/30/17	--	--	2.7	--	--	--	--	0.18	7.25	(180.20)	--	19.96	44.41
	05/08/18	--	--	2.82	--	--	--	--	0.14	7.3	(219.10)	--	14.22	0.47
	09/10/18	--	--	6.33	--	--	--	--	0.09	7.44	(166.20)	--	--	15.81
BPGP90	07/30/17	--	--	2.69	--	--	--	--	1.4	7.05	94	--	19.86	2.39
BPGP91	07/29/17	--	--	2.81	--	--	--	--	0.48	7.09	(137.30)	--	17.25	9.94
	05/09/18	--	--	3.64	--	--	--	--	0.34	7.27	(122.90)	--	13.54	0.98
	05/21/18	--	--	3.63	--	--	--	--	0.21	7.19	(178.30)	--	13.42	1.81
	09/10/18	--	--	7.15	--	--	--	--	0.47	7.33	(134.60)	--	--	7.97
BPGP92	07/30/17	1.2	71.6	2.81	<10	<10	<10	2.2	0.8	6.89	121.4	1030	12.7	9.51
	05/08/18	--	--	3.23	<10	<10	1.9J/ND(10)U*	1.7 J+	0.25	6.99	(75.90)	1240	12.06	2.72
	09/11/18	--	101	3.93	<10	<10	<10	0.78	0.18	6.84	(18.20)	1570	14.39	0.1
BPGP92 Dup	07/30/17	1.2	74.7	--	<10	<10	<10	2.8	--	--	--	1090	--	--
BPGP93	07/31/17	--	--	2.53	--	--	--	--	0.3	7.01	126.9	--	17.96	578.9
	05/09/18	--	--	2.97	--	--	--	--	0.1	6.92	149.7	--	13.54	83.75
	05/21/18	--	--	3.04	--	--	--	--	0.09	6.96	107.1	--	13.36	22.96
	09/13/18	--	--	3.15	--	--	--	--	0.15	7.04	55	--	17.86	7.29
BPGP94	07/30/17	1.1	103	3.01	<10	<10	<10	14.4	1.36	7.09	141.1	1200	15.4	2.3
	05/09/18	--	50.3	2.4	<10 UJ	<10 UJ	<10 UJ	4.2 J+	0.67	7.15	137.7	828	12.77	128.77
	05/21/18	--	--	2.54	--	--	--	--	1.12	7.21	35.4	--	11.9	1.29
	09/11/18	--	103	3.55	<10	<10	76.9	5.9	1.39	7.12	234.4	1330	17.23	0.27
BPGW01	07/26/17	--	--	4.27	--	--	--	--	1.96	6.8	198	--	17.45	6.26
	05/11/18	--	--	3.71	--	--	--	--	0.46	7.03	33	--	11.35	38
	09/15/18	--	--	4.1	--	--	--	--	0.27	6.3	127	--	16.82	3.39
BPGW04	07/27/17	<0.84	180 J+	1.37	<10	<10	<10	7.5	5.74	7.22	74.6	136 J+	15.83	702.38
	05/11/18	--	--	2.94	--	--	--	--	3.42	7.3	213	--	10.83	3.5
	09/11/18	--	--	2.61	--	--	--	--	3.19	7.19	89.7	--	16.15	181.73
CENEX-5	07/28/17	1.5	91.3	2.01	<10	<10	19.4	7.8	0.69	6.74	137.2	444	15.82	44.61
EMW-03	07/28/17	1	116	1.53	<10	<10	<10	10.5	0.12	7	90.3	383	15.94	113.71
	05/07/18	--	--	1.74	--	--	--	--	3.65	7.07	190.3	--	13.16	108
	09/12/18	--	--	2.03	--	--	--	--	0.08	6.97	209.8	--	15.68	513.28
EMW-09	08/01/17	--	--	1.09	--	--	--	--	0.96	7.1	(192.00)	--	16.4	426.11
	05/11/18	--	--	2.54	--	--	--	--	0.09	7.39	(239.00)	--	10.61	5.58
	09/11/18	--	--	2.63	--	--	--	--	0.04	7.27	(260.10)	--	16.62	88.93
EMW-11	07/26/17	--	--	2.26	--	--	--	--	0.14	6.88	20.4	--	16.13	2.12
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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EMW-15	07/31/17	--	--	2.2	--	--	--	--	0.21	6.91	(123.10)	--	17.49	41.45
EMW-18	07/29/17	--	--	2.47	--	--	--	--	1.82	6.9	105.2	--	18.83	122.66
	05/10/18	--	--	3.84	--	--	--	--	1.3	6.94	211.1	--	13.88	11.34
	09/14/18	--	--	2.98	--	--	--	--	3.09	6.66	79	--	18.69	2.39
EMW-21	07/28/17	11.3	218	2.81	<10	<10	1870	0.63	0.23	6.99	(77.10)	748	20.69	103.21
EMW-26	07/29/17	--	--	2.47	--	--	--	--	0.47	6.82	51.3	--	17.84	4.91
EMW-28	07/29/17	--	--	2.32	--	--	--	--	6.91	7.54	87.7	--	16.59	43.15
	05/09/18	--	--	0.5	--	--	--	--	2.81	7.15	96.4	--	10.78	11.41
	05/21/18	--	--	0.47	--	--	--	--	3.83	6.84	78.9	--	13.46	41.96
	09/13/18	--	--	0.58	--	--	--	--	1.77	7.32	(55.40)	--	17.19	1.06
EMW-32	05/10/18	--	--	2.02	--	--	--	--	5.83	6.84	192.1	--	11.74	6.81
	09/13/18	--	--	1.78	--	--	--	--	5.49	6.73	203.8	--	14.62	5.8
GSMW-5	07/31/17	--	--	1.57	--	--	--	--	2.75	7.04	(92.30)	--	16.19	498.46
MW-100	05/07/18	--	--	2.42	--	--	--	--	0.35	7.31	196.7	--	14.39	429.34
	09/14/18	--	--	2.66	--	--	--	--	0.09	6.93	180.1	--	14.64	66.59
MW-101	05/07/18	--	--	2.38	--	--	--	--	0.26	7.14	188.7	--	13.31	76.28
	09/12/18	--	34	--	<10	<10	<10	12.4	--	--	--	395	--	--
MW-102	05/07/18	--	95.3	1.55	<10	1.9 J	9.6J/ND(10)U*	13.3	1.59	7.43	181	907	13.95	124.57
	09/11/18	--	--	2.56	--	--	--	--	1.52	7.05	229.8	--	16.21	83.4
	09/12/18	--	--	1.6	--	--	--	--	0.14	7.17	218.7	--	15.27	28.31
MW-103	05/11/18	--	--	3.5	--	--	--	--	0.11	7.05	(36.00)	--	11.49	72
	09/11/18	--	--	2.83	--	--	--	--	0.08	7	(120.50)	--	15.22	36.48
MW-104	05/10/18	--	--	2.96	--	--	--	--	0.08	6.95	160.3	--	12.43	20.66
	09/11/18	--	--	2.07	--	--	--	--	0.11	7.01	(12.60)	--	15.97	48.13
	09/12/18	--	--	2.19	--	--	--	--	0.64	7.01	103.7	--	14.19	26.27
MW-105	05/08/18	--	--	5.34	--	--	--	--	2.1	7.25	79	--	14.54	278.45
	09/13/18	--	--	3.79	--	--	--	--	0.09	7.2	(39.70)	--	14.66	31.83
MW-106	05/08/18	--	--	2.73	--	--	--	--	0.25	7.12	60.9	--	13.62	256.78
	09/13/18	--	--	3	--	--	--	--	0.01	7.05	17.2	--	13.99	56.7
MW-107	05/10/18	--	--	2.54	--	--	--	--	1.22	7.19	68.6	--	14.43	94.29
	09/12/18	--	--	2.59	--	--	--	--	2.43	6.93	207.8	--	15.42	67.07
MW-108	05/10/18	--	90.3	3.04	<10	<10	6.4J/ND(10)U*	0.005 J	1.67	7.13	(58.70)	1150	14.13	158.78
	09/12/18	--	--	3.71	--	--	--	--	0.1	6.98	(179.00)	--	15.51	13.21
	09/15/18	--	87.1	--	<10	<10	24.4	0.006J/ND (0.01)U*	--	--	--	1240	--	--
MW-109	05/09/18	--	--	2.49	--	--	--	--	0.33	7.16	75.3	--	14.21	167.54
	05/22/18	--	--	2.92	--	--	--	--	0.32	7	109.2	--	14.51	58.82
	09/14/18	--	--	3.26	--	--	--	--	0.16	6.74	89.5	--	14.31	38.75
MW-110	05/09/18	--	--	3.13	--	--	--	--	1.22	6.99	99.1	--	14.48	532.69
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
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DEQ - Montana Department of Environmental Quality
MNA - Monitored natural attenuation
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TABLE 9-6. GROUNDWATER – MNA ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Carbon (mg/L)	Chloride (mg/L)	Specific Conductance Fi (mS/cm)	Ethane (εg/L)	Ethylene (εg/L)	Methane (εg/L)	Nitrogen, Nitrate & Nitrite (mg/L)	Oxygen, Dissolved (mg/L)	pH (Std Units)	Oxidation-Reduction Pote (mV)	Sulfate (mg/L)	Temperature (oC)	Turbidity (NTU)
MW-110	05/22/18	--	--	3.5	--	--	--	--	1.54	6.82	242.2	--	15.34	159.83
	09/13/18	--	--	3.55	--	--	--	--	1.47	6.89	146.1	--	14.02	22.95
MW-111	05/10/18	--	--	2.01	--	--	--	--	1.37	7.28	(77.60)	--	12.93	84.26
	09/12/18	--	--	1.56	--	--	--	--	1.11	7.23	79.7	--	15.71	35.07
MW-112	05/09/18	--	--	3.13	--	--	--	--	0.07	7.07	88.5	--	13.42	27.86
	05/22/18	--	--	3.62	--	--	--	--	0.09	6.91	206.6	--	15.54	45.05
	09/12/18	--	--	2.91	--	--	--	--	0.03	6.86	16.5	--	17.78	36.69
MW-113	05/09/18	--	--	3.54	--	--	--	--	0.19	6.95	260.1	--	11.41	61.37
	05/22/18	--	--	3.78	--	--	--	--	0.06	6.22	160.6	--	13.23	77.23
	09/13/18	--	--	3.81	--	--	--	--	0.03	6.76	77.4	--	19.77	8.16
MW-114	05/09/18	--	--	2.8	--	--	--	--	0.11	7.3	171.3	--	14.92	66.34
	05/22/18	--	--	2.92	--	--	--	--	0.11	7.24	173	--	15.49	112.65
	09/12/18	--	--	2.28	--	--	--	--	0.01	7.12	67.4	--	16.51	38.15
MW-115	05/09/18	--	--	2.68	--	--	--	--	0.56	7.13	202.2	--	13.95	406
	05/22/18	--	--	2.95	--	--	--	--	0.15	6.75	171.5	--	14.27	223.89
	09/13/18	--	--	2.81	--	--	--	--	0.1	6.79	89.7	--	17.55	174.98
MW-116	05/08/18	--	--	2.15	--	--	--	--	0.63	7.07	119.5	--	13.9	225.38
	09/12/18	--	--	2.08	--	--	--	--	0.56	7.07	76.7	--	16.23	110.87
MW-117	05/10/18	--	--	2.71	--	--	--	--	0.12	7.26	(99.80)	--	12.73	368.19
	09/13/18	--	--	--	--	--	--	--	--	6.93	--	--	--	--
	09/14/18	--	--	3.93	--	--	--	--	0.02	--	(191.80)	--	14.84	85.01
MW-118	05/10/18	--	--	2.94	--	--	--	--	1.22	7.06	(82.70)	--	15.32	133.92
	09/14/18	--	--	4.07	--	--	--	--	1.06	6.72	10.1	--	15.84	19.17
MW-119	05/10/18	--	--	3	--	--	--	--	0.26	7.01	20.4	--	24.91	25.52
	09/14/18	--	--	4.37	--	--	--	--	0.28	7.01	229.1	--	15.28	12.72
MW-120	05/07/18	--	--	3.3	--	--	--	--	7.32	7.32	184.5	--	11.92	386.03
	09/14/18	--	--	3.15	--	--	--	--	1.59	7.07	231.6	--	14.71	37.13
MW-121	05/10/18	--	--	4.89	--	--	--	--	4.89	6.98	(66.90)	--	10.76	39.68
	09/14/18	--	--	5.54	--	--	--	--	0.42	6.78	103.8	--	15.23	6.26
MW-122	05/11/18	--	--	4.84	--	--	--	--	3.19	7.09	189	--	10.32	226
	09/14/18	--	--	5.37	--	--	--	--	0.47	6.93	153.8	--	13.85	62.77
MW-123	05/08/18	--	--	3.39	--	--	--	--	0.51	7.07	186.3	--	17.65	399.77
	09/11/18	--	--	3.04	--	--	--	--	0.27	7.1	228.4	--	16.19	635.58
MW-124	05/07/18	--	--	2.78	--	--	--	--	0.19	7.15	203.6	--	13.97	6.42
	09/12/18	--	--	2.96	--	--	--	--	0.15	6.91	206.6	--	15.52	422.87
MW-125	05/10/18	--	--	3.07	--	--	--	--	0.09	7.11	8.4	--	12.22	367.91
	09/11/18	--	--	2.55	--	--	--	--	0.02	7.03	(14.30)	--	15	44.74
MW-126	05/11/18	--	--	4.41	--	--	--	--	5.04	11.67	(270.30)	--	12.77	22.66
	09/10/18	--	--	3.06	--	--	--	--	0.46	10.42	(260.70)	--	16.77	855.97
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
JB - Estimated concentration due to blank contamination
DEQ - Montana Department of Environmental Quality
MNA - Monitored natural attenuation
RBCA - Risk-based Corrective Action
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REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Carbon (mg/L)	Chloride (mg/L)	Specific Conductance Fi (mS/cm)	Ethane (εg/L)	Ethylene (εg/L)	Methane (εg/L)	Nitrogen, Nitrate & Nitrite (mg/L)	Oxygen, Dissolved (mg/L)	pH (Std Units)	Oxidation-Reduction Pote (mV)	Sulfate (mg/L)	Temperature (oC)	Turbidity (NTU)
MW-127	05/12/18	--	--	2.78	--	--	--	--	0.89	8.25	190.7	--	13.72	5700.8
	09/10/18	--	--	6.49	--	--	--	--	0.23	8.15	(84.40)	--	16.73	48.61
MW-128	05/09/18	--	90.5	3.07	5.8 J-	4.1 J-	17 J-	7.7 J+	0.08	7.14	(24.60)	1250	12.26	41.1
	05/22/18	--	--	3.47	--	--	--	--	0.12	7	196	--	14.19	171.01
	09/11/18	--	--	2.67	--	--	--	--	0.06	7.03	0.7	--	15.31	108.68
	09/14/18	--	91.5	3.15	<10	<10	<10	6.7	0.06	7.05	166.6	1090	14.56	20.82
MW-128 Dup	05/09/18	--	90.6	--	5.4 J-	3.9 J-	15.6 J-	7.3 J+	--	--	--	1230	--	--
MW-129	05/23/18	--	--	2.83	--	--	--	--	0.13	7.11	(393.00)	--	12.7	323
	09/11/18	--	--	2.66	--	--	--	--	0.23	7.12	98.1	--	15.59	0.34
	09/14/18	--	--	2.69	--	--	--	--	0.08	7.07	3.3	--	13.47	59.76
MW-130	05/23/18	--	--	1.05	--	--	--	--	8.09	7.47	209.5	--	11.78	44.94
	09/12/18	--	--	1.07	--	--	--	--	4.87	7.33	200.7	--	15.65	32.87
MW-132	05/23/18	--	--	2.74	--	--	--	--	0.61	6.99	(258.80)	--	11.44	158.83
	09/13/18	--	--	2.89	--	--	--	--	0.69	6.91	72.4	--	16.48	125.02
MW-133	05/23/18	--	--	3.3	--	--	--	--	0.25	7.14	241.5	--	12.42	179.58
	09/13/18	--	--	3.32	--	--	--	--	0.53	6.66	63.7	--	16.66	46.23
MW-134	05/23/18	--	--	2.41	--	--	--	--	0.24	7.2	(285.90)	--	12.06	160.58
	09/13/18	--	--	2.42	--	--	--	--	0.08	7.02	57.4	--	18.46	58.11
MW-135	05/23/18	--	--	2.95	--	--	--	--	0.25	7.04	(91.60)	--	13.38	78.62
	09/13/18	--	--	3.32	--	--	--	--	0.53	6.88	63.7	--	16.66	46.23
	09/14/18	--	--	2.64	--	--	--	--	0.1	6.97	243.7	--	12.34	72.09
PAI-WEST	09/15/18	--	--	2.24	--	--	--	--	0.22	7.86	(219.80)	--	16.4	4.58
PEP07	07/31/17	--	--	2.23	--	--	--	--	0.3	7.06	118	--	17.44	39.31
	05/11/18	--	--	2.99	--	--	--	--	1.24	7.15	222	--	12.07	29.24
	09/14/18	--	--	3	--	--	--	--	0.2	6.61	(50.30)	--	15.37	13.05
RH-MW-1	07/30/17	--	--	2.19	--	--	--	--	0.33	6.83	177.1	--	16.4	47.3
	05/09/18	--	--	2.27	--	--	--	--	0.11	7.17	173.7	--	15.76	24.46
	05/22/18	--	--	2.42	--	--	--	--	0.1	7.11	226.7	--	14.82	9.92
	09/12/18	--	--	2.29	--	--	--	--	0.03	7	90.4	--	16.14	4.51
RH-MW-3	07/28/17	<0.84	158	2.28	<10	<10	<10	2.1	0.55	6.87	124.4	645	15.61	45.8
	05/09/18	--	110	1.93	<10 UJ	<10 UJ	2.1J/ND(10)U*	0.89 J+	2.91	6.7	202.4	434	12.98	62.73
	05/22/18	--	--	2.21	--	--	--	--	2.9	7	240.3	--	12.13	9.92
	09/12/18	--	131	--	<10	<10	<10	1.9	--	--	--	483	--	--
RH-MW-7	07/30/17	--	--	1.44	--	--	--	--	3.4	6.95	107.6	--	17.69	46.91
	05/09/18	--	--	2.96	--	--	--	--	2.64	6.98	194	--	12.56	9.89
	05/22/18	--	--	3.29	--	--	--	--	2.71	6.99	228.2	--	13.23	17.27
	09/12/18	--	--	2.86	--	--	--	--	1.95	6.91	106.6	--	16.58	8.73
SD-I-01	08/01/17	1.3	96.9	2.52	<10	<10	<10	8.2	0.29	7.04	30.2	1070	16.3	75.91
	05/08/18	--	118	2.75	<10	<10	<10	7 J+	0.11	7.11	72.5	1000	14.03	101
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Carbon (mg/L)	Chloride (mg/L)	Specific Conductance Fi (mS/cm)	Ethane (εg/L)	Ethylene (εg/L)	Methane (εg/L)	Nitrogen, Nitrate & Nitrite (mg/L)	Oxygen, Dissolved (mg/L)	pH (Std Units)	Oxidation-Reduction Pote (mV)	Sulfate (mg/L)	Temperature (oC)	Turbidity (NTU)
SD-I-01	09/12/18	--	110	2.84	<10	<10	<10	7.5	0.46	7.02	50.7	1050	17.39	41.45
SD-I-02	08/01/17	--	--	2.26	--	--	--	--	4.02	7.02	133.7	--	18.52	1330.6
	05/08/18	--	--	2.16	--	--	--	--	0.19	7.82	(57.00)	--	13.74	76.18
	09/12/18	--	--	2.53	--	--	--	--	0.13	6.97	153.1	--	16.57	10.95
SMW12	07/31/17	--	--	1.29	--	--	--	--	6.13	6.77	111.7	--	14.95	198.11
	05/11/18	--	--	1.69	--	--	--	--	4.77	7.15	(2.40)	--	10.87	151
	09/11/18	--	--	1.43	--	--	--	--	4.17	7.05	1.1	--	15.31	91.34
Whiteley MW-1	07/30/17	--	--	1.39	--	--	--	--	3.23	7.2	(94.40)	--	18.29	6.24
Whiteley MW-2	07/30/17	--	--	3.22	--	--	--	--	1.84	6.71	59.9	--	18.66	7.46
ZPMW-1	08/01/17	--	--	1.97	--	--	--	--	0.83	6.87	45.4	--	16.24	175.93
	05/09/18	--	--	2.25	--	--	--	--	2.86	7.14	71.7	--	12.91	133.29
	05/22/18	--	--	2.76	--	--	--	--	0.15	6.74	167.2	--	14.75	53.03
	09/12/18	--	--	2.57	--	--	--	--	0.07	6.79	204.8	--	15.89	7.35
DEQ-7 GROUNDWATER STANDARD		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DEQ RBCA RBSLs GROUNDWATER		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
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J- - Estimated concentration, possibly biased low
J - Estimated concentration
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
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TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	Bromo- dichloro- methane (ug/L)	Acetone (ug/L)	Benzene (ug/L)	sec- Butylbenzene (ug/L)	C5-C8, Aliphatic, Unadjusted (ug/L)	C5-C8, Aliphatic, Adjusted (ug/L)	C9-C10, Aromatic, Unadju (ug/L)
BPGW04	07/27/17	ND(1)	21.8/ND(21.8)U*	ND(1)	ND(1)	50.6 JB	50.6	25.1
BPGW04P	07/27/17	ND(1)	ND(80)	ND(1)	ND(1)	--	--	--
EMW-03	07/28/17	ND(1)	92.5/ND(92.5)U*	ND(1)	ND(1)	ND(20)	ND(20)	ND(20)
EMW-03P	07/28/17	ND(1)	63.4/ND(63.4)U*	ND(1)	ND(1)	--	--	--
EMW-11	07/26/17	ND(1)	65.8	ND(1)	ND(1)	--	--	--
EMW-11P	07/26/17	ND(1)	ND(80)	ND(1)	ND(1)	--	--	--
EMW-15	07/31/17	ND(1)	72.1	3.8 J	1.7	216 J	212 J	ND(20) UJ
EMW-15P	07/31/17	ND(1)	117	2.8	1.6	--	--	--
EMW-21	07/28/17	ND(1)	62.5/ND(62.5)U*	ND(1)	ND(1)	ND(20)	ND(20)	ND(20)
EMW-21P	07/28/17	ND(1)	74.7/ND(74.7)U*	ND(1)	ND(1)	--	--	--
RH-MW-3	07/28/17	ND(1)	59.1/ND(59.1)U*	ND(1)	ND(1)	28.8 J+	28.8 J+	ND(20)
RH-MW-3P	07/28/17	ND(1)	97.1/ND(97.1)U*	ND(1)	ND(1)	--	--	--

Notes:
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	C9-C12, Aliphatic, Unadju (ug/L)	C11-C22, Aromatic, Unadju (ug/L)	Chloroform (ug/L)	Chloromethane (ug/L)	cis-1,2- Dichloro-ethene (ug/L)	trans-1,2- Dichloro- ethene (ug/L)	n-Propyl-benzene (ug/L)
BPGW04	07/27/17	34.8	--	4.5	ND(4) UJ	ND(1)	ND(1)	1.3
BPGW04P	07/27/17	--	--	5.4	ND(4)	ND(1)	ND(1)	ND(1)
EMW-03	07/28/17	ND(20)	--	ND(1)	4.7	ND(1)	ND(1)	ND(1)
EMW-03P	07/28/17	--	--	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)
EMW-11	07/26/17	--	--	ND(1)	ND(4) UJ	175	ND(1)	ND(1)
EMW-11P	07/26/17	--	--	ND(1)	ND(4)	124 J+	ND(1)	ND(1)
EMW-15	07/31/17	24.9 J	--	ND(1)	ND(4)	119	ND(1)	ND(1)
EMW-15P	07/31/17	--	--	ND(1)	ND(4)	104	ND(1)	ND(1)
EMW-21	07/28/17	ND(20)	237	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)
EMW-21P	07/28/17	--	--	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)
RH-MW-3	07/28/17	ND(20)	--	ND(1)	ND(4)	31.6	1.1	ND(1)
RH-MW-3P	07/28/17	--	--	ND(1)	ND(4)	32.8	ND(1)	ND(1)

Notes:
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	Tetrachloro-ethene (ug/L)	Total Purgeable Hydrocarbon (ug/L)	Trichloro- ethene (ug/L)	Vinyl Chloride (ug/L)	Allyl Chloride (ug/L)	Bromo- benzene (ug/L)	Bromo- chloro-methane (ug/L)
BPGW04	07/27/17	4.1	87.1	ND(0.4)	ND(0.2)	ND(4)	ND(1)	ND(1)
BPGW04P	07/27/17	4.9	--	ND(0.4)	ND(0.2)	ND(4)	ND(1)	ND(1)
EMW-03	07/28/17	ND(4)	ND(20)	ND(0.4)	ND(0.2)	ND(4)	ND(1)	ND(1)
EMW-03P	07/28/17	ND(4)	--	ND(0.4)	ND(0.2)	ND(4)	ND(1)	ND(1)
EMW-11	07/26/17	14.2	--	126	ND(0.2)	ND(4)	ND(1)	ND(1)
EMW-11P	07/26/17	35.2	--	165	ND(0.2)	ND(4)	ND(1)	ND(1)
EMW-15	07/31/17	136	222 J	107	0.54	ND(4)	ND(1)	ND(1)
EMW-15P	07/31/17	132	--	92.9	0.52	ND(4)	ND(1)	ND(1)
EMW-21	07/28/17	ND(1)	ND(20)	ND(0.4)	ND(0.2)	ND(4)	ND(1)	ND(1)
EMW-21P	07/28/17	ND(1)	--	ND(0.4)	ND(0.2)	ND(4)	ND(1)	ND(1)
RH-MW-3	07/28/17	29.2	25.5 J+	11.2	ND(0.2)	ND(4)	ND(1)	ND(1)
RH-MW-3P	07/28/17	30.4	--	10.5	ND(0.2)	ND(4)	ND(1)	ND(1)

Notes:
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TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	Bromoform (ug/L)	Bromo- methane (ug/L)	2-Butanone (ug/L)	n-Butyl- benzene (ug/L)	tert-Butyl- benzene (ug/L)	C9-C12, Aliphatic, Adjuste (ug/L)	C9-C18, Aliphatic, Unadju (ug/L)
BPGW04	07/27/17	ND(4)	ND(4) UJ	ND(5)	ND(1)	ND(1)	ND(20)	--
BPGW04P	07/27/17	ND(4)	ND(4)	ND(5)	ND(1)	ND(1)	--	--
EMW-03	07/28/17	ND(4)	ND(4)	ND(5)	ND(1)	ND(1)	ND(20)	--
EMW-03P	07/28/17	ND(4)	ND(4)	ND(5)	ND(1)	ND(1)	--	--
EMW-11	07/26/17	ND(4)	ND(4) UJ	ND(5)	ND(1)	ND(1)	--	--
EMW-11P	07/26/17	ND(4)	ND(4)	ND(5)	ND(1)	ND(1)	--	--
EMW-15	07/31/17	ND(4)	ND(4)	ND(5)	ND(1)	ND(1)	ND(20) UJ	--
EMW-15P	07/31/17	ND(4)	ND(4)	ND(5)	ND(1)	ND(1)	--	--
EMW-21	07/28/17	ND(4)	ND(4)	ND(5)	ND(1)	ND(1)	ND(20)	ND(210)
EMW-21P	07/28/17	ND(4)	ND(4)	ND(5)	ND(1)	ND(1)	--	--
RH-MW-3	07/28/17	ND(4)	ND(4)	ND(5)	ND(1)	ND(1)	ND(20)	--
RH-MW-3P	07/28/17	ND(4)	ND(4)	ND(5)	ND(1)	ND(1)	--	--

Notes:
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	C19-C36, Aliphatic, Unadju (ug/L)	Carbon tetrachloride (ug/L)	Chlorobenzene (ug/L)	Chloroethane (ug/L)	2-Chloro- toluene (ug/L)	4-Chloro- toluene (ug/L)	1,2-Dibromo 3-chloro- propane (ug/L)
BPGW04	07/27/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
BPGW04P	07/27/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
EMW-03	07/28/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
EMW-03P	07/28/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
EMW-11	07/26/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
EMW-11P	07/26/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
EMW-15	07/31/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
EMW-15P	07/31/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
EMW-21	07/28/17	ND(210)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
EMW-21P	07/28/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
RH-MW-3	07/28/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)
RH-MW-3P	07/28/17	--	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)

Notes:
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	Dibromo-chloromethane (ug/L)	1,2- Dibromo-ethane (ug/L)	Dibromomethane (ug/L)	1,2-Di- chloro-benzene (ug/L)	1,3-Di- chloro-benzene (ug/L)	1,4-Di- chloro-benzene (ug/L)	Dichloro- difluoro-methane (ug/L)
BPGW04	07/27/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
BPGW04P	07/27/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
EMW-03	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
EMW-03P	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
EMW-11	07/26/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
EMW-11P	07/26/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
EMW-15	07/31/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
EMW-15P	07/31/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
EMW-21	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
EMW-21P	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
RH-MW-3	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)
RH-MW-3P	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(1)

Notes:
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	1,1-Dichloro-ethane (ug/L)	1,2- Dichloro-ethane (ug/L)	1,1-Dichloro-ethene (ug/L)	Dichlorofluoromethane (ug/L)	1,2-Dichloro-propane (ug/L)	1,3-Dichloro-propane (ug/L)	2,2-Dichloro-propane (ug/L)
BPGW04	07/27/17	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
BPGW04P	07/27/17	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
EMW-03	07/28/17	ND(1)	ND(1) UJ	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
EMW-03P	07/28/17	ND(1)	ND(1) UJ	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
EMW-11	07/26/17	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
EMW-11P	07/26/17	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
EMW-15	07/31/17	ND(1)	ND(1) UJ	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
EMW-15P	07/31/17	ND(1)	ND(1) UJ	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
EMW-21	07/28/17	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
EMW-21P	07/28/17	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
RH-MW-3	07/28/17	ND(1)	ND(1) UJ	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)
RH-MW-3P	07/28/17	ND(1)	ND(1)	ND(1)	ND(1)	ND(4)	ND(1)	ND(4)

Notes:
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TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	1,1-Dichloro-propene (ug/L)	Cis-1,3- dichloro-propene (ug/L)	trans-1,3-Dichloro- propen (ug/L)	Diethyl ether (ug/L)	Ethyl- benzene (ug/L)	Hexachloro-butadiene (ug/L)	Isopropyl-benzene (ug/L)
BPGW04	07/27/17	ND(1)	ND(4)	ND(4)	ND(4)	ND(1)	ND(1)	ND(1)
BPGW04P	07/27/17	ND(1)	ND(4)	ND(4)	ND(4)	ND(1)	ND(1)	ND(1)
EMW-03	07/28/17	ND(1)	ND(4)	ND(4)	ND(4) UJ	ND(1)	ND(1)	ND(1)
EMW-03P	07/28/17	ND(1)	ND(4)	ND(4)	ND(4) UJ	ND(1)	ND(1)	ND(1)
EMW-11	07/26/17	ND(1)	ND(4)	ND(4)	ND(4)	ND(1)	ND(1)	ND(1)
EMW-11P	07/26/17	ND(1)	ND(4)	ND(4)	ND(4)	ND(1)	ND(1)	ND(1)
EMW-15	07/31/17	ND(1)	ND(4)	ND(4)	ND(4) UJ	ND(1)	ND(1)	ND(1)
EMW-15P	07/31/17	ND(1)	ND(4)	ND(4)	ND(4) UJ	ND(1)	ND(1)	ND(1)
EMW-21	07/28/17	ND(1)	ND(4)	ND(4)	ND(4)	ND(1)	ND(1)	ND(1)
EMW-21P	07/28/17	ND(1)	ND(4)	ND(4)	ND(4)	ND(1)	ND(1)	ND(1)
RH-MW-3	07/28/17	ND(1)	ND(4)	ND(4)	ND(4) UJ	ND(1)	ND(1)	ND(1)
RH-MW-3P	07/28/17	ND(1)	ND(4)	ND(4)	ND(4)	ND(1)	ND(1)	ND(1)

Notes:
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	p-Isopropyl-toluene (ug/L)	4-Methyl- 2-Pentanone (ug/L)	Methylene Chloride (ug/L)	MTBE (ug/L)	Naphthalene (ug/L)	Styrene (ug/L)	1,1,1,2-Tetrachloro- etha (ug/L)
BPGW04	07/27/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(5)	ND(4)	ND(1)
BPGW04P	07/27/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(4)	ND(1)	ND(1)
EMW-03	07/28/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(5)	ND(4)	ND(1)
EMW-03P	07/28/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(4)	ND(4)	ND(1)
EMW-11	07/26/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(4)	ND(4)	ND(1)
EMW-11P	07/26/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(4)	ND(1)	ND(1)
EMW-15	07/31/17	ND(1)	ND(5)	ND(4)	ND(1) UJ	ND(5) UJ	ND(4)	ND(1)
EMW-15P	07/31/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(4)	ND(4)	ND(1)
EMW-21	07/28/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(5)	ND(1)	ND(1)
EMW-21P	07/28/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(4)	ND(1)	ND(1)
RH-MW-3	07/28/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(5)	ND(4)	ND(1)
RH-MW-3P	07/28/17	ND(1)	ND(5)	ND(4)	ND(1)	ND(4)	ND(1)	ND(1)

Notes:
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	1,1,2,2-Tetrachloro- etha (ug/L)	Tetrahydrofuran (ug/L)	Toluene (ug/L)	Total Extractable Hydrocarbon (ug/L)	1,2,3- Trichloro-benzene (ug/L)	1,2,4- Trichloro-benzene (ug/L)	1,1,1- Trichloro-ethane (ug/L)
BPGW04	07/27/17	ND(1)	ND(10)	ND(1)	ND(196)	ND(1)	ND(1)	ND(1)
BPGW04P	07/27/17	ND(1)	ND(10)	ND(1)	--	ND(1)	ND(1)	ND(1)
EMW-03	07/28/17	ND(1)	ND(10)	ND(1)	ND(212)	ND(1)	ND(1)	ND(1)
EMW-03P	07/28/17	ND(1)	ND(10)	ND(1)	--	ND(1)	ND(1)	ND(1)
EMW-11	07/26/17	ND(1)	ND(10)	ND(1)	--	ND(1)	ND(1)	ND(1)
EMW-11P	07/26/17	ND(1)	ND(10)	ND(1)	--	ND(1)	ND(1)	ND(1)
EMW-15	07/31/17	ND(1)	ND(10)	ND(1)	ND(209)	ND(1)	ND(1)	ND(1)
EMW-15P	07/31/17	ND(1)	ND(10)	ND(1)	--	ND(1)	ND(1)	ND(1)
EMW-21	07/28/17	ND(1)	ND(10)	ND(1)	ND(629)	ND(1)	ND(1)	ND(1)
EMW-21P	07/28/17	ND(1)	ND(10)	ND(1)	--	ND(1)	ND(1)	ND(1)
RH-MW-3	07/28/17	ND(1)	ND(10)	ND(1)	ND(205)	ND(1)	ND(1)	ND(1)
RH-MW-3P	07/28/17	ND(1)	ND(10)	ND(1)	--	ND(1)	ND(1)	ND(1)

Notes:
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	1,1,2- Trichloro-ethane (ug/L)	Trichloro-fluoromethane (ug/L)	1,2,3- Trichloro-propane (ug/L)	1,1,2- Trichloro-trifluoro- ethane (ug/L)	1,2,4- Trimethyl-benzene (ug/L)	1,3,5-Trimethyl-benzene (ug/L)	m,p-Xylene (ug/L)
BPGW04	07/27/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
BPGW04P	07/27/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
EMW-03	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
EMW-03P	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
EMW-11	07/26/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
EMW-11P	07/26/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
EMW-15	07/31/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
EMW-15P	07/31/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
EMW-21	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
EMW-21P	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
RH-MW-3	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)
RH-MW-3P	07/28/17	ND(1)	ND(1)	ND(4)	ND(1)	ND(1)	ND(1)	ND(2)

Notes:
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TABLE 9-7. PERISTALTIC AND BLADDER PUMP COMPARISON RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	o-Xylene (ug/L)	Xylenes, Total (ug/L)
BPGW04	07/27/17	ND(1)	ND(3)
BPGW04P	07/27/17	ND(1)	ND(3)
EMW-03	07/28/17	ND(1)	ND(3)
EMW-03P	07/28/17	ND(1)	ND(3)
EMW-11	07/26/17	ND(1)	ND(3)
EMW-11P	07/26/17	ND(1)	ND(3)
EMW-15	07/31/17	ND(1)	ND(3)
EMW-15P	07/31/17	ND(1)	ND(3)
EMW-21	07/28/17	ND(1)	ND(3)
EMW-21P	07/28/17	ND(1)	ND(3)
RH-MW-3	07/28/17	ND(1)	ND(3)
RH-MW-3P	07/28/17	ND(1)	ND(3)

Notes:
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TABLE 9-8. PERISTALTIC AND BLADDER PUMP RPD CALCULATIONS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Location ID	Date Sampled	Acetone (ug/L)	RPD	Benzene (ug/L)	RPD	sec-Butylbenzene (ug/L)	RPD	Chloroform (ug/L)	RPD	cis-1,2-Dichloro-ethene (ug/L)	RPD	PCE (ug/L)	RPD	TCE (ug/L)	RPD	Vinyl Chloride (ug/L)	RPD
BPGW04	07/27/17	21.8/ND(21.8)U*		ND(0.5)		ND(1)		4.5	-18%	ND(1)		4.1	-18%	ND(0.4)		ND(0.2)	
BPGW04P	07/27/17	ND(80)		ND(1)		ND(1)		5.4		ND(1)		4.9		ND(0.4)		ND(0.2)	
EMW-03	07/28/17	92.5/ND(92.5)U*		ND(1)		ND(1)		ND(1)		ND(1)		ND(4)		ND(0.4)		ND(0.2)	
EMW-03P	07/28/17	63.4/ND(63.4)U*		ND(1)		ND(1)		ND(1)		ND(1)		ND(4)		ND(0.4)		ND(0.2)	
EMW-11	07/26/17	65.8		ND(1)		ND(1)		ND(1)		175	34%	14.2	-85%	126	-27%	ND(0.2)	
EMW-11P	07/26/17	ND(80)		ND(1)		ND(1)		ND(1)		124		35.2		165		ND(0.2)	
EMW-15	07/31/17	72.1	-47%	3.8	30%	1.7	6%	ND(1)		119	13%	136	3%	107	14%	0.54	4%
EMW-15P	07/31/17	117		2.8		1.6		ND(1)		104		132		92.9		0.52	
RH-MW-3	07/28/17	59.1/ND(59.1)U*		ND(1)		ND(1)		ND(1)		31.6	-4%	29.2	-4%	11.2	6%	ND(0.2)	
RH-MW-3P	07/28/17	97.1/ND(97.1)U*		ND(1)		ND(1)		ND(1)		32.8		30.4		10.5		ND(0.2)	

Notes:

RPD - relative percent difference

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	2018 Sample IDs	Nearest Identified Potential PCE Source	Building Type	Building Construction	VI Pathway Concerns with Building Construction	Nearest Groundwater Monitoring Well[c]	Nearest Well May 2018 [PCE] Concentration (ug/L)	Recent Depth to Groundwater at Nearest Well (approximate ft btoc)	Sampled Previously by EPA	2018 Indoor Air [PCE] ug/m3	2018 Subslab Vapor [PCE] ug/m3	Indoor Air > Screening Levels[a]	Indoor Air Detection Limit > Screening Levels[b]	Indoor Air Main Level > Indoor Air Upper Level	Indoor Air Lower Level > Indoor Air Main Level	Sub-slab > Indoor Air Lower Level	Sub-slab > Indoor Air Main Level	Potential Indoor Air Sources	Comparison to Applicable Ambient Air Samples ($\mu g/m^3$)	Other Potential Underground Sources	Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence	Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination
120 Wyoming Avenue	**BPIA142_120 Wyoming Ave (2010), BPSS142_120 Wyoming Ave (2010), 120 Wyoming Ave_2nd Floor (2018), 120 Wyoming Ave_Main (2018), 120 Wyoming Ave_Basement (2018), 120 Wyoming Ave_Subslab (2018)**	**Big Sky Linen - property is north of Broadwater Ave on the northern edge of the groundwater plume**	**Residential - Single family home**	**Wood construction bungalow built in 1917. Two story living space with basement for storage beneath main floor. EPA previously installed sub-slab port in storage basement. Poured concrete basement.**	**None noted/observed, utilities appear sealed as they enter/leave basement. Furnace near sub-slab port.**	**BPGP86, 280 feet southwest**	**258**	**10.82**	**Yes**	**12.3 (Main), 12.4 (2nd floor), 12.9 (Basement)**	**10,700**	**PCE, TCE, 1,2-DCA, 1,2,4-trimethylbenzene, benzene, bromodichloromethane, carbon tetrachloride, chloroform, naphthalene, isopropanol**	**1,1,2,2-tetrachloroethane, benzylchloride, bromomethane, 2-hexanone**	**TCE, isopropanol**	**PCE, carbon tetrachloride, dichlorodifluoromethane**	**PCE, TCE, 1,2-DCA, bromodichloromethane, chloroform, dichlorodifluoromethane**	**PCE, TCE, 1,2-DCA, bromodichloromethane, carbon tetrachloride, chloroform, dichlorodifluoromethane**	**None observed. Non-smoking residence.**	**Sampling Date: 3/6/2018 AA-01: benzene (1.1); chloroform (0.14) AA-02: -- Non-Detect MDL Exceedances***	**Nearest LUST site approximately 200-ft up gradient via groundwater direction.**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**The VI pathway appears to be complete for PCE, bromodichloromethane, and chloroform. The pathway may also be complete for TCE and 1,2-DCA. PCE was detected in the subslab at 10,700 ug/m3.**
1020 Cook Avenue	1020 Cook Ave_Crawlspace East, 1020 Cook Ave_Crawlspace West, 1020 Cook Ave_Main East Wing, 1020 Cook Ave_Main West Wing	Former Central Avenue Laundry - property is northeast of Former Central Avenue Laundry and northwest of Central Park	Commercial - Daycare building	Wood construction commercial building, completed in 2007. Single story building over full crawlspace with vapor barrier.	None noted/observed. Crawlspace appears to have a complete vapor barrier.	SD-I-02, 110 feet south	7	8.84	No	0.13, 0.14 (main floor); 0.33, 0.24 (crawlspace)	--	1,1,2,2-tetrachloroethane, bromodichloromethane, carbon tetrachloride, chloroform, isopropanol, TCE	benzylchloride, bromomethane, 2-hexanone,	Single story structure	TCE, 1,1,2,2-tetrachloroethane	Crawlspace - no slab	Crawlspace - no slab	None observed. Non-smoking commercial building.	Sampling Date: 2/8/2018 AA-01: benzene (0.67); carbon tetrachloride (0.51) AA-02: benzene (0.93); carbon tetrachloride (0.49); isopropanol (46.1) Non-Detect MDL Exceedances*	Nearest LUST facility 1,400 ft upgradient	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	Pathway complete only for one compound exceeding screening levels (carbon tetrachloride), but only for one crawlspace sample. Highest concentration found in main floor air is greater than highest concentration found in crawlspace air, suggesting non-VI related sources. Ambient air concentrations were higher than one crawlspace sample, and approximately equivalent to indoor air concentrations. Other screening level exceedances are higher in main floor air than crawlspace air. Two additional compounds (dichlorofluoromethane and PCE) have crawlspace concentrations that are higher than main floor air, but are less than an order of magnitude in difference, and do not exceed indoor air screening levels. VI may be occurring at this structure, but at concentrations below indoor air screening levels.
104 Custer Avenue	**104 Custer Ave_Basement, 104 Custer Ave_Main, 104 Custer Ave_Subslab**	**Big Sky Linen - property is south of Broadwater Ave along the axis of the groundwater plume, roughly 0.9 miles downgradient of Big Sky Linen**	**Residential - Single family home**	**Wood construction bungalow built in 1915. Single story living space with basement for storage. EPA previously sampled but did not install subslab port. Subslab port installed. Poured concrete floor. Detached garage.**	**Crawlspace is open to basement, basement concrete contains cracks**	**BPGP94, 360 feet northeast**	**90.2**	**11.69**	**Yes**	**2.3**	**3,520**	**1,3-butadiene, benzene, chloroform, TCE**	**1,1,2,2-tetrachloroethane, 1,2-DCA, 1,2-dichloropropane, 1,3-butadiene benzylchloride, bromodichloromethane, carbon tetrachloride, chloroform, TCE, VC, bromomethane, 2-hexanone**	**Single story structure**	**No**	**acetone, chloroform, hexane, PCE, toluene, TCE**	**PCE**	**Yes. Gas power chainsaws & blowers, pesticides, oils in basement.**	**Sampling Date: 2/8/2018 AA-01: benzene (0.67); carbon tetrachloride (0.51) AA-02: benzene (0.93); carbon tetrachloride (0.49); isopropanol (46.1) Non-Detect MDL Exceedances***	**Nearest LUST facility 1,900 ft upgradient**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**Pathway complete for chloroform and TCE. Other detected screening level exceedances in indoor air are greater than their concentrations in subslab air. PCE in the subslab is higher in concentration by several orders of magnitude than PCE in basement or main floor air, suggesting that VI of PCE may be occurring, but at levels below indoor air screening levels.**

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	**2018 Sample IDs**	**Nearest Identified Potential PCE Source**	**Building Type**	**Building Construction**	**VI Pathway Concerns with Building Construction**	**Nearest Groundwater Monitoring Well[c]**	**Nearest Well May 2018 [PCE] Concentration (ug/L)**	**Recent Depth to Groundwater at Nearest Well (approximate ft btoc)**	**Sampled Previously by EPA**	**2018 Indoor Air [PCE] ug/m3**	**2018 Subslab Vapor [PCE] ug/m3**	**Indoor Air > Screening Levels[a]**	**Indoor Air Detection Limit > Screening Levels[b]**	**Indoor Air Main Level > Indoor Air Upper Level**	**Indoor Air Lower Level > Indoor Air Main Level**	**Sub-slab > Indoor Air Lower Level**	**Sub-slab > Indoor Air Main Level**	**Potential Indoor Air Sources**	**Comparison to Applicable Ambient Air Samples (µg/m^3)**	**Other Potential Underground Sources**	**Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence**	**Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination**
1044 Cook Avenue	1044 Cook Ave_Basement Boiler,1044 Cook Ave_Crawlspace East, 1044 Cook Ave_Crawlspace West, 1044 Cook Ave_Main Annex, 1044 Cook Ave_Main East Wing, 1044 Cook Ave_Main West Wing, 1044 Cook Ave_Subslab Annex	Former Central Avenue Laundry - property is northeast of Former Central Avenue Laundry	Public School	Brick school building constructed in 1948, 6,900 sq. ft. with crawlspaces throughout, with the exception of a boiler/utility basement room. Annex building is newer, approximately 800 square feet of slab on grade.	None noted/observed.	SD-I-02, 80 feet east	7	8.84	No	0.21 (annex), 0.2 (east wing), 0.12 (west wing)	107	C9-C12 aliphatics, carbon tetrachloride, chloroform, hexachlorobutadiene, isopropanol	1,1,2,2-tetrachloroethane, benzylchloride, bromodichloromethane, bromomethane, 2-hexanone	Single story structure	acetone, carbon tetrachloride, dichlorodifluoromethane, PCE, trichloroethene (comparison of indoor air to crawlspace)	Single story - no lower level above a slab. Subslab collected from annex building without crawlspace.	acetone, C9-C12 aliphatics, PCE	Schools frequently use hand sanitizers, which can contain isopropanol	Sampling Date: 2/11/2018 AA-01: benzene (0.87); carbon tetrachloride (0.48) AA-02: -- Non-Detect MDL Exceedances*	Nearest LUST facility 1,000 ft upgradient	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	Based on this initial sampling event, the vapor intrusion pathway may be complete for carbon tetrachloride. However, ambient air concentrations were greater than indoor air concentrations, and may be contributing to indoor air impacts. The majority of the exceedances in indoor air are higher than the sub-slab results. Carbon tetrachloride was detected in one crawlspace sample at a concentration roughly twice that of indoor air. PCE did not exceed the screening level in indoor air, and detection limits were below indoor air screening levels.
11 Custer Avenue	**11 Custer Ave_2nd Floor, 11 Custer Ave_Main, 11 Custer Ave_Basement, 11 Custer Ave_Subslab**	**Big Sky Linen - property is near Division street, located approximately 1 mile northeast of Big Sky Linen along the axis of the groundwater plume**	**Residential - Single family home**	**Wood construction old style, built in 1908. 5,000 sq. ft of living space, with 2,200 sq. ft of unfinished basement. EPA previously sampled indoor air and subslab vapor. Detached garage.**	**None noted/observed.**	**BPGP94, 180 feet southwest**	**90.2**	**11.69**	**Yes**	**1.5 (2nd floor), 1.4 (main floor), 2.6 (basement)**	**108,000**	**1,3-butadiene, benzene, carbon tetrachloride, chloroform, TCE**	**1,1,2,2-tetrachloroethane, benzylchloride, bromodichloromethane, bromomethane, 2-hexanone**	**Acetone, benzene, chloroform, cyclohexane, dichlorodifluoromethane, ethanol, heptane, toluene**	**carbon tetrachloride, PCE, TCE**	**acetone, chloroform, chloromethane, PCE, TCE**	**acetone, chloroform, chloromethane, PCE, TCE**	**None observed.**	**Sampling Date: 2/27/2018 AA-01: 1,3-butadiene (0.45); benzene (2.3); chloroform (0.14); ethylbenzene (1.4) AA-02: benzene (1.9); carbon tetrachloride (0.62); chloroform (0.14) Non-Detect MDL Exceedances***	**Nearest LUST facility is 2,200 ft upgradient.**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**Vapor intrusion pathway appears to be complete for chloroform and TCE. Chloroform appears to be present in ambient air in excess of residential screening levels, but at concentrations lower than those observed in indoor air. Vapor intrusion appears to be occurring for PCE, but at concentrations below screening levels. PCE is significantly elevated in the subslab (108,000 ug/L).**
112 South 33rd Street	112 S 33rd St_Basement, 112 S 33rd St_Main (DUP), 112 S 33rd St_Subslab	Big Sky Linen - property is south of 1st Avenue South, on the southern boundary of the plume. Located approximately 1 .3 miles northeast of Big Sky Linen	Residential - Single family home	Wood construction Ranch style home built in 1910. Detached garage. Single story living space with full basement. Basement currently being remodeled and finished.	None noted/observed.	MW-110, 515 feet southeast	4.2	16.07	No	ND/1.3 (main/DUP), 0.59 (basement)	25,500	1,3-butadiene, benzene, carbon tetrachloride, chloroform, ethyl acetate	1,1,2,2-tetrachloroethane, 1,2-DCA, 1,2-dichloropropane, 1,3-butadiene, benzylchloride, bromodichloromethane, carbon tetrachloride, chloroform, TCE, vinyl chloride, bromomethane, 2-hexanone	Single story structure	1,3-butadiene	acetone, PCE	PCE, C5-C8 aliphatics, C9-C12 aliphatics	Smoking residence.	Sampling Date: 2/12/2018 AA-01: benzene (0.91); chloroform (0.13) AA-02: benzene (1.1); carbon tetrachloride (0.67); chloroform (0.13); methylene chloride (149) Non-Detect MDL Exceedances*	Nearest LUST facility is 200 ft cross gradient. Also located approximately 1,000 ft downgradient of active fueling facility also having LUST releases.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	Based upon the initial sampling event, the vapor intrusion pathway appears to be complete for 1,3-butadiene, in excess of indoor air screening levels. Although not detected in subslab vapor, it's presence may have been masked by elevated concentrations of other contaminants. PCE, C5-C8 aliphatics, and C9-C12 aliphatics were elevated in subslab vapor in comparison to generic screening levels, but were not observed in excess of screening levels in indoor air.

