Phase II
Sampling & Analysis Plan

Frank Properties
301 North 13th Street
303 North 13th Street
1206 4th Avenue North
2nd – 3rd Avenue North/
North 12th –13th Street
Billings, Montana

Billings, Montana

BIG SKY ECONOMIC DEVELOPMENT
EDA · EDC CREATING MONTANA BUSINESS OPPORTUNITIES

November 2015

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PHASE II ENVIRONMENTAL SITE ASSESSMENT DRAFT SAMPLING & ANALYSIS PLAN

Frank Properties
301 North 13th Street
303 North 13th Street
1206 4th Avenue North
212 North 13th Street (City Block between 2nd – 3rd Avenues North/North 12th – 13th Streets)
Billings, Montana 59101

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NewFields

November 2015
Project No. 350.0181.000

PHASE II ENVIRONMENTAL SITE ASSESSMENT
DRAFT SAMPLING AND ANALYSIS PLAN

Frank Properties
Billings, Montana

Issued: November 19, 2015
(Version 1)

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1.0 INTRODUCTION

NewFields Companies, LLC (NewFields) prepared this Draft Sampling and Analysis Plan (SAP) for a Phase II Environmental Site Assessment (ESA) of the Frank Properties, which consist of five parcels located at 301 North 13th Street; 303 North 13th Street; 1206 4th Avenue North; and 212 North 13th Street (city block between 2nd and 3rd Avenues North and North 12th and 13th Streets) in Billings, Montana (the Site or target property; see **Figures 1** and **2**). This SAP was prepared on behalf of the Big Sky Economic Development (BSED) using U.S. Environmental Protection Agency (EPA) Brownfields Assessment Grant funds.

A Phase I ESA for the Site (NewFields, 2015a) identified the following three Recognized Environmental Conditions (RECs), as defined by ASTM International (ASTM) Publication 1527-13 (ASTM, 2013):

REC 1. WBY, LLC (aka: Energy One Stop #3260) is a leaking underground storage tank (LUST) site located hydraulically upgradient of the target property with a petroleum groundwater plume that has undefined boundaries.

REC 2. Historical automotive repair facilities located both onsite and offsite (hydraulically upgradient) of the target property may have had releases to subsurface soil and/or groundwater.

REC 3. Floor drains located in two buildings on the target property (long warehouse and concrete warehouse) have undocumented connections and may have discharged fluids to subsurface soil and/or groundwater.

Suspect asbestos-containing building materials (ACBM) and lead-based paint (LBP) may be present in the retail store and warehouses located on the target property. These building materials do not fully meet the definition of a REC based on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) definition of hazardous substances (42 United States Code (U.S.C.) 9601 (14)), but the materials are a potential human health concern.

The purpose of the Phase II ESA is to determine whether the historic use of the Site and adjacent properties has resulted in soil and/or groundwater impacts. Additionally, this Phase II ESA will investigate whether ACBM or LBP is present in building materials on the Site.

1.1 BACKGROUND AND GENERAL SITE DESCRIPTION

The Site properties are comprised of five parcels located at 301 North 13th Street; 303 North 13th Street; 1206 4th Avenue North; and 212 North 13th Street (city block between 2nd and 3rd Avenues North and North 12th and 13th Streets) in Billings, Montana and lie in Township 01 North (T01 N), Range 26 East (R26 E), Section 33 (**Figures 1** and **2**). Billings is the largest city in Montana and is the county seat of Yellowstone County. The city has an estimated population of approximately 110,000 people and is a regional hub serving most of Montana and portions of North Dakota, South Dakota, and Wyoming. The Site is at an elevation of approximately 3,111 feet above mean sea level (amsl) and is located at the approximate latitude and longitude of 45° 47’ 34.44’’ North and 108° 29’ 18.24’’ West, respectively.

The five separate parcels that comprise the Site include an office building, store, three warehouses, and two storage yards (**Figure 2**). The storage yards contain building material overflow inventory and large agricultural supplies and equipment. The surrounding neighborhood is mixed use commercial/industrial. According to Montana's Cadastral Mapping Program (MCMP, 2015), the legal property descriptions and Geocodes for the five parcels are:

Parcel 1: 301 North 13th Street

- BILLINGS ORIGINAL TOWNSITE, S33, T01 N, R26 E, BLOCK 29, Lot 23-24; and,
- GEOCODE: 03-1033-33-1-14-04-0000

Parcel 2: 303 North 13th Street

- BILLINGS ORIGINAL TOWNSITE, S33, T01 N, R26 E, BLOCK 29, Lot 21 - 22; and,
- GEOCODE: 03-1033-33-1-14-03-0000

Parcel 3: 1206 4th Avenue North

- BILLINGS ORIGINAL TOWNSITE, S33, T01 N, R26 E, BLOCK 29, Lot 1-12; and,
- GEOCODE: 03-1033-33-1-14-01-0000

Parcel 4: Western ½ of city block between 2nd and 3rd Avenues North and North 12th and 13th Streets (212 North 13th Street)

- BILLINGS ORIGINAL TOWNSITE, S33, T01 N, R26 E, BLOCK 73, Lot 13-24; and,
- GEOCODE: 03-1033-33-1-10-02-0000

Parcel 5: Eastern ½ of city block between 2nd and 3rd Avenues North and North 12th and 13th Streets (212 North 13th Street)

- BILLINGS ORIGINAL TOWNSITE, S33, T01 N, R26 E, BLOCK 73, Lot 1-12; and,
- GEOCODE: 03-1033-33-1-10-01-0000

1.2 Geology and Hydrogeology

Near surface geology in the vicinity of the target property area is characterized by Quaternary Period alluvial sand and gravel. Underlying the unconsolidated sand/gravel unit is shale bedrock of the late Cretaceous Period Colorado Group, which is typical of the Yellowstone River valley (Olsen, 2005).

The Montana Bureau of Mines and Geology (MBMG) Ground Water Information Center (GWIC) database contains records for 84 wells in Section 33 of T01 N, R26 E (MBMG, 2015; **Appendix A**). Most of the wells identified by MBMG GWIC are reported as monitoring wells, with some domestic and

irrigation use wells. Well depths range from 13.5 to 72 feet below ground surface (ft bgs) with an average depth of 22.5 ft bgs. Static water levels (SWL) in the vicinity of the target property range from 7 to 20 ft bgs with an average SWL of approximately 12 ft bgs. Well yields in the area range from 3 to 100 gallons per minute (gpm) with an average yield of approximately 34 gpm.

Soil at the Site is mapped by the U.S. Department of Agriculture (USDA, 2015) as the Haverson-Hysham loams unit. This well-drained soil originated from alluvial parent material and has a typical profile of loam from 0 to 5 inches bgs and stratified fine sandy loam to clay loam from 5 to 68 inches bgs.

1.3 Current and Future Use of the Site and Adjoining Parcels

The Site is located in a mixed use commercial/industrial area of East Billings known as the East Billings Urban Renewal District (EBURD). Western Ranch Supply currently operates its retail business at 301 & 303 North 13th Street which contains a store building, office building, and small warehouse. Western Ranch supply uses the two large warehouses located at 1206 4th Avenue North as storage. The city block between 2nd and 3rd Avenues North and North 12th and 13th Streets (212 North 13th Street) is used as storage for building material overflow inventory and large agricultural supplies and equipment. The Site is currently listed for sale and future buyers may be interested in redeveloping the five parcels.

2.0 PHASE II INVESTIGATION

2.1 Purpose and Objective of Investigation

The purpose of this Phase II ESA is to evaluate whether RECs identified in the Phase I ESA (NewFields, 2015a) have impacted soil and/or groundwater at the Site. In addition to soil and groundwater assessment, investigation of potential ACBM and LBP associated with on-site structures will be completed to determine if these materials pose a threat to human health. The objective of this work is to allow for unencumbered future use and development of the Site.

2.2 Conceptual Site Model

The Conceptual Site Model (CSM) was developed based on findings of the Phase I ESA (NewFields, 2015a). The literature review indicated the following:

- Topography at the Site is generally flat;
- Near-surface materials are predominately fine-grained sandy silt and clay to approximately 15 ft bgs, with silty sand and gravel from 15 to 20 ft bgs;
- The water table is at a depth of approximately 12 to 15 ft bgs at the Site. The presumed groundwater flow direction beneath the Site is east-southeast towards the Yellowstone River;
- The entire Site is paved with either asphalt or concrete;
- There are structures on the three northern parcels of the Site, but none of these structures contain a basement;

- Known groundwater contamination originating from a LUST site at Energy One Stop (**Figure 2**) may be impacting soil and/or shallow groundwater at the Site (**REC 1**);
- Based on the historic presence of automotive repair facilities onsite at 301 and 303 North 13th Street, and several automotive repair facilities on surrounding (hydraulically upgradient) properties (**Figure 2**), a release of petroleum or other hazardous materials could have impacted soil and/or shallow groundwater at the Site (**REC 2**); and
- Floor drains observed in the long warehouse and concrete warehouse (**Figure 2**) were not confirmed to be connected to city sewer, and could have released petroleum and/or hazardous materials to soil and/or shallow groundwater at the Site if piping leaked or if the drains are not connected to city sewer (**REC 3**).

2.3 Contaminants of Potential Concern

Table 1 identifies the contaminants of potential concern (COPCs), potential exposure pathways and impacted media, and possible risk management strategies or options for the suspected contaminants and sources.

Table 1. Contaminants of Potential Concern (COPCs) and Conceptual Exposure Pathways

Potential Contaminant	Potential Exposure Pathways	Possible Risk Management Strategy
Extractable Petroleum Hydrocarbons (EPH) Volatile Petroleum Hydrocarbons (VPH) Resource Conservation and Recovery Act Metals (RCRA 8) Volatile Organic Compounds (VOCs) Semi-Volatile Organic Compounds (SVOCs) Asbestos Containing Building Materials (ACBM) and Lead Based Paint (LBP)	*Future commercial user* Direct contact, inhalation, or ingestion of COPCs during project site uses; media of concern includes building materials, soil, and groundwater. Exposure pathways include consumption of groundwater from future onsite wells, and direct contact or ingestion of soil. *Future construction worker* Direct contact, inhalation, or ingestion of COPCs during building renovation/demolition or soil excavation; medium of concern is building materials and subsurface soil.	Eliminate direct contact and ingestion exposure in soil and groundwater through excavation and disposal of contaminated soil. Implement administrative controls preventing domestic use of shallow groundwater. Encapsulate and manage ACBM or LBP in place.

2.4 Data Gaps and Data Quality Objectives

Based on the CSM and lack of site information, data gaps for the Site include: 1) determining whether petroleum compounds (extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH)), metals (eight Resource Conservation and Recovery Act (RCRA 8) metals), volatile organic compounds (VOCs), or semi-volatile organic compounds (SVOCs) are present in soil and/or groundwater at concentrations which pose an unacceptable human health risk; and 2) determining whether ACBM and LBP are associated with onsite buildings. The specific objectives of this ESA to address data gaps include:

- Evaluate if the offsite petroleum release at the nearby LUST site (Energy One Stop) and the offsite historic automotive repair facilities have impacted soil and/or shallow groundwater on the Site by advancing three (3) direct push borings (B-1, B-2, B-3), up to 20 feet in depth, on the northern parcels (**Figure 2**). Collect two soil samples from each boring for laboratory analysis. If groundwater is intercepted in a boring in conjunction with observed soil impacts, a grab groundwater sample will be collected from the boring(s) and analyzed to evaluate potential impacts to groundwater.
- Assess whether impacts to soil and groundwater exist from the historic automotive repair facilities that operated onsite by advancing one (1) direct push boring (B-4), up to 20 feet in depth, on the 301 North 13th Street parcel (**Figure 2**). Two soil samples will be collected from the B-4 boring for laboratory analysis. If groundwater is intercepted in conjunction with observed soil impacts, a grab groundwater sample will be collected from the boring and analyzed to evaluate potential impacts to groundwater.
- Evaluate whether petroleum/hazardous material releases from historic automotive repair facilities on adjacent properties have impacted soil and/or groundwater on the Site by advancing three (3) direct push borings (B-5, B-6, B-7), up to 20 feet in depth, on the southwest parcel located at 212 North 13th Street (**Figure 2**). Two soil samples will be collected from each boring for laboratory analysis. If groundwater is intercepted in a boring in conjunction with observed soil impacts, a grab groundwater sample will be collected from the boring(s) and analyzed to evaluate potential impacts to groundwater.
- Assess whether impacts to soil and groundwater exist from the floor drains located in the concrete warehouse and long warehouse by advancing one boring immediately adjacent-southeast of each building location. The borings (B-8 and B-9) would be advanced up to 20 ft in depth, at the approximate locations shown on **Figure 2**. Two soil samples will be collected from each boring for laboratory analysis. If groundwater is intercepted in a boring in conjunction with observed soil impacts, a grab groundwater sample will be collected from the boring(s) and analyzed to evaluate potential impacts to groundwater.
- Perform a Building Materials Inspection (BMI) on the retail store and warehouses located on the target property to determine whether ACBM and/or LBP are present.

The EPA (2006) developed the Data Quality Objectives (DQOs) Process as its recommended planning process when environmental data are used to select between alternatives or identify the extent of contamination. Specific goals of the Phase II ESA are described in Site-Specific DQOs presented in

Appendix B. The DQO Seven-Step Planning Approach developed for assessment of the Site is based upon the CSM of potential contamination (**Section 2.2**). DQOs are intended to convey the critical information needed to provide the project manager and field staff with flexible performance guidelines, and to ensure that data collected will be sufficient in both quality and quantity to support the goals of the investigation.

2.5 Scope of Work

The following subsections present the scope of work for this Phase II ESA. All fieldwork will be completed in accordance with the site-specific Health and Safety Plan (HASP) included as **Appendix C**, and the Final Quality Assurance Project Plan (QAPP) approved by EPA for BSED (NewFields, 2015b). Prior to conducting the investigation, NewFields will notify the One-Call Utility Notification Center at least 48-hours prior to conducting subsurface soil investigation activities to verify there are no underground utilities in proximity to proposed boring locations.

2.5.1 Triad Approach

NewFields will follow the EPA Triad Approach for the environmental investigation at the Site (EPA, 2004). The primary goal of the Triad Approach is to increase confidence in project decisions concerning contaminant presence, location, fate, exposure, and risk. The approach comprises three primary components: 1) Systematic Project Planning, 2) Dynamic Work Strategies, and 3) Real-Time Measurement Technologies. The Systematic Project Planning element identifies key decisions to be made with the data and establishes end goals of the project prior to initiating the investigation. Dynamic Work Strategies identify a decision logic that allows for changes to the assessment based on information obtained in the field. Real-Time Measurement Technologies provide data during completion of the fieldwork that can be used to make field decisions and adjust the investigation. Elements of the Triad Approach that were or will be used for the Phase II ESA of the Site are described below:

- NewFields used the findings of the Phase I ESA to develop a site-specific CSM (**Section 2.2**) and the scope of work (**Section 2.5**).
- This SAP was developed with the potential end use of the property in mind (i.e., potential sale, redevelopment, and continued commercial use).
- Laboratory reporting limits (described below) were compared to regulatory screening levels while developing this SAP to ensure that the data collected will allow stakeholders to make informed decisions with respect to contamination and redevelopment. This approach reduces the potential for collecting unusable data.
- The field team leader will be responsible for communicating with the project manager and will have the authority to make decisions to adapt the SAP based on observed field conditions.
- The SAP provides for the collection of additional soil and/or groundwater samples beyond those that are currently planned based on field observations in an effort to determine the extent of soil and groundwater contamination, if discovered. This approach has the following advantages: 1) allows for decisions concerning contamination extent in the field; 2) reduces costs associated with multiple remobilizations; 3) increases the amount of data and information that can be

collected during one mobilization; and 4) reduces the time and costs required for preparation of supplemental planning documents.

- NewFields will use a photoionization detector (PID) capable of providing real-time measurements of volatile organic vapor concentrations in soil samples to aid in evaluating sampling frequency, identifying the presence and relative magnitude of contamination, and determining the need for supplemental sample locations.
- All sample locations will be recorded in the field using a mapping-grade global positioning system (GPS) receiver, which reduces investigation costs by allowing rapid import of accurate investigation locations into a Geographic Information System (GIS).
- All laboratory analytical data will be provided in an electronic format, which will allow NewFields to evaluate and manage the data more efficiently.

2.5.2 Field Data Collection and Transmission

Prior to initiating fieldwork, all field staff will review this SAP and the included Standard Operating Procedures (SOPs) (**Appendix D**) to fully understand the investigative approach and data quality requirements for the investigation. Appropriate sample delivery and shipping arrangements will be made in advance of sampling to ensure samples are received by the laboratory within the required analytical method extraction timelines. A partially completed Field Investigation Planning Form showing the analytical methods, container and preservation requirements, and holding times by analytical method is included in **Appendix E,** along with Table E-1 (soil) and Table E-2 (groundwater) which provide reporting limits compared to screening levels. The planning form in **Appendix E** will be fully completed by field personnel following EPA approval of this SAP.

Field staff will record all relevant data on field logs daily in accordance with SOP-1 (**Appendix D**). The field sampling form presented in **Appendix D** will be filled out at the time of sampling. Field sampling forms will be provided to the project manager for review of accuracy prior to sample shipment. Should there be any issues concerning sampling approach, the project manager will contact field staff immediately to remedy the situation. Field log books and forms will be saved in the hard file in the NewFields' Missoula office.

All samples will be placed in coolers with ice immediately upon sample collection to ensure sample integrity and preservation. Samples will be shipped to the analytical laboratory under chain-of-custody in accordance with SOP-3 and SOP-4 (**Appendix D**). An example chain-of-custody form is included in **Appendix E**. All samples submitted to the laboratory will be analyzed on standard turnaround times of 10 working days.

Each sampling location point will be determined in the field using a mapping grade GPS with sub-meter accuracy.

2.5.3 Asbestos and Lead-Based Paint Sampling

The scope of work and SAP to evaluate for the presence of ACBM and LBP associated with on-site buildings is presented in **Appendix F**.

2.5.4 Subsurface Soil Sampling

NewFields will complete a minimum of nine soil borings using direct-push drilling techniques to evaluate whether the Energy One Stop LUST site, historic automotive repair facilities located onsite and offsite, and onsite floor drains have impacted subsurface soil and groundwater at the Site. Boring locations, shown on **Figure 2**, were selected based on downgradient proximity to the LUST site (Energy One Stop) and the former automotive repair sites, which include the offsite properties at 321 North 13th Street, 310 North 13th Street, 216 North 13th Street, 204 North 13th Street, and 1302 2nd Avenue North. Borings selected for investigating onsite floor drains were selected based on downgradient proximity to assumed floor drain discharge or piping leak locations.

Soil borings will be advanced approximately 5 feet past the anticipated depth of the water table (estimated to be 12 to 15 ft bgs), to a maximum total boring depth of up to 20 ft bgs. Soil samples from each boring will be collected in accordance with SOP-16 (**Appendix D**). NewFields will describe the subsurface conditions in each of the boreholes on individual boring logs in accordance with the Unified Soil Classification System (USCS) as described in SOP-12 (**Appendix D**). Moisture content of the soil and the presence or absence of water-saturated conditions will be noted, as well as whether petroleum sheen, odor, or free product is present. Field observations, including soil conditions, visual indications of potential contamination, and sample locations, will be recorded in a project-dedicated field log book. If groundwater is encountered in conjunction with observed soil impacts, samples will be collected as described below in **Section 2.5.5**.

Each soil sample collected from direct-push macro-cores will be field-screened for headspace with a calibrated PID in accordance with SOP-17 (**Appendix D**). Headspace results will be used to determine submittal of soil samples for laboratory analysis. One soil sample exhibiting the highest headspace concentration from each boring will be submitted for laboratory analysis and one sample from immediately above the soil-groundwater interface, if present, will be submitted for laboratory analysis.

All subsurface soil samples will be submitted to Pace Analytical Services, Inc. (Pace) in Billings, Montana for analysis of EPH, VPH, VOCs, SVOCs, and RCRA 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). All analysis will be performed by methods identified in **Table 2**. A comparison of laboratory reporting limits to applicable screening levels and standards for constituents of concern is included in **Appendix G**. Quality control (QC) samples will not be collected from subsurface soil due to the limited number of soil samples being collected, and the expected heterogeneity of the sampled media. All soil samples will be placed in ice-filled and sealed coolers for shipment to the laboratory under chain-of-custody in accordance with SOP-3 (**Appendix D**). Shipping documents will specify the laboratory analyses for each sample. Each cooler will be secured with tape and clearly display a shipping label with appropriate laboratory information in accordance with SOP-4 (**Appendix D**).

Table 2. Subsurface Soil Sampling Laboratory Analytical Methods

Contaminants of Potential Concern (COPCs)	Locations	Analytical Method
Extractable Petroleum Hydrocarbons (EPH) C9-C18 Aliphatics C19-C36 Aliphatics C11-C22 Aromatics	B-1 through B-9	Massachusetts Department of Environmental Protection (MDEP) EPH[1]
Volatile Petroleum Hydrocarbons (VPH) MTBE Benzene Toluene Ethylbenzene Xylenes Naphthalene C5-C8 Aliphatics C9-C12 Aliphatics C9-C10 Aromatics	B-1 through B-9	MDEP VPH
Volatile Organic Compounds (VOCs)[2]	B-2 through B-9	EPA Method 8260B
Semi-Volatile Organic Compounds (SVOCs)[3]	B-2 through B-9	EPA Method 8270C
RCRA 8 Metals Arsenic Barium Cadmium Chromium Lead Mercury Selenium Silver	B-2 through B-9	EPA Method 6010B /7471

[1] EPH Fractions will be analyzed if the EPH Screen result is above 200 milligrams per kilogram (mg/kg).

[2] Complete VOCs list is given in Appendix G.

[3] Complete SVOCs list is given in Appendix G.

2.5.5 Groundwater Sampling

Groundwater samples may be collected from soil borings by making a field determination to assess whether soil observed in the boring may impact groundwater, and if there is field evidence in groundwater (e.g., sheen, odor) of potential impacts. The field determination will be based on visual, olfactory, and headspace readings. If the field assessment suggests groundwater could potentially be

impacted, a grab groundwater sample will be collected from the boring. Up to nine groundwater samples could be collected for this Phase II ESA – one from each of the proposed borings.

