Montana Quality Assurance Plan for Investigation of Underground Storage Tank Releases

Approvals:

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1.0 Project Management

1.1 Project/Task Organization

The corrective action oversight at leaking underground storage tank (LUST) sites in Montana is the responsibility of the Petroleum Tank Cleanup Section (PTCS) of the Contaminated Site Cleanup Bureau, within the Remediation Division of the Department of Environmental Quality (DEQ). The PTCS Manager is Marla Stremcha, the Contaminated Site Cleanup Bureau (CSCB) Chief is Terri Mavencamp, the Remediation Division Administrator is Jenny Chambers, and the DEQ Director is Christopher Dorrington.

DEQ attorneys support and advise the director and staff on legal aspects of the petroleum tank cleanup (PTC) program including contractual, enforcement, and policy matters. DEQ's PTC attorneys are Paul Nicol and legal management support from Jon Morgan.

Montana's LUST project officer at the U.S. Environmental Protection Agency (EPA) Region VIII is Theresa Martella. The Quality Assurance Officer (QAO) for EPA Region VIII, Linda Himmelbauer, advises the DEQ on quality assurance (QA) procedures and is available to assist in the resolution of problems.

The PTC quality assurance officer (QAO), Reed Miner, is responsible for overseeing all QA activities discussed in this document. He informs management of QA requirements, problems, and overall status, and is the lead point-of-contact for QA matters pertaining to the PTC Program. The QAO is also responsible for maintaining and updating the QAP. Where Reed Miner is a PO on a site, the QAO contact will be Scott Gestring.

Table 1. DEQ and EPA Quality Control Contacts

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1.2 Problem Definition/Background

The purpose of a QA plan is to describe the quality system policies and management guidelines. Environmental programs funded by the Environmental Protection Agency (EPA) are required to establish and implement a quality system: a structured system that describes the policies and procedures for ensuring that work processes, products, or services satisfy stated expectations or specifications. Environmental programs are further required to document their quality system in a Quality Management Plan (QMP). DEQ has quality system and management guidelines for the agency outlined in the DEQ QMP, which is available upon request.

The DEQ PTC Program Quality Assurance Plan (QAP) fits under the DEQ-wide QMP and provides guidance for Montana's PTC programs to ensure data collected at PTC sites are defensible and of known quality and origin. This QAP should be consulted during the design of sampling plans developed under

the PTC program and the components incorporated or referenced in work plans. The goal of this QAP is to describe the quality system that applies universally to Petroleum sites and to ensure that minimum data quality objectives are met, and data is available for multiple uses. The data collected by this program are intended to be used to support, investigation, cleanup, monitoring, resolution, and enforcement activities associated with the release of petroleum and other regulated substances.

In 1984 and 1986, in amendments to the Resource Conservation and Recovery Act (RCRA), Congress directed the EPA to establish standards and regulations for management of underground storage tanks (USTs). In 1987, the Montana Legislature amended the Montana Solid and Hazardous Waste Act (Title 26, Chapter 14, Montana Code Annotated 1953, as amended) to authorize the Department of Health and Environmental Sciences (DHES) to develop an UST program that would meet federal requirements for delegation of primacy. On July 1, 1995, the DEQ was established by merging certain programs from three former state agencies, including the DHES UST program, into one agency. Subsequent reorganization within the DEQ established the Remediation Division on July 1, 1996. Montana's LUST (PTC) and UST programs were granted primacy by the EPA on March 4, 1996.

1.3 Project/Task Description

Data from PTC sites will be used to evaluate compliance with the DEQ PTC program and the protection of public health and the environment.

The primary goal of the PTC sampling program is the identification and quantification of chemicals of concern (COCs) released from USTs. Proper quantification of these regulated substances is necessary to identify leaking tanks and the presence of COCs that threaten human health and the environment.

This QAP broadly describes the data quality requirements that apply to petroleum tank release investigations required by the DEQ PTC section. DEQ's QMP states "development and implementation of a SAP (or equivalent) is required for all projects that produce environmental data, no matter how small or limited in duration. SAPs will be prepared before environmental data collection begins and may be written for a specific project, for activities at a specific sampling site, or for activities falling under a larger monitoring program." SAPs document the logistical and analytical details for a specific monitoring effort. The overarching objectives and QA requirements may already be captured in a QAP, relieving the requirement to restate certain information. SAPs contain details needed by field and lab personnel such as the number and types of environmental samples to be collected, analytical and field methods to be used, sampling schedule, handling requirements, etc. All laboratory methods will be performed as prescribed in Section 2.4 and quality control (QC) requirements for physical and chemical analyses will be performed as outlined in Section 2.5.

Parameters for which each sample will be analyzed depends on individual project objectives. These include analysis for petroleum products, petroleum derivatives and any known breakdown products of these compounds.

The analytical laboratories are responsible for QA from the time samples are received for analysis until the analytical results are reported to the DEQ project manager. Laboratories must practice QA controls for sample custody and handling, instrument calibration and maintenance, and data quality. They are also responsible for problems that are detected during these procedures. Laboratories should follow the specific QA/QC specifications of the method and should update their practices within 60 days of a method update. Results from these analysis are presented in the laboratory report and verified by the project manager using DEQ's data validation checklist (Appendix B), or equivalent form

1.4 Data Quality Objectives and Criteria

Screening levels that pertain to most PTC projects are defined in RBCA and include water quality standards and soil screening levels (DEQ, 2018).

Suitable laboratory limits to effectively evaluate data to achieve the project objectives relative to screening levels are required for all analyses. Lower reporting limits for a project must be below the applicable action limits. Labs determine their Lower Reporting Limits and report these to DEQ during the DEQ lab procurement process. DEQ uses this information to evaluate laboratory capabilities and qualifications when contracting analytical services. This information is available upon request. DEQ has contracts with both Pace and Energy labs. SAPs must specify the required reporting value (the value the lab is required to be able to reliably report at). This number must be lower than a screening level to be able to make meaningful comparisons. If a lab cannot achieve the required reporting value for an analyses, please discuss with your DEQ project officer.