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Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	2018 Sample IDs	Nearest Identified Potential PCE Source	Building Type	Building Construction	VI Pathway Concerns with Building Construction	Nearest Groundwater Monitoring Well[c]	Nearest Well May 2018 [PCE] Concentration (ug/L)	Recent Depth to Groundwater at Nearest Well (approximate ft btoc)	Sampled Previously by EPA	2018 Indoor Air [PCE] ug/m3	2018 Subslab Vapor [PCE] ug/m3	Indoor Air > Screening Levels[a]	Indoor Air Detection Limit > Screening Levels[b]	Indoor Air Main Level > Indoor Air Upper Level	Indoor Air Lower Level > Indoor Air Main Level	Sub-slab > Indoor Air Lower Level	Sub-slab > Indoor Air Main Level	Potential Indoor Air Sources	Comparison to Applicable Ambient Air Samples ($\mu g/m^3$)	Other Potential Underground Sources	Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence	Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination
112 Wyoming Avenue	**112 Wyoming Ave_Basement, 112 Wyoming Ave_main, 112 Wyoming Ave_subslab**	**Big Sky Linen - property is north of Broadwater Ave along the northern edge of the groundwater plume boundary, roughly 0.9 miles downgradient of Big Sky Linen**	**Residential - Single family home**	**Wood construction bungalow built in 1905. 1.5 stories (partial attic, not sampled). Detached garage. Concrete poured basement, finished. EPA installed sample port previously.**	**None noted/observed.**	**BPGP86, 210 feet southeast**	**258**	**10.82**	**Yes**	**4.4 (basement) 4.8 (main)**	**6,510**	**PCE**	**1,1,2,2-tetrachloroethane, 1,2-DCA, 1,2-dichloropropane, 1,3-butadiene, benzylchloride, bromodichloromethane, bromomethane, carbon tetrachloride, chloroform, TCE, vinyl chloride, 2-hexanone**	**Unoccupiable attic not sampled**	**cyclohexane**	**PCE**	**2-butanone, dichlorodifluoro methane, PCE**	**None observed.**	**Sampling Date: 3/5/2018 AA-01: benzene (1.1); carbon tetrachloride (0.61); chloroform (0.21); methylene chloride (354); trichloroethene (0.26) AA-02: -- Non-Detect MDL Exceedances***	**Nearest LUST facility 2,300 ft up, and slightly cross-gradient.**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**Based upon initial sampling event, the vapor intrusion pathway appears to be complete for PCE. Concentrations in the subslab were 3 orders of magnitude greater than indoor air concentrations. Based upon elevated subslab concentrations, and elevated reporting limits in indoor air, TCE vapor intrusion cannot be eliminated at this time.**
1140 Lynn Avenue	1140 Lynn Ave_Main, 1140 Lynn Ave_Crawlspace	Former Central Avenue Laundry - property is northeast of Former Central Avenue Laundry	Residential - Single family home	Wood construction conventional home, built in 1955. 2 Stories with dirt crawlspace, containing no vapor barrier. Attached garage.	None noted/observed.	ZPMW-1, 230 feet southwest	44.4	9.71	No	0.28	--	1,1,2,2-tetrachloroethane, 1,3-butadiene, benzene, carbon tetrachloride, chloroform, dichlorodifluoromethane, ethylbenzene, TCE	1,1,2,2-tetrachloroethane, benzylchloride, bromomethane, 2-hexanone	Crawlspace structure, main floor and crawlspace sampled.	1,2,4-trimethylbenzene, benzene, cyclohexane, ethylbenzene, heptane, hexane, isopropanol, m&p-xylenes, o-xylene, PCE, toluene	Crawlspace - no slab	Crawlspace - no slab	None observed	Sampling Date: 2/27/2018 AA-01: 1,3-butadiene (0.45); benzene (2.3); chloroform (0.14); ethylbenzene (1.4) AA-02: benzene (1.9); carbon tetrachloride (0.62); chloroform (0.14) Non-Detect MDL Exceedances*	Nearest LUST facility 240 ft upgradient	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	Based upon initial sampling event, the VI pathway appears to be complete for benzene. Benzene was also observed in ambient air above screening levels, but at concentrations below those observed in indoor air. PCE concentrations did not exceed screening levels in indoor air, but were higher in crawlspace air than in the main floor. Dichlorodifluoromethane in crawlspace air is less than 1% different than indoor air concentrations. Based on relatively small difference, VI for dichlorodifluoromethane cannot be excluded at this time.The remaining indoor air exceedances do not appear to be attributable to vapor intrusion.
117 Custer Avenue	117 Custer Ave_Main, 117 Custer Ave_Basement/Crawlspace, 117 Custer Ave_Subslab, 117 Custer Ave_2nd Floor	Big Sky Linen - property is south of Broadwater Ave along the axis of the groundwater plume, roughly 0.9 miles downgradient of Big Sky Linen	Residential - Single family home	Wood construction bungalow built in 1905. 2 stories with complete basement and detached garage. Basement is open to crawlspace to the south end of building	Some cracks observed in concrete floor.	BPGP16, 410 feet southwest	155	11.12	Yes	3 (2nd floor), 2.4 (main floor), 2 (basement)	749	1,3-butadiene, benzene, chloroform, chloromethane	1,1,2,2-tetrachloroethane, 1,3-butadiene, benzylchloride, bromodichloromethane, bromomethane, TCE, 2-hexanone	acetone, benzene, carbon tetrachloride, chloroform, chloromethane, dichlorodifluoromethane, hexane, isopropanol, methylene chloride, toluene,	carbon tetrachloride, methylene chloride, hexane	acetone, chloroform, PCE	chloroform, PCE, TCE	Some solvents stored in basement area, including paints and paint thinners. Smoking residence.	Sampling Date: 2/9/2018 AA-01: 1,2-dichloroethane (0.12); benzene (1.5); carbon tetrachloride (0.58); chloroform (1.1) AA-02: benzene (1.2); carbon tetrachloride (0.5); chloroform (0.13) Non-Detect MDL Exceedances*	Nearest LUST facility is 2,100 ft upgradient.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway for chloroform appears to be complete, and concentrations of chloroform exceed screening levels in indoor air. However, chloroform was observed in ambient air at concentrations greater than those observed in indoor air, which may be indicative of an outside source of contamination. PCE was elevated in the subslab by 2 orders of magnitude compared to indoor air concentrations, but did not exceed indoor air screening levels. Vapor intrusion appears to be occurring for PCE, but at concentrations below screening levels.

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BILLINGS, MONTANA

Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	2018 Sample IDs	Nearest Identified Potential PCE Source	Building Type	Building Construction	VI Pathway Concerns with Building Construction	Nearest Groundwater Monitoring Well[c]	Nearest Well May 2018 [PCE] Concentration (ug/L)	Recent Depth to Groundwater at Nearest Well (approximate ft btoc)	Sampled Previously by EPA	2018 Indoor Air [PCE] ug/m3	2018 Subslab Vapor [PCE] ug/m3	Indoor Air > Screening Levels[a]	Indoor Air Detection Limit > Screening Levels[b]	Indoor Air Main Level > Indoor Air Upper Level	Indoor Air Lower Level > Indoor Air Main Level	Sub-slab > Indoor Air Lower Level	Sub-slab > Indoor Air Main Level	Potential Indoor Air Sources	Comparison to Applicable Ambient Air Samples ($\mu g/m^3$)	Other Potential Underground Sources	Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence	Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination
1246 Central Avenue	**1246 Central Ave_Main, 1246 Central Ave_Subslab**	**Located in Former Central Avenue Laundry building.**	**Commercial Smoking supply store**	**Cinderblock construction built in 1966. Concrete slab with wooden dividing walls to create separate commercial spaces. Single story, with commercial storage in the back, and electric heating.**	**Abandoned sump inlet in storage area near hot water heater**	**MW-102, 40 feet north**	**185**	**9.2**	**No**	**4.7**	**74,800**	**1,2-DCA, 1,2-dichloropropane, 1,3-butadiene, benzene, C5-C8 aliphatic, carbon tetrachloride, chloroform, ethyl acetate, methylene chloride, PCE, TCE**	**1,1,2,2-tetrachloroethane, benzylchloride, bromodichloromethane, bromomethane, 2-hexanone**	**Single story structure**	**Single story structure**	**Single story - no lower level above a slab.**	**acetone, isopropanol, PCE, TCE**	**Smoking and vaping shop, containing volatile mixtures, organic propellants, etc.**	**Sampling Date: 2/5/2018 AA-01: benzene (0.74) AA-02: benzene (0.76) Non-Detect MDL Exceedances***	**Nearest LUST facility is across the street at former J&S pioneer service station, approximately 200 ft northwest**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**Vapor intrusion pathway appears to be complete for PCE, and TCE. PCE present in subsurface vapor at 78,400 ug/m3. Due to elevated PCE concentration, reporting limits for C5-C8 aliphatics in subsurface vapor sample may be elevated, and C5-C8 aliphatics exceeded applicable screening levels in indoor air. Therefore, C5-C8 aliphatics VI cannot be excluded at this time.**
125 Broadwater Avenue	125 Broadwater Ave_Main, 125 Broadwater Ave_Crawlspace (DUP)	Big Sky Linen - property is located on northern edge of plume boundary, approximately 0.9 miles northeast of Big Sky Linen	Residential - Single family home	Single story wood construction bungalow built in 1920. Full height crawlspace with gravel floors, no vapor barrier, under 1/3 of the house, dirt crawlspace elsewhere.	None observed/noted.	BPGP25, 315 feet west	172	10.1	Yes. Crawlspace only in July 2007, crawlspace and Indoor air in Dec 2007.	2.1 (main), 3.7/2.0 (crawlspace/DUP)	--	1,1,2,2-tetrachloroethane, benzene, bromodichloromethane, carbon tetrachloride, chloroform, ethyl acetate, ethylbenzene, methylene chloride, isopropanol, naphthalene	1,1,2,2-tetrachloroethane, benzylchloride, bromomethane, 2-hexanone	Single story structure	acetone, carbon tetrachloride, dichlorodifluoromethane, hexane, PCE	Crawlspace - no slab	Crawlspace - no slab	None observed	Sampling Date: 3/1/2018 AA-01: 1,2-dichloroethane (0.12); benzene (1); carbon tetrachloride (0.65); chloroform (0.22); trichloroethene (1.2) AA-02: -- Non-Detect MDL Exceedances*	Nearest LUST facility is approximately 2,100 feet to the southeast	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	Vapor intrusion pathway may be complete for carbon tetrachloride; however, the crawlspace concentrations are only slightly higher than indoor air concentrations. Additionally, carbon tetrachloride was detected in ambient air at concentrations greater than those observed in indoor or crawlspace air, suggesting an outside source. PCE concentrations in the crawlspace were comparable to those concentrations found in indoor air, but did not exceed indoor air screening levels.
146 Terry Avenue	**146 Terry Ave_Basement/Crawlspace, 146 Terry Ave_Main, 146 Terry Ave_Subslab**	**Big Sky Linen - property is located within the main plume body, approximately 0.75 miles northeast of Big Sky Linen**	**Residential - Single family home**	**Single story wood construction bungalow built in 1922. Small unfinished basement furnace room with mostly concrete floors, but a small portion with dirt floors and open to the crawlspace.**	**Some cracks observed in concrete floor.**	**BPGP22, 325 feet southwest**	**65**	**10.49**	**Yes**	**1.4 (main), 0.54 (basement/crawlspace)**	**289**	**1,1,2,2-tetrachloroethane, carbon tetrachloride, chloroform, TCE**	**1,1,2,2-tetrachloroethane, benzylchloride, bromomethane, 2-hexanone**	**Single story structure**	**1,1,1-trichloroethane, 1,2-DCA, carbon tetrachloride, dichlorodifluoromethane, TCE,**	**1,1,1-trichloroethane, acetone, benzene, chloroform, chloromethane, hexane, PCE, toluene, TCE,**	**1,1,1-trichloroethane, acetone, benzene, chloroform, hexane, PCE, TCE**	**Smoking residence, solvents and paints stored in basement/crawlspace.**	**Sampling Date: 2/5/2018 AA-01: benzene (0.74) AA-02: benzene (0.76) Non-Detect MDL Exceedances***	**Nearest LUST facility is approximately 1,200 feet to the southwest, directly upgradient**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**It appears that the VI pathway may be complete for TCE. The VI pathway may also be complete for benzene and chloroform, but concentrations in basement/crawlspace air were not as high as indoor air. PCE was detected in subslab vapor at two orders of magnitude greater than screening levels. PCE VI may also be occurring, but at concentrations below indoor air screening levels.**

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	2018 Sample IDs	Nearest Identified Potential PCE Source	Building Type	Building Construction	VI Pathway Concerns with Building Construction	Nearest Groundwater Monitoring Well[c]	Nearest Well May 2018 [PCE] Concentration (ug/L)	Recent Depth to Groundwater at Nearest Well (approximate ft btoc)	Sampled Previously by EPA	2018 Indoor Air [PCE] ug/m3	2018 Subslab Vapor [PCE] ug/m3	Indoor Air > Screening Levels[a]	Indoor Air Detection Limit > Screening Levels[b]	Indoor Air Main Level > Indoor Air Upper Level	Indoor Air Lower Level > Indoor Air Main Level	Sub-slab > Indoor Air Lower Level	Sub-slab > Indoor Air Main Level	Potential Indoor Air Sources	Comparison to Applicable Ambient Air Samples ($\mu g/m^3$)	Other Potential Underground Sources	Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence	Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination
19 South Broadway (aka 19 S 28th Street)	**19 S Broadway_Main, 19 S Broadway_Subslab**	**Former Rex Cleaner's building**	**Commercial building, modified for automotive repair**	**Multipurpose retail structure. Brick and concrete block construction with wood joist on a concrete slab. Built in 1928, 2 partial floors of office space, attached to two separate bays of garage space for vehicle maintenance.**	**Many significant fissures in concrete and old ports/penetrations in concrete for historical utilities. Floor drains in bay areas.**	**MW-114, 150 feet east**	**24.9**	**14.12**	**No**	**223**	**583,000**	**benzene, PCE**	**1,1,2,2-tetrachloroethane, 1,2-DCA, 1,2-dichloropropane, 1,3-butadiene, benzylchloride, bromodichloromethane, carbon tetrachloride, chloroform, TCE, vinyl chloride, bromomethane, 2-hexanone**	**Single story structure**	**Single story structure**	**Single story - no lower level above a slab.**	**benzene, PCE**	**Former mechanic shop, potential residuals may affect indoor air sampling.**	**Sampling Date: 3/2/2018 AA-01: 1,2-dichloroethane (0.013); benzene (1); carbon tetrachloride (0.68); chloroform (0.26); trichloroethene (0.52) AA-02: 1,1,2,2-tetrachloroethane (0.32); 1,1,2-trichloroethane (0.22); 1,2-dibromoethane (0.16); 1,2-dichloroethane (0.16); benzene (1.1); bromodichloromethane (0.15); chloroform (0.23) Non-Detect MDL Exceedances***	**Nearest LUST facility is directly across the alley, across and slightly upgradient from the structure.**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**The vapor intrusion pathway appears to be complete for benzene and PCE. Benzene was detected in ambient air at concentrations slightly below those observed in indoor air. PCE was detected in the subslab vapor sample at 583,000 ug/m3. TCE was also present in the subslab at 8,680 ug/m3, and C5-C8 aliphatics at 5,090 ug/m3.**
201 South 37th Street	**201 S 37th St_Basement, 201 S 37th St_Crawlspace (DUP), 201 S 37th St_Main, 201 S 37th St_Subslab**	**Big Sky Linen - property is located along southern plume boundary, approximately 1.0 miles east, and slightly north, of Big Sky Linen.**	**Residential - Single family home**	**Wood construction ranch style home built in 1942. Finished basement under less than half of the house, with no carpeting in portions. Crawlspace under remainder of house. Unfinished detached garage.**	**Some cracks observed in concrete floor.**	**BMW-4, 520 feet west**	**54.4**	**14.92**	**No**	**0.48 (main), 0.46/0.65 (crawlspace/DUP), 0.49 (basement)**	**56.1**	**1,3-butadiene, benzene, bromodichloromethane, chloroform, TCE**	**1,1,2,2-tetrachloroethane, benzylchloride, bromodichloromethane, bromomethane, 2-hexanone**	**Single story structure**	**carbon tetrachloride, PCE**	**chloroform, dichlorodifluoromethane, PCE, TCE, vinyl acetate**	**chloroform, PCE**	**None observed.**	**Sampling Date: 2/28/2018 AA-01: benzene (1.7); chloroform (0.15) AA-02: benzene (1.9); carbon tetrachloride (0.54); chloroform (0.19) Non-Detect MDL Exceedances***	**Nearest LUST facility is approximately 1,000 ft upgradient, at Bair's Self Service.**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**The chloroform and TCE vapor intrusion pathways may be complete. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air. PCE was observed in the subslab vapor one order of magnitude above indoor air screening levels, and was detected in all indoor air samples, but at concentrations less than screening levels.**
202 South 38th Street	202 S 38th St_Main, 202 S 38th St_Basement, 202 S 38th_Subslab	Big Sky Linen - property is located along southern plume boundary, approximately 0.9 miles east, and slightly north, of Big Sky Linen.	Residential - Single family home	Wood construction bungalow built in 1934. Single story with partially finished basement, and detached garage.	None noted/observed	BMW-4, 140 feet south	54.4	14.92	No	0.28 (main), 0.32 (basement)	221	1,3-butadiene, benzene, bromodichloromethane, carbon tetrachloride, chloroform	1,1,2,2-tetrachloroethane, benzylchloride, bromomethane, 2-hexanone	Single story structure	acetone, cyclohexane, PCE	acetone, chloroform, dichlorodifluoromethane, PCE	acetone, chloroform, dichlorodifluoromethane, PCE	None observed.	Sampling Date: 2/28/2018 AA-01: benzene (1.7); chloroform (0.15) AA-02: benzene (1.9); carbon tetrachloride (0.54); chloroform (0.19) Non-Detect MDL Exceedances*	Nearest LUST Facility is approximately 600 ft east, and slightly upgradient at Bair's Self Service	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway may be complete for chloroform. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air. Other indoor air exceedances do not appear to be due to VI, and may be attributable to other indoor air sources. PCE was present in the subslab at two orders of magnitude above screening levels. The PCE VI pathway may be complete, but at concentrations less than indoor air screening levels.

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
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BILLINGS PCE GROUNDWATER FACILITY
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Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	**2018 Sample IDs**	**Nearest Identified Potential PCE Source**	**Building Type**	**Building Construction**	**VI Pathway Concerns with Building Construction**	**Nearest Groundwater Monitoring Well[c]**	**Nearest Well May 2018 [PCE] Concentration (ug/L)**	**Recent Depth to Groundwater at Nearest Well (approximate ft btoc)**	**Sampled Previously by EPA**	**2018 Indoor Air [PCE] ug/m3**	**2018 Subslab Vapor [PCE] ug/m3**	**Indoor Air > Screening Levels[a]**	**Indoor Air Detection Limit > Screening Levels[b]**	**Indoor Air Main Level > Indoor Air Upper Level**	**Indoor Air Lower Level > Indoor Air Main Level**	**Sub-slab > Indoor Air Lower Level**	**Sub-slab > Indoor Air Main Level**	**Potential Indoor Air Sources**	**Comparison to Applicable Ambient Air Samples ($\mu g/m^3$)**	**Other Potential Underground Sources**	**Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence**	**Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination**
209 Miles Avenue	**209 Miles Ave_Basement, 209 Miles Ave_Crawlspace, 209 Miles Ave_Main, 209 Miles Ave_Subslab**	**Big Sky Linen - property is located within the centerline of the plume, approximately 0.7 miles downgradient of Big Sky Linen**	**Residential - Single family home**	**Wood construction bungalow built in 1920. Concrete foundation with partial, unoccupied basement, connected to dirt crawlspace.**	**Concrete fractured in places, crawlspace in communication with basement air.**	**BPGP22, 170 feet southeast**	**65**	**10.49**	**Yes**	**1.9 (main), 4.6 (crawlspace), 2.5 (basement)**	**3,040**	**1,3-butadiene, bromodichloromethane, carbon tetrachloride, chloroform, PCE, TCE**	**1,1,2,2-tetrachloroethane, benzylchloride, bromodichloromehtne, bromomethane, 2-hexanone**	**Single story structure**	**benzene, cyclohexane, PCE, TCE**	**acetone, chloroform, ethanol, PCE, TCE**	**chloroform, ethanol, PCE, TCE**	**None observed**	**Sampling Date: 2/9/2018 AA-01: 1,2-dichloroethane (0.12); benzene (1.5); carbon tetrachloride (0.58); chloroform (1.1) AA-02: benzene (1.2); carbon tetrachloride (0.5); chloroform (0.13) Non-Detect MDL Exceedances***	**Nearest LUST Facility is approximately 300 feet south, slightly cross and upgradient.**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**The VI pathway for PCE and TCE may be complete. PCE concentrations only exceed indoor air screening levels in the crawlspace open to the basement. The VI pathway may also be complete for chloroform. Elevated C5-C8 aliphatics in subslab but were not observed in indoor air.**
237 Wyoming Avenue	237 Wyoming Ave_Basement, 237 Wyoming Ave_Crawlspace, 237 Wyoming Ave_Main (DUP), 237 Wyoming Ave_Subslab	Big Sky Linen - property is located on northern plume boundary, north of Broadwater Avenue approximately 0.8 miles northeast Big Sky Linen.	Residential - Single family home	Wood construction bungalow built in 1920. Concrete foundation with finished basement, and separated dirt crawlspace.	Water damage to concrete flooring and coatings.	BPGP31, 410 feet southwest	0.42	10.38	Yes	0.79/0.44 (main/DUP), 0.46 (basement), 0.63 (crawlspace)	554	1,2-DCA, bromodichloromethane, carbon tetrachloride, chloroform	1,1,2,2-tetrachloroethane, benzylchloride, bromomethane, 2-hexanone	Two story structure with occupied basement and main floor sampled only.	chloroform	acetone, bromodichloromethane, chloroform, PCE, TCE	acetone, bromodichloromethane, chloroform, PCE, TCE	None observed	Sampling Date: 2/5/2018 AA-01: benzene (0.74) AA-02: benzene (0.76) Non-Detect MDL Exceedances*	Nearest LUST Facility is located approximately 2,000 feet south.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway for chloroform appears to be complete, and concentrations of chloroform exceed screening levels in indoor air. PCE was elevated in the subslab by 3 orders of magnitude compared to indoor air concentrations, but did not exceed indoor air screening levels. The VI pathway may also be complete for bromodichloromethane.
26 South 24th Street	**26 S 24th St_Shop (DUP), 26 S 24th St_Subslab**	**Rex Cleaners - Property is located toward distal end of plume, roughly 1,300 feet northeast of the former Rex Cleaners property**	**Commercial - Office space and shop bays**	**Steel construction, concrete slab, built in 1974. Office spaces separated from shop area and equipment storage.**	**Floor drain**	**MW-134, 80 feet northeast**	**<1.0**	**7.8**	**No**	**0.28/0.31 (shop/DUP)**	**832**	**1,1,2,2-tetrachloroethane, benzene, chloroform, ethylbenzene, naphthalene, isopropanol, TCE, m,p-xylene**	**benzylchloride, bromomethane, 2-hexanone, bromodichloromethane**	**Single story structure**	**Single story structure**	**Single story - no lower level above a slab.**	**dichlorodifluoromethane, PCE, TCE**	**Smoking in building, pumps and HVAC system repairs and maintenance**	**Sampling Date: 2/28/2018 AA-01: benzene (1.7); chloroform (0.15) AA-02: benzene (1.9); carbon tetrachloride (0.54); chloroform (0.19) Non-Detect MDL Exceedances***	**Nearest LUST Facility is approximately 375 ft upgradient**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**The VI pathway for TCE appears to be complete. PCE was also present in subslab vapor, but did not exceed screening levels in indoor air. Other indoor air contaminants exceeding screening levels appear to have contributing sources indoors.**

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
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Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	**2018 Sample IDs**	**Nearest Identified Potential PCE Source**	**Building Type**	**Building Construction**	**VI Pathway Concerns with Building Construction**	**Nearest Groundwater Monitoring Well[c]**	**Nearest Well May 2018 [PCE] Concentration (ug/L)**	**Recent Depth to Groundwater at Nearest Well (approximate ft btoc)**	**Sampled Previously by EPA**	**2018 Indoor Air [PCE] ug/m3**	**2018 Subslab Vapor [PCE] ug/m3**	**Indoor Air > Screening Levels[a]**	**Indoor Air Detection Limit > Screening Levels[b]**	**Indoor Air Main Level > Indoor Air Upper Level**	**Indoor Air Lower Level > Indoor Air Main Level**	**Sub-slab > Indoor Air Lower Level**	**Sub-slab > Indoor Air Main Level**	**Potential Indoor Air Sources**	**Comparison to Applicable Ambient Air Samples ($\mu g/m^3$)**	**Other Potential Underground Sources**	**Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence**	**Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination**
3 7th Street West	3 7th St W_2nd Floor, 3 7th St W_Boiler Room, 3 7th St W_Main, 3 7th St W_Subslab	Big Sky Linen - property is located across the street from impacted source area at Big Sky Linen.	Residential - Multifamily apartment complex	Wood frame construction, built in 1950. 3 story apartment structure. Poured concrete foundation.	Floor cracks, floor drain, and sump in boiler room.	BPGP59, 60 feet west	1,520	13.41	Yes	1.9 (2nd floor), 3 (main), 1.9 (boiler room)	40.1	benzene, bromodichloromethane, carbon tetrachloride, chloroform, isopropanol	1,1,2,2-tetrachloroethane, benzylchloride, bromomethane, 2-hexanone	acetone, carbon tetrachloride, cyclohexane, PCE, tetrahydrofuran, toluene,	benzene, dichlorodifluoromethane, ethanol, ethyl acetate, hexane, isopropanol,	bromodichloromethane, chloroform, PCE, vinyl acetate	bromodichloromethane, chloroform, cis-1,2-DCE, dichlorodifluoromethane, PCE, vinyl acetate	None observed	Sampling Date: 3/1/2018 AA-01: 1,2-dichloroethane (0.12); benzene (1); carbon tetrachloride (0.65); chloroform (0.22); trichloroethene (1.2) AA-02: -- Non-Detect MDL Exceedances*	Big Sky Linen is has a former LUST site designation approximately 300 feet upgradient	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for chloroform and bromodichloromethane. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air. PCE was detected in subslab vapor at slightly more than an order of magnitude greater than indoor air screening levels, at 40 ug/m3
3 Broadwater Avenue	**3 Broadwater Ave_Board Room, 3 Broadwater Ave_Boiler Room, 3 Broadwater Ave_Gym Hall , 3 Broadwater Ave_Crawlspace, 3 Broadwater Ave_Main Hall, 3 Broadwater Ave_Subslab**	**Big Sky Linen - property is located on the corner of Division and Broadwater, along the main plume body, approximately 1 mile northeast of Big Sky Linen.**	**High School**	**Billings Central High School - multi-structure facility, including separate outbuildings, additions, and levels. Stone and concrete exterior construction, with concrete beam and wood frame interior. Full basement used for classrooms. Crawlspace beneath portions of the school.**	**None observed/noted.**	**BPGP29, 250 feet northwest**	**37.2**	**10.82**	**Yes**	**0.36 (board room), 0.24 (boiler room), 0.25 (gym hall), 3.3 (main crawlspace), 0.57 (main hall)**	**50.6**	**1,3-butadiene, benzene, carbon tetrachloride, chloroform, C9-C12 aliphatics, isopropanol, TCE**	**1,1,2,2-tetrachloroethane, benzylchloride, bromodichloromethane, bromomethane, 2-hexanone**	**Multi-story structure, basement and main floors sampled.**	**1,2-DCA, 1,3-butadiene, chloroform, xylenes, PCE, toluene, TCE, VC**	**chloroform, dichlorodifluoromethane, PCE, TCE, vinyl acetate**	**chloroform**	**None observed**	**Sampling Date: 2/22/2018 AA-01: 1,3-butadiene (0.21); benzene (1.6); carbon tetrachloride (0.63); chloroform (0.13); methylene chloride (153) AA-02: -- Non-Detect MDL Exceedances***	**Nearest LUST Facility is approximately 2,000 feet upgradient**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**The VI pathway appears to be complete for chloroform and TCE. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air. PCE and TCE were detected in the subslab at concentrations exceeding residential air screening levels, and PCE subslab concentrations were also greater than commercial screening levels.**
306 North 30th Street	306 N 30th St_2nd Floor, 306 N 30th St_Main, 306 N 30th St_Basement/Crawlspace, 306 N 30th St_Subslab	Big Sky Linen - property is located approximately 1.4 miles northeast of Big Sky Linen	Residential - Single family home	Conventional wood frame construction built in 1890. Two finished stories with an unfinished partial basement/crawlspace. Poured concrete foundation, basement open to dirt crawlspace.	None observed/noted.	MW-119, 670 feet west	1.7	14.2	No	0.4 (2nd floor), 0.41 (main floor), 0.5 (basement/crawlspace)	247	1,4-dichlorobenzene, benzene, carbon tetrachloride, chloroform, ethylbenzene	1,1,2,2-tetrachloroethane, benzylchloride, bromomethane, 2-hexanone	1,2,4-trimethylbenzene, acetone, chloroform, hexane, PCE, trichlorotrifluoromethane	carbon tetrachloride, PCE, trichlorotrifluoromethane	acetone, chloroform, PCE	2-butanone, acetone, chloroform, PCE,	None observed	Sampling Date: 3/8/2018 AA-01: benzene (1.6); chloroform (0.15) AA-02: -- Non-Detect MDL Exceedances*	Nearest LUST Facility is approximately 1,400 feet upgradient	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for chloroform. However, chloroform was observed in ambient air at concentrations greater than those observed in indoor air, suggesting an outdoor air contribution to chloroform concentrations in indoor air. PCE was detected in the subslab at two orders of magnitude greater than the screening level.

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
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Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	2018 Sample IDs	Nearest Identified Potential PCE Source	Building Type	Building Construction	VI Pathway Concerns with Building Construction	Nearest Groundwater Monitoring Well[c]	Nearest Well May 2018 [PCE] Concentration (ug/L)	Recent Depth to Groundwater at Nearest Well (approximate ft btoc)	Sampled Previously by EPA	2018 Indoor Air [PCE] ug/m3	2018 Subslab Vapor [PCE] ug/m3	Indoor Air > Screening Levels[a]	Indoor Air Detection Limit > Screening Levels[b]	Indoor Air Main Level > Indoor Air Upper Level	Indoor Air Lower Level > Indoor Air Main Level	Sub-slab > Indoor Air Lower Level	Sub-slab > Indoor Air Main Level	Potential Indoor Air Sources	Comparison to Applicable Ambient Air Samples (µg/m^3)	Other Potential Underground Sources	Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence	Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination
308 Miles Avenue	**308 Miles Ave_Basement, 308 Miles Ave_Main, 308 Miles Ave_Subslab**	**Big Sky Linen - property is located approximately 0.6 miles northeast of Big Sky Linen**	**Residential - Single family home**	**Wood construction bungalow built in 1938. Single story with a partially finished basement. Poured concrete foundation.**	**Floor drain in basement,**	**PEP07, 240 feet south**	**520**	**10.81**	**Yes**	**3.3 (main), 4.4 (basement)**	**120,000**	**1,2-DCA, benzene, bromodichloromethane, C5-C8 aliphatics, chloroform, ethylbenzene, PCE, TCE**	**1,1,2,2-tetrachloroethane, 1,3-butadiene, benzylchloride, bromomethane, 2-hexanone**	**Single story structure**	**carbon tetrachloride, PCE, TCE**	**PCE, toluene, TCE**	**chloroform, PCE, TCE**	**Smoking residence**	**Sampling Date: 2/5/2018 AA-01: benzene (0.74) AA-02: benzene (0.76) Non-Detect MDL Exceedances***	**Nearest LUST Facility is approximately 360 feet upgradient**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**The VI pathway may be complete for chloroform, however, basement air concentrations were not greater than main level concentrations. The VI pathway appears complete for TCE and PCE. PCE was detected in the subslab at 120,000 ug/m3, which is 5 orders of magnitude above the screening level, and may have resulted in elevated detection limits. TCE was also detected at 12,200 ug/m3, which is 5 orders of magnitude above the screening level. Methane was detected at 678,000 ug/m3.**
3119 Montana Avenue	3119 Montana Ave_Basement, 3119 Montana Ave_Main, 3119 Montana Ave_Subslab (DUP)	Big Sky Linen - property is located 1.3 miles northeast of Big Sky linen.	Residential - Multifamily transitional living space	Two story wood construction single family dwelling, converted to multifamily dwelling. Fully finished basement, with attached garage, structure built in 1905. Poured concrete basement.	Fractured concrete flooring in laundry room	BPGP44, 260 feet northwest	152	12.58	Yes	1.2 (main), <1.1 (basement)	2,090/6,630 (DUP)	C5-C8 aliphatics, C9-C12 aliphatics, chloroform	1,1,2,2-tetrachloroethane, 1,2-DCA, 1,2-dichloropropane, 1,3-butadiene, benzylchloride, bromodichloromethane, carbon tetrachloride, TCE, VC, bromomethane, 2-hexanone	Occupied basement and main floor sampled only.	2-butanone, chloroform, hexane, tetrahydrofuran	C5-C8 aliphatics, C9-C12 aliphatics, chloroform, toluene,	chloroform, PCE, toluene	None observed	Sampling Date: 2/12/2018 AA-01: benzene (0.91); chloroform (0.13) AA-02: benzene (1.1); carbon tetrachloride (0.67); chloroform (0.13); methylene chloride (149) Non-Detect MDL Exceedances*	Property is located directly adjacent to District 7 Human Resources Council offices, which formerly contained an auto repair shop	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for chloroform, C5-C8 aliphatics, and C9-C12 aliphatics, in excess of indoor air indoor air screening concentrations. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air. PCE was observed in the subsurface at concentrations 3 orders of magnitude greater than the screening level (2,090/6,630 ug/m3 for the subslab and duplicate sample).
312 North 33rd Street	312 N 33rd St_Basement, 312 N 33rd St_Crawlspace, 312 N 33rd St_Main, 312 N 33rd St_Subslab	Big Sky Linen - property located approximately 1.2 miles northeast of Big Sky Linen	Residential - Single family home	Two story wood bungalow built in 1915. Unfinished basement used as a laundry room, and open to the adjacent dirt crawlspace.	Concrete basement is not a single pour, resulting in cracks in basement.	MW-119, 500 feet northeast	1.7	14.2	No	0.64 (basement), 0.43 (crawlspace), 0.41 (main)	663	1,2-DCA, 1,3-butadiene, benzene, carbon tetrachloride, chloroform	1,1,2,2-tetrachloroethane, benzyl chloride, bromodichloromethane, bromomethane, 2-hexanone	Occupied basement and main floor sampled only.	1,1,1-trichloroethane, 1,2-DCA, benzene, chloroform, dichlorodifluoromethane, hexane, PCE, toluene,	acetone, chloroform, dichlorodifluoromethane, PCE	1,1,1-trichloroethane, acetone, chloroform, dichlorodifluoromethane, PCE	Some paint stored in basement.	Sampling Date: 2/28/2018 AA-01: benzene (1.7); chloroform (0.15) AA-02: benzene (1.9); carbon tetrachloride (0.54); chloroform (0.19) Non-Detect MDL Exceedances*	Nearest LUST Facility is approximately 0.6 miles upgradient and slightly cross-gradient from the structure.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for chloroform. Chloroform was observed in ambient air at concentrations above screening levels, but generally below those observed in indoor air. The VI pathway for PCE may also be complete, though at concentrations below the screening level. PCE was detected in the subslab at two orders of magnitude greater than the screening level (663 ug/m3).

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	**2018 Sample IDs**	**Nearest Identified Potential PCE Source**	**Building Type**	**Building Construction**	**VI Pathway Concerns with Building Construction**	**Nearest Groundwater Monitoring Well[c]**	**Nearest Well May 2018 [PCE] Concentration (ug/L)**	**Recent Depth to Groundwater at Nearest Well (approximate ft btoc)**	**Sampled Previously by EPA**	**2018 Indoor Air [PCE] ug/m3**	**2018 Subslab Vapor [PCE] ug/m3**	**Indoor Air > Screening Levels[a]**	**Indoor Air Detection Limit > Screening Levels[b]**	**Indoor Air Main Level > Indoor Air Upper Level**	**Indoor Air Lower Level > Indoor Air Main Level**	**Sub-slab > Indoor Air Lower Level**	**Sub-slab > Indoor Air Main Level**	**Potential Indoor Air Sources**	**Comparison to Applicable Ambient Air Samples ($\mu g/m^3$)**	**Other Potential Underground Sources**	**Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence**	**Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination**
317 Terry Avenue	317 Terry Ave_Basement, 317 Terry Ave_Crawlspace, 317 Terry Ave_Main, 317 Terry Ave_Subslab	Big Sky Linen - property located approximately 0.6 miles northeast of Big Sky Linen	Residential - Single family home	Single story wood construction bungalow built in 1945. Unfinished basement separated from dirt crawlspace. Solid concrete basement floors. EPA installed mitigation system during interim remedial actions	Floor drain	BPGP92, 240 feet southeast	429	9.98	Yes	0.48 (basement), 0.48 (crawlspace), 0.46 (main)	6.3	1,3-butadiene, bromodichloromethane, carbon tetrachloride, chloroform, TCE	1,1,2,2-tetrachloroethane, benzyl chloride, bromomethane, 2-hexanone	Single story structure	1,2-DCA, acetone, benzene, carbon tetrachloride, 1,1,2,2-tetrachloroethane, chloromethane, dichlorodifluoromethane, hexane, isopropanol, PCE, tetrahydrofuran, toluene	carbon tetrachloride, dichlorodifluoromethane, PCE, TCE	carbon tetrachloride, dichlorodifluoromethane, PCE,	Some paint and cleaners stored in basement.	Sampling Date: 2/5/2018 AA-01: benzene (0.74) AA-02: benzene (0.76) Non-Detect MDL Exceedances*	Nearest LUST Facility is approximately 880 feet south, and cross gradient	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for carbon tetrachloride. The VI pathway may also be complete for PCE and dichlorodifluoromethane, though at concentrations below indoor air screening levels. PCE was detected in the subslab at 6.3 ug/m3. VI of TCE may also be occurring, however TCE was detected in indoor at at concentrations higher than those in the lower level air or subslab vapor.
319 Custer Avenue	319 Custer Ave_Basement/Crawlspace, 319 Custer Ave_Main, 319 Custer Ave_Subslab	Big Sky Linen - property located approximately 0.7 miles northeast of Big Sky Linen	Residential - Single family home	Single story wood construction bungalow built in 1945. Partially finished basement adjoins a dirt crawlspace.	Floor drain, fractures in concrete.	BPGP17, 295 feet east	123	10.47	Yes	0.32 (basement/crawlspace), 0.54 (main)	271	1,3-butadiene, 1,4-dichlorobenzene, bromodichloromethane, C9-C12 aliphatics, carbon tetrachloride, chloroform, isopropanol	1,1,2,2-tetrachloroethane, benzylchloride, bromomethane, 2-hexanone	Single story structure	cyclohexane, dichlorodifluoromethane, hexane, trichlorofluoromethane,	C5-C8 aliphatics, chloroform, hexane, PCE	bromodichloromethane, C5-C8 aliphatics, chloroform, hexane, PCE	Former smoking residence, painting on main floor 6 months prior, paint stored in basement.	Sampling Date: 2/9/2018 AA-01: 1,2-dichloroethane (0.12); benzene (1.5); carbon tetrachloride (0.58); chloroform (1.1) AA-02: benzene (1.2); carbon tetrachloride (0.5); chloroform (0.13) Non-Detect MDL Exceedances*	Nearest LUST facility is 1,200 feet south of the property.	Subslab sample port was plugged with quickcrete during installation, and had to be repaired prior to sampling by removing Teflon tubing from port and sampling directly from brass fitting. Helium intrusion issues required additional clay seal around port.	The VI pathway may be complete for chloroform and bromodichloromethane, though concentrations in the basement/crawlspace are lower than concentrations in the main floor. Additionally, chloroform was observed in ambient air at concentrations greater than those observed in indoor air, suggesting an outside air contribution to indoor air concentrations. PCE was detected in the subslab at two orders of magnitude greater than indoor air screening levels, and VI of PCE may be occurring, though at concentrations below screening levels.
323 Miles Avenue	**323 Miles Ave_Crawlspace (DUP), 323 Miles Ave_Main**	**Big Sky Linen - property located approximately 0.6 miles northeast of Big Sky Linen**	**Residential - Single family home**	**Single story wood construction bungalow built in 1930. Dirt/gravel/broken up concrete flooring in expanded crawlspace. Some fieldstone foundation, though a portion has been poured as concrete for a root cellar**	**None observed/noted.**	**BPGP15, 400 feet northwest**	**42.3**	**10.54**	**Yes**	**11.6/12.1 (crawlspace/DUP), 9.2 (main)**	**--**	**1,2-DCA, 1,3-butadiene, benzene, carbon tetrachloride, chloroform, naphthalene, PCE, TCE**	**1,1,2,2-tetrachloroethane, benzylchloride, bromomethane, 2-hexanone**	**Single story structure**	**benzene, chloroform, dichlorodifluoromethane, heptane, hexane, PCE, TCE**	**Crawlspace - no slab**	**Crawlspace - no slab**	**Some paint stored in basement**	**Sampling Date: 2/27/2018 AA-01: 1,3-butadiene (0.45); benzene (2.3); chloroform (0.14); ethylbenzene (1.4) AA-02: benzene (1.9); carbon tetrachloride (0.62); chloroform (0.14) Non-Detect MDL Exceedances***	**Nearest LUST Facility is approximately 800 feet cross-gradient, to the southeast**	**None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.**	**The VI pathway appears to be complete for benzene, chloroform, PCE, and TCE. However, benzene was observed in ambient air at concentrations similar to, though slightly less than, those observed in indoor air, suggesting a possible outside air contribution to indoor air concentrations. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air.**

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	2018 Sample IDs	Nearest Identified Potential PCE Source	Building Type	Building Construction	VI Pathway Concerns with Building Construction	Nearest Groundwater Monitoring Well[c]	Nearest Well May 2018 [PCE] Concentration (ug/L)	Recent Depth to Groundwater at Nearest Well (approximate ft btoc)	Sampled Previously by EPA	2018 Indoor Air [PCE] ug/m3	2018 Subslab Vapor [PCE] ug/m3	Indoor Air > Screening Levels[a]	Indoor Air Detection Limit > Screening Levels[b]	Indoor Air Main Level > Indoor Air Upper Level	Indoor Air Lower Level > Indoor Air Main Level	Sub-slab > Indoor Air Lower Level	Sub-slab > Indoor Air Main Level	Potential Indoor Air Sources	Comparison to Applicable Ambient Air Samples ($\mu g/m^3$)	Other Potential Underground Sources	Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence	Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination
342 Miles Avenue	342 Miles Ave_Basement (DUP), 342 Miles Ave_Furnace Room, 342 Miles Ave_Main, 342 Miles Ave_Subslab	Big Sky Linen - property located approximately 0.5 miles northeast of Big Sky Linen	Residential - Duplex	Single story wood construction duplex on full basement, built in 1950. Poured concrete walls and floors. EPA installed mitigation system in the southern unit (342) during interim remedial actions.	Large extended cracks in furnace room floor. Occupant reported hearing large booms beneath subslab at one point when the slab fractured. May hear additional rumblings once per year. VI mitigation system non-functional during 2018 sampling.	BPGP12, 250 feet southwest	593	11.27	Yes	17.1/17.9 (basement/DUP), 17.7 (furnace room), 13.5 (main)	143,000	benzene, C5-C8 aliphatics, chloroform, chloromethane, ethylbenzene, heptane, isopropanol, PCE, TCE	1,1,2,2-tetrachloroethane, 1,2-DCA, 1,2-dichloropropane, 1,3-butadiene, benzylchloride, bromodichloromethane, carbon tetrachloride, bromomethane, 2-hexanone, vinyl chloride	Single story structure	acetone, ethanol, ethyl acetate, PCE, TCE	2-butanone, acetone, C5-C8 aliphatics, chloroform, hexane, m&p xylenes, PCE, TCE	1,2,4-trimethylbenzene, 2-butanone, acetone, C5-C8 aliphatics, chloroform, hexane, PCE, TCE	Smoking residence	Sampling Date: 3/1/2018 AA-01: 1,2-dichloroethane (0.12); benzene (1); carbon tetrachloride (0.65); chloroform (0.22); trichloroethene (1.2) AA-02: -- Non-Detect MDL Exceedances*	Nearest LUST Facility is approximately 250 feet cross-gradient, to the southeast	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for PCE and TCE. The pathway may also be complete for C5-C8 aliphatics and chloroform. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air. PCE and TCE were measured in the subslab at 143,000 and 18,700 ug/m3, respectively.
4011 2nd Avenue South	4011 2nd Ave S_Basement, 4011 2nd Ave S_Crawlspace, 4011 2nd Ave S_Main, 4011 2nd Ave S_Subslab	Big Sky Linen - property located approximately 0.75 miles east of BSL on southern edge of plume.	Residential - Single family home	Single story wood construction ranch-style built in 1911. Partial concrete basement, with separate dirt crawlspace.	None observed/noted.	MW-108, 360 feet west	<1.0	13.6	No	0.34 (basement), 0.44 (crawlspace), 0.52 (main)	546	1,2-DCA, benzene, bromodichloromethane, carbon tetrachloride, chloroform, ethyl acetate, ethylbenzene, methylene chloride, TCE	1,1,2,2-tetrachloroethane	Single story structure	carbon tetrachloride, cyclohexane, dichlorodifluoro methane, hexane, methylene chloride, styrene,	chloroform, o-xylene, PCE, toluene, TCE	chloroform, o-xylene, PCE, toluene, TCE	Some painting completed in the house in the last 6 months, paint stored in basement.	Sampling Date: 2/27/2018 AA-01: 1,3-butadiene (0.45); benzene (2.3); chloroform (0.14); ethylbenzene (1.4) AA-02: benzene (1.9); carbon tetrachloride (0.62); chloroform (0.14) Non-Detect MDL Exceedances*	Former Russel Oil Company Low Priority CECRA Facility located approximately 500 ft upgradient.	During subslab sampling, excess water was drawn into sample train by canister vacuum. Likely excess water from bentonite hydration during port installation. Test was stopped, port was purged dry, and test resumed.	The VI pathway may be complete for chloroform and TCE. Concentrations in the subslab vapor exceeded indoor air concentrations, though main floor air had higher concentrations than lower level air. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air. PCE was detected in the subslab at concentrations two orders of magnitude above indoor air screening levels (546 ug/m3), but indoor air concentrations did not exceed the screening level.
408 Howard Avenue	408 Howard Ave_Basement, 408 Howard Ave_Main (DUP), 408 Howard Ave_Subslab	Big Sky Linen - property located approximately 0.4 miles northeast of Big Sky Linen, in main plume body.	Residential - Converted duplex single family home	Single story wood construction duplex on full basement, built in 1910. Duplex dividing walls partially removed to convert to a single family dwelling.	Some cracks observed in concrete floor.	BPGP12, 175 feet northeast	593	11.27	Yes	1.4/<1.4 (main/DUP), 6.5 (basement)	21,400	carbon tetrachloride, chloroform, PCE, TCE	1,1,2,2-tetrachloroethane, 1,2-DCA, 1,2-dichloropropane, 1,3-butadiene, benzyl chloride, bromodichloromethane, carbon tetrachloride, chloroform, TCE, VC, bromomethane, 2-hexanone	Single story structure	benzene, PCE, toluene	cis-1,2-DCE, ethanol, PCE, TCE	PCE	Some paint and cleaners stored in basement.	Sampling Date: 3/3/2018 AA-01: benzene (0.91); chloroform (0.15) AA-02: benzene (0.68); chloroform (0.16) Non-Detect MDL Exceedances*	Property is located adjacent, and slightly upgradient of Pepsi bottling company LUST facility.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for PCE and TCE. PCE was detected in the subslab at 21,400 ug/m3, and TCE was detected at 8,930 ug/m3.

