



AJM, Incorporated

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A Full Service Environmental Company

June 21, 2024

Paul Townsend
Town Pump, Inc.
P.O. Box 6000
Butte, MT 59702

William Bergum
Montana Department of Environmental Quality
Petroleum Release Section
PO Box 200901
Helena, MT 59620-0901

RE: Remedial Investigation Work Plan Required for the Petroleum Release at the Town Pump 10, 901 North Excelsior Avenue, Butte, Silver Bow County, Montana; Facility ID 47-08687 (TID 28458), Release 6653, Work Plan 34871

Dear Mr. Bergum:

Per your letter dated May 1, 2024 to Town Pump Inc., AJM Inc. has prepared the following work plan to address the scope of work detailed below:

- Investigate the southwest portion of the property to determine the source of the petroleum contamination encountered.
- Validate all laboratory analytical data using DEQ's Data Validation Summary Form (DVSF) found online under the Guidance dropdown at the PTCS webpage1.
- Discuss ongoing WP tasks and results with DEQ's project manager; submit written agreed-upon WP modifications as required to complete the WP objectives.
- Prepare a Release Closure Plan (RCP); discuss results with DEQ's project manager. DEQ expects the RCP completion to cover the Release investigation information. Use the RCP format found online under the Guidance dropdown at the PTCS webpage1.
- Prepare and submit a Remedial Investigation Report detailing the results of the investigation. The RI Report must include all format sections outlined under the RI Guidance document. Include a brief explanation for each section that had no work conducted or information collected, and include the following: Laboratory analytical data, the completed DVSF, and completed RCP.
- Use standardized DEQ WP and report formats found under the Guidance dropdown at the PTCS webpage1.
- Submit WP and reports electronically following the PTCS submittal requirements found online under the Guidance dropdown at the PTCS webpage1.

Facility History/Release Background

The facility is located at 901 North Excelsior Ave in Butte, Montana 59701. The site is further described as being at the corner of Excelsior and Waukesha. A legal description for the site is SW1/4, SE1/4, Section 11, Range 8 West, Township 3 North. The Town Pump Excelsior Butte #10 location is an active

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fuel station with 2 underground storage tanks (USTs) one storing unleaded gasoline with 10k capacity and another with premium gasoline with 4k capacity located south of the store. There is one fuel pump dispenser island located between the store and Excelsior Ave.

Release 3441 was previously investigated under Work Plan 34567 and determined that a separate release occurred from the UST basin area south of the store, resulting in an additional release number. The work completed under WP 34567 included damaged well deconstruction, new well installation, and two groundwater sampling events. Results from this investigation supported the need for more investigation south and southeast of the tank basin, due to the levels of volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH) exceeding Montana risk based screening levels (RBSLs)

Summary of Facility Conditions

Surface conditions at this location include concrete and asphalt cover. The soil characteristics have been investigated using a geoprobe in 2022 and determined the soil to consist of sandy gravel to 5ft below ground surface (bgs), sand with clay and silt to 10ft bgs, a sandy clay mix with gravel from 10-13ft bgs, and a decomposed granite layer at 13ft bgs. During the 2022 remedial investigation, the geoprobe was unable to be extended to 20ft bgs in all soil borings to install the monitoring wells due to the difficulties drilling into granite geology. Groundwater occurs at around 10ft bgs. All municipal water in this area is sourced from the City of Butte, no known groundwater wells nearby are used for potable drinking water. The nearest wells are monitoring wells installed on the property (See attached map for locations).

Objective of Investigation

The objective of this remedial investigation is to determine the extent and magnitude of the impacted groundwater from the UST basin south of the Town Pump store. To meet this goal, AJM plans to install, develop and sample three monitoring wells. Wells will be installed using an air rotary rig to ensure that depths can be reached when drilling into difficult granite geology. Once the wells are installed to 20ft bgs, they will be developed and sampled for petroleum hydrocarbon constituents specified by the Montana DEQ.

Minimum Work Plan Tasks

The minimum tasks to complete this work plan include constructing three monitoring wells, developing new monitoring wells, and sampling monitoring wells near the UST basin (total 4 wells). All associated costs can be found in the attached cost estimate and PTRCB groundwater monitoring work sheet (Appendix C).

Monitoring Well Installation

To better understand the existing hydrocarbon plume near the UST basin, AJM proposes installing 3 monitoring wells (MW-5, MW-6 and MW-7) downgradient from the underground storage tanks (UST). Using an air rotary drill rig, points will be drilled to a depth of 20 feet below ground surface (bgs).

Boreholes will be drilled to 20 feet bgs in the approximate locations shown on Figure 1 and monitoring wells will be constructed as follows:

- Slotted 2-inch flush-threaded casing with 0.02 slot from 20 to 5 feet bgs;
- Solid flush-threaded casing from 5 to 1 foot bgs;
- 10/20 Colorado silica sand from bottom of borehole to 4 feet bgs;
- Bentonite from 4 to 2 feet bgs;
- 8" steel well box cemented in place;

- Locks and locking caps will be placed on each well;
- Wellhead elevation survey for these new wells will be completed to determine accurate groundwater direction and gradient flows.

Soils cuttings from collected from the construction of the three monitoring wells will be sampled and stored on site in 55 gallon drums until the soils can be properly disposed of at the local landfill.

Well Development

To develop a well, water will be surged and purged using a 12volt purge pump until turbidity is significantly reduced. Purge water will be stored in 55gal poly drums provided by Town Pump. The drums will remain on site, in an accessible location, until Emerald Service has profiled the drums and safely remove the purge water.

Groundwater Sampling

Groundwater sampling shall be conducted according to the AJM's Quality Assurance Project Assurance Project Plan (QAPP) and AJM standard operating procedures (SOPs). VPH and EPH samples will be collected from all new monitoring wells and MW-4. Sampling will be conducted semi-annually for one year during high and low groundwater elevation which have historically been high during spring/early summer, and low during fall/early winter.

Prior to sample collection, depth to water at every well point will be collected for potentiometric evaluation. Groundwater purging and sampling shall be completed with a peristaltic pump using low flow techniques as outlined in the DEQ Groundwater Sampling Guidance Document. A flow through chamber will be used during purging and a YSI meter will be used to measure temperature, dissolve oxygen, pH, ORP, and conductivity. Once the above parameters have stabilized, sampling will be completed. In the event that monitoring wells cannot produce enough water and sustain a strong enough recharge for low flow stabilization, then a sample will be collected without stabilization data. The samples will be sent under chain of custody to an accredited laboratory for analysis of EPH and VPH. Groundwater will be disposed of in according to the Disposal of Untreated Purge Water from Monitoring Wells flowchart found under the Guidance dropdown at the PTCS webpage¹.

After initial groundwater results are obtained, the DEQ and client will be informed of results. An assessment will be made regarding further remedial action for the site. If additional corrective action is determined, a written document for action will be submitted to DEQ for approval as applicable.

Reporting

The first groundwater monitoring event and well construction, a Remedial Investigation Report will be completed and will include details from well installation, soil boring logs and well construction diagrams, and cumulative groundwater results. This report will follow format found under the Guidance dropdown at the PTCS webpage and include monitoring results recommendations and conclusions. In addition, the following reports will be completed and sent to DEQ:

- Data Validation Report using the data validation summary form (DVSF) found at the online DEQ web site;
- Release Closure Plan (RCP) in accordance with DEQ Forms/Guidelines

Following the second monitoring event, an Interim Data Submittal will be completed. Appropriate data will be incorporated into tables and maps and the report will contain discussion of results along with conclusions and recommendations.

With approval from the client and DEQ, the above work will likely begin in the fall 2024 with a final sampling and reporting in the Spring of 2025. Please do not hesitate to call if there are any questions or if we can provide any additional information.

Sincerely,

Lars Heinstedt

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William Bergum, WBergum@mt.gov