The overall DQOs are to develop and implement procedures for field sampling, chain-of-custody protocol, and laboratory analysis and reporting that yield reliable data that can easily be verified and defended. Specific procedures to be used for sampling, chain-of-custody, instrument calibration, laboratory analyses, reporting, internal QC audits, and corrective actions are described in this QAP.

Data quality indicators, such as completeness, accuracy, precision, bias, representativeness, sensitivity, and comparability criteria are defined in Table 2. Data quality objectives for these indicators are specified in Table 3. These objectives should be referenced in the SAP and verified following receipt of results to determine if the DQOs were met and data is usable for the intended purpose.

Table 2: Data Quality Indicator Definitions			
Data Quality Indicator	Definition	Calculation/measurement	Field/lab samples to measure indicator
Accuracy	measure of the overall agreement to a known value; includes random (precision) and systematic error (bias) from both sampling and analytical operations	Percentage Difference = 100* (X-T)/T X=Measured value T= True Value	Reference standard Spike, matrix spike and surrogates
Precision	measure of agreement among repeated measurements of the same property under identical, or similar conditions	RPD = ·|X1-X2|/ ((X1 + X2) / 2) *100 RPD = Relative Percent Difference (as %) X1 - X 2 = Absolute value (always positive) of X1 – X2 X1 = Original sample concentration X2 = Duplicate sample concentration Can also be calculated as standard deviation.	field duplicates, laboratory duplicates, matrix spike/matrix spike duplicates
Bias	measure of the systematic variance in the expected sample measurement from the sample's true value	Same as accuracy	standard reference materials or spiked samples or surrogates
Completeness	percentage of measurements made which are judged to be valid measurements (non-R coded).	Valid samples taken / samples planned *100	
Representativeness	assurance that analytical data accurately and precisely represents the environmental condition.	qualitative	samples collected in a manner that the results appropriately reflect the conditions of the site
Comparability	confidence with which one data set can be compared with another	qualitative	all sampling and analysis documented and carried out as described in this QAP and in the individual approved work plan
Sensitivity	capability of a method or instrument to discriminate between measurement responses	MDL Calculation defined in EPA 821-R-16-006	method (method detection limit), by an instrument (instrument detection limit),

	representing different levels of the variable of interest		or by a laboratory (quantitation limit).
Contamination	Detection of an analyte that should not be in the matrix, can be introduced from field sampling, handling or from laboratory.	Any analytical detection Blank acceptance criteria: field < LRL, lab < LRL.	field, equipment, trip, and lab blanks

Table 3: Data Quality Objectives

Data Quality Indicator	QC Check/QC Sample	Evaluation Criteria	Data Quality Objective
Precision	Field Duplicates	Relative percent difference	RPD ≤ 30% for water samples RPD ≤ 50% for soils
	Laboratory Duplicates	Relative percent difference	RPD below the RPD advisory limit specified by the lab for laboratory duplicates.
	Matrix Spike/Matrix Spike Duplicate	Relative percent difference	RPD below the RPD advisory limit specified by the lab for MS/MSD.
Accuracy/Bias	Is sample location appropriate for the intent of the study?	Sample locations selected based on intent of study	100% compliance; any relocation of sites due to field conditions must be documented.
	Calibration and standard/reference checks for field instruments	Documentation of frequency and successful calibration(s) of instrument	100% compliance
	SOPs applied for environmental data collection	Qualitative determination of SOP adherence and field audits	100% compliance for adherence to SOPs
	Field Blanks	Lower reporting limit	< LRL
	Trip Blanks	Lower reporting limit	< LRL
	Equipment rinsate blanks	Lower reporting limit	< LRL
	Method Blanks	Lower reporting limit	< LRL
	Laboratory Control Sample	% Recovery	% Recovery is between the low limit and high limit specified by the lab for LCS. Usually between 85-115% for water and 75-125% for soil.
	Matrix Spike/Matrix Spike Duplicate	% Recovery	% Recovery is between the low limit and high limit specified by the lab for MS/MSD.
	Split Samples	Relative percent difference	RPD ≤ 30% for water RPD ≤ 50% for soil

Table 3: Data Quality Objectives			
Data Quality Indicator	**QC Check/QC Sample**	**Evaluation Criteria**	**Data Quality Objective**
Representativeness	SOPs applied for environmental data collection	Qualitative determination of SOP adherence and field audits	100% compliance for adherence to SOPs
	Sampling design	Adherence to sampling design, locations, time, and other conditions specified in the SAP.	100% compliance unless approved by project manager and noted in a post-field addendum.
	Holding times	Analysis within holding times specified in SAP/QAPP (can reference RBCA)	100% compliance
Comparability	SOPs applied for environmental data collection	Qualitative determination of SOP adherence and field audits	100% compliance for adherence to SOPs
	Analytical Methods	Adherence to EPA or WMRD-approved methods (see RBCA)	100% compliance
	QC sample checks	Type and frequency of QC samples	Evaluate comparability of QC samples
	QA documentation	Existence and level of detail	QA documentation has sufficient detail (e.g., analytical methods, QA/QC, other key elements)
Completeness	Complete sampling	Percent usable data compared to planned data	95%
Sensitivity	MDL and LRL	Below action level required by SAP (e.g., see RBCA for screening levels)	100% compliance

1.5 Special Training/certification

All data collected for the confirmation, investigation or closure of a petroleum release must be collected by people who are trained in the applicable SOPs for data collection and processing. DEQ personnel and consultants should be trained and familiar with all applicable SOPs, project QA documents (QAPs, SAPs, Workplans) and should keep these documents for reference during monitoring. Whenever feasible, an experienced professional will accompany inexperienced staff during initial sampling events until each field personnel demonstrates proficiency. All sampling personnel should adhere to safety protocols. DEQ staff are required to have Hazardous Waste Operations and Emergency Response (HAZWOPER) training.

1.6 Documentation and Records

Field sampling information will be maintained in facility files and/or in field logbooks that will contain all information pertinent to each sampling event. The information recorded by the sampler should include at a minimum:

A. Date;
B. Site name, location, and facility ID and release numbers;
C. Site description including weather conditions and photo documentation;
D. Name of sampler;
E. Purpose of sampling;
F. Sample number, type, location, and time of collection;
G. Type(s) of sample containers and preservatives used;
H. Field stabilization data, including pH, conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP), temperature, and turbidity, with instrument model and number, and calibration results.
I. Chain-of-custody information including sample number, date and time of collection, place of collection, environmental matrix, sample container, preservation method, signature of the collector, and signature and dates of persons involved in the transportation and handling of the sample.
J. Documentation of sample storage on ice in a cooler for transport.

