WGMGROUP

Limited Remedial Investigation Work Plan & Budget
4000 N Star Blvd, Great Falls, Cascade County, Montana
Pacific Coast Supply, LLC
Facility ID 07-06130 (TID 18615), Release 1054, Work Plan ID 35193
WGM Project Number: 25-03-18
07.16.2026

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PREPARED FOR:
GFA LLC

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WGM Group, Inc.

REPORT DATE:
07.16.2026

W:\Projects\250318\90 Environmental & Water Resources\REPORTS\Limited RI Work Plan\version 2\TEXT\2026-07-16 Pacific Coast Supply - Limited RI CAP.docx

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1.0 INTRODUCTION

WGM Group, Inc. (WGM), prepared this Limited Remedial Investigation (RI) Work Plan (RIWP) for the Pacific Coast Supply property (Facility ID 07-06130, Release 1054) in Great Falls, Montana. The RIWP is being prepared to satisfy a letter request by the Montana Department of Environmental Quality (DEQ) dated May 21, 2026, which is attached as **Appendix A**.

1.1 SITE DETAILS

The Pacific Coast Supply Facility (Site) is comprised of two parcels which are currently owned by GFA, LLC. **Figure 1** shows the Site Vicinity map and **Figure 2** shows the Site Map. The site is developed with an approximate 30,000-square foot (sf) commercial warehouse and an asphalt-paved parking lot. The Site is bordered by vacant land, warehouses, and commercial properties.

1.2 SITE HISTORY

The Site was developed with a structure that appeared to be associated with an adjoining rail yard from at least 1946 until sometime prior to 1964, when it was demolished. The current warehouse structure was constructed in 1978. Previous tenants included various transfer, storage, and transportation facilities (Terracon, 2024). Regulatory history of the Site includes the following information.

- A former underground storage tank (UST) was removed from the Site in 1991 with reported petroleum hydrocarbon impacts, but the facility received regulatory closure at that time.
- A Phase I Environmental Site Assessment (ESA) was completed by Terracon (Terracon, 2020a) that identified two recognized environmental conditions (RECs) at the Site including the removed UST and a trench drain/sump installation in the parking lot south of the warehouse.
- Terracon conducted a Limited Site Investigation (LSI) in October 2020 that reported soil samples in the vicinity of the former UST basin with exceedances of DEQ's Tier 1 Risk-Based Screening Levels (RBSLs) for volatile petroleum hydrocarbons (VPH) and detections of extractable petroleum hydrocarbons (EPH) above RBSLs near the trench drain/sump installation (Terracon, 2020b). The LSI installed temporary groundwater monitoring wells that detected VPH and EPH compounds above RBSLs in the vicinity of the former UST basin; no petroleum compounds were detected in groundwater above RBSLs near the trench drain/sump. The LSI recommended further investigation of impacts near the former UST basin.
- Based on the results of the ESA and LSI, DEQ recategorized release #1054 as "active" in a letter dated May 21, 2021, and required additional remedial investigations for the Site to determine the extent and magnitude of petroleum impacts to soil and groundwater; and to recommend remediation work required to cleanup and resolve the Release.
- Terracon conducted remedial investigations (Terracon, 2024) at the Site in April 2022 and April/May 2023 and prepared an RI report dated May 31, 2024. The RI report described a High-resolution Site Characterization (HRSC) that advanced 12 Laser-induced Fluorescence (LIF) probe locations and 15 Membrane Interface Probe Hydraulic Profiling (MIHPT) probe locations to assess lithology, nonaqueous phase liquid, and dissolved phase organic constituents. The RI report also described installation of six soil borings that were converted into monitoring wells. The RI report delineated petroleum hydrocarbon to the northwest and southeast of the former UST basin but indicated that additional delineation may be required to the northeast and southwest of the UST basin. The RI also included a release closure plan (RCP) that detailed, among other information, RI results, conceptual site model (CSM), evaluation of cleanup alternatives, and expected compliance monitoring. The RCP recommended delineation of impacts to soil and groundwater to the northeast and southwest of the former UST basin and

implementing a petroleum mixing zone (PMZ) along with a restrictive covenant for closure of the Site.

- In response to the recommendations presented in the May 2024 RI report, DEQ requested a Remedial Investigation Work Plan (RIWP) to determine the extent and magnitude of petroleum impacts to soil and groundwater, and to recommend remediation work required to cleanup and resolve the Release.
- At the request of Pacific Coast Supply LLC, Terracon prepared a request to DEQ to extend the due date of the requested RIWP as Pacific Coast Supply LLC was in negotiations with a potential purchaser of the property. DEQ responded that the extension was appropriate and approved it in a letter on September 23, 2024.
- The CAP prepared by Terracon on March 12, 2025 (Terracon, 2025) included an RIWP which was revised by WGM on April 1, 2025 to a Cleanup Work Plan (WGM, 2025) that included injection of Regenesis products. The WGM CWP also included provisions for an RIWP to assess existing conditions at the Facility.
- The CWP prepared by WGM included work for both an additional remedial investigation and cleanup actions (WGM, 2025). On May 7, 2025, DEQ approved the Cleanup Work Plan.
- In July 2025, as part of the DEQ-approved RIWP (WGM, 2025), WGM completed additional remedial investigation (RI) fieldwork to further delineate the extent of petroleum hydrocarbon impacts at the Facility. This work included drilling three additional boreholes and converting two of them into monitoring wells. The results from the soil and groundwater sampling showed that the extent of soil and groundwater contamination at the site was larger than previous data had shown.
- Ongoing coordination between GFA, LLC, WGM, DEQ, and Petroleum Tank Compensation Board staff (PTRCB staff) between May 2025 and May 2026 resulted in postponement and eventual cancelation of injection of Regenesis products described in the CWP.

1.3 CURRENT CONDITIONS

Figure 3 shows the locations of the additional monitoring wells installed during the RI work and the current estimated extent of impacts to soil and groundwater found during the July 2025 fieldwork. **Appendix B** includes all the site data collected at the facility.

1.4 PURPOSE & OBJECTIVES

The purposes of this RIWP are to collect and evaluate data to assess the stability of contaminants of concern (CoCs), characterize temporal variability associated with seasonal fluctuations, and determine whether natural attenuation processes are occurring within the delineated groundwater plume. Additionally, work includes the collection of soil vapor data to evaluate the potential for petroleum hydrocarbon vapor generation and migration via preferential pathways, as well as the potential for vapor intrusion (VI) into nearby structures. Lastly, the RIWP aims to identify potential receptors associated with plume migration.

The overall objective of this investigation is to address existing data gaps, refine the current conceptual site model (CSM), and supplement the existing dataset to support pursuit of site closure under DEQ's Petroleum Mixing Zone (PMZ) requirements.

2.0 SCOPE OF WORK

2.1 GROUNDWATER MONITORING SCOPE OF WORK

Four semi-annual groundwater monitoring events are proposed under this work plan over the course of two years. The groundwater monitoring events will occur during seasonally high and low groundwater fluctuations, which are expected to be May/June and November/December. All groundwater sampling methods below will follow the WGM Standard Operating Procedures (SOPs) included in **Appendix C**.

2.1.1 GROUNDWATER MONITORING SAMPLING

WGM will conduct a total of four groundwater sampling events. Monitoring will include measuring depth-to-water and collecting groundwater samples from the monitoring wells including MW-1, MW-2, MW-5, MW-7, MW-8, and MW-9. Samples will be collected using a bladder pump, disposable polyethylene tubing, and low-flow purge and sampling procedures. Groundwater field parameters (temperature, turbidity, conductivity, dissolved oxygen, pH, and oxygen reduction potential) will be measured in each well every three to five minutes during purging, and once parameters stabilize for three consecutive readings, groundwater samples will be collected in laboratory-supplied containers. The stabilization criteria are presented in the DEQ document entitled Groundwater Sampling Guidance dated March 2018 (DEQ-WMRD-GWM-1).

One trip blank and one field duplicate sample will be analyzed for quality assurance/quality control (QA/QC) purposes. The field duplicate sample will be collected concurrently with the groundwater sample from a randomly chosen monitoring well.

2.1.2 ANALYTICAL METHODS

Groundwater samples will be submitted for laboratory analysis of VPH and EPH Screen. If the EPH screen result for soil is greater than 1,000 micrograms per liter (µg/L), the sample will be submitted for EPH fractionation analysis, by the Montana Method. VPH and EPH results will be compared to DEQ Tier 1 Risk Based Screening Levels (Table 3) for groundwater. In addition to VPH and EPH, the lead scavenger 1,2-dichloroethane (DCA) will be submitted for analysis in all groundwater samples collected.

2.1.3 MONITORED NATURAL ATTENUATION (MNA) METHODS

Groundwater samples from all six wells will be submitted for geochemical indicators to measure natural attenuation of petroleum compounds in groundwater monitoring wells including: dissolved oxygen (DO_2), nitrate (NO_3), sulfate (SO_4), soluble (ferrous) iron (Fe_2), and manganese (Mn). Field analysis of DO_2 and Fe_2 will be completed onsite. MNA results will be analyzed by comparing trends in data using three primary lines of evidence.

1. **Contaminant Trends:** Evaluate concentration data in upgradient, plume core, plume fringe, and downgradient wells for following two main trends:
    - Stable Plume*:* Concentrations remain consistent over time, meaning natural attenuation rates equal mass inputs from the source.
    - Receding Plume: Concentrations decrease over distance and time, indicating natural attenuation rates exceed mass inputs.
2. **Geochemical Indicators:** Evaluate field and laboratory data to confirm that the following biodegradation mechanisms are active.
    - Depleted Electron Acceptors: Inside the plume, dissolved oxygen, nitrate, and sulfate concentrations are typically lower (as microbes consume them) compared to background levels.

- Increased Byproducts: Higher concentrations of metabolic byproducts (such as dissolved iron II, methane, and carbon dioxide) indicate active anaerobic biodegradation.

3. **Rate and Timeframe Calculations:** Predict the long-term attenuation timeframe which typically follows a first-order rate law, allowing for modeling of eventual cleanup. The first order rate law describes how the rate of MNA for a CoC decreases over time.
   - First order rate law: $r = dC/dt = k[C]^1 = k[C]$
   - Estimated shortcut: Y = -0.3260X + 659.7 (EPA, 2012)

2.1.4 SAMPLE SHIPPING AND LABORATORY SUBMITTAL

All samples will be preserved and shipped with appropriate custody sheets and seals. Samples will be analyzed using standard turnaround times unless otherwise requested by DEQ. The selected samples will be placed into a laboratory-supplied container, labeled, stored on ice, and submitted to Energy Laboratory in Helena, Montana.

2.2 SOIL VAPOR INVESTIGATION SCOPE OF WORK

The soil vapor investigation will include advancing up to three shallow boreholes with direct-push boring equipment and converting them into soil gas implants (SGIs; SGI-1, SGI-2, and SGI-3) to assess a potential vapor intrusion (VI) pathway with near slab samples. These vapor samples will be installed as close to the structure's foundation as possible but no more than 10 lateral feet from the structure and extended vertically below the concrete subslab floor of the structure.

The proposed SGI locations are shown in **Figure 4**. These locations were strategically selected to function as sentinel points along the most probable vapor migration pathways, thereby providing representative coverage of potential VI into the building. WGM will contract with Wiley Drilling of Butte, Montana to install the SGIs (**Appendix D**). The installations will use methods compatible with the Montana DEQ (2021) September 2021 Vapor Intrusion (VI) Guide and as described here. The boreholes will be advanced to within two feet of the soil-groundwater interface, which is expected to be between 15- and 17-feet below ground surface (ft bgs).

The SGIs will be constructed using a 6-inch-long stainless-steel screen (Geoprobe®) vapor sampling implant (VSI) placed at the bottom of the borehole with an expendable anchor point and attached to polyethylene tubing. The implant and tubing will be placed at the bottom of the borehole and surrounded with 10/20 silica sand to one foot above the bottom of the borehole. Granular bentonite will be placed in the annular space of the borehole from the top of the silica sand to 1.5 ft bgs and slowly hydrated with distilled water. Cement/bentonite grout will be placed in the borehole annular space from 1.5 ft bgs to 1 ft bgs. The SGI monitoring point will be completed with a traffic-rated well box set in concrete extending to the top of the grout. The tubing extending into the well box will be capped with a valve to prevent movement of gases and moisture into or out of the SGI. Record of subsurface materials encountered, and as-built diagrams of the installed soil vapor point will be recorded by field personnel using WGM well construction field forms.

2.2.1 SOIL VAPOR SAMPLING

Following installation of the soil vapor sampling point and a 20-minute equilibration period, WGM personnel will purge and sample the soil vapor point. A minimum of three dead space volumes will be purged with an air pump or syringe prior to sampling. Purging will occur at a rate less than 200 milliliters per minute (mL/min), and the purge volume and total purge time will be documented. After purging, samples will be collected into individually certified Summa canisters using 1 hour flow controllers. Purging and sampling will be performed using helium for leak detection and a helium meter to monitor the percentage of helium in the shroud. Canister vacuum will be recorded at the start, end, and periodically

during sampling. The soil vapor sample will be labeled with the vapor point number (VP-1), sampling interval (date and time), and start and end vacuum on laboratory provided tags.
Two VI monitoring events are proposed, one in Spring and the other in late Fall. The soil vapor samples will be submitted to ALS Environmental in Simi Valley, California for analysis of Air-Phase Hydrocarbons (APH) and VOCs (EPA Method TO-15). In addition, the TO-15 analysis will include EDB and DCA in the suite of parameters. All analysis will be performed by methods identified in **Table 4**. DEQ's APH VI Calculator for Generic Screening Levels will be used to screen the VI results. All soil vapor investigation sampling methods below will follow the WGM Standard Operating Procedures (SOPs) included in **Appendix C**.