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	2018 Sample IDs	Nearest Identified Potential PCE Source	Building Type	Building Construction	VI Pathway Concerns with Building Construction	Nearest Groundwater Monitoring Well[c]	Nearest Well May 2018 [PCE] Concentration (ug/L)	Recent Depth to Groundwater at Nearest Well (approximate ft btoc)	Sampled Previously by EPA	2018 Indoor Air [PCE] ug/m3	2018 Subslab Vapor [PCE] ug/m3	Indoor Air > Screening Levels[a]	Indoor Air Detection Limit > Screening Levels[b]	Indoor Air Main Level > Indoor Air Upper Level	Indoor Air Lower Level > Indoor Air Main Level	Sub-slab > Indoor Air Lower Level	Sub-slab > Indoor Air Main Level	Potential Indoor Air Sources	Comparison to Applicable Ambient Air Samples (µg/m^3)	Other Potential Underground Sources	Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence	Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination
44 6th Street West	44 6th Street W_Basement, 44 6th Street W_Main, 44 6th Street W_Subslab	Big Sky Linen - Property is located approximately 850 feet northeast of Big Sky Linen, along main plume body.	Residential - Multifamily apartment complex	Three story wood frame construction apartment complex, built in 1978. Full basement containing additional apartments, utility rooms, and laundry facilities for residents. Poured concrete foundation in basement	Utility room was partially flooded during sampling. Not clear if this was surface/groundwater intrusion or condensation of combustion products from inadequately vented furnace operation. Floor drain in laundry room.	BPGP81, 160 feet northwest	94.6	11.87	Yes	2.1 (main, Apt #4), 5.7 (north basement laundry room)	58,500	1,2-DCA, bromodichloromethane, carbon tetrachloride, chloroform, isopropanol, PCE	1,1,2,2-tetrachloroethane, benzyl chloride, bromomethane, 2-hexanone	Occupied basement and main floor sampled only.	1,1,1-trichloroethane, benzene, bromodichloromethane, chloroform, ethanol, PCE, toluene,	chloroform, heptane, hexane, m&p-xylene, PCE, TCE, toluene	chloroform, hexane, PCE, toluene	None observed	Sampling Date: 2/5/2018 AA-01: benzene (0.74) AA-02: benzene (0.76) Non-Detect MDL Exceedances*	Nearest upgradient LUST Facility is co-located at Big Sky Linen.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for chloroform and PCE. PCE was observed in subslab vapor at 58,500 ug/m3. The VI pathway may also be complete for toluene, though at concentrations below indoor air screening levels.
518 Cook Avenue	518 Cook Ave_Crawlspace, 518 Cook Ave_Main	Big Sky Linen - Property is located approximately 0.3 miles northeast of Big Sky Linen, along the main plume body.	Residential - Single family home	Single story wood bungalow built in 1886. Concrete foundation over dirt crawlspace, with an over excavated portion of the crawlspace containing the hot water heater and furnace, in poured concrete walls and gravel/aggregate/crumbled concrete floor.	Concrete floor is fractured and crumbling. Former sewer lines appear to be partially abandoned, but open to crawlspace air.	BPGP08, 280 feet east	361	11.31	Yes	2.1 (crawlspace), 1.5 (main)	--	1,1,2,2-tetrachloroethane, 1,2,4-trimethylbenzene, 1,2-DCA, 1,3,5-trimethylbenzene, 1,3-butadiene, benzene, bromodichloromethane, carbon tetrachloride, chloroform, ethylbenzene, naphthalene, o-xylene, TCE, m,p-xylene	1,1,2,2-tetrachloroethane, benzyl chloride, bromodichloromethane, bromomethane, 2-hexanone	Single story structure	carbon tetrachloride, dichlorodifluoromethane, PCE, TCE	Crawlspace - no slab	Crawlspace - no slab	New flooring installed in Kitchen and remodeling in previous 6 months, plug-in air fresheners	Sampling Date: 2/7/2018 AA-01: benzene (0.82) AA-02: benzene (0.65) Non-Detect MDL Exceedances*	Nearest upgradient LUST Facility is co-located at Big Sky Linen.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for carbon tetrachloride and TCE. The VI pathway may also be complete for dichlorodifluoromethane and PCE, though not at concentrations exceeding indoor air screening levels.
522 Howard Avenue	522 Howard Ave_Basement (DUP), 522 Howard Ave_Main, 522 Howard Ave_Subslab	Big Sky Linen - Property is located approximately 0.3 miles northeast of Big Sky Linen, along the northern edge of the plume boundary.	Residential - Single family home converted to duplex.	Wood construction ranch style home built in 1951. Complete basement with poured concrete walls and floors. Lower level converted to apartment.	None observed/noted.	BPGP85, 310 feet east	10.2	10.78	Yes	5/0.17 (basement/DUP), 0.17 (main)	14.3	1,2-DCA, 1,3-butadiene, bromodichloromethane, carbon tetrachloride, chloroform, isopropanol, PCE, TCE	1,1,2,2-tetrachloroethane, benzyl chloride, bromomethane, 2-hexanone	Single story structure	acetone, carbon tetrachloride, PCE, TCE	chloroform, cis-1,2-DCE, hexane, PCE	1,2-dichloropropane, chloroform, PCE, TCE	None observed	Sampling Date: 3/2/2018 AA-01: 1,2-dichloroethane (0.013); benzene (1); carbon tetrachloride (0.68); chloroform (0.26); trichloroethene (0.52) AA-02: 1,1,2,2-tetrachloroethane (0.32); 1,1,2-trichloroethane (0.22); 1,2-dibromoethane (0.16); 1,2-dichloroethane (0.16); benzene (1.1); bromodichloromethane (0.15); chloroform (0.23) Non-Detect MDL Exceedances*	Nearest upgradient LUST Facility is co-located at Big Sky Linen.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for PCE and chloroform. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air. PCE was observed in subslab vapor at 14.3 ug/m3. The VI pathway may also be complete for TCE, although lower level indoor air concentrations were lower than those in the main floor.

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	2018 Sample IDs	Nearest Identified Potential PCE Source	Building Type	Building Construction	VI Pathway Concerns with Building Construction	Nearest Groundwater Monitoring Well[c]	Nearest Well May 2018 [PCE] Concentration (ug/L)	Recent Depth to Groundwater at Nearest Well (approximate ft btoc)	Sampled Previously by EPA	2018 Indoor Air [PCE] ug/m3	2018 Subslab Vapor [PCE] ug/m3	Indoor Air > Screening Levels[a]	Indoor Air Detection Limit > Screening Levels[b]	Indoor Air Main Level > Indoor Air Upper Level	Indoor Air Lower Level > Indoor Air Main Level	Sub-slab > Indoor Air Lower Level	Sub-slab > Indoor Air Main Level	Potential Indoor Air Sources	Comparison to Applicable Ambient Air Samples (µg/m^3)	Other Potential Underground Sources	Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence	Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination
527 Saint Johns Avenue	527 St Johns Ave_Basement, 527 St Johns Ave_Main, 527 St Johns Ave_Subslab (DUP)	Big Sky Linen - Property is located approximately 1200 feet northeast of Big Sky Linen, along the main plume body.	Residential - Single family home	Wood construction bungalow built in 1940. Single floor with a partial basement separated from dirt crawlspace. Basement has both rubble stone foundation and poured concrete. EPA installed mitigation system.	Sump in basement.	BPGP93, 260 feet east	27.6	11.75	Yes	1.4 (main), 1.4 (basement)	14,600/7280 (DUP)	C9-C12 aliphatics, 1,2-DCA, 1,3-butadiene, benzene, bromodichloromethane, carbon tetrachloride, chloroform	1,1,2,2-tetrachloroethane, benzyl chloride, bromomethane, 2-hexanone	Single story structure	benzene, C5-C8 aliphatics, carbon tetrachloride, dichlorodifluoromethane, TCE	C5-C8 aliphatics, chloroform, ethanol, ethyl acetate, PCE, TCE, VC	benzene, C5-C8 aliphatics, chloroform, ethanol, ethyl acetate, PCE, TCE	None observed	Sampling Date: 2/8/2018 AA-01: benzene (0.67); carbon tetrachloride (0.51) AA-02: benzene (0.93); carbon tetrachloride (0.49); isopropanol (46.1) Non-Detect MDL Exceedances*	Nearest upgradient LUST Facility is co-located at Big Sky Linen.	Mitigation system was not operational upon initial site visit. Mitigation system started several days prior to sampling.	The VI pathway appears to be complete for chloroform. The VI pathway may also be complete for C5-C8 aliphatics, PCE, and TCE, though at concentrations below indoor air screening levels. PCE was observed at concentrations of 14,600 ug/L in subslab vapor.
611 Saint Johns Avenue	611 St Johns Ave_Basement, 611 St Johns Ave_Main, 611 St Johns Ave_Subslab	Big Sky Linen - Property is located approximately 900 feet northeast of Big Sky Linen, along the main plume body.	Residential - Single family home	Wood construction bungalow, single story, built in 1942. Full concrete basement on slab, mostly finished.	Significant fractures in basement slab.	BPGP81, 140 feet southwest	94.6	11.87	Yes	1.5 (basement, 1.6 (main)	1,880	1,2-DCA, 1,3-butadiene, 1,4-dichlorobenzene, benzene, bromodichloromethane, carbon tetrachloride, chloroform	1,1,2,2-tetrachloroethane, benzyl chloride, bromomethane, 2-hexanone	Single story structure	1,1,1-trichloroethane, 1,4-dichlorobenzene, benzene, chloromethane, dichlorodifluoromethane, hexane, methylene chloride	chloroform, methylene chloride, PCE, TCE	chloroform, methylene chloride, PCE, TCE	Solvents, paints, adhesives, and other chemicals stored in the basement	Sampling Date: 2/27/2018 AA-01: 1,3-butadiene (0.45); benzene (2.3); chloroform (0.14); ethylbenzene (1.4) AA-02: benzene (1.9); carbon tetrachloride (0.62); chloroform (0.14) Non-Detect MDL Exceedances*	Nearest upgradient LUST Facility is co-located at Big Sky Linen.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for chloroform. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air. The VI pathway may also be complete for methylene chloride, PCE, and TCE, though at concentrations below indoor air screening levels. PCE was observed in the subslab vapor at 1,880 ug/m3.
632 Saint Johns Avenue, Number 6	632 St Johns Ave No6_Basement, 632 St Johns Ave No6_Subslab, 632 St Johns Ave No6_Main	Big Sky Linen - Property is located approximately 500 feet northeast of Big Sky Linen, along the main plume body.	Residential - Single family home	Wood construction townhome built in 1942. Concrete foundation with finished basement.	Concrete flooring breaks up easily.	BPGP80, 170 feet southeast	1340	12.02	No	3.2 (basement), 3.4 (main)	685	chloroform, isopropanol	1,1,2,2-tetrachloroethane, 1,2-DCA, 1,2-dichloropropane, 1,3-butadiene, benzyl chloride, bromodichloromethane, carbon tetrachloride, TCE, VC, bromomethane, 2-hexanone	Single story structure	chloromethane, cyclohexane, dichlorodifluoromethane, isopropanol	chloroform, PCE	chloroform, dichlorodifluoromethane, PCE	None observed	Sampling Date: 3/7/2018 AA-01: benzene (1.8); chloroform (0.15); ethylbenzene (7.2) AA-02: -- Non-Detect MDL Exceedances*	Nearest upgradient LUST Facility is co-located at Big Sky Linen.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for chloroform, though chloroform concentrations in the lower level are lower than those on the main floor. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air. The VI pathway may also be complete for PCE, though not at concentrations exceeding indoor air screening levels. PCE was detected in the subslab vapor at 685 ug/m3. TCE was detected in subslab vapor but was not detected in indoor ar. However, RLs for indoor air samples were greater than applicable SLs, therefore potential VI of TCE cannot be excluded at this time.

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	2018 Sample IDs	Nearest Identified Potential PCE Source	Building Type	Building Construction	VI Pathway Concerns with Building Construction	Nearest Groundwater Monitoring Well[c]	Nearest Well May 2018 [PCE] Concentration (ug/L)	Recent Depth to Groundwater at Nearest Well (approximate ft btoc)	Sampled Previously by EPA	2018 Indoor Air [PCE] ug/m3	2018 Subslab Vapor [PCE] ug/m3	Indoor Air > Screening Levels[a]	Indoor Air Detection Limit > Screening Levels[b]	Indoor Air Main Level > Indoor Air Upper Level	Indoor Air Lower Level > Indoor Air Main Level	Sub-slab > Indoor Air Lower Level	Sub-slab > Indoor Air Main Level	Potential Indoor Air Sources	Comparison to Applicable Ambient Air Samples ($\mu g/m^3$)	Other Potential Underground Sources	Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence	Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination
711 Central Avenue	711 Central Ave_Basement Church (DUP), 711 Central Ave_Basement East Wing, 711 Central Ave_Basement Hallway, 711 Central Ave_Utility Room, 711 Central Ave_Main East Wing, 711 Central Ave_Main West Wing, 711 Central Ave_Subslab Church, 711 Central Ave_Subslab Utility Room	Big Sky Linen - Property is located over known extent of release area.	Commercial Multistory office complex	Low rise 2-story office building, built in 1950. Wood and beam construction, daylight basement. Mitigation system installed by EPA.	Cracks in flooring in furnace room, open furnace sump. Former bomb shelter beneath church flooring.	Nearby wells range from 1.3 to 39,300 ug/L PCE in 2018. BPGP51 shown, located 30 feet west.	39,300	13.66	Yes	18.4/21.3 (basement church/DUP), 46.6 (basement east), 12.7 (basement hallway), 48.1 (basement utility room), 7.5 (main east wing), 3.9 (main west wing)	26,200 (Church), 1,650,000 (Utility Room)	1,3-butadiene, carbon tetrachloride, chloroform, methylene chloride, PCE, TCE	1,1,2,2-tetrachloroethane, benzyl chloride, bromodichloromethane, bromomethane, 2-hexanone	Occupied basement and main floor sampled only.	1,2-DCA, acetone, carbon tetrachloride, chloroform, dichlorodifluoro methane, PCE, TCE, vinyl acetate	benzene, chloroform, dichlorodifluoro methane, PCE, TCE	benzene, chloroform, dichlorodifluoro methane, isopropanol, PCE, TCE, vinyl acetate	None observed	Sampling Date: 2/7/2018 AA-01: benzene (0.82) AA-02: benzene (0.65) Non-Detect MDL Exceedances*	Former UST associated with big Sky Linen located on adjacent property.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for chloroform, PCE, and TCE. The VI pathway may also be complete for carbon tetrachloride. PCE was detected in subslab vapor at 26,200 ug/m3 beneath the church in the east wing, and at 1,650,000 ug/m3 beneath the utility room.
715 Central Avenue	715 Central Ave_Main East Process, 715 Central Ave_Main Mid Process, 715 Central Ave_Main Office, 715 Central Ave_Subslab Mid Process, 715 Central Ave_Subslab NE Process (DUP), 715 Central Ave_Subslab Office, 715 Central Ave_Subslab SE Process	Known source area	Commercial - light industrial	Single story industrial warehouse housing industrial laundering facilities. Concrete block construction with a concrete slab floor. Newer office addition added to industrial warehouse in approximately 2011.	Cracks in flooring, as well as floor drains and sumps.	Nearby wells range from 1.3 to 39,300 ug/L PCE in 2018. BPGP51 shown, located 30 feet east.	39,300	13.66	Yes - only subslab	85.1 (main east process), 40.2 (main mid process), 26.1 (main office)	209 (Mid Process), 3,310,000/1,390,000 (NE Process/DUP), 833 (Office), 1,420,000 (SE Process)	1,2,4-trimethylbenzene, 1,2-dibromoethane, 1,2-DCA, 1,3,5-trimethylbenzene, 1,3-butadiene, benzene, C5-C8 aliphatics, C9-C10 aromatics, C9-C12 aliphatics, chloroform, ethylbenzene, o-xylene, PCE, TCE, m,p-xylene	1,1,2,2-tetrachloroethane, 1,2-DCA, 1,2-dichloropropane, 1,3-butadiene, 1,4-dichlorobenzene, benzyl chloride, 2-hexanone, bromodichloromethane, carbon tetrachloride, TCE, VC, bromomethane	Single story structure	Single story structure	Single story - no lower level above a slab.	acetone, C5-C8 aliphatics, C9-C12 aliphatics, dichlorodifluoro methane, PCE	Source area contamination, process units.	Sampling Date: 2/12/2018 AA-01: benzene (0.91); chloroform (0.13) AA-02: benzene (1.1); carbon tetrachloride (0.67); chloroform (0.13); methylene chloride (149) Non-Detect MDL Exceedances*	Nearest LUST Facility (excluding on-site UST) is directly adjacent, at the former Tom's Conoco.	None identified. VI samples from 2018 taken during "worst case scenario" winter weather in Winter 2018.	The VI pathway appears to be complete for C5-C8 aliphatics, C9-C12 aliphatics, and PCE. Other COPCs may also have complete pathways, however, subslab detection limits were significantly elevated due to elevated concentrations of PCE in subslab vapor. Subslab PCE concentrations of PCE were 209 (Mid Process), 3,331,000/1,390,000 (NE Process/DUP), 833 (office), 1,420,000 (SE Process) ug/m3.

TABLE 10-1. 2018 VAPOR INTRUSION SAMPLE RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Property Information										2018 - DEQ Vapor Intrusion Sample Results												
Property Address	2018 Sample IDs	Nearest Identified Potential PCE Source	Building Type	Building Construction	VI Pathway Concerns with Building Construction	Nearest Groundwater Monitoring Well[c]	Nearest Well May 2018 [PCE] Concentration (ug/L)	Recent Depth to Groundwater at Nearest Well (approximate ft btoc)	Sampled Previously by EPA	2018 Indoor Air [PCE] ug/m3	2018 Subslab Vapor [PCE] ug/m3	Indoor Air > Screening Levels[a]	Indoor Air Detection Limit > Screening Levels[b]	Indoor Air Main Level > Indoor Air Upper Level	Indoor Air Lower Level > Indoor Air Main Level	Sub-slab > Indoor Air Lower Level	Sub-slab > Indoor Air Main Level	Potential Indoor Air Sources	Comparison to Applicable Ambient Air Samples ($\mu g/m^3$)	Other Potential Underground Sources	Extenuating circumstances potentially contributing to Vapor Intrusion Multiple Lines of Evidence	Vapor Intrusion Pathway Completion and MT DEQ Guidance Appendix B Determination
820 Division Street	820 Division St_Basement, 820 Division St_Main	Big Sky Linen - Property located approximately 1.1 northeast of Big Sky Linen	Commercial office space	Two story commercial office space. Wood construction on a full basement, built in 1918 and appears to be a former residential structure which was converted to a commercial property.	A utility vault in the partially finished basement is open to dirt in the subsurface.	BPGP41, 60 feet northeast	42	10.68	Yes	1.5 (main), 13.7 (basement)	--	1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, carbon tetrachloride, chloroform, isopropanol, PCE, TCE	1,1,2,2-tetrachloroethane, benzyl chloride, bromodichloromethane, bromomethane, 2-hexanone	Single story structure	1,2,4-trimethylbenzene, 4-ethyltoluene, chloroform, PCE, TCE	Samples not collected due to utility occlusion in basement	Samples not collected due to utility occlusion in basement	Basement concrete is fully painted, and appears to have been completed recently	Sampling Date: 2/12/2018 AA-01: benzene (0.91); chloroform (0.13) AA-02: benzene (1.1); carbon tetrachloride (0.67); chloroform (0.13); methylene chloride (149) Non-Detect MDL Exceedances*	Nearest potential underground source is the BNSF Facility, roughly 1,100 ft cross-gradient	Subslab vapor was not able to be sampled, as the utility runs beneath the subslab could not be adequately mapped to ensure safe drilling. Therefore, only basement and indoor air samples were collected.	The VI pathway appears to be complete for 1,2,4-trimethylbenzene, chloroform, PCE, and TCE, however, subslab samples were not collected due to risk of utility strike. Chloroform was observed in ambient air at concentrations above screening levels, but below those observed in indoor air.

Notes:

[a] Current Screening Levels based on November 2018 EPA RSLs for the applicable building type exposure scenario (i.e. residential or commercial/industrial), May 2018 MT DEQ RBSLs for petroleum fractions, and DEQ's Typical Indoor Air Concentrations (TIACs) of Volatile Organic Compounds in Non-Smoking Montana Residences Not Impaced by Vapor Intrusion (2012). The following compounds have higher TIACs than residential RSLs, and therefore were screened using their TIACs for residential exposure:

1,2-DCA
benzene
ethyl acetate
isopropanol
naphthalene

[b] The following compounds have MDLs which are higher than applicable screening levels, and therefore non-detect values will exceed screening levels:

1,1,2 Trichloroethane
1,2,4 Trichlorobenzene
1,2 Dibromoethane
1,4 Dichlorobenzene
1,4 Dioxane
Acrolein
Acrylonitrile
Allyl Chloride
Benzene
Bromoform
C9-C10 Aromatics
Ethylbenzene
Hexachlorobutadiene
Naphthalene
Vinyl Bromide

[c] Distances and directions from structure to nearest well are approximate.

Abbreviations
1,2-DCA - 1,2-dichloroethane
DUP - A duplicate sample was collected at this location
ND - non-detect
PCE - tetrachloroethene
RL - reporting limit
SL - screening level
TCE - trichloroethene
VC - vinyl chloride

TABLE 10-2. SUMMARY OF INDOOR AIR EXCEEDANCES OF APPLICABLE SCREENING LEVELS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Compound	TIAC	Residential RSL	Industrial RSL	DEQ Generic APH Screening Level	Minimum Exceedance	Maximum Exceedance
1,2,4-Trimethylbenzene		6.3	26		9	638
1,2-Dichloroethane	0.23	0.11	0.47		0.24	3.5
1,3-Butadiene		0.094	0.41		0.13	2
Benzene	1.3	0.36	1.6		1.4	9
Bromodichloromethane		0.076	0.33		0.12	1.8
C5-C8, Aliphatic, Unadjusted	94			94	107	906
C9-C12, Aliphatic, Unadjusted	44			44	44.9	2480
Carbon tetrachloride		0.47	2		0.48	1.1
Chloroform		0.12	0.53		1.3	6.1
Tetrachloroethene	0.14	4.2	18		4.4	223
Trichloroethene		0.21	0.88		0.24	2.4
1,1,2,2-Tetrachloroethane		0.048	0.21		0.12	1.5
1,1,2-Trichloroethane		0.021	0.088		0.15	0.15
1,2-Dibromoethane		0.0047	0.02		1.9	1.9
1,2-Dichloropropane		0.42	1.8		0.55	0.55
1,3,5-Trimethylbenzene		6.3	26		7.8	185
1,4-Dichlorobenzene		0.26	1.1		3.7	15.4
C9-C10, Aromatic, Unadjusted				10	2750	2750
Chloromethane		9.4	39		12	12.9
Dichlorodifluoromethane	2.1	10	44		12.6	12.6
Ethyl acetate	8.6	7.3	31		9	82.2
Ethylbenzene	1.1	1.1	4.9		1.4	33.6
Heptane	1.6	42	180		50	50
Hexachlorobutadiene		0.13	0.56		4.4	4.4
Isopropanol	29	21	88		29.8	2020
m,p-Xylene	3.6	10	44		10.1	390
Methylene Chloride		63	260		64.4	560
Naphthalene	0.39	0.083	0.36		4.3	8.3
o-Xylene		10	44		15	150

Notes:

APH - Air-phase Petroleum Hydrocarbons

COPC - Contaminant of potential concern

DEQ - Montana Department of Environmental Quality

RSL - Regional Screening Level

TIAC - Typical Indoor Air Concentration

Values in units of micrograms per cubic meter (µg/m3)

APH values from DEQ State Superfund FAQs (DEQ, n.d.)

Analytes shown in bold are COPCs for the Facility

Residential and Industrial RSLs taken from EPA November 2018 RSL Tables, HQ = 0.1

TIAC values from Typical Indoor Air Concentrations of Volatile OrganicCompounds in Non-Smoking Montana Residences Not Impacted by Vapor Intrusion (DEQ, 2012)

Min./max. exceedance values are from each of the structures sampled during the RI, and not limited to those structures with complete or potentially complete VI pathways.

TABLE 11-1. STORMWATER/SURFACE WATER - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (ug/L)	Allyl Chloride (ug/L)	Benzene (ug/L)	Bromo-benzene (ug/L)	Bromo- chloro-methane (ug/L)	Bromo-dichloro- metha (ug/L)	Bromoform (ug/L)
CC-1	06/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**
CC-2	06/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**
CC-3	06/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**
SD-1	06/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**
SD-1 Dup	06/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**
SD-2	06/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**
SD-3	06/12/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**
SD-4	07/16/18	<20	**<4**	**<1**	<1	<1	**<1**	**<4**
Region III BTAG Surface Water		1,500	NA	NA	NA	NA	NA	NA
DEQ 7 Surface Water		NA	NA	5	NA	NA	9.5	70
2018 November EPA Tap Water RSLs HQ 0.1		1,400	0.21	0.46	6.2	8.3	0.13	3.3

Notes:
BTAG - Biological Technical Assistance Group
DEQ - Montana Department of Environmental Quality
EPA - United States Environmental Protection Agency
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 11-1. STORMWATER/SURFACE WATER - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Bromo-methane (ug/L)	2-Butanone (ug/L)	n-Butyl-benzene (ug/L)	sec-Butylbenzene (ug/L)	tert-Butyl-benzene (ug/L)	Carbon tetrachloride (ug/L)	Chlorobenzene (ug/L)
CC-1	06/12/18	**<4**	<5	<1	<1	<1	**<1**	<1
CC-2	06/12/18	**<4**	<5	<1	<1	<1	**<1**	<1
CC-3	06/12/18	**<4**	<5	<1	<1	<1	**<1**	<1
SD-1	06/12/18	**<4**	<5	<1	<1	<1	**<1**	<1
SD-1 Dup	06/12/18	**<4**	<5	<1	<1	<1	**<1**	<1
SD-2	06/12/18	**<4**	<5	<1	<1	<1	**<1**	<1
SD-3	06/12/18	**<4**	<5	<1	<1	<1	**<1**	<1
SD-4	07/16/18	**<4**	<5	<1	<1	<1	**<1**	<1
Region III BTAG Surface Water		NA	14,000	NA	NA	NA	NA	NA
DEQ 7 Surface Water		100	NA	NA	NA	NA	4	100
2018 November EPA Tap Water RSLs HQ 0.1		0.75	560	100	200	69	0.46	7.8

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TABLE 11-1. STORMWATER/SURFACE WATER - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (ug/L)	Chloroform (ug/L)	Chloromethane (ug/L)	2-Chloro-toluene (ug/L)	4-Chloro-toluene (ug/L)	1,2-Dibromo 3-chloro- propan (ug/L)	Dibromo-chloromethane (ug/L)
CC-1	06/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**
CC-2	06/12/18	<1	**0.5J/ND(1)U***	<4	<1	<1	**<10**	**<1**
CC-3	06/12/18	<1	**0.49J/ND(1)U***	<4	<1	<1	**<10**	**<1**
SD-1	06/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**
SD-1 Dup	06/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**
SD-2	06/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**
SD-3	06/12/18	<1	**<1**	<4	<1	<1	**<10**	**<1**
SD-4	07/16/18	<1	**<1**	<4	<1	<1	**<10**	**<1**
Region III BTAG Surface Water		NA	NA	NA	NA	NA	NA	NA
DEQ 7 Surface Water		NA	60	600	NA	NA	0.2	8
2018 November EPA Tap Water RSLs HQ 0.1		2,100	0.22	19	24	25	0.00033	0.87

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* - The first result represents the laboratory reported concentration. The second result was evaluated to be undetected at the reported concentration by the data validator. The result was determined to be a false positive.

TABLE 11-1. STORMWATER/SURFACE WATER - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2- Dibromo- ethane (ug/L)	Dibromometha ne (ug/L)	1,2-Di- chloro- benzene (ug/L)	1,3-Di- chloro- benzene (ug/L)	1,4-Di- chloro- benzene (ug/L)	Dichloro- difluoro- metha (ug/L)	1,1-Dichloro- ethane (ug/L)
CC-1	06/12/18	**<1**	**<4**	<1	<1	**<1**	<1	<1
CC-2	06/12/18	**<1**	**<4**	<1	<1	**<1**	<1	<1
CC-3	06/12/18	**<1**	**<4**	<1	<1	**<1**	<1	<1
SD-1	06/12/18	**<1**	**<4**	<1	<1	**<1**	<1	<1
SD-1 Dup	06/12/18	**<1**	**<4**	<1	<1	**<1**	<1	<1
SD-2	06/12/18	**<1**	**<4**	<1	<1	**<1**	<1	<1
SD-3	06/12/18	**<1**	**<4**	<1	<1	**<1**	<1	<1
SD-4	07/16/18	**<1**	**<4**	<1	<1	**<1**	<1	<1
Region III BTAG Surface Water		NA	NA	NA	NA	NA	NA	47
DEQ 7 Surface Water		0.017	NA	600	7	75	1,000	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.0075	0.83	30	NA	0.48	20	2.8

Notes:
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EPA - United States Environmental Protection Agency
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RSL - Regional screening level
UJ - Estimated reporting limit
U - Evaluated to be undetected at the reported concent
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TABLE 11-1. STORMWATER/SURFACE WATER - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2- Dichloro-ethane (ug/L)	1,1-Dichloro-ethene (ug/L)	cis-1,2-Dichloro- ethen (ug/L)	trans-1,2-Dichloro- ethen (ug/L)	Dichlorofluoro methane (ug/L)	1,2-Dichloro-propane (ug/L)	1,3-Dichloro-propane (ug/L)
CC-1	06/12/18	**<1**	<1	<1	<1	<1	**<4**	<1
CC-2	06/12/18	**<1**	<1	<1	<1	<1	**<4**	<1
CC-3	06/12/18	**<1**	<1	<1	<1	<1	**<4**	<1
SD-1	06/12/18	**<1**	<1	<1	<1	<1	**<4**	<1
SD-1 Dup	06/12/18	**<1**	<1	<1	<1	<1	**<4**	<1
SD-2	06/12/18	**<1**	<1	<1	<1	<1	**<4**	<1
SD-3	06/12/18	**<1**	<1	<1	<1	<1	**<4**	<1
SD-4	07/16/18	**<1**	<1	<1	<1	<1	**<4**	<1
Region III BTAG Surface Water		NA	NA	NA	NA	NA	NA	NA
DEQ 7 Surface Water		5	7	70	100	NA	5	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.17	28	3.6	36	NA	0.82	37

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TABLE 11-1. STORMWATER/SURFACE WATER - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	2,2-Dichloro-propane (ug/L)	1,1-Dichloro-propene (ug/L)	Cis-1,3-dichloro- prope (ug/L)	trans-1,3-Dichloro- prope (ug/L)	Diethyl ether (ug/L)	Ethyl- benzene (ug/L)	Hexachloro-butadiene (ug/L)
CC-1	06/12/18	<4	<1	**<4**	**<4**	<4	<1	**<4**
CC-2	06/12/18	<4	<1	**<4**	**<4**	<4	<1	**<4**
CC-3	06/12/18	<4	<1	**<4**	**<4**	<4	<1	**<4**
SD-1	06/12/18	<4	<1	**<4**	**<4**	<4	<1	**<4**
SD-1 Dup	06/12/18	<4	<1	**<4**	**<4**	<4	<1	**<4**
SD-2	06/12/18	<4	<1	**<4**	**<4**	<4	<1	**<4**
SD-3	06/12/18	<4	<1	**<4**	**<4**	<4	<1	**<4**
SD-4	07/16/18	<4	<1	**<4**	**<4**	<4	<1	**<1**
Region III BTAG Surface Water		NA	NA	NA	NA	NA	NA	NA
DEQ 7 Surface Water		NA	NA	3.4	2	NA	68	0.1
2018 November EPA Tap Water RSLs HQ 0.1		NA	NA	NA	NA	390	1.5	0.14

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TABLE 11-1. STORMWATER/SURFACE WATER - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (ug/L)	p-Isopropyl-toluene (ug/L)	4-Methyl- 2-Pentanone (ug/L)	Methylene Chloride (ug/L)	MTBE (ug/L)	Naphthalene (ug/L)	n-Propyl-benzene (ug/L)
CC-1	06/12/18	<1	<1	<5	<4	<1	**<5**	<1
CC-2	06/12/18	<1	<1	<5	<4	<1	**<5**	<1
CC-3	06/12/18	<1	<1	<5	<4	<1	**<5**	<1
SD-1	06/12/18	<1	<1	<5	<4	<1	**<5**	<1
SD-1 Dup	06/12/18	<1	<1	<5	<4	<1	**<5**	<1
SD-2	06/12/18	<1	<1	<5	<4	<1	**<5**	<1
SD-3	06/12/18	<1	<1	<5	<4	<1	**<5**	<1
SD-4	07/16/18	<1	<1	<5	<4 UJ	<1	**<5**	<1
Region III BTAG Surface Water		2.6	85	170	NA	NA	NA	128
DEQ 7 Surface Water		NA	NA	NA	5	30	100	NA
2018 November EPA Tap Water RSLs HQ 0.1		45	NA	630	11	14	0.17	66

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TABLE 11-1. STORMWATER/SURFACE WATER - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Styrene (ug/L)	1,1,1,2-Tetrachloro- et (ug/L)	1,1,2,2-Tetrachloro- et (ug/L)	Tetrachloro-ethene (ug/L)	Tetrahydrofuran (ug/L)	Toluene (ug/L)	1,2,3- Trichloro - benzene (ug/L)
CC-1	06/12/18	<1	**<1**	**<1**	<1	<10	<1	**<1**
CC-2	06/12/18	<1	**<1**	**<1**	<1	<10	<1	**<1**
CC-3	06/12/18	<1	**<1**	**<1**	<1	<10	<1	**<1**
SD-1	06/12/18	<1	**<1**	**<1**	<1	<10	<1	**<1**
SD-1 Dup	06/12/18	<1	**<1**	**<1**	<1	<10	<1	**<1**
SD-2	06/12/18	<1	**<1**	**<1**	<1	<10	<1	**<1**
SD-3	06/12/18	<1	**<1**	**<1**	<1	<10	<1	**<1**
SD-4	07/16/18	<1	**<1**	**<1 UJ**	0.55 J	<10	<1	**<1**
Region III BTAG Surface Water		NA	NA	NA	NA	NA	NA	8
DEQ 7 Surface Water		100	NA	2	5	NA	57	NA
2018 November EPA Tap Water RSLs HQ 0.1		120	0.57	0.076	4.1	340	110	0.7

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TABLE 11-1. STORMWATER/SURFACE WATER - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4- Trichloro - benzene (ug/L)	1,1,1- Trichloro - ethane (ug/L)	1,1,2- Trichloro - ethane (ug/L)	Trichloro- ethene (ug/L)	Trichloro- fluoromethane (ug/L)	1,2,3- Trichloro - propane (ug/L)	1,1,2- Trichloro - trifluoro- etha (ug/L)
CC-1	06/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1
CC-2	06/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1
CC-3	06/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1
SD-1	06/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1
SD-1 Dup	06/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1
SD-2	06/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1
SD-3	06/12/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1
SD-4	07/16/18	**<1**	<1	**<1**	**<0.4**	<1	**<4**	<1
Region III BTAG Surface Water		NA	NA	NA	NA	NA	NA	NA
DEQ 7 Surface Water		0.071	200	5	5	2,000	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		0.4	800	0.041	0.28	520	0.00075	1,000

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TABLE 11-1. STORMWATER/SURFACE WATER - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4- Trimethyl - benzene (ug/L)	1,3,5-Trimethyl - benzene (ug/L)	Vinyl Chloride (ug/L)	m,p-Xylene (ug/L)	o-Xylene (ug/L)	Xylenes, Total (ug/L)
CC-1	06/12/18	<1	<1	**<0.2**	<2	<1	<3
CC-2	06/12/18	<1	<1	**<0.2**	<2	<1	<3
CC-3	06/12/18	<1	<1	**<0.2**	<2	<1	<3
SD-1	06/12/18	<1	<1	**<0.2**	<2	<1	<3
SD-1 Dup	06/12/18	<1	<1	**<0.2**	<2	<1	<3
SD-2	06/12/18	<1	<1	**<0.2**	<2	<1	<3
SD-3	06/12/18	<1	<1	**<0.2**	<2	<1	<3
SD-4	07/16/18	<1	<1	**<0.2**	<2	<1	<3
Region III BTAG Surface Water		33	71	NA	NA	NA	NA
DEQ 7 Surface Water		NA	NA	0.22	NA	10,000	10,000
2018 November EPA Tap Water RSLs HQ 0.1		5.6	6	0.019	NA	19	19

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TABLE 11-2. STORMWATER/SURFACE WATER - METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Aluminum, Total (ug/L)	Antimony, Total (ug/L)	Arsenic, Total (ug/L)	Barium, Total (ug/L)	Beryllium, Total (ug/L)	Cadmium, Total (ug/L)	Chromium, Total (ug/L)
CC-1	06/12/18	**1010**	0.16 J	**2**	36.1	<0.2 UJ	<0.08	1.7 JB
CC-2	06/12/18	**351**	0.16 J	**3.2**	41.5	<0.2 UJ	<0.08	1.3 JB
CC-3	06/12/18	**339**	0.23 J	**3**	42.3	<0.2 UJ	<0.08	0.94 JB
SD-1	06/12/18	**1030**	0.21 J	**4.9**	48.3	<0.2 UJ	<0.08	1.2 JB
SD-1 Dup	06/12/18	**1100**	0.22 J	**5.1**	50.4	<0.2 UJ	<0.08	1.2 JB
SD-2	06/12/18	**1570**	0.25 J	**5.4**	54.5	0.11 J+	0.029 J	1.8 JB
SD-3	06/12/18	**1750**	0.25 J	**5.9**	58	0.083 J+	<0.08	2 JB
SD-4	07/16/18	**562**	0.26 J	**5.3**	38.4	<0.2	<0.08	0.9 JB
Region III BTAG Surface Water		87	NA	NA	NA	NA	NA	NA
DEQ 7 Surface Water		NA	5.6	10	1,000	4	5	100
Aquatic Life Criteria - Acute		750	NA	340	NA	NA	3.8	NA
Aquatic Life Criteria - Chronic		87	NA	150	NA	NA	1.4	NA
2018 November EPA Tap Water RSLs HQ 0.1		2,000	0.78	0.052	380	2.5	0.92	NA

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.
Acute and chronic aquatic life criteria are hardness-dependent, and were adjusted as directed in the May 2017 DEQ-7 Water Quality Standards, Footnote 12, using a site-specific conservative hardness of 203 mg/L as $CaCO_3$.

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J+ - Estimated concentration, possibly biased high
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-2. STORMWATER/SURFACE WATER - METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Cobalt, Total (ug/L)	Copper, Total (ug/L)	Hardness, Total (ug/L)	Iron, Total (ug/L)	Lead, Total (ug/L)	Manganese, Total (ug/L)	Mercury, Total (ug/L)
CC-1	06/12/18	0.47 J	2.3	1230000	**980**	1.3	18.9 JB	0.004 J
CC-2	06/12/18	0.25 J	1.8	828000	**310**	0.36 JB	12.5 JB	<0.01
CC-3	06/12/18	0.27 J	1.9	807000	**303**	0.42 JB	15.6 JB	<0.01
SD-1	06/12/18	0.35 J	1.7	203000	**834**	0.85	14.4 JB	0.004 J
SD-1 Dup	06/12/18	0.36 J	1.8	--	**884**	0.9	15 JB	0.004 J
SD-2	06/12/18	0.52	2.1	217000	**1290**	1.1	22.3 JB	0.004 J
SD-3	06/12/18	0.59	2.2	211000	**1490**	1.2	25.8 JB	0.004 J
SD-4	07/16/18	0.23 J	2.3	473000	**537**	0.66	15.9	<0.01
Region III BTAG Surface Water		23	NA	NA	300	NA	120	NA
DEQ 7 Surface Water		NA	1,300	NA	NA	15	NA	0.05
Aquatic Life Criteria - Acute		NA	27.3	NA	NA	201.1	NA	1.4
Aquatic Life Criteria - Chronic		NA	17.1	NA	1,000	7.8	NA	0.77
2018 November EPA Tap Water RSLs HQ 0.1		0.6	80	NA	1,400	15	43	0.063

Notes:
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TABLE 11-2. STORMWATER/SURFACE WATER - METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Nickel, Total (ug/L)	Selenium, Total (ug/L)	Silver, Total (ug/L)	Thallium, Total (ug/L)	Vanadium, Total (ug/L)	Zinc, Total (ug/L)
CC-1	06/12/18	1.6	**19.3 J+**	<0.5	**<0.1**	5.1	11.6 JB
CC-2	06/12/18	1.2 JB	**12.9 J+**	<0.5	**<0.1**	3.4	7.3 JB
CC-3	06/12/18	1.2 JB	**12.4 J+**	<0.5	**<0.1**	3.1	8.8 JB
SD-1	06/12/18	1.4 JB	2.2 J+	<0.5	**<0.1**	3.9	8.5 JB
SD-1 Dup	06/12/18	1.5	2.2 J+	<0.5	**<0.1**	4.1	8.9 JB
SD-2	06/12/18	1.9	2.2 J+	<0.5	**0.041 J**	5	12 JB
SD-3	06/12/18	2.1	2.5 J+	<0.5	**<0.1**	5.7	9.2 JB
SD-4	07/16/18	1.6	3.9	<0.5	**<0.1**	3.3	9.4
Region III BTAG Surface Water		NA	NA	NA	NA	20	NA
DEQ 7 Surface Water		100	50	100	0.24	NA	7,400
Aquatic Life Criteria - Acute		854	20	13.7	NA	NA	218.3
Aquatic Life Criteria - Chronic		95	5	NA	NA	NA	218.3
2018 November EPA Tap Water RSLs HQ 0.1		39	10	9.4	0.02	8.6	600

Notes:
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TABLE 11-3. STORMWATER/SURFACE WATER - EPH/VPH ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Benzene (ug/L)	Ethyl-benzene (ug/L)	MTBE (ug/L)	Naphthalene (ug/L)	Toluene (ug/L)	m,p-Xylene (ug/L)	o-Xylene (ug/L)
CC-1	06/12/18	**<0.5**	<0.5	<1	**<5**	<0.5	<0.5	<0.5
CC-2	06/12/18	**<0.5**	<0.5	<1	**<5**	<0.5	<0.5	<0.5
CC-3	06/12/18	**<0.5**	<0.5	<1	**<5**	<0.5	<0.5	<0.5
SD-1	06/12/18	**<0.5**	<0.5	<1	**<5**	<0.5	<0.5	<0.5
SD-1 Dup	06/12/18	**<0.5**	<0.5	<1	**<5**	<0.5	<0.5	<0.5
SD-2	06/12/18	**<0.5**	<0.5	<1	**<5**	<0.5	<0.5	<0.5
SD-3	06/12/18	**<0.5**	<0.5	<1	**<5**	<0.5	<0.5	<0.5
SD-4	07/16/18	**<0.5**	<0.5	<1	**<5**	<0.5	<0.5	<0.5
Region III BTAG Surface Water		NA	NA	NA	NA	NA	NA	NA
DEQ 7 Surface Water		5	68	30	100	57	NA	10,000
2018 November EPA Tap Water RSLs HQ 0.1		0.46	1.5	14	0.17	110	NA	19

Notes:
Bolded values exceed one or more applicable screening levels
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RSL - Regional screening level
UJ - Estimated reporting limit
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TABLE 11-3. STORMWATER/SURFACE WATER - EPH/VPH ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Xylenes, Total (ug/L)	C5-C8, Aliphatic, Adjusted (ug/L)	C9-C12, Aliphatic, Adjusted (ug/L)	Total Extractable Hydrocarbon (ug/L)	Total Purgeable Hydrocarbon (ug/L)
CC-1	06/12/18	<2	<20	<20	78J/ND(222)U*	<20
CC-2	06/12/18	<2	<20	<20	<209 UJ	<20
CC-3	06/12/18	<2	<20	<20	<204	<20
SD-1	06/12/18	<2	<20	<20	85.8J/ND(204) U*	<20
SD-1 Dup	06/12/18	<2	<20	<20	70.8J/ND(202) U*	<20
SD-2	06/12/18	<2	<20	<20	<207 UJ	<20
SD-3	06/12/18	<2	<20	<20	90.7J/ND(206) U*	<20
SD-4	07/16/18	<2	<20	<20	127 J	<20
Region III BTAG Surface Water		NA	NA	NA	NA	NA
DEQ 7 Surface Water		10,000	NA	NA	NA	NA
2018 November EPA Tap Water RSLs HQ 0.1		19	NA	NA	NA	NA

Notes:
Bolded values exceed one or more applicable screening levels
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RSL - Regional screening level
UJ - Estimated reporting limit
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TABLE 11-4. STORMWATER/SURFACE WATER SEDIMENT - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Acetone (ug/kg)	Allyl Chloride (ug/kg)	Benzene (mg/kg)	Bromo- benzene (ug/kg)	Bromo- chloro- methane (ug/kg)	Bromo- dichloro- methane (ug/kg)	Bromoform (ug/kg)
CC-1 (0-0.5 ft)	06/12/18	<1390 UJ	<278 UJ	<0.032	<69.6 UJ	<69.6 UJ	<69.6 UJ	<278 UJ
CC-3 (0-0.5 ft)	06/12/18	<1130 UJ	<226 UJ	<0.027	<56.5 UJ	<56.5 UJ	<56.5 UJ	<226 UJ
SD-1 (0-0.5 ft)	06/12/18	<1610 UJ	<322 UJ	<0.04	<80.5 UJ	<80.5 UJ	<80.5 UJ	<322 UJ
SD-1 (0-0.5 ft) Dup	06/12/18	<1550	<310	<0.037	<77.6	<77.6	<77.6	<310
SD-2 (0-0.5 ft)	06/12/18	<1660	<331	<0.039	<82.9	<82.9	<82.9	<331
SD-3 (0-0.5 ft)	06/12/18	<1720	<344	<0.042	<85.9	<85.9	<85.9	<344
SD-4 (0-0.5 ft)	07/16/18	<1140	<228	<0.028	<57	<57	<57	<228
EPA Region 3 BTAG Freshwater Sediment		NA	NA	NA	NA	NA	NA	654

Notes:

Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-4. STORMWATER/SURFACE WATER SEDIMENT - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Bromo-methane (ug/kg)	2-Butanone (ug/kg)	n-Butyl-benzene (ug/kg)	sec-Butylbenzene (ug/kg)	tert-Butyl-benzene (ug/kg)	Carbon tetrachloride (ug/kg)	Chlorobenzene (ug/kg)
CC-1 (0-0.5 ft)	06/12/18	<696 UJ	<348 UJ	<69.6 UJ	<69.6 UJ	<69.6 UJ	**<278 UJ**	**<69.6 UJ**
CC-3 (0-0.5 ft)	06/12/18	<565 UJ	<283 UJ	<56.5 UJ	<56.5 UJ	<56.5 UJ	**<226 UJ**	**<56.5 UJ**
SD-1 (0-0.5 ft)	06/12/18	<805 UJ	<402 UJ	<80.5 UJ	<80.5 UJ	<80.5 UJ	**<322 UJ**	**<80.5 UJ**
SD-1 (0-0.5 ft) Dup	06/12/18	<776	<388	<77.6	<77.6	<77.6	**<310**	**<77.6**
SD-2 (0-0.5 ft)	06/12/18	<829	<414	<82.9	<82.9	<82.9	**<331**	**<82.9**
SD-3 (0-0.5 ft)	06/12/18	<859	<430	<85.9	<85.9	<85.9	**<344**	**<85.9**
SD-4 (0-0.5 ft)	07/16/18	<570	<285	<57	<57	<57	**<228**	**<57**
EPA Region 3 BTAG Freshwater Sediment		NA	NA	NA	NA	NA	64.2	8.42

Notes:

Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-4. STORMWATER/SURFACE WATER SEDIMENT - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Chloroethane (ug/kg)	Chloroform (ug/kg)	Chloromethane (ug/kg)	2-Chloro-toluene (ug/kg)	4-Chloro-toluene (ug/kg)	1,2-Dibromo 3-chloro- propane (ug/kg)	Dibromo-chloromethane (ug/kg)
CC-1 (0-0.5 ft)	06/12/18	<696 UJ	<69.6 UJ	<278 UJ	<69.6 UJ	<69.6 UJ	<696 UJ	<278 UJ
CC-3 (0-0.5 ft)	06/12/18	<565 UJ	<56.5 UJ	<226 UJ	<56.5 UJ	<56.5 UJ	<565 UJ	<226 UJ
SD-1 (0-0.5 ft)	06/12/18	<805 UJ	<80.5 UJ	<322 UJ	<80.5 UJ	<80.5 UJ	<805 UJ	<322 UJ
SD-1 (0-0.5 ft) Dup	06/12/18	<776	<77.6	<310	<77.6	<77.6	<776	<310
SD-2 (0-0.5 ft)	06/12/18	<829	<82.9	<331	<82.9	<82.9	<829	<331
SD-3 (0-0.5 ft)	06/12/18	<859	<85.9	<344	<85.9	<85.9	<859	<344
SD-4 (0-0.5 ft)	07/16/18	<570	<57	<228	<57	<57	<570	<228
EPA Region 3 BTAG Freshwater Sediment		NA	NA	NA	NA	NA	NA	NA

Notes:

Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-4. STORMWATER/SURFACE WATER SEDIMENT - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2- Dibromo-ethane (ug/kg)	Dibromomethane (ug/kg)	1,2-Di- chloro-benzene (ug/kg)	1,3-Di- chloro-benzene (ug/kg)	1,4-Di- chloro-benzene (ug/kg)	Dichloro-difluoro- methan (ug/kg)	1,1-Dichloro-ethane (ug/kg)
CC-1 (0-0.5 ft)	06/12/18	<69.6 UJ	<69.6 UJ	**<69.6 UJ**	<69.6 UJ	<69.6 UJ	<278 UJ	<69.6 UJ
CC-3 (0-0.5 ft)	06/12/18	<56.5 UJ	<56.5 UJ	**<56.5 UJ**	<56.5 UJ	<56.5 UJ	<226 UJ	<56.5 UJ
SD-1 (0-0.5 ft)	06/12/18	<80.5 UJ	<80.5 UJ	**<80.5 UJ**	<80.5 UJ	<80.5 UJ	<322 UJ	<80.5 UJ
SD-1 (0-0.5 ft) Dup	06/12/18	<77.6	<77.6	**<77.6**	<77.6	<77.6	<310 UJ	<77.6
SD-2 (0-0.5 ft)	06/12/18	<82.9	<82.9	**<82.9**	<82.9	<82.9	<331 UJ	<82.9
SD-3 (0-0.5 ft)	06/12/18	<85.9	<85.9	**<85.9**	<85.9	<85.9	<344 UJ	<85.9
SD-4 (0-0.5 ft)	07/16/18	<57	<57	**<57**	<57	<57	<228	<57
EPA Region 3 BTAG Freshwater Sediment		NA	NA	16.5	4,430	599	NA	NA

Notes:

Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-4. STORMWATER/SURFACE WATER SEDIMENT - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2- Dichloro-ethane (ug/kg)	1,1-Dichloro-ethene (ug/kg)	cis-1,2- Dichloro - ethene (ug/kg)	trans-1,2- Dichloro- ethene (ug/kg)	Dichlorofluorom ethane (ug/kg)	1,2-Dichloro-propane (ug/kg)	1,3-Dichloro-propane (ug/kg)
CC-1 (0-0.5 ft)	06/12/18	<69.6 UJ	**<69.6 UJ**	<69.6 UJ	<69.6 UJ	<696 UJ	<69.6 UJ	<69.6 UJ
CC-3 (0-0.5 ft)	06/12/18	<56.5 UJ	**<56.5 UJ**	<56.5 UJ	<56.5 UJ	<565 UJ	<56.5 UJ	<56.5 UJ
SD-1 (0-0.5 ft)	06/12/18	<80.5 UJ	**<80.5 UJ**	<80.5 UJ	<80.5 UJ	<805 UJ	<80.5 UJ	<80.5 UJ
SD-1 (0-0.5 ft) Dup	06/12/18	<77.6	**<77.6**	<77.6	<77.6	<776	<77.6	<77.6
SD-2 (0-0.5 ft)	06/12/18	<82.9	**<82.9**	<82.9	<82.9	<829	<82.9	<82.9
SD-3 (0-0.5 ft)	06/12/18	<85.9	**<85.9**	<85.9	<85.9	<859	<85.9	<85.9
SD-4 (0-0.5 ft)	07/16/18	<57	**<57**	<57	<57	<570	<57	<57
EPA Region 3 BTAG Freshwater Sediment		NA	31	NA	1,050	NA	NA	NA

Notes:

Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-4. STORMWATER/SURFACE WATER SEDIMENT - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	2,2-Dichloro-propane (ug/kg)	1,1-Dichloro-propene (ug/kg)	Cis-1,3- dichloro - propene (ug/kg)	trans-1,3- Dichloro- propen (ug/kg)	Diethyl ether (ug/kg)	Ethyl- benzene (mg/kg)	Hexachloro-butadiene (ug/kg)
CC-1 (0-0.5 ft)	06/12/18	<278 UJ	<69.6 UJ	<278 UJ	<278 UJ	<278 UJ	<0.0696 UJ	<348 UJ
CC-3 (0-0.5 ft)	06/12/18	<226 UJ	<56.5 UJ	<226 UJ	<226 UJ	<226 UJ	<0.0565 UJ	<283 UJ
SD-1 (0-0.5 ft)	06/12/18	<322 UJ	<80.5 UJ	<322 UJ	<322 UJ	<322 UJ	<0.081	<402 UJ
SD-1 (0-0.5 ft) Dup	06/12/18	<310	<77.6	<310	<310	<310	<0.0776	<388
SD-2 (0-0.5 ft)	06/12/18	<331	<82.9	<331	<331	<331	<0.0829	<414
SD-3 (0-0.5 ft)	06/12/18	<344	<85.9	<344	<344	<344	<0.0859	<430
SD-4 (0-0.5 ft)	07/16/18	<228	<228	<57	<228	<228	<0.057	<285
EPA Region 3 BTAG Freshwater Sediment		NA	NA	NA	NA	NA	1.1	NA

Notes:

Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-4. STORMWATER/SURFACE WATER SEDIMENT - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Isopropyl-benzene (ug/kg)	p-Isopropyl-toluene (ug/kg)	4-Methyl- 2-Pentanone (ug/kg)	Methylene Chloride (ug/kg)	MTBE (mg/kg)	Naphthalene (mg/kg)	n-Propyl-benzene (ug/kg)
CC-1 (0-0.5 ft)	06/12/18	<69.6 UJ	<69.6 UJ	<348 UJ	<278 UJ	<0.0696 UJ	**<0.76**	<69.6 UJ
CC-3 (0-0.5 ft)	06/12/18	<56.5 UJ	<56.5 UJ	<283 UJ	37.9 J-	<0.0565 UJ	**<0.64**	<56.5 UJ
SD-1 (0-0.5 ft)	06/12/18	<80.5 UJ	<80.5 UJ	<402 UJ	<322 UJ	<0.081	**<0.97**	<80.5 UJ
SD-1 (0-0.5 ft) Dup	06/12/18	<77.6	<77.6	<388	<310	<0.0776	**<0.89**	<77.6
SD-2 (0-0.5 ft)	06/12/18	<82.9	<82.9	<414	<331	<0.0829	**<0.94**	<82.9
SD-3 (0-0.5 ft)	06/12/18	<85.9	<85.9	<430	<344	<0.0859	**<1**	<85.9
SD-4 (0-0.5 ft)	07/16/18	<57	<57	<285	<228	<0.057	**<0.67**	<57
EPA Region 3 BTAG Freshwater Sediment		86	NA	NA	NA	NA	0.176	NA

Notes:

Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-4. STORMWATER/SURFACE WATER SEDIMENT - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Styrene (ug/kg)	1,1,1,2-Tetrachloro- eth (ug/kg)	1,1,2,2-Tetrachloro- eth (ug/kg)	Tetrachloro-ethene (ug/kg)	Tetrahydrofuran (ug/kg)	Toluene (mg/kg)	1,2,3- Trichloro-benzene (ug/kg)
CC-1 (0-0.5 ft)	06/12/18	<69.6 UJ	<278 UJ	<69.6 UJ	<69.6 UJ	<2780 UJ	<0.0696 UJ	<69.6 UJ
CC-3 (0-0.5 ft)	06/12/18	<56.5 UJ	<226 UJ	<56.5 UJ	<56.5 UJ	<2260 UJ	<0.0565 UJ	<56.5 UJ
SD-1 (0-0.5 ft)	06/12/18	<80.5 UJ	<322 UJ	<80.5 UJ	<80.5 UJ	<3220 UJ	<0.081	<80.5 UJ
SD-1 (0-0.5 ft) Dup	06/12/18	<77.6	<310	<77.6	<77.6	<3100	<0.0776	<77.6
SD-2 (0-0.5 ft)	06/12/18	<82.9	<331	<82.9	<82.9	<3310	0.01 J	<82.9
SD-3 (0-0.5 ft)	06/12/18	<85.9	<344	<85.9	<85.9	<3440	0.0117 J	<85.9
SD-4 (0-0.5 ft)	07/16/18	<57	<228	<57	<228	<2280	<0.057	<57
EPA Region 3 BTAG Freshwater Sediment		559	NA	1,360	468	NA	NA	858

Notes:

Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-4. STORMWATER/SURFACE WATER SEDIMENT - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4- Trichloro- benzene (ug/kg)	1,1,1- Trichloro- ethane (ug/kg)	1,1,2- Trichloro- ethane (ug/kg)	Trichloro- ethene (ug/kg)	Trichloro- fluoromethane (ug/kg)	1,2,3- Trichloro- propane (ug/kg)	1,1,2- Trichloro- trifluoro- ethane (ug/kg)
CC-1 (0-0.5 ft)	06/12/18	<69.6 UJ	**<69.6 UJ**	<69.6 UJ	<69.6 UJ	<278 UJ	<278 UJ	<696 UJ
CC-3 (0-0.5 ft)	06/12/18	<56.5 UJ	**<56.5 UJ**	<56.5 UJ	<56.5 UJ	<226 UJ	<226 UJ	<565 UJ
SD-1 (0-0.5 ft)	06/12/18	<80.5 UJ	**<80.5 UJ**	<80.5 UJ	<80.5 UJ	<322 UJ	<322 UJ	<805 UJ
SD-1 (0-0.5 ft) Dup	06/12/18	<77.6	**<77.6**	<77.6	<77.6	<310	<310	<776
SD-2 (0-0.5 ft)	06/12/18	<82.9	**<82.9**	<82.9	<82.9	<331	<331	<829
SD-3 (0-0.5 ft)	06/12/18	<85.9	**<85.9**	<85.9	<85.9	<344	<344	<859
SD-4 (0-0.5 ft)	07/16/18	<57	**<228**	<57	<57	<228	<228	<570
EPA Region 3 BTAG Freshwater Sediment		2,100	30.2	1,240	96.9	NA	NA	NA

Notes:

Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-4. STORMWATER/SURFACE WATER SEDIMENT - VOC ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	1,2,4- Trimethyl-benzene (ug/kg)	1,3,5-Trimethyl-benzene (ug/kg)	Vinyl Chloride (ug/kg)	m,p-Xylene (mg/kg)	o-Xylene (mg/kg)	Xylenes, Total (mg/kg)
CC-1 (0-0.5 ft)	06/12/18	<69.6 UJ	<69.6 UJ	<27.8 UJ	<0.13	<0.13	<0.25
CC-3 (0-0.5 ft)	06/12/18	<56.5 UJ	<56.5 UJ	<22.6 UJ	<0.11	<0.11	<0.21
SD-1 (0-0.5 ft)	06/12/18	<80.5 UJ	<80.5 UJ	<32.2 UJ	<0.16	<0.16	<0.32
SD-1 (0-0.5 ft) Dup	06/12/18	<77.6	<77.6	<31	<0.15	<0.15	<0.3
SD-2 (0-0.5 ft)	06/12/18	<82.9	<82.9	<33.1	<0.16	<0.16	<0.31
SD-3 (0-0.5 ft)	06/12/18	<85.9	<85.9	<34.4	<0.17	<0.17	<0.34
SD-4 (0-0.5 ft)	07/16/18	<57	<57	<228	<0.11	<0.11	<0.22
EPA Region 3 BTAG Freshwater Sediment		NA	NA	NA	NA	NA	NA

Notes:

Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-5. STORMWATER/SURFACE WATER SEDIMENT - METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Aluminum, Total (mg/kg)	Antimony, Total (mg/kg)	Arsenic, Total (mg/kg)	Barium, Total (mg/kg)	Beryllium, Total (mg/kg)	Cadmium, Total (mg/kg)	Chromium, Total (mg/kg)
CC-1 (0-0.5 ft)	06/12/18	4290	<1.3 UJ	2.6	43.5	0.27 J	0.1 J	10.5
CC-3 (0-0.5 ft)	06/12/18	3100	<1.1 UJ	4.4	71.4	0.28	0.075 J	24.1
SD-1 (0-0.5 ft)	06/12/18	21300	<1.6 UJ	**15.7**	158 J	0.84	0.21 J	27.7
SD-1 (0-0.5 ft) Dup	06/12/18	13500	<1.5 UJ	**10**	92.4 J	0.68	0.17 J	16.8
SD-2 (0-0.5 ft)	06/12/18	15600	<1.6 UJ	7.8	127	0.85	0.22 J	20.1
SD-3 (0-0.5 ft)	06/12/18	15600	<1.7 UJ	**10.2**	132	0.87	0.18 J	20
SD-4 (0-0.5 ft)	07/16/18	3530	<1.1	1.1 J	92.3	0.054 J	0.19	6.7
EPA Region 3 BTAG Freshwater Sediment		NA	2	9.8	NA	NA	0.99	43.4

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.

BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-5. STORMWATER/SURFACE WATER SEDIMENT - METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Cobalt, Total (mg/kg)	Copper, Total (mg/kg)	Iron, Total (mg/kg)	Lead, Total (mg/kg)	Manganese, Total (mg/kg)	Mercury, Total (mg/kg)	Nickel, Total (mg/kg)
CC-1 (0-0.5 ft)	06/12/18	2.4	7.1	6520	10.3	82.2 J+	<0.023	5
CC-3 (0-0.5 ft)	06/12/18	3.3	**571**	**39600**	**330**	312 J+	<0.021	8.7
SD-1 (0-0.5 ft)	06/12/18	9.4 J	28.5	**26600**	**39.7 J**	224 J+	0.028 J	**24.6 J**
SD-1 (0-0.5 ft) Dup	06/12/18	5.4 J	17.7	**20700**	19.8 J	139 J+	0.024 J	14.1 J
SD-2 (0-0.5 ft)	06/12/18	6.2	19.9	**23300**	17.8	147 J+	0.028	16.8
SD-3 (0-0.5 ft)	06/12/18	7.2	19.7	**24400**	15.3	188 J+	0.029	17.7
SD-4 (0-0.5 ft)	07/16/18	2.7	8.9	6840	**129**	100	0.014 J	5.9
EPA Region 3 BTAG Freshwater Sediment		50	31.6	20,000	35.8	460	0.18	22.7

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.

BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-5. STORMWATER/SURFACE WATER SEDIMENT - METALS ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Selenium, Total (mg/kg)	Silver, Total (mg/kg)	Thallium, Total (mg/kg)	Vanadium, Total (mg/kg)	Zinc, Total (mg/kg)
CC-1 (0-0.5 ft)	06/12/18	0.58 J	<0.65	<1.3	13.5	49.2 J-
CC-3 (0-0.5 ft)	06/12/18	0.4 J	<0.56	<1.1	14	73.2 J-
SD-1 (0-0.5 ft)	06/12/18	0.65 J	<0.82	<8.2	49	**161 J-**
SD-1 (0-0.5 ft) Dup	06/12/18	<1.5	<0.74	<1.5	31.5	93.4 J-
SD-2 (0-0.5 ft)	06/12/18	<1.6	<0.82	<1.6	36.7	103 J-
SD-3 (0-0.5 ft)	06/12/18	<1.7	<0.85	<1.7	35.6	95.5 J-
SD-4 (0-0.5 ft)	07/16/18	<1.1	<0.57	<1.1	13.1	33.9
EPA Region 3 BTAG Freshwater Sediment		2	1	NA	NA	121

Notes:
Bolded results indicate exceedance of one or more applicable screening levels.

BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J+ - Estimated concentration, possibly biased high
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-6. STORMWATER/SURFACE WATER SEDIMENT - EPH/VPH ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Benzene (mg/kg)	Ethyl- benzene (mg/kg)	MTBE (mg/kg)	Naphthalene (mg/kg)	Toluene (mg/kg)	m,p-Xylene (mg/kg)	o-Xylene (mg/kg)
CC-1 (0-0.5 ft)	06/12/18	<0.032	<0.064	<0.064	**<0.76**	<0.064	<0.13	<0.13
CC-3 (0-0.5 ft)	06/12/18	<0.027	<0.053	<0.053	**<0.64**	<0.053	<0.11	<0.11
SD-1 (0-0.5 ft)	06/12/18	<0.04	<0.081	<0.081	**<0.97**	<0.081	<0.16	<0.16
SD-1 (0-0.5 ft) Dup	06/12/18	<0.037	<0.074	<0.074	**<0.89**	<0.074	<0.15	<0.15
SD-2 (0-0.5 ft)	06/12/18	<0.039	<0.078	<0.078	**<0.94**	<0.078 UJ	<0.16	<0.16
SD-3 (0-0.5 ft)	06/12/18	<0.042	<0.084	<0.084	**<1**	<0.084 UJ	<0.17	<0.17
SD-4 (0-0.5 ft)	07/16/18	<0.028	<0.055	<0.055	**<0.67**	<0.055	<0.11	<0.11
EPA Region 3 BTAG Freshwater Sediment		NA	1.1	NA	0.176	NA	NA	NA

Notes:
Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 11-6. STORMWATER/SURFACE WATER SEDIMENT - EPH/VPH ANALYTICAL RESULTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Location ID	Date Sampled	Xylenes, Total (mg/kg)	C5-C8, Aliphatic, Adjust (mg/kg)	C9-C12, Aliphatic, Adjust (mg/kg)	Total Extractable Hydrocarbon (mg/kg)	Total Purgeable Hydrocarbon (mg/kg)
CC-1 (0-0.5 ft)	06/12/18	<0.25	0.34 J	0.029 J	64.9 J-	0.32 J
CC-3 (0-0.5 ft)	06/12/18	<0.21	<5.3	<5.3	147	<10.7
SD-1 (0-0.5 ft)	06/12/18	<0.32	<8.1	<8.1	53.4 J	<16.1
SD-1 (0-0.5 ft) Dup	06/12/18	<0.3	<7.4	<7.4	53.3 J	<14.8
SD-2 (0-0.5 ft)	06/12/18	<0.31	<7.8	<7.8	73.9	<15.6
SD-3 (0-0.5 ft)	06/12/18	<0.34	<8.4	<8.4	70.1	<16.9
SD-4 (0-0.5 ft)	07/16/18	<0.22	<5.5	<5.5	84 J	<11.1
EPA Region 3 BTAG Freshwater Sediment		NA	NA	NA	NA	NA

Notes:
Bolded values exceed one or more applicable screening levels
BTAG - Biological Technical Assistance Group
EPA - United States Environmental Protection Agency
J- - Estimated concentration, possibly biased low
J - Estimated concentration
RSL - Regional screening level
UJ - Estimated reporting limit

TABLE 12-1. FACILITY CHEMICALS OF POTENTIAL CONCERN
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

Media	COPCs
Surface soil - leaching to groundwater	tetrachloroethene (PCE)
Subsurface soil - direct contact	benzo(a)pyrene
Subsurface soil - leaching to groundwater	1,2,4-trimethylbenzene PCE
Groundwater	1-methylnaphthalene benzene cobalt C5-C8 aliphatic hydrocarbons C9-C10 aromatic hydrocarbons C9-C12 aliphatic hydrocarbons *cis*-1,2-dichloroethene iron manganese PCE trichloroethene (TCE) vinyl chloride
Indoor air	1,2-dichloroethane 1,2,4-trimethylbenzene 1,3-butadiene benzene bromodichloromethane carbon tetrachloride chloroform TCE PCE C5-C8 aliphatic hydrocarbons C9-C12 aliphatic hydrocarbons

Notes

COPC - chemical of potential concern

PCE - tetrachloroethene

TCE - trichloroethene

TABLE 12-2. GENERAL PHYSICAL AND CHEMICAL PROPERTIES OF COPCs
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

COPC	CAS#	Aqueous Solubility (mg/L)	Log K_{ow}	Log K_{oc}	Vapor Pressure (mmHg)	Henry's Law Constant (kPa-m^3/mol)	Density, g/mL	Flashpoint °C
1,2,4-trimethylbenzene	95-63-6	57	3.8	3.34	1*	0.524	0.88	44
1,2-dichloroethane	107-06-2	8,690	1.48	1.52	79.1	0.14	1.253	--
1,3-butadiene	106-99-0	735	1.99	2.45	2110	--	0.65	-76
1-methylnaphthalene	90-12-0	25.8	3.87	2.76-5.78	0.054	0.036	1.01	--
benzene	71-43-2	1,800	2.13	1.5-1.7	75	0.557	0.879	-11
benzo(a)pyrene	50-32-8	0.0023	6.06	6.74	5.6×10^{-9}	4.9×10^{-7}	1.351	--
bromodichloromethane	75-27-4	3,030	2	1.8	50	0.223	1.98	--
C5-C8 aliphatics	--	11	--	--	76	--	--	--
C9-C10 aromatics	--	51	--	--	2.2	--	--	--
C9-C12 aliphatics	--	0.07	--	--	0.66	--	--	--
carbon tetrachloride	56-23-5	800	2.64	2.04	90	2.98	1.59	--
chloroform	67-66-3	7,430	1.97	2.4	160	0.411	1.485	--
cis -1,2-dichloroethene	156-59-2	3,500	1.86	1.69	180	0.46	1.28	6
cobalt	7440-48-4	<1	--	--	--	--	8.9	--
iron	7439-89-6	<1	--	--	--	--	7.87	--
manganese	7439-96-5	--	--	--	--	--	7.26	--
PCE	127-18-4	206	3.4	2.2-2.54	18.5	1.73	1.623	--
TCE	79-01-6	1,280	2.61	2	69	1.03	1.464	--
vinyl chloride	75-01-4	2,763	1.36	1.99	2,530	2.68	--	-78

Notes

-- - Data not reported

* - vapor pressure reported at 13.3 C

< - less than

°C - degrees Celsius

COPC Contaminant of Potential

Koc - Organic-carbon partition

Kow - Octanol-water partition

kPa-m3/mol - kilopascals cubic meters per mol

mg/L - milligrams per liter

mmHg - millimeters mercury

PCE - tetrachloroethene

TCE - trichloroethene

TABLE 12-3. PHYSICAL PROPERTIES OF ORGANIC CONTAMINANTS
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

Property	Range	Qualitative Description	Source
Sorption- Soil-organic carbon water partitioning coefficient (K_{oc})	< 10	Very weakly sorbed	Little, A.D. inc., 1989
	10 - 100	Weakly sorbed	
	100 - 1000	Moderately sorbed	
	1,000 - 10,000	Moderately to strongly sorbed	
	>100,000	strongly sorbed	
Mobility - Based on a combination of solubility(s) and soil adsorption (K_{oc})	s > 3500 and K_{oc} < 50	Very high mobility	Cohen and Mercer, 1993; Ney 1990
	3500 > s > 850 and 50 < K_{oc} < 500	High mobility	
	800 > s > 150 and 150 < K_{oc} < 2,000	Moderate mobility	
	150 > s > 15 and 500 < K_{oc} < 20,000	Low mobility	
	15 > s > 0.2 and 2,000 < K_{oc} < 20,000	Slight mobility	
	s < 0.2 and K_{oc} > 20,000	Immobile	
Volatility - Henry's Law Constant (H)	$H < 3 \times 10^{-7}$	Non-volatile	Fetter, C. W., 1988
	$3 \times 10^{-7} < H < 10^{-5}$	Low volatility	
	$10^{-6} < H < 10^{-3}$	Moderate volatility	
	$10^{-3} < H$	High volatility	

Notes:
This table reproduced from Table 5-2 of the North Belmont PCE Site Remedial Investigation Report. North Belmont, Gaston County NC, SESD Project No. 96S-058/ June, 1997

TABLE 12-4. RETARDATION FACTORS CALCULATED FOR ORGANIC COPCs
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA

COPC	K_{oc} (ml/g)	f_{oc}	K_d (ml/g)	Bulk Density (g/mL)	Total Porosity	R
1,2,4-trimethylbenzene	2187.8	0.013	28.4409	2.13	0.28	217
1,2-dichloroethane	33.113	0.013	0.43047	2.13	0.28	4.27
1,3-butadiene	281.84	0.013	3.6639	2.13	0.28	28.9
1-methylnaphthalene	575.44	0.013	7.48072	2.13	0.28	57.9
benzene	59	0.013	0.767	2.13	0.28	6.83
benzo(a)pyrene	5E+06	0.013	71440.3	2.13	0.28	5.43E+05
bromodichloromethane	63.096	0.013	0.82024	2.13	0.28	7.24
C5-C8 aliphatics	--	0.013	--	2.13	0.28	--
C9-C10 aromatics	--	0.013	--	2.13	0.28	--
C9-C12 aliphatics	--	0.013	--	2.13	0.28	--
carbon tetrachloride	109.65	0.013	1.42542	2.13	0.28	11.8
chloroform	251.19	0.013	3.26545	2.13	0.28	25.8
cis-1,2-dichloroethene	48.978	0.013	0.63671	2.13	0.28	5.84
PCE	155	0.013	2.015	2.13	0.28	16.3
TCE	100	0.013	1.3	2.13	0.28	10.9
vinyl chloride	97.724	0.013	1.27041	2.13	0.28	10.7

Notes

-- - Data not reported

COPC - Contaminant of Potential Concern

f_{oc} - fraction organic carbon

g/ml - grams per milliliter

K_d - distribution coefficient

K_{oc} - Organic-carbon partition

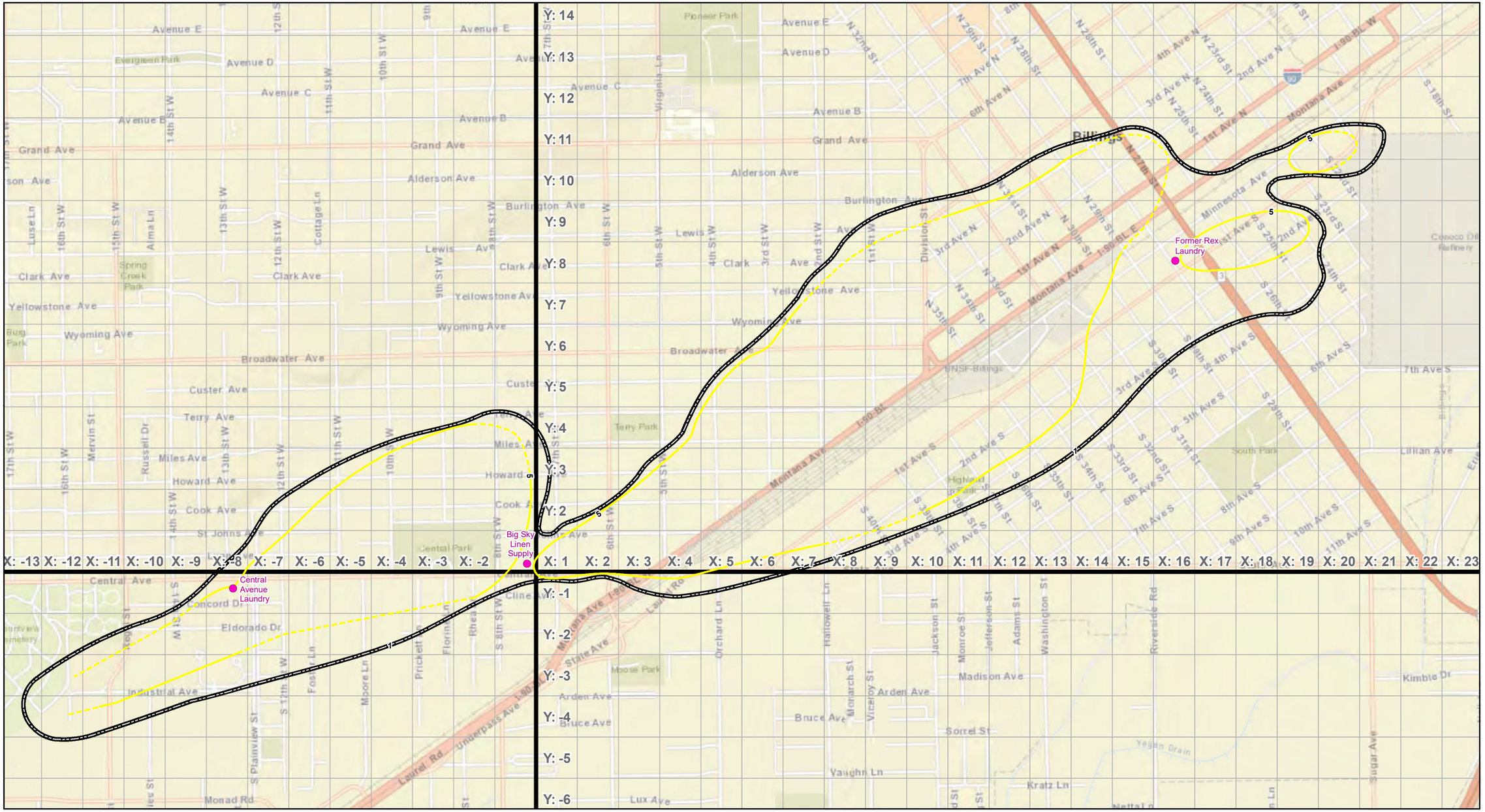
ml/g - milliliters per gram

PCE - tetrachloroethene

R - retardation factor

TCE - trichloroethene

FIGURES



EXPLANATION

- DRY CLEANING SITES
- 5 µg/L PCE CONTOUR, DASHED WHERE INFERRED (SEPT. 2018)
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

NOTE:
PCE = TETRACHLOROTHENE

N

0 1,200'

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FIGURE 1-1

FACILITY LOCATION AND BOUNDARY

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 12/27/18	File: Fig1-1_Billings_FacilityDiscussion.mxd

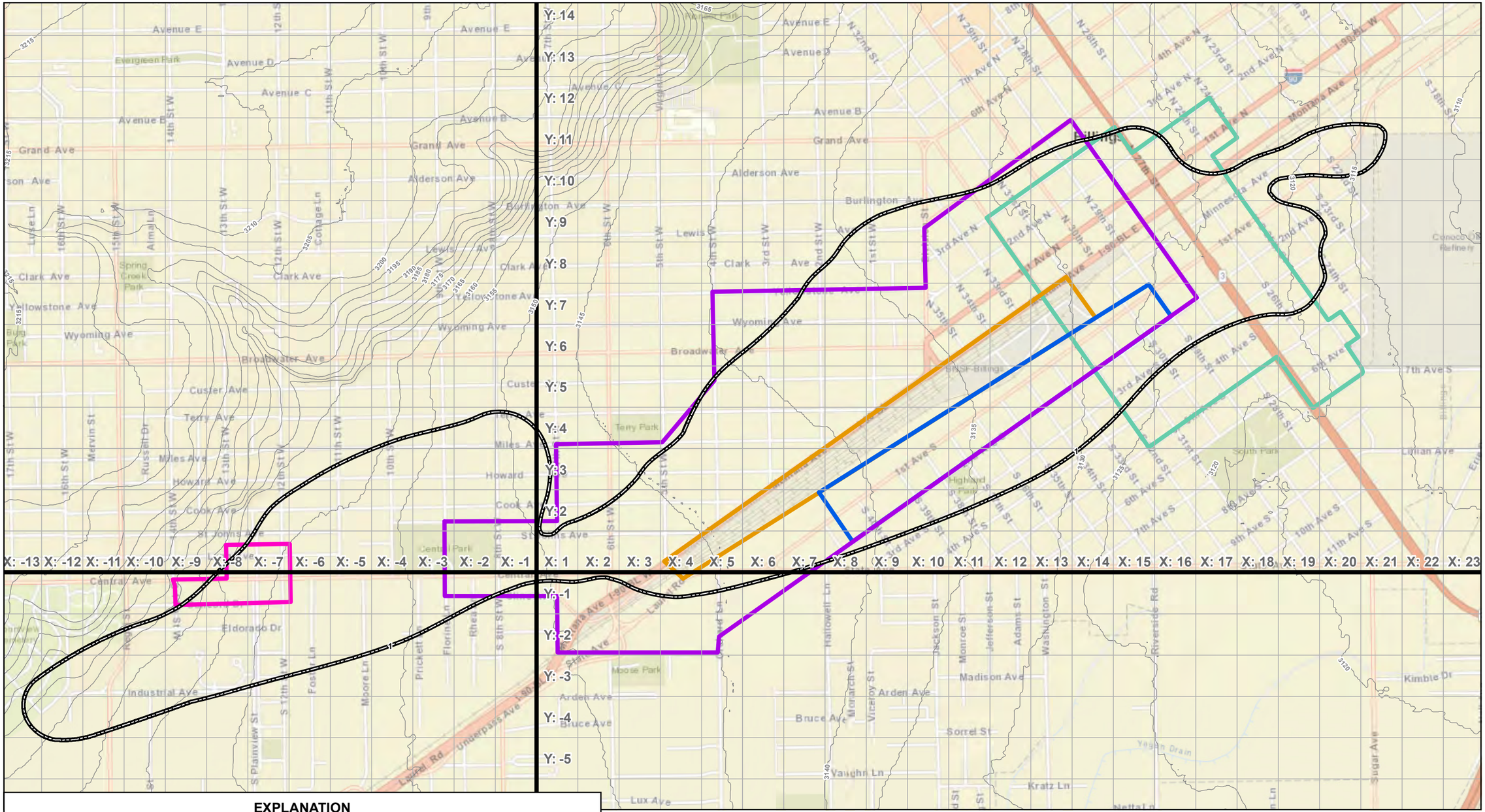

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FIGURE 2-1

FACILITY SURFACE TOPOGRAPHY

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 12/27/18	File: Fig2-1_Billings_Topo.mxd

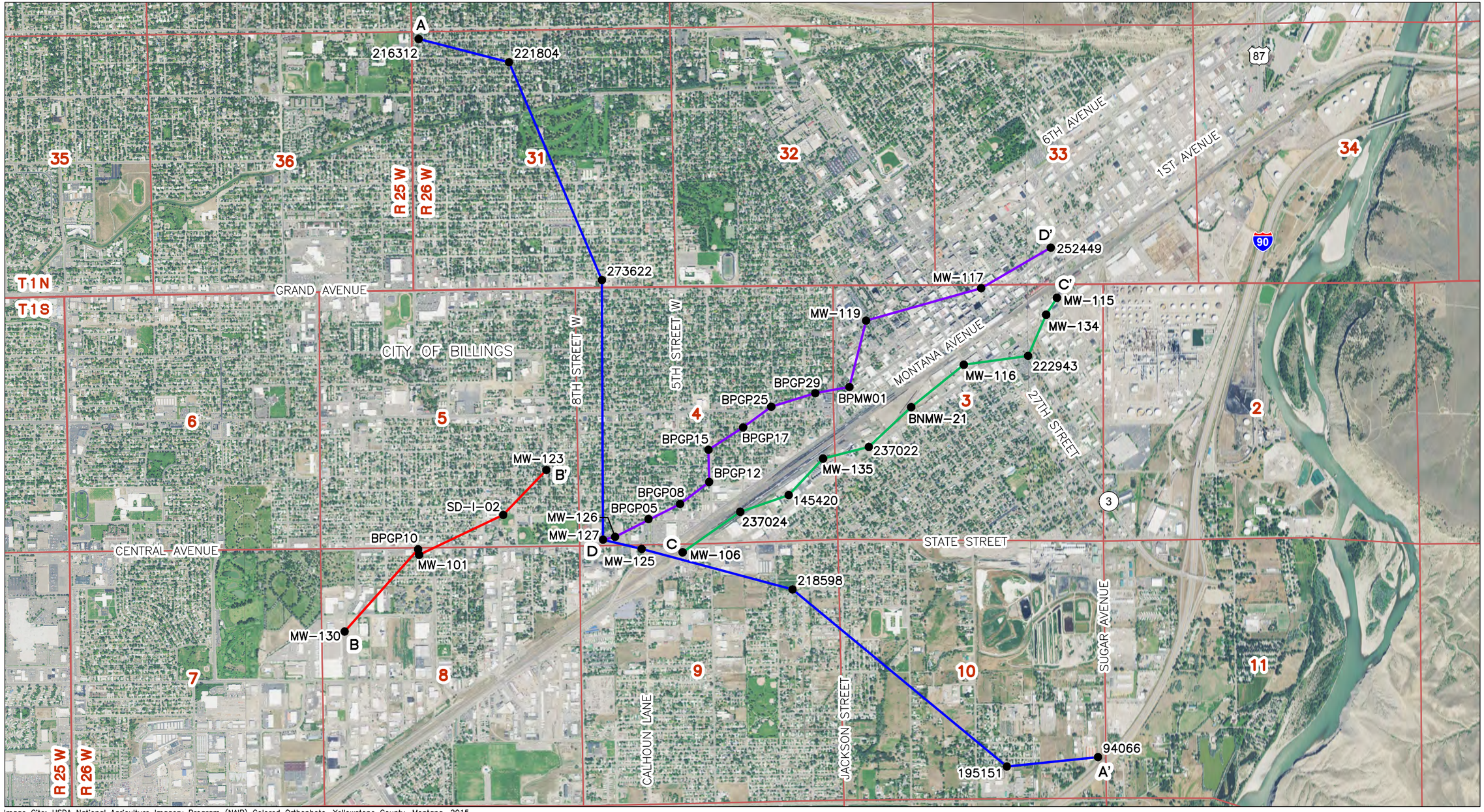

Image Cite: USDA National Agriculture Imagery Program (NAIP) Colored Orthophoto, Yellowstone County, Montana, 2015

SITE LOCATION

EXPLANATION

90	INTERSTATE HIGHWAY
87	US HIGHWAY AND DESIGNATION
3	STATE HIGHWAY AND DESIGNATION
MW-130	MONITORING WELL AND DESIGNATION
	SECTION LINE
	TOWNSHIP/RANGE LINE
A — A'	CROSS SECTION A-A'
B — B'	CROSS SECTION B-B'
C — C'	CROSS SECTION C-C'
D — D'	CROSS SECTION D-D'

N

0 2,000'

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FIGURE 2-2

CROSS SECTION LOCATIONS

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PAC	Checked By: DF	Scale: 1" = 2,000'	Date: 9/5/18	File: 776-XSECLOCATION201808

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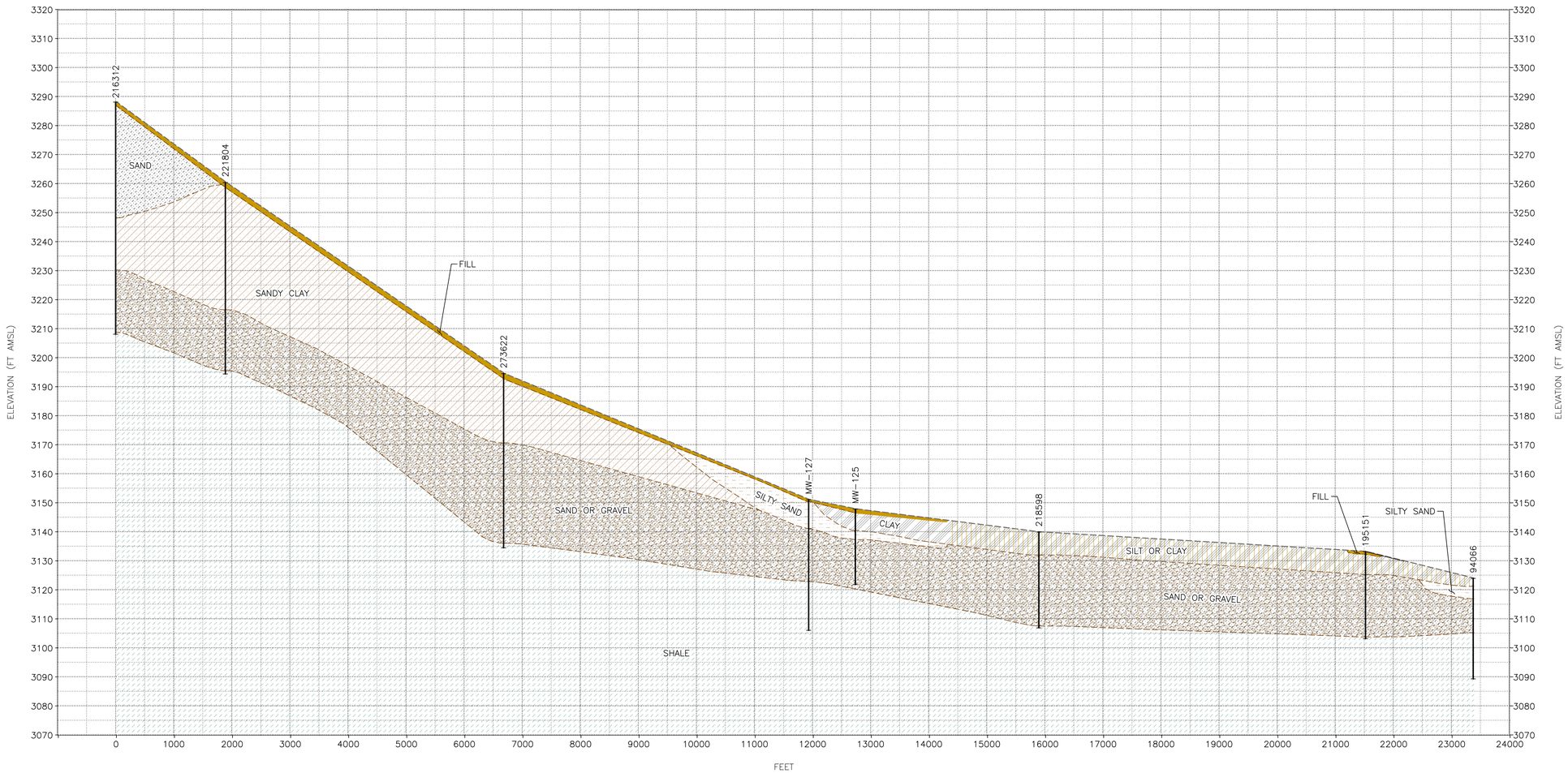

EXPLANATION

WELL/BORING ID → 216312

WELL/BORING SHAFT

- FILL (INCLUDES ASPHALT, FILL, AND TOPSOIL)
- SILT
- CLAYEY SILT
- SANDY SILT
- SILTY SAND
- SANDY CLAY
- GRAVEL
- SANDY GRAVEL
- SAND
- GRAVELLY SAND
- CLAY
- SILTY CLAY
- SHALE

0 — 1,000' — 2,000' HORIZONTAL

0 — 20' — 40' VERTICAL

VERTICAL EXAGGERATION = 50X

WARNING

IF THIS BAR DOES NOT MEASURE 1" THEN THIS DRAWING IS NOT TO SCALE

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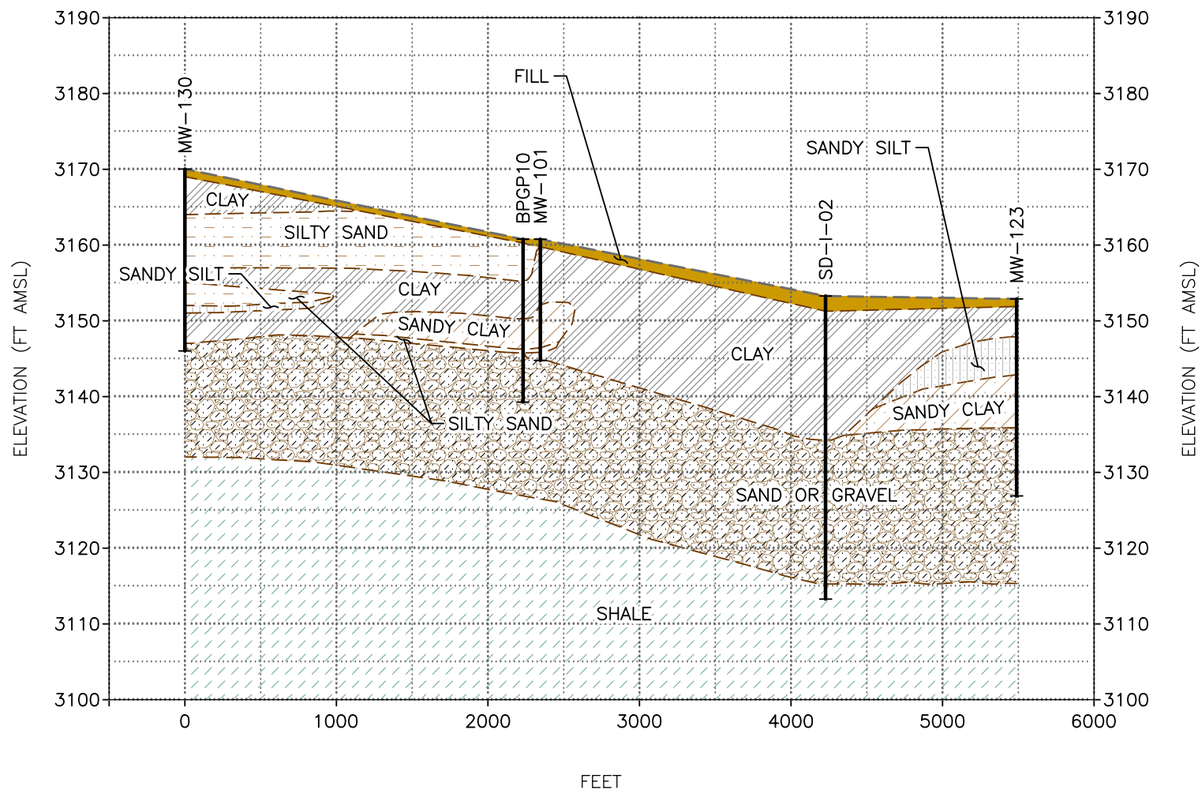
FIGURE 2-3

CROSS SECTION A-A'

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PAC	Checked By: DF	Scale: AS SHOWN	Date: 4/12/19	File: 776-XSECA-D-201904



EXPLANATION

WELL/BORING ID → MW-130

WELL/BORING SHAFT

- FILL (INCLUDES ASPHALT, FILL, AND TOPSOIL)
- SILT
- CLAYEY SILT
- SANDY SILT
- SILTY SAND
- SANDY CLAY
- GRAVEL
- SAND
- CLAY
- SILTY CLAY
- SHALE

0 — 1,000' HORIZONTAL

0 — 20' VERTICAL

VERTICAL EXAGGERATION = 50X

WARNING

IF THIS BAR DOES NOT MEASURE 1" THEN THIS DRAWING IS NOT TO SCALE

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FIGURE 2-4

CROSS SECTION B-B'

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PAC	Checked By: DF	Scale: AS SHOWN	Date: 4/12/19	File: 776-XSECA-D-201904