DEQ will maintain final reports including technical review documentation, raw data, data collection sheets (as specified above), calculations, instrument calibration records, and QA information.

DEQ is beginning to utilize EQuIS and at the DEQ project manager's request, all field and laboratory data must be reported using the Montana EQuIS electronic data deliverables (EDD) format and submitted directly to DEQ's Montana EQuIS database after validation by contractor. Contractor must use the EQuIS Data Processor (EDP), along with client Reference Value files (.rvf), and client EDP Format files to check EDDs for errors and warnings prior to submission to DEQ. Contractor must review all Error Logs provided by Montana EQuIS, fix any identified errors in the EDDs, and resubmit the checked EDDs with the Error Log showing no errors. Upon successful completion of EDD submissions, Contractor will receive an electronic receipt confirmation (Error Logs) generated by Montana EQuIS. Contractor must submit (via email or FTP/FTPS) checked EDDs and error log showing no errors to DEQ's liaison. In addition, electronic results (sample list, analytical summary, lab results, quality assurance and control (QA/QC) report, scanned SVF/COC or COC), and data validation checklist/report must be submitted electronically to DEQ in a PDF format. Contractor will submit analytical data and required associated PDF documents to DEQ via email, FTP/FTPS, direct upload (as appropriate) within 30 days of receipt of the data from the laboratory. Electronic data deliverables (EDDs) must be submitted into a compatible format with the DEQ's eWQX database located at https://deq.mt.gov/cleanupandrec/resources .

2.0 Measurement/Data Acquisition

2.1 Sampling Process Design

Investigations at UST sites in response to known or suspect releases require chemical and physical analyses of soil, groundwater, and air samples collected on site. The data obtained serves as the basis for the evaluation of impacts to soil and potential drinking water supplies and in the assessment of actual and potential impacts to human health and the environment. Data obtained from soil, groundwater, and air samples at UST sites must be accurate and representative of site conditions.

Environmental samples must be collected during UST closure, subsurface investigations, and after corrective actions at PTC sites. All samples must be analyzed by an accredited laboratory. Soil samples may also be collected and analyzed for soil type and classification (e.g., the Unified Soil Classification System). The following is a brief discussion of factors for determining sample location, soil, groundwater, and air sampling protocol, and other considerations in sampling.

2.1.1 UST Closure Sampling Locations

Sample locations associated with UST site assessment should conform with ARM 17.56.703 (Appendix A). **UST closure sampling must comply with the Waste and Underground Storage Tank Management Bureau (WUSTMB) permit requirements**.

For UST removals, the minimum number of closure sample locations depend on the number and capacities of tanks at the site and whether groundwater is encountered during excavation. If no groundwater is encountered, one soil sample must be collected 1 to 2 feet below each end of a single tank equal to or greater than 600 gallons in capacity, for a minimum of two samples per tank. A minimum of one soil sample must be collected at a depth of 1 to 2 feet below the center of each tank having a capacity less than 600 gallons. Samples should be collected as soon as possible after the tank has been removed.

- If groundwater is encountered at the base of the excavation, at least one groundwater grab sample should be collected. When groundwater is encountered, soil sample(s) should be collected from the unsaturated zone immediately above the soil-water interface. Groundwater samples must be collected using proper surface water collection techniques or from a properly installed groundwater monitoring well.

For piping removals, required soil samples must be collected at the base of the piping trench at suspected worst-case locations and one sample taken for every 20 feet of piping. Up to five piping trench samples may be composited into a single sample if there is no qualitative evidence of petroleum contamination. Samples should be collected as soon as possible after the piping has been removed.

- If groundwater is encountered at the base of the excavation or trench, soil samples should be collected from the unsaturated zone immediately above the soil-water interface and a groundwater sample should be collected using proper surface water collection techniques or from a properly installed groundwater monitoring well.

Other closure samples required include suspected worst-case locations which may include:

- areas around the tank, and piping that record the highest concentrations of hydrocarbon vapor recorded with vapor monitoring instruments,
- areas around the tank and piping that look stained or discolored,
- the lowest point of the base of the tank,
- where the tank meets the piping, and
- beneath fill lines and vent piping.

2.1.2. Subsurface Investigation Sampling Locations

Soil borings and monitoring wells are installed as part of subsurface investigations to assess the magnitude and delineate the lateral and vertical extent of contamination at LUST sites. Decisions on the location and number of soil borings and monitoring wells must be made in consultation with the DEQ project manager and will be based on site-specific information. At some sites three or four soil borings may be adequate to delineate the extent of contamination, while at other sites a dozen or more borings may be required. Soil samples shall be collected and screened in the field using the heated headspace method with a photoionization detector (PID) or flame ionization detector (FID). A minimum of one soil sample from each boring is to be sent to a laboratory for analysis, regardless of depth of the boring. One soil sample shall be collected from the soil/groundwater interface, or the bottom of the soil boring if groundwater is not encountered. A second sample must be collected from the zone of worst contamination as determined by the heated headspace sampling. If the soil/groundwater interface is the zone of worst contamination, then one soil sample may be sufficient. More samples may be required if there are multiple zones of contamination.

Groundwater monitoring wells are required at sites where groundwater may be impacted. Generally, a minimum of three groundwater-monitoring wells is necessary to define the groundwater flow direction. In practice, more than three wells are typically necessary so that at least one monitoring well is directly down gradient from the source of the contamination. A down gradient monitoring well is necessary to demonstrate if contamination remains onsite or has migrated off site. Conversely, an up gradient well will demonstrate if contamination is moving on to the site from an off-site source. Both down gradient and upgradient wells can provide water quality data for natural attenuation determinations. Well installation and abandonment must be conducted in accordance with the Montana Department of Natural Resources (DNRC) Board of Water Well Contractors specifications.