2.2.2 VAPOR INTRUSION SAMPLING SCHEDULE

A total of two VI monitoring events are proposed to occur during seasonally high and low groundwater fluctuations, which are expected to be May/June and November/December.

2.3 RECEPTOR SURVEY SCOPE OF WORK

To evaluate data gaps for a future PMZ closure, WGM will perform a receptor survey of human and ecological receptors within 500-feet of a pending PMZ boundary. WGM will provide a map identifying and depicting the location of potential receptors (i.e., water wells, structures, buried utilities, and surface water bodies) and identify general land uses (i.e., residential, commercial/industrial) within the receptor survey area. A proposed PMZ boundary along with the 500-foot receptor survey area will be depicted on the map along with all potential receptors including drinking water, vapors in structures; dermal contact with surface soil, buried utilities, surface water, and groundwater. If any potential receptors are identified, exposure pathways that may be complete will be listed along with potential pathways including exposure to surface soil, subsurface soil, groundwater, surface water/sediments, and petroleum vapors.

2.4 DISPOSAL OF INVESTIGATION-DERIVED WASTE

Soil removed from direct-push boreholes will be monitored by field staff for obvious signs of staining, olfactory clues of petroleum presence. If impacted soil is observed, the soil cuttings will be placed into sealable plastic buckets (direct-push cuttings will be minimal). The containerized soil cuttings will be kept in sealable containers and stored onsite. If results indicate that soil requires landfill disposal, it will be properly disposed of in accordance with state regulations based on the analytical results. Any drill cuttings that reach the surface and do not show signs of visual or olfactory clues of contamination will be spread at a property owner-approved location on the Site. All groundwater monitoring purge water will be disposed of in accordance with the DEQ's Disposal of Untreated Purge Water from Monitoring Wells Flow Chart (DEQ, 2015). If the purge water is determined to not require disposal, it will be disposed of at a location where there are no aesthetic concerns.

2.5 QA/QC PROCEDURES

Quality assurance and quality control procedures will be in accordance with WGM SOPs (**Appendix C**).

2.6 DATA VALIDATION

Data validation will be completed in accordance with DEQ's *Data Validation Summary Form* (DVSF; DEQ, 2018).

3.0 SCHEDULE & REPORTING

The fieldwork will be scheduled upon DEQ approval of this RIWP. The approximate schedule for the work proposed in this WP is presented below.

APPROXIMATE WORK SCHEDULE

DELIVERABLE / ACTION	APPROXIMATE COMPLETION DATE*
RIWP Approval by DEQ	August 2026
Receptor Survey	September 2026
Soil Gas Implant Installation & 1st VI Monitoring	November 2026
1st Groundwater Monitoring Event	
2nd VI monitoring Event	May 2027
2nd Groundwater Monitoring Event	
3rd Groundwater Monitoring Event	November 2027
4th Groundwater Monitoring Event	May 2028
Limited Remedial Investigation Report	June 2028

* Actual completion dates will be dependent upon DEQ approval timelines, laboratory turnaround times, and subcontractor availability.

Following the final groundwater monitoring event in May 2028, a limited RI Report will be prepared that includes all data and results described in this RIWP. The RI Report summarizing the results will be completed by June 2028. The RI Report will include all pertinent information described in DEQ's RI Report Expectations guidance document dated October 2017.

4.0 COSTS

Implementation of the proposed work can begin within 30 calendar days following DEQ approval of this RIWP, which is expected sometime in July or August 2026. WGM requests that all requested work associated with the previous Cleanup Work Plan (April 1, 2025) and the Cleanup Work Plan Modification (January 21, 2026) be discarded. The project, as described in this work plan, will be completed by June 2028.

WGM proposes completing the required scope of work as described herein on a Time and Materials basis for the estimated cost of $65,865. This cost estimate includes WGM's professional labor costs, travel, and direct client expenses required to complete this scope of work. Work effort levels have been estimated based on WGM's experience on the project site and on similar projects. A detailed cost estimate to perform this scope of work is included **Appendix E**.

5.0 REFERENCES

EPA, 2012. Approach for Evaluating the Progress of Natural Attenuation in Groundwater. Office of Research and Development. National Risk Management Research Laboratory. EPA 600/R-11/204, December 2011

DEQ, 2015. Disposal of Untreated Purge Water from Monitoring Wells. July 2015

DEQ, 2018. Data Validation Summary Form, Version 1.3.0. Montana Department of Environmental Quality guidance for data validation. Revised, January 2018.

Terracon, 2020a. Phase I Environmental Site Assessment. Report No. 26207128. October 5, 2020.

Terracon, 2020b. Limited Site Investigation Report, 4000 North Star Boulevard, Great Falls, Cascade County, Montana. Prepared for Locke Lord LLP. December 20, 2020.

Terracon, 2024. Remedial Investigation Report, Pacific Coast Supply LLC, 4000 North Star Boulevard Great Falls, Cascade County, Montana, Facility ID 07-06130 (TID 18615), Release 1054, Work Plan ID 34891. May 31, 2024.

Terracon, 2025. Remedial Investigation Work Plan - Revised, Petroleum Release at Pacific Coast Supply LLC, 4000 North Star Boulevard Great Falls, Cascade County, Montana, Facility ID 07-06130 (TID 18615), Release 1054, Work Plan ID 34891. March 12, 2025.

WGM Group, Inc., 2025. Cleanup Work Plan, Pacific Coast Supply, LLC. Facility 07-06130 (TID 18615), Release 1054, Work Plan ID 34891. April 1, 2025.

FIGURES

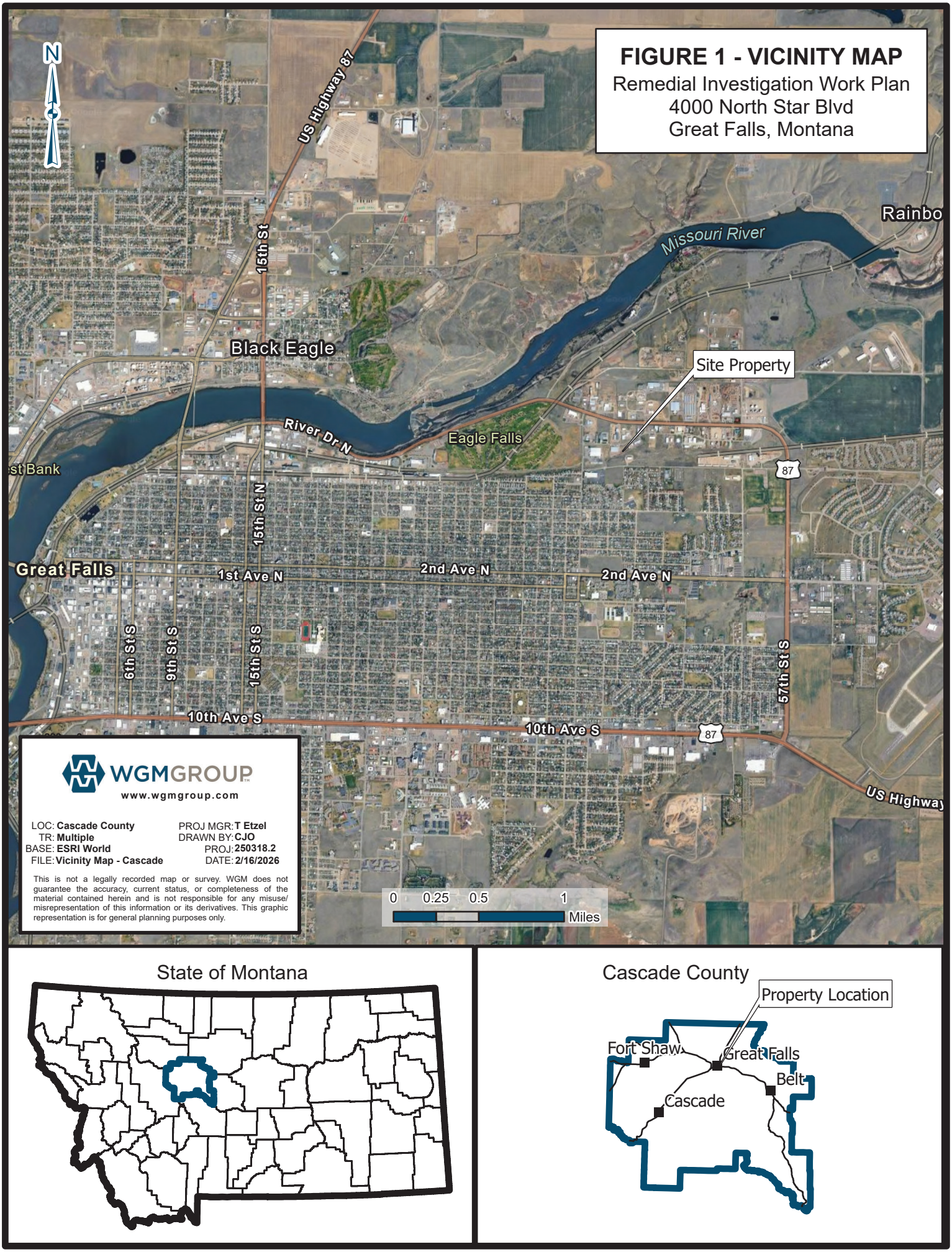
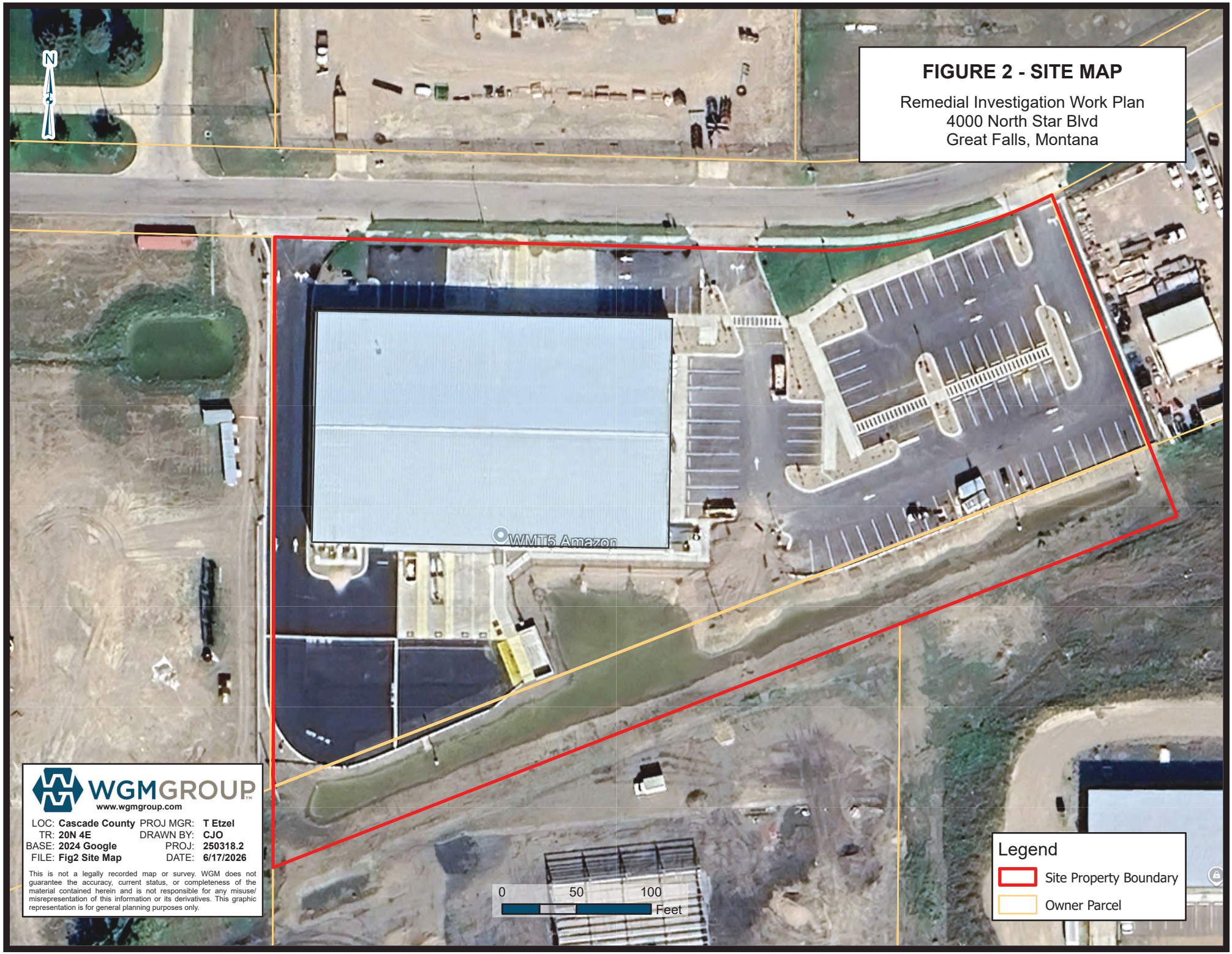