Prior to installing a temporary screen to facilitate collection of a groundwater sample, the static water level will be measured in each borehole using a decontaminated, electronic well probe, and the results will be recorded on individual sampling logs in accordance with SOP-5 (**Appendix D**).

Groundwater samples will be collected using the direct-push rig by advancing decontaminated probe rods equipped with a stainless steel screen enclosed within a steel sheath. When the desired sampling depth is reached, the screen will be exposed to allow groundwater to flow into the screened sampling rod. Polyethylene tubing connected to a purge-and-trap bailer tip (inertial pump) will be lowered through the chamber to collect groundwater samples for laboratory analysis. Prior to collecting the samples, groundwater will be purged sufficiently from each soil boring to remove excess turbidity. Due to low purge volumes, field parameters will not be collected using the inertial pump sampling method.

Each groundwater sample will be appropriately containerized, preserved, and placed in ice-filled and sealed coolers for shipment to Pace under chain-of-custody in accordance with SOP-3 (**Appendix D**). Shipping documents will specify the laboratory analyses for each sample. Each cooler will be secured with tape and clearly display a shipping label showing laboratory information in accordance with SOP-4 (**Appendix D**). Each groundwater sample collected will be analyzed for EPH and VPH. In addition, any groundwater samples collected from borings B-2 through B-9 will also be analyzed for VOCs, SVOCs, and RCRA 8 metals (dissolved). In the event the total EPH concentration is above the Montana Department of Environmental Quality (MDEQ) screening level of 1,000 micrograms per liter (µg/L) in any sample, the sample will also be analyzed for EPH fractions.

Table 3. Groundwater Sampling Laboratory Analytical Methods

Contaminants of Potential Concern (COPCs)	Locations[1]	Analytical Method
Extractable Petroleum Hydrocarbons (EPH) C9-C18 Aliphatics C19-C36 Aliphatics C11-C22 Aromatics	B-1 through B-9	Massachusetts Department of Environmental Protection (MDEP) EPH[2]
Volatile Petroleum Hydrocarbons (VPH) MTBE Benzene Toluene Ethylbenzene Xylenes Naphthalene C5-C8 Aliphatics C9-C12 Aliphatics C9-C10 Aromatics	B-1 through B-9	MDEP VPH
Volatile Organic Compounds (VOCs)[3]	B-2 through B-9	EPA Method 8260B
Semi-Volatile Organic Compounds (SVOCs)[4]	B-2 through B-9	EPA Method 8270C
RCRA 8 Metals Dissolved Arsenic Dissolved Barium Dissolved Cadmium Dissolved Chromium Dissolved Lead Dissolved Mercury Dissolved Selenium Dissolved Silver	B-2 through B-9	EPA Method 6010B /7471

[1] Groundwater sampling locations dependent upon encountering impacted soil in conjunction with groundwater.

[2] EPH Fractions will be analyzed if the EPH Screen result is above 1,000 micrograms per liter (µg/L).

[3] Complete VOCs list is given in Appendix G.

[4] Complete SVOCs list is given in Appendix G.

2.6 Decontamination Procedures and Handling of Investigation-Derived Waste

To avoid cross-contamination between borings and sampling intervals, all downhole sampling equipment will be decontaminated on-site between individual borings using a high-pressure wash, or wash with tap water and an environmentally benign detergent, such as Alconox, in accordance with SOP-2 (**Appendix D**). Sampling equipment placed downhole will also be decontaminated using the same methods. Decontamination procedures will be conducted at a designated decontamination area on the

Site, and wash fluids that do not contain a petroleum sheet or free-phase petroleum will be allowed to infiltrate or evaporate.

Investigation-derived waste (soil cuttings, wash water, and potential purge water) will be handled in accordance with SOP-25 (**Appendix D**). Contaminated soil cuttings will be containerized in labeled 55-gallon drums and stored on-site pending laboratory characterization for appropriate disposal. Upon completion of soil and groundwater sampling, boreholes will be backfilled with bentonite chips to the ground surface.

2.7 Field and Laboratory Quality Control Procedures

The EPA-approved QAPP (NewFields, 2015b), which establishes specific quality assurance and quality control (QA/QC) policies and activities, will be followed during the site investigation. Applicable SOPs (**Appendix D**) will be followed during the Phase II ESA. A Field Investigation Planning Form is provided in **Appendix E**, which will be used by NewFields field staff to ensure that the field data collection will be obtained in accordance with this SAP. The following field QC samples will be collected:

- One equipment rinseate blank (ERB) sample will be collected for subsurface soil analytes by running distilled water over the decontaminated continuous core soil sampler used during the assessment.
- One field duplicate (DUP) groundwater sample will be collected during the assessment.
- One ERB will be collected if non-disposable sampling equipment is used for groundwater sample collection.
- A laboratory-provided trip blank (TB) sample will accompany each set of groundwater sample during the field assessment and during shipment.

The ERB will be analyzed for EPH, VPH, VOCs, SVOCs, and dissolved RCRA Metals. The TB will be analyzed for VPH and VOCs.

3.0 DATA ANALYSIS AND REPORTING

3.1 DATA REVIEW AND VALIDATION

A data usability review and validation will be conducted on all data collected for this investigation. Data validation undertakings will be completed in conformance with the EPA-approved QAPP (NewFields, 2015b). All laboratory analytical data will be provided by Pace electronically, both in portable document format (PDF) and as a tabulated electronic data deliverable (EDD). To facilitate data review, the PDF report will be searchable (embedded text) and bookmarked. Laboratory data packages will contain the following information:

- A narrative specific to the sample data group (SDG) identifying any difficulties encountered during sample analysis and exceedances in the laboratory's QC sample results;
- Analytical and preparatory method references;
- A table cross-referencing field and laboratory identification numbers;
- A list and definition of any data qualifiers used;
- A chain-of-custody signed and dated by the laboratory indicating data receipt. Cooler temperature at time of laboratory receipt will be noted in the chain-of-custody. Shipping air bills will also be provided, as appropriate;
- Results for each field sample and QC samples. Reporting limits will be provided and any analyte which is not detected will be reported as less than the reporting limit;
- Dilution factor for each sample or analyte, if any;
- Internal standard data, and surrogate data; and
- Laboratory QC data including method blank data, laboratory duplicate data reported as a relative percent difference (RPD), lab control spike data reported as a RPD, and matrix spike/matrix spike duplicate (MS/MSD) data reported as percent recovery with RPD calculated.

Data qualifiers will be applied to the data consistent with EPA guidelines. Upon receipt of data from the laboratory, the PDFs and EDDs will be checked for completeness. During the data evaluation process, several checks of the data will be completed, including:

- Verification of whether field staff conformed to SOPs and field methodologies proposed in this SAP and QAPP;
- Determination of whether the laboratory reported all requested analyses;
- Review to ensure that units of measurements are consistent, and reviews of sample definitions for consistency; and
- Inspection for the presence of elevated detection limits due to matrix interference or other data quality concerns indicated by laboratory QC testing.

The impact of nonconformance will be discussed in the Report of Findings (see **Section 3.2**). Deviations from approved field and laboratory procedures and sampling approach will be identified in the Report, including whether the deviation adversely impacted the quality of data obtained.

3.2 Report of Findings

NewFields will prepare a Report of Findings summarizing results of the Phase II ESA. The Report of Findings will be provided to BSED, site owner, MDEQ, and EPA. Methods of investigation, results of field and laboratory testing, and any deviations from the scope of work will be presented in the Report. The Report will provide conclusions and recommendations based on the data. In addition, the Report will include the following supporting information:

- Figures depicting sample locations;
- Laboratory analytical reports and tabulated summaries of the laboratory data, along with a comparison of the data to applicable screening levels as discussed in **Section 3.3**;
- Summary of QC findings and data usability and validation completed as described in **Sections 2.7** and **3.1**; and,
- Field notes, including boring logs, sampling forms, and investigation photographs.

3.3 Evaluation of Human Health Risks

A comparison of site data to relevant screening levels will be used to determine if soils or groundwater will require additional investigation or response actions consistent with anticipated land use. Detected concentrations will be compared to the following regulatory screening or action levels: Montana Tier 1 Risk Based Screening Levels (RBSLs) (MDEQ, 2009); Circular DEQ-7 Montana Numeric Water Quality Standards (MDEQ, 2012); and EPA Industrial (Commercial) Regional Screening Levels (RSLs) (EPA, 2015), as outlined in **Table 4** and **Table 5** for soil and groundwater, respectively.

Table 4. Applicable Soil Screening Levels

Contaminants of Potential Concern (COPCs)	Montana Tier 1 RBSLs Subsurface Soil (10 -20 ft GW)	EPA Industrial (Commercial) RSLs
EPH	x	
VPH	x	
VOCs	x	x
SVOCs	x	x
Metals (RCRA 8)		x

Note: RBSL = Risk Based Screening Level; GW = groundwater; RSL = Regional Screening Level; EPH = Extractable Petroleum Hydrocarbons; VPH = Volatile Petroleum Hydrocarbons; VOCs = Volatile Organic Compounds; SVOC = Semi-Volatile Organic Compounds.

Table 5. Applicable Groundwater Screening Levels

Contaminants of Potential Concern (COPCs)	Montana Tier 1 Groundwater RBSLs	DEQ-7 Numeric Water Quality Standards	EPA Industrial (Commercial) RSLs
EPH	x		
VPH	x		
VOCs	x	x	x
SVOCs	x	x	x
Metals (RCRA 8)		x	x

Note: RBSL = Risk Based Screening Level; GW = groundwater; RSL = Regional Screening Level; EPH = Extractable Petroleum Hydrocarbons; VPH = Volatile Petroleum Hydrocarbons; VOCs = Volatile Organic Compounds; SVOC = Semi-Volatile Organic Compounds.

4.0 PROJECT SCHEDULE

Field activities will be initiated upon review and approval of this plan by BSED and EPA. It's anticipated the investigation will be completed in December 2015 or within the first quarter of 2016 (dependent upon weather). The Phase II Report of Findings will be prepared within four weeks following receipt of all laboratory analytical results.

5.0 REFERENCES

ASTM International (ASTM), 2013. Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process. Publication E1527 – 13. November 2013.

Code of Federal Regulations (CFR), 2013. Title 29– Labor, Subtitle B – Regulations Relating to Labor, Chapter Xvii – Occupational Safety and Health Administration, Department of Labor, Part 1910 – Occupational Safety and Health Standards, Subpart H – Hazardous Materials, Section 1910.06 – Flammable Liquids. July 1, 2013.

Massachusetts Department of Environmental Protection (MDEP), 2002. Characterizing Risks Posed by Petroleum Contaminated Sites: Implementation of the MDEP VPH/EPH Approach, Final Policy, Policy #WSC-02-411. October 2002.

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____, 2009. Montana Tier 1 Risk-Based Corrective Action Guidance for Petroleum Releases. Prepared by Montana Department of Environmental Quality. Published September 2009, as corrected by rule amendments published June 24, 2010.

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Olsen, J.L., 2005. Characterization of Alluvial Aquifers in Treasure and Yellowstone Counties, Middle Yellowstone River Area, Montana. Montana Bureau of Mines and Geology: Ground-Water Assessment Atlas 3B-03, 1 sheet, 1:50,000.

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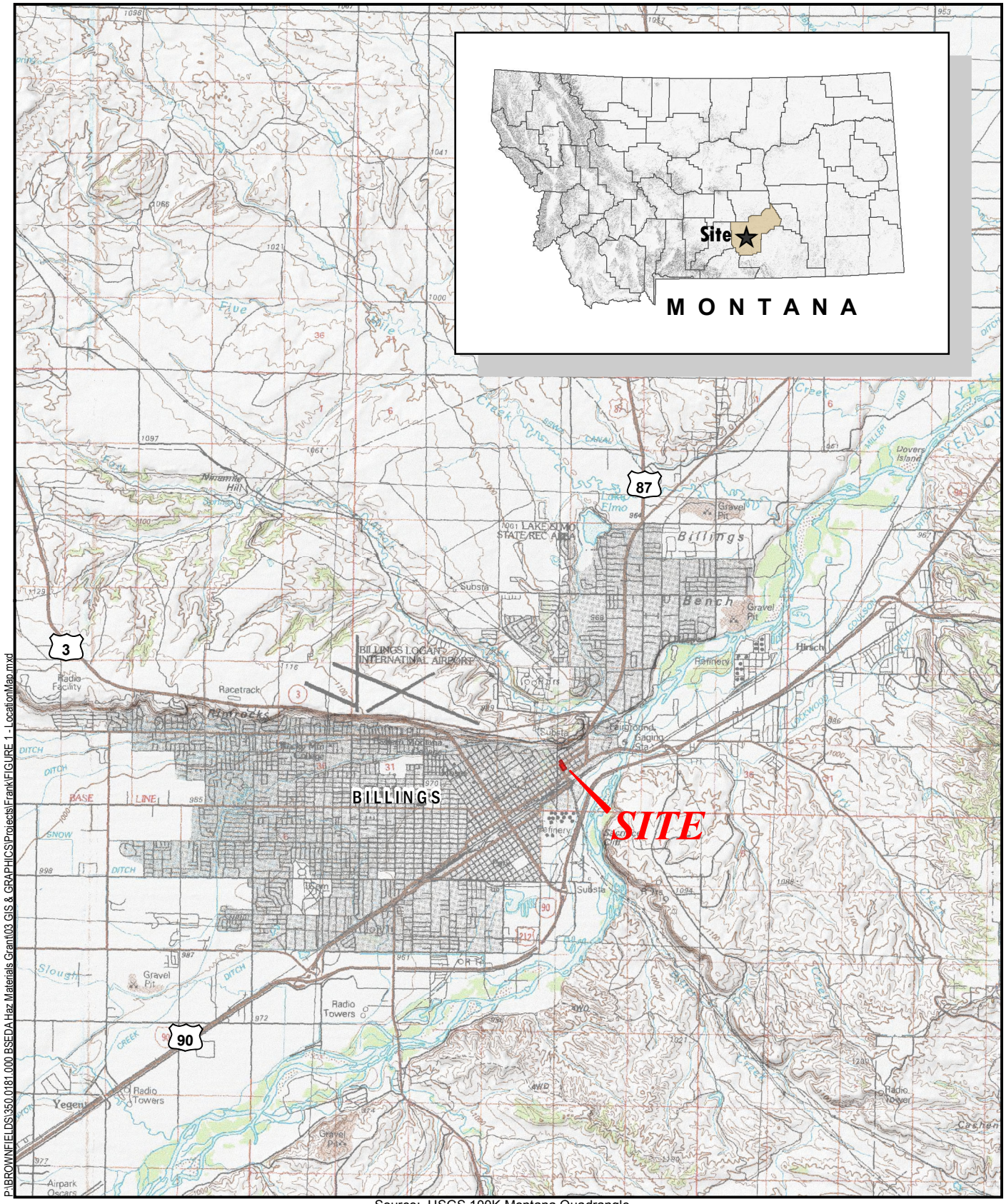
____ 2015. Regional Screening Levels for Chemical Contaminants at Superfund Sites (THQ = 1.0), published by the U.S. Environmental Protection Agency. June 2015.

Billings, Montana

FIGURES

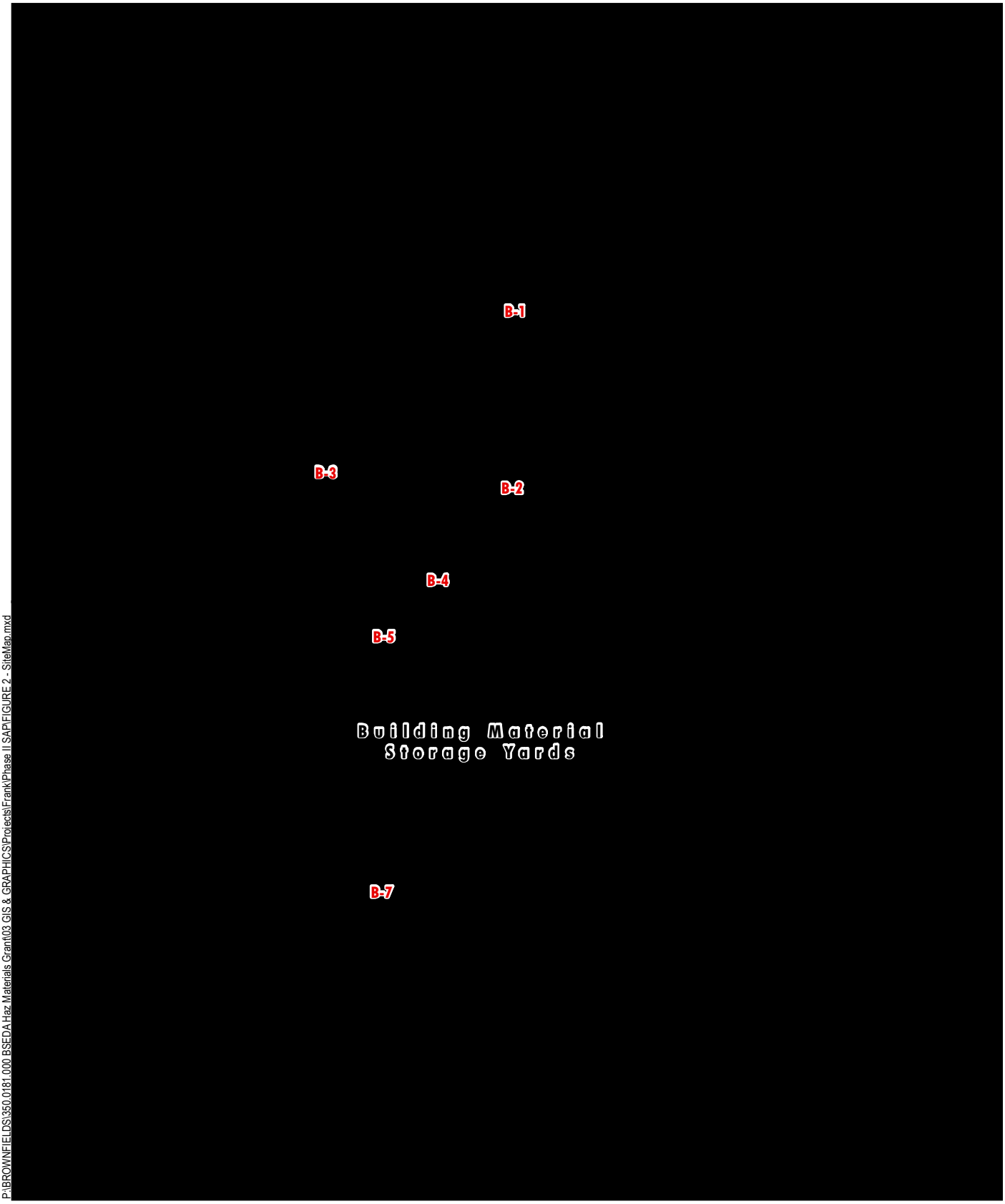


Source: USGS 100K Montana Quadrangle

0 Miles 2

NewFields

Location Map
Frank Properties
Billings, Montana
FIGURE 1



P:\BROWNFIELDS\350.0181.000 BSEDA Haz Materials Grant\03 GIS & GRAPHICS\Projects\Frank\Phase II SAP\FIGURE 2 - SiteMap.mxd

0 Feet 150

NewFields

Approximate Property Boundary

Approximate Parcel Boundary

Proposed Boreholes

Site Map
Frank Properties
Billings, Montana
FIGURE 2

Well Reports

Billings, Montana

APPENDIX A

Ground Water Information Center
Montana Bureau of Mines and Geology
Montana Tech of The University of Montana
1300 West Park Street - Natural Resources Building Room 329
Butte Montana 59701-8997
Ph: (406) 496-4336 Fx: (406) 496-4343

You are currently signed in. | 9/1/2015
Sign Out

| Home | Well Data | Reports | Data Coop | DrillerWeb | DNRC | Help! |

Menus: | Main | SWL | GWCP | Projects | Coal | Coal Quality | Geothermal

GWIC Data > Well Construction Data > Township: 01N Range: 26E Sec: 33

The following data were returned from the GWIC databases for the area you requested. For a more detailed description of the data view the GWIC Metadata report. If you notice data entry errors or have questions please let us know by sending us an Email at **GWIC@mtech.edu**. If you wish to view a one page report for a particular site, click the hyperlinked **Gwic Id** for that well. Scroll to the right of your screen to view all the data. All data displayed on the screen may not show up when printed.

Retrieval Statistics*

Field	Max	Min	Avg
Total Depth (ft)	72.00	13.50	22.50
Static Water Level (ft)	20.00	7.00	12.37
Yield (gpm)	100.00	3.00	34.30

* These statistics do not take any geographic, topographic, or geologic factors into consideration. Negative swl values are reported for water levels that are above land surface.

Did you know about...

Other GWIC data

Thanks, Just take me back to the menu.

Other MBMG data

MBMG has 529 publications available for BIG HORN county.
MBMG has 427 publications available for YELLOWSTONE county.
MBMG has 2 abandoned mine record(s) for this request area.