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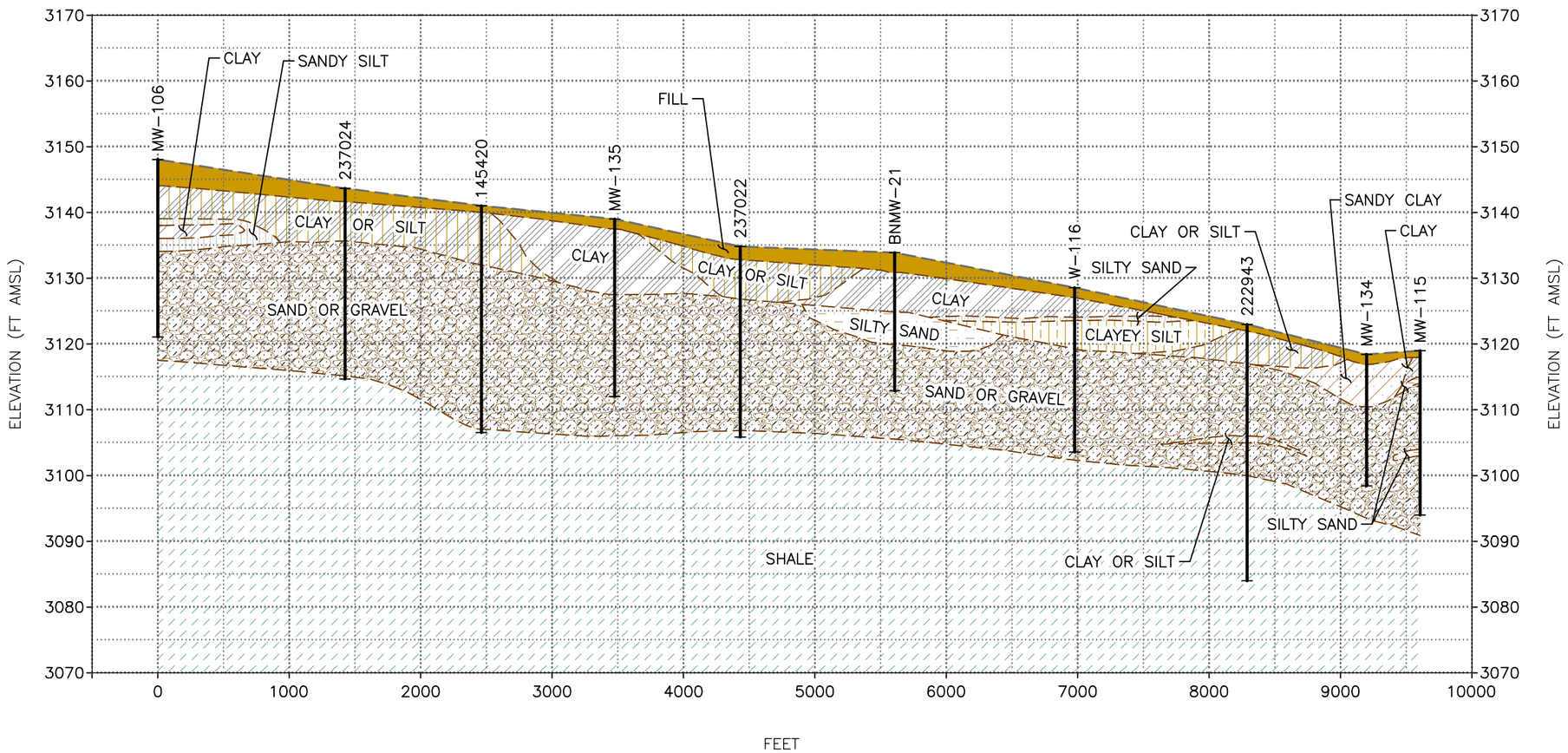

EXPLANATION

WELL/BORING ID → MW-106

WELL/BORING SHAFT

- FILL (INCLUDES ASPHALT, FILL, AND TOPSOIL)
- SILT
- CLAYEY SILT
- SANDY SILT
- SILTY SAND
- SANDY CLAY
- GRAVEL
- SAND
- CLAY
- SILTY CLAY
- SHALE

0 — 1,000' HORIZONTAL

0 — 20' VERTICAL

VERTICAL EXAGGERATION = 50X

WARNING

IF THIS BAR DOES NOT MEASURE 1" THEN THIS DRAWING IS NOT TO SCALE

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FIGURE 2-5

CROSS SECTION C-C'

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PAC	Checked By: DF	Scale: AS SHOWN	Date: 4/12/19	File: 776-XSECA-D-201904

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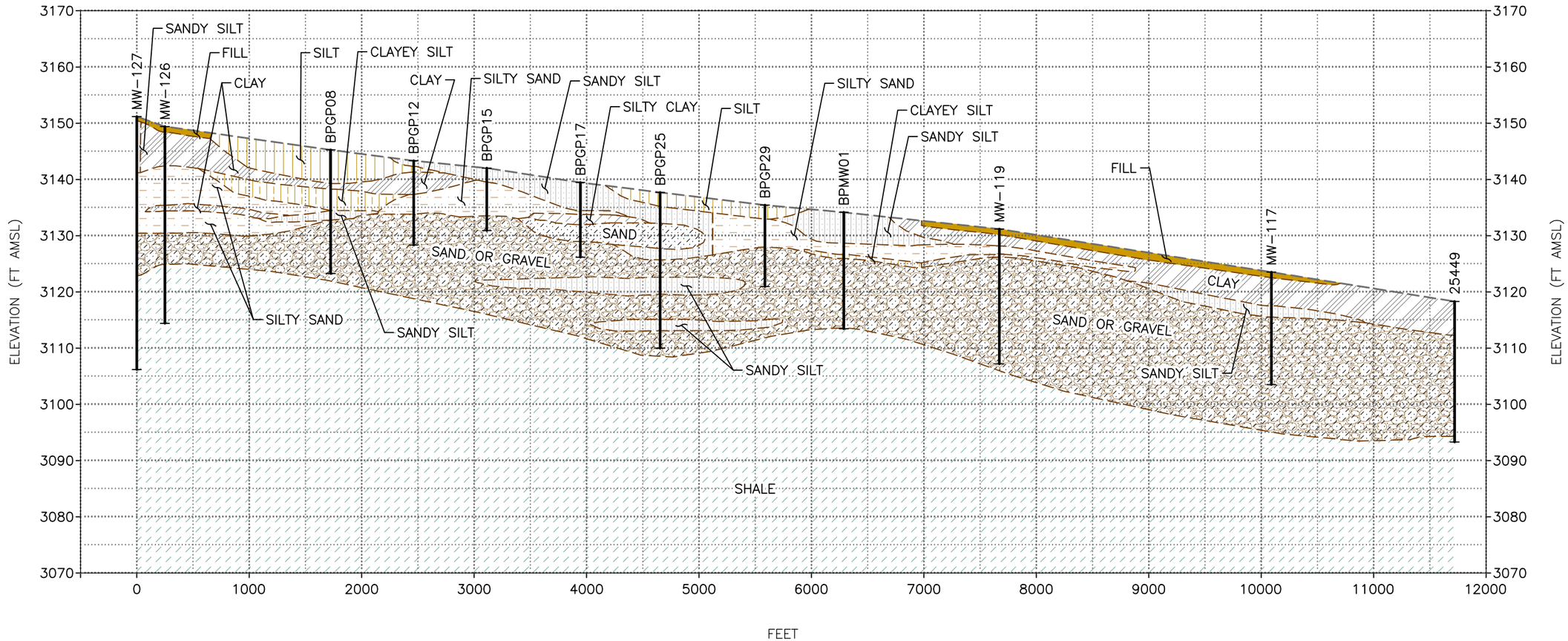

EXPLANATION

WELL/BORING ID → MW-127

WELL/BORING SHAFT

- FILL (INCLUDES ASPHALT, FILL, AND TOPSOIL)
- SILT
- CLAYEY SILT
- SANDY SILT
- SILTY SAND
- SANDY CLAY
- GRAVEL
- SAND
- CLAY
- SILTY CLAY
- SHALE

0 1,000' HORIZONTAL

0 20' VERTICAL

VERTICAL EXAGGERATION = 50X

WARNING

IF THIS BAR DOES NOT MEASURE 1" THEN THIS DRAWING IS NOT TO SCALE

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FIGURE 2-6

CROSS SECTION D-D'

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PAC	Checked By: DF	Scale: AS SHOWN	Date: 4/12/19	File: 776-XSECA-D-201904

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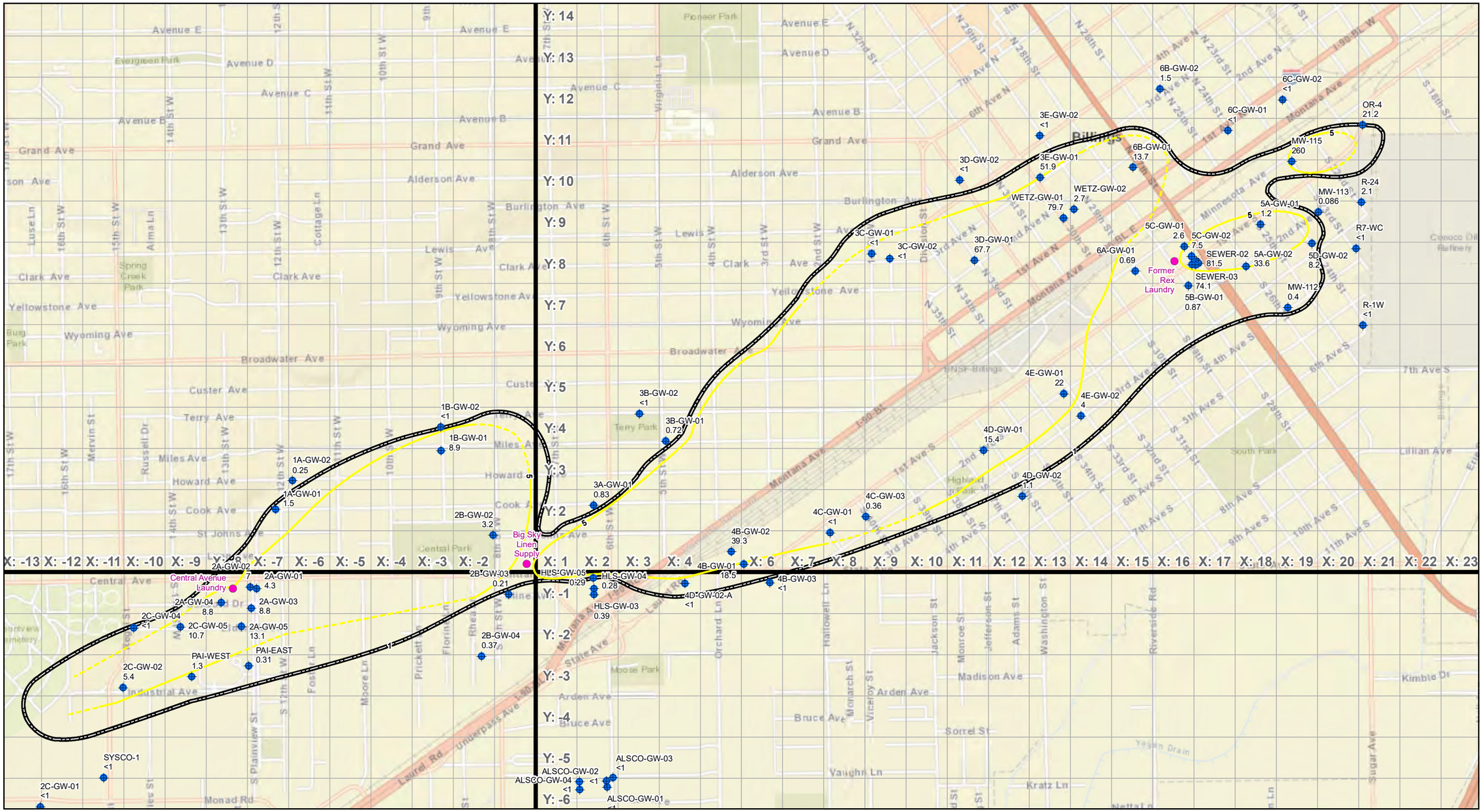

EXPLANATION

- GROUNDWATER SCREENING SAMPLING LOCATION WITH PCE CONCENTRATION (µg/L) (NOV. 2017 - APRIL 2018)
- DRY CLEANING SITES
- 5 µg/L PCE CONTOUR, DASHED WHERE INFERRED (SEPT. 2018)
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

NOTES:

- PCE = TETRACHLOROTHENE
- 5 µg/L PCE CONTOUR FROM SEPTEMBER 2018 GROUNDWATER SAMPLING EVENT SHOWN FOR REFERENCE. SCREENING-LEVEL SAMPLE RESULTS ARE NOT CONTOURED.

N

0 1,200'

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FIGURE 5-1

PCE GROUNDWATER SCREENING LOCATIONS AND RESULTS

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 4/5/19	File: Fig5-1_Billings_PCE_GW17_18.mxd

EXPLANATION

- MiHPT LOCATION
- MiHPT AND SOIL LOCATION (SOIL SAMPLE DEPTHS, FT BGS)
- SOIL SAMPLE LOCATION (SOIL SAMPLE DEPTHS, FT BGS)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

NOTES:

- MiHPT: MEMBRANE INTERFACE PROBE/HYDRAULIC PROFILING TOOL
- BORING LOCATIONS AND IDENTIFIERS (ID) WERE DECIDED UPON DURING RIWP SCOPING. DESPITE THE IMPLICATION THAT ALL LOCATIONS HAD MiHPT PROBING PERFORMED IN THEIR NAMING CONVENTION OR BORING ID, MiHPT WAS NOT PERFORMED AT BSL-MIP-T18 AND BSL-MIP-09, ONLY CONVENTIONAL DIRECT PUSH PROBING AND SOIL SAMPLE COLLECTION.
- * INDICATES SURFACE SOIL SAMPLES (TOTAL DEPTH LESS THAN 2 FT BGS)
- FT BGS: FEET BELOW GROUND SURFACE

N

0 70'

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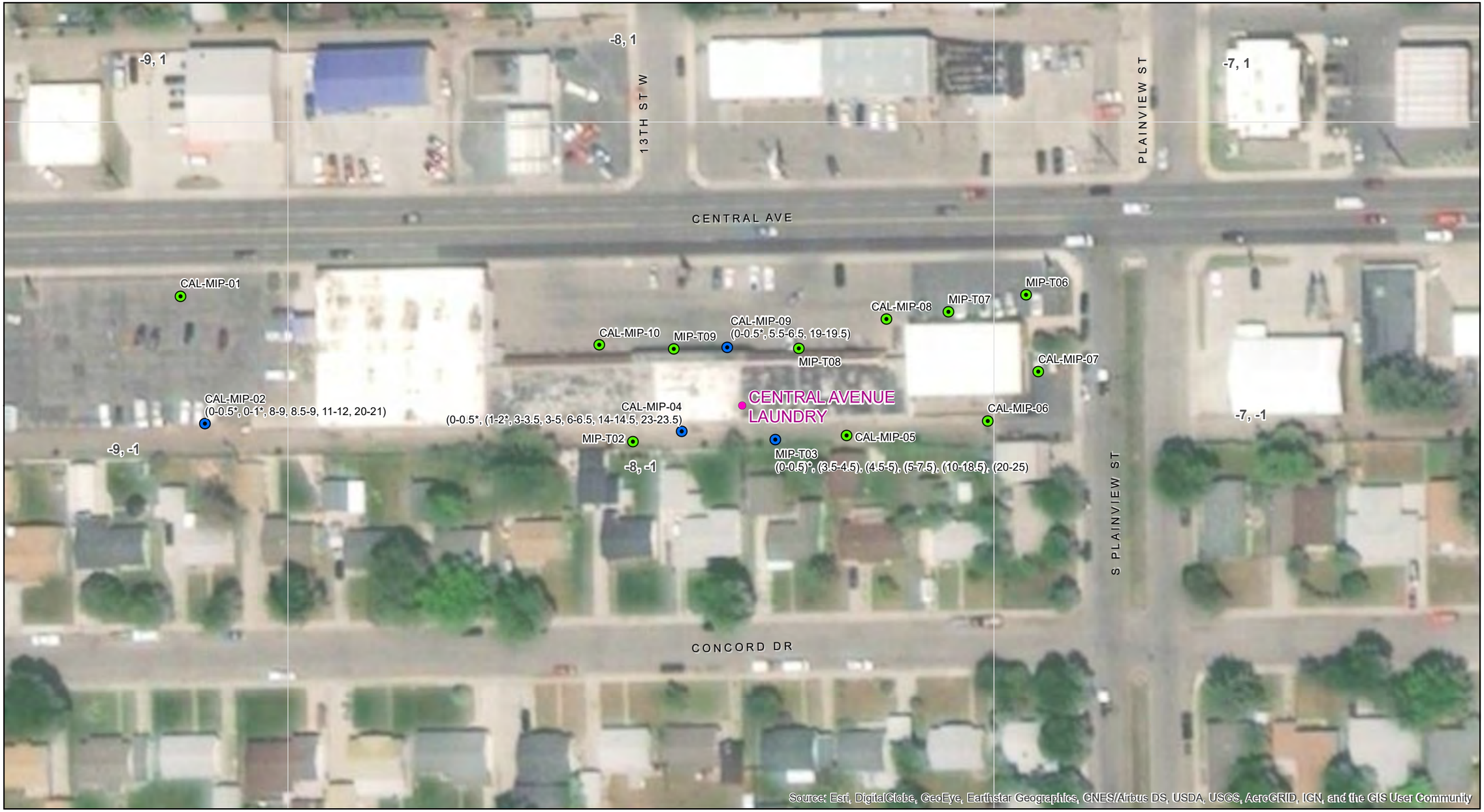
FIGURE 8-1

MiHPT AND SOIL SAMPLING LOCATIONS AT BIG SKY LINEN

**REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA**

Drawn By: PH	Checked By: MO	Scale: 1 " = 70 '	Date: 4/2/19	File: Fig8-1_Billings_InvLocsBigSky.mxd

\\TRIHYDRO.COM\CLIENTS\GOVSTATEMDEQ\RSBILLINGSPCE\GIS\MAPPING\2018_RI_REPORT\FIG8-1_BILLINGS_INVLOCSBIGSKY.MXD



EXPLANATION

- MiHPT LOCATION
- MiHPT AND SOIL LOCATION (SOIL SAMPLE DEPTHS, FT BGS)
- SOIL SAMPLE LOCATION (SOIL SAMPLE DEPTHS, FT BGS)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

NOTES:

- MiHPT: MEMBRANE INTERFACE PROBE/HYDRAULIC PROFILING TOOL
- BORING LOCATIONS AND IDENTIFIERS (ID) WERE DECIDED UPON DURING RIWP SCOPING. DESPITE THE IMPLICATION THAT ALL LOCATIONS HAD MiHPT PROBING PERFORMED IN THEIR NAMING CONVENTION OR BORING ID, MiHPT WAS NOT PERFORMED AT BSL-MIP-T18 AND BSL-MIP-09, ONLY CONVENTIONAL DIRECT PUSH PROBING AND SOIL SAMPLE COLLECTION.
- * INDICATES SURFACE SOIL SAMPLES (TOTAL DEPTH LESS THAN 2 FT BGS)
- FT BGS: FEET BELOW GROUND SURFACE

N

0 70'

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FIGURE 8-2

MiHPT AND SOIL SAMPLING LOCATIONS AT CENTRAL AVENUE LAUNDRY

**REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA**

Drawn By: PH	Checked By: MO	Scale: 1 " = 70 '	Date: 4/19/19	File: Fig8-2_Billings_InvLocsCenAv.mxd

\\TRIHYDRO.COM\CLIENTS\GIO\VSTATEMIDE\SRS\BILLINGS\PCE\GIS\MAPPING\2018_RI_REPORT\FIG8-2_BILLINGS_INVLOCSCENAV.MXD

EXPLANATION

- MiHPT LOCATION
- MiHPT AND SOIL LOCATION (SOIL SAMPLE DEPTHS, FT BGS)
- SOIL SAMPLE LOCATION (SOIL SAMPLE DEPTHS, FT BGS)
- SEWER SAMPLE LOCATION
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

NOTES:

- MiHPT: MEMBRANE INTERFACE PROBE/HYDRAULIC PROFILING TOOL
- BORING LOCATIONS AND IDENTIFIERS (ID) WERE DECIDED UPON DURING RIWP SCOPING. DESPITE THE IMPLICATION THAT ALL LOCATIONS HAD MiHPT PROBING PERFORMED IN THEIR NAMING CONVENTION OR BORING ID, MiHPT WAS NOT PERFORMED AT BSL-MIP-T18 AND BSL-MIP-09, ONLY CONVENTIONAL DIRECT PUSH PROBING AND SOIL SAMPLE COLLECTION.
- * INDICATES SURFACE SOIL SAMPLES (TOTAL DEPTH LESS THAN 2 FT BGS)
- FT BGS: FEET BELOW GROUND SURFACE

N

0 70'

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FIGURE 8-3

MiHPT AND SOIL SAMPLING LOCATIONS AT REX'S CLEANERS

**REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA**

Drawn By: PH	Checked By: MO	Scale: 1 " = 70 '	Date: 4/15/19	File: Fig8-3_Billings_InvLocsRexs.mxd

\\TRIHYDRO.COM\CLIENTS\GO\STATEWIDE\GSRS\BILLINGSPCE\GIS\MAPPING\2018_RI_REPORT\FIG8-3_BILLINGS_INVLOCSREXS.MXD

EXPLANATION

- MiHPT LOCATION
- MiHPT AND SOIL LOCATION (SOIL SAMPLE DEPTHS, FT BGS)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

NOTES:

- MiHPT: MEMBRANE INTERFACE PROBE/HYDRAULIC PROFILING TOOL
- BORING LOCATIONS AND IDENTIFIERS (ID) WERE DECIDED UPON DURING RIWP SCOPING. DESPITE THE IMPLICATION THAT ALL LOCATIONS HAD MiHPT PROBING PERFORMED IN THEIR NAMING CONVENTION OR BORING ID, MiHPT WAS NOT PERFORMED AT BSL-MIP-T18 AND BSL-MIP-09, ONLY CONVENTIONAL DIRECT PUSH PROBING AND SOIL SAMPLE COLLECTION.
- * INDICATES SURFACE SOIL SAMPLES (TOTAL DEPTH LESS THAN 2 FT BGS)
- FT BGS: FEET BELOW GROUND SURFACE

N

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FIGURE 8-4

MiHPT AND SOIL SAMPLING LOCATIONS AT DISTRICT 7 HUMAN RESOURCE COUNCIL

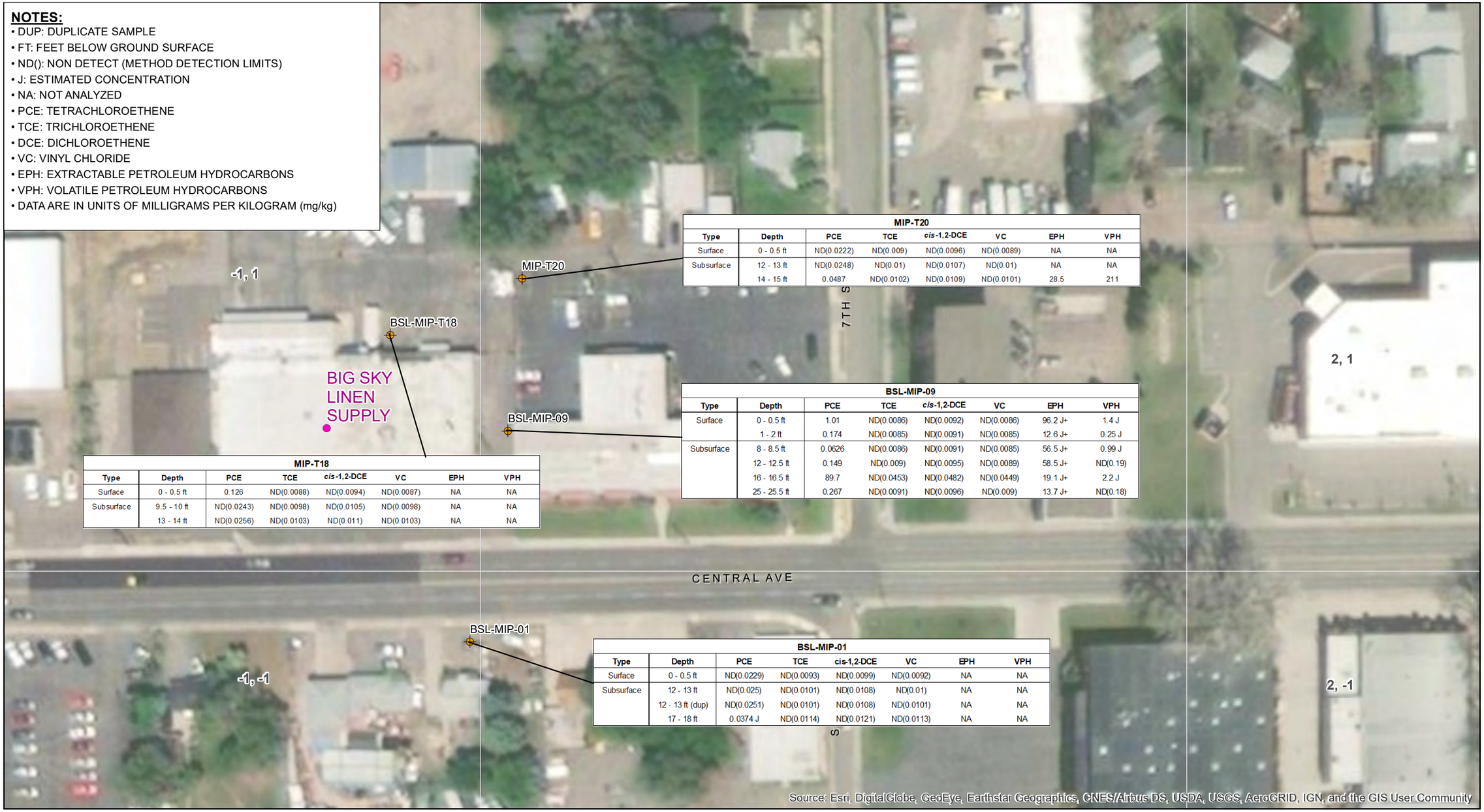
**REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA**

Drawn By: PH	Checked By: MO	Scale: 1 " = 70 '	Date: 4/2/19	File: Fig8-4_Billings_InvLocsDist7.mxd

\\TRIHYDRO.COM\CLIENTS\GOVSTATEWIDE\QSRS\BILLINGSPCE\GIS\MAPPING\2018_RI_REPORT\FIG8-4_BILLINGS_INVLOCSDIST7.MXD

NOTES:

- DUP: DUPLICATE SAMPLE
- FT: FEET BELOW GROUND SURFACE
- ND(): NON DETECT (METHOD DETECTION LIMITS)
- J: ESTIMATED CONCENTRATION
- NA: NOT ANALYZED
- PCE: TETRACHLOROETHENE
- TCE: TRICHLOROETHENE
- DCE: DICHLOROETHENE
- VC: VINYL CHLORIDE
- EPH: EXTRACTABLE PETROLEUM HYDROCARBONS
- VPH: VOLATILE PETROLEUM HYDROCARBONS
- DATA ARE IN UNITS OF MILLIGRAMS PER KILOGRAM (mg/kg)



MIP-T20

Type	Depth	PCE	TCE	*cis*-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	ND(0.0222)	ND(0.009)	ND(0.0096)	ND(0.0089)	NA	NA
Subsurface	12 - 13 ft	ND(0.0248)	ND(0.01)	ND(0.0107)	ND(0.01)	NA	NA
	14 - 15 ft	0.0487	ND(0.0102)	ND(0.0109)	ND(0.0101)	28.5	211

BSL-MIP-09

Type	Depth	PCE	TCE	*cis*-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	1.01	ND(0.0086)	ND(0.0092)	ND(0.0086)	96.2 J+	1.4 J
	1 - 2 ft	0.174	ND(0.0085)	ND(0.0091)	ND(0.0085)	12.6 J+	0.25 J
Subsurface	8 - 8.5 ft	0.0626	ND(0.0086)	ND(0.0091)	ND(0.0085)	56.5 J+	0.99 J
	12 - 12.5 ft	0.149	ND(0.009)	ND(0.0095)	ND(0.0089)	58.5 J+	ND(0.19)
	16 - 16.5 ft	89.7	ND(0.0453)	ND(0.0482)	ND(0.0449)	19.1 J+	2.2 J
	25 - 25.5 ft	0.267	ND(0.0091)	ND(0.0096)	ND(0.009)	13.7 J+	ND(0.18)

MIP-T18

Type	Depth	PCE	TCE	*cis*-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	0.126	ND(0.0088)	ND(0.0094)	ND(0.0087)	NA	NA
Subsurface	9.5 - 10 ft	ND(0.0243)	ND(0.0098)	ND(0.0105)	ND(0.0098)	NA	NA
	13 - 14 ft	ND(0.0256)	ND(0.0103)	ND(0.011)	ND(0.0103)	NA	NA

BSL-MIP-01

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	ND(0.0229)	ND(0.0093)	ND(0.0099)	ND(0.0092)	NA	NA
Subsurface	12 - 13 ft	ND(0.025)	ND(0.0101)	ND(0.0108)	ND(0.01)	NA	NA
	12 - 13 ft (dup)	ND(0.0251)	ND(0.0101)	ND(0.0108)	ND(0.0101)	NA	NA
	17 - 18 ft	0.0374 J	ND(0.0114)	ND(0.0121)	ND(0.0113)	NA	NA

EXPLANATION

SOIL SAMPLE LOCATION

FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

N

0 70'

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FIGURE 8-5

SURFACE AND SUBSURFACE SOIL DATA AT BIG SKY LINEN

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: MO	Scale: 1 " = 70 '	Date: 12/28/18	File: Fig8-5_Billings_SoilBigSky.mxd

\\TRIHYDRO.COM\CLIENTS\GO\STATEMDE\SRS\BILLINGSPCE\GIS\MAPPING\2018 RI REPORT\FIG8-5 BILLINGS SOILBIGSKY.MXD

NOTES:

- DUP: DUPLICATE SAMPLE
- FT: FEET BELOW GROUND SURFACE
- ND(): NON DETECT (METHOD DETECTION LIMITS)
- J: ESTIMATED CONCENTRATION
- NA: NOT ANALYZED
- PCE: TETRACHLOROETHENE
- TCE: TRICHLOROETHENE
- DCE: DICHLOROETHENE
- VC: VINYL CHLORIDE
- EPH: EXTRACTABLE PETROLEUM HYDROCARBONS
- VPH: VOLATILE PETROLEUM HYDROCARBONS
- DATA ARE IN UNITS OF MILLIGRAMS PER KILOGRAM (mg/kg)

CAL-MIP-09

Type	Depth	PCE	TCE	*cis*-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	0.0713	ND(0.0096)	ND(0.0102)	ND(0.0095)	NA	NA
Subsurface	5.5 - 6.5 ft	ND(0.0247)	ND(0.01)	ND(0.0106)	ND(0.0099)	NA	NA
	19 - 19.5 ft	ND(0.0231)	ND(0.0094)	ND(0.01)	ND(0.0093)	NA	NA

CAL-MIP-02

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	ND(0.0232)	ND(0.0094)	ND(0.01)	ND(0.0093)	NA	NA
Subsurface	8.5 - 9 ft	ND(0.0254)	ND(0.0103)	ND(0.0109)	ND(0.0102)	NA	NA
	20 - 21 ft	ND(0.0265)	ND(0.0107)	ND(0.0114)	ND(0.0106)	NA	NA

CAL-MIP-04

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	0.101	ND(0.0093)	ND(0.0099)	ND(0.0092)	1520	0.5 J
	1 - 2 ft	0.0877	ND(0.0099)	ND(0.0105)	ND(0.0098)	ND(3.3)	0.34 J
Subsurface	3 - 3.5 ft	ND(0.0252)	ND(0.0102)	ND(0.0108)	ND(0.0101)	ND(3.4)	ND(0.2)
	6 - 6.5 ft	ND(0.0254)	ND(0.0103)	ND(0.0109)	ND(0.0102)	ND(3.5)	ND(0.21)
	6 - 6.5 ft (dup)	0.0422 J	ND(0.0108)	ND(0.0116)	ND(0.0108)	3.9 J	ND(0.22)
	14 - 14.5 ft	0.17	ND(0.0105)	ND(0.0112)	ND(0.0104)	ND(3.5)	ND(0.22)
	23 - 23.5 ft	ND(0.0232)	ND(0.0094)	ND(0.01)	ND(0.0093)	NA	ND(0.18)

MIP-T03

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	ND(0.0229)	ND(0.0093)	ND(0.0099)	ND(0.0092)	NA	NA
Subsurface	4.5 - 5 ft	ND(0.0245)	ND(0.0099)	ND(0.0106)	ND(0.0098)	NA	NA

EXPLANATION

SOIL SAMPLE LOCATION

FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

N

0 70'

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FIGURE 8-6

SURFACE AND SUBSURFACE SOIL DATA AT FORMER CENTRAL AVENUE LAUNDRY

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: MO	Scale: 1 " = 70 '	Date: 1/4/19	File: Fig8-6_Billings_SoilCenAv.mxd

\\TRIHYDRO.COM\CLIENTS\GO\VSTATEWIDE\GIS\BILLINGS\PCE\GIS\MAPPING\2018_RI_REPORT\FIG8-6_BILLINGS_SOILCENAV.MXD

NOTES:

- DUP: DUPLICATE SAMPLE
- FT: FEET BELOW GROUND SURFACE
- ND(): NON DETECT (METHOD DETECTION LIMITS)
- J: ESTIMATED CONCENTRATION
- NA: NOT ANALYZED
- PCE: TETRACHLOROETHENE
- TCE: TRICHLOROETHENE
- DCE: DICHLOROETHENE
- VC: VINYL CHLORIDE
- EPH: EXTRACTABLE PETROLEUM HYDROCARBONS
- VPH: VOLATILE PETROLEUM HYDROCARBONS
- DATA ARE IN UNITS OF MILLIGRAMS PER KILOGRAM (mg/kg)

REX-MIP-08

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	ND(0.0206)	ND(0.0083)	ND(0.0089)	ND(0.0083)	1420 J-	NA
	1 - 2 ft	ND(0.0214)	ND(0.0087)	ND(0.0092)	ND(0.0086)	593	ND(0.18)
Subsurface	5 - 5.5 ft	ND(0.0236)	ND(0.0096)	ND(0.0102)	ND(0.0095)	58.7 J+	26.6
	9.5 - 10 ft	ND(0.0248)	ND(0.01)	ND(0.0107)	ND(0.01)	15.4 J+	ND(0.2)
	15 - 15.5 ft (dup)	ND(0.0252)	ND(0.0102)	ND(0.0109)	ND(0.0101)	NA	NA
	17 - 17.5 ft	ND(0.114)	ND(0.046)	ND(0.049)	ND(0.0457)	54.5 J+	241
	23 - 23.5 ft	ND(0.023)	ND(0.0093)	ND(0.0099)	ND(0.0093)	11.6 J+	ND(0.19)

REX-MIP-03

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	0.0421 J	ND(0.0109)	ND(0.0116)	ND(0.0108)	NA	NA
Subsurface	10 - 10.5 ft	ND(0.0251)	ND(0.0102)	ND(0.0108)	ND(0.0101)	NA	NA
	17 - 17.5 ft	ND(0.0231)	ND(0.0093)	ND(0.0099)	ND(0.0093)	NA	NA

REX-MIP-07

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	0.0519 J	ND(0.0101)	ND(0.0108)	ND(0.01)	NA	NA
Subsurface	3.5 - 4 ft	ND(0.026)	ND(0.0105)	ND(0.0112)	ND(0.0105)	NA	NA

SEWER-01

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Subsurface	5.5 - 6 ft	ND(0.0248)	ND(0.01)	ND(0.0107)	ND(0.01)	NA	NA

REX-MIP-04

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Surface	0 - 0.5 ft	0.083	ND(0.0093)	ND(0.0099)	ND(0.0093)	NA	NA
Subsurface	12 - 12.5 ft	ND(0.0218)	ND(0.0088)	ND(0.0094)	ND(0.0088)	NA	NA

SEWER-02

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Subsurface	5.5 - 5.5 ft	ND(0.0238)	ND(0.0096)	ND(0.0102)	ND(0.0095)	NA	NA

SEWER-04

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Subsurface	14.5 - 15.5 ft	ND(0.022)	ND(0.0089)	ND(0.0095)	ND(0.0089)	NA	NA

SEWER-03

Type	Depth	PCE	TCE	cis-1,2-DCE	VC	EPH	VPH
Subsurface	17 - 17 ft	ND(0.0215)	ND(0.0087)	ND(0.0093)	ND(0.0086)	NA	NA

EXPLANATION

- SOIL SAMPLE LOCATION
- SEWER SAMPLE LOCATION
- FRACTURED SEWER (APPROXIMATE LOCATION)
- SANITARY SEWER GRAVITY MAINS (CITY OF BILLINGS 2017)
- INTERIOR MAINS 12" AND LESS
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

N

0 70'

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FIGURE 8-7

SURFACE AND SUBSURFACE SOIL DATA AT FORMER REX'S CLEANERS

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH | Checked By: MO | Scale: 1 " = 70 ' | Date: 1/4/19 | File: Fig8-7_Billings_SoilRexs.mxd

\\TRIHYDRO.COM\CLIENTS\GOV\STATEMDEQSR\BILLINGS\PCE\GIS\MAPPING\2018 RI REPORT\FIG8-7 BILLINGS SOILREXS.MXD

NOTES:

- DUP: DUPLICATE SAMPLE
- FT: FEET BELOW GROUND SURFACE
- ND(): NON DETECT (METHOD DETECTION LIMITS)
- J: ESTIMATED CONCENTRATION
- NA: NOT ANALYZED
- PCE: TETRACHLOROETHENE
- TCE: TRICHLOROETHENE
- DCE: DICHLOROETHENE
- VC: VINYL CHLORIDE
- EPH: EXTRACTABLE PETROLEUM HYDROCARBONS
- VPH: VOLATILE PETROLEUM HYDROCARBONS
- DATA ARE IN UNITS OF MILLIGRAMS PER KILOGRAM (mg/kg)

D7HRC-MIP-01							
Type	Depth	PCE	TCE	*cis*-1,2-DCE	VC	EPH	VPH
Subsurface	7 - 9 ft	ND(0.0243)	ND(0.0098)	ND(0.0105)	ND(0.0098)	ND(3.4)	ND(0.2)

EXPLANATION

SOIL SAMPLE LOCATION

FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

N

0 70'

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FIGURE 8-8

SUBSURFACE SOIL DATA AT DISTRIC 7 HUMAN RESOURCE COUNCIL

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: MO	Scale: 1 " = 70 '	Date: 12/26/18	File: Fig8-8_Billings_SoilDist7.mxd

\\TRIHYDRO.COM\CLIENTS\GOVSTATEMUDEQSRS\BILLINGSPCE\GIS\MAPPING\2018_RI_REPORT\FIG8-8_BILLINGS_SOILDIST7.MXD

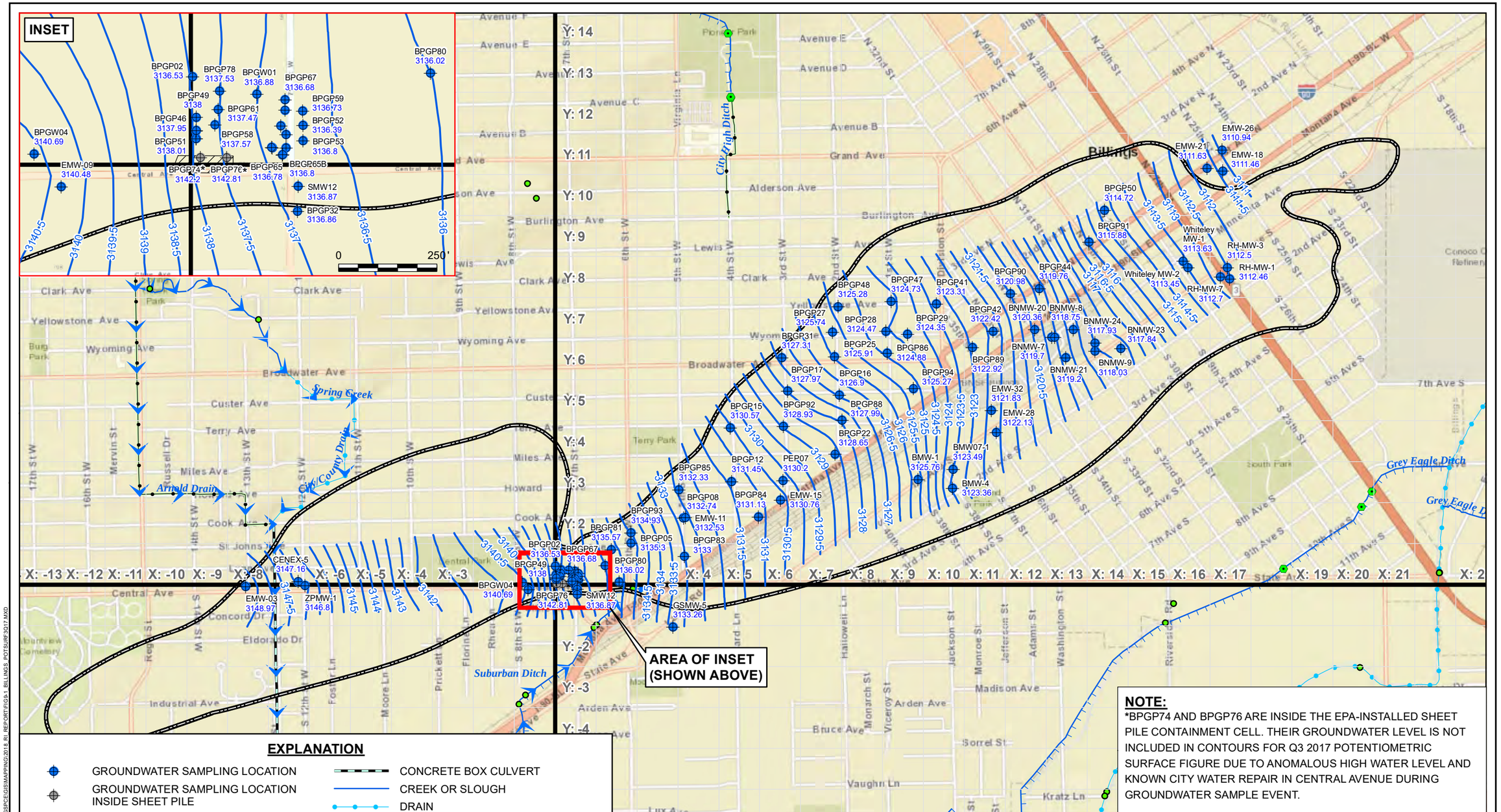

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FIGURE 9-1

GROUNDWATER POTENTIOMETRIC SURFACE JULY 2017

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 4/15/19	File: Fig9-1_Billings_PotSurf3Q17.mxd

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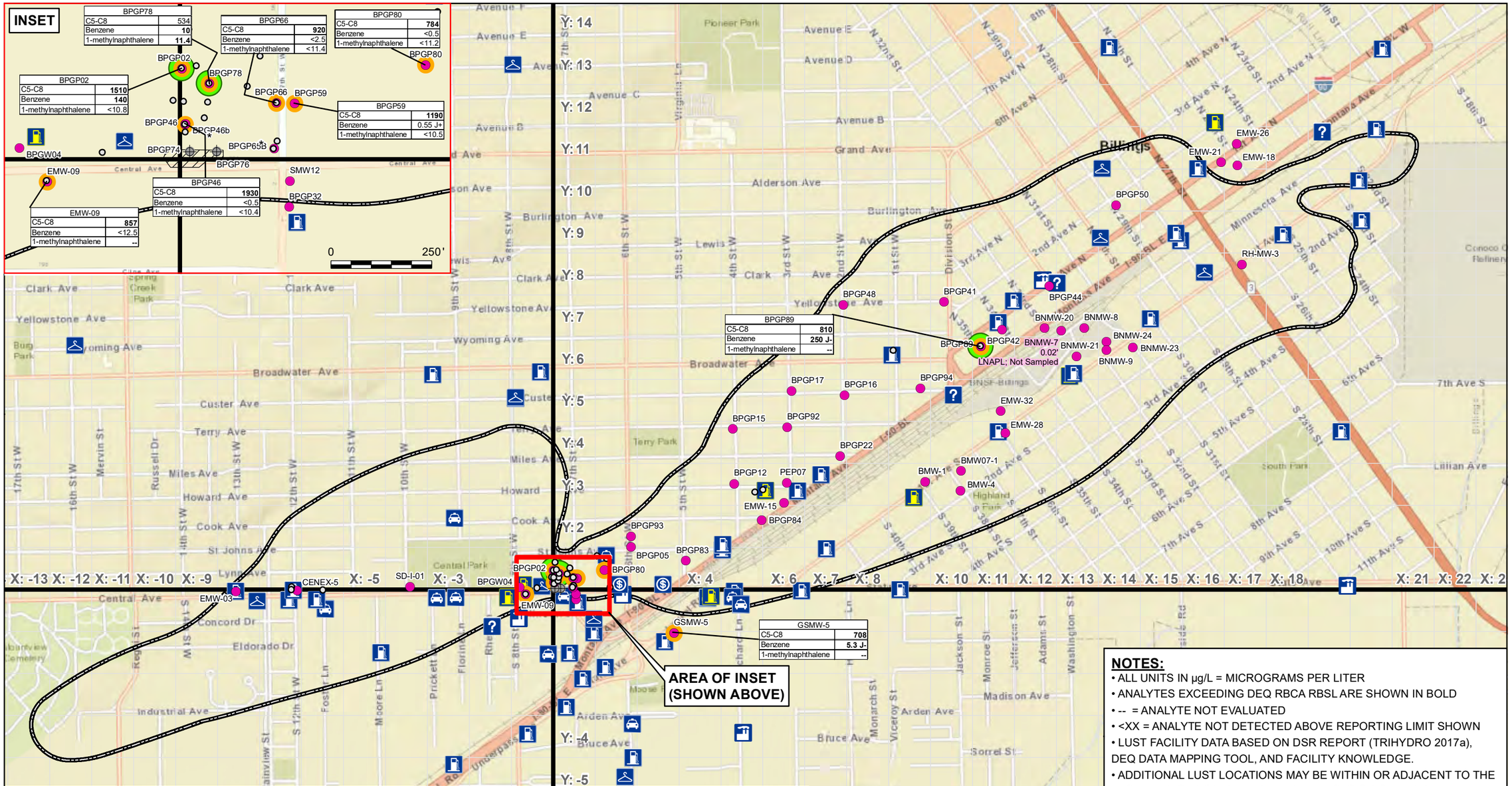

EXPLANATION

- EPH/VPH/SVOC SAMPLE LOCATION
- GROUNDWATER SAMPLING LOCATION INSIDE SHEET PILE
- EPH/VPH EXCEEDANCE
- HISTORICAL BENZENE RESULTS ABOVE SCREENING LEVEL
- BENZENE SCREENING LEVEL EXCEEDANCE (VOC METHOD 8260)
- SHEET PILING CONTAINMENT CELL
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)
- DRY CLEANER
- LUST SITE
- LUST SITE WITH POTENTIAL SOLVENT IMPACT
- MANUFACTURING
- OTHER
- REPAIR SHOP
- RETAIL

N

0 1,200'

NOTES:

- ALL UNITS IN µg/L = MICROGRAMS PER LITER
- ANALYTES EXCEEDING DEQ RBCA RBSL ARE SHOWN IN BOLD
- -- = ANALYTE NOT EVALUATED
- <XX = ANALYTE NOT DETECTED ABOVE REPORTING LIMIT SHOWN
- LUST FACILITY DATA BASED ON DSR REPORT (TRIHYDRO 2017a), DEQ DATA MAPPING TOOL, AND FACILITY KNOWLEDGE.
- ADDITIONAL LUST LOCATIONS MAY BE WITHIN OR ADJACENT TO THE FACILITY BASED ON DIFFERENT DATABASES OR OTHER DATA SOURCES.