FIGURE 1 - VICINITY MAP
Remedial Investigation Work Plan
4000 North Star Blvd
Great Falls, Montana
N
US Highway 87
15th St
Missouri River
Rainbo
Black Eagle
Site Property
River Dr N
Eagle Falls
st Bank
87
15th St N
Great Falls
1st Ave N
2nd Ave N
2nd Ave N
6th St S
9th St S
15th St S
57th St S
10th Ave S
10th Ave S
87
US Highway
WGMGROUP
www.wgmgroup.com
LOC: Cascade County
TR: Multiple
BASE: ESRI World
FILE: Vicinity Map - Cascade
PROJ MGR: T Etzel
DRAWN BY: CJO
PROJ: 250318.2
DATE: 2/16/2026
This is not a legally recorded map or survey. WGM does not guarantee the accuracy, current status, or completeness of the material contained herein and is not responsible for any misuse/ misrepresentation of this information or its derivatives. This graphic representation is for general planning purposes only.
0 0.25 0.5 1
Miles
State of Montana
Cascade County
Property Location
Fort Shaw
Great Falls
Belt
Cascade


N
FIGURE 2 - SITE MAP
Remedial Investigation Work Plan
4000 North Star Blvd
Great Falls, Montana
WMT5 Amazon
0
50
100
Feet
Legend
Site Property Boundary
Owner Parcel
WGMGROUP
www.wgmgroup.com
LOC: Cascade County
TR: 20N 4E
BASE: 2024 Google
FILE: Fig2 Site Map
PROJ MGR: T Etzel
DRAWN BY: CJO
PROJ: 250318.2
DATE: 6/17/2026
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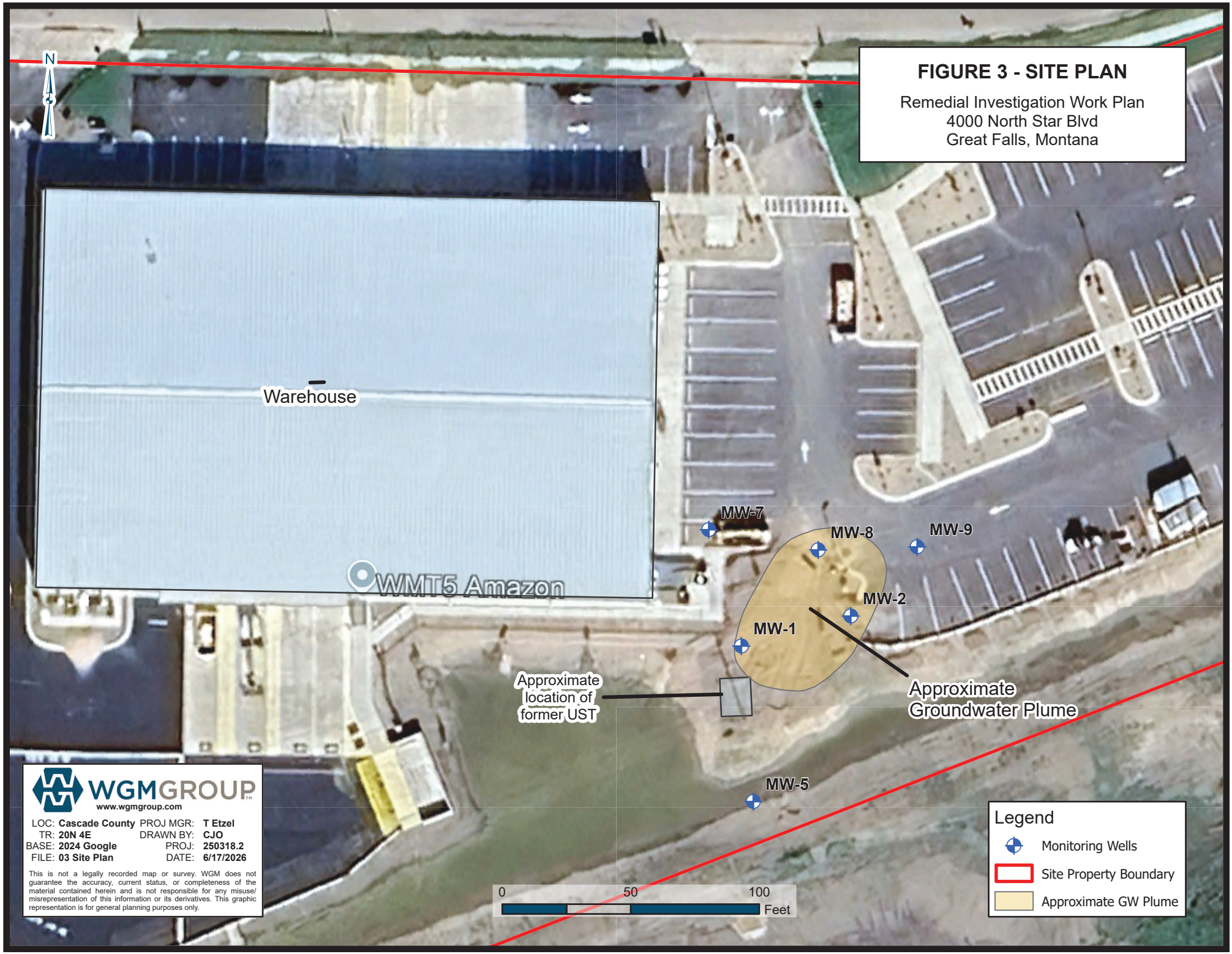
FIGURE 3 - SITE PLAN
Remedial Investigation Work Plan
4000 North Star Blvd
Great Falls, Montana
N
Warehouse
WMT5 Amazon
MW-7
MW-8
MW-9
MW-2
MW-1
MW-5
Approximate location of former UST
Approximate Groundwater Plume
0
50
100
Feet
Legend
Monitoring Wells
Site Property Boundary
Approximate GW Plume
WGMGROUP
www.wgmgroup.com
LOC: Cascade County
TR: 20N 4E
BASE: 2024 Google
FILE: 03 Site Plan
PROJ MGR: T Etzel
DRAWN BY: CJO
PROJ: 250318.2
DATE: 6/17/2026
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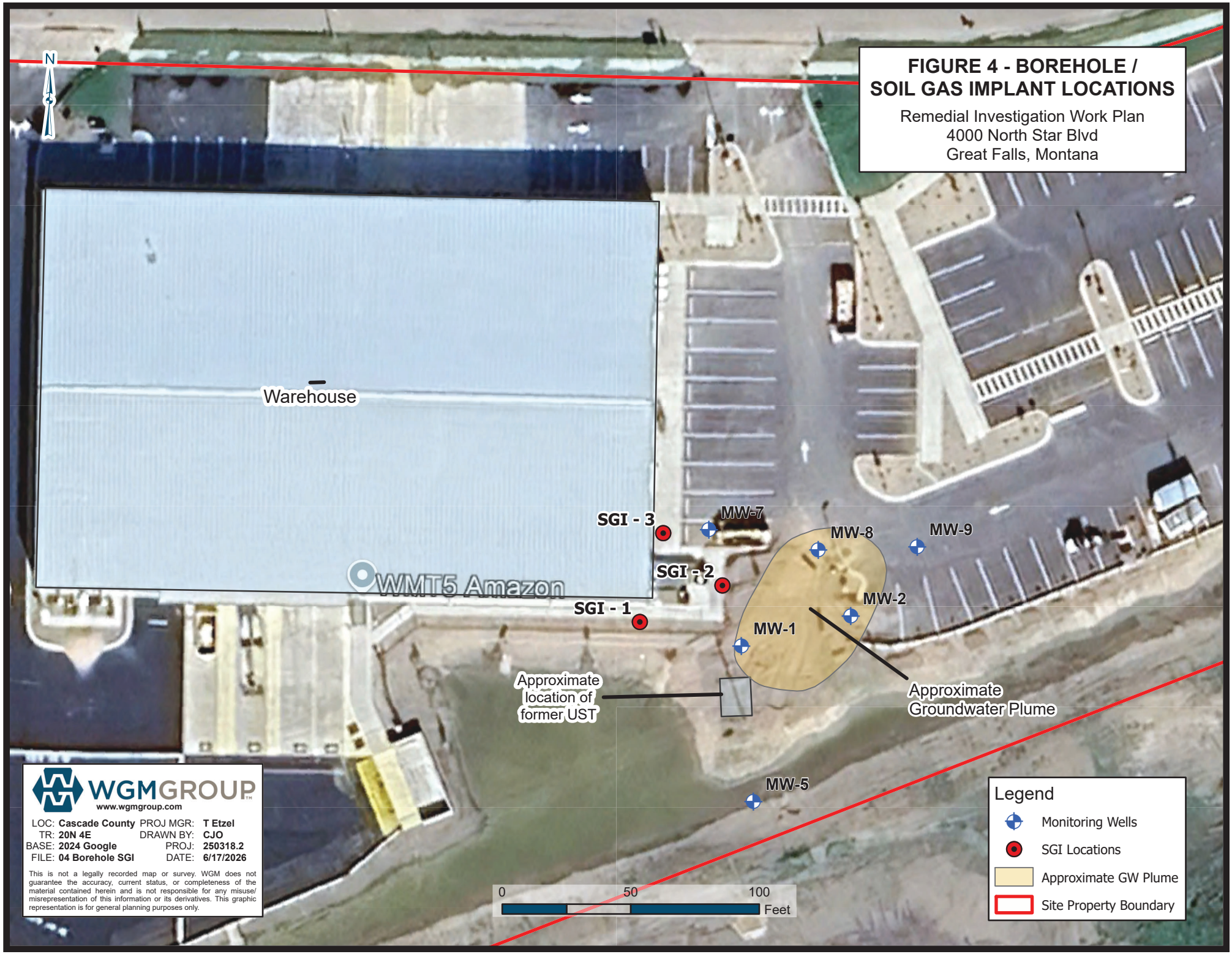
FIGURE 4 - BOREHOLE / SOIL GAS IMPLANT LOCATIONS
Remedial Investigation Work Plan
4000 North Star Blvd
Great Falls, Montana
N
Warehouse
WMT5 Amazon
SGI - 3
SGI - 2
SGI - 1
MW-7
MW-8
MW-9
MW-2
MW-1
MW-5
Approximate location of former UST
Approximate Groundwater Plume
0
50
100
Feet
Legend
Monitoring Wells
SGI Locations
Approximate GW Plume
Site Property Boundary
WGMGROUP
www.wgmgroup.com
LOC: Cascade County
TR: 20N 4E
BASE: 2024 Google
FILE: 04 Borehole SGI
PROJ MGR: T Etzel
DRAWN BY: CJO
PROJ: 250318.2
DATE: 6/17/2026
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APPENDIX A
DEQ RIWP MODIFICATION REQUEST LETTER

DEQ
Montana Department
of Environmental Quality

May 21, 2026

GFA LLC
PO Box 787
Bozeman, MT 59771

Re: Work Plan Requested for a Limited Remedial Investigation to Evaluate Data Gaps in Petroleum-Contaminated Media with the intent of pursuing a Petroleum Mixing Zone (PMZ) Closure at the Pacific Coast Supply, 4000 N Star Blvd, Great Falls, Cascade County, Montana; Facility ID 07-06130 (TID 18615), Petroleum Release 1054, Work Plan 35193

GFA LLC:

DEQ has reviewed the available reports and data for your petroleum release (Release) confirmed at the above-referenced facility (Facility). This information documents persistent petroleum-contaminated media – soil and groundwater – at your Facility.

Your consultant – WGM Group – and DEQ discussed the scope of your proposed work plan (WP) on May 4, 2026. Your consultant has recommended WP tasks to include the following: conduct groundwater monitoring; assess petroleum vapor intrusion for the onsite building; evaluate data gaps needed to pursue a PMZ; and propose additional work needed to resolve your Release.

Please submit your WP with an implementation schedule and dates to DEQ **by June 26, 2026.**

Use DEQ's guidance documents to plan, conduct, and report your work, results, and recommendations; these documents are available online under the Guidance dropdown menu on the Petroleum Tank Cleanup Section (PTCS) webpage.[1]

DEQ recommends that you include time in your WP implementation schedule for the 15-day comment period for local government offices as required by Montana Code Annotated (MCA) Title 75, Chapter 11, Part 309(1)(e)(i))[2].

You can implement the WP after you receive DEQ's written notification that the scope of your WP has been approved.

The following sections outline roles and responsibilities for you as the Responsible Party and the DEQ Petroleum Tank Cleanup Section (PTCS).

GFA LLC: As the Responsible Party for the Release, during implementation of your WP you and your consultant are expected to evaluate ongoing WP tasks and results; discuss these tasks and results with DEQ's project manager; and submit written agreed-upon WP modifications as needed to complete your WP objectives.

[1] https://deq.mt.gov/cleanupandrec/Programs/petrocleanup
[2]https://leg.mt.gov/bills/mca/title_0750/chapter_0110/part_0030/section_0090/0750-0110-0030-0090.html

You and your consultant compile, tabulate, and review the cumulative data for the Release and compare concentrations of petroleum compounds in soil and groundwater to their respective risk-based screening levels (RBSLs) listed in DEQ's Risk-Based Corrective Action Guidance. Use the data and locations of compounds that exceed their respective RBSLs to plan the additional investigation, cleanup, and monitoring work necessary to move your Release towards resolution.

DEQ Petroleum Tank Cleanup Section (PTCS): DEQ is the regulatory agency for petroleum releases in Montana. PTCS reviews the reports submitted by your consultant and determines whether the current results and cumulative data are sufficient to resolve your Release. Resolution requires that your cumulative investigation, cleanup, and compliance monitoring results satisfy the requirements detailed in Administrative Rules of Montana (ARM) Title 17, Chapter 56, Subchapter 6.

Petroleum Tank Release Compensation Board (PTRCB): The PTRCB is an independent organization created by the Montana Legislature to administer the Petroleum Tank Release Cleanup Fund (Fund). The PTRCB determines whether your Release is Fund eligible. The PTRCB has established processes for reviewing and approving costs associated with Fund-eligible WPs; and they may provide comments under separate correspondence.