Appendix A
Figure 1 – Site Location
Figure 2 – Site Map

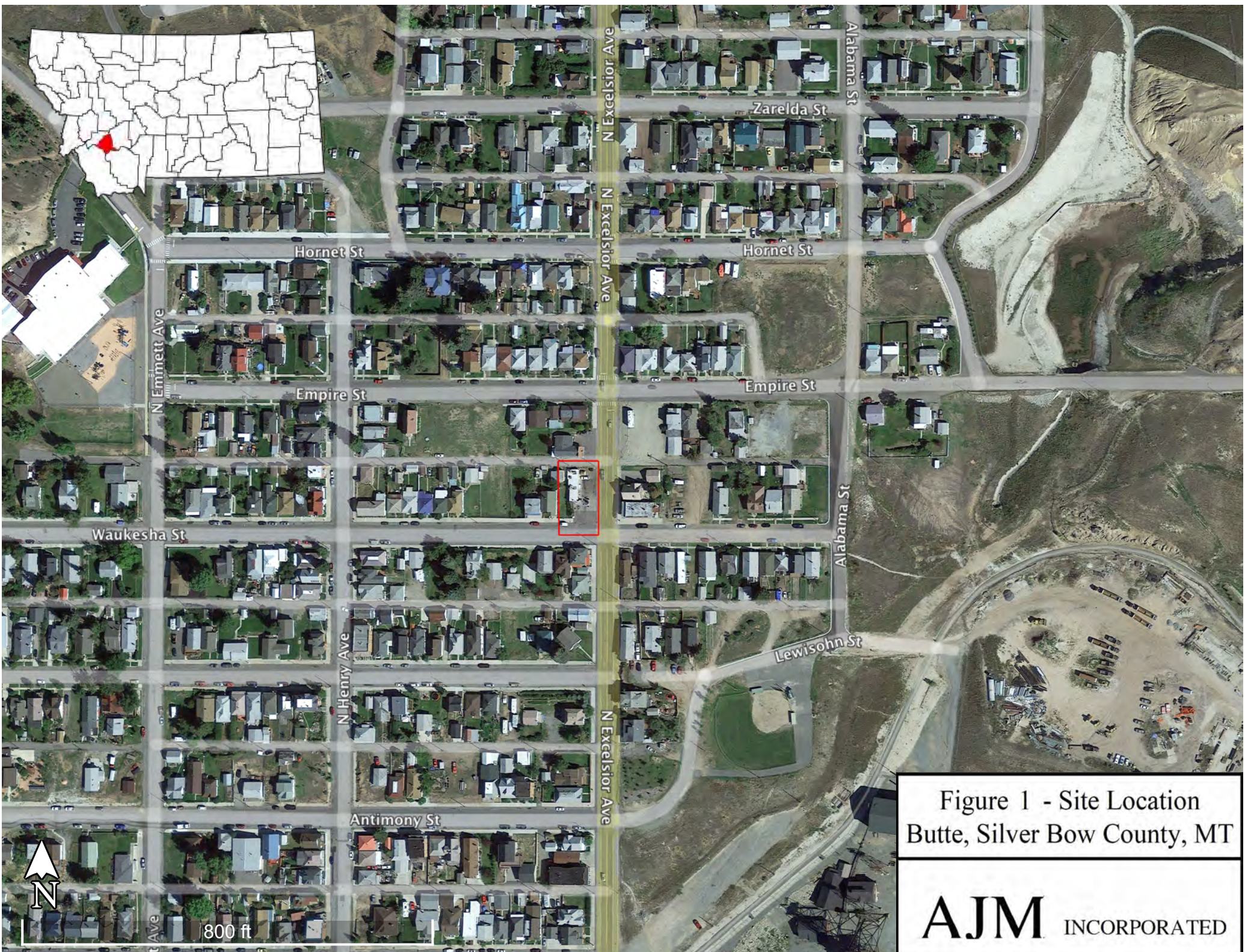
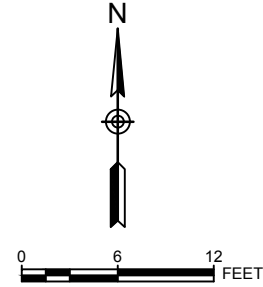
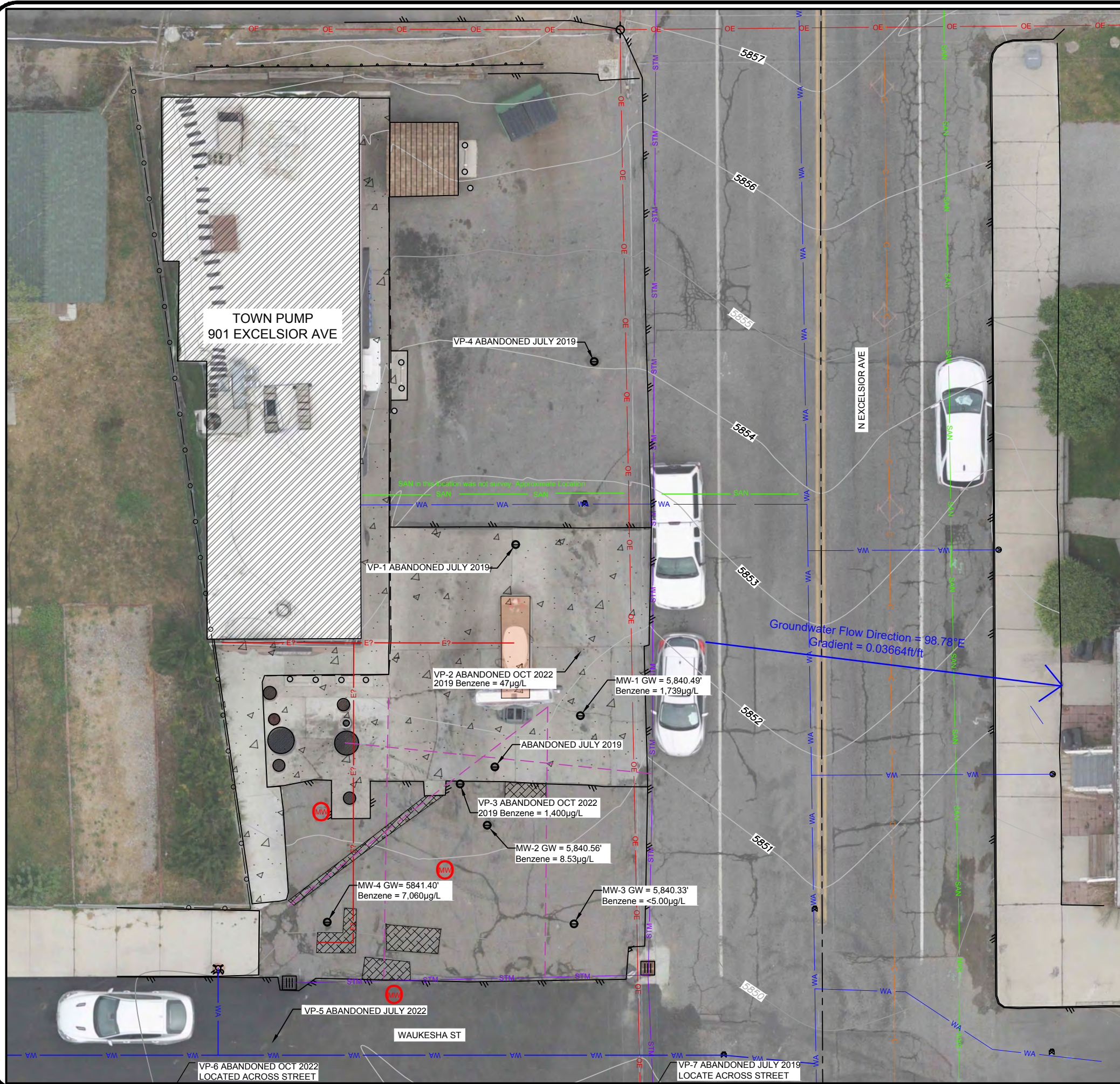


Figure 1 - Site Location
Butte, Silver Bow County, MT

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M:\AJMM01-Excel TownPump\CAD\SURVEY\MV-BM01-AJMM01.dwg PLOT DATE 2022-1-6 15:28 USER: sfrazee



LEGEND

	OE	OVERHEAD ELECTRIC LINES		UTILITY POLE
	WA	WATER LINES		STORM DRAIN INLET
	SAN	SANITARY SEWER LINES		WATER VALVE
	STM	STORM DRAIN LINES		WATER HYDRANT
	C	COMMUNICATION MARKED		CURB STOP
	E?	UNDERGROUND ELECTRIC (APPROXIMATE - NO SURVEY)		BOLLARD
		UNKNOWN UNDERGROUND UTILITY (APPROXIMATE - NO SURVEY)		MONITORING WELL
		FENCE LINE		FUEL TANK
		ROAD CENTER LINE		FUEL PUMP
		EDGE OF ASPHALT		ASPHALT PATCH
		EXISTING CONTOURS		SITE CONCRETE
	MW	PROPOSED MONITORING WELL 2024		EXISTING BUILDING
				EXISTING SHED

NORTHING	EASTING	TOC ELEV	DESCRIPTION
407338.15	263710.28	5864.32	CM-FND-ROW
407119.55	263624.01	5849.49	MW-4 TOP OF CASING
407119.35	263652.60	5849.71	MW-3 TOP OF CASING
407130.78	263642.55	5850.90	MW-2 TOP OF CASING
407143.48	263653.34	5851.30	MW-1 TOP OF CASING

SURVEY NOTES:

- UTILITIES SHOWN ARE BASED ON AVAILABLE RECORD DRAWINGS AND UTILITIES LOCATED BY ELECTRONIC METHOD IN THE FIELD. NO GUARANTEE IS GIVEN OR IMPLIED AS TO THE ACCURACY OF LOCATIONS PROVIDED OR THAT ALL UTILITIES ARE SHOWN. ALL UTILITY LOCATIONS ARE SUBJECT TO THE ACCURACY OF THE LOCATION METHOD, AND SUBJECT TO RELOCATION PRIOR TO ANY CONSTRUCTION ACTIVITIES. NO EXCAVATION WAS PERFORMED TO VERIFY UTILITIES. CONTRACTOR RESPONSIBLE FOR VERIFICATION OF LOCATION AND DEPTH OF ALL UTILITIES PRIOR TO CONSTRUCTION.
- NO BOUNDARY SURVEY WAS CONDUCTED AS PART OF THIS PROJECT. ALL BOUNDARY LINES SHOWN WERE APPROXIMATED FROM RECORDS AND/OR MONTANA STATE LIBRARY CADASTRAL FRAMEWORK. BOUNDARY LINES ON THIS MAP DO NOT REPRESENT A LEGAL SURVEY AND SHOULD BE CONSIDERED APPROXIMATE. THESE BOUNDARY LINES ARE TO BE USED FOR GENERAL REFERENCE ONLY. NO LIABILITY IS ASSUMED BY WET FOR THE ACCURACY OF THESE BOUNDARY LINES.

BUTTE-ANACONDA LDP SURVEY NOTES:

- VERTICAL DATUM: NAVD88 GEOID 12B
- LINEAR UNIT: INTERNATIONAL FEET (IFT)
- GEODETIC DATUM: NORTH AMERICAN DATUM OF 1983
- PROJECTION: TRANSVERSE MERCATOR
 LATITUDE OF ORIGIN: 46° 00' 00" N
 LONGITUDE OF CENTRAL MERIDIAN: 112° 48' 00" W
 FALSE NORTHING: 400,000.00 IFT
 FALSE EASTING: 200,000.00 IFT
 SCALE FACTOR AT ORIGIN: 1.00026
- COORDINATES ARE SHOWN IN UNITS OF INTERNATIONAL FEET UNLESS INDICATED OTHERWISE.

IMPORTANT NOTES:
 UNKNOWN UNDERGROUND UTILITIES WERE NOT SURVEYED. THESE WERE APPROXIMATED USING MAPS AND PHOTOS PROVIDED BY THE CLIENT DEVELOPED AT THE TIME OF MONITORING WELL INSTALLATION.
 AERIAL PHOTO TAKEN 09-14-2022

No.	Description	Date	Drawn By

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TOWN PUMP BUTTE #10 2022 SITE MAP
 PROJECT NAME: TOWN PUMP MONITORING WELLS
 LOCATION: BUTTE, MONTANA
 FILE NO.: MV-BM01-AJMM01.dwg

JOB NO:	AJMM01
DATE:	6/12/23
DRAFTER:	JH
CHECKED BY:	SF

SHEET
FIG2

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Appendix C
AJM Standard Operating Procedures

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STANDARD OPERATING PROCEDURES (SOP)

AJM, Inc.

Submitted to:

Prepared & Submitted by:

AJM Inc.
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Bozeman, Montana 59715-4644
(406) 600-2045

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1.0 PROGRAM DESCRIPTION

1.1 Background

The Montana Leaking Underground Storage Tank (LUST) Program is administered in accordance with a 1986 amendment to the Resource Conservation and Recovery Act (RCRA). Congress amended RCRA to provide federal funds to clean up petroleum leaks and spills from underground storage tanks (USTs). The Montana Department of Environmental Quality (MDEQ) has authorization to administer the Montana LUST Program.

1.2 Objectives

The Montana LUST Program was established to identify and abate hazards to public health and safety, and the environment, resulting from UST system releases. The primary statutes and rules governing the operation of this program include: (1) the Montana UST Rules for Tank Management and Operation - Administrative Rules of Montana (ARM) Title 17, Chapter 56; (2) the Montana UST Installation and Permitting Act - 75-11 Montana Code Annotated (MCA); (3) the Montana Hazardous Waste Management and UST Act - 75-10-4 and 75-11-2 MCA; (4) regulations pertaining to the Petroleum Tank Release Compensation Board (PTRCB) contained in 75-11-3 MCA, ARM Title 17, Chapter 56 and all applicable federal laws.

State regulations require the implementation of a corrective action process (CAP) by an owner/operator (O/O) when a confirmed or suspected release has been reported to the MDEQ. This CAP addresses both field investigation and cleanup activities at a leaking tank and other environmental clean-up or sampling sites and requires work plan approval from the MDEQ (and the PTRCB, if these funds are involved) prior to conducting investigation and remediation.

The AJM Environmental Inc. Standard Operating Procedure (SOP) will guide all data collection activities required for field investigation.