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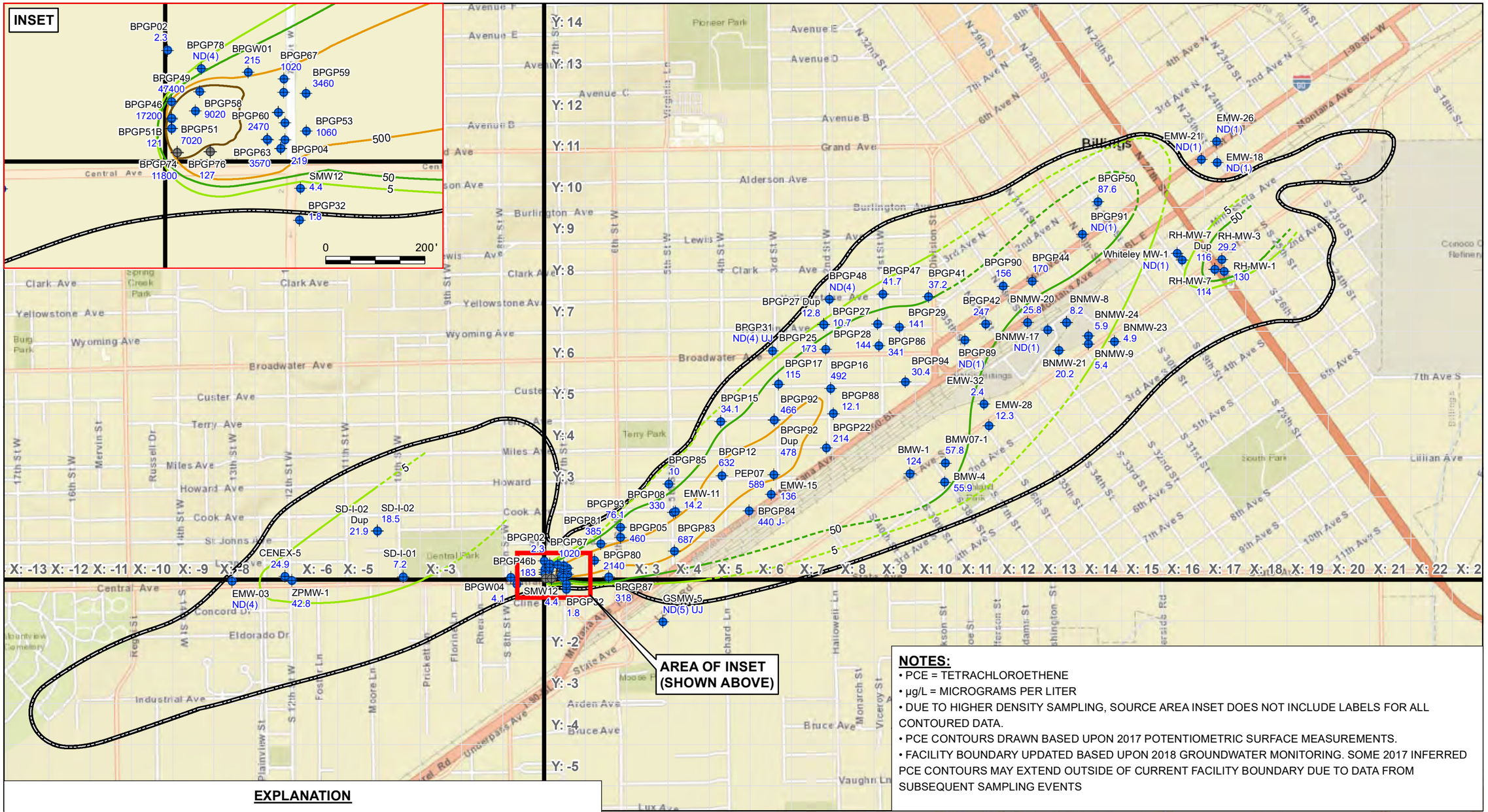
FIGURE 9-2

EPH/VPH AND SVOC GROUNDWATER ANALYTICAL RESULTS JULY 2017

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 4/4/19	File: Fig9-2_Billings_EPH3Q17.mxd

\\TRIHYDRO.COM\CLIENTS\GOVSTATEMDEQ\RSB\BILLINGSPCE\GIS\MAPPING\2018_RI_REPORT\FIG9-2_BILLINGS_EPH3Q17.MXD



NOTES:

- PCE = TETRACHLOROETHENE
- µg/L = MICROGRAMS PER LITER
- DUE TO HIGHER DENSITY SAMPLING, SOURCE AREA INSET DOES NOT INCLUDE LABELS FOR ALL CONTOURED DATA.
- PCE CONTOURS DRAWN BASED UPON 2017 POTENTIOMETRIC SURFACE MEASUREMENTS.
- FACILITY BOUNDARY UPDATED BASED UPON 2018 GROUNDWATER MONITORING. SOME 2017 INFERRED PCE CONTOURS MAY EXTEND OUTSIDE OF CURRENT FACILITY BOUNDARY DUE TO DATA FROM SUBSEQUENT SAMPLING EVENTS

EXPLANATION

- GROUNDWATER SAMPLING LOCATION SHOWING PCE CONCENTRATION (µg/L)
- GROUNDWATER SAMPLING LOCATION INSIDE SHEET PILE
- 5 µg/L PCE CONTOUR, DASHED WHERE INFERRED
- 50 µg/L PCE CONTOUR, DASHED WHERE INFERRED
- 500 µg/L PCE CONTOUR
- 50,000 µg/L PCE CONTOUR
- SHEET PILING CONTAINMENT CELL
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

N

0 1,200'

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FIGURE 9-3

PCE GROUNDWATER PLUME JULY 2017

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/2/19	File: Fig9-3_Billings_PCE3Q17.mxd

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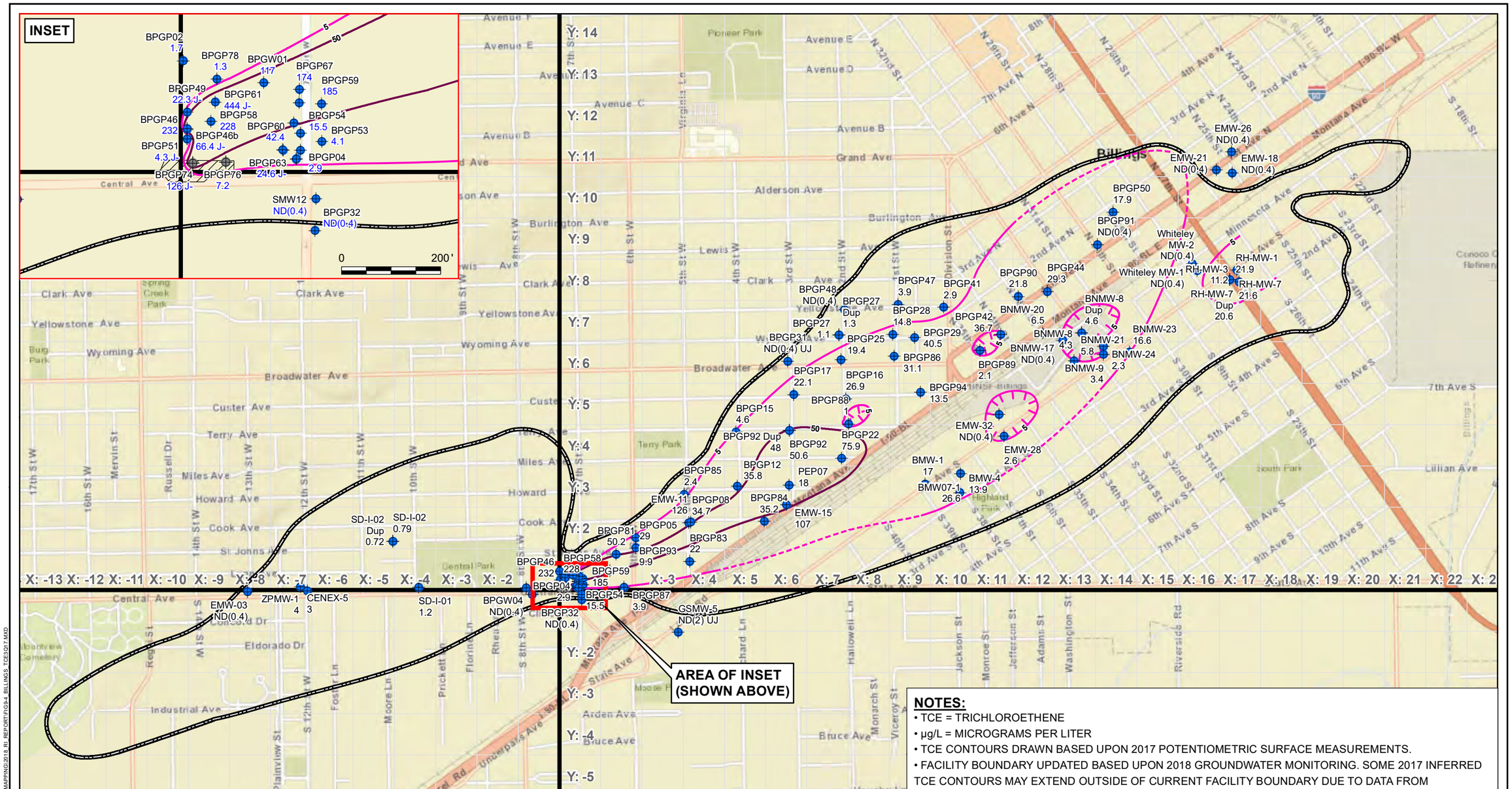

NOTES:

- TCE = TRICHLOROETHENE
- µg/L = MICROGRAMS PER LITER
- TCE CONTOURS DRAWN BASED UPON 2017 POTENTIOMETRIC SURFACE MEASUREMENTS.
- FACILITY BOUNDARY UPDATED BASED UPON 2018 GROUNDWATER MONITORING. SOME 2017 INFERRED TCE CONTOURS MAY EXTEND OUTSIDE OF CURRENT FACILITY BOUNDARY DUE TO DATA FROM SUBSEQUENT SAMPLING EVENTS.

EXPLANATION

- GROUNDWATER SAMPLING LOCATION SHOWING TCE CONCENTRATION (µg/L)
- GROUNDWATER SAMPLING LOCATION INSIDE SHEET PILE
- 5 µg/L TCE CONTOUR, DASHED WHERE INFERRED
- 5 µg/L TCE DEPRESSION CONTOUR, DASHED WHERE INFERRED
- 50 µg/L TCE CONTOUR, DASHED WHERE INFERRED
- SHEET PILING CONTAINMENT CELL
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

N

0 1,200'

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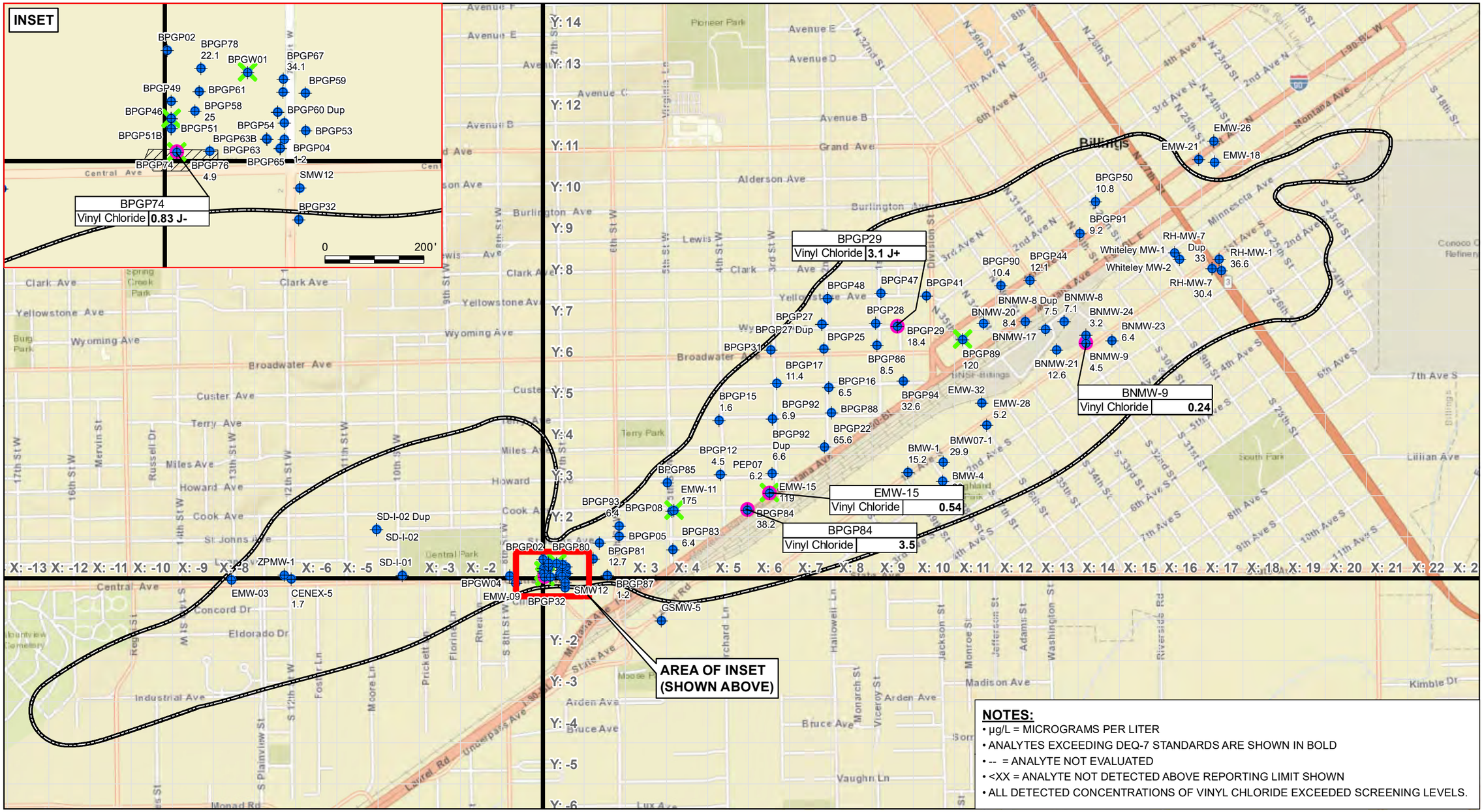
FIGURE 9-4

TCE GROUNDWATER PLUME JULY 2017

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/2/19	File: Fig9-4_Billings_TCE3Q17.mxd

\\TRIHYDRO.COM\CLIENTS\GOVSTATE\MDEQ\RS\BILLINGSPCE\GIS\MAPPING\2018_RI_REPORT\FIG9-4_BILLINGS_TCE3Q17.MXD



NOTES:

- µg/L = MICROGRAMS PER LITER
- ANALYTES EXCEEDING DEQ-7 STANDARDS ARE SHOWN IN BOLD
- -- = ANALYTE NOT EVALUATED
- <XX = ANALYTE NOT DETECTED ABOVE REPORTING LIMIT SHOWN
- ALL DETECTED CONCENTRATIONS OF VINYL CHLORIDE EXCEEDED SCREENING LEVELS.

EXPLANATION

- GROUNDWATER SAMPLING LOCATION WITH CIS-1,2-DCE CONCENTRATION
- CIS-1,2-DCE EXCEEDANCE
- VINYL CHLORIDE EXCEEDANCE
- SHEET PILING CONTAINMENT CELL
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)

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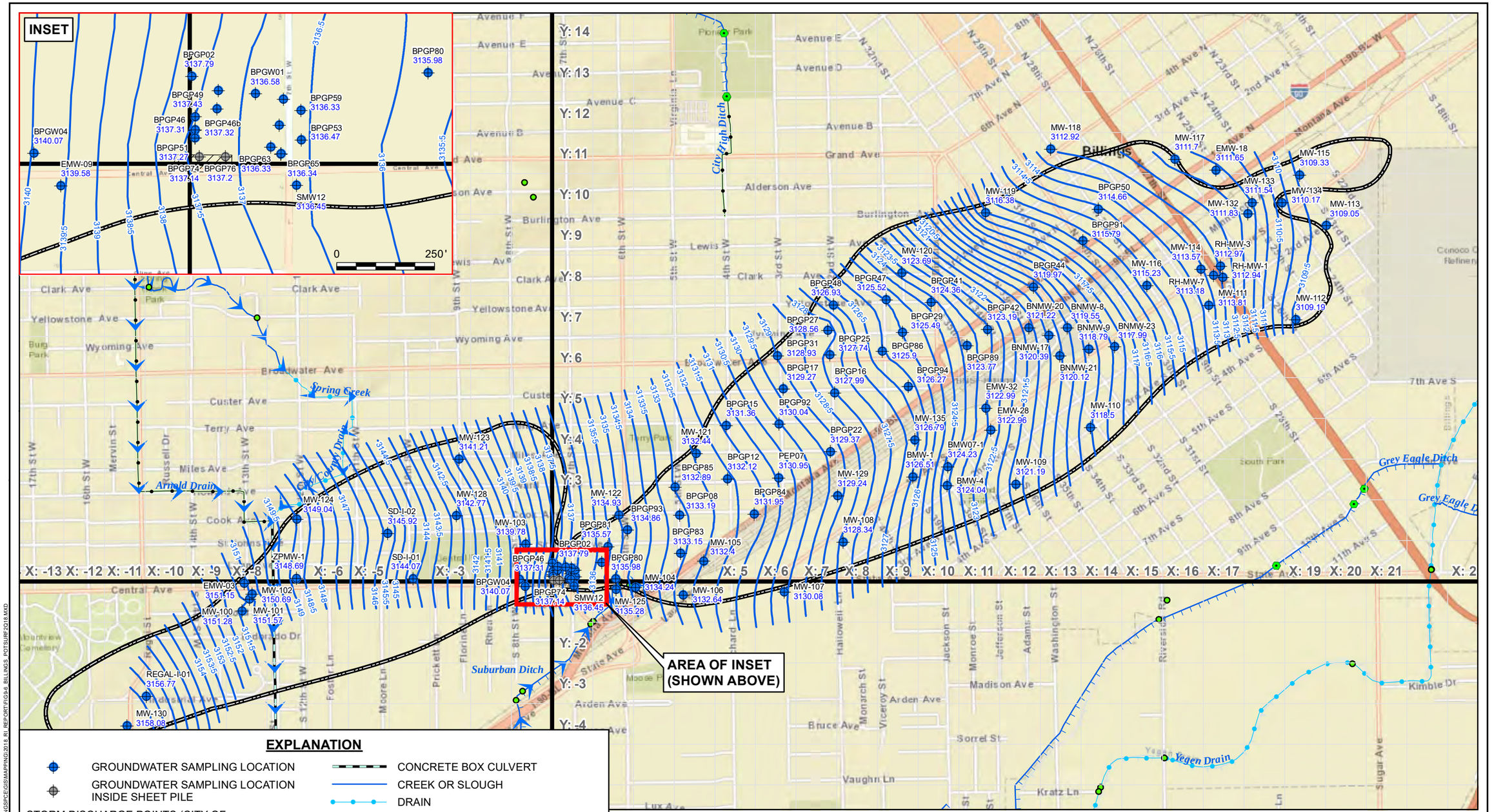
FIGURE 9-5

CIS-1,2-DCE AND VC GROUNDWATER ANALYTICAL RESULTS JULY 2017

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/2/19	File: Fig9-5_Billings_CIS3Q17.mxd

\\TRIHYDRO.COM\CLIENTS\GOVSTATE\MDEQ\RS\BILLINGS\PCE\GIS\MAPPING\2018_RI_REPORT\FIG9-5_BILLINGS_CIS3Q17.MXD



EXPLANATION

- GROUNDWATER SAMPLING LOCATION
- GROUNDWATER SAMPLING LOCATION INSIDE SHEET PILE

STORM DISCHARGE POINTS (CITY OF BILLINGS 2017)

- SECONDARY OUTFALL
- STANDARD OUTLET
- POTENTIOMETRIC SURFACE CONTOUR , INTERVAL = 0.5 FEET

STREAMS (CITY OF BILLINGS 2017)

- CANAL OR DITCH
- CONCRETE BOX CULVERT
- CREEK OR SLOUGH
- DRAIN
- PIPE
- SHEET PILING CONTAINMENT CELL
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)

N

0 1,200'

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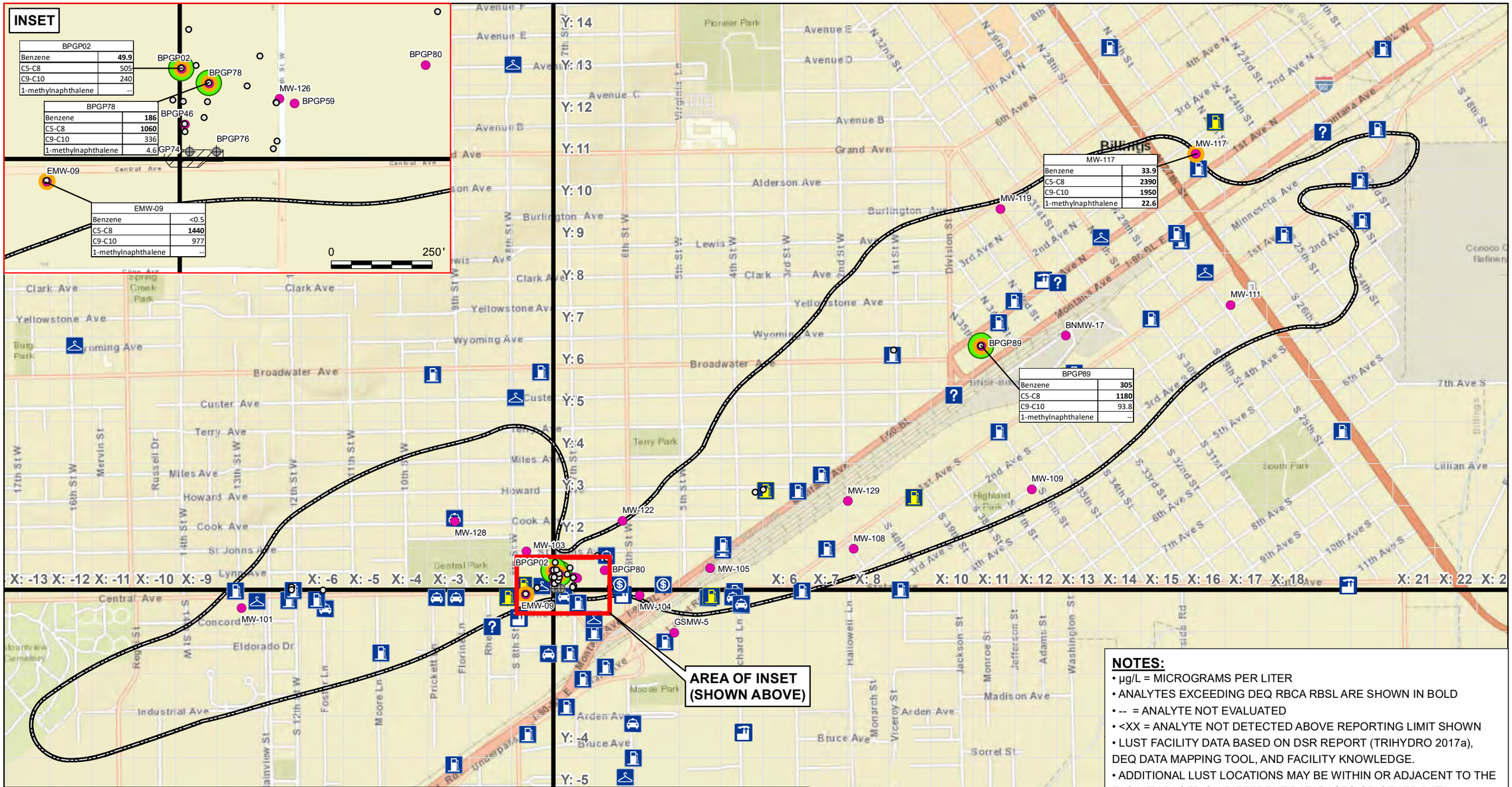
FIGURE 9-6

GROUNDWATER POTENTIOMETRIC SURFACE MAY 2018

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 4/15/19	File: Fig9-6_Billings_PotSurf2Q18.mxd

\\TRIHYDRO.COM\CLIENTS\GO\STATEMDEQSRS\BILLINGSPCE\GIS\MAPPING\2018 RI REPORT\FIG9-6 BILLINGS POTSURF2018.MXD



NOTES:

- µg/L = MICROGRAMS PER LITER
- ANALYTES EXCEEDING DEQ RBCA RBSL ARE SHOWN IN BOLD
- -- = ANALYTE NOT EVALUATED
- <XX = ANALYTE NOT DETECTED ABOVE REPORTING LIMIT SHOWN
- LUST FACILITY DATA BASED ON DSR REPORT (TRIHYDRO 2017a), DEQ DATA MAPPING TOOL, AND FACILITY KNOWLEDGE.
- ADDITIONAL LUST LOCATIONS MAY BE WITHIN OR ADJACENT TO THE FACILITY BASED ON DIFFERENT DATABASES OR OTHER DATA SOURCES.

EXPLANATION

- EPH/VPH/SVOC SAMPLE LOCATION
- GROUNDWATER SAMPLING LOCATION INSIDE SHEET PILE
- EPH/VPH EXCEEDANCE
- HISTORICAL BENZENE RESULTS ABOVE SCREENING LEVEL
- BENZENE SCREENING LEVEL EXCEEDANCE (VOC METHOD 8260)
- SHEET PILING CONTAINMENT CELL
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)
- DRY CLEANER
- LUST SITE
- LUST SITE WITH POTENTIAL SOLVENT IMPACT
- MANUFACTURING
- OTHER
- REPAIR SHOP
- RETAIL

N

0 1,200'

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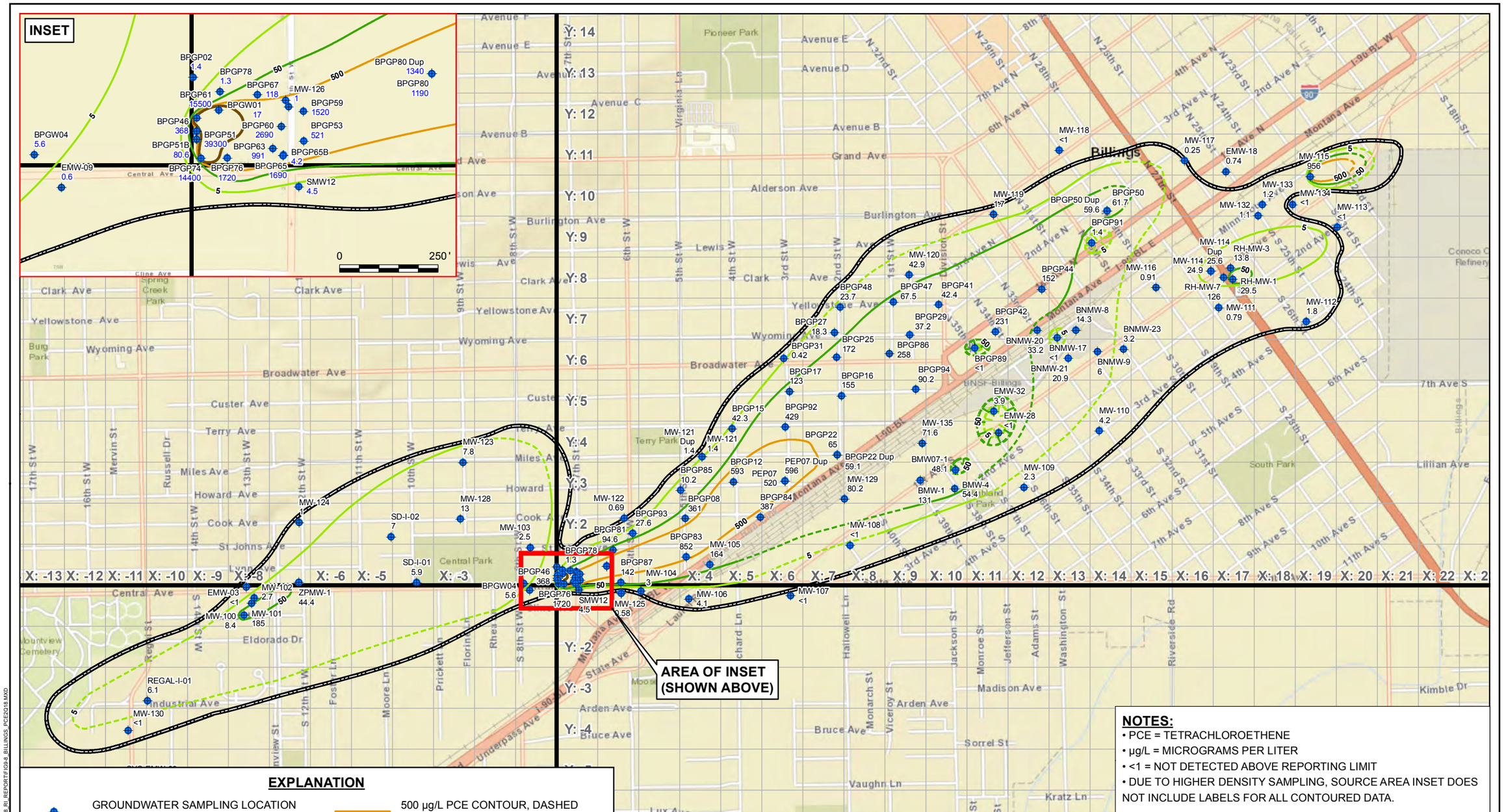
FIGURE 9-7

EPH/VPH AND SVOC GROUNDWATER ANALYTICAL RESULTS MAY 2018

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 4/4/19	File: Fig9-7_Billings_EPH2Q18.mxd

\\TRIHYDRO.COM\CLIENTS\GOVSTATEMIDEQSRS\BILLINGSPCE\GIS\MAPPING\2018_RI_REPORT\FIG9-7_BILLINGS_EPH2Q18.MXD



EXPLANATION

- GROUNDWATER SAMPLING LOCATION WITH PCE CONCENTRATION (µg/L)
- 5 µg/L PCE CONTOUR, DASHED WHERE INFERRED
- 5 µg/L PCE DEPRESSION CONTOUR, DASHED WHERE INFERRED
- 50 µg/L PCE CONTOUR, DASHED WHERE INFERRED
- 50 µg/L PCE DEPRESSION CONTOUR, DASHED WHERE INFERRED
- 500 µg/L PCE CONTOUR, DASHED WHERE INFERRED
- 5,000 µg/L PCE CONTOUR
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

NOTES:

- PCE = TETRACHLOROETHENE
- µg/L = MICROGRAMS PER LITER
- <1 = NOT DETECTED ABOVE REPORTING LIMIT
- DUE TO HIGHER DENSITY SAMPLING, SOURCE AREA INSET DOES NOT INCLUDE LABELS FOR ALL CONTOURED DATA.

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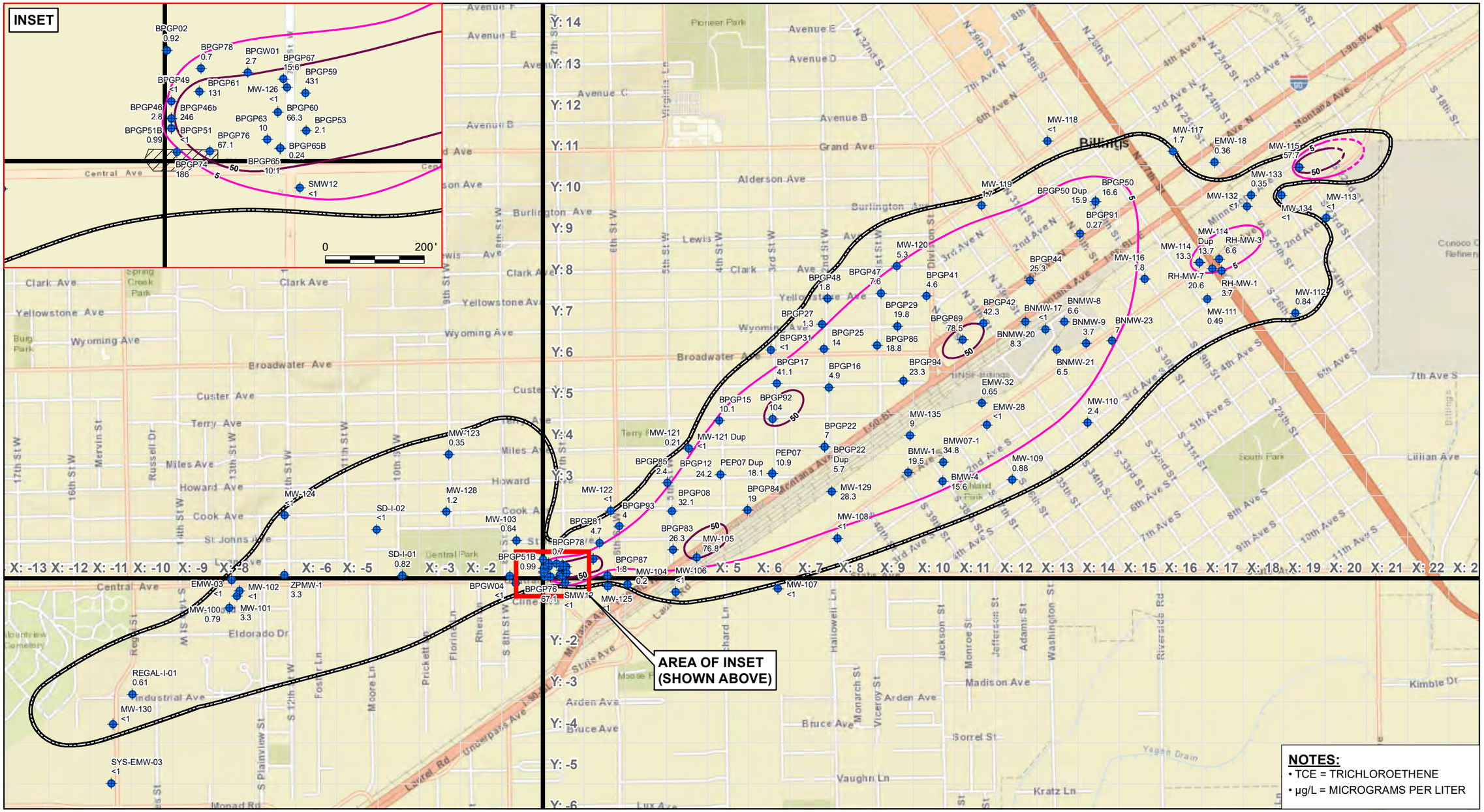
FIGURE 9-8

PCE GROUNDWATER PLUME MAY 2018

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/2/19	File: Fig9-8_Billings_PCE2Q18.mxd

M:\GIS\STAFE\MDEQ\RS\BILLINGS\PCE\GIS\MAPPING\2018_RI_REPORT\FIG9-8_BILLINGS_PCE2Q18.MXD



NOTES:
- TCE = TRICHLOROETHENE
- µg/L = MICROGRAMS PER LITER

EXPLANATION

- GROUNDWATER SAMPLING LOCATION WITH TCE CONCENTRATION (µg/L)
- 5 µg/L TCE CONTOUR, DASHED WHERE INFERRED
- 50 µg/L TCE CONTOUR, DASHED WHERE INFERRED
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)
- SHEET PILING CONTAINMENT CELL

N

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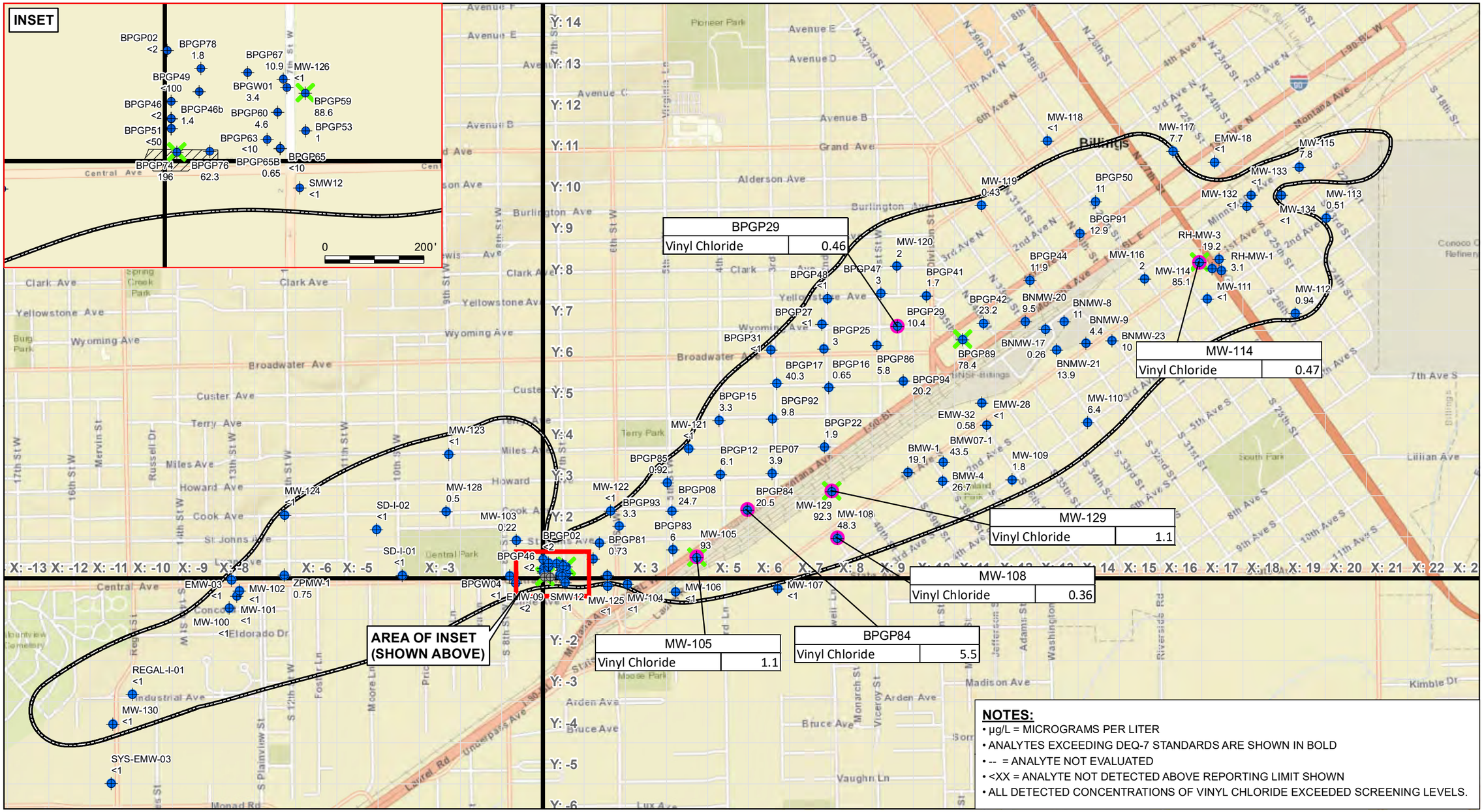
FIGURE 9-9

TCE GROUNDWATER PLUME MAY 2018

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/2/19	File: Fig9-9_Billings_TCE2Q18.mxd

\\TRIHYDRO.COM\CLIENTS\GOVSTATE\MDEQ\RS\BILLINGSPCE\GIS\MAPPING\2018_RI_REPORT\FIG9-9_BILLINGS_TCE2Q18.MXD



NOTES:

- µg/L = MICROGRAMS PER LITER
- ANALYTES EXCEEDING DEQ-7 STANDARDS ARE SHOWN IN BOLD
- -- = ANALYTE NOT EVALUATED
- <XX = ANALYTE NOT DETECTED ABOVE REPORTING LIMIT SHOWN
- ALL DETECTED CONCENTRATIONS OF VINYL CHLORIDE EXCEEDED SCREENING LEVELS.

EXPLANATION

- GROUNDWATER SAMPLING LOCATION WITH CIS-1,2-DCE CONCENTRATION
- GROUNDWATER SAMPLING LOCATION INSIDE SHEET PILE
- CIS-1,2-DCE EXCEEDANCE
- VINYL CHLORIDE EXCEEDANCE
- SHEET PILING CONTAINMENT CELL
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)

N

0 1,200'

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FIGURE 9-10

CIS-1,2-DCE AND VC GROUNDWATER ANALYTICAL RESULTS MAY 2018

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/2/19	File: Fig9-10_Billings_CIS2Q18.mxd

\\TRIHYDRO.COM\CLIENTS\GOV\STATEMDE\SRS\BILLINGSPCE\GIS\MAPPING\2018 RI REPORT\FIG9-10_BILLINGS_CIS2Q18.MXD

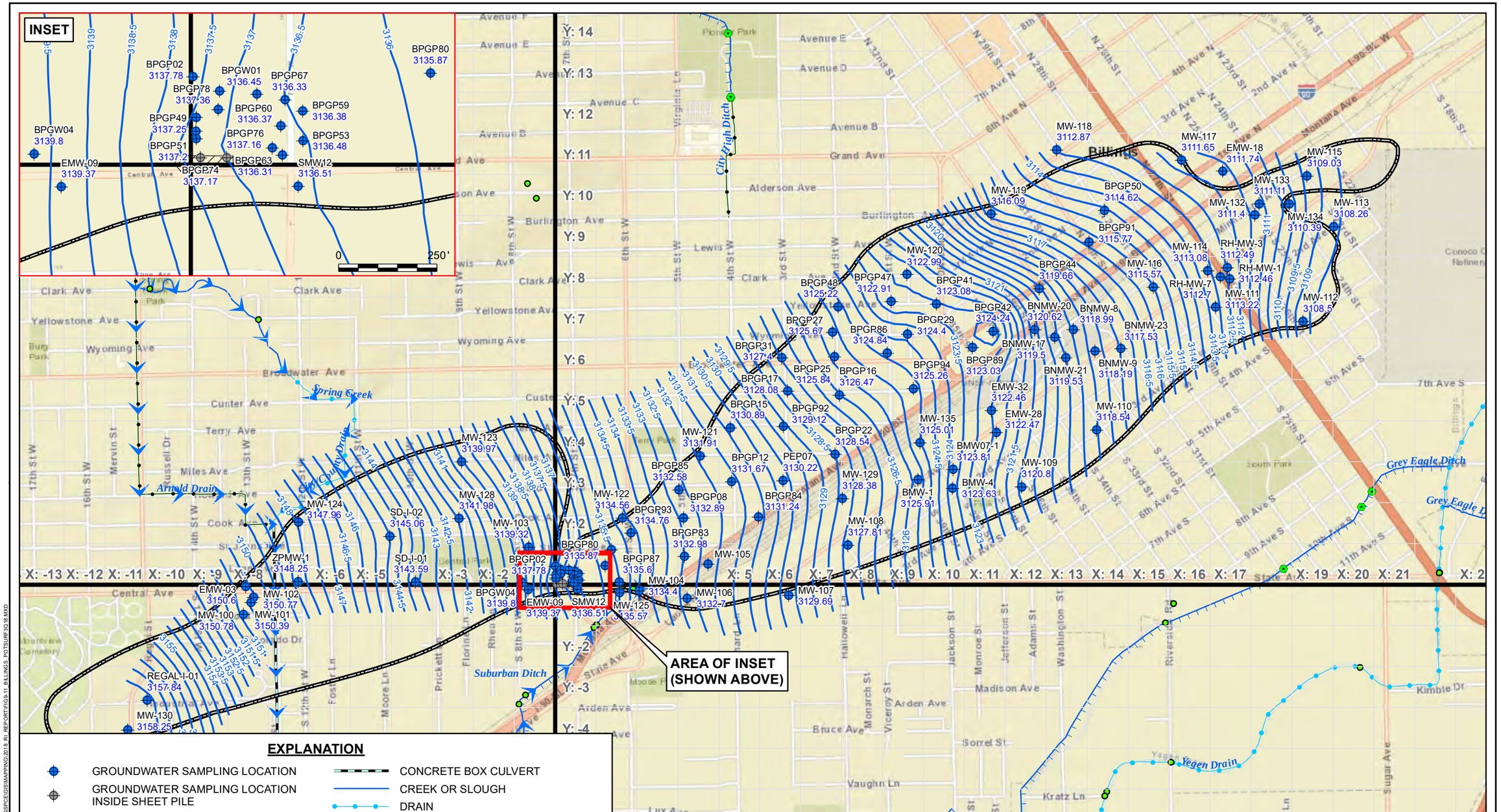

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FIGURE 9-11

GROUNDWATER POTENTIOMETRIC SURFACE SEPTEMBER 2018

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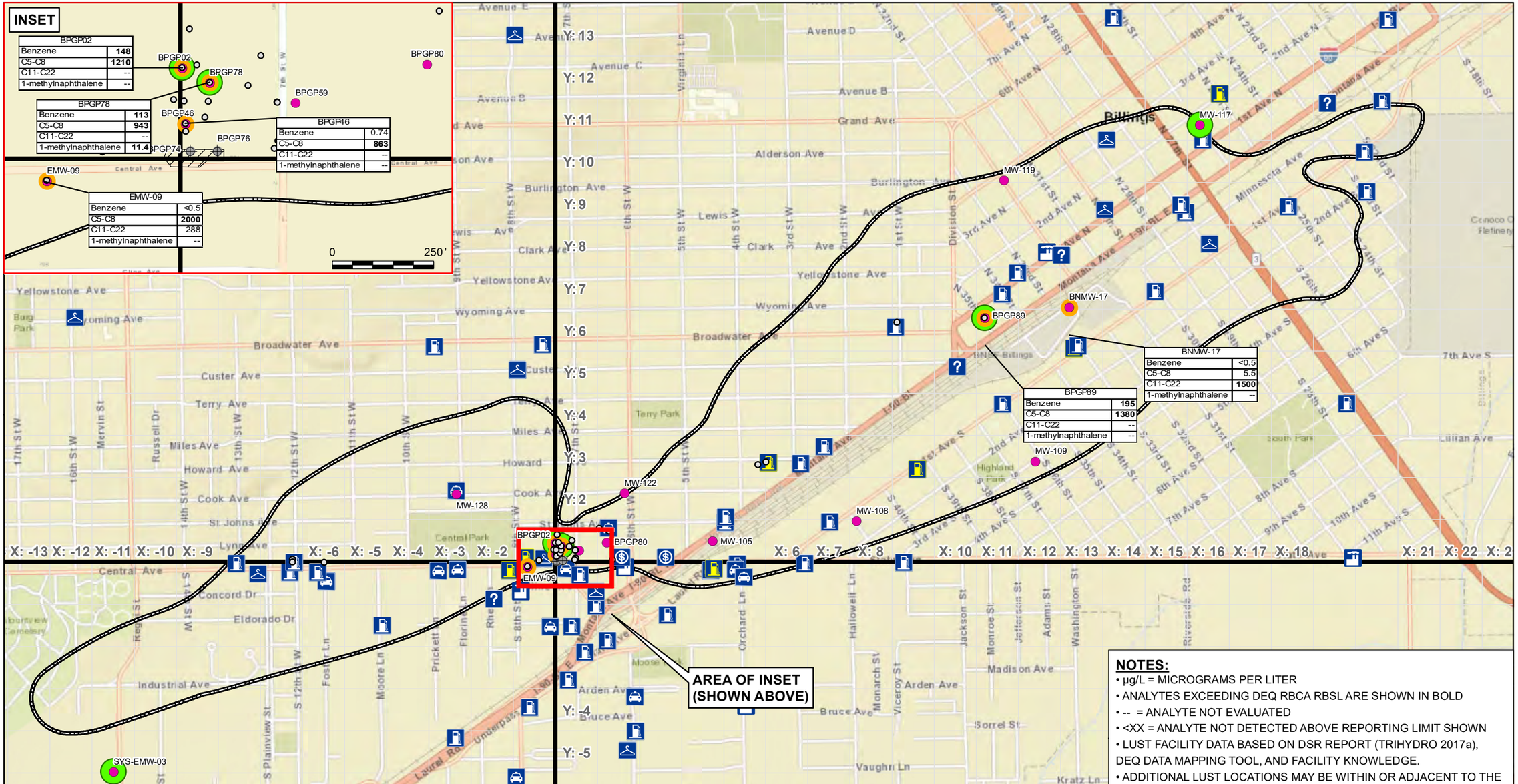
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 4/15/19	File: Fig9-11_Billings_PotSurf3Q18.mxd

\\TRIHYDRO.COM\CLIENTS\GOV\STATEWIDE\GSRS\BILLINGS\PCE\GIS\MAPPING\2018_RI_REPORT\FIGS-11_BILLINGS_POTSURF3Q18.MXD



NOTES:

- µg/L = MICROGRAMS PER LITER
- ANALYTES EXCEEDING DEQ RBCA RBSL ARE SHOWN IN BOLD
- -- = ANALYTE NOT EVALUATED
- <XX = ANALYTE NOT DETECTED ABOVE REPORTING LIMIT SHOWN
- LUST FACILITY DATA BASED ON DSR REPORT (TRIHYDRO 2017a), DEQ DATA MAPPING TOOL, AND FACILITY KNOWLEDGE.
- ADDITIONAL LUST LOCATIONS MAY BE WITHIN OR ADJACENT TO THE FACILITY BASED ON DIFFERENT DATABASES OR OTHER DATA SOURCES.