DEQ's approval of the scope of work does not guarantee PTRCB will obligate funding for or reimburse you for costs incurred to implement your WP. Work plan tasks not obligated by the PTRCB in a DEQ-approved WP may still be necessary to move your release forward towards resolution. If you have any questions regarding eligibility or reimbursement, please contact PTRCB at (406) 444-0710 or (800) 556-5291 or contact the PTRCB staff named below.

Please contact me at (406) 444-7219 or rachel.mindt@mt.gov if you have any questions regarding this letter or the petroleum release at your Facility.

Sincerely,

Rachel Mindt

Rachel Mindt
Environmental Project Officer
Petroleum Tank Cleanup Section

ec: Rhonda Knudsen, Cascade County Sanitarian
Todd Waller
Tyler Etzel, WGM Group
AJ Pate, PTRCB staff

APPENDIX B
TABULATED SITE DATA

TABLE 1
Soil Results - VPH
Pacific Source Supply
Great Falls, Montana

Sample ID	Date Collected	Sample Type	Sample Depth (feet bgs)	Volatile Petroleum Hydrocarbons (VPH)									
				MTBE	Benzene	Ethylbenzene	Toluene	Total Xylene	Naphthalene	C5-C8 Aliphatics	C9-C12 Aliphatics	C9-C10 Aromatics	TPH
DEQ Default RBSL [1]				**0.078**	**0.07**	**6.4**	**21**	**72**	**2.2**	**52**	**77**	**130**	**n/a**
MW-1	4/11/2023	grab	13-15	<0.0439	**28**	**168**	**301**	**1,310**	**87.8**	**3,030**	**2,870**	**2,340**	**10,800**
MW-2	4/11/2023	grab	17-19	<0.0391	**2.78**	**7.11**	<0.145	**28.8**	**15.4**	**754**	**446**	**460**	**1,760**
MW-5	4/12/2023	grab	19-21	<0.000525	<0.000701	<0.00111	**0.0133**	**0.00684** J	<0.00732	<10.3	<10.3	<10.3	<20.5
WSB7-1	7/8/2025	grab	18.3-18.8	<1.1	<0.56	<0.56	<0.56	<0.56	<1.1	<22	<22	<22	<22
WSB8-2 (MW-8)	7/8/2025	grab	15.8-16.1	<3.0 D	**7.2**	**103**	**181**	**607**	**68**	**1,420**	**2,160**	**2,260**	**6,320**
WSB8-1 (MW-8)	7/8/2025	grab	17.8-18.2	<0.50 D	**0.72**	**11**	**0.88**	**34**	**11**	**348**	**391**	**390**	**1,110**
MW-9	7/9/2025	grab	18.3-19	<0.21 D	<0.11 D	**2.8**	**0.29**	**2.1**	**1.1**	**73**	**178**	**128**	**388**

Notes:

All results in milligrams per kilogram (mg/kg; ppm)

[1] DEQ Tier 1 RBSLs for soil – (DEQ Table 1, Feb, 2024)

< indicates that the analyte was not detected above the laboratory reporting limit

n/a indicates no screening level available or not published

J indicates the value was estimated by the laboratory because it was present but less than the reporting limit

D indicates that the reporting limit (RL) was increased due to sample matrix interference

MTBE and Benzene were not detected, but the laboratory reporting limits are above the DEQ Default RBSLs

TABLE 2
Soil Results - EPH
Pacific Source Supply
Great Falls, Montana

Sample ID	Date Collected	Sample Type	Sample Depth (inches bgs)	Extractable Petroleum Hydrocarbons (EPH)				
				EPH Screen	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	TEH
DEQ Default RBSLs [1]				**200 ***	**290**	**25,000**	**370**	**n/a**
MW-1	4/11/2023	grab	13-15	**1,890**	**539** DJ	**5.09** DJ	**307**	**851**
MW-2	4/11/2023	grab	17-19	**366**	**125**	**3.11** DJ	**73.0**	**201**
MW-5	4/12/2023	grab	19-21	**10.2** J	----	----	----	----
WSB7-1 (MW-7)	7/8/2025	grab	18.3-18.8	<200	----	----	----	----
WSB8-2 (MW-8)	7/8/2025	grab	15.8-16.1	**421**	**68**	**15**	**34**	**190**
WSB8-1 (MW-8)	7/8/2025	grab	17.8-18.2	**923**	**275**	<11	**87**	**583**
MW-9	7/9/2025	grab	18.3-19	**58**	----	----	----	----

Notes:

All results in milligrams per kilogram (mg/kg; ppm)

[1] DEQ Tier 1 Default RBSLs for soil – (DEQ Table 1, Feb, 2024)

* DEQ RBCA screening level used to determine whether EPH fractionation is required (not an RBSL exceedance)

< indicates that the analyte was not detected above the laboratory reporting limit

---- indicates that the compound was not analyzed for the indicated parameter

n/a indicates no screening level available or not published

Bolded value indicates the parameter was detected above the laboratory reporting limit

D qualifier indicates the laboratory reporting limit (RL) was increased due to sample matrix interference

J indicates the value was estimated by the laboratory because it was present but less than the reporting limit

Table 3
VPH_VOCs Results - Groundwater
Pacific Coast Supply
Great Falls, Montana

Well ID	Date Collected	Volatile Petroleum Hydrocarbons (VPH)										Lead Scavengers	
		MTBE	Benzene	Toluene	Ethylbenzene	Total Xylenes	Naphthalene	C9-C10 Aromatics	C5-C8 Aliphatics	C9-C12 Aliphatics	TPH	1,2-Dichloroethane (DCA)	1,2-Dibromoethane (EDB)
MDEQ Tier 1 RBSL		**30**	**5**	**1,000**	**700**	**10,000**	**100**	**980**	**700**	**3,000**	**n/a**	**4**	**0.017**
MW-1	5/17/2023	<0.101	**53.4**	**1,090**	**159**	**2,820**	**66.3**	**3,160**	**1020**	<33.3	**8,520**	<0.0819	<0.126
	7/9/2025	<6.5 D	**459**	**4.6**	**465**	**38**	**4.9 DJ**	**1,740**	**1080**	**1,010**	**4490**	----	----
MW-2	5/17/2023	<0.101	**64.5**	**0.627** J	**9**	**73**	**13.2**	**446**	**515**	**274**	**1,380**	**2.61**	<0.126
	7/9/2025	<1.9 D	**70**	**0.57**	**20**	**1.0**	<1.0	**135**	**196**	**93**	**488**	----	----
MW-5	5/17/2023	<0.101	<0.0941	<0.278	<0.137	<0.174	<1.00	<33.3	<33.3	**41.9** J	<66.7	<0.0819	<0.126
	7/8/2025	<1.0	<0.50	<0.50	<0.50	<0.50	<1.0	<20	<20	<20	<20	----	----
MW-8	7/9/2025	<10 D	**108**	**833**	**235**	**1,240**	**52**	**1,240**	**1,050**	**894**	**5,140**	----	----
MW-9	7/9/2025	<1.0	<0.50	**0.35**	**1.2**	**4.0**	**1.8**	**90**	**45**	**52**	**181**	----	----

Notes:

All results in micrograms per Liter (µg/L)

< indicates that the analyte was not detected above the laboratory reporting limit

J indicates the value was estimated by the laboratory because it was present but less than the reporting limit

D indicates that the laboratory Reporting Limit (RL) increased due to sample matrix interference

---- indicates no analysis was performed for the analyte

Bolded value indicates the value was detected above the laboratory reporting limit

Bolded/shaded value indicates the analyte exceeds Montana Department of Environmental Quality (MDEQ) Tier 1 Risk-Based Screening Level (RBSL), Table 3, Feb. 20, 2024

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Table 4
EPH Results - Groundwater
Pacific Coast Supply
Great Falls, Montana

Well ID	Date Collected	Extractable Petroleum Hydrocarbons (EPH)				
		TEH SW 8015M	C9-C18 Aliphatics	C19-C36 Aliphatics	C11-C22 Aromatics	TEH MA-EPH
MDEQ Tier 1 RBSL		**1,000** [1]	**1,400**	**1,000**	**1,100**	**n/a**
MW-1	5/17/2023	**4,090**	<200	<200	**547** J	**547** J
	7/9/2025	**2,650**	**194** JL	< 314 L	**343**	**1,660**
MW-2	5/17/2023	**536**	----	----	----	----
	7/9/2025	**411**	----	----	----	----
MW-5	5/17/2023	<100	----	----	----	----
	7/8/2025	<300	----	----	----	----
MW-8	7/9/2025	**2,380**	**164** JL	<307 L	<307 L	**1,460**
MW-9	7/9/2025	<300	----	----	----	----

Notes:

All results in micrograms per Liter (µg/L)

[1] indicates the TEH concentration exceeded the level used to determine if additional analysis (fractionation) is needed

< indicates that the analyte was not detected above the laboratory reporting limit

J indicates the value was estimated by the laboratory because it was present but less than the reporting limit

L indicates that the lowest available Reporting Limit (RL) for the analytical method used and/or volume submitted

---- indicates no analysis was performed for the analyte

Bolded value indicates the value was detected above the laboratory reporting limit

Bolded/shaded indicates the analyte exceeds TEH screening level, Table 3, Feb. 20, 2024

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APPENDIX C
WGM STANDARD OPERATING PROCEDURES (SOPS)

SOP 101 – FIELD DOCUMENTATION

PURPOSE

Provide guidance to properly document activities in the field.

A field logbook will be kept for each project to provide a permanent accountable record of field activities. The logbook will have bound, consecutively numbered pages. Each logbook will be labeled with the logbook number, company name, project number, document custodian, and date. The field logbook should contain a complete record of activities including any site survey notes, well installation and development, sampling events, field measurements, personnel, photographs, pits, excavations, borings, audits, and ancillary data. Entries in the field log book shall include:

- Project and client name
- Purpose of the fieldwork
- Names of all personnel onsite
- Description of Site conditions and weather conditions
- Details of actual work effort
- Deviations from the field work plan or standard operating procedures
- Location of sample Site, including map reference, if relevant
- Field observations
- Field measurements (e.g., PID readings, pH, temperature) on applicable forms.
- Date and time of initiation and cessation of work

Specific details for each sample collected should be recorded using WGM Group's standardized field forms. These field forms contain blank queries to be filled in by field personnel. Items typically recorded on field sampling forms consist of the following:

- Sample name
- Time and date samples were collected
- Number and type (media; natural, duplicate, QA/QC) of samples collected
- Analysis requested
- Sample preservative (if applicable)
- Sampling method, particularly any deviations from standard operating procedures
- Signature of sampler

Upon completion of the field effort, the original field forms shall be filed in the project file. Photocopies of the original field forms can be made and used as working documents.

EQUIPMENT

- Field Notebook
- Field Sampling Forms

SOP 102 – SAMPLE DOCUMENTATION

PURPOSE

Identify the requirements for labeling and documenting sample collection.

SAMPLE NOMENCLATURE

Samples will be coded to contain the project number, sample type, sample number, and sample depth. The project number shall be a six-character WGM project number which identifies the site. The sample type indicates sample media and method of collection. The sample number will be unique to each project. The sample depth will indicate the depth (if applicable) the sample was collected.

Project Number- sample type- sampling method- sample number-sample depth.

For example, the sample 999999-SS-TP1-2', indicates the sample was collected for the project number (999999), the sample was a sub-surface soil sample (SBSS), was from test pit 1 (TP-1), and was collected at 2 feet below ground surface. Prior to initiating sampling, field personnel should familiarize themselves with the work plan and the nomenclature to be used for the Site. The character prefixes in the table below will be used for sample identification.

SAMPLE DOCUMENTATION

In addition to the chain-of-custody forms discussed below, field personnel will keep a list of samples collected at the field in the field log book and on appropriate field sampling forms. Upon returning to the office, the field log book and forms should be kept in the project file and subsequent copies sent to the laboratory, or other designated parties, as needed. All entries on the log bog and field sampling forms must be made in indelible ink.

SAMPLING ACRONYM	LABEL
EB	Equipment Blank
TB	Trip Blank
FB	Field Blank
MW	Monitoring Well
DW	Domestic Well
IW	Injection Well
OB	Observation Well
UST	Underground Storage Tank
VE	Vapor Extraction
AA	Ambient Air
SUMP	Sump (Water sample)
POND	Ponds
SPR	Spring
LAKE	Lake
SW	Surface Water, Stream or River
SR	Surface Runoff
TP	Excavated Test Pit
SS	Surface Soil Sample
SBSS	Subsurface Soil Sample
GW	Groundwater Sample

SAMPLE CUSTODY PROCEDURES

The field person is responsible for custody of the samples at all times until transferred or shipped to the laboratory using a chain-of-custody form. The chain-of-custody form will be completed for all samples collected in the field for laboratory analysis and copies will be maintained in the project file. The information to be included on the chain-of-custody form will include, but is not limited to:

- Project number/Site name
- Sampler's name and signature
- Date and time of sample collection
- Unique sample identification number or name
- Number of containers
- Sample media (e.g., soil, water, vapor, etc.)
- Sample preservative (if applicable)
- Requested analysis
- Comments or special instructions to the laboratory

Each sample will be assigned a unique sample identification number as described above in WGM SOP-3. The information on the chain-of-custody form, including the sample identification number, will correspond to the information recorded by the sampler on the field forms and field log book and the label on the sample container.

When custody of a sample is relinquished by the sampler, the sampler will sign and date the chain-of-custody form and note the time that custody was relinquished. Samples must be shipped to the analytical laboratory following the procedures described in in SOP-4. Notify the analytical laboratory of shipment and request pick up and receipt of delivery. The project manager will determine if proper custody procedures have been followed upon review of field activities, and audits may also be conducted by the client or appropriate regulatory agency.