Gwic Id	PDF	DNRC WR	Site Name	Twn	Rng	Sec	Q Sec	Ver?	Type	Td	Swl	Pwl	Rwl	Yield	Test	Date	Use
11498			BUFF JOHN B	01N	26E	33		No	WELL	24.00				49.00	PUMP	5/2/1973	DOMESTIC
140976			KOCH MATERIALS	01N	26E	33		No	WELL	19.00	8.00			20.00	AIR	5/28/1991	IRRIGATION
11497			KUHL SYDNEY M.	01N	26E	33		No	WELL	14.00	9.00	11.00		15.00	OTHER	5/10/1963	DOMESTIC
11499			LECHNER MARCUS J.	01N	26E	33		No	WELL	22.00	7.00	7.00		3.00	BAILER	6/1/1948	DOMESTIC
11496		C014534-00	MAHAN WAYNE	01N	26E	33		No	WELL	21.00	11.00	11.00		35.00	PUMP	5/27/1977	DOMESTIC
191375			WASHINGTON CORP * DOWN GRADIENT	01N	26E	33		No	WELL	22.50	13.90				OTHER	8/7/2001	MONITORING
191374			WASHINGTON CORP * U.S.T.	01N	26E	33		No	WELL	22.50	14.00				OTHER	8/7/2001	MONITORING
280922			BARRY O'LEARY, INC.	01N	26E	33	AA	No	WELL	20.00	20.00					11/26/2014	MONITORING
11521			ORCHOWSKI, FRANK	01N	26E	33	AAD	No	WELL	22.00	20.00			40.00	OTHER	1/1/1950	DOMESTIC
228979			STOCKTON OIL CO.	01N	26E	33	AC	No	WELL	20.00	13.00				OTHER	9/11/2006	MONITORING
154330			TOWN PUMP * MW-01	01N	26E	33	AC	No	WELL	22.00					OTHER	12/12/1995	DOMESTIC
154379			TOWN PUMP * MW-02	01N	26E	33	AC	No	WELL	21.00					OTHER	1/31/1996	MONITORING
154382			TOWN PUMP * MW-03	01N	26E	33	AC	No	WELL	20.00					OTHER	12/12/1995	MONITORING
154385			TOWN PUMP * MW-04	01N	26E	33	AC	No	WELL	21.00					OTHER	12/13/1995	MONITORING
171820			TOWN PUMP BILLINGS * 8305	01N	26E	33	AC	No	WELL	22.00					OTHER	4/28/1998	MONITORING
171819			TOWN PUMP BILLINGS * 8306	01N	26E	33	AC	No	WELL	22.00					OTHER	4/28/1998	MONITORING
174981			TOWN PUMP BILLINGS * 8307	01N	26E	33	AC	No	WELL	25.00					OTHER	4/28/1998	PUBLIC WATER SUPPLY
157757			TOWN PUMP BILLINGS * COMBO 1	01N	26E	33	AC	No	WELL	13.50					OTHER	6/26/1996	INJECTION
157758			TOWN PUMP BILLINGS * COMBO 2	01N	26E	33	AC	No	WELL	13.50					OTHER	6/26/1996	INJECTION
157759			TOWN PUMP BILLINGS * COMBO 3	01N	26E	33	AC	No	WELL	13.50					OTHER	6/26/1996	INJECTION
11500			WAGNER CARL	01N	26E	33	ACC	No	WELL	20.17	9.00	10.00		55.00	PUMP	3/19/1973	DOMESTIC

11501		PARSHALL HUGH P.	01N	26E	33	AD	No	WELL	20.00	12.00			5.00	OTHER	7/1/1961	DOMESTIC
122061		PETES AUTOMATIC TRANSMISSION * DH-04	01N	26E	33	AD	No	WELL	19.00	8.00				OTHER	2/5/1990	MONITORING
282251		FIRST INTERSTATE BANK * MMW-1	01N	26E	33	BD	No	WELL	20.00	14.00					4/11/2015	MONITORING
282252		FIRST INTERSTATE BANK * MMW-2	01N	26E	33	BD	No	WELL	20.00	14.70					4/11/2015	MONITORING
282253		FIRST INTERSTATE BANK * MMW-3	01N	26E	33	BD	No	WELL	20.00	13.10					4/10/2015	MONITORING
282254		FIRST INTERSTATE BANK * MMW-4	01N	26E	33	BD	No	WELL	20.00	13.11					4/10/2015	MONITORING
282255		FIRST INTERSTATE BANK * MMW-5	01N	26E	33	BD	No	WELL	20.00	13.35					4/10/2015	MONITORING
222061		TOWN PUMP * M-08	01N	26E	33	BD	No	WELL	20.00	13.50				OTHER	10/4/2005	MONITORING
191179		WASHINGTON CORP. (MODERN MACHINERY) * UP GRADIENT	01N	26E	33	BD	No	WELL	22.50	13.90				OTHER	8/7/2001	MONITORING
198253		MODERN MACHINERY	01N	26E	33	BDD	No	WELL	22.00					OTHER	3/22/2002	MONITORING
11502		SCHOOL DISTRICT #2 (NORTH PARK SCHOOL)	01N	26E	33	BDD	No	WELL	31.00	13.00	17.20		40.00	PUMP	8/25/1983	IRRIGATION
11503		BAILEY C.E.	01N	26E	33	C	No	WELL	21.00	13.00			40.00	PUMP	7/7/1972	DOMESTIC
252449		1ST INTERSTATE BANK	01N	26E	33	CA	No	WELL	26.00	16.00			45.00	AIR	6/11/2009	IRRIGATION
252449		1ST INTERSTATE BANK	01N	26E	33	CA	No	WELL	26.00	16.00		16.00	45.00	PUMP	6/11/2009	IRRIGATION
212998		HILSENDEGER PATRICIA * MW-01	01N	26E	33	CA	No	WELL	18.00	9.50				OTHER	7/21/2004	MONITORING
213000		HILSENDEGER PATRICIA * MW-02	01N	26E	33	CA	No	WELL	18.00	9.50				OTHER	7/21/2004	MONITORING
177380		PUBLIC AUCTION YARDS * CS-04	01N	26E	33	CA	No	WELL	18.50	9.90				OTHER	6/19/1999	
133634		METZ C.B. & DOROTHY * MW-01A	01N	26E	33	CAD	No	WELL	21.00	13.02				BAILER	11/2/1992	MONITORING
133637		METZ C.B. & DOROTHY * MW-02	01N	26E	33	CAD	No	WELL	21.00	12.91				BAILER	11/2/1992	MONITORING
133642		METZ C.B. & DOROTHY * MW-03	01N	26E	33	CAD	No	WELL	21.00	12.52				BAILER	11/2/1992	MONITORING
247357		BATERSLUB ROB	01N	26E	33	CB	No	WELL	26.00	15.00		15.00	15.00	AIR	3/27/2008	IRRIGATION
11504		HUTZENBILER KARL J.	01N	26E	33	CB	No	WELL	22.00	12.00	22.00		25.00	PUMP	7/13/1973	DOMESTIC
11505		BJORNSON WILLIAM	01N	26E	33	CBA	No	WELL	22.00	12.00	22.00		12.00	PUMP	7/16/1973	DOMESTIC
11506		SOLBERG BJARNE	01N	26E	33	CBA	No	WELL	25.00	12.00	24.00		20.00	PUMP	7/17/1973	DOMESTIC
208656		BILLINGS GREYHOUND BUS * MW-09	01N	26E	33	CC	No	WELL	18.50	10.58				OTHER	10/21/2003	MONITORING
208659		BILLINGS GREYHOUND BUS * MW-10	01N	26E	33	CC	No	WELL	18.60	11.00				OTHER	10/21/2003	MONITORING
208662			01N	26E	33	CC	No	WELL	17.50	11.50				OTHER	10/22/2003	MONITORING

			BILLINGS GREYHOUND BUS * MW-11															
208665			BILLINGS GREYHOUND BUS * MW-12	01N	26E	33	CC	No	WELL	18.70	11.33				OTHER	10/22/2003	MONITORING
177382			C&D WAREHOUSE * CS-03	01N	26E	33	CC	No	WELL	15.50	9.50				OTHER	6/19/1999	MONITORING
256579			GENERAL SERVICES ADMINISTRATION (GSA) * B-02	01N	26E	33	CC	No	WELL	40.00	14.90					5/24/2010	MONITORING
256580			GENERAL SERVICES ADMINISTRATION (GSA) * B-03	01N	26E	33	CC	No	WELL	25.00	14.90					5/25/2010	MONITORING
256581			GENERAL SERVICES ADMINISTRATION (GSA) * B-04	01N	26E	33	CC	No	WELL	25.00	15.00					5/25/2010	MONITORING
11507			LARSSON MRS L B	01N	26E	33	CC	No	WELL	17.00	13.00			35.00	OTHER	8/15/1960	DOMESTIC
11508		C014604-00	SMITH ELIZABETH	01N	26E	33	CC	No	WELL	20.00	14.80			35.00	PUMP	6/21/1977	DOMESTIC
267400			ARNDORFER, JULIE	01N	26E	33	CD	No	WELL	17.00	10.00					7/19/2012	MONITORING
11509		C002740-00	CITY OF BILLINGS	01N	26E	33	CD	No	WELL	26.00	13.00	21.00		80.00	OTHER	10/1/1973	IRRIGATION
278649			GREYHOUND LINES INC.	01N	26E	33	CD	No	WELL	17.00	10.00					6/11/2014	MONITORING
278648			GREYHOUND LINES INC.	01N	26E	33	CD	No	WELL	17.00	10.00					6/11/2014	MONITORING
227915			HILSENDEGER PATRICA * MW-03	01N	26E	33	CD	No	WELL	18.00	9.84				OTHER	8/9/2006	MONITORING
235349			KING RESOURCES * MW07-01	01N	26E	33	CD	No	WELL	20.00	12.70					3/28/2007	MONITORING
235348			KING RESOURCES * MW07-02	01N	26E	33	CD	No	WELL	20.00	12.50					3/28/2007	MONITORING
235347			KING RESOURCES * MW07-03	01N	26E	33	CD	No	WELL	20.00	13.00					3/27/2007	MONITORING
235345			KING RESOURCES * MW07-04	01N	26E	33	CD	No	WELL	20.00	13.00					3/27/2007	MONITORING
258251			WAITER, DELBERT	01N	26E	33	CDD	No	WELL	59.00	17.00		17.00	100.00	AIR	5/28/2010	DOMESTIC
271715			PERMIER HOLDINGS	01N	26E	33	DA	No	WELL	18.00	11.00					2/1/2013	MONITORING
271713			PREMIER HOLDINGS	01N	26E	33	DA	No	WELL	18.00	11.00					2/1/2013	MONITORING
238985			BLESKIN PETE * MW07-01	01N	26E	33	DB	No	WELL	20.00	12.50					9/14/2007	MONITORING
238986			BLESKIN PETE * MW07-02	01N	26E	33	DB	No	WELL	20.00	12.00					9/14/2007	MONITORING
238987			BLESKIN PETE * MW07-03	01N	26E	33	DB	No	WELL	20.00	12.00					9/14/2007	MONITORING
222210			BILLINGS GREYHOUND BUS * 01	01N	26E	33	DC	No	WELL	23.60	11.00				OTHER	5/17/2005	MONITORING
222212			GREYHOUND BUS BILLINGS * 02	01N	26E	33	DC	No	WELL	24.00	11.00				OTHER	5/18/2005	MONITORING
11510			WILCOXSON'S ICE CREAM & CANDY CO	01N	26E	33	DCBA	No	WELL	22.00	9.00	14.00		15.00	OTHER	1/26/1959	INDUSTRIAL
181412			CONOCO INC * RW-A	01N	26E	33	DCD	No	WELL						OTHER	10/15/1999	
204925			PELICAN CONNIE * PO-01	01N	26E	33	DD	No	WELL	20.50	10.00				OTHER	8/25/2003	MONITORING

204928		PELICAN CONNIE * PO-02	01N	26E	33	DD	No	WELL	20.50	12.00				OTHER	8/26/2003	MONITORING
204929		PELICAN CONNIE * PO-03	01N	26E	33	DD	No	WELL	20.50	10.00				OTHER	8/26/2003	MONITORING
204930		PELICAN CONNIE * PO-04	01N	26E	33	DD	No	WELL	20.50	12.00				OTHER	8/25/2003	MONITORING
205502		PELICAN CONNIE * PO-05	01N	26E	33	DD	No	WELL	20.50	11.00				OTHER	8/26/2003	MONITORING
177381		CONOCO	01N	26E	33	DDB	No	WELL	20.50	10.25				OTHER	6/24/1999	
181411		CONOCO INC * RW-C	01N	26E	33	DDB	No	WELL						OTHER	10/15/1999	
181040		SUNWALL BRUCE	01N	26E	33	DDC	No	WELL	72.00	18.00	38.00	18.00	25.00	PUMP	1/26/2000	DOMESTIC
181040		SUNWALL BRUCE	01N	26E	33	DDC	No	WELL	72.00	18.00			35.00	AIR	1/26/2000	DOMESTIC
129568		BILLINGS REFINERY * OR-05	01N	26E	33	DDD	No	WELL	22.00	10.50				OTHER	3/12/1991	MONITORING

End of Report.
84 record(s) listed.

Items of Note:

[1]This report is restricted to site types of **WELL, BOREHOLE, SPRING, COAL BED METHANE WELL, PETWELL, PIEZOMETER**.

[2]A single well record (a distinct GWIC Id) may be represented by more than one line in this report if more than one performance test was conducted on the well at the time of drilling.

Explanation of Columns:
GWIC Id = Key field for the GWIC database. Links to one page reports.
PDF = Are scanned documents available through the Document Manager?

- = Yes, click on the icon to download the PDF file.
- = No, well was submitted electronically. No paper record exists.
- = No, record does have a known well log but it is not scanned yet.
- = No, record may or may not have a document to scan. Metadata is unclear.
- = No, record was created from a source other than a well log. No paper record exists.

DNRC WR = Water right number assigned to this site by Department of Natural Resources and Conservation.
Site Name = Current owner name assigned to GWIC record.
Location = Location of site in Montana township, range, section, and quarter-section coordinates.
Ver? = Has this location been verified by field staff?
Type = Type of site assigned to GWIC record.
Td = **T**otal **d**epth of well in feet below ground.
Swl = **S**tatic **w**ater **l**evel in feet above/below ground - Negative values are reported for water levels that are above land surface.
Pwl = **P**umping **w**ater **l**evel in feet below ground.
Rwl = **R**ecovery **w**ater **l**evel in feet below ground.
Yield = Yield in gallons per minute.
Test = Type of performance test reported.
Date = Completion date of well/borehole.
Use = Reported use of water.

Disclaimer:
The preceding materials represent the contents of the GWIC databases at the Montana Bureau of Mines and Geology at the time and date of the retrieval. The information is considered unpublished and is subject to correction and review on a daily basis. The Bureau warrants the accurate transmission of the data to the original end user at the time and date of the retrieval [9/1/2015 10:43:46 AM]. Retransmission of the data to other users is discouraged and the Bureau claims no responsibility if the material is retransmitted. There may be wells in the request area that are not recorded at the Information Center.

Ground Water Information Center Online © 1998 - 2015
Staff | Privacy Statement

Site-Specific Data Quality Objectives

Billings, Montana

APPENDIX B

Appendix B

Site-Specific Data Quality Objectives

Frank Properties

Billings, Montana

Step 1: Problem Statement	Step 2: Identifying the Decisions	Step 3: Decision Inputs	Step 4: Study Boundaries	Step 5: Decision Rules	Step 6: Tolerance Limits on Errors	Step 7: Optimization of Sample Design
Future sale and/or redevelopment of the property is affected by concerns about contamination from the Energy One Stop LUST site to the northwest and historic use of the property and surrounding properties as automotive repair facilities. Two warehouses contain floor drains that have no documented connections to City Sewer.	Are COPCs (petroleum, solvents, metals, VOCs) in subsurface soil above or at the groundwater interface at levels of concern? If so, is groundwater contaminated at concentrations of concern for human health?	1) Subsurface soil samples will be collected and analyzed for COPCs at and above the groundwater interface. 2) Groundwater , if encountered, will be sampled and analyzed for COPCs. 3) Concentration of COPCs will be compared to MDEQ Tier 1 RBSLs and EPA and MDEQ screening levels based on commercial/industrial use of the facility.	The Study Area consists of five parcels located at 301 North 13th Street; 303 North 13th Street; 1206 4th Avenue North; and 212 North 13th Street (which is the city block between 2nd and 3rd Avenues North and North 12th and 13th Streets) in Billings, Montana	- If soil COPC concentrations exceed MDEQ/EPA screening levels, results will indicate the Site is impacted at concentrations requiring additional assessment and/or cleanup. - If groundwater COPC concentrations exceed MDEQ screening levels and standards, results will indicate the Site is impacted at concentrations requiring additional assessment and/or cleanup.	Soil boring sampling locations will be biased toward areas of suspected contamination therefore calculating numeric tolerance limits on errors is not appropriate. No previous Site data is available for estimating the distribution of surface soil results, therefore quantitative estimate of error was not performed. Quality assurance procedures, quality control procedures, and data validation will be completed in accordance with the EPA-approved QAPP.	The findings of the Phase I ESA were used to develop a site-specific CSM and the proposed assessment strategy. The soil and groundwater sampling strategy was designed to evaluate the area of the site with the highest potential for containing COPCs. The site assessment strategy is based upon the Triad Approach which allows real-time field data to be used in an effort to determine extent of contamination, if observed.

Notes:

COPCs - Contaminants of Potential Concern

MDEQ - Montana Department of Environmental Quality

EPA - U.S. Department of Environmental Protection

QAPP - Quality Assurance Project Plan

CSM - Conceptual Site Model

RBSL - Risk Based Screening Level

RSLs - EPA Regional Screening Levels

Health & Safety Plan

Billings, Montana

APPENDIX C

NewFields

HEALTH AND SAFETY PLAN

Frank Properties, Billings, Montana

Project No.: 350.0181.000

1. HASP Preparation and Approval

Project Name: Frank Properties, Billings, Montana
Task: Phase II Environmental Site Assessment
Proposed Start Date: January 2016

Prepared by/Reviewed by:

Printed Name: David Tooke

Signature _____ Date 11-19-2015

Title: Project Health & Safety Officer

Approved by:

Printed Name: Chris Cerquone

Signature _____ Date 11-19-2015

Title: Project Manager

Note to Project Managers:

A signed and completed copy of the Health and Safety Plan and a signed and completed copy of the safety briefing (last page) must be included in the project file.

2. Project Description:

A subsurface investigation will be completed at the Frank Properties in Billings, Montana. The purpose of the work is to determine if the Energy One Stop LUST on an adjacent property and historic use of onsite and surrounding properties as automotive repair facilities has impacted soil and groundwater. The investigation may include:

- Direct push drilling;
- Soil and groundwater sampling.

3. Location:

The Site properties are comprised of five parcels located at 301 North 13th Street; 303 North 13th Street; 1206 4th Avenue North; and the city block between 2nd and 3rd Avenues North and North 12th and 13th Streets in Billings, Montana and lie in Township 01 North, Range 26 East, Section 33 (Figures 1 and 2). Billings is the largest city in Montana and is the county seat of Yellowstone County. The city has an estimated population of approximately 110,000 people and acts as a regional hub serving most of Montana and portions of North Dakota, South Dakota, and Wyoming.

4. Facility/Work Site Description:

The five separate parcels that comprise the Site consist of an office building, a store, three warehouses and two storage yards. The Site is generally located in a mixed use commercial/industrial area of East Billings known as the East Billings Urban Renewal District (EBURD). Frank Family Limited Partnership is the current owner. The specific objectives of this work are as follows:

- Install boreholes at locations shown on the attached Site Map, and collect soil samples from the boreholes; and
- Collect grab groundwater samples if groundwater is observed.

5. Proposed Personnel and Tasks:

Field Team Leader: Brian Nickel (perform Project Coordination, Health & Safety Oversight, Project Reporting; Field Investigation, Data Collection & Documentation)

6. Confined Space Entry

A confined space is defined as any space not currently used or intended for human occupancy, having a limited means of egress, which is subject to the accumulation of toxic contaminants, a flammable or oxygen deficient atmosphere, or other hazards, such as engulfment, or electrical or mechanical hazards should equipment be inadvertently activated while an employee is in the space. Confined spaces include but are not limited to storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, air pollution control devices, smoke stacks, underground utility vaults, sewers, septic tanks, and open top spaces more than four feet in depth such as test pits, waste disposal trenches, sumps and vats.

Will this task require entry into any confined or partially confined space?

☐ YES - Describe below

☒ No

7. Cutting and Welding

Will this task involve use of a cutting torch or welding?

☐ YES - Describe below

☒ No

8. Other Potential Hazards

- ☒ Chemical
- ☐ Radiological
- ☒ Fire/Explosion
- ☐ Heat Stress
- ☒ Electrical
- ☒ Machinery/Mechanical Equipment
- ☒ Trips, Slips, Falls
- ☐ Trenching/Shoring
- ☒ Heavy Equipment/Vehicular Traffic
- ☐ Overhead Hazards
- ☒ Unstable/Uneven Terrain
- ☒ Other – Cold Stress

9. Chemical/Radiological Hazard Evaluation

Waste Media	**Hazardous Characteristics**
☒ Airborne Contamination	☒ Ignitable
☒ Surface Contamination	☐ Corrosive
☒ Contaminated Soil	☐ Reactive
☒ Contaminated Groundwater	☒ Explosive
☐ Contaminated Surface Water	☒ Toxic (non-radiological)
☐ Solid Waste	☐ Radioactive
☐ Liquid Waste	
☐ Sludge	

This task involves a reasonable possibility of exposure to the substances listed below at concentrations or in quantities which may be hazardous to the health of the site personnel.

- Petroleum Hydrocarbons (gasoline, diesel)
- Metals
- VOCs

11. Ambient Air/Site Monitoring Procedures

The following instruments shall be used to monitor the work environment and workers' breathing zones prior to site entry and at the specified intervals.

Instrument	**Monitoring Frequency**
☒ PID (HNU, OVM) w/ 10.6 eV lamp	Cont. 15min. 30min. hourly other as needed*
☐ Multi Gas Meter	Cont. 15min. 30min. hourly other _____
☐ Combustible Gas Indicator	Cont. 15min. 30min. hourly other _____
☐ H2S Detector	Cont. 15min. 30min. hourly other _____
☐ Colorimetric Detector Tubes	Cont. 15min. 30min. hourly other _____
☐ Other (describe below)	Cont. 15min. 30min. hourly other _____

* Monitoring performed during soil sampling.

12. Action Levels

Task personnel shall observe the following Action Levels:

Instrument	Action Level	Specific Action
PID	Any detection for a continuous period of time (> 5 minutes) in the breathing space of site workers.	Contact H&S Officer to determine if respirators should be worn or if other exposure prevention methods are needed.

13. Personal Monitoring

☐ Passive Dosimeter ☐ Personal Air Sampling ☒ Other: visual and olfactory observation

14. Onsite Control

Work zones will be delineated with cones. Field Team Leader will instruct site visitors to stay at least one drilling mast height away from the drill rig in all directions.