EXPLANATION

- EPH/VPH/SVOC SAMPLE LOCATION
- GROUNDWATER SAMPLING LOCATION INSIDE SHEET PILE
- EPH/VPH EXCEEDANCE
- HISTORICAL BENZENE RESULTS ABOVE SCREENING LEVEL
- BENZENE SCREENING LEVEL EXCEEDANCE (VOC METHOD 8260)
- SHEET PILING CONTAINMENT CELL
- FACILITY BOUNDARY (1 µG/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)
- DRY CLEANER
- LUST SITE
- LUST SITE WITH POTENTIAL SOLVENT IMPACT
- MANUFACTURING
- OTHER
- REPAIR SHOP
- RETAIL

N

0 1,200'

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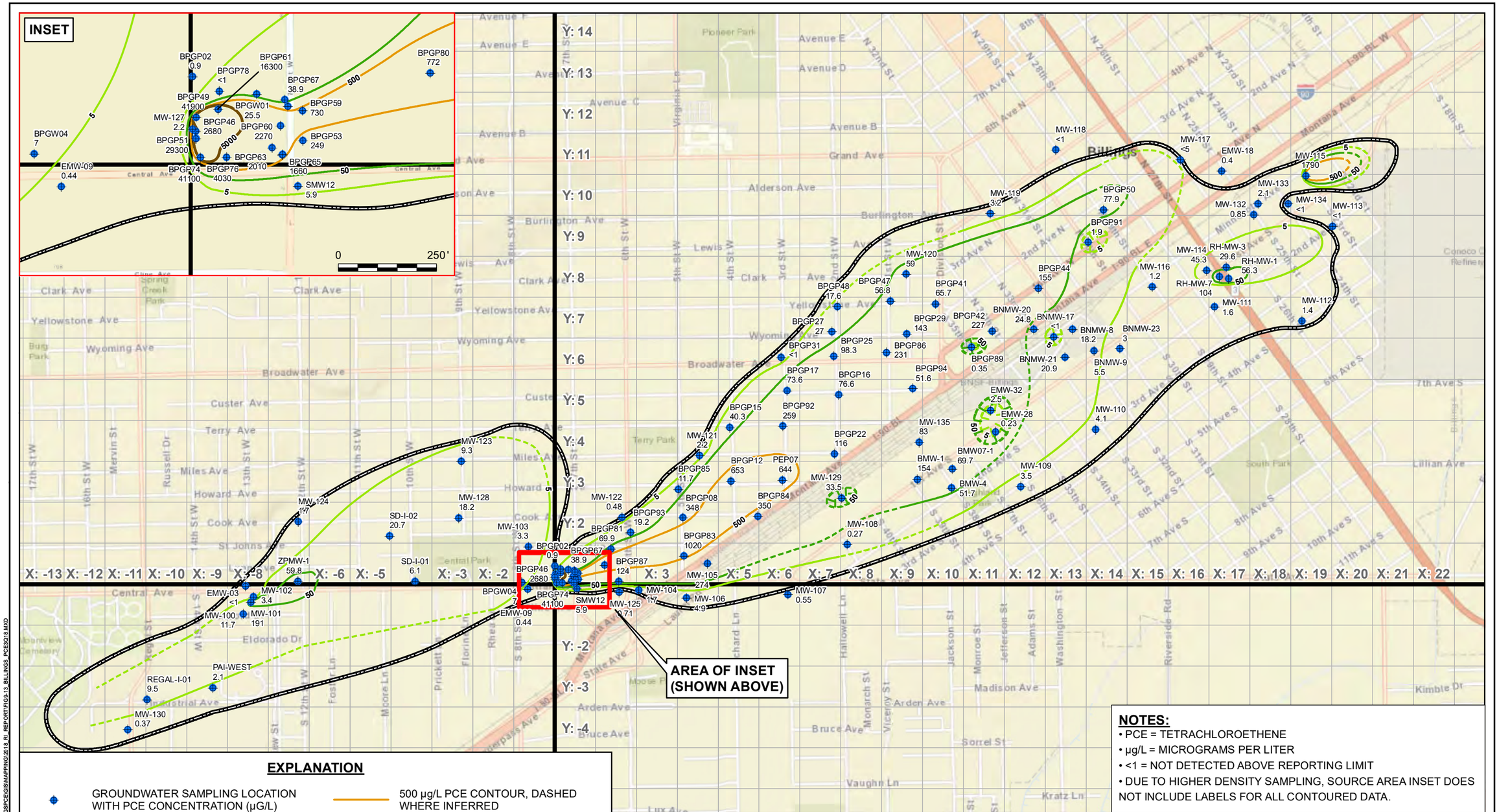
FIGURE 9-12

EPH/VPH AND SVOC GROUNDWATER ANALYTICAL RESULTS SEPTEMBER 2018

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 4/4/19	File: Fig9-12_Billings_EPH3Q18.mxd

\\TRIHYDRO.COM\CLIENTS\GO\VSTATE\DEQSR\BILLINGSPCE\GIS\MAPPING\2018 RI REPORT\FIG9-12_BILLINGS_EPH3Q18.MXD



NOTES:

- PCE = TETRACHLOROETHENE
- µg/L = MICROGRAMS PER LITER
- <1 = NOT DETECTED ABOVE REPORTING LIMIT
- DUE TO HIGHER DENSITY SAMPLING, SOURCE AREA INSET DOES NOT INCLUDE LABELS FOR ALL CONTOURED DATA.

EXPLANATION

- GROUNDWATER SAMPLING LOCATION WITH PCE CONCENTRATION (µG/L)
- 5 µg/L PCE CONTOUR, DASHED WHERE INFERRED
- 5 µg/L PCE DEPRESSION CONTOUR, DASHED WHERE INFERRED
- 50 µg/L PCE CONTOUR, DASHED WHERE INFERRED
- 50 µg/L PCE DEPRESSION CONTOUR, DASHED WHERE INFERRED
- 500 µg/L PCE CONTOUR, DASHED WHERE INFERRED
- 5,000 µg/L PCE CONTOUR
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

N

0 1,200'

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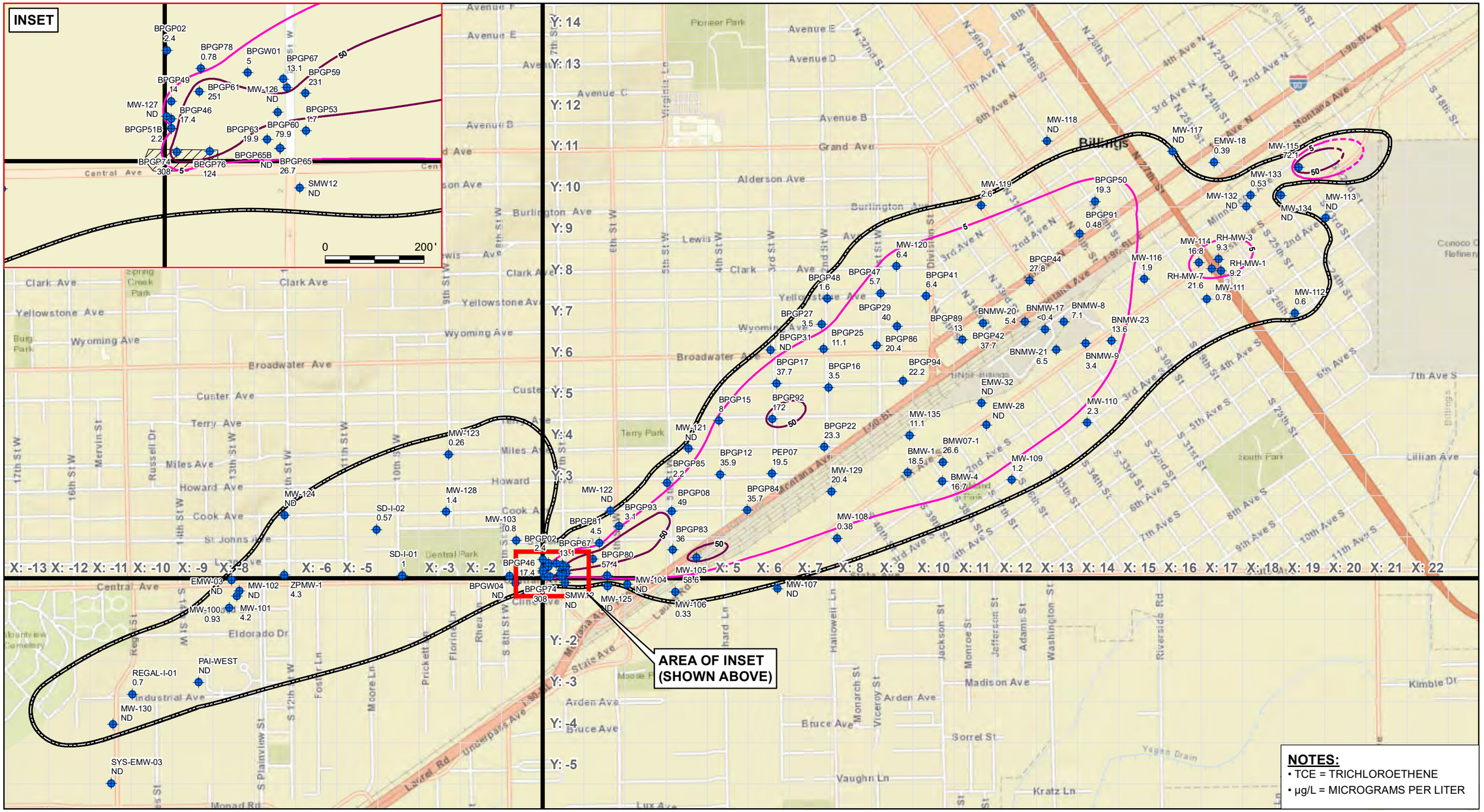
FIGURE 9-13

PCE GROUNDWATER PLUME SEPTEMBER 2018

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/3/19	File: Fig9-13_Billings_PCE3Q18.mxd

\\TRIHYDRO.COM\CLIENTS\GO\VSTATEMDE\SRS\BILLINGS\PCE\GIS\MAPPING\2018_RI_REPORT\FIG9-13_BILLINGS_PCE3Q18.MXD



EXPLANATION

- GROUNDWATER SAMPLING LOCATION WITH TCE CONCENTRATION (µg/L)
- 5 µg/L TCE CONTOUR, DASHED WHERE INFERRED
- 50 µg/L TCE CONTOUR, DASHED WHERE INFERRED
- SHEET PILING CONTAINMENT CELL
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

N

0 1,200'

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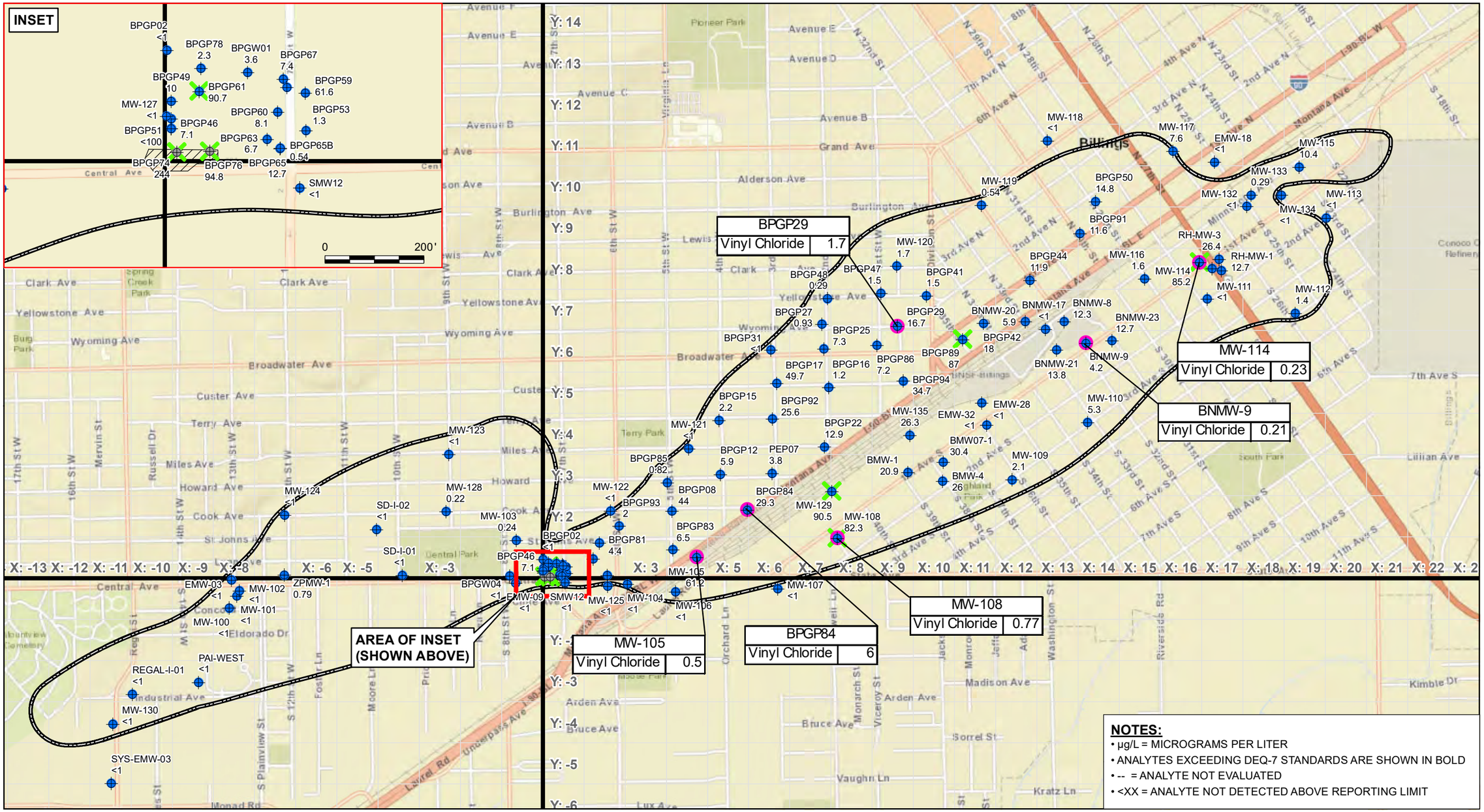
FIGURE 9-14

TCE GROUNDWATER PLUME SEPTEMBER 2018

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/4/19	File: Fig9-14_Billings_TCE3Q18.mxd

\\TRIHYDRO.COM\CLIENTS\GO\VSTATEMIDE\SRS\BILLINGS\PCE\GIS\MAPPING\2018_RI_REPORT\FIG9-14_BILLINGS_TCE3Q18.MXD



NOTES:

- µg/L = MICROGRAMS PER LITER
- ANALYTES EXCEEDING DEQ-7 STANDARDS ARE SHOWN IN BOLD
- -- = ANALYTE NOT EVALUATED
- <XX = ANALYTE NOT DETECTED ABOVE REPORTING LIMIT

EXPLANATION

- GROUNDWATER SAMPLING LOCATION WITH CIS-1,2-DCE CONCENTRATION
- GROUNDWATER SAMPLING LOCATION INSIDE SHEET PILE
- CIS-1,2-DCE EXCEEDANCE
- VINYL CHLORIDE EXCEEDANCE
- SHEET PILING CONTAINMENT CELL
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)

N

0 1,200'

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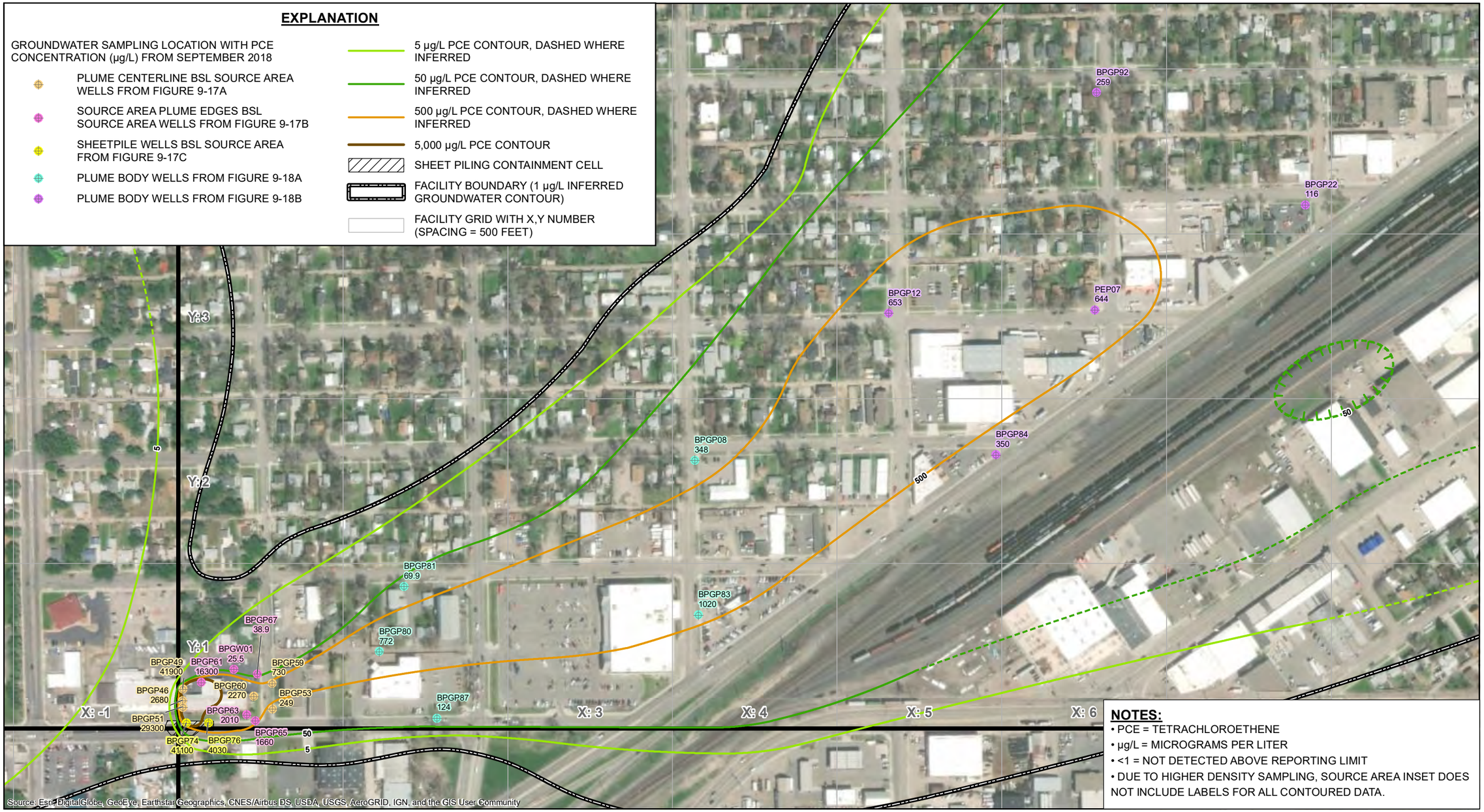
FIGURE 9-15

CIS-1,2-DCE AND VC GROUNDWATER ANALYTICAL RESULTS SEPTEMBER 2018

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/2/19	File: Fig9-15_Billings_CIS3Q18.mxd

\\TRIHYDRO.COM\CLIENTS\GOV\STATEMDEQ\RS\BILLINGSPCE\GIS\MAPPING\2018 RI REPORT\FIG9-15_BILLINGS_CIS3Q18.MXD



NOTES:

- PCE = TETRACHLOROETHENE
- µg/L = MICROGRAMS PER LITER
- <1 = NOT DETECTED ABOVE REPORTING LIMIT
- DUE TO HIGHER DENSITY SAMPLING, SOURCE AREA INSET DOES NOT INCLUDE LABELS FOR ALL CONTOURED DATA.

N

0 300'

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FIGURE 9-16

BSL GROUNDWATER MONITORING WELL LOCATIONS FOR TREND EVALUATION

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: BR	Checked By: AV	Scale: 1 " = 300 '	Date: 4/5/19	File: Fig9-16_Billings_BSL_Wells.mxd

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FIGURE 9-17a. BSL SOURCE AREA WELL PCE CONCENTRATIONS 2009 TO PRESENT
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

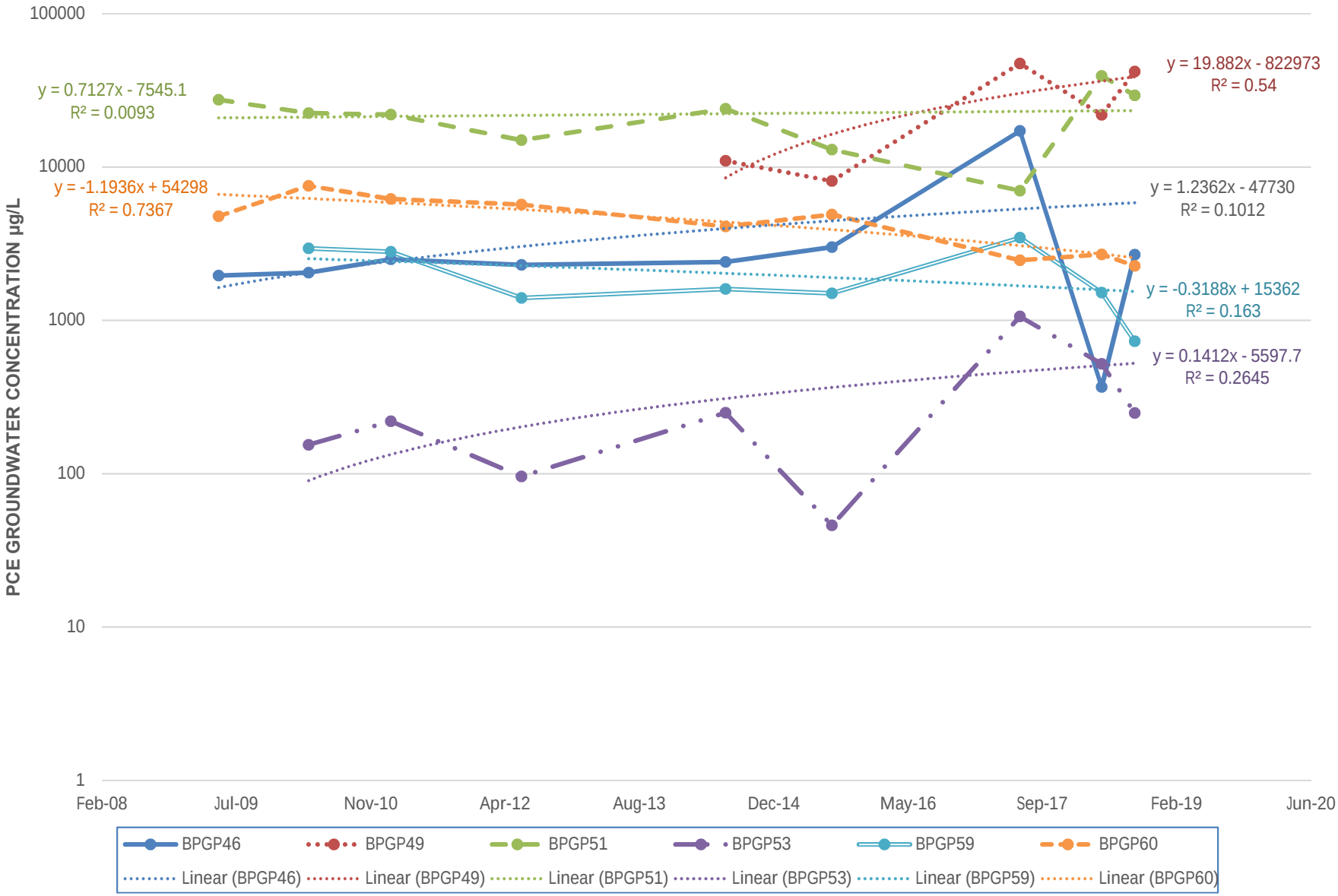


FIGURE 9-17b. BSL SOURCE AREA WELL PCE CONCENTRATIONS 2009 TO PRESENT
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

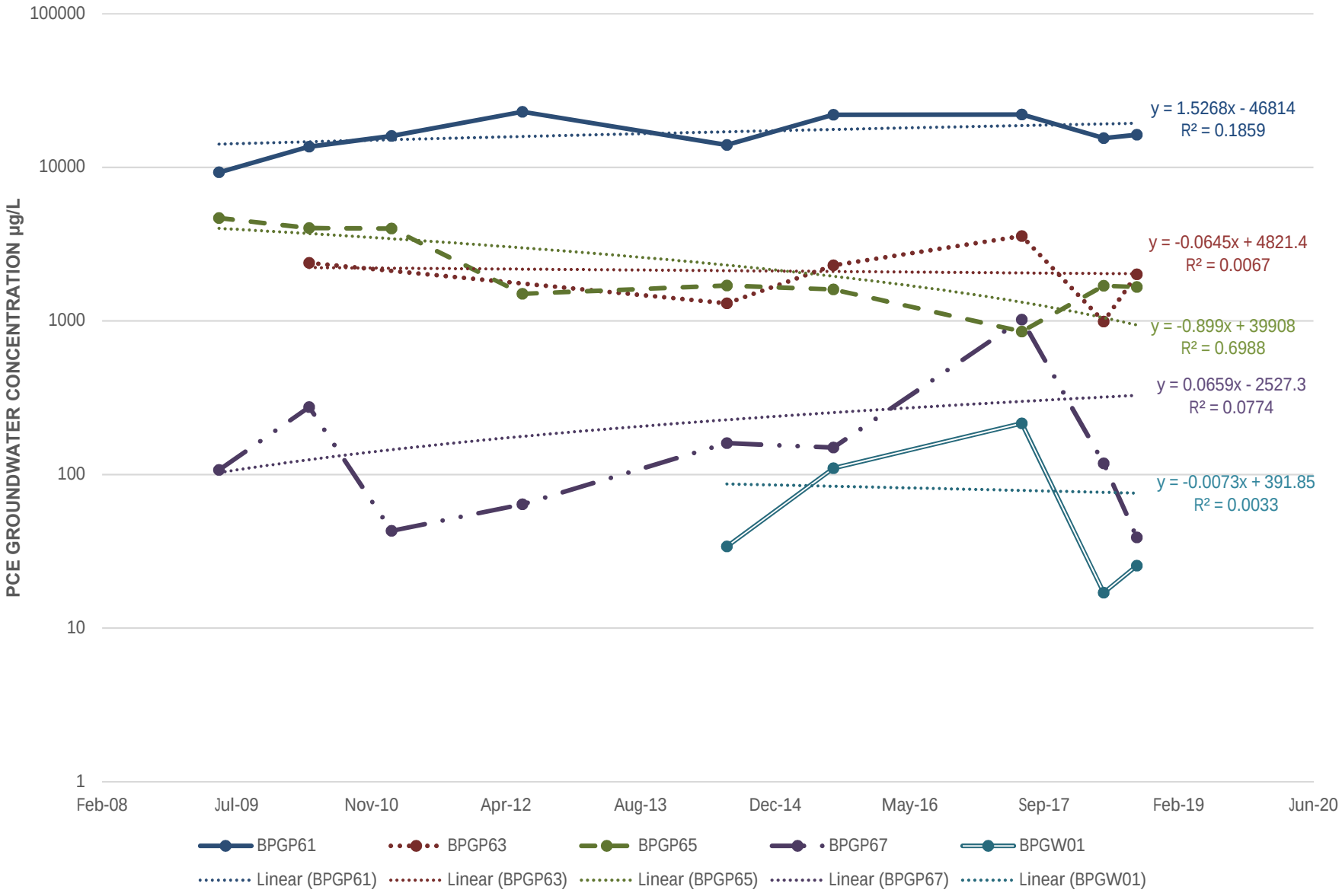


FIGURE 9-18a. BSL PLUME BODY WELL PCE CONCENTRATIONS 2009 TO PRESENT
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

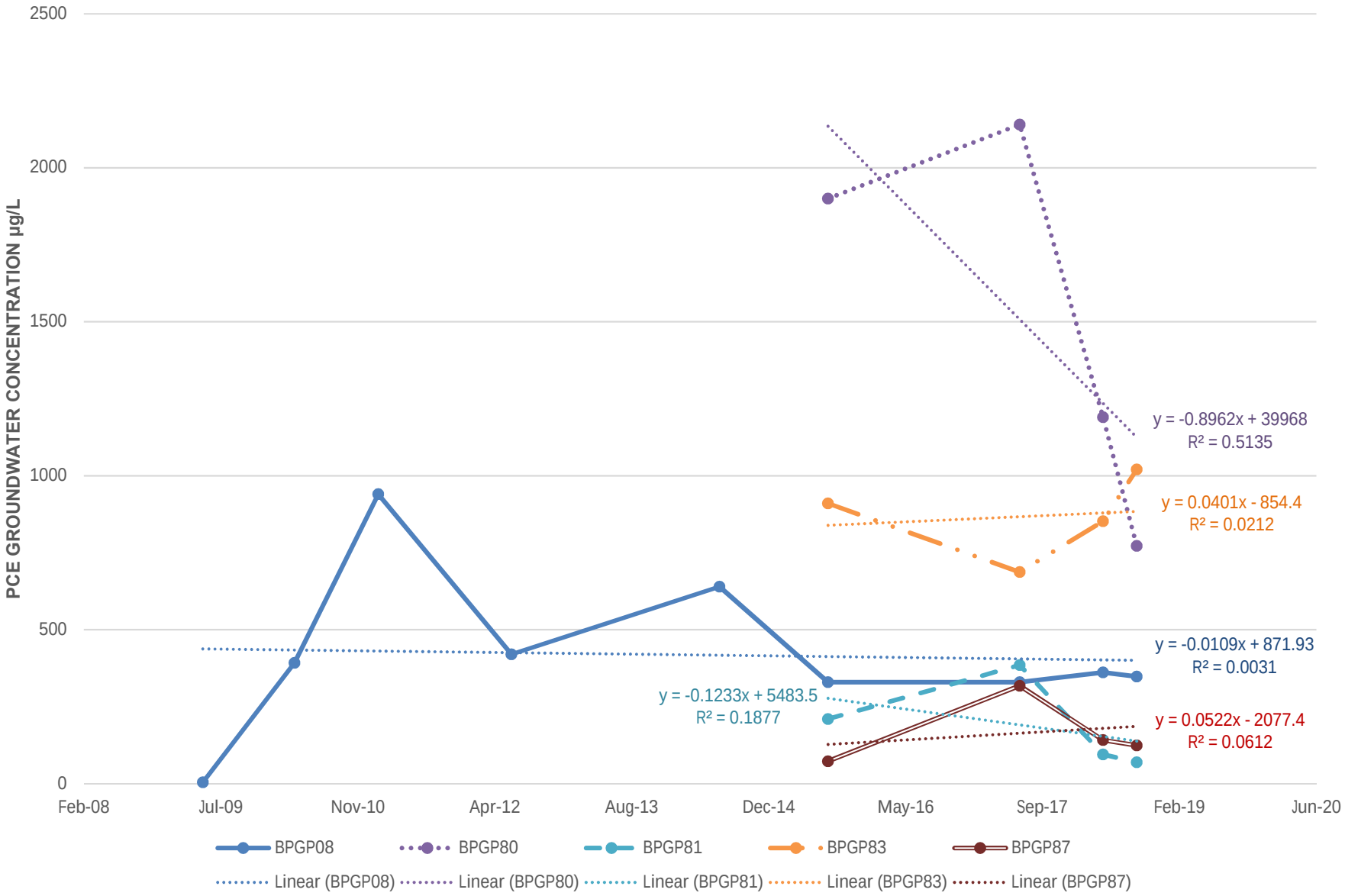


FIGURE 9-18b. BSL PLUME BODY WELL PCE CONCENTRATIONS 2009 TO PRESENT
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS MONTANA

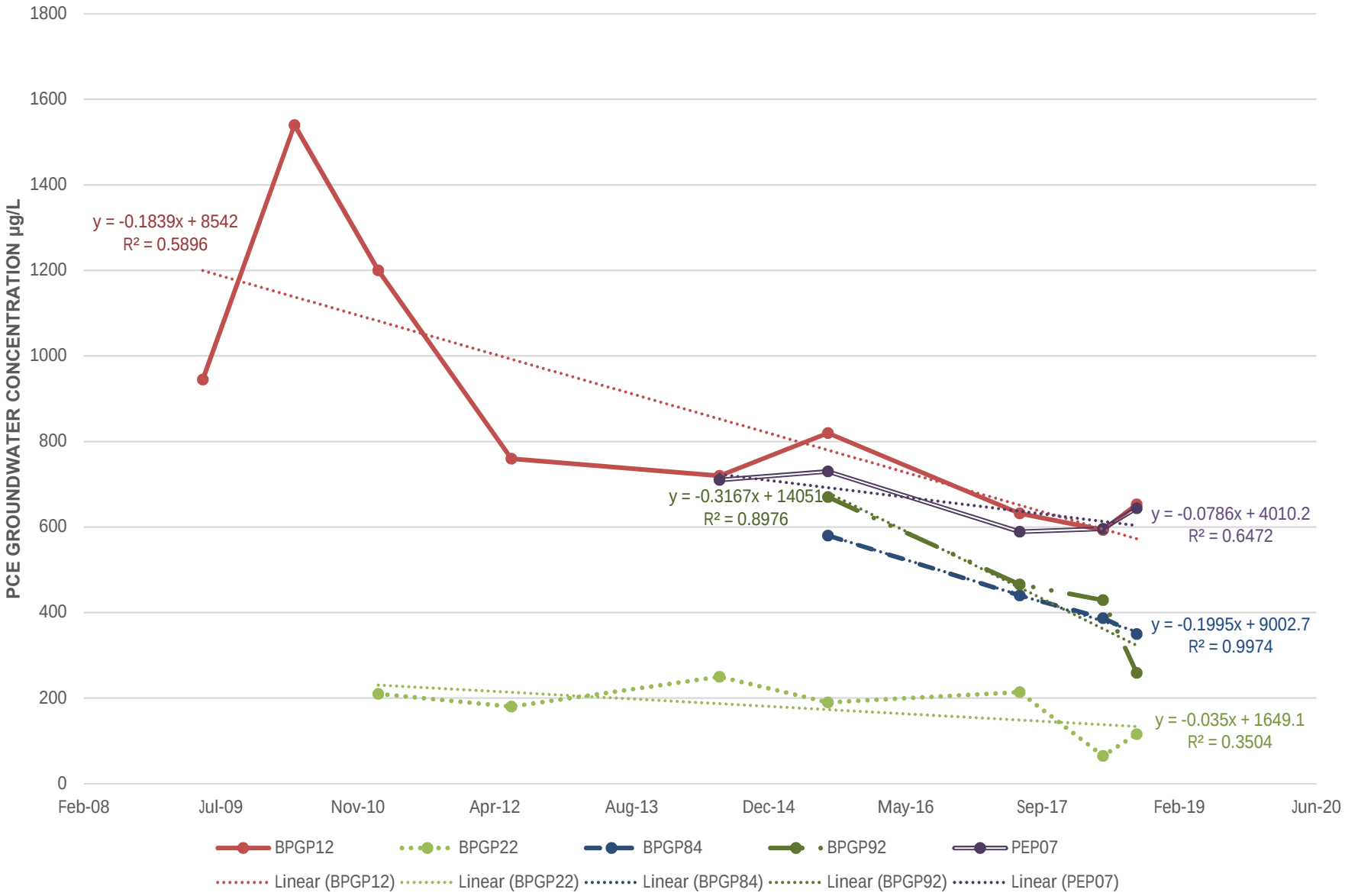
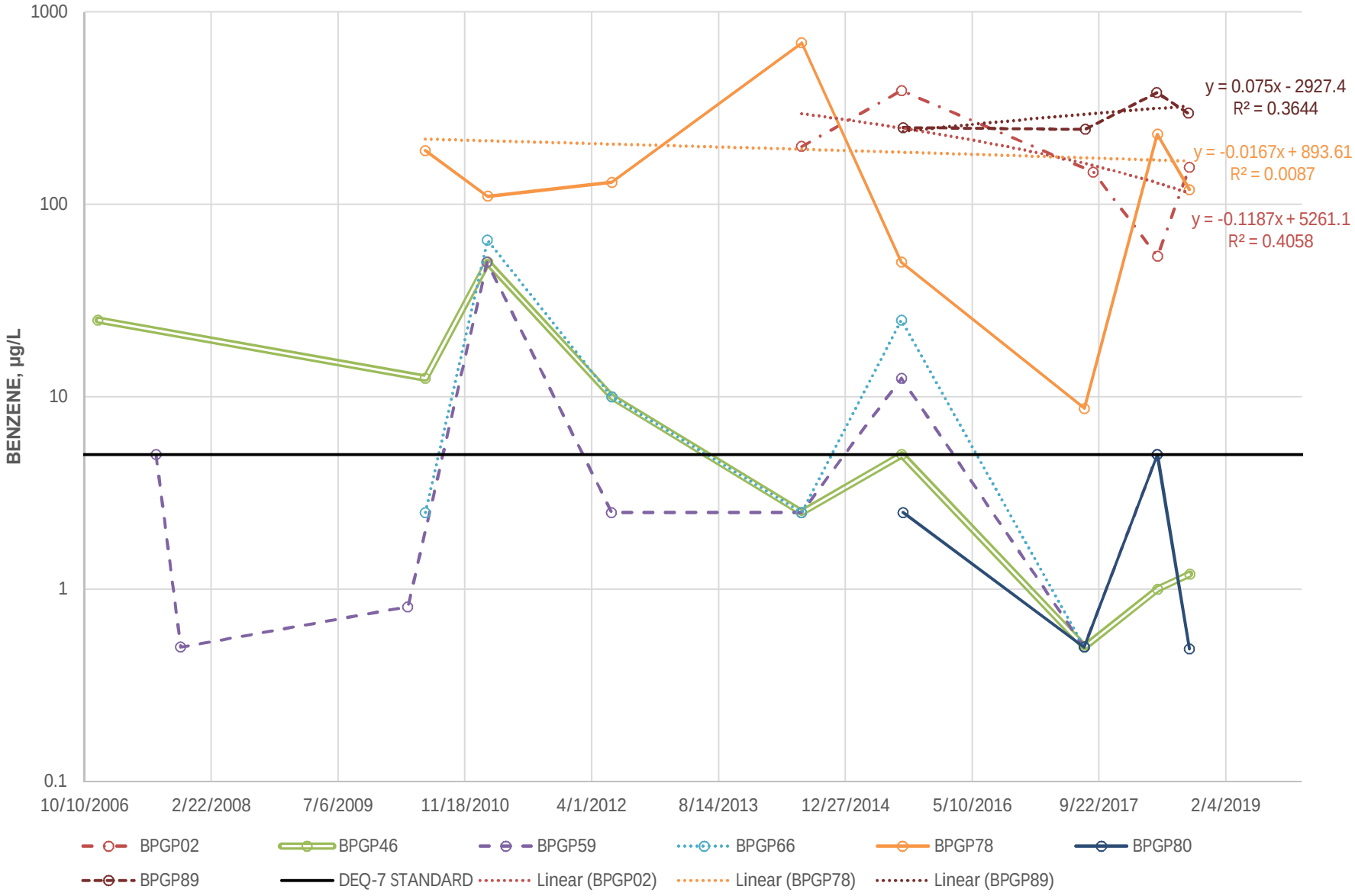


FIGURE 9-19. BENZENE CONCENTRATIONS 2006 TO 2018
REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY, BILLINGS, MONTANA



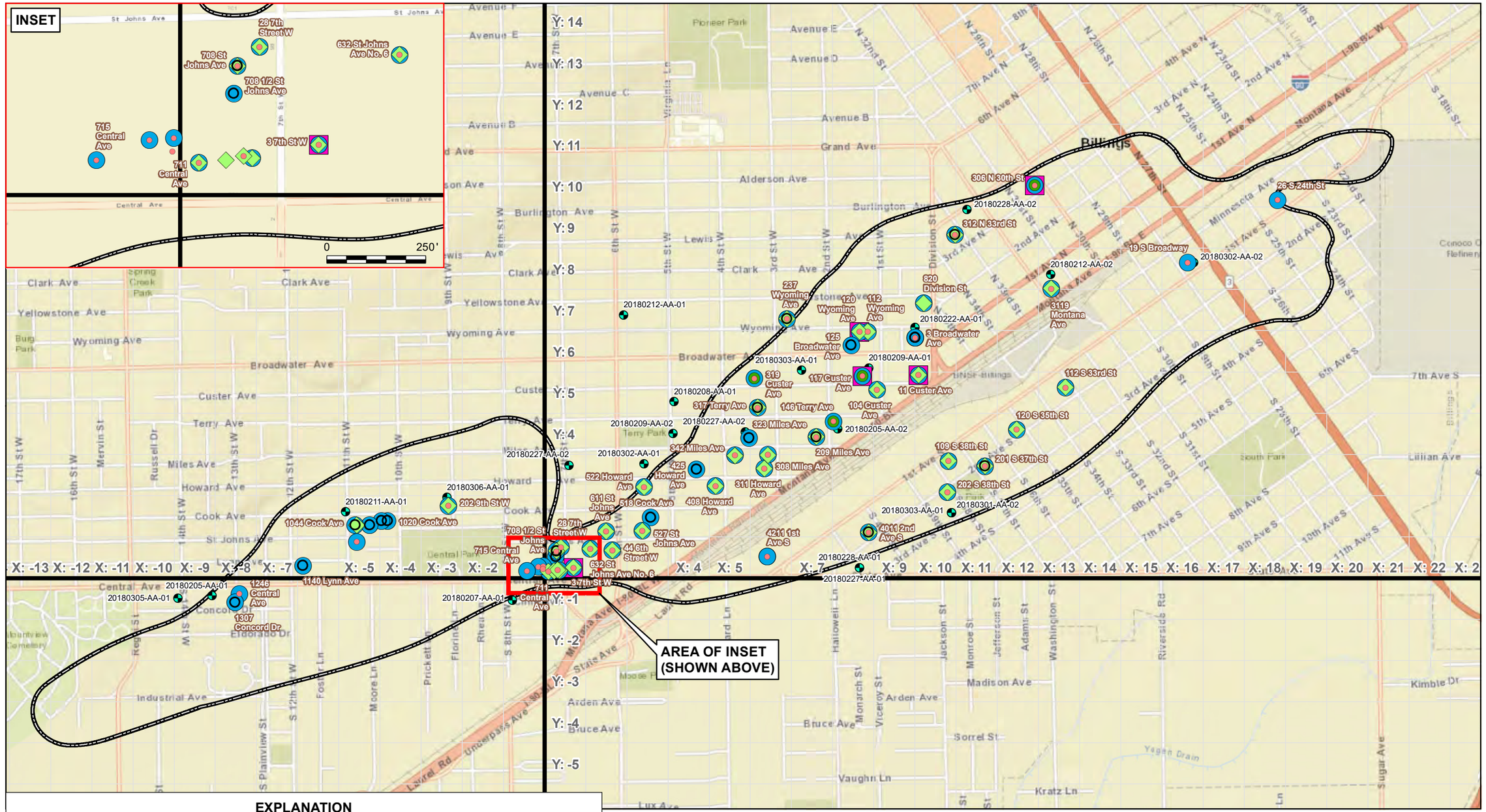


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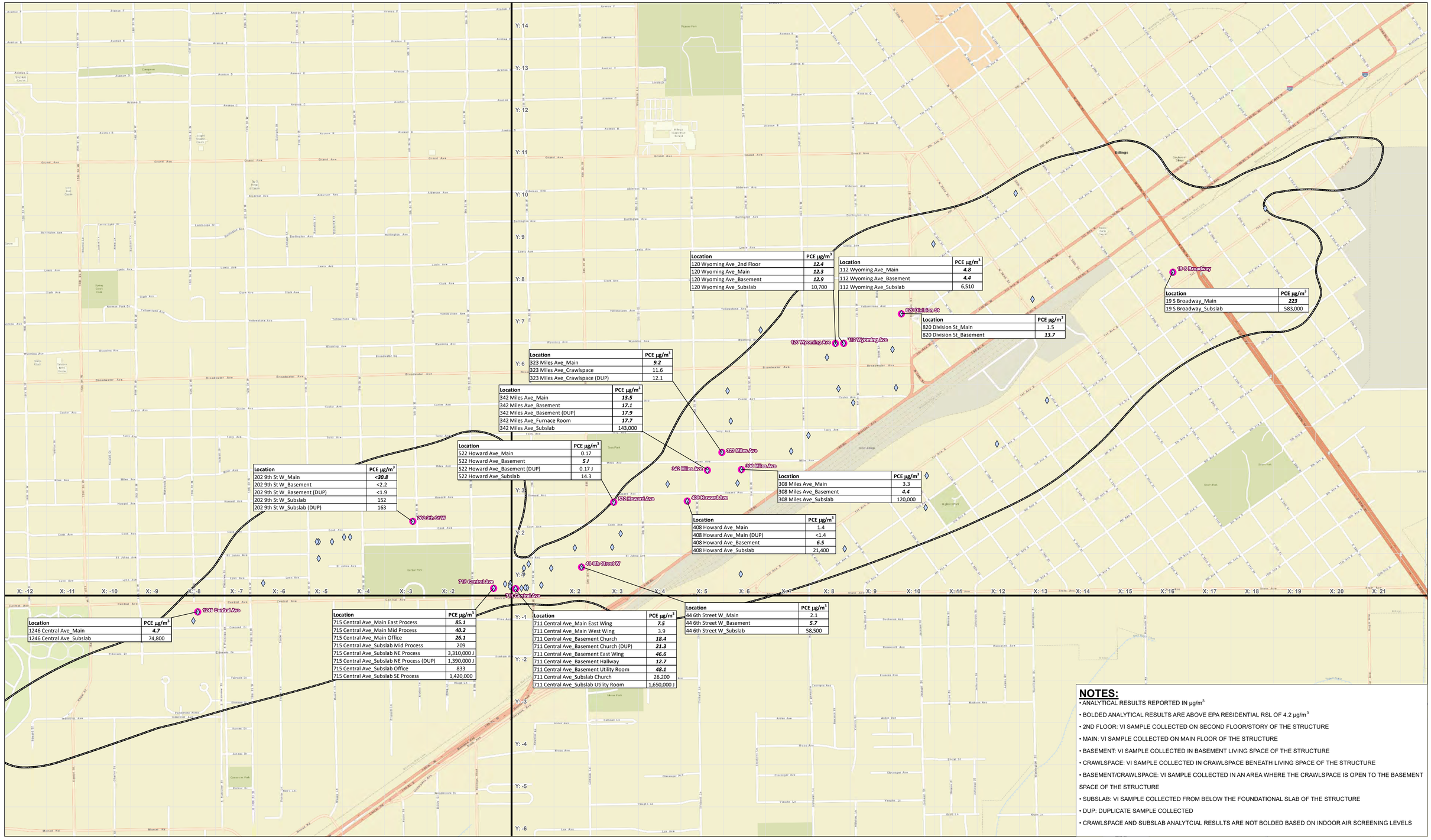
FIGURE 10-1

VAPOR INTRUSION INVESTIGATION LOCATIONS 2018

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 12/28/18	File: Fig10-1_Billings_VI_InvLocs.mxd

\\TRIHYDRO.COM\CLIENTS\GO\VSTATE\MDE\SRS\BILLINGS\PCE\GIS\MAPPING\2018_RI_REPORT\FIG 10-1_BILLINGS_VI_INVLOCS.MXD



Location	PCE µg/m³
120 Wyoming Ave_2nd Floor	***12.4***
120 Wyoming Ave_Main	***12.3***
120 Wyoming Ave_Basement	***12.9***
120 Wyoming Ave_Subslab	10,700

Location	PCE µg/m³
112 Wyoming Ave_Main	***4.8***
112 Wyoming Ave_Basement	***4.4***
112 Wyoming Ave_Subslab	6,510

Location	PCE µg/m³
820 Division St_Main	1.5
820 Division St_Basement	***13.7***

Location	PCE µg/m³
19 S Broadway_Main	***223***
19 S Broadway_Subslab	583,000

Location	PCE µg/m³
323 Miles Ave_Main	***9.2***
323 Miles Ave_Crawlspace	11.6
323 Miles Ave_Crawlspace (DUP)	12.1

Location	PCE µg/m³
342 Miles Ave_Main	***13.5***
342 Miles Ave_Basement	***17.1***
342 Miles Ave_Basement (DUP)	***17.9***
342 Miles Ave_Furnace Room	***17.7***
342 Miles Ave_Subslab	143,000

Location	PCE µg/m³
308 Miles Ave_Main	3.3
308 Miles Ave_Basement	***4.4***
308 Miles Ave_Subslab	120,000

Location	PCE µg/m³
522 Howard Ave_Main	0.17
522 Howard Ave_Basement	***5.1***
522 Howard Ave_Basement (DUP)	0.17 J
522 Howard Ave_Subslab	14.3

Location	PCE µg/m³
408 Howard Ave_Main	1.4
408 Howard Ave_Main (DUP)	<1.4
408 Howard Ave_Basement	***6.5***
408 Howard Ave_Subslab	21,400

Location	PCE µg/m³
202 9th St W_Main	***<30.8***
202 9th St W_Basement	<2.2
202 9th St W_Basement (DUP)	<1.9
202 9th St W_Subslab	152
202 9th St W_Subslab (DUP)	163

Location	PCE µg/m³
1246 Central Ave_Main	***4.7***
1246 Central Ave_Subslab	74,800

Location	PCE µg/m³
715 Central Ave_Main East Process	***85.1***
715 Central Ave_Main Mid Process	***40.2***
715 Central Ave_Main Office	***26.1***
715 Central Ave_Subslab Mid Process	209
715 Central Ave_Subslab NE Process	3,310,000 J
715 Central Ave_Subslab NE Process (DUP)	1,390,000 J
715 Central Ave_Subslab Office	833
715 Central Ave_Subslab SE Process	1,420,000

Location	PCE µg/m³
711 Central Ave_Main East Wing	***7.5***
711 Central Ave_Main West Wing	3.9
711 Central Ave_Basement Church	***18.4***
711 Central Ave_Basement Church (DUP)	***21.3***
711 Central Ave_Basement East Wing	***46.6***
711 Central Ave_Basement Hallway	***12.7***
711 Central Ave_Basement Utility Room	***48.1***
711 Central Ave_Subslab Church	26,200
711 Central Ave_Subslab Utility Room	1,650,000 J