EQUIPMENT

- Indelible Ink Pen
- Chain-of-Custody Forms
- Field Notebook
- Field Sampling Forms

SOP 103 – SAMPLE SHIPPING

PURPOSE

Ensure samples are packaged to prevent breakage/damage and comply with appropriate regulations. When packaging samples:

- Use sample labels from the laboratory whenever possible. Place the sample label on the side of the sample container and use indelible ink when completing the label.
- Place labeled sample bottles in a cooler. Place the samples in an upright position inside the cooler and wrap the samples with cushioning material for protection during transport. The cooler should be able to withstand tough handling during shipment without sample breakage.
- Make sure the cooler has an adequate amount of ice (inside sealed plastic bags) and/or frozen blue ice (appropriate for the season) to maintain a temperature of 4°C or less inside the cooler from the time the samples are placed in the cooler until they are received by the laboratory.
- Fill out the appropriate chain-of-custody forms and place them in a plastic bag and tape it to the inside lid of the shipping container. If more than one cooler is used per chain of custody, put a photocopy in the other coolers and mark them as a copy.
- Close and seal the cooler using strapping tape.
- Place completed sample custody seals on the outside of the cooler.
- Secure the custody seals on the cooler with clear strapping tape.
- Secure a shipping label with address, phone number, and return address on the outside of the cooler where it is clearly visible.

SHIPPING HAZARDOUS MATERIALS/WASTE

Transportation regulations for shipping of hazardous substances and dangerous goods are defined by the U.S. DOT in 49 CFR, Subchapter C, Part 171 (October 1, 1988); IATA and ICAO. According to DOT regulations, environmental samples are classified as Other Regulated Substances (ORS). ORS are articles, samples, or materials that are suspected or known to contain contaminants and can pose a risk to health, safety, or property when transported by ground or air. Materials shipped under the classification of ORS will not meet any of the following definitions: Class 1: Explosives; Class 2: Gases; Class 3 Flammable Liquids; Class 4: Substances susceptible to spontaneous combustion; Class 5: Oxidizing substances; Class 6: Poisonous; Class 7: Radioactive materials; Class 8: Corrosives. If your samples might meet any of the above definitions, contact the project manager to obtain instructions on sample shipment.

EQUIPMENT

- Indelible Ink Pen
- Chain-of-Custody Forms
- Custody Seals
- Laboratory Sample Labels
- Coolers and Ice
- Field Sampling Forms

SOP 201 – GROUNDWATER LEVEL

PURPOSE

To ensure groundwater levels are accurately measured in the field.

- Verify the water level indicator is operating correctly prior to leaving for the field by placing probe in water to test the buzzer and light. Repair as necessary. Make certain the meter and extra batteries are in the carrying case.
- Prior to collecting a measurement, decontaminate the water level indicator, as appropriate, and calibrate the probe to a steel tape. Note any corrections to water level meter measurements on field forms.
- Measure all wells (monitoring and domestic) from the top of the well casing in the north quadrant or from a designated measuring point, as appropriate. Measure and record the distance from the measuring point to ground level. Make sure the measuring point is labeled on the well, so future measurements can be made from the same location.
- Measure the depth to water from the measuring point to the nearest hundredth of a foot.
- Record measurements on the appropriate field forms. Also record the presence/absence of free product on the field forms.
- Decontaminate the water level meter between each.
- If free product is known or suspected to be present in a well, an oil-water level indicator or other method should be used to measure the depth to water and the thickness of free product in the well.

EQUIPMENT

- Water Level Indicator
- Extra Set of Batteries
- Inedible Ink Pen
- Field Sampling Forms

SOP 202 - LNAPL MEASUREMENT

PURPOSE

Provide guidelines for measuring the thickness of free- phase LNAPL in monitoring wells.

GOAL & OBJECTIVE

To employ consistent measuring methods for LNAPL in monitoring wells.

Three different procedures are described in this SOP for measuring light non-aqueous phase liquid (LNAPL or product) thickness in a monitoring well. These include using a specialized probe, bailer, and product/water finding paste.

USING INTERFACE OR LNAPL PROBE

Turn the probe on and rotate the disc at the top of the probe head. To test the batteries, insert the probe into the holder, this should cause a steady beep sound. Remove the probe from the holder and slowly lower the probe into the well. When the top of the product is reached, the probe should emit a steady beep. Note the depth from measuring point on a field form and label "Depth to Product". Continue to lower the probe in the well. When the water column is reached the sound should change from a steady to an intermittent beep sound. Note this depth on the field form under "Depth to Water". Remove the probe and rotate the disc back to the off position and turn the meter off. Product thickness can be calculated by subtracting the depth to product from the depth to water. Decontaminate probe before and after each use.

USING BAILER

This method is less precise but can provide a general idea of product thickness. The resulting thickness will likely be less than what is actually in the well. Lower a bottom loading clear disposable bailer slowly into the well. You should be able to hear when it reaches the top of the fluid column. Continue to SLOWLY lower the bailer into the well no deeper than the total length of the bailer (i.e., top of bailer should remain above top of fluid in the well). Remove the bailer and measure the product thickness with a tape measure on outside of bailer.

USING PASTE AND STEEL TAPE

Using a steel tape, smear water-finding paste over a 3-4 foot interval of one side of the tape. Smear product-finding paste (or chalk) over the other side of the tape. Lower tape into the well until the bottom of the tape is roughly 2-3 feet below the top of the fluid surface in the well. Note the depth of the tape from the measuring point on the field form. Remove the steel tape and note the reading indicated by the water-finding paste or chalk, and the reading indicated by the product-finding paste (both of these should be evident as a change in color, or a wet line in the case of chalk). Depth to water is calculated by subtracting the water reading from the total tape depth. The depth to product is calculated by subtracting the product reading from the total tape depth. Product thickness is calculated by subtracting depth to product from depth to water. This procedure may need to be repeated several times, especially if the depth to water is not known, or if the product thickness is greater than the depth the tape is lowered into the fluid. Previous depth to water and product thickness readings for a particular well can be used as a guide. Decontaminate steel tape before and after each use.

EQUIPMENT

- Interface or LNAPL Probe or equivalent
- Extra Set of Batteries
- Indelible Ink Pen

- Field Sampling Form
- Decontamination Supplies

SOP 203 – WELL STABILIZATION MEASUREMENTS

PURPOSE

To ensure measurement of well stabilization parameters are done consistently and correctly in the field

GOAL & OBJECTIVE

To obtain accurate well stabilization measurements in the field

CONDUCTIVITY INSTRUMENT CALIBRATION

The conductivity meter should be calibrated prior to each sampling event following the manufacturer's recommendations. If the instrument is a multi-parameter meter, follow the instructions for measurement of electric conductivity (EC) or specific conductance (SC) from the manual.

Prior to conducting field measurements, verify the EC/SC meter automatically corrects for temperature variations. If the meter does not, apply the appropriate temperature correction to the field measurements.

FIELD MEASUREMENT PROCEDURE

Rinse a decontaminated glass container or plastic flow-through cell with sample water. Fill the container or flow-through cell with sample water, with enough available space to insert the EC/SC probe without undesired overflow.

Rinse the EC/SC or multi-parameter probe with deionized or distilled water and place it in the beaker of sample water. Immerse the probe in sample and move it around to displace any air bubbles. Keep the probe tip off of the sides of the beaker. Record the conductivity value from the meter on the field form.

Be sure to recognize the units of the meter reading value (i.e., microsiemens/centimeter (µS/cm), micromhos/centimeter (µmhos/cm), or millisiemens/centimeter (mS/cm)). Record the reading on the field sampling form and field logbook. If the reading is being taken in-situ or using a flow-through cell, wait until the reading stabilizes and record it on the sample field form.

Remove the probe from sample and decontaminate probe. Store the probe following the manufacturer's recommendations. Refer to SOP-2 for complete decontamination procedures.

PH INSTRUMENT CALIBRATION

The pH meter must be calibrated prior to each field event and after every 10 samples during a sampling event, or more frequently if required by the project/client. Follow the manufacturer's recommendations to calibrate the meter. This typically involves the following sequence of steps:

1. Verify sensor is clean and filled with solution, then turn on meter.
2. Place in pH 7 solution, press "cal", and wait until calibration is complete.
3. Rinse sensor in deionized or distilled water.
4. Place in pH 10 (or pH 4) buffer solution, press "cal" a second time, and wait until endpoint is reached.
5. Rinse in distilled water.

Three-point calibration is the standard procedure. If the instrument is a multi-parameter meter, follow instructions for measurement of pH from the manual.

Periodically throughout the field day, place the probe in 7.0 pH buffer solution. If the measured value differs from the expected
value by more than 0.1 pH units, recalibrate the meter according to the manufacturer's instructions.

FIELD MEASUREMENT PROCEDURE

1. Rinse a decontaminated glass beaker or plastic flow-through cell with sample water three times.
2. Rinse the pH probe with deionized or distilled water.
3. Fill the container with sample water.
4. Immerse the probe in the sample and agitate it to provide thorough mixing. Continue to agitate until the reading has stabilized. Read the pH value from the meter to the nearest 0.1 standard unit (s.u.) and record on the field sampling form. If the reading is being taken in-situ or using a flow-through cell, wait until the reading stabilizes and record the final pH value.
5. Note any problems such as erratic readings. If previous readings are available, compare the current measurement to previous reading to check that the current reading is within reasonable limits.
6. Rinse probe with deionized or distilled water and store according to the manufacturer's instructions (see SOP-2 for complete decontamination procedures).

ORP INSTRUMENT CALIBRATION

The oxidation-reduction potential (ORP) meter should be calibrated prior to each sampling event following the manufacturer's recommendations. If the instrument is a multi- parameter meter, follow the instructions for measurement and calibration of ORP. Use table of temperature adjustment information provided with the instrument instructions.

FIELD MEASUREMENT PROCEDURE

1. Decontaminate a clean plastic or glass container with deionized or distilled water.
2. Rinse the ORP electrode with deionized or distilled water and then with sample water prior to inserting it into the sample beaker.
3. If possible, obtain an in-situ measurement of ORP. If not possible, preferably use a flow-through cell receiving a constant stream of water from the well or sample source material. If obtaining a sample for ORP measurement, minimize agitation of the sample in an effort to limit exposure to oxygen.
4. Immerse the ORP electrode in the sample and allow at least one minute for the probe to equilibrate with the water.
5. Obtain a reading to the nearest 10 millivolts (mV).
6. Record the reading on standardized field form. Note any problems such as erratic or drifting readings.
7. Decontaminate the probe in accordance with SOP-2.

DO INSTRUMENT CALIBRATION

Before each use, clean and rinse the dissolved oxygen (DO) electrode tip in accordance with decontamination procedures outlined in SOP-2. Verify that the
membrane cap has been filled with DO electrolyte in accordance with manufacturers required maintenance schedule.

Calibrate the probe and meter using the fresh water-air calibration method described in the manufacturer's manual. Correct the calibration value for temperature and altitude and adjust the meter accordingly. Sensor can maintain polarization when disconnected from the meter for up to three hours.

FIELD MEASUREMENT PROCEDURE

Place the probe directly into the stream or well to be measured. If possible, place the probe into a flow-through cell receiving a continuous stream of water from the source being measured. Allow sufficient time for the probe to stabilize to sample temperature and DO concentration. Record the DO value on the field form. Rinse probe with deionized or distilled water when measurement is complete.

If sensor will not calibrate, becomes sluggish or erratic:

- Clean tip and refill cap with DO electrolyte in accordance with manufacturer's instructions (care must be taken to eliminate air bubbles from inside probe, and probe tip must be scarified using manufacturer-provided sandpaper).
- Check membrane for damage; replace if necessary.
- Check meter with test plug.
- Replace battery.

EQUIPMENT

- EC/SC Meter
- pH Meter
- ORP Meter
- Dissolved Oxygen Meter
- Calibration Standard(s)
- Glass Container or Flow- through Cell
- Extra Set of Batteries
- Indelible Ink Pen
- Deionized/Distilled Water
- Field Sampling Form

SOP 301 – GROUNDWATER SAMPLING

PURPOSE

Provide guidelines for sampling groundwater

Prior to initiating groundwater sampling, all equipment should be inspected for damage and repaired. Check with the project manager to be sure you understand what type of pump will be used to purge and sample groundwater. Equipment to be placed down hole must be decontaminated. Begin with the well containing the lowest level of contamination, and sample wells in succession based on anticipated increasing concentrations. If the relative degree of concentrations cannot be determined, wells should be sampled in order of increasing proximity to the suspected source of contamination, preferably from the perimeter towards the center of the site. Field sampling forms must be completed for each well to document purging and sampling.

SAMPLING FROM TEMPORARY BOREHOLES

If samples are to be collected from temporary boreholes, a temporary well screen (PVC or stainless steel) should be placed in the borehole when feasible, and the water level should be measured prior to sampling and at least 15 minutes after completion of the borehole to the sampled depth. If it is not feasible to set temporary well screen, collect the sample initially into unpreserved, laboratory-provided ultraclean containers, then filter the sample prior to placement in the final sampling containers.

When sampling from a temporary well screen, use either new tubing (LOPE or Teflon) with a stainless steel foot valve, or use a new/decontaminated bailer. Note the physical appearance of the sample (color and qualitative turbidity) on the field sampling form. Where feasible, avoid sampling from the bottom I -foot of the borehole or well screen to minimize entrainment of sediment into the sample.