If soil borings or wells are emplaced, the following information is required:

A. The type of drilling equipment and decontamination procedures used, and detailed geologic boring logs as described in the Montana Remedial Investigation Guidance for Petroleum Releases with an appropriate vertical scale;
B. As-built drawings showing: well and/or boring identification number; total depth of well and boring; well construction materials including casing screen type, length, slot size, and filter pack material and particle size; location of the bentonite seal, sample locations for soil or groundwater; and any organic vapor meter measurements;
C. The type and placement of extraction pumps, if applicable;
D. Identification of the depth of groundwater encountered at the site during sampling or investigation; and
E. Description of the volume of purge water generated and the procedures used to dispose of drill cuttings, purged water or other waste materials generated during any phase of the work at the release site.

2.1.3 Corrective Action Confirmation Sampling Locations

Corrective action confirmation samples are samples that are collected to demonstrate that cleanup goals have been achieved after corrective action at the site is thought to be complete. The number and locations of samples must be determined in consultation with and approved by the DEQ project manager and are usually based on the following information:

A. Confirmation samples (soil, groundwater, etc.) are required any time contamination is removed from the subsurface or release site area;

B. At least one soil sample should be collected and analyzed from each sidewall and the pit bottom of an excavation pit after over-excavation is complete; and
C. Groundwater samples should be collected from monitoring wells at a site after groundwater remediation is complete as determined by the DEQ project manager.

2.1.4 Soil Sampling

Sampling and analysis of soils is an integral part of the investigation and evaluation at petroleum release sites. Numerous methodologies can be utilized in the collection of surface and subsurface soils to help determine the extent and magnitude of contamination at LUST sites. These methodologies may include, but are not limited to: grab samples, hand augers, direct push including Geoprobes®, rotosonic and hollow stem auger drill rigs with split spoons, etc. Care should be taken to ensure the cleanliness of all sampling equipment. To minimize or avoid cross-contamination, all non-disposable sampling equipment must be cleaned and properly stored/handled between sample locations. An acceptable decontamination protocol should be included in the firm's Standard Operating Procedure (SOP) documents included in the DEQ approved work plan and strictly adhered to.

Montana Risk-Based Corrective Action Guidance for Petroleum Releases (Appendix B) should be consulted to determine the appropriate analytical requirements for individual samples. Sampling procedures must be conducted in a manner that minimizes the loss of volatile organic compounds (VOCs). Bulk soil sample containers must be filled to limit air or head- space between the soil and the cap. Soil samples preserved in the field with methanol are usually collected as 5 to 25 grams of soil at a ratio of 1 gram soil/1 mL methanol such that the soil is completely immersed in methanol. All samples should be preserved with ice (cooled to 4 degrees Centigrade) and shipped to an approved laboratory as soon as reasonably possible after sampling. The maximum holding time referenced in the RBCA Guidance from sample collection to analysis may not be exceeded.

Photo-ionization detectors (PID) and flame ionization detectors (FID) are commonly used organic vapor analyzers. Field screening using a PID/FID is necessary for the protection of worker health as well as screening of environmental samples. Field screening results aid in the determination of which samples to analyze and provide the relative concentrations of organic vapors that the samples may contain.

2.1.5 Groundwater Sampling

Several methodologies may be employed in the collection of groundwater samples. They include, but are not limited to, low-flow sampling, multiple volume purge sampling, no purge sampling, and passive sampling. Guidelines for using these methods are outlined in detail in the DEQ CSCB Groundwater Sampling Guidance (Appendix B*).* In general, the following requirements are necessary during groundwater sample acquisition.

Prior to initiating sampling activities at a given location, depth to water should be measured at existing monitoring wells. The static water level in a well will be measured using an electronic water-level indicator or an electronic oil/water interface probe to the nearest one hundredth of a foot (0.01 foot). The water level will be measured from a scribed mark at the top of the steel or PVC well casing that corresponds to the point at which the elevation for the well was surveyed. All measurements will be recorded. If non-aqueous phase liquid (NAPL) is suspected or verified during water level measurement, an interface probe should be used to measure the depth to NAPL and depth to NAPL/water interface. If NAPL is present, consult with the DEQ project manager prior to purging.

Monitoring wells should be evacuated and sampled beginning with the least contaminated and proceeding to the most contaminated well to minimize the potential for cross-contamination. The sampling order of

the wells from least to most contaminated should be based on historical data or knowledge of the existing site conditions. Purge water should be handled in a manner consistent with the Disposal of Untreated Purge Water from Monitoring Wells flowchart (Appendix B).

Collection of field parameters is necessary during collection of groundwater samples to help ensure the validity of the sample results. These parameters should include pH, temperature, conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity. During low-flow sampling, the depth-to-water should be measured routinely during purging to assess drawdown. Field meters used during sampling will be checked for calibration consistent with manufacturer-recommended procedures. At a minimum, field instrument and equipment calibration should be conducted daily. Calibration is the process of establishing a relationship of a measured output to a known input and provides a point of reference to which other sample analyses can be correlated. More frequent calibration will be conducted as necessary, based on instrument performance checks and operator judgment. All calibrations will be performed using standard industry practices and/or equipment manufacturer recommendations.

Care should be taken to ensure the cleanliness of all sampling equipment. Non-disposable sampling equipment should be decontaminated between each location. An acceptable decontamination protocol must be included in the firm's SOP documents included in the DEQ approved work plan and strictly adhered to.

Prior to mobilization to the site, the RBCA Guidance should be consulted to determine the appropriate analytical requirements for individual samples, ensure the appropriate sample containers are available, and arrange for shipping such that maximum holding times from sample collection to analysis are not exceeded. Sampling consistency will produce repeatable results and data of a higher quality. Multiple purging methods will not be accepted at a site unless approval is granted by DEQ. The collected sample should be of sufficient volume to fill the sampling container to its recommended level. For a VOA sample, no air should be allowed between the liquid surface and the lid of the container. Also refer to the DEQ CSCB Groundwater Sampling Guidance (Appendix B) for considerations on field filter use.