1.3 Standard Operating Procedure Requirements

The Environmental Protection Agency (EPA) and MDEQ policy requires all field investigation activities be conducted within the guidelines of a centrally managed, comprehensive quality assurance (QA) program. This requirement applies to all environmental monitoring and quantification efforts mandated or supported by the lead agency or their contractors.

This SOP provides the policies, organization, objectives, functional activities, and specific QA and quality control (QC) activities designed to ensure that quantitative results of sample collection and analysis for program sites are representative and defensible. This SOP was prepared using remedial investigation guidance promulgated by the MDEQ and is designed to be

a stand-alone, working document which addresses field QA/QC procedures, laboratory QA/QC programs, and data documentation, validation, and tracking procedures.

AJM Inc. has the responsibility for implementing the procedures within the SOP to ensure that the precision, accuracy, completeness, representativeness, comparability, and defensibility of data is known and documented, whether collected by our field team or under their direction. This SOP has also been designed to ensure that this responsibility is met uniformly throughout the remedial investigation of any site, regardless of time or location of work plan execution.

Project quality rests with every person involved; however, primary responsibility for project quality rests with the AJM Project Manager (PM) and appropriate State of Montana project personnel. Where quality assurance problems or deficiencies requiring special action are uncovered, the PM will consult the various QA personnel in order to identify the appropriate corrective action(s). The PM will then be responsible for implementing corrective action(s) after concurrence is reached with appropriate State of Montana staff.

2.0 QUALITY ASSURANCE OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements which provide a means of control and review of data and to promote collection of representative site data. DQOs are expressed in terms of precision, accuracy, representativeness, completeness, and comparability objectives (PARCC). QC samples are collected in addition to the field samples and are used in conjunction with laboratory QC samples to evaluate the quality of the data produced from the field sampling program. QC samples serve to meet the DQOs by meeting the laboratory's established acceptance criteria. QC samples that do not meet the criteria may serve as indicators of unacceptable data resulting in the implementation of corrective action procedures or in the data being qualified.

2.1 Data Required

Analytical results for organic chemicals in water will be reported in micrograms per liter ($\mu\text{g/L}$), and in micrograms per kilogram ($\mu\text{g/kg}$) for solid matrices (soil, sludge, etc.). Inorganic chemical analytical results for both aqueous and nonaqueous media will be reported in milligrams per liter (mg/L). All analytes tested for will be reported in units typical of the lab and or regulatory standards. Section 6.0 discusses analytical methods for required analyses.

2.2 Detection Limits

Appropriate QA/QC methodologies, standard operating guidelines (SOGs) and procedures (SOPs) will be employed to provide accurate and concise results by utilizing method blanks and matrix spikes/matrix spike duplicates (MS/MSD).

Table 2-1 contains a list of typical analytes and their detection limits.

2.3 PARCC Criteria

Critical indicators of project data quality are precision, accuracy, representativeness, completeness, and comparability. The following sections discuss the data quality objectives for each of these indicators.

2.3.1 Precision

Precision is the degree of mutual agreement between individual measurements of the same property under prescribed similar conditions. Data precision is a function of field sampling precision and laboratory analytical precision. Precision requirements for samples analyzed by an analytical laboratory will be evaluated by collecting and analyzing field duplicates at a frequency of one per 20 samples (5 percent) for soil samples. In addition, analytical precision will be evaluated when budget allows by analyzing one matrix spike (MS) and one matrix spike

duplicate (MSD) per 20 samples (5 percent) for organic analyses, and one matrix duplicate per 20 samples (5 percent) for inorganic analyses. Table 2-2 describes the relationship between the number of samples collected and the number and type of QA/QC samples required.

The results of the duplicate analyses are used to calculate the relative percent difference (RPD), which is used to evaluate precision:

$$\text{RPD} = (|A - B| / ((A + B) / 2)) \times 100\%$$

Where: A = first duplicate concentration
B = second duplicate concentration

The precision of field measurements will be evaluated based on the results of field duplicate measurements. At least 10 percent of the field measurements for water samples will be obtained in duplicate, and the results will be compared with the established precision goals listed in Table 2-3.

In evaluating RPD results, there are four factors that may affect the precision of the field duplicates: matrix interferences, laboratory imprecision, sample heterogeneity, and the nature of the RPD calculation. Matrix interferences are caused by chemical constituents present in the field sample that interfere with the accurate quantification of the target analytes. Laboratory imprecision is a result of laboratory inconsistency in the preparation and analysis of the samples. Sample heterogeneity of soil samples is inherent because of the difficulty in collecting homogenous field samples. For extremely low or high concentrations detected in the duplicates, the RPD calculation results in high variances that do not represent the precision of the results. If precision results do not meet the acceptance criteria, and it is determined that matrix interferences or laboratory imprecision is the cause, the data will be qualified as estimated.

2.3.2 Accuracy

Accuracy is the degree of agreement between an analytical measurement and a reference accepted as true value. The accuracy of a measurement system is impacted by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques. Sampling accuracy will be evaluated based on the results of the analysis of field blanks including trip blanks, equipment rinsate blanks, and source water blanks. To evaluate laboratory accuracy, a program of sample spiking will be conducted by the analytical laboratory. This program includes the analysis of MS/MSD samples, laboratory control standards (LCS) or blank spikes, surrogate standards, and method blanks. MS/MSD samples analyses will be performed at a frequency of 5 percent and LCS or blank spike analyses at a frequency of 5 percent. Surrogate standards, where available, will be added to every sample analyzed for organic constituents. The results of the spiked samples are used to calculate the percent recovery for evaluating accuracy.

$$\text{Percent Recovery} = ((S - C) / T) \times 100\%$$

Where: S = measured spike sample concentration
C = sample concentration
T = true or actual concentration of the spike

Accuracy results which are not within the acceptance range will be further evaluated on the basis of other QC samples. Field and laboratory blanks will be evaluated for accuracy based on the criteria that appear in Section 7.0.

2.3.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population, parameter variations at a sampling point, or an environmental condition they are intended to represent. Representative data will be obtained through careful selection of sampling sites and analytical parameters. They will also be obtained through the proper collection and handling of samples to avoid interferences and minimize contamination and loss. Representativeness of data will be verified through the use of established field and laboratory procedures and their consistent application. To aid in the evaluation of the representativeness of the sample, field and laboratory blank samples and background samples will be evaluated for the presence of contaminants. Data determined to be nonrepresentative by comparison with the existing data will be used only if appropriate qualifiers and limits of uncertainty accompany the data.

2.3.4 Completeness

Completeness is a measure of the percentage of project-specified data that is valid. Valid data is obtained when: (1) samples are collected and analyzed in accordance with the QC procedures outlined in this SOP and (2) none of the QC criteria that affect data quality are exceeded. The project completeness value will be determined at the conclusion of the data validation phase. Completeness will be calculated by dividing the number of valid sample results by the total number of sample analyses. The data completeness goal is established at 100 percent, since small quantities of widely dispersed (spatially and temporally) samples will be frequently collected.

2.3.5 Comparability

The comparability objective determines whether analytical conditions are sufficiently uniform for each analytical run to promote consistency among the reported data. This requires adherence to the specified analytical methodology and to the laboratory and field procedures. Additionally, comparability is promoted through the use of standard units of measurements in reporting analytical data.

TABLE 2-1
 DETECTION LIMITS FOR TARGET COMPOUNDS

PARAMETER	DETECTION LIMIT (ppb) ^a	METHOD	INSTRUMENTATION ^c
VPH/EPH	1000	MDEQ-VPH MDEQ-EPH 8260B	GC
Purgeable Aromatic Hydrocarbons (PAH)	1	EPA 502.1, 503.1, and 602	GC
Volatile Organic Carbons (VOC)	10	EPA 601, 624	GC/MS and GC
Base/Neutral and Acid Extractable Organics	10	EPA 604, 606, 609, 610, 612, and 625	GC/MS and GC
PCB/Pesticides	10	EPA 608/505	GC
Metals	^b	EPA 200 Series	ICP or AA
Hazardous Waste Characteristics (TCLP, Ignitability, Corrosivity, and Reactivity)	varies	Ref. SW-846	varies
MBTEX	0.5 ppb Water 0.2 ppm Soil	EPA 602/8020	GC

Notes:

^a Optimum detection excluding interfering compounds

^b Varies depending on target metal

^c GC - gas chromatograph
 GC/MS - gas chromatograph/mass spectrometer
 ICP - inductively-coupled plasma
 AA - atomic adsorption

VPH & EPH can also be analyzed using MA-VPH & SW8015M respectively. Many other compounds not listed will be analyzed using standard industry accepted laboratory methods.

TABLE 2-2
FIELD SCREENING SAMPLES UNDERGOING LABORATORY CONFIRMATION

# of Field Samples	Laboratory Confirmation Samples	MS/MSD Samples	Duplicate Samples
1-20	2	1	1
21-40	4	2	2
41-60	6	3	3
61-80	8	4	4
81-100	10	5	5

TABLE 2-3
PRECISION GOALS FOR FIELD PARAMETERS

Parameter	Precision
pH	± 0.1 unit
Specific Conductance	$\pm 10 \mu$ mhos/cm
Temperature	$\pm 1^\circ$ C
Water Level	± 0.01 foot
Dissolved Oxygen Meter	± 0.3 mg/L
Turbidity	1 NTU

3.0 SAMPLING PROCEDURES

Sampling activities could include the collection of surface soils, subsurface soils, sediment, and ground water samples. Samples will be recovered by a variety of drilling and sampling methods, placed in containers appropriate for the intended analyses, preserved as necessary, labeled and sealed according to established AJM procedures, and transferred under Chain-of-Custody (COC) protocol to a certified laboratory for analysis. All sample information will be written into a field log book by the field technician or field team leader at the time of sample collection. Table 3-1 summarizes sample containers, holding times, and preservative requirements for organic, inorganic, and petroleum hydrocarbon analyses. Section 4.0 addresses sample documentation and custody procedures, and Section 6.0 describes the analytical procedures that will be used to conduct site characterization.

The phased corrective action & sampling work plans will contain detailed information regarding specific sampling requirements for field investigations at the various sites. This information will be based on the following factors:

1. Site sampling rationale
2. Sampling techniques and equipment
3. Sample selection criteria
4. Sample documentation, handling, and shipment
5. Well installation design
6. Preparation and decontamination of sampling equipment
7. Waste characterization

The sampling procedures described in the following sections; however, outline specific protocol to be followed for each different environmental matrix in order to provide SOGs and SOPs that will ensure uniform sampling techniques regardless of the person(s) conducting the sampling.

General locations for surface sampling points, test pits, bore holes, and monitoring wells will be initially located using site plans, city/county maps, and/or topographic maps and documented by survey from an appropriate site benchmark. Sampling locations will be mapped to scale and recorded in a field log book. This information will then be transferred to the appropriate logs or profiles (to scale) for reporting purposes.

3.1 Soil Sampling

Prior to any sampling event, all sample equipment, lab containers and personal protective equipment (PPE) will be assembled near the sample area. Sample containers will be labeled prior to depositing sample contents.