WELL PURGING

Purging must be performed on all wells prior to sample collection. Before purging each well, record the depth to water from the top of the well casing to the nearest 0.01 foot using a water level meter. If sampling at a site where there may be free product, wells shall be checked for the presence of free product prior to purging and sampling using an oil-interface probe. Determine the saturated thickness by subtracting the total well depth from the depth to water.

Monitoring wells shall be purged until a minimum of three casing volumes have been removed and water quality characteristics (pH, temperature, conductivity) have stabilized. Field parameters should be measured during well purging at least three times per casing volume purged. Stabilization is achieved when pH readings stabilize to within 0.1 and temperature and conductivity stabilize to within 5% over a casing volume.

The following equation is used to calculate well volume in gallons:

$$V = 3.14 * (r^2) * d * 7.48$$

Where, V = volume (gallons)
r = well radius, feet
d = depth of water in well (feet)

The radius of the well pack will be used for the well radius for calculating bore volumes where appropriate. For example, a 2" PVC monitoring well installed in a 6" hole with sand filter pack would use a well radius of 3" or 0.25 feet.

Several general methods can be used for well purging. Well purging may be achieved using bailers, bladder pumps and submersible pumps. The specific pumping method shall be chosen based on depth to groundwater, diameter of well, existing well configuration and contaminant(s) of concern. If the recovery of a low-yield well exceeds two hours after purging, a sample shall be extracted as soon as sufficient volume is available in the well. At no time should a monitoring well be pumped dry if the recharge rate causes formation water to cascade down the well casing causing an accelerated loss of volatiles and change in pH.

Purge water must be handled in accordance with the SOP for investigative-derived wastes. is discharged directly to the ground, attention must be given to avoid direct recharge of shallow wells with the purge water. Purge water must be discharged down gradient and at an adequate distance from the well to avoid mounding and interference.

COLLECTING WATER QUALITY SAMPLES

Label each sample container with project number, sample location, well owner, date, military time, sampler's initials, preservative, and analysis required. Don clean latex or nitrite gloves immediately prior to obtaining the sample.

Obtain the sample from the well using a disposable polyethylene bailer, a decontaminated stainless steel or Teflon bailer, or pump and tubing (submersible, bladder, peristaltic, etc.), as appropriate. The pump to be used should be determined by the contaminants of concern, so check with the project manager. The pump or bailer intake should generally be placed at the midpoint of the saturated thickness in the casing for sampling. If the well is pumped dry during the purge, the pumping rate shall be reduced to match well yield if possible and a note made on the sampling form. When using a bailer, take care to minimize degassing or contamination of the sample by submerging and withdrawing the bailer slowly to avoid splashing. Do not place the bailer on the ground.

When sampling a domestic well connect a hose to the outside fixture to direct water away from the home to an area where the water can soak into the ground. Turn on the faucet and let it run for 60 minutes. Turn flow rate down and collect a water sample in appropriate containers. Make sure to add preservatives to the sample containers prior to filling them, in accordance with the table below.

When sampling a monitoring well, add preservatives to the sample container prior to sample collection (this is often done by the analytical laboratory). Remove water from the well and transfer sample water directly into sample bottles or filter apparatus (should filtering be necessary), maintaining a slow linear flow with as little agitation as possible. For volatile analyses fill vials at the rate of 100 milliliters per minute (24 seconds for 40 milliliter vial) or less. Fill each sample vial completely so the water forms a convex meniscus at the top to ensure no air space exists in the vial after it has been capped. After filling, immediately cap, invert, and gently tap the vial to check for trapped air. If air bubbles are present, un-cap vial, add more sample water and repeat procedure. If air bubbles are still present, discard the vial. Samples should be preserved as described in the table below.

PARAMETER	#	CONTAINER	PRESERVATION	MAXIMUM HOLDING TIME EXTRACTION/ANALYSIS
VOCs	2	40 ml glass	4°C & HCL	14 days to analysis
SVOCs	1	1 liter glass	4°C	7 days/40 days from extraction to analysis
Metals	1	500 ml HDPE	4°C & HNO_3	6 months to analysis, Hg 28 days to analysis
Nutrients	1	500 ml HDPE	4°C & H_2SO_4	Varies – contact laboratory for additional information
Common Ions	1	1 liter HDPE	4°C	7 days/40 days from extraction to analysis

Be sure to properly cap and lock the well when sampling is complete.

Be sure to complete the necessary shipping and handling paperwork and record all pertinent information on Field Sampling Forms.

EQUIPMENT

- Five-gallon bucket graduated in gallons
- Purge/sampling pump(s)
- Oil-Interface Probe, as necessary
- Water Level Meter
- pH, temperature, and conductivity meter
- Filtering apparatus and hand pump (if filtering samples)
- Sample Containers
- Preservatives, as required
- Field Sampling Forms
- Decontamination equipment and fluids
- Tubing, as needed
- Generator or power supply
- Coolers and Ice

- Stopwatch
- Rope and Bailer, for backup

SOP 302 – LOW FLOW MONITORING WELL SAMPLING

PURPOSE

Provide guidelines for sampling of groundwater using low-flow methods

GOAL & OBJECTIVE

To employ a method of collecting groundwater samples that are representative of the chemistry of the aquifer

Prior to initiating groundwater sampling, all equipment should be inspected for damage and repaired/replaced, if necessary. Have on- hand: copies of well logs; sampling and analysis plan or work plan; any previous site sampling information/data; field planning worksheet; and field forms. Check with project manager to be sure you understand what type of pump(s) will be used to purge and sample groundwater. Equipment to be placed down-hole must be decontaminated.

Begin sampling at the well containing the lowest level of contamination, and sample wells in succession based on increasing contaminant concentrations. If the relative degree of concentrations cannot be determined, wells should be sampled in order of increasing proximity to the suspected source of contamination, preferably from the perimeter towards the center of the site. A standard field sampling form must be completed for each well to document purging and sampling in accordance with relevant SOPs; individual sampling forms must also be completed for any field quality control samples (e.g., duplicates, rinsate blanks, and field blanks).

WATER LEVEL MEASUREMENT

Before purging each well, record the depth to water from the designated measuring point on the top of the well casing (or the north side of the top of casing if a measuring point is not identified) to the nearest 0.01-foot using an electronic water level meter. If sampling at a site where there may be free product, wells shall be checked for the presence of free product prior to purging and sampling using an oil-interface. Determine the thickness of free product by subtracting the depth to free product from the depth to water.

Record the following dimensions on the groundwater sampling form: depth to water; total well depth; depth to top of screened interval; depth to bottom of screened interval; depth to top of filter pack interval; depth to bottom of filter pack interval; and casing diameter. Well and filter pack depth information should be referenced from the well log; do not measure total depth of the well prior to purging and sample collection to avoid resuspension of any settled solids which may have accumulated within the casing. Use the following formula to calculate the volume of water present in the well casing (casing volume):

$V = 3.14*(r2)*d*7.48$

Where:
V = volume (gallons) r = well radius (feet)
d = depth of water or saturated thickness in well (feet)

The radius of the filter pack will be used for the well radius (r) for calculating borehole volumes, if required. For example, a 2-inch diameter PVC monitoring well installed in a 6-inch diameter hole with sand filter pack would use a well radius of 3 inches or 0.25 foot.

LOW FLOW PURGING

The goal of low flow purging is to collect water samples that reflect the total mobile organic and inorganic loads transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. During low flow purging, emphasis is placed on minimizing hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations. Low flow purging can be completed using a submersible pump and low flow controller, an air or nitrogen powered bladder pump, or a peristaltic pump where appropriate (e.g., shallow wells; sampling for non-volatile constituents). The specific pumping method shall be chosen based on depth to groundwater, diameter of well, existing well configuration, and contaminant(s) of concern.

Decontaminated or dedicated low flow sampling equipment shall be used for purging and sampling. The pump and disposable tubing should be lowered gently and slowly and set within the upper third or fourth of the screened interval. If the static water level is below the top of the screen, then the pump shall be lowered to within the upper third or fourth of the water column. In either case, the pump intake will be placed a sufficient distance above the bottom of the well to avoid mobilization of any accumulated sediment.

Purge at a rate of 0.1 to 0.5 liter per minute (Lpm) while monitoring drawdown of the water level in the well using an electronic water level meter every 5 minutes. If drawdown exceeds 0.3 foot (0.1 meter), reduce the purge rate accordingly. Purging rates should, as needed, be reduced to the minimum capabilities of the pump to ensure drawdown of less than 0.3 foot or stabilization of the water level. If the minimal drawdown that can be achieved exceeds 0.3 foot, but remains stable, continue purging until three casing volumes are removed and/or water quality parameters stabilize (see below).

Indicator field parameters (see below) are monitored every 5 minutes during purging in order to determine when sample collection may begin in accordance with the stabilization goals specified in the table below. Indicator field parameters, including pH, Oxidation/Reduction Potential (ORP), Electrical Conductivity (EC) or Specific Conductance (SC), Temperature, and Dissolved Oxygen (DO) should be measured using a flow-through cell. Turbidity should be measured using discharge from a T-valve located upstream of the flow-through cell. Turbidity should not be measured downstream of the flow-through cell because it can entrain suspended solids resulting in inaccurate turbidity readings.

INDICATOR PARAMETER	UNITS	STABILIZATION GOAL	COMMENT
pH	standard units (s.u.)	+/- 0.1 s.u. between three readings	
Electrical Conductivity (EC) or Specific Conductance (SC)	microsiemens, millisiemens, or micromhos per centimeter (µS/cm, mS/cm or µmhos/cm)	+/- 3% between three consecutive readings	
Oxidation/Reduction Potential (ORP)	millivolts (mV)	+/- 10 mV between three consecutive readings	
Temperature	degrees Celsius (°C)	+/- 3% between three consecutive readings	

INDICATOR PARAMETER	UNITS	STABILIZATION GOAL	COMMENT
Dissolved Oxygen (DO)	milligrams per liter (mg/L)	+/- 10% between three readings or <0.5 mg/L	Considered stable if three DO values are less than 0.5 mg/L
Turbidity	Nephelometric Turbidity Units (NTU)	+/-10% between three readings and <10 NTU	If turbidity is >10 NTU, consider stable if three turbidity values are +/-10%

Note that the stabilization criteria listed in the table above are goals and may not be achievable under all situations. Dissolved oxygen and turbidity generally require the longest time to stabilize. A turbidity value of 10 NTU may not be achievable in all monitoring wells. In the event that turbidity stabilizes (+/- 10% between three readings) above 10 NTU, proceed with sample collection and note the suspected reason(s) for the elevated turbidity. Attempt to remedy the elevated turbidity for subsequent sampling events at a given monitoring well or site. Remedies for elevated turbidity may include well re- development, slightly higher pump placement, slower submersion of the sampling pump and tubing, and/or a reduced purge rate. If the water level recovery of a low-yield well exceeds 2 hours after purging, a sample shall be extracted as soon as sufficient volume is available in the well. At no time should a monitoring well be pumped dry if the recharge rate results in formation water to cascade down the well screen, causing an accelerated loss of volatiles and possible change in pH.

COLLECTING WATER QUALITY SAMPLES

Label each sample container with project number, sample location, well owner, date, military time (24- hour), sampler's initials, preservative, and analysis required. Wear new disposable latex or nitrile gloves immediately prior to obtaining the sample.

Verify that the appropriate preservatives were added by the analytical laboratory or should be added by field personnel. If required, add the necessary preservative to the appropriate sample container prior to sample collection (see table below).

Prior to filling the sample container, disconnect the flow-through cell from the pump discharge tubing while the well is still being purged. Water quality samples should never be collected downstream of the flow-through cell because the flow-through cell can entrain suspended sediment and result in a cross- contaminated sample volume with a biased concentration of analytes. Place the pump's discharge tubing directly above the receiving sample container and add the sample volume directly to the bottle, minimizing turbulence as much as possible. For volatile analyses, fill appropriate vials at the rate of about 100 milliliters per minute (mL/min) (24 seconds to fill a 40 mL vial) or less. Fill each sample vial completely so the water forms a convex meniscus at the top to ensure that no head space exists in the vial after it has been capped. After filling, immediately cap, invert, and gently tap the vial to check for trapped air. If air bubbles are present, un-cap vial, add slightly more sample water and repeat procedure. If air bubbles are still present, discard the vial and fill another sample vial. If analyzing for dissolved constituents, add field filter (usually 0.45 micron (µm) pore size) to the end of the pump's discharge line, and then fill the appropriate container(s). Samples should be preserved as described in the table below, unless otherwise specified by the laboratory.

PARAMETER	NUMBER OF BOTTLES	CONTAINER	PRESERVATION	MAXIMUM HOLDING TIME EXTRACTION/ ANALYSIS
VOCs	3	40 mL glass vial	≤6°C & HCL	14 days to analysis
SVOCs	2	1 L glass	≤6°C	7 days / 40 days from extraction to analysis
Metals	1	500 mL plastic	≤6°C & HNO_3	6 months to analysis; mercury 28 days to analysis
Nutrients	1	500 mL plastic	≤6°C & H_2SO_4	Varies – contact laboratory for additional information
Common Ions	1	1 L plastic	≤6°C	7 days / 40 days from extraction to analysis

Note: VOC = volatile organic compound; SVOC = semi-volatile organic compound; mL = milliliter; L = liter; HCL = hydrochloric acid; HNO3 = nitric acid; H2SO4 = sulfuric acid; C = Celsius.

Properly cap and lock the well when sampling is complete. In the field notebook, record any damage to the well, monument, or items related to the well that need attention or repair prior to the next sampling event.