2.1.6. Vapor/Air Sampling

Vapor/air sampling is often utilized to determine potential impacts to human health and the environment. Several different types of environmental samples may be collected: soil vapor samples, near-slab soil vapor samples, sub-slab vapor samples, samples from the air found in crawl spaces, indoor air samples, and outdoor air (sometimes referred to as "ambient air") samples. Additional information pertaining to vapor/air sampling methods and procedures can be found in the Montana Department of Environmental Quality's Montana Vapor Intrusion Guide, dated April 22, 2011.

Soil vapor/soil gas samples are collected to characterize the nature and extent of vapor contamination in the soil in a given area. They may be collected before sub-slab vapor and/or indoor air samples to help identify buildings or groups of buildings that need to be sampled. Soil gas samples are used to determine the potential for vapors to accumulate beneath buildings. Soil gas samples are also used on undeveloped properties (no structures) to determine the possibility of vapor intrusion in future structures. Near-slab soil gas samples are samples collected from borings or probes installed outside of a structure and generally within 10 feet of the structure where a sub-slab sample may not be feasible.

Please note that soil gas samples are not the same as soil samples. Soil gas samples only assess contamination present in the soil vapor between the soil particles. Soil samples measure the total amount of contamination present in the soil, including that which adheres to soil particles and is not detected in a soil vapor sample (e.g. metals).

Sub-slab vapor samples are collected to characterize the nature and extent of vapor contamination in the soil immediately beneath a building with a slab. In buildings without a slab, crawl space air and/or soil gas samples may be collected below the building. Sub-slab vapor results are used to determine the potential for vapor intrusion as are soil gas samples collected from beneath buildings without slabs.

Indoor air samples are collected to characterize the nature and extent of vapors within a building. Indoor air sample results help to evaluate whether vapors are currently migrating into a building. They are also compared to sub-slab vapor and outdoor ambient air results to help determine potential sources of volatile chemicals (e.g., indoor sources, outdoor sources, and/or beneath the building).

Outdoor ambient air samples are collected to characterize site-specific background air conditions. Outdoor air results are used to evaluate the extent to which outdoor sources, such as automobiles, lawn mowers, oil storage tanks, gasoline stations, commercial/industrial facilities, and so forth, may be affecting indoor air quality.

In addition to the types of air sampling mentioned above, vapor/air samples may also be collected from remediation systems (e.g., soil vapor extraction systems) to determine system performance and efficiency. Field screening air samples using a PID/FID can aid in qualitatively determining the extent and magnitude of impacts to soil and groundwater, but more quantitative results are obtained through proper sample collection and laboratory sample analysis.

Air sampling procedures must be conducted in a manner that minimizes the loss of volatile organic compounds (VOCs). The sample container should be shipped to an approved laboratory as soon as reasonably possible after sampling. The maximum holding time from sample collection to analysis may not be exceeded. Refer to the Montana Vapor Intrusion Guide for details on sample collection, appropriate sample containers, holding times, and laboratory analytical methods.

2.2 Sampling Methods Requirements

Sampling will be conducted following the protocol established in A Guide for Field Samplers (EPA Region VIII ESD, 1980), Standard Operating Procedures for Field Samplers (EPA Region VIII ESD, 1986), Samplers and Sampling Procedures for Hazardous Waste Streams (January 1980, EPA document 600/2-80-018), Sampling for Hazardous Materials (course book EPA course 165.9, EPA Hazardous Response Support Division, Cincinnati, Ohio), and National Handbook of Recommended Methods for Water Data Acquisition (revised), U.S. EPA et al, 1984.

Samples must be collected using equipment that has been properly decontaminated and procedures appropriate to site-specific factors including the matrix, the parameters to be analyzed, and the sampling objective.

The volume of the sample collected must be sufficient to perform the analyses requested, as well as the QA/QC requirements. Sample volumes, container types, and preservation techniques should also be confirmed with the approved laboratory.

The RBCA Guidance and the Montana Vapor Intrusion Guide contain the required analytical methods for soil, groundwater, and vapor/air sampling.

Before leaving the facility, the sampler should:

A. Check all paperwork for accuracy and completeness.
B. Match the physical samples with the paperwork. The sampler should check for proper samples in the correct containers and that the field numbers on the samples correspond with the numbers on

the sample request forms.

C. Verify that samples are properly stored and secure for transport.
D. Clean and package all non-disposable equipment.
E. Make sure the items on the sample tags, request forms, chain-of-custody record, and log book match.
F. Bag all disposable items that need to be discarded.
G. Ensure that all sample containers are free of any debris.

2.3 Sample Handling and Custody Requirements

For analytical results to be defensible, a chain-of-custody must be established for all samples collected. Chain-of-custody must demonstrate that samples have not been tampered with during collection, transfer, storage, or analysis. This requires custody of the samples be documented from the time the samples are collected.

A sample is under custody if:

A. It is in the person's possession, or
B. It is in the person's view, after being in the person's possession, or
C. It was in the person's possession and then it was locked up or placed in a sealed container to prevent tampering, or
D. It is in a designated secure area.

Coordination with an Analytical Laboratory

The sampler should contact a laboratory before sampling to verify that the lab is capable of conducting the sample analysis within the holding time specified and can attain the appropriate reporting limits so results can be compared to screening levels. DEQ has contracts with both Energy and Pace labs and can supply supporting information upon request (MDL, LRLs). The lab will often provide containers and preservatives for sampling or require specific containers be purchased for sampling. Upon requests, labs will provide coolers for shipping, plastic bags for ice containment, temperature blanks, trip blanks, chain of custody forms, chain of custody seals, labels, etc.

Preservation and Shipping Procedures

Soil and water samples must be placed on ice immediately after collection to minimize the loss of volatiles. Please see RBCA, table A and table D for soil and water methods, container, sample handling, preservation and holding times. Please see the Montana Vapor Intrusion Guide for vapor analytical methods, containers, sample handling, preservation, and holding times. Once the sampling is complete and the sampler has left the site, chain-of-custody must be maintained and properly documented. Preferably, soil, groundwater and air samples should be transported directly to the laboratory by the sampler or representative. When shipping is required, the samples must be placed in a container acceptable to both the laboratory and the carrier. Dry ice should not be used when shipping water samples to prevent the samples from freezing and breaking the glass containers. When shipping samples of a NAPL, space should be left in the top of the container to prevent breakage of the glass container from expansion that can occur during transport.