3.1.1 Surface Sampling

Disposable scoops, depth-calibrated hand augers or shovels will be used to collect soils from the upper two feet of the soil horizon. Soil samples will be collected from the auger flight at the point corresponding to the required depth after the hand auger has been slowly removed from the bore hole. If necessary, a tube sampler can be attached to the auger rods after advancing the bore hole to the desired depth. The sample will be collected by inserting the tube sampler into the open bore hole and advancing the sampler into the deposits at the base of the boring. Whenever possible, individual, disposable trowels will be used for each sampling event. Otherwise, sampling equipment will be decontaminated prior to each use. For EPH samples, up to 5 soil samples can be composited in the field. With VPH samples, up to five individual samples will be collected and sent to the laboratory for composite. Additionally, a VPH grab sample using specialized lab soil syringes and pre-preserved (methanol) VOAs can be used. Decontamination procedures are outlined in Section 3.9.

3.1.2 Test Pit Excavation and Sampling

Test pits will be excavated in compliance with all applicable Occupational Safety and Health Act (OSHA) regulations, especially those regarding excavation and side-wall stabilization requirements. Walls will be cut as near vertical as possible to facilitate stratigraphic logging. Test pit dimensions will be recorded in a field log book.

Photographs of specific geologic features may be taken for documentation purposes. A scale or item providing a size perspective and the test pit number will be included in each photograph. The frame number and picture location will also be documented in the log book and printed on the back of the photograph.

Each test pit will be inspected visually, for odors, and with a Photoionization Detector (PID) to determine if soil and/or groundwater samples are necessary. Soil samples may be obtained from the backhoe bucket if test pit depth precludes safe entry. All test pits will be backfilled with excavated soil following inspection and/or sampling. Pits will be backfilled and compacted to original grade unless disposal of contaminated soil from the excavation is necessary. In such cases, DEQ landfarming requirements will be followed, and the excavation will be backfilled with clean soil.

3.1.3 Subsurface Sampling

Borings for monitor well completion are typically advanced by two methods, Geo-Probe and hollow stem auger. The casing will be of the flush joint or flush couple type and of sufficient size to allow for soil sampling, coring and/or well installation. All casing sections must be straight and free of any obstructions. Hollow stem augers or solid flight augers with casing may be used according to specific project requirements. Geo-Probe system use will be completed using typical protocols and poly lined split spoon sample procedures. The drilling method chosen will be site-specific based on past borings in the project area and the site's geological conditions.

When excessive cobble and boulder geologic conditions exist, an air rotary system will be used. However, due to the volume of air used to push the soil cutting from the borehole, sample integrity is compromised and laboratory samples will not be collected.

Representative subsurface soil samples will be obtained using a split spoon sampler advanced using the standard penetration test (SPT), which allows for the assessment of resistance within the deposits. Samples will be taken at a minimum of every five feet when using a hollow stem auger and every 3 feet when using Geo-Probe. The interval exhibiting the maximum PID reading will be selected for the collection of analytical samples. Discharge from air rotary cyclones, or cuttings from cable tool rigs or solid stem augers will be screened for volatile organic compounds (VOCs) using a PID and will be logged continuously. Split spoon samples taken at the saturated zone and elsewhere will be logged as determined necessary by changes in field conditions.

The split spoon sampler must be opened upon removal from the casing to expose the cored material. If material recovery is inadequate, further attempts must be made until the amount of material is of a sufficient quantity for the required sample size. The sampling device must then be decontaminated before the next sampling event (see Section 3.9).

In the event that gravel or other material prevents penetration by the split spoon, samples will be collected from the auger flights as the auger is retracted from the hole.

3.1.4 Compositing

Composite samples, if required, will be obtained by collecting an equal and sufficient amount of soil from each subsample location so that the final composite volume will provide enough sample for all required analyses. Stones and other hard inorganic objects, which are not likely to affect soil chemistry, will not be included in the samples.

Each composite subsample will have dedicated, disposable sampling equipment, i.e., glass or stainless steel bowls, polyethylene gloves, and Teflon scoops to prevent possible cross contamination. Soil subsamples collected for each composite will be deposited into a stainless steel mixing bowl. The soils will be commingled to represent a composite sample for that designated sample zone. Additionally, if samples are expected to contain materials with high vapor pressures, individual five point samples can be collected with the intent that the laboratory will conduct the composite within there facility.

3.1.5 Waste Management

When sampling in any specific area is complete, the sampling equipment will be placed in plastic bags and labeled according to the sampling area. All disposable sampling equipment will then be stored in appropriate drums/containers prior to disposal. Equipment from nonhazardous areas

will be disposed of as uncontaminated debris. Contaminated sampling equipment will be disposed of according to local, state and federal regulations.

3.2 Sediment Sampling

Sediment sample points within surface water systems will be selected based on topography, erosion, transportation, ground water discharge, and accumulation. Accumulation areas typically reveal better data as compared with erosion or transport areas because minimized stream bottom dynamics allow undisturbed sediment accumulation¹. Sediment samples taken from creeks will be extracted using a Shelby Tube (ST) or similar instrument.

A separate ST will be used for each sample location. This will eliminate the need for decontamination of the ST between sample areas. A one foot core sample, with a diameter of 2 inches, will be extracted and composited. The core sample will consist of the sediments at the water/sediment interface and extend to a depth of one foot. Four vertical slices, each of one-quarter inch thickness, equally distributed throughout the core, will be composited to represent a single composite sample. Stones and other hard inorganic objects, which are not likely to adsorb contaminants, will not be included in the samples.

The sediment subsamples collected from each specified sample point will be deposited into glass or stainless steel mixing bowls. The sediments will be commingled to represent a composite sample of the core.

Each sample area will have dedicated sampling equipment, i.e., glass or stainless steel bowls, polyethylene gloves, and teflon scoops and Shelby Tubes, to avoid possible cross contamination and the need for rinsate samples.

All disposable sampling equipment will be placed in plastic bags and labeled according to the sampling area. This equipment will then be stored in 85 gallon storage drums prior to disposal. Equipment used to collect samples which are shown to be non-hazardous will be disposed of as uncontaminated debris. Contaminated sampling equipment will be disposed of according to local, state and federal regulations.

3.3 Groundwater Sampling

The installation and sampling of groundwater monitoring wells will be performed according to established procedures which are designed to produce consistency between well locations. These specifications and procedures ensure meaningful analytical results and a high degree of quality in monitor well performance. In all cases both the MDEQ QAP and or the AJM SOP will be used.

3.3.1 Groundwater Monitoring Well Installation

Wells will be drilled to a minimum depth of ten feet below the lowest seasonal groundwater elevation. Borings will be logged for lithology and monitored for petroleum hydrocarbon vapors using a PID. Figure 3-1 depicts an example of a typical boring log. Cuttings from five foot intervals (modified by specific site conditions) will be placed in clean glass jars covered with aluminum foil where any VOCs will be allowed to equilibrate with the headspace air prior to PID analysis. Any headspace samples exhibiting a PID reading of 100 ppm or more may be analyzed for Volatile Petroleum Hydrocarbons (VPH) and/or Extractable Petroleum Hydrocarbons (EPH) depending on contamination suspected at facility. All drilling equipment in contact with soil that will be re-used on the project will be steam cleaned immediately after each well completion.

The well screen will consist of two or four inch diameter, flush-threaded, slotted Schedule 40 polyvinyl chloride (PVC) pipe set from one foot off the bottom of the boring to five feet above the highest anticipated water table elevation. Slot size will vary dependent on site conditions. The PVC riser will extend three feet above ground surface. Silica sand ("Colorado") will be used to fill the annulus around the well screen from total depth to approximately one foot above the highest screened interval. Sand size will be site specific and will be in accordance with screen size. Bentonite chips will be used to seal the well above the screened casing for no more than five feet above the sand pack or to within two feet of the ground surface. Bentonite will be fully hydrated once it is placed in the well bore. A locking well cover will then be cemented in place using Portland cement. Typically, the well head vaults will be finished at grade; however, wells in remote locations will include well covers which extend three to four feet above the ground surface. An as-built record of well construction will be completed on the boring log. Figure 3-1 illustrates the construction of a typical groundwater monitoring well.

3.3.2 Monitoring Well Development

All monitoring wells will be allowed to equilibrate for 48 hours after construction. The wells will then be developed by continuous pumping, surging, or air lift methods until visibly clear water is discharged during the active portion of well development and at least two of the four field parameter (pH, conductivity, dissolved oxygen (DO) and temperature) measurements stabilize.

3.3.3 Monitoring Well Sampling

All groundwater monitoring wells will be sampled after a 72-hour stabilization period following well development.

All equipment that is used for purging, sampling, or depth measurement will be decontaminated with an Alconox wash solution followed by a distilled water triple rinse prior to each use.

A groundwater sampling log will be completed for each sampling event. See Figure 3-3 for an example of a typical groundwater monitoring well sampling log.

The following procedure will be followed when sampling a groundwater monitoring well:

1. The depth-to-water will be measured using a clean electronic water sounder. Measurement datum is the top of the well casing, north side. Measurement device will be decontaminated between wells.
2. Depth to the bottom of the well will be measured by an electronic water sounder. If possible, this will be compared to the well construction log to determine inconsistencies, i.e. damaged casing, sediment in casing, etc. Measurement device will be decontaminated between wells.
3. A pre-purge sample will be collected if necessary using a disposable bailer to visually inspect for free phase hydrocarbons. The pre-sample purge will consist of pumping water through a flow through cell until steady state conditions within the screened interval has been reached based on pH, conductivity, DO, temperature, ORP and turbidity. Peristaltic pump (PP) or a small diameter submersible pump (SP) with flow controllers will be used to purge the wells. This pump will be decontaminated between wells, dedicated HDPE tubing in each well (for PP or SP) will be used for each well. The volume purged and the field measurement data will be recorded using a well sampling data sheet, Figure 3-2.
4. A clean pair of disposable nitrile gloves will be worn during each phase of the well sampling activities. (Sampling via micro-purging with a dedicated pump will be considered on a site specific basis.)
5. Groundwater samples collected for dissolved metal analyses may be filtered prior to bottling. Filtration will be accomplished using either a peristaltic pump or portable hand pump and 0.45 micron (μm) filter paper. Samples will be filtered directly from collection device into sample containers.

Note that all fluids resulting from monitoring well installation, development, sampling, and equipment decontamination will be contained and disposed of in accordance with local, state and federal requirements.

3.4 Surface Water Sampling

Surface water samples will be collected for particular analytical measurements as required by project managers. Appropriate sampling gear such as protective gloves and wet gear will be

worn in the field. All equipment will be decontaminated prior to sample collection. Collection of sample will proceed so that the containers are submerged under the water to the point at which the desired depth is reached. The cap (top) of the container will slowly be removed just enough to allow the slow collection of water into the container. The container will not be overfilled to the point at which preservatives (i.e. HCL, H₂SO₄) will be washed out of the vessel. When appropriate, a visible meniscus will be applied to the top of a volatile organic analysis (VOA) container by dipping the cap back into the water and applying to the container. Special sampling for deep water samples will require the purchase of specific equipment and will be discussed in site specific work plans.