Purge water must be handled in accordance with management of investigative-derived wastes. Groundwater purged from a well during purging or sampling that has a sheen or contains free product must be containerized in an appropriately labeled 55-gallon drum or tank pending receipt of analytical results. A drum should be dedicated to each well sampled so that analytical results of the groundwater sample can be used to characterize the water in the drum. Groundwater that contains no free product, sheen, or odors may be discharged directly to the ground if approved by the property owner. If groundwater is discharged directly to the ground, attention must be given to avoid direct recharge of shallow groundwater with purge water near the well. Purge water must be discharged downgradient and at an adequate distance from the well to be sampled to avoid mounding and interference with the water table.

Complete the necessary sample handling paperwork, sample handling, packaging, and shipping, and record all pertinent information on field sampling forms and field logbook.

EQUIPMENT

- 5-gallon Bucket, graduated in gallons
- Purge/Sampling Pump(s)
- Oil-Interface Probe, as necessary Water Level Meter
- Meters or Flow-through cell to measure temperature, pH, EC/SC, DO, and ORP.
- Filtering apparatus/pump (if filtering samples)
- Sample Containers Preservatives, as required
- Field Planning & Sampling Forms Decontamination Supplies
- Tubing for pump (include air-line and water-line for bladder pump)
- Disposable bladders and O-ring kit for bladder pump
- Generator or Power Supply; controller for bladder pumps
- Coolers and Ice Stop-watch
- Rope and Bailer (for backup)

SOP 303 – FIELD SAMPLING FILTRATION

PURPOSE

Provide guidelines for filtering water samples in the field.

GOAL & OBJECTIVE

To employ a method of filtering samples in the field, thus removing sediment from the sample and allowing for analysis of dissolved constituents in the sample.

FIELD PROCEDURE

Set-up a system whereby water samples can be filtered, including a filter apparatus/pump for retrieving water from a well or water body. To avoid the need for decontamination, use disposable tubing and equipment, if possible. If using a hand-vacuum pump, place groundwater or surface water into a vessel that can be pressurized using the hand- vacuum pump. Filtered effluent from the pump can be placed directly into sample containers post-filtering with a disposable 0.45 micron (µm) filter. The filter can be attached in-line with sampling tubing. As appropriate, fill pre-preserved, laboratory supplied sample containers with filtered sample and cap each container. Invert sample container several times to insure complete sample-preservative mixing, if applicable. Place samples into cooler; package and ship in accordance with SOP-4.

If extremely turbid sample water is obtained, may need to pre-filter the sample using 3.0- or 5.0-micron filter paper followed by 0.45 micron filtration. Decontaminate all sample collection equipment.

EQUIPMENT NEEDS

- 0.45, 3.0, and 5.0 micron Disposable Filters
- Sample Collection and Filter Apparatus (Pump)
- Preservatives, as required
- Indelible Ink Pen
- Field Sampling Form

SOP 402 – MONITORING WELL INSTALLATION WITH DIRECT-PUSH EQUIPMENT

PURPOSE

Provide guidelines for installing monitoring wells using direct- push techniques

GOAL & OBJECTIVE

To employ a standard method of well installation using direct- push techniques

FIELD PROCEDURE

The following is a generalized procedure for installing a typical monitoring well using direct-push equipment. Refer to the project-specific work plan which should include more details about the design and method of completing monitoring wells on a project site.

Arrive on-site with the appropriate drilling equipment and materials for site conditions. Ensure driller has properly decontaminated all drilling equipment and materials prior to arrival on-site.

Safety equipment required on-site is mandatory. Personal protective equipment includes (at a minimum): hard hat, safety glasses, steel-toed boots, gloves, first aid kit, and site health and safety plan (with routes to nearest hospital known by all personnel on-site).

Review work plan to determine if soil samples should be collected during advancement of direct-push equipment. If so, follow methods described in applicable SOPs for subsurface soil sampling.

Advance direct-push drill rods to the desired depth for monitoring well installation.

Describe lithology encountered on a detailed lithologic boring log form during drilling activities. Soils should be described according to procedures outlined in the United Soil Classification System (USCS; method ASTM D2487) or Soil Conservation Service (SCS) classification system. Soil texture should be classified by either the USCS or U.S. Department of Agriculture (USDA) classification.

If encountered, water-bearing characteristics of the formations should also be denoted on the boring log. In addition, details of monitoring well construction should be described on the well log, including total depth, perforated interval, sizes and types of construction materials, etc.

Construct the monitoring well with Schedule 40 or 80 PVC casing and factory-slotted well screen up to 1-inch in diameter. Once the drill rods are at the desired depth, lower the well screen and casing through the drill rods. Retract the drill rods out of the borehole while placing an inert silica sand around the screen interval to one foot above the well screen.

Install a bentonite plug above the sand at least 2-feet in thickness. Above the bentonite, backfill the remaining well annulus with a bentonite slurry or grout to ground surface.

Place locking protective well cover over the well casing after the drill rods have been removed from the borehole. Place bentonite plug below bottom of well cover; grout the cover in place and install lock on the cover.

EQUIPMENT

- Well Completion Materials, as necessary
- Latex or Nitrile Gloves
- Field Logbook
- Boring Well Log Form

SOP 405 – INVESTIGATIVE-DERIVED WASTE

PURPOSE

Provide guidelines for handling wastes generated during site investigation.

This procedure describes how wastes generated during the investigation should be handled and is applicable to non-hazardous wastes.

SOIL

Whenever possible, soils excavated from test pits should be placed back in the test pit in the reverse order that it was excavated. To determine appropriate method for handing of drill cuttings from soil borings or monitoring well installation, soils exhumed from the borehole should be monitored for visual or olfactory impacts. If a Photoionization Detector (PID) is utilized for field screening during the investigation, it should also be used to screen soil.

Borehole cuttings with observed impacts or organic vapor concentrations greater than 100 ppm should be containerized in labeled 55-gallon drums (or roll-off containers if large volumes of cuttings are anticipated) pending further characterization. Alternatively, project personnel may elect to containerize all drill cuttings based on the presence of known contamination and contaminant concentrations. Containerized soil must be disposed of in accordance with state and federal regulations based on of soil analytical results.

Soil that does not appear to be contaminated based on observations by field personnel and PID screening may be spread on the ground near the point of origin.

GROUNDWATER

Groundwater purged from a well during development or sampling that has a sheen or contains free product will be containerized in an appropriately labeled 55-gallon drums or tank pending receipt of analytical results. A drum should be dedicated to each well sampled so that the analytical results of the groundwater sample can be used to characterize the water in the drum. If groundwater from several wells is placed in a drum, the water in the drum should be sampled for adequate characterization. The containerized water must be disposed of in accordance with state and federal regulations based on the analytical results. Groundwater that does not have a sheen or contain free product may be discharged to the ground surface and monitored to confirm infiltration in place within site boundaries.

EQUIPMENT

- DOT approved 55-gallon drums
- Drum Wrench
- PID

SOP 601 – SOIL VAPOR & AIR SAMPLING

PURPOSE

Describe field methodology for soil vapor sampling and ambient air sampling

GOAL & OBJECTIVE

To ensure soil vapor and air samples are collected correctly and consistently in the field

GENERAL PROCEDURE – PURGING

Prior to sample collection, purging of soil vapor from the sampling probe must be performed. If previous purge testing has not been performed, a purge optimization test should be conducted to select an appropriate purge volume for the site. During purge optimization, remove 1, 3, and 7 volumes of dead air space (including internal volume of tubing, probe, and air within filter pack surrounding the probe). Measure organic vapor concentrations using a photoionization detector (PID) or comparable instrument during purge and select the number of purge volumes that yield the highest PID reading.

After selecting a purge volume, purging should be conducted using a pump (such as personal air sampling pump), syringe, or vacuum canister (either one-time use, such as a Summa canister, or electric- powered canister maintaining a consistent vacuum). Maintain constant flow rates during purge either by monitoring air flow and manually adjusting the pumping rate or using a vacuum canister with customized flow meter. The rate of purging (e.g., milliliters per minute (mL/min)), and the start/stop time of purging (recorded as hour:minute: second) should be recorded at each sampling location. Following purge, close the line from the probe, attach the sampling canister, then re-open the line.

COLLECTING SOIL VAPOR SAMPLES USING ISOPROPYL ALCOHOL TRACER

Generally, sample sites (soil vapor probes) shall be sampled from the least contaminated to the most contaminated, if known.

- Prior to initiating sampling, confirm that all connections from the vapor sampling point to the vacuum canister are tightly sealed, the flow controller is in-place in the sampling train, and that a pressure gauge is installed between the flow controller and sampling canister.
- Place a weighted absorbent towel on the ground at the point where the sampling train enters the subsurface and beneath any connections in the sampling train, then soak the towel with liquid isopropyl alcohol.
- Open the valve on the summa canister, and record time, canister pressure (in negative inches of mercury), and the serial number of the canister in the field logbook and field sampling form. If using a 6-liter Summa canister, the initial vacuum should be between -30 and -25 inches of mercury. If this is not the case, contact the laboratory and start the purging and sampling process over with a different Summa canister.
- Using a field instrument such as a PID, also record organic vapor concentrations (dominated by isopropyl alcohol tracer compound) in the ambient air near the base of the sampling probe.
- At about half the time necessary to complete sampling, record time and canister pressure, and ambient organic vapor concentrations. The pressure on a 6-liter Summa canister should be between -20 and -12 inches of mercury at half of the sampling time. Determine whether the sampling time will have to be extended to obtain sufficient sample volume.

- At the end of the designated time necessary to complete sampling with the flow controller used (for example, exactly at the end of one hour), again record time and canister pressure, and ambient organic vapor concentrations.
- Continue to draw air from the soil vapor probe until the 6-liter Summa canister vacuum is reduced to between -10 and -5 inches of mercury. Record the time and canister pressure, then close the canister valve to end sampling.
- Remove the canister to a location distant from the soil vapor probe and tracer gas application and prepare the canister for shipment to the laboratory.
- Label each Summa canister with project name, project number, sampling location, date, military time (at the end of the sampling interval), sampler's initials, and analysis required.
- Ship samples to the laboratory under proper handling, packaging, and chain-of-custody.

COLLECTING SOIL VAPOR SAMPLES USING HELIUM LEAK DETECTION

- Attach flow controller and vacuum gauge to Summa canister.
- Seal the upstream end of controller/canister with a brass cap, then open the canister valve for approximately 5 seconds. Observe vacuum gauge. Vacuum should stay constant at an initial point between 30 and 23 inches of mercury. If the initial vacuum is above or below this range, contact the laboratory and use a different Summa canister. If the vacuum changes, re-tighten connections and repeat.
- Confirm that sample tubing (3 to 4 feet) is attached to the soil vapor probe, and also place a short section of tubing for helium monitoring adjacent to the soil vapor probe.
- Seal the distant ends of the helium monitoring tubing and sample tubing using a valve or clamped section of silicon tubing.
- Provide helium supply line to near the soil vapor probe entrance to the ground and cover the probe and adjacent sections of helium supply line, helium monitoring line, and sample tubing with a shroud (plastic bag weighed down to the surrounding surface using sand-filled hose).
- Open the helium monitoring line, turn on the helium meter, and connect the meter to the monitoring line.
- Add helium until the concentration monitored under the shroud is 20%.
- Purge 3 dead-space volumes from the sample tubing and probe using a syringe, personal air sampling pump, or vacuum canister (either one-time use, such as a Summa canister, or electric-powered canister maintaining a consistent vacuum). Maintain constant flow rates during purge either by monitoring air flow and manually adjusting the pumping rate or using a vacuum canister with customized flow meter. The rate of purging (usually in milliliters per minute (mL/min)), and the start/stop time of purging (recorded as hour:minute:second) should be recorded at each sampling location. If a syringe is used for purge, record total volume purged and time interval.
- Detach the helium monitor from the monitoring line, close the helium monitoring line, and allow the helium monitor to return to a reading of zero. Attach the helium monitor to the sample tubing (note that some helium meters only function if placed in an open air stream, such as being loosely placed into a much larger rigid tube, rather than a tight connection).
- Record the stabilized helium concentration in the sample tubing, and the estimated purge volume, if any, removed by action of the helium monitoring device. The helium concentration in the sample tubing must be no more than 10% of the concentration previously monitored under the shroud (ideally less than 2%). If this condition is met, proceed. If the concentration in the tubing is more than 10% of the concentration in the

shroud, remove the shroud, repair sampling train connections and seal of the probe to the ground, and repeat helium supply and purge.

- When post-purge helium reading is acceptable, remove the shroud.
- Attach the sample tubing to the regulator/Summa canister train.
- Replace the shroud over the entire sampling train (including Summa canister) and over the helium supply line and helium monitoring line.
- Add helium and until the concentration monitored under the shroud is at least 20%.
- Open the valve on the Summa canister, and record time, canister vacuum (in negative inches of mercury), and the serial number of the canister.
- Record the helium concentration during sampling at 2-minute intervals for the entire sampling period, if 15 minutes or less; or for the first 15 minutes if sampling for a longer period. Add helium as needed to maintain 20% inside the shroud.
- At approximately half the time necessary to complete sampling with the flow controller used, again record time, canister vacuum, and helium concentration under the shroud. Make a preliminary evaluation of whether the sampling time will have to be extended or shortened to obtain appropriate sample volume (the vacuum on a 6-liter Summa canister should be between -20 and -12 inches of mercury at half of sampling time). Add helium as necessary.
- At the end of the designated time necessary to complete sampling with the flow controller used, record time, canister vacuum, and helium concentration under the shroud. If using a 6-liter Summa canister, extend the sampling interval until the canister vacuum is between -10 and -5 inches of mercury; record time, canister vacuum, and helium concentration, then close the canister valve to end sampling.
- Connect PID to sample port. Record the stabilized reading, then close the sample tubing.
- Prepare the sample canister for shipment to the laboratory: replace the brass cap, label the Summa canister with project name, project number, sampling location, date, military time (at the end of the sampling interval), sampler's initials, and analysis required. Analysis must include helium.
- Ship samples to the laboratory, including one copy of the chain-of-custody form with each package. See applicable SOPs for proper sample handling and packaging procedures.