15. Personal Protective Equipment

List the specific protective equipment, where applicable, for each Level of Protection identified below:

Level D PPE ☒

☐ Flame resistant clothing

☒ Hard hat, steel toed boots, safety glasses

☒ Ear protection during equip. operation

☒ Protective Eyewear

☒ Inert latex or nitrile gloves

16. Special Instructions

None

17. Sanitation Requirements

Potable water supply available on work site? ☐ Yes ☒ No

Portable toilets required on work site? ☐ Yes, how many? _____ ☒ No

Temporary washing/shower facilities required at work site? ☐ Yes, describe below. ☒ No

18. Emergency Procedures (This page is to be posted at prominent location on site)

Yes No

☐ ☒ On-site Communications Required? Emergency Channel: _____

Nearest Telephone: Cell phone

Fire and Explosion

In the event of a fire or explosion:

1. Evacuate the area – Safe Refuge Area (Empty Lot on the corner of N 13th St. and 4th Avenue N)
2. Notify emergency personnel (Emergency Services: 911).
3. Notify NewFields project manager (Chris Cerquone: 406-830-6102)

On Site Injury or Illness

In the event of an injury requiring more than minor first aid, or any employee reporting any sign or symptom of exposure to hazardous substances, immediately call for emergency medical assistance by calling:
Emergency Services: 911.

Local Emergency Room *(SEE ATTACHED MAP)*

Name: **Billings Clinic Hospital**
Location: **2800 10th Avenue North, Billings, Montana 59101** (see attached map)
Phone: **406-238-2500**

Contacts in Case of Injury, Illness, or Near Miss:

Project Manager: Chris Cerquone Phone (cell): 406-830-6102

Health and Safety Officer: David Tooke Phone (cell): 406-240-8360

25. Safety Briefing

The following personnel were present at pre-job safety briefing conducted at _____ (time) on _____ (date) at _____ (location), and have read the above plan and are familiar with its provisions:

Printed Name	Signature

Fully charged ABC Class fire extinguisher available on site? ☐ YES

Fully stocked First Aid Kit available on site? ☐ YES

All project personnel advised of location of nearest phone? ☐ YES

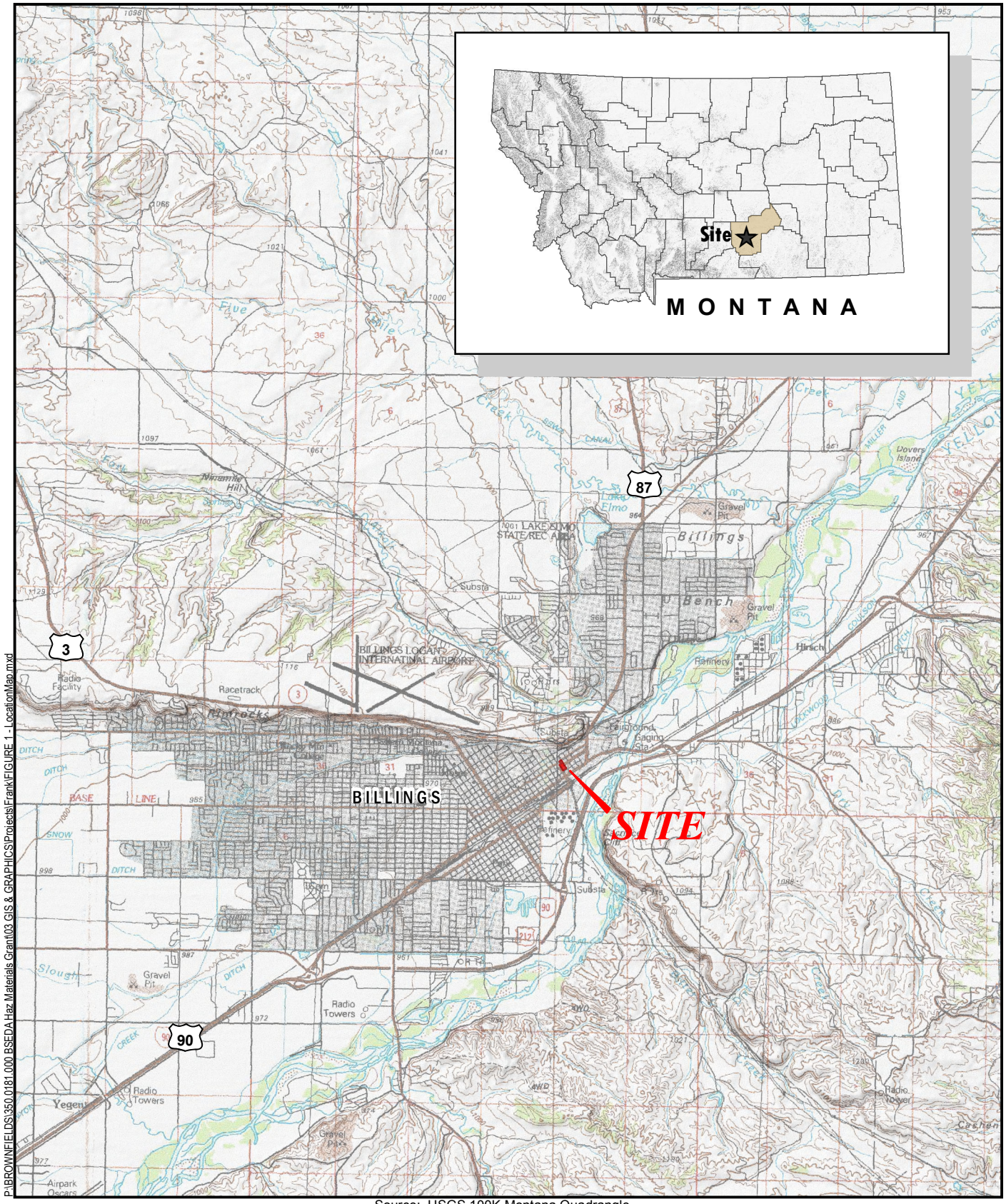
All project personnel advised of location of designated medical facility or facilities? ☐ YES

Printed Name of Field Team Leader or Site Safety Officer:

_____ _____

Signature Date

SITE MAP



Source: USGS 100K Montana Quadrangle

0 Miles 2

NewFields

Location Map
Frank Properties
Billings, Montana
FIGURE 1

0 Feet 100

Approximate Property Boundary

Approximate Parcel Boundary

NewFields

Site Map
Frank Properties
Billings, Montana
FIGURE 2

MAP TO HOSPITAL

Google Maps

301 N 13th St, Billings, Mt 59101 to Billings Clinic Hospital

Drive 1.6 miles, 5 min

Imagery ©2015 Google, Map data ©2015 Google 1000 ft

301 N 13th St

Billings, Mt 59101

1. Head northwest on N 13th St toward 4th Ave N — 0.2 mi
2. Turn left onto 6th Ave N — 1.0 mi
3. Turn right onto N 27th St — 0.3 mi
4. Turn left onto 10th Ave N — 377 ft
   Destination will be on the left

Billings Clinic Hospital

2800 10th Avenue North, Billings, MT 59101

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Live traffic	*Fast* *Slow*

Standard Operating Procedures (SOPs)

Billings, Montana

APPENDIX D

STANDARD OPERATING PROCEDURES
TABLE OF CONTENTS

SOP	TITLE
1	Field Log Book and Field Sampling Forms
2	Equipment Decontamination
3	Sample Nomenclature, Documentation, and Chain-of-Custody Procedures
4	Sample Packaging and Shipping
5	Field Measurement of Groundwater Level
6	Field Measurement of LNAPL (Free Product)
7	Field Measurement of Electric or Specific Conductance
8	Field Measurement of pH
9	Field Measurement of Dissolved Oxygen
10	Field Measurement of Oxidation Reduction Potential (ORP)
11	Field Sample Filtration
12	Groundwater Sampling
13	Surface Soil Sampling
14	Subsurface Soil Sampling
15	Monitoring Well Construction
16	Monitoring Well Installation with Direct Push Equipment
17	Field Screening of Volatile Organic Compounds in Soil
18	Monitoring Well Development
19	Surface Water Sampling
20	Sediment Sample Collection
21	Soil Vapor Sampling (Summa canister with isopropyl alcohol tracer)
22	Soil Vapor Sampling (Summa Canister with Helium Leak Detection)
23	Ambient Air Sampling
24	Quality Control Sampling
25	Management of Investigative-Derived Waste
26	Using a PetroFlag® Hydrocarbon Analyzer
27	Asbestos Sample Collection
28	Lead-Based Paint Sample Collection
29	Air Sampling for Asbestos & Lead
30	Methamphetamine Sampling
31	Precursory Methcheck Sampling
32	Asbestos Fiber Air Sample Collection
33	Air Sampling with Sorbent Tube
34	Sampling Groundwater with a HydraSleeve™

SOP-1

FIELD LOG BOOK AND FIELD SAMPLING FORMS

Pertinent field investigation and sampling information should be recorded on a daily field log book and appropriate sampling forms to provide a continual record of actions taken each day on the site. Each employee is responsible for completing a record of the day's activities in a log book and field forms of sufficient detail such that someone can reconstruct the field activities without relying on the memory of the field crew. At a minimum, entries on the field log book shall include:

- Project and client name
- Purpose of the field effort
- Names of field crew leader and team members present on the site, and other site visitors
- Description of site conditions and any unusual circumstances, including weather conditions
- Details of actual work effort, particularly any deviations from the field work plan or standard operating procedures
- Location of sample site, including map reference, if relevant
- Field observations
- Field measurements made (e.g., PID readings, pH, temperature) on appropriate forms.
- Date and time of initiation and cessation of work.

Purpose

To provide guidance on how to document activities completed in the field by NewFields employees

Goal and Objective

To provide a record of our project work and the decisions made in the field

Equipment Needs

Field Note Book
Field Sampling Forms

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

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

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

SOP-2

EQUIPMENT DECONTAMINATION

Decontamination of field equipment is necessary to prevent cross contamination between sites and sampling locations. Decontamination should be performed on all non-dedicated and non-disposable sampling equipment that may contact potentially contaminated media. Field personnel must wear disposable gloves while decontaminating equipment to prevent cross contamination.

The following should be done to decontaminate field equipment:

- Set up a decontamination area, preferably upwind from your sampling area to reduce the potential for windborne contamination.
- Prior to initiating decontamination, visually inspect sampling equipment for evidence of contamination; use stiff brush to remove visible material.
- Once rough brushing is complete, decontaminate each piece of equipment following a sequential process of washing with Liquinox or an equivalent degreasing detergent; rinsing with distilled water; rinsing with 10% dilute nitric acid; and finally rinsing with distilled water three times. Best procedure is to set up wash tubs for each of the above processes.
- Rinse equipment with methanol instead of nitric acid if sampling for organic contamination.
- Decontaminated equipment that is used for sampling organics should be wrapped in aluminum foil or another inert material if not used immediately.

Field equipment can be decontaminated by steam cleaning as an alternative. If equipment is steam cleaned, it should still be rinsed with 10% dilute nitric acid and distilled water.

All disposable items (e.g., paper towels, latex gloves) should be deposited into a garbage bag and disposed of in a proper manner. Handling and disposal procedures for the rinse and wash water will depend on the likely presence and type of contaminant in the wash water. The project Sampling & Analysis Plan should be reviewed to determine the process for handling wash water.

Purpose

The purpose of this SOP is to describe general decontamination procedures for field equipment

Goal and Objective

To sufficiently clean field equipment to prevent cross contamination between sites and sample locations

Equipment Needs

5-gallon plastic tubs

Distilled water

1-gallon cube of 10% Nitric Acid

Spray Bottle of 10% Methanol

Liquinox Soap

Hard Bristle Brush

Garbage Bags

Disposable Gloves

Paper Towels

55-gallon drums (optional depending on need to containerize wash water)

A list of equipment for decontamination is provided below. The amount of dissolved water needed on site will depend on the number of samples to be collected and the sampling methods. For this reason, the you should evaluate the need prior to going in the field.

SOP-3

SAMPLE NOMENCLATURE, DOCUMENTATION, AND CHAIN-OF CUSTODY PROCEDURES

When completing sampling it is critical that the process used to label and transport samples to the laboratory for analysis is sufficient to demonstrate with confidence that the samples were collected from the location indicated, and that during transport to the lab no actions were taken to potentially alter the integrity of the samples. Without following strict sample labeling and chain-of-custody procedures, analytical data collected at a site has little to no value.

SAMPLE NOMENCLATURE

Samples should be labeled in such a way to allow a person unfamiliar with the site to understand where the samples were collected. Samples should be labeled sequentially as follows:

> Project site initials- sample type- sampling method- sample number-sample depth.

For example, the sample KR-SBSS-TP1-12', indicates the sample was collected at Knife River (KR), the sample was a sub-surface soil sample (SBSS), was from test pit 1 (TP-1), and was collected at 12 feet below ground. Samples numbers should be numerically sequential (TP1, TP2, etc.). Prior to initiating sampling, field personnel should familiarize themselves with the Sampling & Analysis Plan and the nomenclature to be used for the site. The character prefixes in the table below are recommended for sample types.

Purpose

To identify the specific requirements for labeling and documenting sample collection

Goal and Objective

To increase the confidence in sample locations and to submit samples to the laboratory without risk of integrity loss

Equipment Needs

Indelible ink pen

Chain-of-custody forms

Field Log Book

Field Sampling Form

SAMPLE DOCUMENTATION

In addition to the chain-of-custody forms discussed below, field person must keep a list of samples collected at the field in the field log book and on appropriate field sampling forms. This allows you to go back and verify sample locations and numbers should there be any confusion at a later time. Upon returning to the office, the field log book and forms should be kept in the project file and subsequent copies sent to the laboratory, or other designated parties, as needed.

Each person in the field is responsible for putting entries into the field log and sampling forms. Designating an individual from the sampling team for record keeping is fine, provided all field personnel come to an agreement as to who this will be, and the field crew leader is certain field personnel are familiar with the record keeping requirements. All entries on the log book and field sampling forms must be made in indelible ink.

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

CHAIN OF CUSTODY PROCEDURES

A chain-of-custody form must be generated for all samples collected in the field for laboratory analysis. Samples from more than one project should not be included on the same chain of custody; however, multiple samples from a specific project can be included on the same custody form.

Copies of the chain-of-custody form should be maintained in the project file. The sampler may use a NewFields' chain-of-custody form or a chain- of-custody form provided by the laboratory. Sample custody records must be maintained from the time of sample collection until the time of sample delivery to the analytical laboratory and should accompany the sample through analysis and final disposition. The information to be included on the chain-of-custody form will include, but is not limited to:

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

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

A sample is considered under a person's control when it is in their possession. When custody of a sample is relinquished by the sampler, the sampler will sign and date the chain-of-custody form and note the time that custody was relinquished. The person receiving custody of the sample will also sign and date the form and note the time that the sample was accepted into custody. The goal is to provide a complete record of control of the samples. Should the chain be broken (signed by the relinquisher but not receiver or vice versa), the integrity of the sample is lost and the resulting analytical data suspect. Samples must be shipped to the analytical laboratory following the procedures described in in SOP-4. If an overnight shipping service is used to transport the samples to the laboratory, custody of the samples must be relinquished to the shipping service. If possible, have the shipping service sign the chain-of-custody form prior to placing the chain of custody in the sample cooler. If this is not possible (i.e. form placed in the sealed cooler), a note should be included on the chain of custody that the shipping company has received the samples with the chain of custody inside the cooler.

SOP-4

SAMPLE PACKAGING AND SHIPPING

SAMPLE PACKAGING

Samples must be packaged to preclude breakage or damage to sample containers, and shipped to comply with shipper, U.S. EPA, and U.S. DOT regulations. When packaging samples:

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

Purpose

To ensure samples are properly packaged for shipment to the analytical laboratory

Goal and Objective

To have samples received by the analytical laboratory in good condition and within EPA temperature thresholds

Equipment Needs

Indelible ink pen

Chain-of-custody forms

Custody Seals

Sample Labels from Lab

Coolers and Ice

Field Sampling Form

SHIPPING HAZARDOUS MATERIALS/WASTE

Transportation regulations for shipping of hazardous substances and dangerous goods are defined by the U.S. DOT in 49 CFR, Subchapter C, Part 171 (October 1, 1988); IATA and ICAO. These regulations are accepted by Federal Express and other ground and air carriers.

According to DOT regulations, environmental samples are classified as Other Regulated Substances (ORS). ORS are articles, samples, or materials that are suspected or known to contain contaminants and/or are capable of posing a risk to health, safety, or property when transported by ground or air. Samples, substances, or materials from sources other than material drums, leachate streams, and sludges should be considered as ORS or environmental samples. Materials shipped under the classification of ORS must not meet any of the following definitions:

Class 1: Explosives; Class 2: Gases- compressed, liquefied, dissolved under pressure, or deeply refrigerated; Class 3 Flammable Liquids; Class 4: Substances susceptible to spontaneous combustion; Class 5: Oxidizing substances; Class 6: Poisonous (toxic and infectious); Class 7: Radioactive materials; Class 8: Corrosives.

If your samples might meet any of the above definitions, contact the project manager to obtain instructions on sample shipment.

SOP-5

FIELD MEASUREMENT OF GROUNDWATER LEVEL

FIELD PROCEDURE

- Verify the water level indicator is operating correctly prior to leaving for the field by placing probe in water to test the buzzer and light. Repair as necessary. Make certain the meter and extra batteries are in the carrying case.
- Prior to collecting a measurement, decontaminate the water level indicator, as appropriate, and calibrate the probe to a steel tape. Note any corrections to water level meter measurements on field forms.
- Measure all wells (monitoring and domestic) from the top of the well casing in the north quadrant or from a designated measuring point, as appropriate. Measure and record the distance from the measuring point to ground level. Make sure the measuring point is labeled on the well, so future measurements can be made from the same location.
- Measure the depth to water from the measuring point to the nearest hundredth of a foot.
- Record measurements on the appropriate field forms. Also record the presence/absence of free product on the field forms.
- Decontaminate the water level meter between each measurement following the procedures in SOP-2.
- If free product is known or suspected to be present in a well, an oil-water level indicator or other method should be used to measure the depth to water and the thickness of free product in the well, as described in SOP-6.

Purpose

To ensure groundwater levels are accurately measured in the field

Goal and Objective

To have samples received by the analytical laboratory in good condition and within EPA temperature thresholds

Equipment Needs

Water Level Indicator

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

SOP-6

FIELD MEASUREMENT OF GROUNDWATER LEVEL

Three different procedures are described in this SOP for measuring product thickness in a monitoring well. These include using a specialized probe, using a bailer, and using product and water finding paste.

Purpose

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

Goal and Objective

To employ a consistent measuring method for LNAPL in monitoring wells

Equipment Needs

Solinst LNAPL Probe or equivalent

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

Using a Solinst LNAPL Probe:

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

Using a Bailer:

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

Using Paste:

- • Using a steel tape, smear water finding paste over a 3-4 foot interval of one side of the tape. Smear product finding paste (or chalk) over the other side.
- • Lower the tape into the well until the bottom of the tape is roughly 2-3 feet below the top of the fluid in the well. Note the depth of the tape on the form.
- Remove the tape and note the reading indicated by the water finding paste or chalk, and the reading indicated by the product finding paste (both of these should be evident as a change in color, or a wet line in the case of chalk).

- The depth to water is calculated by subtracting the water reading from the total tape depth. The depth to product is calculated by subtracting the product reading from the total tape depth. Product thickness is calculated by subtracting depth to product from the depth to water.
- This may need to be repeated several times, especially if the depth to water is not known, or if the product thickness is greater than the depth the tape is lowered into the fluid. Previous depth to water and product thickness readings can be used as a guide.

SOP-7

FIELD MEASUREMENT OF ELECTRIC OR SPECIFIC CONDUCTANCE

INSTRUMENT CALIBRATION

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

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

FIELD MEASUREMENT PROCEDURE

Rinse a decontaminated glass container or plastic flow-through cell with sample water.

Fill the container or flow-through cell with sample water, with enough available space to insert the probe without undesired overflow.

Rinse the conductivity or multi-parameter probe with deionized water and place it in the beaker of sample water. Immerse the probe in sample and move it around to displace any air bubbles. Keep the probe tip off of the sides of the beaker. Record the conductivity reading. Be sure to recognize the units of the reading (i.e. microseimens/centimeter (µs/cm), micromhos/centimeter (µmhos/cm), or milliseimens/centimeter (ms/cm). Record the reading on the field sampling form and filed log book. If the reading is being taken in-situ or using a flow-through cell, wait until the reading stabilizes and record it on the sample field form.

Remove the probe from sample and decontaminate probe. Store the probe following the manufacturer's recommendations.

Purpose

To ensure measurement of specific conductance is done consistently and correctly in the field

Goal and Objective

To obtain accurate specific conductivity measurements in the field

Equipment Needs

Specific Conductivity Meter

Calibration standard

Measurement container

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

SOP-8

FIELD MEASUREMENT OF PH

Purpose

Provide guidelines for pH measurements in water samples

Goal and Objective

To obtain accurate pH measurements in the field

Equipment Needs

pH Meter

Calibration standards

Glass container or flow-through cell

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

INSTRUMENT CALIBRATION

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

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

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

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

FIELD MEASUREMENT PROCEDURE

- Rinse a decontaminated glass beaker or plastic flow-through cell sample water three times.
- Rinse the pH probe with deionized water.
- Fill the container with sample water.
- Immerse the probe in the sample and agitate it to provide thorough mixing. Continue to agitate until the reading has stabilized. Read the pH to the nearest 0.1 s.u. and record on the field sampling form. If the reading is being taken in-situ or using a flow-through cell, wait until the reading stabilizes and record it.
- Note any problems such as erratic readings. If previous readings are available, compare the current measurement to previous reading to check that the current reading is within reasonable limits.
- Rinse probe with deionized water and store according to the manufacturer's instructions.

SOP-9

FIELD MEASUREMENT OF DISSOLVED OXYGEN

FIELD MEASUREMENT PROCEDURE

Before each use, clean and rinse the electrode tip with distilled water. Verify that the membrane cap has been filled with DO electrolyte in accordance with manufacturers required maintenance schedule.

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

Place probe the directly into the stream or well to be measured. If not possible, place the probe into a flow-through cell receiving a continuous stream of water from the source being measured. Allow sufficient time for the probe to stabilize to sample temperature and dissolved oxygen concentration. Record the dissolved oxygen value on the appropriate field forms. Decontaminate probe when measurement is complete.