Location	PCE µg/m³
44 6th Street W_Main	2.1
44 6th Street W_Basement	***5.7***
44 6th Street W_Subslab	58,500

NOTES:

- ANALYTICAL RESULTS REPORTED IN µg/m³
- BOLDED ANALYTICAL RESULTS ARE ABOVE EPA RESIDENTIAL RSL OF 4.2 µg/m³
- 2ND FLOOR: VI SAMPLE COLLECTED ON SECOND FLOOR/STORY OF THE STRUCTURE
- MAIN: VI SAMPLE COLLECTED ON MAIN FLOOR OF THE STRUCTURE
- BASEMENT: VI SAMPLE COLLECTED IN BASEMENT LIVING SPACE OF THE STRUCTURE
- CRAWLSPACE: VI SAMPLE COLLECTED IN CRAWLSPACE BENEATH LIVING SPACE OF THE STRUCTURE
- BASEMENT/CRAWLSPACE: VI SAMPLE COLLECTED IN AN AREA WHERE THE CRAWLSPACE IS OPEN TO THE BASEMENT SPACE OF THE STRUCTURE
- SUBSLAB: VI SAMPLE COLLECTED FROM BELOW THE FOUNDATIONAL SLAB OF THE STRUCTURE
- DUP: DUPLICATE SAMPLE COLLECTED
- CRAWLSPACE AND SUBSLAB ANALYTCIAL RESULTS ARE NOT BOLDED BASED ON INDOOR AIR SCREENING LEVELS

EXPLANATION

ANALYTICAL RESULTS SHOWN FOR PROPERTIES WITH AN INDOOR AIR PCE CONCENTRATION EXCEEDING AN APPLICABLE SCREENING LEVEL

- PCE EXCEEDANCE LOCATION
- NO PCE EXCEEDANCE LOCATION
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)

N

0 500 1,000'

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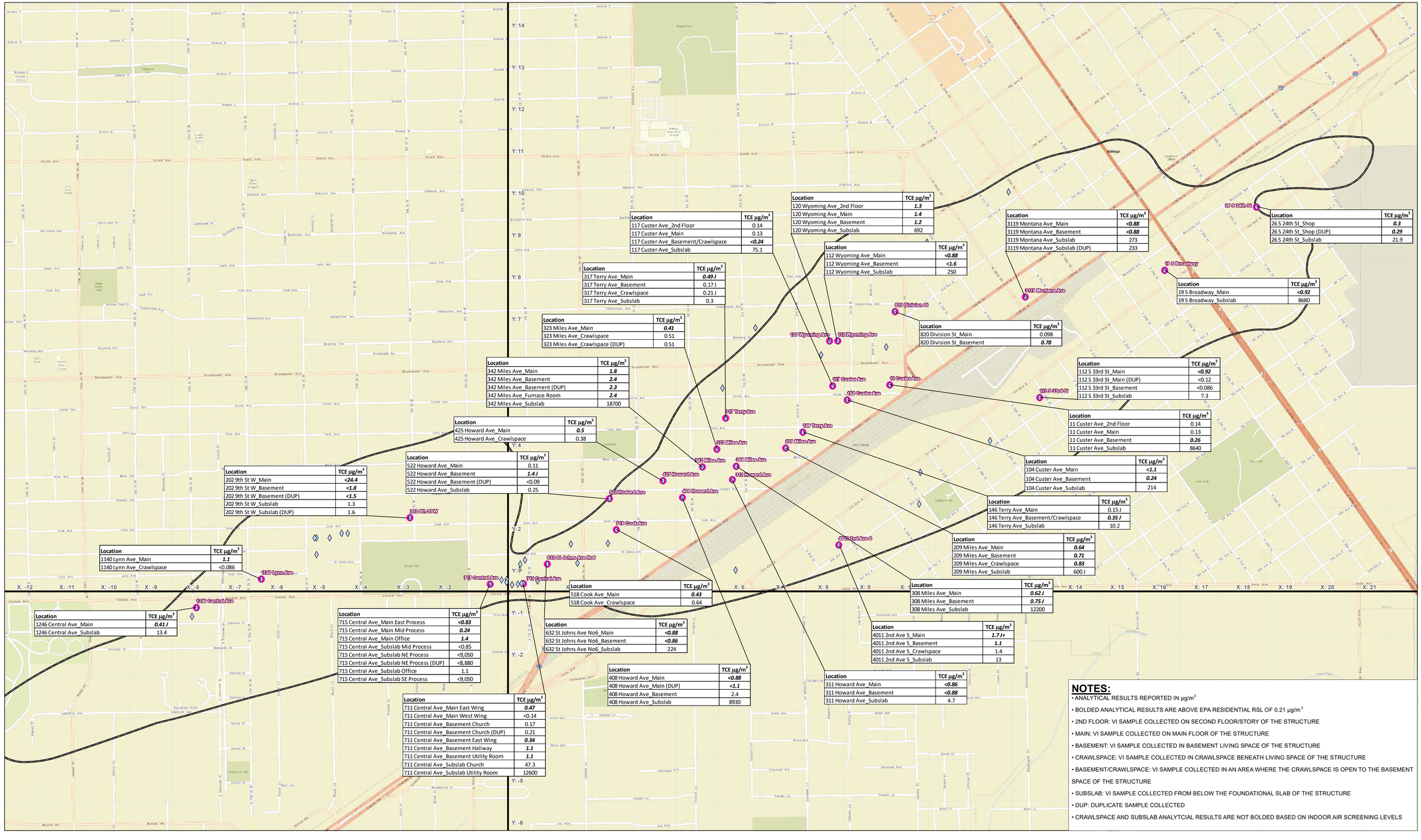
FIGURE 10-2

PCE VAPOR INTRUSION SAMPLING RESULTS 2018

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 500 '	Date: 12/27/18	File: Fig10-2_Billings_VI_PCEResD.mxd



Location	TCE µg/m³
26 S 24th St_Shop	*0.3*
26 S 24th St_Shop (DUP)	*0.29*
26 S 24th St_Subslab	21.9

Location	TCE µg/m³
19 S Broadway_Main	*<0.92*
19 S Broadway_Subslab	8680

Location	TCE µg/m³
3119 Montana Ave_Main	*<0.88*
3119 Montana Ave_Basement	*<0.88*
3119 Montana Ave_Subslab	273
3119 Montana Ave_Subslab (DUP)	233

Location	TCE µg/m³
820 Division St_Main	0.098
820 Division St_Basement	*0.78*

Location	TCE µg/m³
120 Wyoming Ave_2nd Floor	*1.3*
120 Wyoming Ave_Main	*1.4*
120 Wyoming Ave_Basement	*1.2*
120 Wyoming Ave_Subslab	692

Location	TCE µg/m³
112 Wyoming Ave_Main	*<0.88*
112 Wyoming Ave_Basement	*<1.6*
112 Wyoming Ave_Subslab	250

Location	TCE µg/m³
117 Custer Ave_2nd Floor	0.14
117 Custer Ave_Main	0.13
117 Custer Ave_Basement/Crawlspace	*<0.24*
117 Custer Ave_Subslab	75.1

Location	TCE µg/m³
112 S 33rd St_Main	*<0.92*
112 S 33rd St_Main (DUP)	<0.12
112 S 33rd St_Basement	<0.086
112 S 33rd St_Subslab	7.3

Location	TCE µg/m³
11 Custer Ave_2nd Floor	0.14
11 Custer Ave_Main	0.13
11 Custer Ave_Basement	*0.26*
11 Custer Ave_Subslab	8640

Location	TCE µg/m³
104 Custer Ave_Main	*<1.1*
104 Custer Ave_Basement	*0.24*
104 Custer Ave_Subslab	214

Location	TCE µg/m³
317 Terry Ave_Main	*0.49 J*
317 Terry Ave_Basement	0.17 J
317 Terry Ave_Crawlspace	0.21 J
317 Terry Ave_Subslab	0.3

Location	TCE µg/m³
146 Terry Ave_Main	0.15 J
146 Terry Ave_Basement/Crawlspace	*0.35 J*
146 Terry Ave_Subslab	10.2

Location	TCE µg/m³
323 Miles Ave_Main	*0.41*
323 Miles Ave_Crawlspace	0.51
323 Miles Ave_Crawlspace (DUP)	0.51

Location	TCE µg/m³
209 Miles Ave_Main	*0.64*
209 Miles Ave_Basement	*0.71*
209 Miles Ave_Crawlspace	*0.83*
209 Miles Ave_Subslab	600 J

Location	TCE µg/m³
342 Miles Ave_Main	*1.8*
342 Miles Ave_Basement	*2.4*
342 Miles Ave_Basement (DUP)	*2.3*
342 Miles Ave_Furnace Room	*2.4*
342 Miles Ave_Subslab	18700

Location	TCE µg/m³
308 Miles Ave_Main	*0.62 J*
308 Miles Ave_Basement	*0.75 J*
308 Miles Ave_Subslab	12200

Location	TCE µg/m³
425 Howard Ave_Main	*0.5*
425 Howard Ave_Crawlspace	0.38

Location	TCE µg/m³
522 Howard Ave_Main	0.11
522 Howard Ave_Basement	*1.4 J*
522 Howard Ave_Basement (DUP)	<0.09
522 Howard Ave_Subslab	0.25

Location	TCE µg/m³
202 9th St W_Main	*<24.4*
202 9th St W_Basement	*<1.8*
202 9th St W_Basement (DUP)	*<1.5*
202 9th St W_Subslab	1.3
202 9th St W_Subslab (DUP)	1.6

Location	TCE µg/m³
518 Cook Ave_Main	*0.43*
518 Cook Ave_Crawlspace	0.64

Location	TCE µg/m³
4011 2nd Ave S_Main	*1.7 J+*
4011 2nd Ave S_Basement	*1.1*
4011 2nd Ave S_Crawlspace	1.4
4011 2nd Ave S_Subslab	13

Location	TCE µg/m³
1140 Lynn Ave_Main	*1.1*
1140 Lynn Ave_Crawlspace	<0.086

Location	TCE µg/m³
632 St Johns Ave No6_Main	*<0.88*
632 St Johns Ave No6_Basement	*<0.86*
632 St Johns Ave No6_Subslab	224

Location	TCE µg/m³
1246 Central Ave_Main	*0.41 J*
1246 Central Ave_Subslab	13.4

Location	TCE µg/m³
715 Central Ave_Main East Process	*<0.83*
715 Central Ave_Main Mid Process	*0.24*
715 Central Ave_Main Office	*1.4*
715 Central Ave_Subslab Mid Process	<0.85
715 Central Ave_Subslab NE Process	<9,050
715 Central Ave_Subslab NE Process (DUP)	<8,880
715 Central Ave_Subslab Office	1.1
715 Central Ave_Subslab SE Process	<9,050

Location	TCE µg/m³
408 Howard Ave_Main	*<0.88*
408 Howard Ave_Main (DUP)	*<1.1*
408 Howard Ave_Basement	2.4
408 Howard Ave_Subslab	8930

Location	TCE µg/m³
311 Howard Ave_Main	*<0.86*
311 Howard Ave_Basement	*<0.88*
311 Howard Ave_Subslab	4.7

Location	TCE µg/m³
711 Central Ave_Main East Wing	*0.47*
711 Central Ave_Main West Wing	<0.14
711 Central Ave_Basement Church	0.17
711 Central Ave_Basement Church (DUP)	0.21
711 Central Ave_Basement East Wing	*0.34*
711 Central Ave_Basement Hallway	*1.1*
711 Central Ave_Basement Utility Room	*1.1*
711 Central Ave_Subslab Church	47.3
711 Central Ave_Subslab Utility Room	12600

NOTES:

- ANALYTICAL RESULTS REPORTED IN µg/m³
- BOLDED ANALYTICAL RESULTS ARE ABOVE EPA RESIDENTIAL RSL OF 0.21 µg/m³
- 2ND FLOOR: VI SAMPLE COLLECTED ON SECOND FLOOR/STORY OF THE STRUCTURE
- MAIN: VI SAMPLE COLLECTED ON MAIN FLOOR OF THE STRUCTURE
- BASEMENT: VI SAMPLE COLLECTED IN BASEMENT LIVING SPACE OF THE STRUCTURE
- CRAWLSPACE: VI SAMPLE COLLECTED IN CRAWLSPACE BENEATH LIVING SPACE OF THE STRUCTURE
- BASEMENT/CRAWLSPACE: VI SAMPLE COLLECTED IN AN AREA WHERE THE CRAWLSPACE IS OPEN TO THE BASEMENT SPACE OF THE STRUCTURE
- SUBSLAB: VI SAMPLE COLLECTED FROM BELOW THE FOUNDATIONAL SLAB OF THE STRUCTURE
- DUP: DUPLICATE SAMPLE COLLECTED
- CRAWLSPACE AND SUBSLAB ANALYTCIAL RESULTS ARE NOT BOLDED BASED ON INDOOR AIR SCREENING LEVELS

EXPLANATION

ANALYTICAL RESULTS SHOWN FOR PROPERTIES WITH AN INDOOR AIR TCE CONCENTRATION EXCEEDING AN APPLICABLE SCREENING LEVEL

- TCE EXCEEDANCE LOCATION
- NO TCE EXCEEDANCE LOCATION
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)

N

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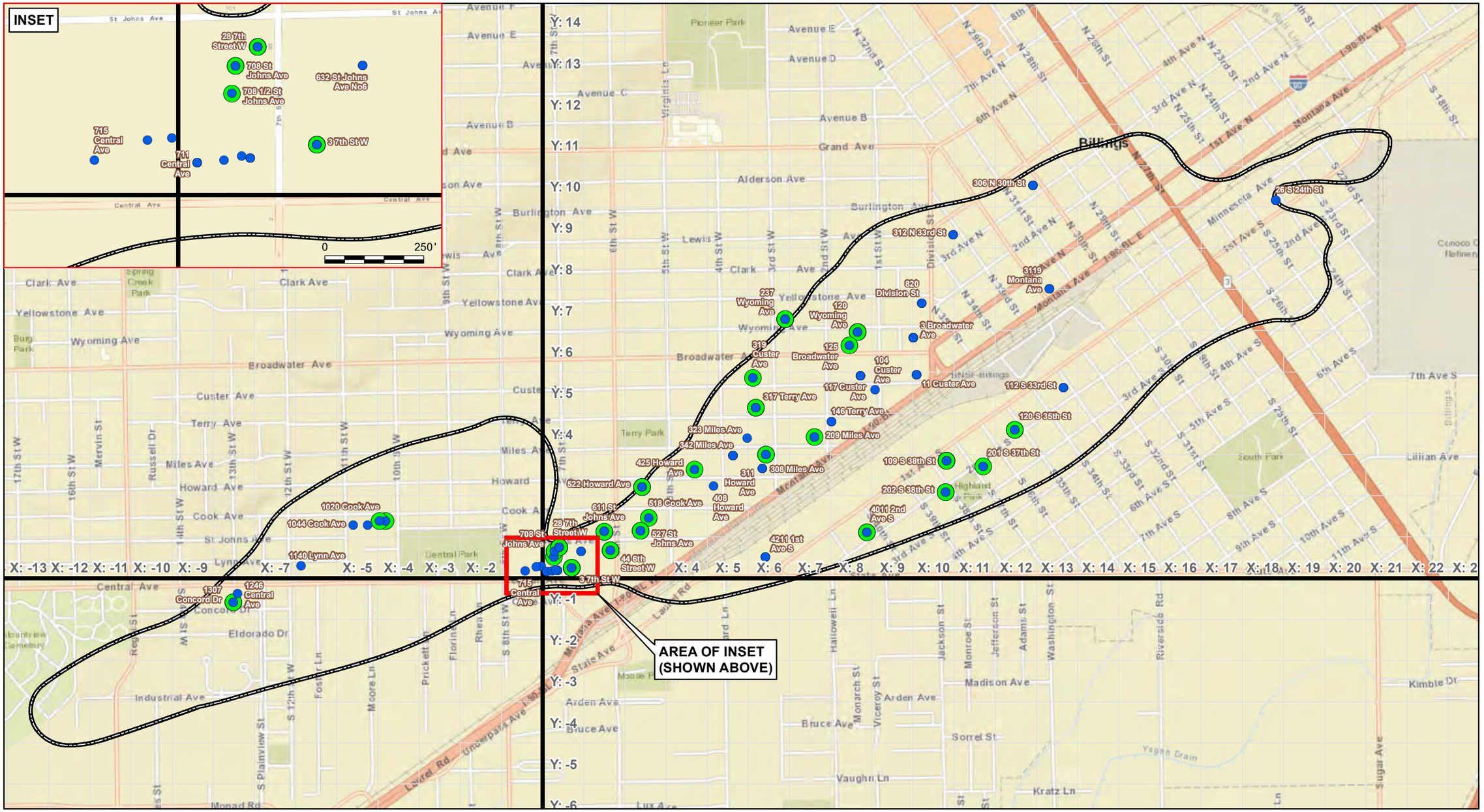
FIGURE 10-3

TCE VAPOR INTRUSION SAMPLING RESULTS 2018

REMEDIAL INVESTIGATION REPORT BILLINGS PCE GROUNDWATER FACILITY BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 500 '	Date: 12/27/18	File: Fig10-3_Billings_VI_TCEResD.mxd



EXPLANATION

- CHLOROFORM EXCEEDANCE
- BROMODICHLOROMETHANE EXCEEDANCE
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)

N

0 1,200'

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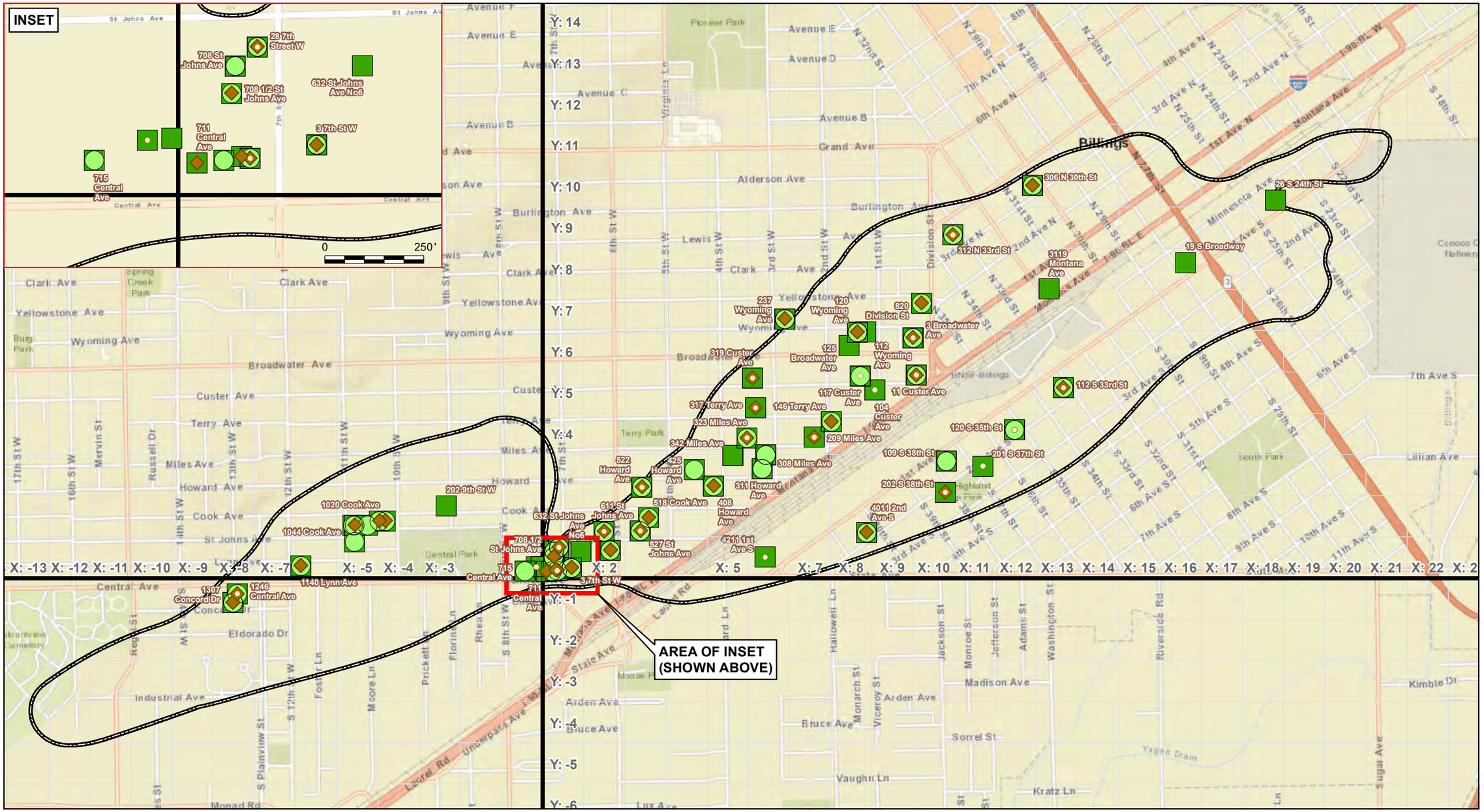
FIGURE 10-4

TRIHALOMETHANES INDOOR AIR EXCEEDANCES 2018

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/2/19	File: Fig10-4_Billings_VI_THM.mxd

\\TRIHYDRO.COM\CLIENTS\GIO\VSTATEWIDE\SRS\BILLINGS\PCE\GIS\MAPPING\2018 RI_REPORT\FIG 10-4_BILLINGS_VI_THM.MXD



EXPLANATION

- 1,3-BUTADIENE
- CARBON TETRACHLORIDE
- 1,2-DCA
- BENZENE
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID (SPACING = 500 FEET)

N

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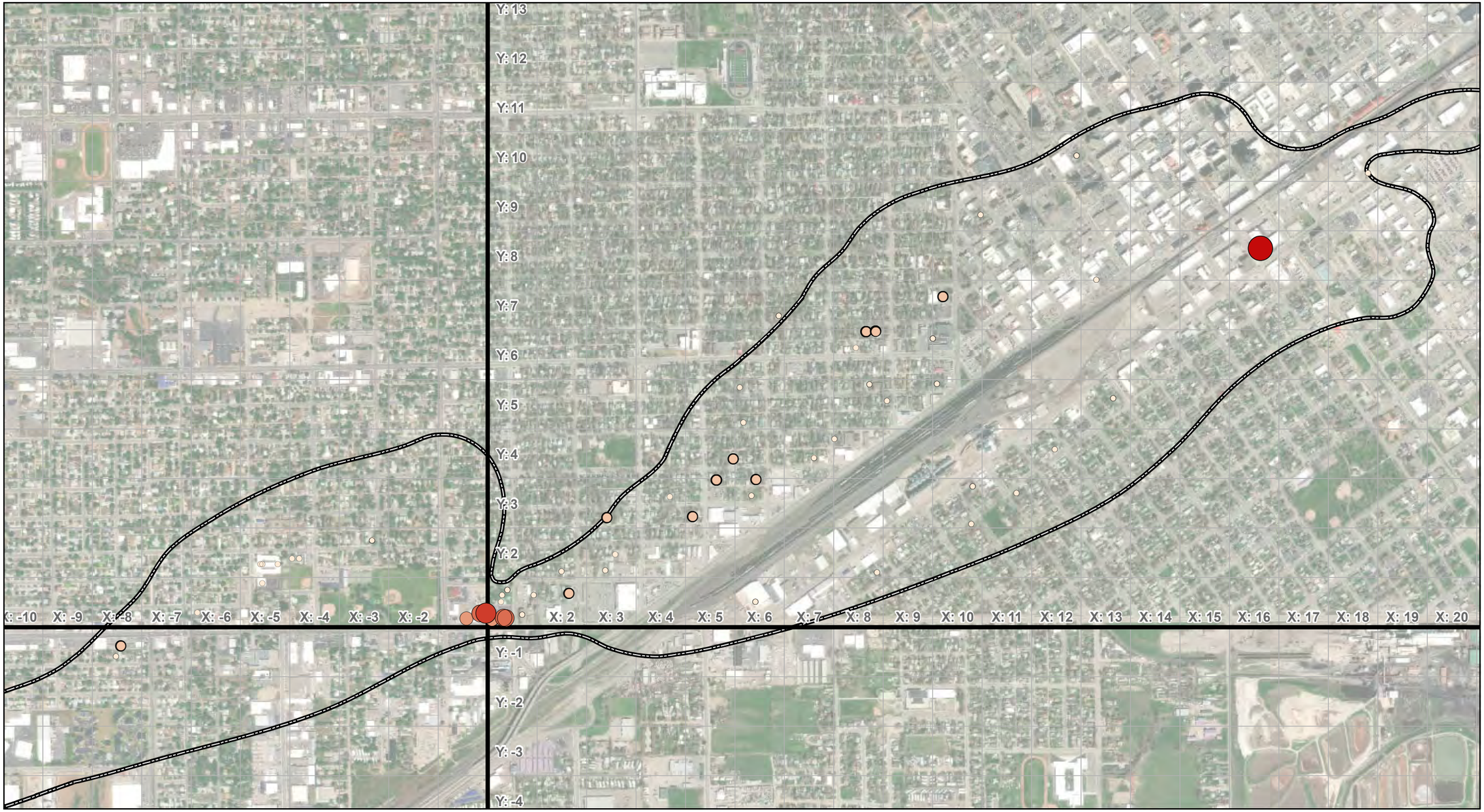
FIGURE 10-5

OTHER VOC INDOOR AIR EXCEEDANCES 2018

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: PH	Checked By: AV	Scale: 1 " = 1,200 '	Date: 1/2/19	File: Fig10-5_Billings_VI_OtherVOC.mxd

\\TRIHYDRO.COM\CLIENTS\GOV\STATEMDE\SRS\BILLINGSPCE\GIS\MAPPING\2018 RI REPORT\FIG 10-5_BILLINGS_VI_OTHERVOC.MXD



INDOOR AIR PCE CONCENTRATIONS (µg/M³)

- BELOW DETECTION LIMIT - 4.2
- >4.2 - 18
- >18 - 35
- >35 - 50

EXPLANATION

- >50 - 100
- >100
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

APPLICABLE PCE SCREENING LEVELS:

- 4.2 µg/M³ - RESIDENTIAL EPA REGIONAL SCREENING LEVEL (RSL)
- 18 µg/M³ - INDUSTRIAL EPA RSL

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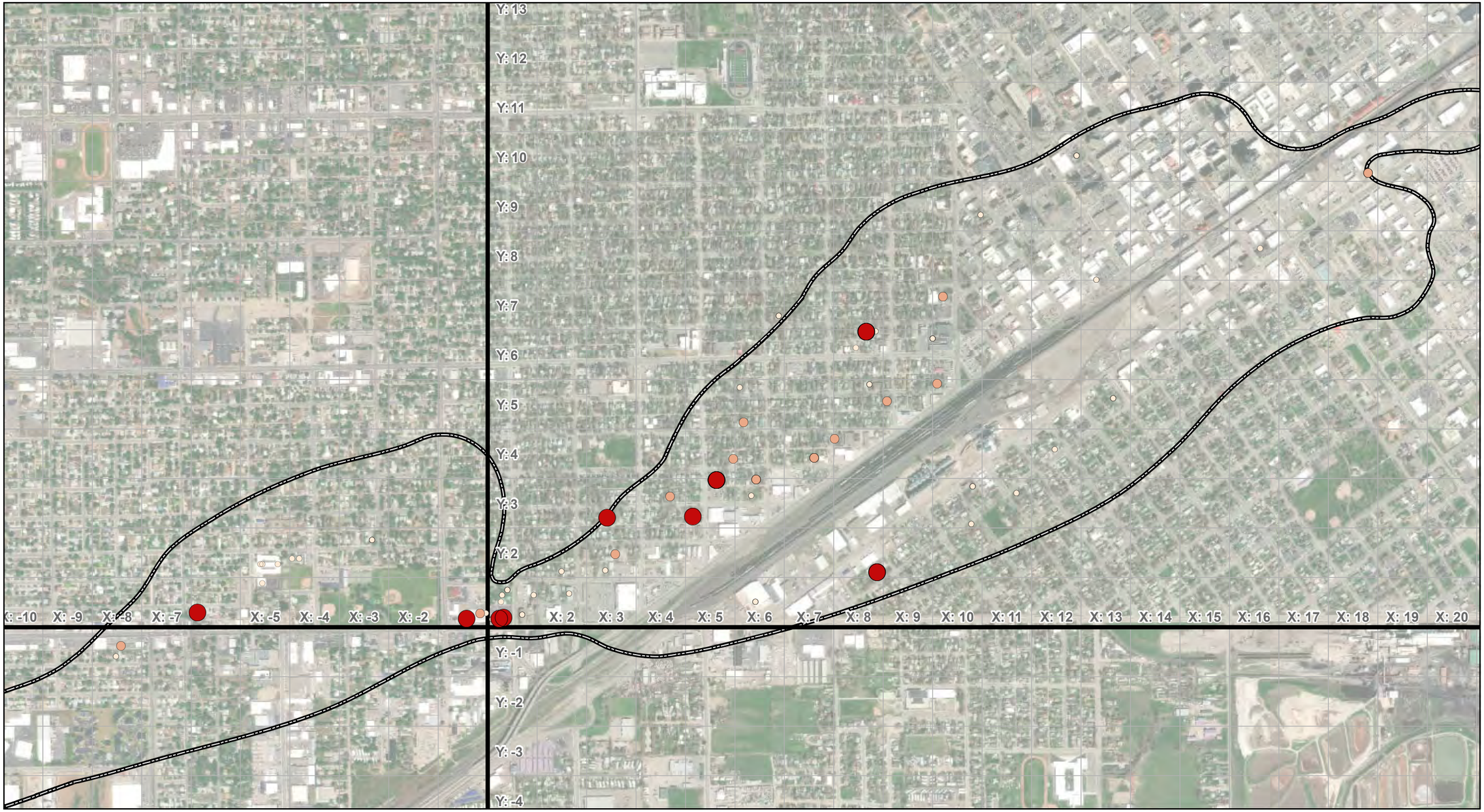
FIGURE 10-6

INDOOR AIR PCE SAMPLE RESULTS 2018

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: BR	Checked By: AV	Scale: 1 " = 1,000 '	Date: 4/19/19	File: Fig10-6_Billings_AirPCE.mxd



INDOOR AIR TCE CONCENTRATIONS (µg/M^3)

- BELOW DETECTION LIMIT - 0.21
- >0.21 - 0.88
- >0.88 - 1
- >1

EXPLANATION

FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)

FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

APPLICABLE TCE SCREENING LEVELS:

- 0.21 µg/M^3 - RESIDENTIAL EPA REGIONAL SCREENING LEVEL (RSL)
- 0.88 µg/M^3 - INDUSTRIAL EPA RSL

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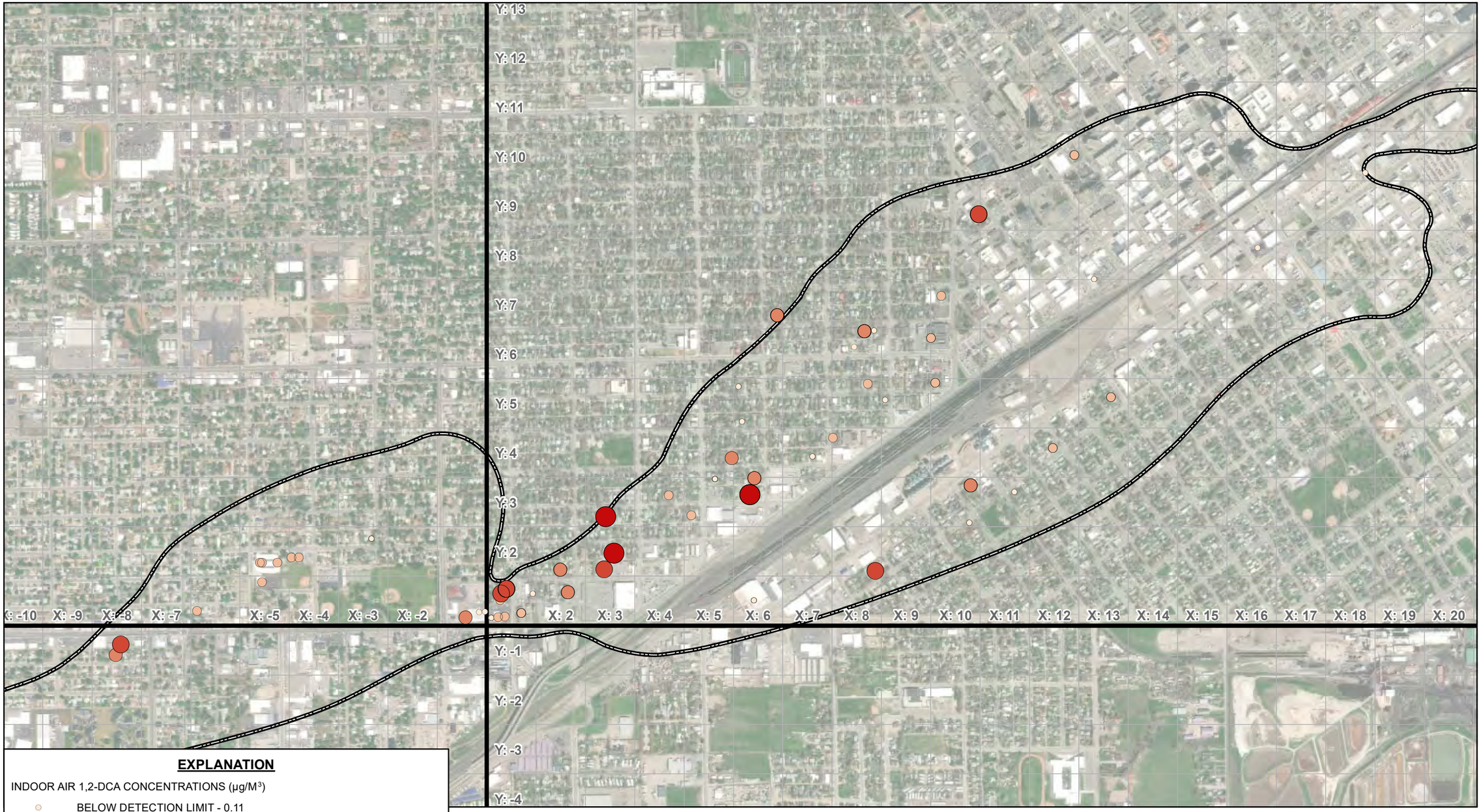
FIGURE 10-7

INDOOR AIR TCE SAMPLE RESULTS 2018

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: BR	Checked By: AV	Scale: 1 " = 1,000 '	Date: 4/19/19	File: Fig10-7_Billings_AirTCE.mxd



EXPLANATION

INDOOR AIR 1,2-DCA CONCENTRATIONS (µg/M^3)

- BELOW DETECTION LIMIT - 0.11
- >0.11 - 0.23
- >0.23 - 0.47
- >0.47 - 1
- >1
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

APPLICABLE 1,2-DCA SCREENING LEVELS:

- 0.11 µg/M^3 - RESIDENTIAL EPA REGIONAL SCREENING LEVEL (RSL)
- 0.23 µg/M^3 - MT TYPICAL INDOOR AIR CONCENTRATION
- 0.47 µg/M^3 - INDUSTRIAL EPA RSL

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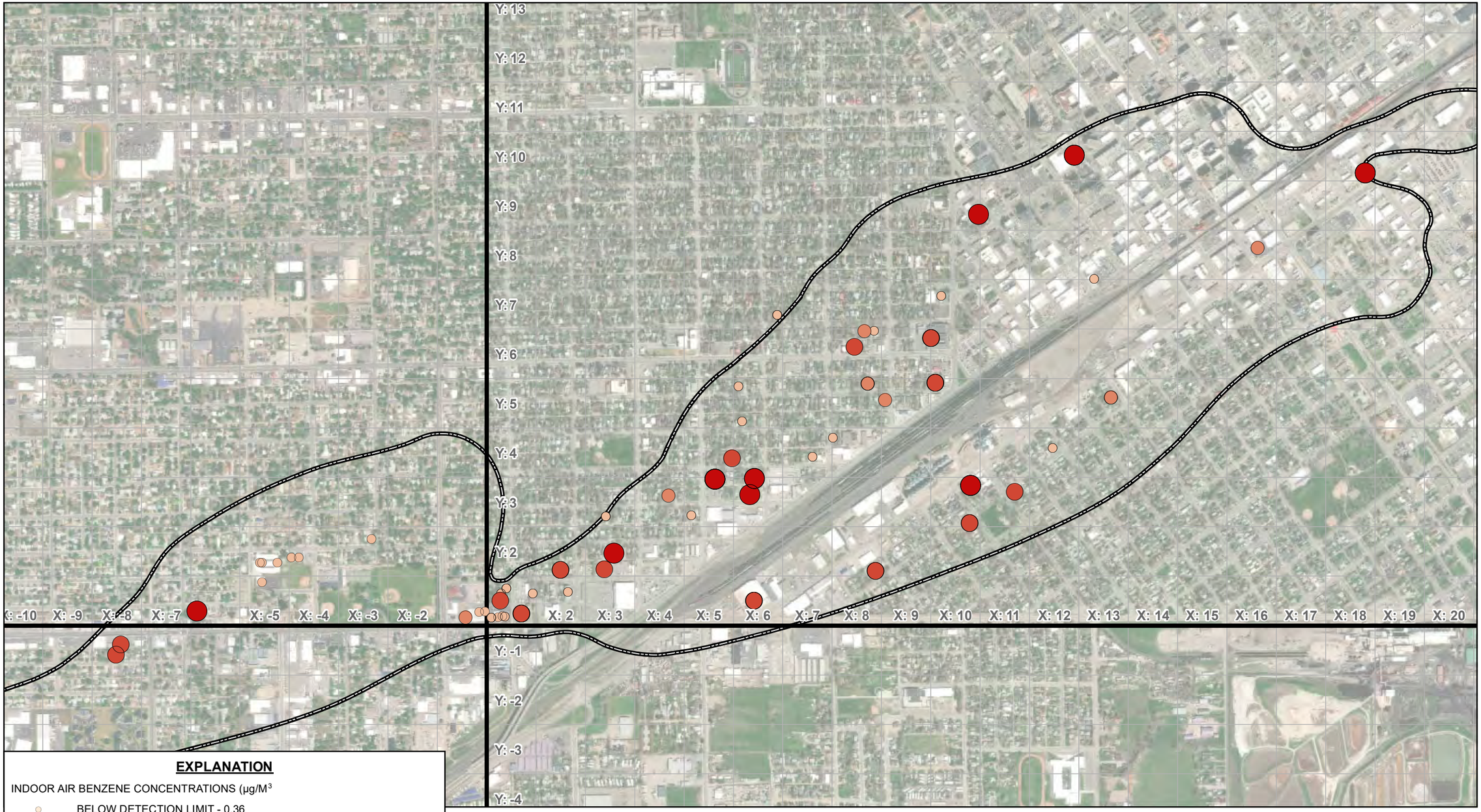
FIGURE 10-8

INDOOR AIR 1,2-DCA SAMPLE RESULTS 2018

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: BR	Checked By: AV	Scale: 1 " = 1,000 '	Date: 4/19/19	File: Fig10-8_Billings_Air12DCA.mxd



EXPLANATION

INDOOR AIR BENZENE CONCENTRATIONS (µg/M^3

- BELOW DETECTION LIMIT - 0.36
- >0.36 - 1.3
- >1.3 - 1.6
- >1.6 - 3
- >3
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

APPLICABLE BENZENE SCREENING LEVELS:

- 0.36 µg/M^3 - RESIDENTIAL EPA REGIONAL SCREENING LEVEL (RSL)
- 1.3 µg/M^3 - MT TYPICAL INDOOR AIR CONCENTRATION
- 1.60 µg/M^3 - INDUSTRIAL EPA RSL

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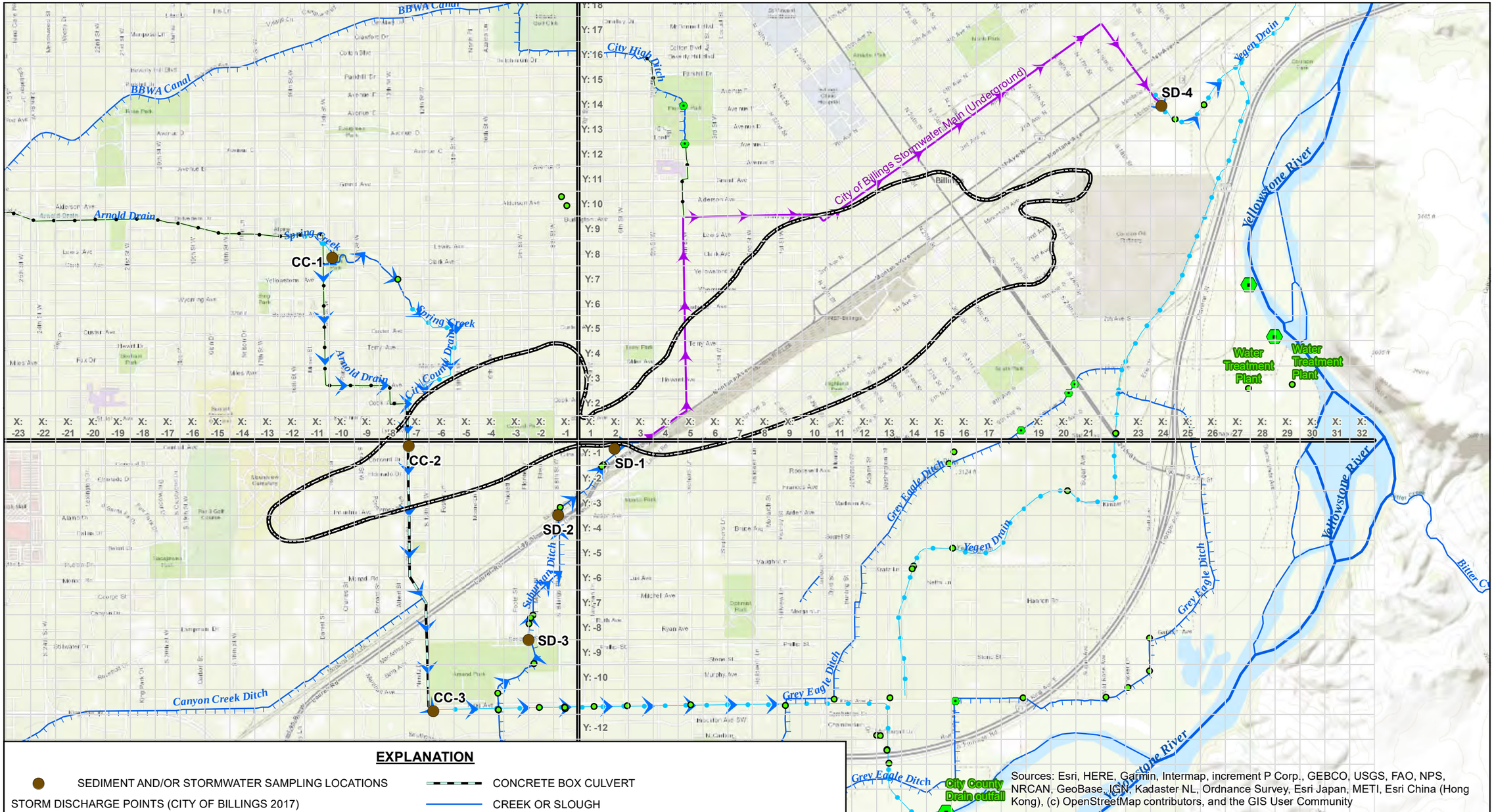
FIGURE 10-9

INDOOR AIR BENZENE SAMPLE RESULTS 2018

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: BR	Checked By: AV	Scale: 1 " = 1,000 '	Date: 4/19/19	File: Fig10-9_Billings_AirBenzene.mxd



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

EXPLANATION

- SEDIMENT AND/OR STORMWATER SAMPLING LOCATIONS
- STORM DISCHARGE POINTS (CITY OF BILLINGS 2017)
  - PRIMARY OUTFALL
  - SECONDARY OUTFALL
  - STANDARD OUTLET
- CITY OF BILLINGS STORMWATER MAIN (UNDERGROUND)
- STREAMS (CITY OF BILLINGS 2017)
  - CANAL OR DITCH
- CONCRETE BOX CULVERT
- CREEK OR SLOUGH
- DRAIN
- PIPE
- RIVER
- FACILITY BOUNDARY (1 µg/L INFERRED GROUNDWATER CONTOUR)
- FACILITY GRID WITH X,Y NUMBER (SPACING = 500 FEET)

N

0 2,000 '

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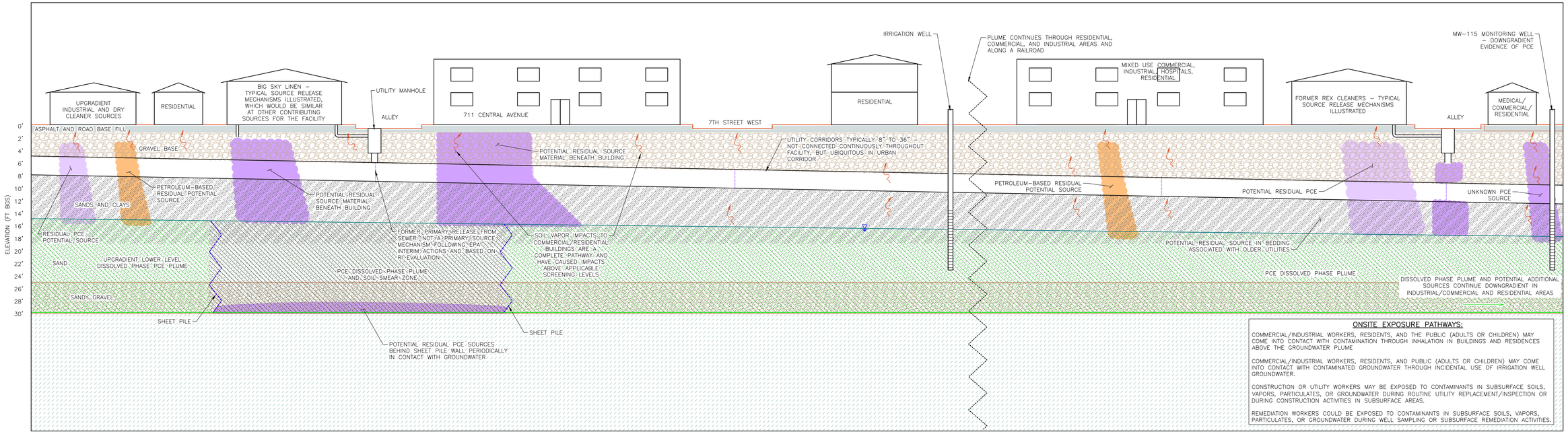
FIGURE 11-1

STORMWATER/SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By: BR	Checked By: AV	Scale: 1 " = 2,000 '	Date: 5/14/19	File: Fig11-1_Billings_SWSed.mxd



EXPLANATION

- RESIDUAL SOURCE DISCHARGE TO SUBSURFACE
- RESIDUAL SOURCE DISCHARGE TO SUBSURFACE
- SCHEMATIC PCE PLUME
- SCHEMATIC PCE DISSOLVED-PHASE PLUME
- TOPSOIL
- ASPHALT/FILL
- SANDY SILT
- SILTY SAND
- SANDY CLAY
- GRAVEL
- SANDY GRAVEL
- SAND
- CLAY
- SILTY CLAY
- SHALE BEDROCK
- PLUME
- SHEET PILE WALL SOUTH OF BIG SKY LINEN AND 711 CENTRAL
- SOIL VAPOR EXPOSURE PATHWAY
- FT BGS — FEET BELOW GROUND SURFACE
- ug/L — MICROGRAMS PER LITER

WARNING

IF THIS BAR DOES NOT MEASURE 1" THEN THIS DRAWING IS NOT TO SCALE

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Laramie, Wyoming 82070
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(P) 307/745.7474 (F) 307/745.7729

FIGURE 12-1

PICTORIAL CONCEPTUAL SITE MODEL FOR RESIDUAL SOURCES BASED ON REMEDIAL INVESTIGATION

REMEDIAL INVESTIGATION REPORT
BILLINGS PCE GROUNDWATER FACILITY
BILLINGS, MONTANA

Drawn By:DMB	Checked By: SS	Scale: NONE	Date: 4/23/2019	File: 776-PICCONC201904

M:\LOGFILES\MEDSPR\BILMCDPC\CADD\REPORTS\SPR\776-PICCONC201904

APPENDIX A THROUGH I

(PLEASE SEE ATTACHED USB)

A. GEOLOGY DATA

B. SEWER SCOPE INVESTIGATION

C. GROUNDWATER SAMPLING PLAN ADDENDUMS

D. MEMBRANE INTERFACE PROBE/HYDRAULIC PROFILING TOOL INVESTIGATION MEMO WITH ATTACHED DAKOTA MiHPT REPORT

E. FIELD FORMS AND OBSERVATIONS

F. ANALYTICAL LABORATORY REPORTS

G. DATA VALIDATION REPORTS

H. VAPOR INTRUSION RESULTS BY PROPERTY

I. SCREENING LEVELS

TABLES

FIGURES

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