3.5 Vapor Extraction System Effluent

Sample collection from the soil vapor extraction (SVE) system are taken up-stream of the blower and any dilution inlets to minimize volatility loss through turbulent conditions. A sample port is installed by drilling and tapping a hole into the influent portion of the piping system. A steel plug is installed in the tapped hole to allow for future access. This port is utilized for airflow measurements in cubic feet per minute (cfm) and air bag (Tedlar) sample collection. The air bag sample is collected by inserting a small handheld vacuum pump into the sample port and pumping air directly into the air bag. The valve to the air bag is then closed to retain the sample.

It is important that the air bag is not over-inflated which could cause leaks in the bag. Furthermore, ambient air temperatures can cause the bags to expand or contract which could cause bag damage. For these reasons the air bag samples are kept at between 50°F and 75°F during transport to the lab. Additionally, it is important that the bag sample is not exposed to excessive sunlight, particularly the ultraviolet (UV) rays, which can effect the quality of the sample. Whenever possible, air bag samples will be analyzed by the laboratory within twenty four hours of collection.

Field samples which are not taken to a laboratory are measured from the air bag using a PID. It is recommended that a dedicated air bag be assigned to a particular SVE for PID measurement purposes. If an air bag is not available at the time of field work, the PID may be used in conjunction with the vacuum pump which will supply the PID with air samples from the SVE system.

3.6 Free Product and Liquid Waste

Several methods may be employed when free phase hydrocarbons or waste is being measured either in an established monitoring well or containment vessel. Type of equipment may be as follows: polypropylene disposable bailer, product interface bailer, colliwasa tubes or electronic interface probe. Currently, the primary means of determining thickness of free phase hydrocarbons by AJM technicians in a groundwater monitoring well is by electronic interface probe.

Prior to well purge, the decontaminated electronic oil/water interface probe (sound) will be slowly lowered into the well casing. When the sound is a single pitch alarm, free phase hydrocarbons have been contacted on top of the water column. This measurement will be cataloged. As the sounder is further lowered into the column, an on/off alarm indicates that water has been reached. This depth will also be recorded and a determination of free product (non-aqueous phase liquid (NAPL)) will be calculated. Any free phase hydrocarbons collected from monitoring wells is placed in a gas can for future use or disposal.

3.7 Microbiological and Inorganic Samples

Microbiological samples will be collected as necessary and with MDEQ approval to help determine the potential for natural degradation of hydrocarbons from microbes which are presently in soils at specific facilities. Typically, soil samples will be collected from borings just above the soil water interface. Immediately after sample collection and during storage and shipment of soil samples to the laboratory, samples will be kept at approximately 45°F. This temperature is estimated by the laboratory as the optimum temperature which would prevent the unnecessary decline in bacteria count. Soil samples will be analyzed for Heterotrophs and total Hydrocarbon Degraders.

Heterotrophic plate counts will be performed according to standard methods for the analysis of Water and Wastewater using R2A agar with 25 degree Celsius incubation for 7 days. Cells will be eluted from soil using 0.1% sodium pyrophosphate and high agitation for 10 minutes. Other methods for determining bacteria counts will be described in site specific work plans if laboratory methods change. An addendum to this SOP will be forwarded to the MDEQ if fundamental changes in these methods change in the future.

The percentage of total hydrocarbon degraders will be compared to the heterotrophic bacteria to determine if natural degradation is occurring and to some degree what the expected rate might be. Selection/stimulation of hydrocarbon degrader populations will also be noted in contaminated soils after an aeration study is conducted by the lab to determine if aerobic or anaerobic conditions are favorable to hydrocarbon degradation.

Inorganic samples will be collected of either soil or groundwater in a similar fashion as that mentioned in Section 3.1, 3.2 or 3.3. The analytical methods and preservatives will be appropriate for the chemical analysis as described in Table 3-1.

3.8 Underground Storage Tank Removal

Activities associated with UST removal must include a site assessment to demonstrate whether a release of fuel has occurred. All appropriate MDEQ permitting, sampling and safety requirements will be followed. The following activities represent the minimum SOP required to demonstrate the above:

1. Review of product inventory records, including physical measurements, meter readings and deliveries, for a six-month period immediately preceding the tank removal.
2. Visual inspection of the tank upon removal. All external tank surfaces will be inspected for evidence of holes or leakage.
3. Visual inspection of excavation. All excavation surfaces will be inspected for evidence of leakage. Evidence of leakage would include stained soil, odor and areas of free product.
4. If analytical verification of the degree of contamination is needed, typically two soil samples will be collected and analyzed from beneath each end of the tank. If stained or contaminated areas exist in locations other than the two above locations, then additional soil samples may be analyzed from these areas. It may also be necessary to sample and characterize the product.
5. If necessary, samples will be collected from the native soil at or just below the interface of the backfill with the native soil.
 - a) Immediately upon removal of the tank, a backhoe bucket of native soil will be taken from the native/backfill interface (approximately 2 feet below tank). This soil will be brought to the surface. Soil samples will be taken directly from the backhoe bucket.
 - b) The samples will be immediately placed on ice for transport under COC to a laboratory for analysis.
6. If the bottom of the tank is below the groundwater table, then soil samples may not be required. In this case, a water sample may be collected as soon as possible at the soil/groundwater interface. The water will be examined for any free floating product or product sheen. If no floating product is detected, a water sample may be taken with a stainless steel or teflon bailer. The water sample will be immediately transferred into a 40 ml VOA vial with as little agitation as possible to prevent air entrainment. An additional 1 liter bottle for EPH may also be required for groundwater collection.
7. Disposable bailers will be used whenever possible. Other bailers used to collect water samples will be decontaminated in the field between sampling locations using the decontamination procedures outlined in Section 3.9.
8. Soil and water samples will be analyzed for various parameters as dictated by the project manager or MDEQ representative.

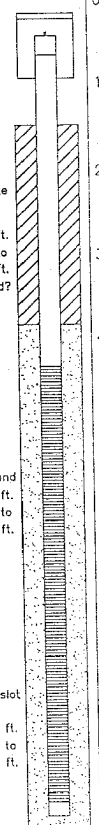
3.9 Decontamination

All downhole drilling equipment, sampling equipment, and any other equipment used in soil borings or sampling will be cleaned between use to prevent cross-contamination. Large equipment including backhoes will be steam cleaned.

The extent of known contamination will determine the degree of decontamination required. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated.

The standard procedures listed below can be considered the procedure for full field decontamination. If different or more elaborate procedures are required for a specific project, they will be detailed in the specific project work plan. Such variations in decontamination may include following all, just part, or an expanded scope of the decontamination procedure stated herein:

1. Remove any solid particles from the equipment or material by brushing and rinse with available tap water. This initial step is performed to remove gross contamination.
2. Wash and scrub equipment with a soap (Liquinox) or trisodium phosphate detergent solution. Use a 1% Liquinox solution or a 5% trisodium phosphate solution.
3. Rinse with tap water.
4. Solvent rinse with either acetone (pesticide grade or better) or methanol. Allow sufficient time for the solvents to evaporate.
5. Triple rinse with deionized water.
6. Wrap sampling equipment in foil, shiny side out.
7. Repeat entire procedure or any parts of the procedure as necessary.

Borehole Location _____				Job # _____ Date _____ Job Name _____ Location: City _____ State _____ Monitoring Well # _____ Driller/Method _____ Site Supervisor _____ Total Borehole Depth _____ Depth to Groundwater _____ Surface Conditions _____	
Total Organic Vapor Reading	Sample Number	Well Construction	FT. BCS	Graphic Representation	Geologic Description
			0 1 2 3 4 5 6 7 8 9 10		
		Locking Cap? — Y — N			
		Bentonite Chips _____ ft. to _____ ft. Hydrated? — Y — N			
		Filter Pack sand _____ ft. to _____ ft.			
		Well Screen slot _____ ft. to _____ ft.			
COMMENTS					

PAGE ___ OF ___

FIGURE 3-1 (Typical soil boring/well construction log)

MONITOR WELL WATER SAMPLING FORM

job number _____ jobsite _____ date _____
 well number _____ field conditions _____ tech _____

Site Characterization

aboveground wellbox _____ flush mounted wellbox _____ iron lid covered _____

Monitor Well Data

static water level _____ total depth of well _____ wellbox condition _____
 well casing dia _____ type of well _____ (mon. well, domestic well, geoprobe well, piezometer well,)
 product (yes / no) thickness _____ petro sheen ___heavy___medium___slight___ petro odors ___strong/mild
 need for new or re-survey yes / no has a bench mark been established w/correct usgs elev. yes / no

Purge/Sample Collection Method

disposable bailer _____ 12 v purge pump _____ 12 v peristaltic purge pump _____ other _____

Analytical Parameters

pre-purge sample _____ natural atten. _____ ibi sampling _____ vph/eph samples _____ other samples _____

Stabilization Parameters

Sample Collection Time _____

Time	purge Vol.	Temp in C	pH	Spec. Cond	Diss. Oxy % sat.	Diss. Oxy-mg/l	ORP mv +_	h2O color	silty/sandy

Decontamination Parameters

Alconox wash _____ Methonol / Distilled water solution _____ Steam clean / pressure wash _____

COMMENTS:

*Note: Dissolved Oxygen is measured in mg/l or % of saturation] milligrams/litre is the amount of oxygen in a litre of water.
 Dissolved Oxygen % of saturation] is the amount of oxygen in a litre of water relative to the total amount of oxygen that the water can hold at that temperature. Normal Range based on temperatures [8°C to 15°C = 11.83 mg/l to 10.07 mg/l D.O.]*

FIGURE 3-2 Well Sampling Data Sheet

Table 3-1
 Sample Container, Preservation & Holding Time Requirements

Analytical Method	Sample Container	Preservation	Holding Time (days) Water	Holding Time (days) Soil
SW8015	G-1000 ml	Cool, Acidify pH<2	28	28
MA-VPH	VOA-40 ml(x3)	Cool, Acidify pH<2	7	14
524.1, 503,601, 624, 8020, 8260	VOA 40 ml (x3)	Cool, Acidify pH<2	7	14
Metals	p-500 ml	Cool, Acidify pH<2	6 months	6 months
Write-In as Necessary				
Write-In as Necessary				

4.0 SAMPLE DOCUMENTATION AND CUSTODY

Documentation during sampling activities is essential to promote proper sample identification. Standard sample custody procedures will be used to maintain and document sample integrity during collection, transportation, storage, and analysis. A sample is considered to be in custody if one of the following applies:

1. Kept in an authorized person's physical possession or view
2. Stored in a secure area with restricted access
3. Containerized and secured to prevent any unwarranted tampering

Samples and documentation must be maintained in the custody of authorized personnel or under documented control in a secure area. The field team leaders are responsible for proper sample handling and documentation which will allow for tracing the possession and handling of individual samples from the time of collection to laboratory receipt. The laboratory's QA officer is responsible for establishing a sample control system which will allow for tracing sample possession from laboratory receipt to final sample disposition.

The following sections describe sample custody documentation and handling procedures to be followed in the field, while transporting the sample to the laboratory, and at the laboratory.

4.1 Field Custody Procedures

The sample custody procedures, including documentation, to be employed in the field are discussed in this section. All sample custody materials will be documented in indelible ink by field personnel. Corrections will be made by drawing one line through any incorrect entry, entering the correct information, and initialing and dating the change.