If sensor will not calibrate, becomes sluggish or erratic:

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

Purpose

Provide guidelines for Dissolved Oxygen measurements in water samples

Goal and Objective

To obtain accurate dissolved oxygen measurements in the field

Equipment Needs

Dissolved Oxygen Meter

Distilled water

Calibration cup

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

SOP-10

FIELD MEASUREMENT OF OXIDATION REDUCTION POTENTIAL (ORP)

FIELD MEASUREMENT PROCEDURE

- Calibrate the meter in accordance with the manufacturer's instructions prior to each sampling event.
- Decontaminate a plastic or glass container in accordance with SOP-2.
- Rinse the ORP electrode with distilled water and then with sample water prior to inserting it into the sample beaker.
- If possible, obtain an in situ measurement of ORP. If not possible, preferably use a flow-through cell receiving a constant stream of water from the well, or (least preferred) collect a sample of water. If obtaining a sample for ORP measurement, minimize agitation of the sample in an effort to limit exposure to oxygen.
- Immerse the ORP electrode in the sample and allow at least one minute for the probe to equilibrate with the water.
- Obtain a reading to the nearest ten millivolts.
- Record the reading on standardized field forms and the field book. Note any problems such as erratic or drifting readings.
- Decontaminate the probe following the SOP-2.

Purpose

Provide guidelines for Redox Potential measurements in water samples

Goal and Objective

To obtain accurate Redox Potential measurements in the field

Equipment Needs

Redox Potential Meter

Distilled water

Calibration solution with table of temperature adjustment information

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

SOP-11

FIELD SAMPLE FILTRATION

FIELD PROCEDURE

- Set up a system whereby water samples can be filtered, including a filter apparatus and hand-vacuum pump.
- To avoid the need for decontamination, use disposable tubing and equipment and a hand-vacuum pump.
- Place groundwater or surface water into a vessel that can be pressurized using the hand-vacuum pump. The filtered effluent from the pump can be placed directly into sample containers post filtering with a 0.45 micron filter.
- As appropriate, fill pre-preserved, laboratory supplied sample containers with filtered sample and cap.
- Invert sample container several times to insure complete sample-preservative mixing.
- Place sample into cooler; package and ship accordance with the SOP concerning shipping.
- If extremely turbid sample water is obtained, you may need to pre-filter the sample using 3.0 or 5.0 micron filter paper followed by 0.45 micron filtration.
- Decontaminate, if necessary, all equipment in accordance with the SOP concerning decontamination.

Purpose

Provide guidelines for filtering water samples in the field

Goal and Objective

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

Equipment Needs

0.4, 3.0, and 5.0 micron filters

Filter apparatus and Hand-vacuum pump

Preservatives, as required

Indelible Ink Pen

Field Sampling Form

SOP-12

GROUNDWATER SAMPLING

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

Field sampling forms must be completed for each well to document purging and sampling.

SAMPLING FROM TEMPORARY BOREHOLES

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

When sampling from a temporary well screen, use either new tubing (LDPE or Teflon) with a stainless steel foot valve, or use a new/decontaminated bailer. Note the physical appearance of the sample (color and qualitative turbidity) on the field sampling form. Where feasible, avoid sampling from the bottom 1-foot of the borehole or well screen to minimize entrainment of sediment into the sample.

WELL PURGING

Purging must be performed on all wells prior to sample collection.

Before purging each well, record the depth to water from the top of the well casing to the nearest 0.01 foot using a water level meter. If sampling at a site where there may be free product, wells shall be checked for the presence of free product prior to purging and sampling using an oil-interface probe.

Purpose

Provide guidelines for sampling groundwater

Goal and Objective

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

Equipment Needs

Five gallon bucket graduated in gallons

Purge/sampling pump(s)

Oil-Interface Probe, as necessary

Water Level Meter

pH, temperature, and conductivity meter

Filtering apparatus and hand pump (if filtering samples)

Sample Containers

Preservatives, as required

Field Sampling Forms

Decontamination equipment and fluids

Tubing, as needed

Generator or power supply

Coolers and Ice

Stop Watch

Rope and Bailer, for backup

Determine the saturated thickness by subtracting the total well depth from the depth to water.

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

1) V=3.14*(r2)*d*7.48 where V= volume (gallons)
r= well radius, feet
d= depth of water in well (feet)

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

Several general methods can be used for well purging. Well purging may be achieved using bailers, bladder pumps and submersible pumps. The specific pumping method shall be chosen based on depth to groundwater, diameter of well, existing well configuration and contaminant(s) of concern.

If the recovery of a low-yield well exceeds two hours after purging, a sample shall be extracted as soon as sufficient volume is available in the well. At no time should a monitoring well be pumped dry if the recharge rate causes formation water to cascade down the well casing causing an accelerated loss of volatiles and change in pH.

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

COLLECTING WATER QUALITY SAMPLES

Label each sample container with project number, sample location, well owner, date, military time, sampler's initials, preservative, and analysis required.

Don clean latex or nitrile gloves immediately prior to obtaining the sample.

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

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

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

Samples should be preserved as described in the table below.

Parameter	Number	Container	Preservation	Maximum Holding Time Extraction/ Analysis
VOCs	2	40 ml glass	4°C & HCL	14 days to analysis
SVOCs	1	1 liter glass	4°C	7 days/40days from extraction to analysis
Metals	1	500 ml HDPE	4°C & HNO_3	6 months to analysis,, Hg 28 days to analysis
Nutrients	1	500 ml HDPE	4°C & H_2SO_4	Varies – contact laboratory for additional information
Common Ions	1	1 liter HDPE	4°C	7 days/40 days from extraction to analysis

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

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

SOP-13

SURFACE SOIL SAMPLING

This SOP describes the field equipment and sampling methods for surface sampling of soil. Be sure to review the project specific Sampling and Analysis Plan (SAP) for additions or deletions to the methods noted below. These procedures may be modified in the field based on field and site conditions after appropriate annotations have been made in the field logbook and the project manager is consulted to discuss.

All sampling equipment shall be decontaminated before arriving on site.

Purpose

Provide guidelines for sampling of surface soil.

Goal and Objective

To employ a method of collecting surface soil samples representative of field conditions.

Equipment Needs

Stainless steel mixing bowl and sampling trowel

Hand lens (10) power

pH and electrical conductivity meters (if required)

Munsel color book (if required)

Latex or Nitrile gloves

Locating Flags

Coolers and Ice

GPS Unit

Field forms and field book

SURFACE SOIL SAMPLING

Commonly, there are two different methods of surface soil sampling completed on a site: Discreet or Grab Samples, and Composite Samples. The methods for each of these are described below.

For both methods, surface soil samples should be collected from the surface to a depth of six inches unless otherwise specified in the project specific SAP.

Soils should be described according to the procedures outlined in the United Soil Classification System (USCS; method ASTM D2487) or the Soil Conservation Service (SCS) classification system. Soil texture should be classified by either the USCS or the U.S. Department of Agriculture (USDA) classification. Descriptions shall be recorded in the field books or on standard morphological description logs as provided in the SAP.

Discrete or Grab Soil Samples

- Locate the site as directed in the appropriate sampling and analysis plan.
- Wearing disposable latex or nitrile gloves collect a sample by scraping the 0-6 inch interval of soil with a stainless steel spoon.
- Place the soil in a stainless steel bowl.
- Remove all coarse fragments greater than 0.5 inches from the bowl. If volatile organics analysis is not required, mix the remaining sample in the bowl with the stainless steel spoon.
- Transfer the soil sample directly into a glass sample jar with Teflon cap (4 or 8 ounce, depending on number of analyses required) and store in a cooler at 4 degrees Celsius or less. Retain approximately 30 grams of the sample in a plastic bag for field measurement of pH or PID screening, if required.

- Push flag into the ground at the sample location, which will allow for obtaining the coordinates of the sample location later with a GPS Unit, or take a coordinate reading of the location prior to moving to another sample location.
- Record information about the sample collection on the appropriate forms.

Composite Samples

Review the work plan or SAP to determine the location and spacing of sampling area grids for the collection of composite samples. When reviewing, determine the grids to be cordoned off in the field and the number of composite samples to be collected within the each grid. Follow the process below to collect the composite samples. **Composite soil samples should not be collected for analysis of volatile organic compounds.**

- Prior to collecting the composite samples, mark off the sampling grid as described in the SAP.
- Collect five to eight (as indicated in the SAP) surface soil samples of equal volume using a sampling trowel from discrete locations within a sampling area and place them in the mixing bowl. If a sod or duff layer is present, this layer should be peeled back to the top of the mineral soil.
- Remove all coarse fragments greater than 0.5 inches from the bowl.
- Mix the samples in the mixing bowl well and then a fill a laboratory supplied sample container with the mixed soil.
- Complete appropriate field sampling forms and the chain of custody. Store all samples in a cooler with ice.

SOP-14

SUBSURFACE SOIL SAMPLING

SUBSURFACE SOIL SAMPLING

Typically, subsurface sampling is completed using a hand auger, split spoon sampler, direct push drilling equipment, or backhoe or excavator. Sampling procedures for each type of equipment is described below.

Hand Auger

- Arrive on-site equipped with stainless steel auger rod and hand auger. If you intend to collect samples from different intervals below grade, bring several sizes of stainless steel augers (e.g. 2-inch, 4-inch, 6-inch, etc.).
- Hand auger holes can be drilled as one size or in a telescoping manner if you wish to collect discreet samples at intervals below grade and prevent risk of cross contamination between intervals. If a single depth sample is required, advance the auger bucket to the desired sampling interval depth and empty the contents of the auger in a stainless steel mixing bowl. Mix and place soil into appropriate sample containers.
- For the telescoping method, advance the largest auger first to the desired depth, collecting a specified depth increment sample as the auger bucket is advanced. Install temporary decontaminated PVC casing with a diameter slightly smaller than the borehole to keep the hole open and reduce possible cross-contamination between depth intervals. Using the next size smaller auger bucket, repeat the process.
- Fill out appropriate sample labels, field forms and chain-of-custody paperwork and place samples for lab analysis in a cooler with ice.
- Decontaminate all equipment between sample locations.

Purpose

Provide guidelines for sampling of subsurface soil.

Goal and Objective

To employ a method of collecting subsurface soil samples representative of field conditions.

Equipment Needs

Will depend on sampling method

Stainless steel mixing bowl and sampling trowel

Hand lens (10) power

Munsel color book (if required)

Latex or Nitrile gloves

Locating Flags

GPS Unit

Coolers and Ice

Field forms and field book

Split Spoon Sampler

- Arrive on-site equipped with at least two standard 1.4 inch inside diameter split spoon samplers. If geotechnical information is desired, a 140 pound drive hammer is required.
- Install split-spoon sampler into borehole and advance to the desired depth with the 140 pound drop hammer. Record number of blow counts to complete sampling over each 18-inch interval, as necessary.
- Retrieve sampler and place on work table. Using the other sampler, repeat this sequence.

- Record lithology and percent recovery from cores retrieved from split spoon sampler.
- If required by the project work plan or sampling and analysis plan, composite like core intervals by mixing in stainless steel bowl in a similar manner as described for surface sampling. When sampling for volatile organic compounds, the sample should not be mixed.
- Decontaminate sampling equipment between each interval sampled if required by the SAP.
- Decontaminate sampling equipment between sampling sites.

Direct Push Drilling Equipment

- Locate the site to be sampled and ensure that drilling equipment can safely access the site.
- Minimize off road travel to prevent off site damage to surrounding vegetation.
- Advance sampling rods lined with acetate sleeves to the prescribed depth. Retrieve the rods, remove the sample sleeves, and secure on the work table.
- Record lithology and percent recovery from the retrieved sample sleeve.
- If required by the project work plan or sampling and analysis plan, composite like core intervals by mixing in stainless steel bowl in a similar manner as described for surface sampling. When sampling for volatile organic compounds, the sample should not be mixed.
- Decontaminate sampling equipment between each interval sampled if required by the SAP.
- Decontaminate sampling equipment between sampling sites.

Backhoe or Hand Dug Excavations

- Locate the site to be sampled and ensure that equipment can safely access the site.
- Minimize off road travel to prevent off site damage to surrounding vegetation.
- Orient excavation to maximize use of the angle of the sun to illuminate the pit for photographs.
- Excavate to the prescribed depth. Place excavated material a sufficient distance from the excavation. If the pit exceeds five feet in depth, OSHA construction standards for shoring or sloping must be observed to prevent accidental burials. Sampling personnel should avoid entering any pit to collect samples, and if required to do so, strict adherence to all OSHA standards must be implemented.
- Soil profile descriptions shall be made from a hand cleaned surface along the pit wall.
- Complete profile descriptions and take photographs before pit is sampled.
- Soil samples shall be collected from depth intervals specified in the SAP. When a depth interval is sampled, an equal volume of soil should be collected from the entire interval exposed on the pit wall by the excavating bucket. When the bucket is brought to the surface, soil samples should be collected from the bucket with the stainless steel trowel and mixing bowl according to methods described for surface soil sampling. When sampling for volatile organic compounds, the sample should not be mixed.
- After sampling is completed, the pit should be backfilled with excavated material in the reverse order that it was excavated so that topsoil material is returned to the top of the pit. When backfilling is complete the area should be cleaned up to its original condition. If a test pit is left open overnight, temporary fencing and appropriate signs and flagging tape should be used to prevent access to the excavation.

- Decontaminate the excavator bucket and all sampling equipment between sampling sites. Excavation equipment should be cleaned between sites with water (where possible) or with a shovel to remove accumulated dirt and mud.

SAMPLE CONTAINERS AND PRESERVATION

Soil samples should be preserved as described in the table below.

Parameter	Number	Container	Preservation	Maximum Holding Time Extraction/ Analysis
VOCs	1	4 oz glass	4°C	14 days to analysis
VPH	1	4 oz glass	4°C	Preserve in methanol within 7 days/40 days from preservation to analysis
EPH	1	4 oz glass	4°C	14 days/40 days from extraction to analysis
SVOCs	1	4 oz glass	4°C	7 days/40days from extraction to analysis
Metals	1	4 oz glass or plastic	4°C	6 months to analysis,, Hg 28 days to analysis

SOP-15

MONITORING WELL CONSTRUCTION

- Arrive on site with the appropriate drilling equipment and materials for site conditions. Be sure to review the SAP to determine anticipated lithology. Filter pack and well-screen slotting should be based on the lithology. Ensure that the driller has properly decontaminate all drilling equipment and materials prior to arrival on- site.
- Many states now require certification and licensing for monitoring well drillers. Verify the driller is licensed in the State (if required) prior to beginning fieldwork.
- Safety equipment required on-site of the drill rig is mandatory. Personal protective equipment includes (at a minimum): hardhat, safety glasses, steel toed boots, gloves, first aid kit, and site safety plan-with routes to hospitals known by all personnel on-site.
- Acceptable drilling techniques for the installation of monitoring wells include air- rotary, cable tool, and hollow-stem auger. If unconsolidated material is encountered, it may be necessary to drive steel casing during drilling to maintain borehole integrity.
- Appropriate decontamination of the auger flights between boreholes is required.
- Drilling mud or drilling solutions of any kind are not to be used during drilling activities in conjunction with monitoring well construction. Hydraulic jacks or the drill rig can be used to pull back the steel casing following emplacement of plastic casing.
- Subsurface samples must be collected by the driller at intervals specified in the SAP. Down-hole soil samples should be collected using a standard 1.4-inch inside diameter split spoon sampler and a 140-pound drive hammer. The number of blows necessary to obtain an 18-inch length of sampler by the driller should be recorded on the boring log.
- A detailed lithologic boring log must be completed during drilling activities. Soils should be described on the log according to the procedures outlined in the United Soil Classification System (USCS; method ASTM D2487) or the Soil Conservation Service (SCS) classification system. Soil texture should be classified by either the USCS or the U.S. Department of Agriculture (USDA) classification. Water bearing characteristics of the formations should also be denoted on the log. In addition, details of monitoring well construction should be described on the well log including total depth, perforated interval, sizes

Purpose

Provide guidelines for installing monitoring wells in the field

Goal and Objective

To employ a standard method of installation monitoring wells, which will allow for collected of representative groundwater samples

Equipment Needs

Drilling system

Well completion material (screen, filter pack, borehole seal, and surface seal) consistent with anticipated lithology

Hand lens (10) power

USGS Soil Classification Chart and Munsel color book

Latex or Nitrile gloves

Boring Log and field book

and types of construction materials, etc.

- When completing the well, install factory slotted well screen (size dependent on lithology) and blank PVC (or stainless steel or PTFE for organics) well casing into the borehole. Emplace chemically inert silica sand at least 2 feet above and below any perforated sections and install a bentonite plug above the sand. Backfill remaining well annulus with bentonite slurry or grout to the ground surface. Develop the well prior to sample in accordance with the appropriate SOP.
- Place locking protective well cover over well casing(s) after outer steel casing has been removed from the borehole (if necessary). Place bentonite plug below bottom of well cover; grout cover in place and lock with high quality lock.

SOP-16

MONITORING WELL INSTALLATION WITH DIRECT PUSH EQUIPMENT

FIELD PROCEDURE

- Arrive on-site with the appropriate drilling equipment and materials for site conditions. Ensure drill has properly decontaminate all drilling equipment and materials prior to arrival on- site.
- Safety equipment required on-site is mandatory. Personal protective equipment includes (at a minimum): hard hat, safety glasses, steel toed boots, gloves, first aid kit, and site safety plan-with routes to hospitals known by all personnel on-site.
- Check SAP to determine if soil samples should be collected during advancement of direct push equipment. If so, follow methods described in SOP for subsurface soil sampling.
- Advance the direct push drill rods to the desired depth for monitoring well installation.
- Describe lithology encountered following method described in SOP for subsurface soil sampling. A detailed lithologic log should be completed. Water bearing characteristics of the formations should be denoted on the log. In addition, details of monitoring well construction should also be described on the well log including total depth, perforated interval, sizes and types of construction materials, etc.
- Construct the monitoring well of Schedule 40 or 80 PVC casing and factory- slotted well screen up to 1-inch in diameter. Once the drill rods are at the desired depth, lower the well screen and casing through the drill rods. Retract the drill rods out of the borehole while placing a chemically-inert silica sand around the screen interval to one foot above the well screen. Install a bentonite plug above the sand at least 2 feet in thickness. Above the bentonite, backfill the remaining well annulus with a bentonite slurry or grout to ground surface.
- Place locking protective well cover over the well casing after the drill rods have been removed from the borehole. Place bentonite plug below bottom of well cover; grout the cover in place and lock with high quality lock.

Purpose

Provide guidelines for installing monitoring wells using direct push techniques

Goal and Objective

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

Equipment Needs

Ink Pen

Well Completion materials, as necessary

Latex or Nitrile gloves

Field Log Book and Boring Well Log

SOP-17

FIELD SCREENING OF VOLATILE ORGANIC COMPOUNDS IN SOIL

- Field screening can be done using a flame ionization detector (FID), photoionization detector (PID), or combustible gas indicator (GCI). Which instrument is used will depend on the contaminants at the site and site conditions. The project SAP should be reviewed to identified the field screening instrument to be used at the site.
- If using a PID, ensure the instrument is equipped with the appropriate lamp for the compound(s) of interest (refer to table below). Use a filter to prevent moisture and dust from contacting the PID lamp.
- Calibrate the instrument prior to each field day following the manufacturer's instructions. Document the calibration on the appropriate field form or in the project field book.
- Obtain a soil sample from the interval of interest, place it in a new ziploc bag, and seal the bag. Shake the bag to thoroughly mix the sample with the air in the headspace.
- Allow the sample to come to room temperature (approximately 70 - 80° F) by placing it in a warm location (not in direct sunlight). In the winter, it may be necessary to place the sample bag under a vehicle heater vent.
- Insert the probe in the ziploc bag and record the maximum reading on the appropriate field forms.

Purpose

Provide guidelines for field screening of volatile organic compounds in soil

Goal and Objective

To employ a standard method of measuring the concentration of volatile organics in soil

Equipment Needs

FID, PID, or GCI, as required by SAP

Ink Pen

Zip Lock Bags

Latex or Nitrile gloves

Field Log Book and Sampling Forms

PID Lamp Selection

Lamp	Description	Typical Compounds Detected
9.8 eV	Most selective lamp	Benzene, aromatic compounds, amines
10.6 eV	Standard PID lamp	All compounds detected by 9.8 eV lamp and chlorinated compounds, including vinyl chloride, DCE, TCE, PCE, and chlorobenzene
11.7 eV	Detects broadest range of analytes	All compounds detected by 10.6 eV lamp, used to detect methylene chloride, carbon tetrachloride, chloroform, 1,1,1-trichloroethane

SOP-18

MONITORING WELL DEVELOPMENT

FIELD PROCEDURE

Prior to sampling of a monitoring well, the well must be developed to remove excess fines and set the filter pack installed during well construction.

Purpose

Provide guidelines for developing monitoring wells

Goal and Objective

To ensure wells are developed prior to sampling

Equipment Needs

Decontamination equipment and fluids

Latex or Nitrile gloves

Well Development Form

- Visually inspect all well development equipment for damage and repair as necessary.
- Decontaminate all stingers, air hoses, surge blocks following the SOP developed for decontamination of field equipment.
- If using compressed air method for well development, verify the compressor utilized does not produce air laden with hydraulic fluid for lubricating purposes. This may affect the integrity of the monitoring well for producing viable water quality data.
- Develop well by using surging techniques (surge block or bailer) followed by evacuation of water and sediment. Place the surge block or bailer in the well and lower to bottom. Move the surge block or bailer up and down over the entire length of the well screen several times. Remove and evacuate water from the well. Repeat this procedure until evacuated water is visibly clean and essentially sand-free. Record clarity of water after development on the well development form.
- Evacuated water should be disposed of following to the process defined in the SAP or project work plan.
- Report field observations and volume of water removed on well development form.