2.4 Analytical Methods Requirements

All SAPs must list the analytical methods and associated reporting limits required for the project for each sample matrix and analyte and specify which analytical lab(s) samples will be sent to for analysis. Analytical methods will be selected that provide comparable, sensitive, and accurate data for the sample matrix and range of expected values for the constituents being analyzed. Approved and published

methods from EPA or another accepted entity (such as Standard Methods, Massachusetts Method) will be used whenever possible. Other analytical methods must be reviewed and approved by the QA Officer and program managers before use. It is important that method detection limits be at or below the screening levels (Section 1.4) applicable to a project.

RBCA details the analytical methods that will be applied to most Petroleum Tank projects. Analytical methods that differ from those in RBCA, must be pre-approved by the QA Officer.

It is the responsibility of the laboratory to provide analytical results conforming to the requirements of the methods that they perform. Where a substantial modification to a recognized method is being performed, the reference must note this by including "mod" or "modified" following the method citation. The State of Montana has a term contract for environmental services, including analytical laboratories; DEQ specifies in work orders or other contractual agreements, the specific analytical requirements per project. Each laboratory used for analytical services must have documented analytical method protocols available for review. Biological contractors must report taxonomic names that correspond exactly to valid entries in the Integrated Taxonomic Information System (ITIS) database, as this is the approved reference list.

If project personnel will perform any sample processing or analysis, the protocols must be cited or described in the project SAP, including applicable equipment, sample preparation and/or extraction methods, and waste disposal.

2.5 Quality Control Requirements

Field Quality Control Samples

QC activities are completed in the field to help ensure DQOs are met and to assess reliability and confidence in the data. These include actions taken by field personnel to review and perform QC checks on tasks completed in the field, as well as QC samples such as duplicates and blanks which are used to evaluate precision, accuracy, and to detect potential contamination. Project-specific SAPs may specify a higher frequency of QC sample collection than listed below. When determining the appropriate type and frequency of field QC samples to include in a sampling plan, project managers will consider the composition and expertise of field crews, variability in likely contamination among sampling sites, frequency and timing of sample delivery, budgetary restrictions, and other factors.

Field QC Checks: Prior to departure from the field, field personnel must perform a QC review of all field forms for completeness and accuracy. Subsequent QC review of field forms is performed upon return from the field by the project manager and data management personnel. QC checks will ensure that all samples are recorded on the chain-of-custody form, location information is complete, units are indicated, and all forms are present. Samples will also be reviewed to ensure all labels are intact and legible and all samples are accounted for. The laboratory will check and record the temperature of each batch of samples upon receipt to ensure holding temperatures were maintained.

Field Duplicates: Field duplicates are two collocated samples collected as close as possible to the same time and place by the same person and carried through identical sampling and analytical procedures. Field duplicate samples are collected at a rate of one in twenty field samples and ideally one per sampling event. Precision is assessed by ensuring that relative percent difference (RPD) between duplicates greater than five times the LRL is less than 30% for water and less than or equal to 50% for soil, or less than the RSD specified in the method for water and soil (where greater than 30 or 50%, respectively) (Section 1.4). If the RPD of field duplicates is greater than required and the parent and duplicate result values are

greater than five times the lower reporting limit, the result values will be flagged with a "J". Following initial field preparation, all duplicate samples will be handled in the same manner as all other samples being analyzed for the same parameter. Identification will be fictitious but consistent with the identification of principal study samples. Duplicates will be collected on a site-specific basis and may not be required at all sites investigated.

Field Blanks: Field blanks will be submitted to the laboratory for analysis after being prepared in the field by filling the appropriate container with analyte-free, laboratory grade sand, soil, or deionized water using the same handling techniques/containers as used for other samples. Field blanks should ideally be submitted at a rate of one per day per sampling event. Field blanks are used to evaluate sample contamination from field handling, transport and storage. Criteria for acceptance are below the lower reporting limit of any analyte being tested for at a site. Field blanks will be collected on a site-specific basis and may not be required at all sites investigated.

Trip Blanks: Trip blanks are required only when sampling for volatile organics. Trip blanks are prepared in the laboratory prior to sampling by filling the appropriate container with distilled/deionized water. The trip blank is transported to the field, handled in the same manner as the other VOC samples, and submitted to the lab with the other samples for analysis. A minimum of one trip blank should be analyzed per VOC sampling excursion. Criteria for acceptance are below the lower reporting limits of any analyte being tested for at a site.

Equipment Blanks: Equipment blanks are prepared in the field by collecting analyte-free, laboratory-grade deionized water in sample containers after the water has been used to rinse decontaminated equipment prior to sampling. Equipment blanks may be collected at a rate of one per day per sampling device unless dedicated or disposable sampling equipment is used. Criteria for acceptance are below lower reporting limits of any analyte being tested for at a site.

Split Samples: Split samples are field samples collected from the same location but sent to an alternate lab for analysis. Split samples will be selected on a site-specific basis but should be collected at a minimum of two per site when utilized. The acceptance criteria for the results from the two laboratories will be the intra-laboratory precision indicated in the referenced analytical methods (e.g., Standard Methods) for any sample results >5x the laboratories' MDL. For methods without an intra-laboratory precision value, field duplicate precision criteria will apply.
Laboratory Quality Control:

DEQ contract laboratories are accredited under national programs, and/or their quality system is known and meets the QA requirements specified in this document. Laboratories analyzing samples under this QAP are responsible for providing personnel qualified for the methods requested and for adhering to their Laboratory Quality assurance Plan (LQAP).

In lieu of formal laboratory accreditation/certification, DEQ includes a list of acceptable evaluations of competency and documentation in the agency QMP (DEQ, 2019a), including:

1. Results from on-going performance testing programs or studies,
2. Reports from technical or quality systems assessments of documentation such as laboratory QAPPs and SOPs, and descriptions of applicable instrumentation, sampling equipment, method sensitivities, data reporting processes, capacity, experience, staff education and experience, etc.,
3. Agency on-site evaluation or selective proficiency tests on specific parameters compared to national proficiency tests such as EPA's Water Supply and Water Pollution studies, or
4. Results from an independent proficiency testing vendor.