4.1.1 Sample Labels

A sample label will be affixed to all sample containers sent to the laboratory. This identification label will be completed with the following information written in indelible ink:

1. Project name and location
2. Sample location
3. Field identification number
4. Date and time of sample collection
5. Preservative used
6. Sampler collector's name and initials
7. Filtering (if applicable)
8. Type of sample (grab or composite)
9. Analyses required

Sample labels with identical information will be attached to each sample container if a sample is split with another party. After labeling and appropriately sealing, each sample will be refrigerated or placed in a cooler containing ice to maintain the sample temperature at 4° C.

4.1.2 Custody Seals

Custody seals will be used on each sample to prevent or indicate tampering. Custody seals used during the course of the project will consist of security tape provided by the laboratory as requested with the date and initials of the sampler. Samples will be sealed in this manner immediately following collection. The tape will be placed such that the seals must be broken to gain access to the contents. Samples will be sealed with the tape and initialed and dated by the sampler with indelible ink immediately following collection.

4.1.3 Chain-of-Custody Records

Chain-of-Custody (COC) record procedures provide an accurate written record tracing the possession of individual samples from the time of collection in the field to the time of acceptance at the laboratory. The COC record will also document samples collected and the analyses requested. Figure 4-1 provides an example of a COC record used by RAM Environmental, LLC. Laboratory-specific COC records may also be used depending on the site investigation. Field personnel will record on the COC record(s) the following information:

1. Project name and number
2. Sampling location
3. Name and signature of sampler(s)
4. Destination of samples (laboratory name)
5. Sample identification number
6. Date and time of collection
7. Number and type of containers filled
8. Analyses requested
9. Preservatives used
10. Filtering (if applicable)
11. Sample designation (grab or composite)
12. Signatures of individuals involved in custody transfer (including date and time of transfer)
13. Airbill number (if applicable)

Unused lines on the COC record will be crossed out. COC records initiated in the field will be signed by the field personnel with the airbill number recorded, then they will be placed in a plastic bag and taped to the inside of the shipping container used for sample transport. Signed airbills will serve as evidence of custody transfer between the field personnel and courier, and

the courier and the laboratory. Copies of the COC record and the airbill will be retained and filed by the field personnel prior to shipment.

Occasionally, multiple coolers will be sent in one shipment to the laboratory. Each cooler will have a separate COC record with the samples contained in that cooler list. The outside of the coolers will be marked indicating the number of coolers in the shipment.

4.1.4 Additional Sample Documentation

In addition to the field documentation already discussed in Section 4.1, sampling activities during the field effort require several other forms of documentation. This documentation is prepared to provide an accurate record of the events and observations which occur during the field activities. Field documentation will be maintained in field logbooks, boring logs, well construction diagrams, groundwater development and sampling logs, photographs, and daily field progress reports. Each of these documents is discussed in detail in the SOPs.

AJM will use the following guidelines for maintaining field documentation:

1. Documentation will be completed in permanent black ink.
2. All entries will be legible.
3. Errors will be corrected by crossing out with a single line, dating and initialing.
4. Unused portions of pages will be crossed out.
5. Each page entry will be signed by the field team member who made the entry.

4.2 Laboratory Custody Procedures

Upon receipt of an ice chest, laboratory personnel will review the contents and will sign and retain the COC record and the airbill. Information that will be recorded on the COC record, or another appropriate document, at the time of sample receipt will include the following:

1. Status of custody seals
2. Temperature of ice chest upon receipt
3. Identification number of broken sample containers, if any
4. Description of discrepancies between the COC record, sample labels, and requested analytes

Laboratory personnel will contact the analytical coordinators regarding discrepancies in paperwork and sample preservation and will document non-conformities and corrective actions according to the laboratory SOP for COC procedures. These procedures will be on file at the laboratory. Once samples have been accepted by the laboratory, checked, and logged in, they must be maintained in a manner consistent with custody and security requirements specified in detail in the laboratory QA/QC plan.

5.0 EQUIPMENT CALIBRATION AND MAINTENANCE

Laboratory and field equipment will be calibrated and maintained in accordance with EPA guidance or manufacturers' recommendations. Laboratory equipment refers to equipment used in the laboratory for sample analysis whereas field equipment refers to equipment used for on-site monitoring and testing.

5.1 Laboratory Equipment Calibration

Laboratory instrument calibration procedures and frequencies will be performed in accordance with SW-846 requirements. Laboratory SOPs for instrument calibration will be provided in the quality assurance program plans provided by the laboratories selected to perform the various analyses.

5.2 Laboratory Equipment Maintenance

A description of specific preventive maintenance procedures for laboratory equipment will be available in the laboratory Quality Assurance Program Plans (QAPPs), SOPs, and SOGs. These documents identify personnel responsible for major, preventive, and day-to-day analytical equipment maintenance, the frequency and type of maintenance, and preventive maintenance documentation procedures.

5.3 Field Equipment Calibration

Measurement equipment used during the field activities will be calibrated at the beginning of the field effort and at prescribed intervals. The frequency of calibration is dependent on the type and stability of equipment, the analytical methods employed, the intended use of the equipment, and the recommendation of the manufacturer. Table 5-1 summarizes the calibration requirements for the equipment expected to be needed during field investigations. Detailed calibration procedures for equipment is available from the specific manufacturer's instruction manuals.

All calibration information will be recorded in the field logbook. Additionally, equipment labels will be used to specify calibration dates and preventive maintenance parts replacement. Equipment malfunctions will be reported to field team leaders in order that prompt service can be performed or substitute equipment can be obtained. Backup systems will be available for each instrument in use and will be calibrated prior to use in the field. Any action of this type will be reported in a corrective action report. Section 9.2 discusses the corrective action report.

5.4 Field Equipment Maintenance

Detailed information regarding required maintenance and service is available in the operation manual of the specific instrument to be used. Service and maintenance information will be

recorded in field logbooks by field personnel. Instrument problems encountered during the field program will be recorded, and if possible, remedied in the field. Specific preventive maintenance practices will be in strict accordance with manufacturer's recommendations.

Table 5-2 outlines general preventive maintenance tasks required for all field equipment anticipated during field investigations . Common spare parts for all field equipment will be kept on-site and readily available to all field personnel through the team leader. Scheduling preventive maintenance tasks will also be the responsibility of the field team leader. Additional details regarding equipment maintenance procedures appear in the operation manuals for specific equipment.

TABLE 5-1
FIELD EQUIPMENT CALIBRATION

INSTRUMENT TYPE	STANDARD REFERENCE	CALIBRATION TECHNIQUE	CALIBRATION FREQUENCY	ACCEPTANCE SPECIFICATIONS
pH Meter	Two buffers	Set range and span based on expected field conditions	Daily	Buffer solution values
Temperature meter w/ temperature compensation probe	Mercury thermometer	Manufactures user manual	Daily	Mercury thermometer value
Water level indicator	Steel tape	Manufactures user manual	Prior to daily field activities	Steel tape values
Conductivity	Standard Solution	Manufactures user manual	Daily	Standard solution value
PID	Isobutalyene	Manufactures user manual	Before each use	Indication of standard value
Dissolved Oxygen Meter		Altitude, Salinity	Daily	
Tanktector	40% Hexane	Manufactures user manual	Daily	Indication of standard value

TABLE 5-2
FIELD EQUIPMENT PREVENTATIVE MAINTENANCE

INSTRUMENT TYPE	MAINTENANCE TASK ^a
pH Meter	<ul style="list-style-type: none"> - Check that pH electrode contains sufficient liquid. - Verify that the outside of the probe stays moist. - Check sensor bulb for development of film if drifting is a problem - lightly clean with liquid cleaner. - Rinse electrode with deionized water and replace storage cap after each use.
Temperature Meter	<ul style="list-style-type: none"> - Regularly clean and maintain the instrument and any accessories.
Conductivity Meter	<ul style="list-style-type: none"> - Check charge on battery regularly. Recharge or replace as appropriate. - Clean electrode with deionized water after each reading. Rinse well.
Water Level Indicator	<ul style="list-style-type: none"> - Check charge on battery regularly. Recharge or replace as appropriate. - Rinse probe and tap after use. - Inspect cable and all electrical connections for breaks and/or bare wire.
PID	<ul style="list-style-type: none"> - Check charge on battery regularly. Recharge as appropriate. - Replace pre-filter as necessary. - When drift is apparent, clean UV bulb with methanol.
Tanktector	<ul style="list-style-type: none"> - Check charge on battery regularly. Recharge as appropriate. - If oxygen readings begin to drift or will not stay steady at 21%, the oxygen cell needs to be replaced. Typically this cell should be replaced once every two years.

to manufacturer's user manual for guidance.

6.0 ANALYTICAL PROCEDURES

Table 6-1 presents the analytical methods that will be used to characterize the listed target compounds in the various environmental matrices (soil, ground water, sludge, etc.). Other analytical methods may be selected when site conditions warrant the analysis of contaminants not addressed in Table 6-1. All analytical methods will be EPA approved and those methods not already identified in the table will be appended to the SOP as appropriate.

Potential laboratories and their analytical responsibilities are described in Table 6-2. Each contract laboratory's QAPP will be provided to the DEQ upon written request.

TABLE 6-1
DETECTION LIMITS FOR TARGET COMPOUNDS

PARAMETER	DETECTION LIMIT (ppb) ^a	METHOD	INSTRUMENTATION ^c
VPH/EPH	1000	Modified 8015 or MA-VPH	GC
Purgeable Aromatic Hydrocarbons (PAH)	1	EPA 502.1, 503.1, and 602	GC
Volatile Organic Carbons (VOC)	10	EPA 601, 624	GC/MS and GC
Base/Neutral and Acid Extractable Organics	10	EPA 604, 606, 609, 610, 612, and 625	GC/MS and GC
PCB/Pesticides	10	EPA 608/505	GC
Metals	^b	EPA 200 Series	ICP or AA
Hazardous Waste Characteristics (TCLP, Ignitability, Corrosivity, and Reactivity)	varies	Ref. SW-846	varies
MBTEX	1.0 ppb Water 0.2 ppm Soil	EPA 602/8020	GC

Notes:

^a Optimum detection excluding interfering compounds

^b Varies depending on target metal

^c GC - gas chromatograph
GC/MS - gas chromatograph/mass spectrometer
ICP - inductively-coupled plasma
AA - atomic adsorption

TABLE 6-2
 LABORATORIES CONDUCTING EPA TEST METHODS

LABORATORY	CONTRACTED EPA TEST METHODS	
Energy Laboratories, Inc	200 418.1 524.2 505 601 602	604 608 609 610 612 624
Advanced Analytical Labs	625 8020	Modified EPA 8015 SW-846 Methodology for Determining Hazardous Waste Characteristics

7.0 INTERNAL QUALITY CONTROL

The principle objectives of any sampling and analysis program are to obtain accurate and representative environmental samples and to provide valid analytical data. To achieve these goals, a program to evaluate field and laboratory data has been developed. Data quality will be determined through the collection and analysis of field QC samples. Laboratory QC samples will also be analyzed, per SW-846 analytical method protocols, to verify that laboratory procedures and analyses are being conducted as accurately as possible.