SOP-19

SURFACE WATER SAMPLING

Purpose

To provide field sampling methodologies for surface water

Goal and Objective

.To ensure surface water samples are collected consistently in the field

Equipment Needs

Decontamination equipment and fluids

Latex or Nitrile gloves

pH, conductivity, temperature meter

Coolers and ice

Sample bottles Preservatives

Indelible marker

Field sampling Form

Chain-of-custody

GRAB SAMPLING

- When collecting a grab sample of surface water attempt to collect the sample at the interval in the stream which exhibits the largest volume of flow and/or highest velocity. More than one interval may be sampled.
- Field parameters should be measured in accordance with applicable SOP prior to collect a sample for analytical testing. Take care to collect measurements from the sample locations in the stream as the grab sample.
- To collect a sample, submerge a pre-labeled sample bottle such that mouth of bottle is submerged below the water surface 2 to 3 inches, if possible. If sampling inorganics, allow bottle to fill partially; rinse bottle by shaking and discharge this water away from sample site. Repeat this procedure three times. Do not rinse sample bottles for organics analysis.
- Once the sample container is filled, add preservative (if necessary), and cap. If water is too shallow to fill directly to sample bottles use a decontaminated container to collect sample water. Transfer water from compositing container into pre-labeled sampling bottles.
- Fill out appropriate field form(s) documenting sample location, time, and other pertinent information prior to leaving sampling site.

SAMPLING FREE PRODUCT ON SURFACE WATER

This sampling procedure to be used when sampling for free phase organic constituents floating on top of water is described below.

- Decontaminate sample container in accordance with appropriate SOP.
- Using a wide mouth jar, submerge the sample container in such a manner that leaves the mouth of the container half-way out of the water. Wait for the container to fill.
- Transfer directly into sampling bottles.
- Fill out appropriate field form(s) documenting sampling location, time, and other pertinent information prior to leaving the sampling site.

SOP-20

SEDIMENT SAMPLE COLLECTION

This SOP describes the field equipment and sampling methods for collection of fresh-water sediment samples in shallow water (less than eight feet deep). Methods explained in this SOP may be different from those identified in the project specific Sampling and Analysis Plan (SAP) and the project specific SAP should be referenced for additions or deletions to the methods noted below.

Purpose

To describe field sampling methodology for sediment water

Goal and Objective

To ensure sediment samples are collected consistently in the field

Equipment Needs

Decontamination equipment and fluids

Latex or Nitrile gloves

Stainless steel scope, spoon, or trowel

Stainless steel mixing bowl

Sample jars with Teflon-lined lids

Sample jar labels

Cooler and ice

Field forms and field book

Chain-of-custody

SAMPLE COLLECTION

- Prior to sample collection and between samples, be sure to decontaminant all non-disposable sampling equipment in accordance with standard operating procedures.
- Label your sample containers in accordance with standard operating procedures.
- If you can wade into the surface water body, collect the sediment sample using a stainless steel scoop or spoon. Collect the sediment sample with the scoop or spoon while facing upstream. Excess water may be removed from the scoop or spoon; however, care should be exercised to avoid the loss of fines when decanting excess water.
- In surface water bodies that are too deep to wade, but less than eight feet deep, a stainless steel spoon or scope attached to a piece of pipe may be used from the banks if the surface water body is narrow or from a boat.
- Following collection, place the sample in a stainless steel mixing bowl, mix it thoroughly, and then place a portion of the sample in the sample container. When sampling soil for organics, do not mix the samples as this may release organics from the sediments. Place sample containers in a cooler with ice.
- Complete all out appropriate field sampling forms and chain-of-custody forms.

SOP-21

SOIL VAPOR SAMPLING

(SUMMA CANISTER WITH ISOPROPLY ALCOHOL TRACER)

GENERAL PROCEDURE – PURGING

Prior to sample collection, purging of soil vapor from the sampling probe must be performed. If previous purge testing has not been performed, a purge optimization test should be conducted to select an appropriate purge volume for the site. During purge optimization, remove 1, 3, and 7 volumes of dead space (tubing, probe, air within filter pack surrounding the probe). The number of purge volumes that yields the highest concentrations of target analytes as measured using a PID should be selected.

After selecting a purge volume, purging should be conducted using a pump (such as personal air sampling pump) or vacuum canister (either one-time use, such as a Summa canister, or electric canister maintaining a consistent vacuum). Constant flow rates during purge should be maintained by air flow meters with adjustable purge pumps or the use of flow controllers with vacuum canisters. The rate of purging (usually in mL/min), and the start and stop time of purging (recorded as hour:minute:second) should be recorded at each sampling location.

Following purging, and prior to soil vapor sampling, the sampling train should be sealed to influence from outside ambient air using valves or other closure mechanisms.

COLLECTING SOIL VAPOR SAMPLES

Generally, sampling locations shall be sampled from the least contaminated to the most contaminated, if known.

- Prior to initiating sampling, confirm that all connections from the vapor sampling point to the vacuum canister are tightly sealed, the flow controller is in-place in the sampling train, and that a pressure gauge is properly installed between the sampling canister and the flow controller (or that the flow controller has a built-in sampling gauge installed in the proper orientation).
- Place a weighted absorbent towel on the ground at the point where the sampling train enters the subsurface and beneath any connections in the sampling train, then soak the towel with liquid isopropyl alcohol.

Purpose

To describe field sampling methodology for soil vapor

Goal and Objective

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

Equipment Needs

Summa canister

Flow controller Pressure gauge

Flow controller-to-tubing and purge pump-to-tubing connections

Tubing

Other fittings for top of soil vapor probe (if necessary)

Tracer gas and absorbent towels

Purge pump

Stop watch

PID, or volatile organic meter that can detect both the target environmental analyte and the tracer gas

Field forms and field book

Chain-of-custody

- Open the valve on the summa canister, and record time, canister pressure (in negative inches of mercury), and the serial number of the canister in the field log book and field sampling form. If using a 6-liter Summa canister, the initial vacuum should be between -30 and -25 inches of mercury. If this is not the case, contact the laboratory and start the purging and sampling process over including use of a different Summa canister.
- Using a field instrument, also record organic vapor concentrations (dominated by isopropyl alcohol tracer compound) in the ambient air near the base of the sampling probe.
- At about ½ the time necessary to complete sampling, record time and canister pressure, and ambient organic vapor concentrations. The pressure on a 6-liter Summa canister should be between -20 and -12 inches of mercury at ½ of the sampling time. Determine whether the sampling time will have to be extended to obtain sufficient sample volume, and adjust accordingly.
- At the end of the designated time necessary to complete sampling with the flow controller used, record time and canister pressure, and ambient organic vapor concentrations.
- Continue to draw air from the soil vapor probe until the 6-liter Summa canister vacuum is reduced to between -10 and -5 inches of mercury. Record the time and canister pressure, then close the canister valve to end sampling.
- Remove the canister to a location distant from the soil vapor probe and tracer gas application, and prepare the canister for shipment to the laboratory
- Label each Summa canister with project name, project number, sampling location, date, military time (at the end of the sampling interval), sampler's initials, and analysis required.
- Ship the samples to the laboratory under chain-of-custody, include one copy of the chain of custody form with each package.

SOP-22

SOIL VAPOR SAMPLING

(SUMMA CANISTER WITH HELIUM LEAK DETECTION)

FIELD PROCEDURE

- Attach flow controller and pressure gauge to Summa canister.
- Seal the upstream end of controller/canister with a brass cap, then open the canister valve for approximately 5 seconds. Observe pressure gauge. Pressure should stay constant at an initial point between 30 and 23 inches of mercury. If the initial pressure is above or below this range, contact the laboratory and use a different Summa canister. If the pressure changes, re-tighten connections and repeat.
- Confirm that sample tubing (3 to 4 feet) is attached to the soil vapor probe, and also place a short section of tubing for helium monitoring adjacent to the soil vapor probe.
- Seal the distant ends of the helium monitoring tubing and sample tubing using a valve or clamped section of silicon tubing.
- Provide helium supply line to near the soil vapor probe entrance to the ground, and cover the probe and adjacent sections of helium supply line, helium monitoring line, and sample tubing with a shroud (plastic bag weighed down to the surrounding surface using a sand-filled hose).
- Open the helium monitoring line, turn on the helium meter, and connect the meter to the monitoring line.
- Add helium and until the concentration monitored under the shroud is 20%.
- Purge 3 dead-space volumes from the sample tubing and probe using a syringe, personal air sampling pump, or vacuum canister (either one-time use, such as a Summa canister, or electric canister maintaining a consistent pressure). Maintain constant flow rate during purging using an air flow meter with adjustable purge pump or flow controller with vacuum canister. The rate of purging (usually in mL/min), and the start and stop time of purging (recorded as hour:minute.second) should be recorded at each sampling location. If pump or canister is not used, a syringe can be used for purge, in which case simply record

Purpose

To describe field sampling methodology for soil vapor

Goal and Objective

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

Equipment Needs

Summa canister

Flow controller Pressure gauge

Flow controller-to-tubing and purge pump-to-tubing connections

Tubing (silicon and Teflon)

Other fittings for top of soil vapor probe (if necessary)

Syringe or pump for purge

Stop watch

PID

Shroud (clear plastic bag, hose filled with sand for weighing down bag)

Helium

Helium Meter

Field forms and field book

Chain-of-custody

total volume purged and time interval of purge.

- Detach the helium monitor from the monitoring line, close the helium monitoring line, and allow the helium monitor to return to a reading of zero. Attach the helium monitor to the sample tubing (note that some helium meters only function if placed in a open air stream, such as being loosely placed into a much larger rigid tube – rather than a tight connection).
- Record the stabilized helium concentration in the sample tubing, and the estimated purge volume, if any, removed by action of the helium monitoring device. The ratio of helium concentration in the sample tubing to the concentration previously monitored under the shroud should be no more than 0.1 (i.e. approximately 2%). If this condition is met, proceed. If the ratio is more than 0.1, remove the shroud, repair sampling train connections and seal of the probe to the ground, and repeat helium supply and purge.
- Connect PID to the sample port. Record the stabilized reading, and the estimated purge volume removed by action of the vapor detector, then close the sample tubing.
- Remove the shroud.
- Attach the sample tubing to the regulator/Summa canister train.
- Replace the shroud over the entire sampling train (including Summa canister) and over the helium supply and monitoring lines.
- Add helium and until the concentration monitored under the shroud is 20%.
- Open the valve on the Summa canister, and record time, canister pressure (in negative inches of mercury), and the serial number of the canister.
- Record the helium concentration during sampling at 2-minute intervals for the entire sampling period, if 15 minutes or less; or for the first 15 minutes if sampling for a longer period. Add helium as needed to maintain 20% inside the shroud.
- At approximately ½ the time necessary to complete sampling with the flow controller used, again record time, canister pressure, and helium concentration under the shroud. Make a preliminary evaluation of whether the sampling time will have to be extended or shortened to obtain appropriate sample volume (the pressure on a 6-liter Summa canister should be between -20 and -12 inches of mercury at ½ of the sampling time). Add helium as necessary.
- At the end of the designated time necessary to complete sampling with the flow controller used, record time, canister pressure, and helium concentration under the shroud. If using a 6-liter Summa canister, extend the sampling interval until the canister vacuum is between -10 and -5 inches of mercury; record time, canister pressure, and helium concentration, then close the canister valve to end sampling.
- Prepare the canister for shipment to the laboratory: replace the brass cap, label the Summa canister with project name, project number, sampling location, date, military time (at the end of the sampling interval), sampler's initials, and analysis required. Analysis must include helium.
- Make sure to record all data on appropriate field sampling form. Ship the samples to the laboratory, including one copy of the Chain of Custody form with each package.

SOP-23

AMBIENT AIR SAMPLING

PRIOR TO SAMPLING

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

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

SAMPLING PROCEDURES

Use 6-liter stainless-steel Summa canisters and flow controllers provided by the laboratory. Place indoor air sampling canisters such that the intake into the sampling train is at a height of approximately 4 to 5 feet above floor level (i.e., in the breathing zone of a standing worker).

At least three outdoor ambient air sampling locations should be used to provide background data at the time of the indoor air sampling. The outdoor locations should be upwind of the subject building(s), and one of the outdoor ambient air sampling locations should be on the roof near the intake of one of HVAC units, if present. Begin sampling of outdoor ambient air at least one hour before sampling indoor air, and continue collecting outdoor air until at least 30 minutes prior to the end of the indoor air sampling period.

Purpose

To describe a field sampling methodology for sediment water

Goal and Objective

To ensure sediment samples are collected consistently in the field

Equipment Needs

Summa canister

Flow controller

Tubing (and associated connections) Apparatus for setting height of air intake

Wind speed meter

Vapor detector (such as PID, if applicable)

Field forms and field book

Chain-of-custody

Collect one field duplicate quality control (QC) sample per sampling event, unless specifically exempted by the project manager. Record meteorological conditions, including temperature, barometric pressure, wind direction, and wind speed during the sampling period. Meteorological conditions may be estimated, and reported along with weather information from outside sources, if approved by the project manager. Take a photograph of each sample location.

Using pre-calibrated 8-hour flow controllers to fill each 6-liter Summa canister to within the pressure range recommended by the laboratory. For each sample, record times of the start and end of sampling. Record initial and final canister pressures. Label each canister with a unique sample number. Complete field sampling sheets (including canister serial number, pressure and time at the start and end of sampling) and chain-of-custody documents for all samples prior to shipment to the laboratory for analysis.

SOP-24

QUALITY CONTROL SAMPLING

Quality Control (QC) samples are submitted along with natural samples to provide supporting laboratory data to validate laboratory results. QC field samples are submitted blind to the lab with the exception of trip blanks. In general, field equipment and duplicate samples should be collected during every sampling event. Duplicate samples should be collected at a frequency of one sample for every 20 natural samples. Always check the SAP before going to the field to understand what QC samples are required for the sampling event, and at what frequency samples should be collected.

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

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

Purpose

To outline the quality control samples to be collected in the field

Goal and Objective

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

Equipment Needs

Field Forms and field book

Chain-of-custody

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

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

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

SOP-25

MANAGEMENT OF INVESTIGATIVE-DERIVED WASTE

Prior to the field sampling event, review the Sampling and Analysis Plan to understand how wastes generated during the investigation should be handled. This standard operating procedure is applicable to non-hazardous wastes. If hazardous wastes may be generated, please consult with the project manager.

Purpose

To outline the procedure for handling wastes generated during site investigation

Goal and Objective

To employ a method for appropriate handling investigative-derived wastes that limits contamination of the environment

Equipment Needs

PID

Field Forms and field book

DOT approved 55-gallon drums

Drum wrench

SOIL

Whenever possible, soils excavated from test pits should be placed back in the test pit in the reverse order that it was excavated.

To determine appropriate method for handing of drill cuttings from soil borings or monitoring well installation, soils exhumed from the borehole should be monitored for staining and field screened for VOCs using a PID in accordance with standard operating procedures. Based on the PID screening, cuttings with organic vapor concentrations greater than 100 ppm should be containerized in labeled 55-gallon drums (or roll-off containers if large volumes of cuttings are anticipated) pending further characterization. Alternatively, project personnel may elect to containerize all drill cuttings based on the presence of known contamination and contaminant concentrations. Containerized soil must be disposed of in accordance with state and federal regulations based on of soil analytical results.

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

GROUNDWATER

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

SOP-26

USING A PETROFLAG® HYDROCARBON ANALYZER

Purpose

Provide guidelines for operating the PetroFlag® test kit

Goal and Objective

To ensure field staff use the PetroFlag Test Kit correctly and consistently in the field.

Equipment Needs

PetroFlag Kit and manual

Field Forms and Field book

Calibration:

- The PetroFlag meter should be calibrated with each batch of 10 samples or, at least daily.
- The extraction solvent (vial with blue polypropylene top) is used as the blank solution and the calibration standard supplied with each 10 pack (vial with white polypropylene top) is used as the standard solution.
- A reagent calibration (rC) can be used or, if uncontaminated soil is available, a soil calibration (SC) can be used to prepare a site specific calibration.
- Either of the two calibrations, "rC" and "SC", can be selected from the main menu of the PetroFlag analyzer, then choose an appropriate response factor.

Preparing/Reading Blanks and Standards:

- Label two soil tubes (yellow caps) as "blank" and "standard", then pour contents of the extraction solvent into the 'blank' tube and the contents of the calibration standard into the 'standard' tube.
- Process the blank and standard tubes exactly as the unknown soil samples are pre- pared (described below). Once the blank and calibration standard have been read, discard them. They fade with time and cannot be reused.
- A soil calibration is prepared in the same way, with the additional step of adding 10 grams of uncontaminated native soil to each of the labeled calibration tubes.
- The blank is ready to be read after the response factor is chosen and the 'next' is pressed, causing the screen to prompt with "bL". Insert the blank vial and press "read".
- After 5 seconds the display should read "0" for 2 seconds, then a prompt of "Csd" for the calibration standard is given. Insert the calibration standard and press read. When 5 seconds have passed the meter should then verify a valid calibration and display "1000".
- If an error message is displayed, a recalibration must be completed.

Soil Testing Procedure:

- Label the soil tubes and developer vials (black caps, half filled with liquid) with the appropriate sample ID. Label either the top or bottom of the developer vial.
- Weigh 10 grams (±0.1 gram) of all unknown soils into labeled soil tubes.
- Set timer for 5 minutes. Add extraction solvent to first tube, start timer and shake tube for 15

seconds making sure all soil is saturated.

- Add extraction solvent to each of the remaining samples, allowing sufficient time intervals between samples to operate efficiently.
- Shake all tubes intermittently for a total of 4 minutes, then let stand for the re-maining 1 minute.
- Pour free liquid from the soil tube into the barrel of a filter-syringe assembly (make sure the filter disk is firmly attached). Discard the first few drops from the filter to a waste container, then filter into the properly labeled developer vial.
- Add extraction solvent drop-wise to developer solution until meniscus just enters the neck, shake for 10 seconds, start 10 minute timer and proceed to next sample.
- Begin reading the developer vials with the PetroFlag analyzer when 10 minutes have elapsed. Attempt to make each 'reading' at approximately the same elapsed time, as varying time intervals will result in a higher % of error.
- Turn meter on by pressing "read/on". Place sample vial into reader (make sure outside of vial is clean) and press "read/on", then record result.

Standard Analyzer Operation:

- When daily calibrations are run and the ambient temperature deviates from the calibration temperature by more than 10°C, an error condition will result. The analyzer will display "err4" which can be cleared by pressing "next" and recalibrating the meter.
- To take a standard reading, the last operation mode must have been in "read", the calibration data must be current, and the response factor last used must be valid.
- Turn meter on by pressing "read/on". The last reading is displayed for 2 seconds, followed by the calibration curve and response factor. The meter is now ready to read your sample. Insert vial and replace cap, then press "read/on". The display will show "calc" for seconds, the calibration curve, response factor, and finally the result.

SOP-27

ASBESTOS SAMPLE COLLECTION

PLANNING PHASE

Prior to commencing building inspection activities the following tasks should be performed:

- Contact management of the facility to inform them as to what will take place during the inspection.
- Develop a project schedule agreeable to the building owner including arrival time at the site and time of initial meeting with building personnel.
- Review existing as-built drawings, if available, to become familiar with the facility as to the mechanical system layout, and materials used in construction. Develop scaled drawings from as-built drawings, if provided by the building owner, for use in the inspection.
- Review any previous asbestos inspections that may have been conducted in the past.

INSPECTION PHASE

Inspections should be performed using the currently recognized standard protocol developed for schools under AHERA. General guidelines for conducting the inspection are as follows:

- Conduct on-site informational meetings with facility personnel to inform them of what will transpire during the inspection. Discuss bulk sampling protocol with maintenance personnel and determine sampling locations that will be acceptable to the owner.
- Perform an initial walk through of the building accompanied by a maintenance person if possible.
- Observe the building layout and whether the building was built in phases or all at once.
- Observe where the divisions are between construction phases.
- Locate all mechanical areas.
- Document location of and access to all pipe chases, pipe tunnels, crawl spaces, attics, and roof(s).

Purpose

To identify the specific requirements for asbestos sample collection in the field

Goal and Objective

To employ a method of asbestos sample collection to ensure staff safety and to prevent cross contamination between sites and sample locations

Equipment Needs

Ladder to access areas

Flashlight to aid in visibility

Air tight sampling containers (film canisters, centrifuge tubes, zip lock baggies)

Spray mister bottle with water to spray the area to be sampled

Plastic drop cloth to spread beneath the area to be sampled

Knife, linoleum cutter, cork borer, or other tool appropriate for extracting samples

Caulking gun and compound for filling holes once a sample has been extracted

Spray acrylic or adhesive to encapsulate sample extractions.

- Walk completely around the outside of the building.
- Fill out asbestos inspection checklist sheet.
- Fill out building information sheet.
- Fill out homogeneous area summary sheet.
- Fill out room by room sheets.
- Prepare a building diagram.

NUMBER OF SAMPLES

Nine samples per homogeneous sampling area are generally recommended. Cost or other constraints, may limit the number of samples that can be collected. If nine samples cannot be collected, use the following table to determine the minimum number as required by AHERA Rules.

Friable Surfacing Material

The number of samples collected from friable surfacing material was determined based on the following protocol developed under AHERA.

- 1,000 square feet or less: Three bulk samples
- 1,000 to 5,000 square feet: Five bulk samples
- Over 5,000 square feet: Seven bulk samples

Thermal System Insulation

Thermal system insulation should be sampled in a randomly distributed manner, with at least three bulk samples collected from each homogeneous material. At least one bulk sample should be collected from each homogeneous material of patched thermal system insulation that is not assumed to be ACBM.

Bulk samples should also be collected from each insulated mechanical system where cement or plaster was used on fittings, such as tees, elbows, or valves. The number of samples should be sufficient to determine whether the material is asbestos containing. Generally, a minimum of three samples should be collected from each homogenous area.

Bulk samples should not be collected from any homogeneous material where the inspector determined that the thermal system insulation is fiberglass, foam glass, rubber, or other non- asbestos containing building material.

Miscellaneous Material

Bulk samples should also be collected from each miscellaneous material. The number of samples should be sufficient to determine whether the material is asbestos containing. Generally, a minimum of three samples were collected from each homogenous area.

Equipment Needs
(Continued)

Duct tape for repairing thermal system insulation jackets

Cloth (pre-moistened) for cleaning up debris and tools

Vacuum cleaner equipped with high efficiency particulate air (HEPA) filters

Indelible ink pen for labeling sample containers

Camera for photographic documentation

Disposable protective clothing, gloves and bootees

Personal respirator, either a negative pressure full or half mask with HEPA cartridge.

Safety glasses for eye protection

Non-friable suspected ACBM.

The number of samples collected from non-friable suspect ACBM should be sufficient to determine whether the material is asbestos containing. Generally, a minimum of three samples should be collected from each homogenous area.