Matrix Spike/Matrix Spike Duplicates: Spiked samples are prepared in the lab by adding a known

concentration of target analyte to a matrix sample. Spiked samples are used to evaluate the effect of the matrix on the recovery efficiency of the analytical method. Spike concentrations should be 3 to 5 times the parent sample concentration, or 20 to 50 times the MDL.

Lab duplicate: A lab duplicate is a sample that is split into subsamples at the lab. Each subsample is then analyzed and the results compared. They are used to test the precision of the laboratory measurements and acceptance criteria are method-specific.

Method blanks: Method blanks (also known as reagent blanks) are used to assess possible contamination during sample preparation and processing. Method blanks must be processed along with and under the same conditions as the associated samples to include all steps of the analytical procedure. Method Blanks must be analyzed at a minimum of one per preparation batch with a maximum batch size of 20 environmental samples of the same matrix.

Laboratory Control Samples: Laboratory control samples (LCS) assess the laboratory performance to successfully recover target analytes from a control matrix and report unbiased measurements. LCS are spiked at 10 to 20 times the MDL to reflect the methods' ability to accurately measure low-level concentrations of the target analyte. LCS results are compared to method acceptance criteria which usually include both accuracy or bias (% recovery) and precision (% RPD – or reproducibility) measurements. LCS are processed along with samples and are analyzed at a minimum of 1 per preparation batch with a maximum batch size of 20 samples of the same matrix. All samples associated with an out-of-control LCS must be reanalyzed.

Continuing Calibration Verification Standard: Laboratories analyze calibration standards and develop calibration curves for all applicable methods. The initial calibration should be continuously monitored by analyzing a continuing calibration standard every 10 to 20 samples, or within a specified time frequency, and at the end of each analytical sequence, depending on the method and instrumentation. Results must be within an established range as described by the method SOP. Initial calibrations are verified against a standard from a second source.

Performance-evaluation Samples: Performance-evaluation samples are prepared by a third party with a concentration of analytes that will be known by the submitter but unknown to the lab. The Performance-evaluation samples should be submitted at a rate of one per analyte of interest. Criteria for acceptance are 80% to 120% recovery, or as specified in the method

2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Preventive maintenance tasks and schedules recommended by the manufacturers will be conducted and followed for all field instrumentation. Records of preventive maintenance performed will be maintained. The project manager will ensure the prescribed maintenance on field instrumentation is conducted.

Preventive maintenance procedures for laboratory equipment are the responsibility of the laboratories and must be documented in laboratory protocols that will be monitored periodically.

2.7 Instrument Calibration and Frequency

Laboratory calibrations will be conducted according to instrument user manuals or SOPs. Equipment used for field measurements will be calibrated according to manufacturer's specifications. The project manager is responsible for recording calibration procedures for each sampling event.

3.0 Assessment/Oversight

3.1 Assessments and Response Actions

Performance audits by PTC staff will be conducted periodically to evaluate whether samplers are adhering to the QA/QC controls identified herein, including the proper execution and use of sample identification, sample control, chain-of-custody procedures, documentation, and sampling procedures.

Analytical results meeting data quality objectives (DQOs), section 1.4 and further outlined in each SAP, will be accepted. If QC samples are outside acceptance criteria, they will be evaluated by including field QC sets with internal laboratory QC samples. If combined sets meet acceptance criteria the data will be accepted. All analyzed data still not meeting acceptance criteria will be referred for corrective action. The corrective action may entail reanalysis of the sample(s) or QC, recalibration and reanalysis of the sample batch, re-prepping and analyzing the sample batch. Two types of corrective action reports routinely used by contract labs are the Analytical Non-Conformance Report and a Corrective Action Report.

Implementation of QC requirements for sampling is the responsibility of the person carrying out the sampling. Persons carrying out the sampling will follow the sampling procedures described in Section 2 of this document. Analytical data will be reviewed by individual DEQ site project managers, and if necessary, the PTC Program QAO, the PTC supervisor or the CSCB Chief.

The PTC program agrees to allow the EPA Project Officer and the EPA Quality Assurance Staff to have access to oversee the field collection and the laboratory procedures.

3.2 Reports to Management

Site-specific QA/QC information will be included in the appropriate facility files from each sampling event. For each facility, the final summary of reported data from the laboratory will reflect all laboratory QA/QC measures taken. If further reporting and clarification is necessary, the laboratory QA chemist will prepare a report detailing recommendations and submit the report with the data to the PTC project manager who will share it with the QAO. These individuals will review the QA recommendations and take necessary corrective actions.

4.0 Data Validation & Usability

The level of detail and frequency with which data is reviewed, verified, and validated may be scaled to the importance of the intended decisions to be made based on the data.

4.1 Data Review, Validation, and Verification Requirements

Data review, verification and validation procedures will focus on determining if the data meets DQOs and other specifications in this QAP and the project specific SAP. Specifically, the PTC project managers will routinely review sampling, calibration, field measurement, field logging, and chain-of-custody procedures. Where possible, generated data will be compared with previous data to evaluate consistency. Any data generated outside standard protocol will be either rejected or identified with the inconsistency. The PTC DQO will be consulted on any abnormal findings.

4.2 Validation and Verification Methods (Data Analysis, Validation and Reporting)

Field Form QC Review

Field personnel will perform a QC review of field forms to ensure they have been filled out completely and accurately prior to departure from the field. Subsequent review of field forms may be completed upon return from the field by the sample custodian or project manager, and corrections are made on original hard copies. Forms will also be reviewed to ensure chain of custody remained intact from the time of collection to the time of receipt at the laboratory.

Laboratories

Laboratories compile a data package which includes lab reports, a QA/QC Summary Report and potentially an EDD. Laboratories analyze lab QC samples and assign result qualifiers as needed. Actions taken by laboratories to review, verify, and validate data include the following:

- Visually inspect sample integrity.
- Perform a temperature check for each cooler containing samples and will record these temperatures on the site visit/chain-of-custody forms.
- Ensure COC signatures.
- Provide QA/QC summary report in data package.
- Perform lab QC and assign result qualifiers as necessary:
    - Flag dilutions (D flag)
    - Flag holding times if exceeded and record to the minute (H flag)
    - Measure cooler temperatures upon receipt and report temperatures in QA/QC summary report notes in EDD.
    - Flag result values that are > MDL and ≤ LRL as estimates (J flag) (result comment "Result between MDL and LRL, J flagged as estimate).
    - Flag results when the lowest LRL they could achieve is higher than the RRL in the SAP (L flag)
    - Identify detections ("hits") in blanks.
    - Add activity comments to distinguish duplicate samples ("duplicate to…")
    - Indicate instances in the QA/QC summary report if lab QC samples (laboratory control samples, blanks, duplicates, matrix spikes) were outside the required control limits.
- Use EQuIS Data Processor (EDP) application to validate EDD formatting; review error logs, fix any identified errors, and submit error-free EDD.