The following sections identify and define the types of QC samples required to assure the production of quality data. Additional QC procedures not discussed in this section may also be implemented by field and laboratory personnel according to specific method protocols or special conditions. These additional QC procedures will also serve to verify the quality and reproducibility of the analytical data.

7.1 Field Quality Control Samples

Quality control samples will be collected in the field and used to evaluate the validity of the field sampling effort. These field QC samples will be analyzed along with site characterization samples to check sampling and analytical precision, accuracy, and representativeness. The following sections define the types of field QC samples that will be collected for this project.

7.1.1 Field Duplicates

Field duplicate samples are two samples collected at the same time from the same source but submitted as separate samples to one laboratory for analysis. Field duplicates evaluate the consistency (precision) of the overall sampling and analysis system.

Field duplicates are collected at a frequency of 5 percent and are analyzed as a site characterization sample. Soil and groundwater duplicates will be collected from locations having the greatest potential for contamination. These samples will be collected, numbered, packaged, and sealed in the same manner as other samples and will be submitted blind to the laboratory.

Field duplicate results are used to evaluate the precision of the analysis by means of the RPD. Limits imposed on acceptable RPD ranges are provided by SW-846 method-specific protocol and are usually matrix-based. Soil duplicate results tend to have a greater variance due to the difficulty associated with the collection of homogeneous field samples. Section 2.3.1 further discusses the evaluation of duplicate sample precision.

7.1.2 Matrix Spike and Matrix Spike Duplicates (MS/MSD)

A matrix spike consists of a known concentration of target analyte(s) added to an aliquot of a field sample. A MSD is determined by analyzing two identically spiked field samples. MS/MSD samples are spiked in the laboratory at the time of sample preparation to minimize errors. These QC samples measure the efficiency of all steps of the analytical process in recovering target analytes from an environmental sample matrix. The percent recoveries are calculated for each of the spiked analytes and used to evaluate analytical accuracy. The relative percent difference between spiked samples are calculated to evaluate precision. For inorganic analyses, a matrix duplicate is analyzed in place of a MSD. Precision is based on the RPD between the duplicate and the original analysis.

MS/MSD samples are collected at a frequency of 5 percent. Additional sample volumes will be collected for MS/MSD water samples. MS/MSD soil samples will be obtained from the same sample container as the field sample.

If MS/MSD percent recovery results (accuracy) or RPD results (precision) fall outside established acceptance limits, appropriate laboratory protocol specific for the method will be followed to determine the usability of the data. LCS, if available, will be examined to determine the effect of the out-of-control event on the results reported. Table 9-1 provides control limits for the evaluation of MS/MSD precision and accuracy.

7.1.3 Field Blanks

Contamination can be introduced from many external sources during sample collection or laboratory preparation of samples. Several types of field blanks will be collected and analyzed to discern these potential sources of contamination: bottle blanks, source water blanks, trip blanks, equipment rinsate blanks, and method blanks. The applicability of each of these blanks and their effects on the analytical data will be discussed in the following subsections.

Source Water Blank

Source water blanks consist of the water used in detergent wash and steam cleaning decontamination activities. This water may be obtained at taps, fire hydrants, or any other suspected clean source. At a minimum, one sample from each source used will be collected and analyzed for the same parameters as those at the site characterization samples collected during the event. A sampling event is defined as a period of time during which any sampling activities requiring decontamination occur. An extended absence followed by a return to the site would constitute two events.

Bottle Blank

Deionized (DI) water or high performance liquid chromatography (HPLC) water will be used in the final equipment decontamination step following detergent wash/steam cleaning and tap water

rinse. The type of water to be used will be dependent on the analyses to be performed. A bottle blank consisting of the DI or HPLC water will be collected before use and analyzed to determine if this final rinse water could be a source of contamination to site characterization samples. A minimum of one bottle blank for each type of water from each sampling/decontamination event will be collected and analyzed for the same parameters as the field samples.

Equipment Blank

An equipment blank or rinsate is a sample collected after a sample collection device has been subjected to standard decontamination procedures. The collection and analysis of an equipment rinsate sample demonstrates the effectiveness of a decontamination procedure in removing contaminants that may be present as a result of field sample collection procedures. Appropriate water or solvents for the intended analysis will be poured over or through the sample collection device, collected in a sample container, and sent blind to the laboratory for analysis. For organic parameters, analytically certified, organic-free, and HPLC-grade water or reagent-grade solvents will be used. For inorganic parameters, metal-free (deionized-distilled) water will be used.

The presence of contamination in an equipment blank would indicate a high potential for cross contamination due to ineffective decontamination. Equipment rinsates will be collected daily and analyzed for the same parameters as the field samples collected that day. During the data validation process, the results of the equipment blank analyses will be used to flag data or evaluate the levels of analytes in the field samples collected that day.

7.2 Field Measurement QC Procedures

Field measurements will be conducted as part of the sampling program. These measurements and the associated quality control practices will include: pH, conductivity, temperature, and water levels to be measured in duplicate at a frequency of 10 percent.

Field activities will follow QC practices as provided in the AJM SOP. Results from field measurements and QC checks will be compared to the project's PARCC criteria. For field analytical equipment, if the results fail to meet the objectives set for data quality, the instrument will be calibrated. Should discrepancies continue, general maintenance procedures will be performed. If the field instrument still fails to meet the QC criteria, it will be removed from service and replaced with a backup instrument.

AJM Inc. has implemented internal QC procedures to promote the quality of the field sampling. AJM Inc. internal QC includes:

1. Development and consistent use of SOPs
2. Documentation of sampling procedures
3. COC records

4. Documentation of fieldwork
5. Identification and correction of nonconformance situations
6. Communication with the client regarding work schedules, field procedures, subcontractors, and laboratory performance

7.3 Laboratory QC Sample

An analytical quality control program must generate information which can be used to: (1) evaluate the accuracy and precision of analytical data in order to establish the quality of the data; (2) provide an indication of the need for corrective actions when comparison of analytical QC results with regulatory or program criteria or data trends shows that activities must be changed or monitored to a different degree; and (3) determine the effect of corrective actions. Laboratory QC samples are prepared and analyzed at the laboratory at a frequency specified in the methodology(s) used for sample analysis.

7.3.1 Method Blanks

Method blanks will be used to determine whether there is contamination arising from the reagents used in the handling, preparation, and analysis of a sample. Method blanks are critical in distinguishing between low-level field contamination and laboratory contamination. A method blank consists of laboratory organic-free water and all of the reagents used in the analytical procedure. Such blanks are prepared for every analysis in the same manner as a field sample and are processed through all analytical steps. Method blanks are analyzed at frequency prescribed in each individual method.

7.3.2 Laboratory Control Standard or Blank Spike

A laboratory control standard (LCS) originates in the laboratory as deionized or distilled water that has been spiked with standard reference material(s) of known concentrations. LCSs are analyzed to verify the accuracy of the calibration standards. This internal QC sample is also used to evaluate laboratory accuracy in the absence of chemical matrix interferences related to the field samples. LCSs, like field samples, are processed through the entire analytical procedure. The LCS is analyzed at a 10 percent frequency throughout the analytical run to provide matrix independent data on accuracy and instrument precision.

If LCS percent recovery results (accuracy) or RPD results (precision) are outside the established acceptance limits, appropriate laboratory specific protocol will be followed to determine the usability of the data.

7.3.3 Surrogate Standards

Surrogate standards consist of known concentrations of nontarget analytes that are added to each sample prior to preparation and analysis for organic parameters. The purpose of a surrogate standard is to measure the efficiency of all steps of the analytical method in recovering the target analytes from an environmental sample matrix.

Surrogate standards provide an indication of laboratory accuracy and matrix effects for every field and QC sample analyzed for organic compounds. Surrogate compounds may be used in the analysis of organics to monitor purge efficiency and analytical performance.

Laboratory control limits are the criteria used to evaluate the surrogate percent recoveries obtained from the sample analysis. The evaluation of the results is not always straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is frequently subjective and demands analytical experience and professional judgment.

7.3.4 Internal Standards

Internal standards are compounds that are added to every standard, blank, MS/MSD, and sample extracts at a known concentration prior to instrumental analysis. They are used as the basis for quantification of the target compounds. Internal standards verify that GC/MS sensitivity and response are stable during every analytical run. Additionally, an internal standard is used to evaluate the efficiency of the sample introduction process, and it serves to monitor the efficiency of the analytical procedure for each sample matrix encountered. Internal standards are also used in the analysis of organic compounds by GC to monitor retention time shifts. Internal standards will be validated based on the criteria presented in Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (EPA, 1988b).

8.0 DATA REDUCTION, VALIDATION, REPORTING, & ASSESSMENT

To verify that data management activities provide an accurate and controlled means of summarizing information to support conclusions, it is important that the data handling and reporting steps be defined and implemented for every field or laboratory measurement collected. This section describes proper techniques for both field and laboratory activities.

8.1 Field Data Reduction

No data reduction will be necessary for field chemical and physical measurements. All readings will be recorded directly from the instruments. The following units will be used when recording the data:

1. Water Levels: reported to the nearest 0.01 feet after two measurements coincide
2. Water Temperature: reported to 1 Celsius degree unit
3. pH: digital reading rounded to 0.1 pH units
4. Specific Conductance: reported to 10 micromhos per centimeter
5. Survey Data: well casing elevations surveyed to 0.01 feet; coordinates to 1.0 feet

8.2 Laboratory Data Reduction

Laboratory data reduction involves the transfer of raw data from either bench sheets or computer screens to data tables of actual analyte concentrations. A typical procedure would consist of the following steps:

1. Concentration calculations from bench sheet results or computer chromatograms
2. Transfer of concentrations to data sheets
3. Compilation of database spreadsheets
4. Transfer of concentrations to data tables

8.3 Field Data Validation

Field personnel will validate field data by reviewing data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved immediately, if possible, by seeking clarification from those personnel responsible for data collection. All field personnel will be responsible for following the sampling and documentation procedures described in the investigation work plan.

8.4 Laboratory Data Validation

Laboratory personnel will validate analytical data at the time of analysis and reporting by reviewing raw concentration data sheets for any anomalies with data trends or expected orders of

magnitude. Additional validation procedures include a detailed review of 10 percent of each analyst's run for data reduction errors. (Detailed procedures for laboratory validation and corrective action will be provided in each laboratory's QAPP.)

8.5 Field Data Reporting

Field data generated during the sampling activities will be initially recorded in field logbooks, daily field progress reports, and COC forms. This information will then be compiled and reported in summary tables and figures, as appropriate. Corresponding descriptions will also be provided to accurately reflect field conditions.