SELECTION OF SAMPLES

Sample locations should be selected so that they are representative of the sample area. Sample locations should be distributed evenly throughout the sampling area. If fewer than nine samples are collected, a random sampling scheme should be used to determine their location. Choosing sample locations according to personal judgment produces samples which may not be representative and can lead to a wrong decision about the presence or absence of asbestos. The sampling scheme described below should be used to avoid this problem.

> *Divide the sampling area into nine equally sized sub areas and label them 1 through 9. This can be done carefully by eye. Exact measurements are not needed. If three samples are going to be collected, randomly select three numbers from 1 to 9 and collect a sample from the corresponding subarea shown on map.*

For each sampling area, use a new diagram. If you have more than 18 sampling areas, start again at the top of the random number diagram (sample area #1) to determine sampling locations for sampling area 19.

IDENTIFICATION OF SAMPLES

Assign a unique sample ID number to each sample location. This ID number should be placed on the sampling container when shipped to the certified laboratory for analysis. Record the ID number and the sample location on the sample area diagrams and also on room by room summary sheets.

This must be done carefully so that there is no uncertainty about the location and identity of each sample collected. Make sure that no two samples have the same ID number. Non- sequential numbers are used to prevent the laboratories from knowing which samples come from the same sample areas or the same buildings. On the other hand, non-sequential ID numbers make organizing the analytical results by homogeneous area much more difficult.

SAMPLE COLLECTION

- Since inhalation of asbestos fibers during asbestos inspections and sampling projects may pose a health hazard, the use of personal protective equipment by building inspectors is required during the sampling process. As a minimum level of protection, inspectors should wear a respirator, either a negative pressure full or half mask with HEPA cartridges. Disposable clothing should be worn during sampling if the sampling operation is likely to dislodge pieces of suspect material or if the environment is extremely dusty. Inspectors should have plastic bags, twisters, and labels with them to handle the disposal of cartridges, protective clothing, wet cloths, and debris. These waste materials should be stored pending survey results. If laboratory results establish the presence of asbestos containing materials, these waste materials should be disposed of as asbestos containing waste.

- If possible, collect samples after hours or when the building is not in use.
- Spread the plastic drop cloth and set up other equipment.
- Put on protective equipment.
- Label containers with its ID, sample location, and type of material to be sampled on a sample data form. Always place the label on the container itself. If using ridged containers always place the ID on the container, not on the lid, as lids can be inadvertently switched by a laboratory when handling numerous sample containers.
- Mark the location of the sample on the sampling diagram and record the sample identification number on the plan diagram as well.
- Moisten the area to be sampled (spray the immediate area with water).
- Extract sample using a clean knife to cut or scrape off a small piece of the material. Be sure to penetrate all layers of material. Be careful not to disturb adjacent material.
- Place sample in a container and tightly seal it.
- Wipe the exterior of the container with a wet wipe to remove any material which may have adhered to it during sampling.
- Clean your tools with wet wipes and wet mop or vacuum sampling area with a HEPA vacuum to clean all debris.
- Fill hole with calking compound on highly friable material and/or spray with an encapsulant (to minimize subsequent fiber release).
- Repeat the above steps at each sample location. Place sample containers in plastic bags.
- Discard protective clothing, wet wipes and rags, filter cartridges, and drop cloth in a labeled plastic bag.

SAMPLE HANDLING

- After placing a sample in a container according to the procedures outlined earlier, enter the ID number on the Chain-of-Custody Sheet.
- Upon receipt of samples from the inspector, the laboratory should check and sign the Chain-of-Custody Sheet(s), copy same and return original(s) to the inspector. It is important that this, or a similar arrangement for sample accountability be agreed upon by the laboratory prior to sending samples for analysis.
- Each individual or laboratory engaged in asbestos identification shall participate in the American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) Program of quarterly external audits, the Asbestos Analyst Registry, or equivalent.
- Polarized light microscopy (PLM) according to EPA Method 600/R4-93-116 is the approved method for analyzing bulk materials for asbestos. PLM utilizes a light microscope equipped with polarizing filters. The identification of asbestos fiber bundles is determined by the visual properties displayed when the sample is treated with various dispersion staining liquids. Identification is substantiated by the actual structure of the fiber and the effect of polarized light on the filter, all of which is viewed by the trained technician. The limit of detection of asbestos by PLM is about 1% by area. Samples containing lower levels of asbestos are not reliable detected by this technique.

QUALITY ASSURANCE

After inspection is completed perform a field quality assurance program including the following tasks.

- Review all inspection forms for completeness. (Remember a physical street address is required by AHERA).
- Walk through building one last time to verify that you have identified all the suspect homogeneous areas.
- Review Chain-of-Custody document for completeness and verify the number of samples and sample numbers for the suspect materials collected during the inspection.

SOP-28

LEAD-BASED PAINT SAMPLE COLLECTION

PLANNING & PREPARATION

Prior to commencing building inspection activities the following tasks should be performed:

- Schedule the inspection with the site contact so adequate notice can be given to building occupants and/or tenants and review historical information regarding any previous lead-based paint activities at the site.
- Determine the hours of operation for the facility.
- Develop a project schedule agreeable with the building owner, including arrival time at the site and time of initial meeting with site personnel.
- Review any previous lead-based paint inspection reports, lead risk assessments, or lead-hazard screens.
- Collect all materials necessary for the inspection.
- Insure that all the XRF components are in its case. Equipment in the case should include; XRF with battery, spare battery, battery charger, charger cords, bar-code reader wand, XRF Computer interface cable, building component barcode pages, lead calibration pages, leak test documentation, and XRF source documentation.
- Insure that both batteries are fully charged and ready to go. Note that batteries will slowly lose a charge from sitting in the case and should be recharged before going into the field.
- Obtain the XRF Performance Characteristic Sheet for the instrument to be used for the inspection. Review it to determine the inconclusive range for the XRF.
- Follow radiation safety procedures when handling or using the XRF, as it is a potential source of radiation. Radiation dosimeter badges are assigned to personnel who routinely use the XRF instruments.
- For multi-family buildings, determine how many units can be considered homogeneous, based on the HUD Guidelines and determine the number of units required to be sampled.

Purpose

To identify the specific requirements for lead-based paint sample collection in the field

Goal and Objective

To employ a method of lead-based paint sample collection to ensure staff safety and to prevent cross contamination between sites and sample locations

Equipment Needs

X-Ray Fluorescence Spectrum Analyzer (XRF)

Ladder to access areas

Flashlight to aid in visibility

Air tight sampling containers (film canisters or centrifuge tubes)

Plastic drop cloth to spread beneath the area to be sampled

Heat gun, scraper or other tool appropriate for extracting samples

Required forms

Cloth (pre-moistened) for cleaning up debris and tools

Vacuum cleaner equipped with high efficiency particulate air (HEPA) filters

XRF INSPECTION PROCEDURE

Inspections should be performed using the currently recognized standard protocol developed by HUD. General guidelines for conducting the inspection for lead-based paint are described below:

Calibration of XRF

- Take at least three calibration check readings prior to the commencement of the lead-based paint inspection. These calibration check readings should be repeated every four hours, every time the XRF is turned on, or at the conclusion of the sampling job, which ever is more frequent.
- The XRF calibration check readings are taken on the red 1.02 mg/cm2 Standard Reference Material (SRM) paint film, developed by the National Institute of Standards and Technology (NIST). These films can be obtained by calling (301) 975-6776 and referencing SRM #2579.
- Calibration check readings should be taken through the red 1.02 mg/cm2 SRM paint film when the film itself is at least 12 inches away from any source of lead. For example, the red NIST SRM film should not be placed on a tool box or suitcase or on a surface coated with lead-based paint to take calibration check readings.
- The red NIST SRM film should be attached to a wooden board measuring about 6 inches long by 4 inches wide by 1 inch thick or attached directly to the XRF probe. Readings can then be taken while standing further than a foot from the wall. Alternatively, the red NIST SRM film can be placed on top of a 12 inch piece of Styrofoam or some other lead-free material as recommended by the manufacturer before taking readings.
- Each time calibration check readings are made, three nominal-time readings should be taken on the red NIST (1.02 mg/cm2) SRM film and the results recorded. The average of the three calibration check readings should be computed and also recorded.
- Large differences of calibration check reading averages from 1.02 mg/cm2 may alert the lead-based paint inspector to problems in the instrument's performance. The calibration check reading averages should not differ from 1.02 mg/cm2 by more than the calibration check tolerance specified in the XRF Performance Characteristics Sheet for the specific instrument used.
- If the observed calibration check average minus 1.02 is greater than the calibration check tolerance, the instructions provided by the manufacturer should be followed in order to bring the instrument back into control before any more XRF testing is done. All readings taken by the suspended instrument since the last successful calibration check test should be repeated. If a backup XRF instrument is used as a replacement, the backup instrument must successfully pass the initial calibration check test before retesting the affected test locations.

Equipment Needs

(Continued)

Pen and indelible ink pen for labeling sample containers and completing field forms

Camera for photographic documentation

Disposable protective clothing, gloves and bootees

Personal respirator, either a negative pressure full or half mask with HEPA cartridges

Safety equipment required for the particular site (safety glasses, hearing protection, hard hat, steel-toed boots, etc.)

Radiation Dosimeter Badre

Laptop for downloading XRF readings

Single-Family Housing

- Obtain a drawing of the building and exterior areas.
- Perform a walk-through of the building with building personnel to familiarize yourself with the layout of the building. An inventory of suspect paint in the house should be completed prior to any XRF testing. It may be also done on a room-by- room basis during testing.
- Determine the testing combinations in each room equivalent or on each exterior building component. An inventory of the painted surfaces in interior rooms, on exterior walls, and on surfaces in other exterior areas, such as fences, playground equipment, and garages, should be conducted.
- A testing combination is characterized by the room equivalent, component, substrate, and visible color of the paint. A completed inventory of the painted components in a room equivalent is a list of the testing combinations in that room equivalent.
- A room equivalent is an identifiable part of a residence, such as a room, a house exterior side, or an exterior area. Hallways, stairways, and exterior areas, such as porches, back yards, and each side of the house, are all examples of room equivalents. Closets or other adjoining areas to room equivalents should be designated room equivalents if large (for example, a walk-in closet) or if obviously dissimilar (for example, a different color) from the adjoining room equivalent. In most closets are not considered room equivalents.
- Each room equivalent is made up of components. Components can be located inside or outside the dwelling. For example, components in a bedroom could be the
- ceiling, floor, walls, a door and its casing, the window sash, and window casings. All components that are coated with paint, varnish, shellac, stain, or other coating should also be tested. Some components may be grouped if painting histories are identical as described below.
- Take at least one XRF Reading on each testing combination.
- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that testing combination. If necessary, determine the substrate correction value using the method specified in the HUD Guideline.
- XRF results are corrected for substrate bias by subtracting a correction value determined separately in each house for each type of substrate. The substrate is the material underneath the paint. Substrates are generally classified into one of six substrate types: brick, concrete, drywall, metal, plaster, and wood. These substrate types are intended to include a broad range of materials. For example, the concrete substrate type includes poured concrete, precast concrete, and concrete block. If the true substrate is not one of the six types, the substrate type that most closely matches the true substrate should be selected. For substrates on top of substrates, such as plaster over concrete, the substrate directly beneath the painted surface should be used.

  The correction value is an average of XRF readings taken from test locations that have been scraped clean of their paint covering to expose the substrate. A criterion for selecting these test locations is that their initial XRF results should be less than 2.5 mg/cm2. If test locations with XRF results equal to or greater than 2.5 mg/cm2 are selected, the outcome might "overcorrect" XRF results. Therefore, only test locations with initial XRF results less than 2.5 mg/cm2 should be chosen. If all initial readings on a substrate type are above 2.5 mg/cm2, the locations with the lowest initial reading should be chosen. This will help ensure that XRF readings taken from non-

representative portions of substrates and other underlying materials, such as hidden nails and pipes, are not used to compute the substrate correction. It is important to note that some XRF results may not need to be corrected for substrate bias depending on the specific instruments used and the specifications in the XRF Performance Characteristics Sheet.

Using the same XRF instrument, take a reading on the first bare substrate area. Record the substrate and XRF readings. Repeat this procedure for each bare substrate area and record the readings on the same form. A variant to this step is to first cover the bare area with an NIST SRM film prior to taking the readings. The need for this variation will be specified in the XRF Performance Characteristics

- Sheet for affected XRF instruments and instructions will be provided explaining how to compute the correction value when this variation is used. Compute the correction value for each necessary substrate type in the house by computing the average of all readings.
- Take at least one XRF Reading on each testing combination.
- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that testing combination. If necessary, determine the substrate correction value using the method specified in the HUD Guidelines.
- Classify the XRF results as negative, positive, or inconclusive. For inconclusive readings, collect a bulk sample of the inconclusive paint for laboratory analysis. If sampling is not desired, inconclusive readings must be assumed positive.
- Record the locations, component, substrate, and color of paint found to be positive for lead or assumed to be positive for lead. The recorded location of the material should include room and side of the room. Component should be the component being tested. Substrate should be one of the six substrate types described above. For practical purposes, paint is almost always differentiated by color. Since more than one color may be observed when paint is peeling or the substrate is damaged, both "white" and "blue over green" would be acceptable color entries.

Multi-Family Housing

- Obtain a list of all units, common areas, and exterior site areas.
- Obtain a drawing of the building and exterior areas.
- Perform a walk-through of the building with building personnel to familiarize yourself with the layout of the building.
- Determine, using the HUD Guidelines, the areas that can be grouped together and the minimum number of units to be inspected. The minimum number of units to be sampled can be determined by using Table 7.3 located in Chapter 7 of the HUD Guidelines.
- Select units to be inspected using the random technique explained in the HUD Guidelines.
- For each unit, common area, or exterior site to be tested, determine the testing combinations in each room equivalent.
- Take at least one XRF Reading on each testing combination.
- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that testing combination. If necessary, determine the substrate correction value using the method specified in the HUD Guidelines.

- Classify the XRF results as negative, positive, or inconclusive.
- Record location of materials found positive for lead or assumed to be positive for lead.

FIELD FORMS

Since the information required for a lead-based paint inspection report is gathered in the field, accurate and complete forms are required.

LABORATORY ANALYSIS OF PAINT CHIP SAMPLES

For XRF results that fall into the inconclusive range and for areas that cannot be tested using XRF instruments due to project budget constraints or other reasons, a paint-chip sample should be collected from suspect painted surfaces and sent to a laboratory for lead determination.

If the sampled portions of the building are to remain in-place, lead analysis should be conducted by EPA Method 6010, and results should be reported in mg/cm2, the primary unit of measure. Results may be reported as percent by weight if the dimensions of the surface area cannot be accurately measured or if all paint within the sampled area cannot be appropriately removed. In these cases, results should not be reported in mg/cm2, but in mg/kg or weight percent.

If the sampled portions of the building are to be demolished and disposed of, lead analysis should be conducted according to TCLP procedure (EPA Method 1311) for waste characterization purposes.

If it is necessary to remove a paint-chip sample for laboratory analysis, only one paint-chip sample is needed for each testing combination. The paint-chip sample location should be representative of the paint on the entire testing combination. If the testing combination is replicated, one representative paint-chip sample should be taken from one randomly selected replicate.

Collect at least four square inches of material to ensure that the laboratory has a sufficient sample to conduct the analysis and that it is representative of the testing material sampled. Samples collected should be placed in sealable rigid container such as screw top, plastic centrifuge tubes rather than plastic bags which generate static electricity. Paint-chip collection should include, as a priority, collection of all the paint layers, while minimizing any collection of actual substrate. If substantial substrate material is included, results should be reported in mg/cm2 to avoid a downward bias in results.

Assign a unique sample ID number to each bulk paint sample. This ID number should be placed on the sampling container when it goes to the certified laboratory for analysis. Record the ID number and the sample location on the sample area diagrams, the room by room summary sheets, and the chain-of-custody form. This must be done carefully so that there is no uncertainty about the location and identity of each sample collected. Make sure that no two samples have the same ID number.

QUALITY ASSURANCE

After inspection is completed perform a field quality assurance including the following tasks.

- Review all inspection forms for completeness.
- Walk through building one last time to verify that you have identified all the homogeneous areas of paint suspected to be lead-based.

- Review Chain-of-Custody documents for completeness and verify that the number of samples, the sample numbers for the bulk samples collected.

SOP-29

AIR SAMPLING FOR ASBESTOS AND LEAD

This SOP describes the field equipment and sampling methods for the collection of air samples for asbestos fibers and/or lead dust. This SOP is based on the SOP developed by Region 8 of the U.S. Environmental Protection Agency for the Sampling of Asbestos Fibers in Air.

GENERAL SAMPLING PROCEDURE

Samples are collected by drawing air through a fine-pore filter in order to trap suspended particulate matter, including asbestos and lead suspended in air. For asbestos, the filters are examined using an appropriate microscopic technique to observe, characterize, and quantify the number of asbestos fibers on the filter. For lead, the sample cassettes are packaged and shipped in accordance with SOP-4, and analyzed in accordance with NIOSH 7082 for detection of lead in air.

Sampling in dusty conditions should be avoided, if possible. High levels of dust and particulate may clog or overload the filter. Sampling flow rate and time should be adjusted to avoid filter overload in dusty conditions.

Air samples will be collected using filter cassettes pre-loaded with 0.8 micron mixed cellulose ester (MCE) filters. The crease between the cassette base and cowl should be sealed with a shrink band or adhesive tape to hold the cassette together and reduce the potential for contamination. Samples will be collected using an air sampling pump capable of maintaining a constant flow rate between 2 to 10 liters per minute.

AIR PUMP CALIBRATION

Prior to sampling, the flow rate of the air pump should be set to the flow rate specified in the project specific Sampling and Analysis Plan (SAP), as follows:

1. Turn on the pump and let it run for a minimum of 5 minutes before calibrating the pump.
2. Remove the end plugs on a new filter cassette. Attach one end of a length of tygon tubing to the cassette base and attach the other end of the tubing to the pump's air inlet. Use another length of tubing to connect a flow meter to the cassette cap.

Purpose

To identify the specific requirements for air sampling for asbestos and lead

Goal and Objective

To employ a method of air sampling for asbestos and lead to ensure staff safety and to employ a consistent measuring method for air sampling of asbestos and lead

Equipment Needs

Air sampling pump

Asbestos sample filter cassettes with 0.8 micron filters.

Lead sample filter cassettes with 37 mm filters.

Tripod and spring clips

Tygon tubing

Air pump calibration equipment

Quart and gallon size re-sealable bags

Indelible ink pen for labeling sample containers

Camera for photographic documentation

Sample coolers, packing material

3. Hold the flow meter so that it is vertical and note the flow rate.
4. Adjust the flow rate drawn by the pump until it meets the flow rate specified in the SAP (+/- 5%).

Three separate flow rate measurements will be obtained before and after sampling. The mean value of these six flow rate measurements will be used to calculate the volume of air drawn through the filter cassette during sampling.

Equipment Needs
(Continued)

Personal respirator, either a negative pressure full or half mask with HEPA cartridges

Safety glass's for eye protection

SAMPLE COLLECTION

Position a tripod in the location to be sampled. Set up the tripod so that the filter cassette will be positioned at a height of 4 to 6 feet above the ground (i.e., within a typical breathing zone). Secure the filter cassette to the tripod with a spring clip. The cassette should be oriented so the open face of the cowl is pointing downward to avoid particulate entering the filter by precipitation. Remove the protective cap over the open face of the cowl and turn on the calibrated pump. Record the starting time, sample identification, and initial flow rate on the field form. The pump should be periodically checked during the collection of any samples over a period longer than two hours to ensure the pump is working properly and that the flow rate is stable. After the specified sampling time has elapsed, measure the ending pump flow rate and record the time and flow rate on the field form. Turn off the pump and remove the cassette. Place the end caps on the cassette and place a seal over the end caps in a manner that will prevent the removal of the end caps without tearing the seal.

IDENTIFICATION OF SAMPLES

Assign a unique sample ID number to each sample location. This ID number should be placed on the filter cassette prior to shipment to the certified laboratory for analysis.

SAMPLE ANALYSIS, PACKAGING, & SHIPMENT

Lead sample cassettes will be packaged and shipped in accordance with SOP-4, and analyzed in accordance with NIOSH 7082 for detection of lead in air. In general, air sample analysis for asbestos will be completed utilizing Phase Contrast Microscopy (PCM) techniques for field verification of asbestos, in accordance with the National Institute for Occupational Safety and Health (NIOSH) Method 582. Results from the air sampling event will be reported in fibers per cubic centimeter of air (f/cc) and measured against current Occupational Safety and Health Administration (OSHA) permissible exposure limits (PEL) for asbestos. If the OSHA PEL for asbestos is exceeded, or if gross contamination is observed by accredited asbestos personnel, the air sample cassettes will be packaged and shipped under chain-of-custody procedures to a recognized laboratory participating in the National Voluntary Laboratory Accreditation Program (NVLAP) for analysis in accordance with the NIOSH Method 7402, utilizing Transmission Electron Microscopy (TEM).

QUALITY CONTROL

The following quality control samples will be submitted:

- Field Blank – One field blank will be collected per sampling event. Field blanks will be collected by removing the end caps on a new filter cassette at a representative sample location. Hold the

cassette open for approximately 30 seconds. Close and seal the cassette as described above and submit it for analysis with the other sample cassettes. Field blanks are not required for lead sample collection.

- Lot Blank – For final clearance air sampling in schools or for consulting firms not participating in the Industrial Hygiene Proficiency Testing Program (consulting firms capable of performing filed verification of asbestos), one filter or "lot" blank will be submitted to a NVLAP accredited laboratory for TEM analysis. Whereby, one new filter cassette will be randomly selected and submitted with the sample cassettes for analysis and all filter cassettes for the sampling event will be rejected if any asbestos fiber is detected on any filter. However, for field verification of asbestos in industrial type settings or office buildings, boiler rooms, mechanical rooms, etc. "lot" blanks are generally analyzed by the accredited asbestos personnel utilizing PCM techniques.

SOP-30

MATERIAL METHAMPHETAMINE SAMPLING

This SOP describes the process that should be used to evaluate the presence of methamphetamine (meth) on building materials. The procedure described below provides guidance on how to systematically evaluate for meth when there is an indication that meth cooking occurred at the facility. Meth-related sampling should only be completed by a certified Meth Cleanup Contractor Supervisor.