The EDP is a standalone application that must be used by data providers to check their EDD files prior to submission to the MT-eWQX database. The EDP performs a series of formatting checks on the EDD and then identifies any records that have errors, including required fields, field length, data types, valid reference values, duplicate rows, etc. Prior to submitting EDDs to DEQ, laboratories must use the EDP, along with client Reference Value files (.rvf), and client EDP Format files, to check EDDs for errors, and must submit checked EDDs according to established upload procedures (e.g., via email, FTP file transfer service, direct upload to Enterprise). The laboratories must review all Error Logs, fix any identified errors in the EDDs, and resubmit the checked EDDs with the Error Log showing no errors.

Table 4: Result Qualifier Descriptions	
Result Qualifier	**Description**
B	Detection in method or field blank.
D	Contract Required Quantitation Limit (CRQL) not met due to sample matrix interference, dilution required.
H	Holding time exceeded.
J	Estimated[1]: The analyte was positively identified, and the associated numerical value is the approximate concentration of the analyte in the sample.
L	Lowest available reporting limit for the analytical method used
R	Rejected: The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.
U	Not Detected: Analyzed but not detected at a level ≥ the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.

Project Managers

DEQ project managers routinely verify laboratory results against the QC limits specified in this document and/or by using the DEQ Data Validation Checklist.

4.3 Reconciliation and User Requirements

Data will be evaluated for suitability for its intended use by DEQ POs before it is applied to decision-making. The DQOs described in Section 1.4 (precision, accuracy, representativeness, comparability, completeness, and sensitivity) are used as expressions of data quality and will be verified by reviewing the data package (including QC samples such as duplicates, blanks, spikes) against the specifications and limits in this document or other QAPPs.

Where data fails, corrective action will be taken as described in section 3.1.

5.0 References

Administrative Rules of Montana (ARM) 17.56.703; http://deq.mt.gov/dir/legal/Chapters/Ch56-07.pdf

Data Validation Summary Form (DEQ Waste Management and Remediation Division, 2018)

Definition and Procedure for the Determination of the Method Detection Limit, Revision 2 (EPA 821-R-16-006, December 2016)

Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters and Analyzed By Gas Chromatography/Mass Spectrometry (GC/MS), Environmental Protection Agency, January 1999. http://www.epa.gov/ttnamti1/files/ambient/airtox/to-15r.pdf

Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes, Environmental Protection Agency, January 1999. http://www.epa.gov/ttnamti1/files/ambient/airtox/to-17r.pdf

Final Rule and Interim Final Rule and Proposed Rule (40 CFR Part 136 - Federal Register, Friday, October 26, 1984, current edition of standard methods)

Groundwater Sampling Guidance (DEQ Contaminated Site Cleanup Bureau, 2018)

A Guide for Field Samplers (EPA Region VIII ESD, 1980)

Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act

Hazardous Substance List (HSL) compounds (as defined by the federal Comprehensive Environmental Responsibility, Compensation, and Liability Act, Section 101[14])

Massachusetts Method for the Determination of Volatile Petroleum Hydrocarbons (VPH), Massachusetts Department of Environmental Protection, May 2004

Massachusetts Method for the Determination of Extractable Petroleum Hydrocarbons (EPH), Massachusetts Department of Environmental Protection, May 2004

Massachusetts Method for the Determination of Air-Phase Petroleum Hydrocarbons (APH), Massachusetts Department of Environmental Protection, December 2008

Methods for Chemical Analysis of Water and Wastes (EPA-600/4-79-020)

Montana Department of Natural Resources (DNRC) Board of Water Well Contractors, March 1997

Montana Solid and Hazardous Waste Act (Title 26, Chapter 14, Montana Code Annotated 1953)

Montana Risk-Based Corrective Action Guidance for Petroleum Releases, MDEQ, May 2018

Montana Vapor Intrusion Guide, MDEQ, September 2021

Procedures for Preparing Blind Duplicate and Spiked Field Samples in Water, Document Control R8-QAO-82-SOP-011, EPA

Sampling for Hazardous Materials (course book EPA course 165.9, EPA Hazardous Response Support Division, Cincinnati, Ohio)

Samplers and Sampling Procedures for Hazardous Waste Streams (January 1980, EPA document 600/2-80-018)

Standard Methods for the Examination of Water and Wastewater, 16th Edition, APHA, et al., 1985

Standard Operating Procedures for Field Samplers (EPA Region VIII ESD, 1986)

Test Methods for Evaluating Solid Waste (SW846, Second Edition and its subsequent revisions), 40 CFR 136, October 26, 1984, EPA

Test Methods For Evaluating Solid Waste (SW 846, Third Edition, 1996), EPA

Appendix A

Administrative Rules of Montana (ARM)

17.56.504, and

17.56.703

Appendix B

Links to Technical Guidance Documents

Data Validation Summary Form, available under the Technical Guidance Documents section of the "Guidance" drop-down at: https://deq.mt.gov/cleanupandrec/Programs/petrocleanup

Disposal of Untreated Purge Water from Monitoring Wells, available under the Technical Guidance Documents section of the "Guidance" drop-down at: https://deq.mt.gov/cleanupandrec/Programs/petrocleanup

Groundwater Sampling Guidance, available under the Technical Guidance Documents section of the "Guidance" drop-down at: https://deq.mt.gov/cleanupandrec/Programs/petrocleanup

Montana Risk-Based Corrective Action Guidance for Petroleum Releases, available under the "Guidance" drop-down at: https://deq.mt.gov/cleanupandrec/Programs/petrocleanup