COLLECTING AMBIENT AIR SAMPLES

Prior To Sampling

During the 48-hours prior to sampling and throughout the duration of the sampling event, the facility should be controlled in the following manner:

- If an HVAC system is present, ensure that the HVAC system is operated in a typical manner for the sampled space.
- Control cleaning and maintenance activities, as well as dry-cleaned clothing, to minimize potential sources of VOCs within the facility.

Sampling Procedures

Use stainless-steel Summa canisters and flow controllers provided by the laboratory. Place indoor air sampling canisters and tubing such that the intake into the sampling train is at a height of approximately 4 to 5 feet above floor level (i.e., in typical breathing zone).

- At least one outdoor ambient air sampling location should be used to provide background data at the time of the indoor air sampling. The outdoor location(s) should be upwind of the subject building. If more than one outdoor ambient air sampling location is used, one of the outdoor locations should be on the roof near the intake of one of HVAC units (if present).
- Collect one field duplicate quality control (QC) sample per sampling event, unless specifically exempted by the project manager or project work plan. Record meteorological conditions, including temperature, barometric pressure, wind direction, and wind speed during the sampling period. Meteorological conditions may be estimated, and reported along with weather information from outside sources, if approved by the project manager. Take a photograph of each sample location.
- Use pre-calibrated flow controllers to fill each Summa canister to within the pressure range recommended by the laboratory (typical starting vacuum between -30 and -23 inches of mercury, and typical vacuum of between -10 and -5 inches of mercury at the end of sampling). For commercial buildings, sample over an 8-hour period during the workday. For residential buildings, sample over a full 24 hours. For each sample, record times of the start and end of sampling. Record initial and final canister pressures, and at least one other reading approximately midway during sampling. Label each canister tag with the sample number. Complete field sampling sheets (including canister serial number, pressure and time at the start and end of sampling) and chain-of-custody documents for all samples prior to shipment to the laboratory.

EQUIPMENT NEEDS

- Summa Canister
- Flow Controller Pressure/Vacuum Gauge
- Flow Controller-to-Tubing and Purge Pump-to-Tubing Connections
- Tubing (Silicon and Teflon)
- Other Fittings for Top of Soil Vapor Probe (if necessary)
- Syringe or Pump for Purge Stop-Watch
- Tracer Gas and Absorbent Towels
- Shroud (clear plastic bag, hose filled with sand for weighing down bag)
- Helium and Helium Meter
- PID, or Volatile Organic Meter that can detect both the target environmental analyte and the tracer gas
- Apparatus for Setting Height of Air Intake
- Field Forms
- Field Book
- Chain-of-Custody Form

SOP 603 – SOIL VAPOR WELL INSTALLATION

PURPOSE

This Standard Operating Procedure (SOP) describes the guidelines for installing soil vapor wells as stated in the Sampling and Analysis Plan (SAP) or as otherwise specified. Soil vapor wells are installed to monitor subsurface soil vapor migration.

EQUIPMENT & MATERIALS NEEDED (GPE)

- Daily Field Report
- Soil Vapor Well Construction Form
- Measuring Tape
- Camera
- Zip Ties, if needed to differentiate nested soil vapor wells

EQUIPMENT & MATERIALS NEEDED (DRILLER)

- Drill Rig
- Screen materials
- Casing Materials
- Annular Seal (if applicable)
- Bentonite Seal
- Fine Sand Material (if applicable)
- Filter Pack
- Surface Seal
- Soil vapor well manhole cover
- 4-way micro valve (Probes/well less than 1 inch in diameter)
- ¼ - inch outside diameter silicone, Tygon, or Teflon tubing (Probes/well less than 1 inch in diameter)
- Expandable well cap retrofitted with a 1/8-inch, PT, chrome-plated brass, non-valved coupling insert and vinyl slip cap (Probes/well less than 1 inch in diameter)

BEFORE ARRIVING ONSITE

- Obtain permits from appropriate local, state, and/or federal agencies. If there is a fee for permits, drilling subcontractors usually include this fee in their estimate.
- Notify (verbally or in writing) the client, landowner, and appropriate local, state, and/or federal authorities, as appropriate, in advance of the date that drilling and installation is scheduled to begin.
- Conduct a public utility locate at all planned drilling locations. If drilling in an area with a suspected high density of either public or private utilities, consider using a private locate.
- Make provisions for containment, storage, and disposal of all cuttings, drilling fluids, and other refuse generated during well installation. Waste characterization may be necessary prior to disposal.
- Review the lithology of the site to determine drilling materials needed.
- Work with the drillers to ensure that the appropriate drilling materials are available on site at the time of installation. If drilling into concrete or asphalt, notify the driller to ensure that a saw is available.

SOIL VAPOR WELL INSTALLATION PROCEDURES (DRILLER)

- Connect tubular stainless steel screen to flexible Teflon tubing. The size of the screen will be dependent on lithology. Confirm the length of tubing is adequate to lower to the

bottom of the borehole. Insert and lower the stainless steel screen and flexible Teflon tubing into the borehole. Leave a short amount of Teflon tubing, sealed by a cap at the surface end above the surface.

- Pour in sand to seal and support the screen and Teflon tubing. Based on boring and casing diameters, determine volume of filter pack material required to place the filter approximately 2 feet above and below screened sections, if multiple.
- Slowly pour filter material down annulus, being careful to evenly distribute the material around the screen and Teflon tubing and to avoid the material becoming packed between the sidewall and screen and Teflon tubing. Use a small-diameter pipe to dislodge packed material and to ensure adequate height and settlement of filter pack.
- Do not use water to settle the filter pack.
- Pour bentonite grout rather than pellets or chips down the annulus on top of the filter pack, if possible. Hydrating bentonite pellets or chips is not a preferred method when installing soil vapor wells. The bentonite grout should be placed rapidly to prevent swelling and bridging around the tubing. The bentonite should be allowed to hydrate for at least 15 minutes before backfilling remaining annulus to ground surface.
- Install the monitoring manhole cover so that at least 2 feet of its length is embedded in the below the ground surface, if possible. Place sand over bentonite and in between the well cover and casing.
- Pour a concrete pad approximately 3 feet in diameter around the base of the monitoring manhole cover. The concrete pad should be sloped away from the manhole cover to allow flow away from the well.
- Mark the inside of the manhole cover with the soil vapor monitoring well ID. Install the valve to the top of the tubing casing install a locking device to prevent unauthorized entry or vandalism to the well.

DOCUMENTATION

Field Personnel overseeing drilling and installation activities are responsive for the documentation of well installation. Field personnel will document well installation activities on a Soil Vapor Well Construction Form. The following information should be recorded during well installation activities:

- Project name and number
- Borehole and soil vapor well ID
- City and state
- Township/Range/Section
- Northing and easting
- Date and time well installed
- Drilling company, rig and method
- Surface seal type
- Locked? Yes or no
- Depth to bottom of concrete
- Depth to top of screen and bottom of screen
- Total length of Teflon Tubing and screens
- Depth to top of filter pack (if applicable)
- Depth to top of bentonite seal
- Depth to top of fine sand material (if applicable)
- Depth to top and bottom of screen
- Total depth drilled

REFERENCES

ASTM International, ASTM Standard D 5314-92 (2001) *Standard Guide for Soil Gas Monitoring in the Vadose Zone*. 2001

SOP 701 – QUALITY CONTROL SAMPLING

PURPOSE

Outline the quality control samples to be collected in the field

GOAL & OBJECTIVE

To ensure quality control samples are collected along with natural samples to validate laboratory results

Quality Control (QC) samples are submitted along with natural samples to provide supporting laboratory data to validate laboratory results. QC field samples are submitted blind to the laboratory with the exception of trip blanks. In general, field equipment blanks and duplicate samples should be collected during every sampling event.

Duplicate samples should be collected at a frequency of one sample for every 20 natural samples. Check the project-specific work plan before going to the field to determine what QC samples are required for the sampling event, and at what frequency QC samples should be collected.

With the exception of trip blanks, QC samples are prepared in the field. Trip blanks are supplied by the laboratory and will accompany each sample cooler containing samples for analysis of volatile organic compounds (VOC). Trip blanks provide data to evaluate whether the samples were affected by organic compounds during transport to the laboratory. Matrix spike and matrix spike duplicates (MS/MSD) are generated by submitting three duplicate samples from the same sample to the laboratory. The laboratory spikes two of the three samples with known concentrations of select target compounds, and all three are analyzed to evaluate the accuracy of the analysis.

The most common QC samples are shown in the table below:

MOST COMMON QUALITY CONTROL SAMPLES	
SP - Split Sample	A portion of a natural sample collected for independent analysis; used in calculating laboratory precision
D - Duplicate Sample	Two samples taken from the same media under similar conditions; also used to calculate precision
FB - Field Blank	Deionized water collected in sample bottle; used to detect contamination introduced during the sampling process.
RB - Rinsate Blank	Deionized water run through or over decontaminated equipment; used to verify the effectiveness of equipment decontamination procedures
MS/MSD – Matrix Spike/ Matrix Spike Duplicate	Certified materials of known concentration; used to assess laboratory precision and accuracy
TB - Trip Blank	Inert material (deionized water or diatomaceous earth) included in sample cooler; sent by the lab, the sample is used to detect any contamination or cross-contamination during handling and transportation.

QC sample collection frequencies are presented in the table below. Each field crew leader will be responsible for all QC samples prepared by that crew.

QC SAMPLE	PURPOSE	COLLECTION FREQUENCY
Field Duplicate	Measure analytical precision.	1 per every 20 samples
Matrix Spike/Matrix Spike Duplicate	Measure analytical accuracy.	1 per every 20 samples
Equipment Rinse Blanks	Evaluate effectiveness of equipment decontamination and sample handling procedures.	1 per sampling event per media
Field Blank	Assess possible cross- contamination of samples due to ambient conditions during sample collection.	1 per sampling event
Trip Blanks	Evaluate sample preservation, packing, shipping, and storage.	1 per sampling event with volatile constituents

EQUIPMENT

- Field Forms and Field book
- Chain-of-Custody Forms

SAMPLING ACRONYM	LABEL
EB	Equipment Blank
TB	Trip Blank
FB	Field Blank
MW	Monitoring Well
DW	Domestic Well
IW	Injection Well
OB	Observation Well
UST	Underground Storage Tank
VE	Vapor Extraction
AA	Ambient Air
SUMP	Sump (Water sample)
POND	Ponds
SPR	Spring
LAKE	Lake
SW	Surface Water, Stream or River
SR	Surface Runoff
TP	Excavated Test Pit
SS	Surface Soil Sample
SBSS	Subsurface Soil Sample
GW	Groundwater Sample

SAMPLE CUSTODY PROCEDURES

The field person is responsible for custody of the samples at all times until transferred or shipped to the laboratory using a chain-of-custody form. The chain-of-custody form will be completed for all samples collected in the field for laboratory analysis and copies will be maintained in the project file. The information to be included on the chain-of-custody form will include, but is not limited to:

- Project number/Site name
- Sampler's name and signature
- Date and time of sample collection
- Unique sample identification number or name
- Number of containers
- Sample media (e.g., soil, water, vapor, etc.)
- Sample preservative (if applicable)
- Requested analysis
- Comments or special instructions to the laboratory

Each sample will be assigned a unique sample identification number as described above in WGM SOP-3. The information on the chain-of-custody form, including the sample identification number, will correspond to the information recorded by the sampler on the field forms and field log book and the label on the sample container.

When custody of a sample is relinquished by the sampler, the sampler will sign and date the chain-of-custody form and note the time that custody was relinquished. Samples must be shipped to the analytical laboratory following the procedures described in in SOP-4. Notify the analytical laboratory of shipment and request pick up and receipt of delivery. The project manager will determine if proper custody procedures have been followed upon review of field activities, and audits may also be conducted by the client or appropriate regulatory agency.

EQUIPMENT

- Indelible Ink Pen
- Chain-of-Custody Forms
- Field Note Book
- Field Sampling Forms

SOP 702 – EQUIPMENT DECONTAMINATION

PURPOSE

Provide guidelines for decontamination procedures of field sampling equipment.

The following actions should be performed to decontaminate field sampling equipment:

- Set up a decontamination area upwind from your sampling area to reduce the potential for windborne contamination.
- Prior to initiating decontamination, inspect equipment and use stiff brush to remove visible material.
- Decontaminate each piece of equipment following a sequential process of washing with phosphate-free soap or an equivalent degreasing detergent; rinsing with distilled water; rinsing with 10% dilute nitric acid (or methanol if sampling for organics); and finally rinsing with distilled water three times.
- Decontaminated equipment should be wrapped in inert material if not used immediately.

All disposable items (e.g., paper towels, latex gloves) should be deposited into a garbage bag and disposed of in a proper manner. Handling and disposal procedures for the rinse and wash water will depend on the presence of contaminant in the wash water. The decontamination wash water will be containerized and disposed of in accordance with the site-specific sampling and analysis plan and/or state and federal regulations.

EQUIPMENT

- Tubs or 5-gallon buckets
- 10% nitric acid
- Spray bottle with 10% methanol or denatured alcohol
- Non-phosphate soap
- Brushes
- Garbage bags
- Disposable gloves (nitrile or latex)
- Paper towels

The amount of distilled water needed on Site will depend on the number of samples to be collected and the sampling methods. For this reason, you should evaluate the need prior to going in the field.