8.5.1 Field Logbooks

Field personnel will use bound field logbooks to record all activities associated with the field investigation. These books are intended to provide sufficient data to reconstruct events that occurred in the field. The field logbooks will be kept by the field team leaders. The general information to be recorded within the logbooks will include the following:

1. Summary of daily activities
2. Equipment on site
3. Equipment calibration records
4. Observations made during sampling activities
5. Descriptions of deviations from field sampling procedures (FSP)
6. Names and addresses of subcontractors
7. Personnel on site
8. Weather
9. Sampling and shipment summary including airbill number (if applicable)
10. COC record number, sample destination, and time of pickup
11. Date
12. Signature of Recorder

Information specific to sampling activities will include the following:

1. Client
2. Project number
3. Sample number
4. Location of sample
5. Sample collection method
6. Number and size of sample containers for each analysis
7. Destination of samples
8. Analyte(s)
9. Date and time of sample collection

10. Name of sampler(s)
11. Sampling method
12. Field instrument readings
13. Decontamination procedures used
14. Any other observations, as appropriate

8.5.2 Daily Field Progress Reports

The daily field progress report may be submitted to the project manager each day during field activities. The report will include a discussion of the following topics at a minimum:

1. Date
2. Weather, including temperature, wind speed, and direction
3. Work performed
4. Sampling performed, including specific observations made
5. Level(s) of protection used
6. Field parameter measurements, including calibration checks
7. Any problems encountered and corrective actions taken
8. QC activities initiated
9. Next day's planned activities
10. Personnel on site and activities performed
11. Any visitors to the site
12. Signature of individual completing the report

8.5.3 Chain-of-Custody Forms

Refer to Section 4.1.3 for COC documentation procedures.

8.6 Laboratory Data Reporting

Laboratory data reporting formats vary; however, the following items are required from the laboratory for the presentation of analytical data:

1. Laboratory manager approval and certification that the final data presentation was checked in accordance with data verification requirements
2. Data presented in a tabular format whenever possible
3. Each page of data identified with the project number and name, date of issue, and client name
4. Sample identification number
5. Name of analyst responsible for run or batch
6. Laboratory identification number
7. Analytical method reference and parameters analyzed
8. Reported values, units, and quantification limits

9. QA/QC summary data sheets for all internal laboratory QC samples and their acceptance limits
10. Footnotes referenced to specific data if required to explain reported values
11. Report case narratives which include any problems that occurred at the laboratory in reference to the samples

8.7 Data Assessment

The degree of data validity is based on the comparison of analytical and QC results to the DQOs for the project. The integrity of the data is maintained by observing procedures designed to prevent errors and loss of data during manipulation and transfer.

Upon receipt of the analytical data package from the laboratory, project personnel, under the guidance of the analytical coordinators, will check for the following items:

1. Presence of all requested deliverables
2. Samples analyzed as requested
3. Sample holding times met
4. Field and laboratory QC sample results within established control limits
5. Appropriate detection limits obtained

Data review will be performed by the analytical coordinators for all analyzed samples. In addition, data for 10 percent of the samples analyzed will be validated by an independent data validation subcontractor. The review and validation of laboratory data will be performed according to Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (EPA, 1988b).

9.0 QUALITY ASSURANCE OVERSIGHT

Quality Assurance for field operations is the responsibility of all field personnel. These individuals have specific QA responsibilities in the form of SOPs, SOGs and QC documentation. It is the responsibility of the QA/QC Manager to ensure that all QC activities proposed in this SOP are implemented, and this plan is kept current and accurate. The QA/QC Manager will also initiate revisions to any section as they become necessary.

Oversight of SOPs activities will be through the use of three types of audits. Additionally, any problems encountered during the field investigation will require appropriate corrective action procedures to verify that problems do not go unresolved. The following sections describe the types of audits which will be performed and appropriate corrective action procedures which will be taken to resolve field or laboratory problems.

9.1 Performance, System, and Field Audits

An audit evaluates the capability and performance of a measurement system or its components and identifies problems. Three types of audits may be conducted during the fieldwork for this project: performance, system, and field audits. Audits will be performed at scheduled intervals by the QA program manager, project QA officers, or senior technical staff. All auditors will be independent of the activities audited and will be selected by the project QA officer. Technical expertise and experience in auditing will be considered in the selection of an auditor or audit team.

The auditor or audit team will develop an individual audit plan to provide a basis for each audit. Audits may include reviews of project plan adherence, training status, health and safety procedures, activity performance and records, budget status, QC data, calibration, conformance to SOPs, and compliance with laws, regulations, policies, and procedures. Following completion of an audit, the auditor or audit team will prepare and submit an audit report to the client. This report will also be included in the project summary report. The QA program manager will coordinate a management review of any deficiencies noted.

The auditor or audit team can issue a corrective action request to identify and schedule specific corrective actions to be undertaken and completed by the project manager as a result of audit findings. Completion of corrective action is verified by the auditor or audit team. After acceptance and verification of all corrective actions, the corrective action request form will be used to close the audit.

9.1.1 Performance Audits

A performance audit is a review of the existing project and QC data to determine the accuracy of a total measurement system(s) or a component of the system. Laboratory performance audits

will be conducted routinely by RAM Environmental, LLC. Internal audit routines for the laboratory are described in the laboratory QAPP.

9.1.2 System Audits

A system audit is used to verify adherence to QA policies and SOPs. This type of audit may consist of on-site review of measurement systems including facilities, equipment, and personnel. Additionally, procedures for measurement, QC, and documentation may be evaluated. System audits are conducted on a regularly scheduled basis, with the first audit conducted shortly after a system becomes operational.

9.1.3 Field Audits

A field audit involves an on-site visit by an auditor or audit team. Items to be examined include the availability and implementation of approved field procedures, calibration and operation of equipment, packaging, storage, and shipping of samples, health and safety procedures, documentation of procedures and instructions, and nonconformance documentation.

9.2 Corrective Action

An effective QA program requires prompt and thorough correction of nonconformities affecting data quality. Rapid and effective corrective action minimizes the possibility of questionable data or documentation.

Two types of corrective actions exist: immediate and long term. Immediate corrective actions include the correction of documentation deficiencies or errors, the repair of faulty instrumentation, or the correction of inadequate procedures. Often, the source of the problem is obvious and can be corrected at the time of the observation. Long-term corrective actions are designed to eliminate sources of problems. Examples of long-term corrective actions include the correction of systematic errors in sampling or analysis, or the correction of procedures producing questionable results. Corrections can be made through additional personnel training, instrument replacement, or procedural improvements.

All QA problems and corrective actions will be documented to provide a complete record of QA activities and to help identify needed long-term corrective actions. Defined responsibility is required for scheduling, performing, documenting, and assuring the effectiveness of the corrective action. This section describes the corrective action procedures to be followed in the field and laboratory.

9.2.1 Field Procedures

Field nonconformities are defined as occurrences or measurements that are either unexpected or do not meet established acceptance criteria which will impact data quality if corrective action is not implemented. These nonconformities may include the following:

1. Incorrect use of field equipment
2. Improper sample collection, preservation, and shipment procedures
3. Incomplete field documentation, including COC records
4. Inadequate decontamination procedures
5. Improper collection of QC samples

Corrective action procedures will depend on the severity of the nonconformance. In cases where immediate and complete corrective action is implemented by field personnel, corrective actions will be recorded in the field logbook and summarized in the daily field progress report.

Nonconformities identified during routine audits that have substantial impact on data quality require the completion of a corrective action request form. This form may be filled out by an auditor or any individual who suspects that any aspect of data integrity is being affected by a field procedure. Each form is limited to a single nonconformance; if additional problems are identified, multiple forms must be used for documentation.

Copies of corrective action request forms will be distributed to the project managers, the field team leaders, the project QA officers, and the project file. The project QA officers will forward completed corrective action forms to the program manager and the QA program manager as appropriate. The project managers, field team leaders, and the project QA officers will meet to discuss the appropriate steps to resolve the problem. This discussion will include the following:

1. Determine when and how the problem developed
2. Assign responsibility for problem investigation and documentation
3. Determine the corrective action to eliminate the problem
4. Design a schedule for the completion of the corrective action.
5. Assign responsibility for implementing the corrective action
6. Document and verify that the corrective action has eliminated the problem

A corrective action status form will be used by the project QA officers to monitor the status of all corrective actions. In addition to a brief description of the problem and the individual who identified it, the report will list personnel responsible for the determination and implementation of the corrective action. Completion dates for each phase of the correction action procedure will also be listed, along with the due date for the QA program manager to review and check the effectiveness of the solution. Follow-up data will also be listed to verify that the problem has not reappeared. This follow-up is conducted to verify that the solution has adequately and permanently corrected the problem.

The QA program manager can require data acquisition to be limited or discontinued until the corrective action is completed and the nonconformance is eliminated. The QA program manager can also request the reanalysis of any data acquired since the system was last in control.

9.2.2 Laboratory Procedures

The internal laboratory corrective action procedures and a description of out-of-control situations requiring corrective action will be contained in the laboratory QAPjP. At a minimum, corrective action will be implemented when: control chart warning or control limits are exceeded, method QC requirements are not met, or sample holding times are exceeded. Out-of-control situations will be reported to the project analytical coordinator within two working days of identification. In addition, a correction action report, signed by the laboratory director or project manager and the laboratory QC coordinator, will be provided to the project analytical coordinators.

10.0 ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirements
ARM	Administrative Rules of Montana
AST	Aboveground Storage Tank
ASTM	American Society for Testing and Materials
BETX	Benzene, Ethylbenzene, Toluene, & Xylenes
BGS	Below Ground Surface
CAP	Corrective Action Process
CECRA	Comprehensive Environmental Cleanup and Responsibility Act (MT Superfund Act)
CERCLA	Comprehensive Environmental Response Compensation and Liability Act (Federal Superfund Act)
CFR	Code of Federal Regulations
CFM	Cubic Feet per Minute
CLP	Contract Laboratory Program
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COC	Chain of Custody
DI	Deionized Water
DO	Dissolved Oxygen
DQO	Data Quality Objective
DRO	Diesel Range Organics
EPA	Environmental Protection Agency
FS	Feasibility Study
FSP	Field Sampling Procedures
GC/MS	Gas Chromatography/Mass Spectrometry
GFAA	Graphite Furnace Atomic Adsorption
GRO	Gasoline Range Organics
HPLC	High Performance Liquid Chromatography
LCS	Laboratory Control Standard
LUST	Leaking Underground Storage Tank
MCA	Montana Code Annotated
MCL	Maximum Contaminant Level
MDEQ	Montana Department of Environmental Quality
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSDS	Material Safety Data Sheet
MTBE	Methyl Tert-butyl Ether
MW	Monitor Well
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration

PAH	Polyaromatic hydrocarbons
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCB	Polychlorinated biphenyl
PID	Photoionization Detector
PM	Project Manager
PPE	Personal Protective Equipment
PRP	Potentially Responsible Party
PTRCB	Petroleum Tank Release Compensation Board
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
QAPP	Quality Assurance Program Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative Percent Difference
SARA	Superfund Amendments and Reauthorization Act of 1986
SMPM	State of Montana Project Manager
SOG	Standard Operating Guideline
SOP	Standard Operating Procedure
SPM	Site Project Manager
SPT	Standard Penetration Test
ST	Shelby Tube
SVE	Soil Vapor Extraction
SW-846	EPA Test Methods for Evaluating Solid Waste
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbon
TSP	Trisodium Phosphate
TSS	Total Suspended Solids
UST	Underground Storage Tank
VOA	Volatile Organics Analysis Vial
VOC	Volatile Organic Compound
WP	Work Plan

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