SITE RECONNAISSANCE

When completing initial sampling, a site reconnaissance of the property should be completed to identify chemical usage and potential discharge of chemicals. Items to be evaluated during on-site inspection of the property should include:

- Attics and crawlspace areas
- Outbuildings
- Bathrooms for evidence of dumping
- Presence/absence of septic systems
- Discarded chemicals in potential or confirmed cooking areas, burn piles and waste disposal areas onsite

Whether additional assessment of these areas in addition to building materials is warranted, will depend on what is found during the site reconnaissance. Sampling approaches for these areas is not addressed in this SOP. You should consult with the project manager to devise a sampling strategy for these other areas.

After it has been confirmed the property was used for meth cooking through review of DEQ, Health Department, or Police records, or by visual reconnaissance of the property, interior finishes should be considered as contaminated with meth. Wipe samples should be collected to confirm/or deny the presence of meth as described in SOP-28 MethChek Immunoassay, the results of this screening determining whether additional analytical testing for meth is required. If the MethCheck Immunoassay wipe samples are positive for the presence of meth, an additional wipe sample of the material should be collected and analyzed for meth using EPA Method

8270C-modified. The same wipe sampling process described in SOP-28 should be used to complete the sampling.

Purpose

To identify the specific requirements for methamphetamine sampling

Goal and Objective

To employ a method of methamphetamine sampling that ensures staff safety and consistent sampling procedures

Equipment Needs

Disposable Coveralls w/ bootees (Tyvek® suit or equivalent)

Latex gloves

Safety glasses

½-face air purifying respirator

Tape (duct or equivalent)

Wax paper or plastic sheeting to place equipment on

Gauze

Spray bottle of alcohol

Sample container/vial

Indelible ink pen for labeling sample

Disposable bag for waste

Photo ionization detector (PID) for testing plumbing (e.g. sink drains)

SOP-31

PRECURSORY METHCHECK SAMPLING

PRECURSORY SAMPLING PREPARATION

MethChek Immunoassay sampling may be utilized during an initial inspections to detect for potential meth contamination. MethChek Immunoassay sampling may also be utilized to check cleanliness of a work area prior to final clearance wipe sampling.

- Put on clean latex gloves supplied in kit. Use a new pair of clean gloves for each test.
- Place wax paper on level surface in close proximity to sample area.
- Place Step 2 Extractor bottle on wax paper.
- Remove plunger from syringe and place on wax paper.
- Place supplied template (100 cm2) on test surface. It is recommended to tape template to surface.
- Prepare Step 1 Wetting Agent by removing cap and replacing cap with spray nozzle.
- Prime spray bottle in a waste can (or equivalent).
- Remove supplied gauze pad from package and spray gauze pad 2-times with Step 1
- Wetting Agent at a distance of approximately 4-inches.

PRECURSORY SAMPLE COLLECTION

- Use firm hand pressure, collect the sample by wiping the surface inside the template with moistened gauze pad in a "W", then "Z", and then "W", pattern. Try not to trap of push residue from sampling area under template. Also, when wiping try to orient the to concentrate the sample in one area on the gauze, which will enhance extraction.
- Insert gauze pad containing sample into syringe.
- Insert syringe into plunger and gently push gauze pad toward base of syringe, remove plunger.
- Hold syringe over the plastic tray, then open and pour Step 2 Extractor into syringe.
- Continue holding syringe tip over the plastic tray and slowly insert plunger into syringe, depressing the plunger to compress and extract the sample into the plastic tray. Continue depressing the plunger onto the gauze pad until liquid no longer flows.

Purpose

To identify the specific requirements for precursory methcheck sampling

Goal and Objective

To employ a method of precursory methcheck sampling that ensures staff safety and consistent sampling procedures

Equipment Needs

Gloves

Templates (10 cm x 10 cm)

Tape (duct or equivalent)

Plastic "disposable" Trays

Wax paper

Gauze

Swabs

Pipettes

Vials

Latex Gloves

Safety Glasses

Disposable test packet bag

Personal protective equipment (use discretion based on condition of sampling area)

- Place syringe tip in liquid in the plastic tray and slowly pull plunger halfway to draw sample back into syringe.
- Repeat the process by depressing the plunger to compress the gauze pad until liquid no longer flows.
- Remove and place Step 3 Cartridge from packet and place on wax paper.
- Use supplied disposable pipette to extract liquid from the plastic tray and place 3-drops of the extracted liquid into the sample well (marked "S") on the Step 3 Cartridge.
- Observe Step 3 Cartridge. Lines will appear within one minute, results will develop completely within 5-minutes. Do not disturb cartridge during sample development.
- See Reading MethChek Results on page 7 of the Operating Instructions Manual.
- Record and report results for client.
- MethChek results are reported in 0.05, 0.1, 0.5, and 1.5 micrograms per 100 cm2 for the lower limit of identification (LLOI).

SOP-32

ASBESTOS FIBER AIR SAMPLE COLLECTION

FINAL CLEARANCE VISUAL & AIR SAMPLE COLLECTION

Following asbestos abatement operations, abatement personnel will communicate that the abatement work is completed and the following tasks will be performed:

- Asbestos accredited personnel will meet asbestos abatement contractor on site.
- Don disposable protective clothing and personal respirator.
- Conduct a final clearance visual inspection of the work area containment to insure that all asbestos-containing building materials (ACBM) have been abated from the work area.
- Once the final clearance visual inspection has been completed, the abatement contractor will apply a thin layer of encapsulant to lock-down any loose fibers from the abatement operation.
- Allow work area to dry for approximately 1-hour.
- Accredited personnel will calibrate sampling pumps, not to exceed 16 LPM.
- Accredited personnel will re-enter the work area containment with sampling equipment.
- Place tripod stand, sample pump, tubing, and TEM air sample cassette in 5-different locations within the work area containment.
- Remove cap on TEM air sample cassette and turn pump on. Allow pump to run long enough to insure a sample volume of no less than 1,199 and no more than 1,599 liters of air.
- Stop sample pumps at the appropriate time to insure no less than 1,199 liter of air have been collected.

SAMPLE PREPARATION FOR SHIPMENT

- Insure that all caps are in place on TEM air sample cassette (*Note – Laboratories scheduled to perform TEM analysis will not accept any sample cassette with missing or dislodged caps).
- Insure labels are filled out completely (e.g. date, sample number, pump ID, flow rate, start time, and stop time).

Purpose

To identify the specific requirements for Asbestos Fiber Air Sample Collection

Goal and Objective

To employ a method of asbestos fiber air sample collection to ensure staff safety and consistent sampling procedures

Equipment Needs

5-high flow vacuum pumps capable of collecting air samples from .5-16 liters per minute (LPM)

5-tripod stands

7-TEM air sample cassettes with mixed cellulose ester (MCE) filters of .045µm pore size. (5-air sample cassettes for sample collection, one field blank (open 30-seconds), and one lab blank)

Labels and indelible ink pen for labeling air sample cassettes

Calibration instrument to calibrate air sample pumps

Extension cords

Box fan

Duct Tape (or equivalent).

Chain-of-Custody

Disposable protective clothing with bootees

- Use two pieces of duct tape (one for the tips of the air sample cassettes and one for the bottoms of the cassettes). Insure that the length of the duct tape is long enough, such that the seven sample cassettes can be placed on the duct tape. Wrap the duct tape up the side of the cassettes to seal the caps. Use the second piece of duct tape to secure the tips of the sample cassettes.
- Completely fill out the chain-of-custody and ship to a NVLAP (National Voluntary Laboratory Accreditation Program) laboratory.

Equipment Needs
(continued)

Personal respirator, either a negative pressure full or half mask with HEPA cartridges

SAMPLE ANALYSIS & MEASUREMENT

Request laboratory analysis - Asbestos Fiber Analysis by Transmission Electron Microscopy, Performed by EPA 40 CFR Part 763 Appendix A to Subpart E.

QUALITY ASSURANCE/QUALITY CONTROL

Laboratories will have QA/QC guidelines.

SOP-33

AMBIENT AIR SAMPLING WITH SORBENT TUBE FOR TO-17 ANALYSIS

GENERAL PROCEDURE – ACTIVE METHOD

1. Determine the desired flow rate and sampling time in accordance with Table 1 shown below. If low detection limits are desired (parts per million to parts per trillion range) between 1000 and 6000 mL of sample should be collected.

Table 1. Sampling Time, Flow Rate, and Volume Guide

Time (Minutes)	Flow Rate (mL/min) 20	50	80	100
5	100	250	400	500
10	200	500	800	1000
15	300	750	1200	1500
20	400	1000	1600	2000
30	600	1500	2400	3000
60	1200	3000	4800	6000

= Will result in high to mid ppb reporting limits
= Mid to low ppb reporting limits
= Low ppb to ppt reporting limits

2. Calibrate the flow rate of the air pump with the calibration tube attached (do not attach the sampling tube for this step), then turn off the sampling pump.

3. Allow sample tubes to reach ambient temperature, including the tube to be used for a field blank.

4. Record the tube serial number on the chain of custody form. Do not mark on the tube or label the tube directly.

5. Place the sampling pump at the desired sampling location. If sampling from the center of the room at breathing height of 3 to 5 feet, use a tripod to suspend the pump at the appropriate location. Use inert straps, string, or chains to suspend the pump (do not use tape, which may off-gas contaminants).

6. Attach inert tubing to the pump as an adapter from the pump to the sampling tube.

Purpose

To describe field sampling methodology for ambient air using sorbent tube, including both active pumping and passive sorption techniques.

Goal and Objective

To ensure sorbent tube samples are collected correctly and consistently in the field.

Equipment Needs – Active Method

Sampling tube with wrenches for each end

Air sampling pump (20 to 100 mL/min)

Airflow calibrator

Tripod (optional)

Equipment Needs – Passive Method

Sampling cartridge with diffusive body, supporting plate, glass case, and stopper such as Radiello system by Supelco

Shipping Case for Tube

Sample ID Bag

Tripod (optional)

7. Using wrenches, remove the caps from the end of the tube (do not remove the identification clip from the tube).

8. Place the outlet end of the tube into the tubing connected to the pump. The grooved inlet end of the tube should be facing away from the pump.

9. Turn on the pump, and note the time and date.

10. Operate the pump for the pre-determined amount of time (see Step 1), then shut the pump off and note the time and date, total duration of sampling, and sampled volume. (Do not exceed the sampled volume recommended for the tube and analytical method, for example use a maximum volume of 6 L for typical conditions.)

11. Recap both ends of the tube using the original fittings from that tube. Turn caps only ¼ turn past finger-tight, otherwise tubes may become damaged and/or unusable.

12. Pack sample tubes (including field blank) in plastic shipping cases, then enclose each sample in a labeled plastic bag. Place the enclosed samples in a cooler with frozen ice packs or other sealed cooling media to keep the samples near 4°C. Place the chain of custody form in the cooler, seal the cooler, and ship the cooler to the laboratory.

GENERAL PROCEDURE – PASSIVE METHOD

1. Verify whether the expected overall concentration of all air contaminants exceed 2,000 micrograms per cubic meter. If no, use standard media such as Cabograph. If yes, use activated charcoal media.

2. When ready to sample, note the date and time on the Radiello label, and on the sample bag using a non-solvent marking instrument (i.e. do not use Sharpie pens or similar).

3. Remove the cartridge from the plastic shipping case and glass tube, and put it in the diffusive (yellow) body in an upright vertical position. (Do not touch the cartridge with exposed fingers. Do keep the associated parts together in one sample bag.)

4. Ensure that the cartridge is seated completely flush with the top of the diffusive body. If the cartridge is sticking out even a small amount such as a millimeter, tap on the bottom of the diffusive body to cause the cartridge to seat properly. (Do not touch the sides of the diffusive body.)

5. With the cartridge still in a vertical position to retain the seated cartridge, screw the diffusive body into the supporting plate.

6. Place the assembled device in the sampling location. (See Item 5 of Active Method for breathing zone sampling using a tripod. If outdoors, provide protection from precipitation.)

7. At the end of sampling, record the date and time on the Radiello label and sample bag, unscrew the diffusive body, transfer the cartridge into the glass tube, seal the tube with stopper. Put the glass tube in the plastic shipping case, then place the sample into the sample bag. Peel the label off the supporting plate and attach it to the sample bag. Fill out the chain of custody form in conformance with the accurate sampling interval listed on the label, and ship the sample(s) to the laboratory.

SOP-34

SAMPLING GROUNDWATER WITH A HYDRASLEEVE™

Before installing a HydraSleeve™ in any well, you will need to know the following:

- Inside diameter of the well
- Length of the well screen
- Water level in the well
- Position of the well screen in the well
- Total depth of the well

Non-disposable equipment to be placed down the well must be decontaminated.

Field sampling forms must be completed for each well to document sampling.

COLLECTING WATER SAMPLES

Label each sample container with the project number(s), sample location, well owner, date, military time, sampler's initials, preservative, and analysis required.

Always wear sterile gloves when handling and discharging the HydraSleeve™. Assemble the HydraSleeve™ using the manufacturer's instructions.

Before deploying the HydraSleeve™ in the well, obtain the depth-to-water measurement to establish the preferred position of the HydraSleeve™ in the well. Measure the precise amount of tether needed to suspend the sleeve in the well, make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve.

Deploy and retrieve the sampling unit per the attached instructions provided by GeoInsight.

The recovered HydraSleeve™ and the sample release tubing should be disposed as per the waste management plan for the site.

Purpose

To describe field sampling methodology for collection of ground-water samples directly from the screened interval of a well without having to purge the well prior to sample collection.

Goal and Objective

To ensure appropriate sample collection from within the screen using a single-use disposable) sampler.

Equipment Needs

HydraSleeve ™ and discharge tube (designed for one-time use only)

Spring Clip

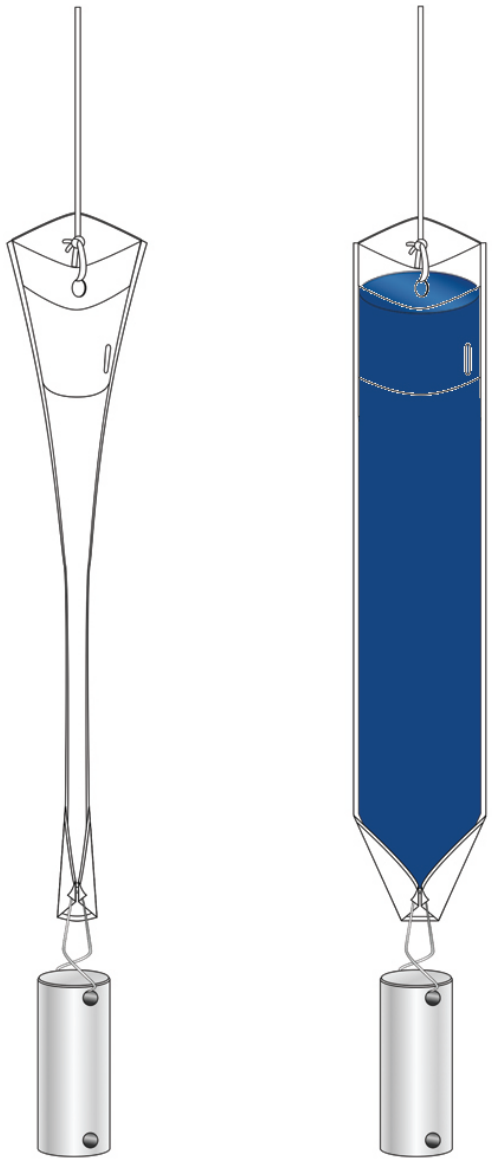
Weight and Weight Clip

Suspension cord, generally disposed after one use unless it is dedicated to the well.

HYDRASleeve™

Simple by Design US Patent No. 6,481,300; No. 6,837,120 others pending

Standard Operating Procedure: Sampling Ground Water with a HydraSleeve



This Guide should be used in addition to field manuals appropriate to sampling device (i.e., HydraSleeve or Super Sleeve).

Find the appropriate field manual on the HydraSleeve website at http://www.hydrasleeve.com.

For more information about the HydraSleeve, or if you have questions, contact: GeoInsight, 2007 Glass Road, Las Cruces, NM 88005, 1-800-996-2225, info@hydrasleeve.com.

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Introduction

The HydraSleeve is classified as a no-purge (passive) grab sampling device, meaning that it is used to collect ground-water samples directly from the screened interval of a well without having to purge the well prior to sample collection. When it is used as described in this Standard Operating Procedure (SOP), the HydraSleeve causes no drawdown in the well (until the sample is withdrawn from the water column) and only minimal disturbance of the water column, because it has a very thin cross section and it displaces very little water (<100 ml) during deployment in the well. The HydraSleeve collects a sample from within the screen only, and it excludes water from any other part of the water column in the well through the use of a self-sealing check valve at the top of the sampler. It is a single-use (disposable) sampler that is not intended for reuse, so there are no decontamination requirements for the sampler itself.

The use of no-purge sampling as a means of collecting representative ground-water samples depends on the natural movement of ground water (under ambient hydraulic head) from the formation adjacent to the well screen through the screen. Robin and Gillham (1987) demonstrated the existence of a dynamic equilibrium between the water in a formation and the water in a well screen installed in that formation, which results in formation-quality water being available in the well screen for sampling at all times. No-purge sampling devices like the HydraSleeve collect this formation-quality water as the sample, under undisturbed (non-pumping) natural flow conditions. Samples collected in this manner generally provide more conservative (i.e., higher concentration) values than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling (Parsons, 2005).

Applications of the HydraSleeve

The HydraSleeve can be used to collect representative samples of ground water for all analytes (volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], common metals, trace metals, major cations and anions, dissolved gases, total dissolved solids, radionuclides, pesticides, PCBs, explosive compounds, and all other analytical parameters). Designs are available to collect samples from wells from 1” inside diameter and larger. The HydraSleeve can collect samples from wells of any yield, but it is especially well-suited to collecting samples from low-yield wells, where other sampling methods can’t be used reliably because their use results in dewatering of the well screen and alteration of sample chemistry (McAlary and Barker, 1987).

The HydraSleeve can collect samples from wells of any depth, and it can be used for single-event sampling or long-term ground-water monitoring programs. Because of its thin cross section and flexible construction, it can be used in narrow, constricted or damaged wells where rigid sampling devices may not fit. Using multiple HydraSleeves deployed in series along a single suspension line or tether, it is also possible to conduct in-well vertical profiling in wells in which contaminant concentrations are thought to be stratified.

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As with all groundwater sampling devices, HydraSleeves should not be used to collect groundwater samples from wells in which separate (non-aqueous) phase hydrocarbons (i.e., gasoline, diesel fuel or jet fuel) are present because of the possibility of incorporating some of the separate-phase hydrocarbon into the sample.

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Description of the HydraSleeve

The HydraSleeve (Figure 1) consists of the following basic components:

- A suspension line or tether (A.), attached to the spring clip or directly to the top of the sleeve to deploy the device into and recover the device from the well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer.
- A long, flexible, 4-mil thick lay-flat polyethylene sample sleeve (C.) sealed at the bottom (this is the sample chamber), which comes in different sizes, as discussed below with a self-sealing reed-type flexible polyethylene check valve built into the top of the sleeve (B.) to prevent water from entering or exiting the sampler except during sample acquisition.
- A reusable stainless-steel weight with clip (D.), which is attached to the bottom of the sleeve to carry it down the well to its intended depth in the water column. Bottom weights available from the manufacturer are 0.75" OD and are available in three sizes: 5 oz. (2.5" long); 8 oz. (4" long); and 16 oz. (8" long). In lieu of a bottom weight, an optional top weight may be attached to the top of the HydraSleeve to carry it to depth and to compress it at the bottom of the well (not shown in Figure 1);
- A discharge tube that is used to puncture the HydraSleeve after it is recovered from the well so the sample can be decanted into sample bottles (not shown).
- Just above the self-sealing check valve at the top of the sleeve are two holes which provide attachment points for the spring clip and/or suspension line or tether. At the bottom of the sample sleeve are two holes which provide attachment points for the weight clip and weight.

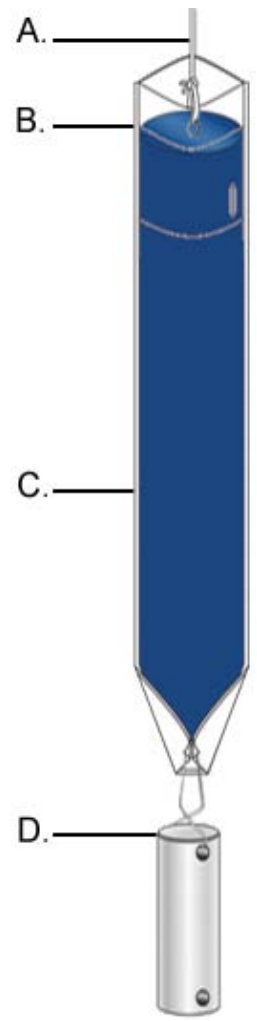

Figure 1. HydraSleeve components.

Note: The sample sleeve and the discharge tube are designed for one-time use and are disposable. The spring clip, weight and weight clip may be reused after thorough cleaning. Suspension cord is generally disposed after one use although, if it is dedicated to the well, it may be reused at the discretion of the sampling personnel.

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Selecting the HydraSleeve Size to Meet Site-Specific Sampling Objectives

It is important to understand that each HydraSleeve is able to collect a finite volume of sample because, after the HydraSleeve is deployed, you only get one chance to collect an undisturbed sample. Thus, the volume of sample required to meet your site-specific sampling and analytical requirements will dictate the size of HydraSleeve you need to meet these requirements.

The volume of sample collected by the HydraSleeve varies with the diameter and length of the HydraSleeve. Dimensions and volumes of available HydraSleeve models are detailed in Table 1.

Table 1. Dimensions and volumes of HydraSleeve models.

Diameter	Volume	Length	Lay-Flat Width	Filled Dia.
2-Inch HydraSleeves				
Standard 625-ml HydraSleeve	625 ml	< 30”	2.5”	1.4”
Standard 1-Liter HydraSleeve	1 Liter	38”	3”	1.9”
1-Liter HydraSleeve SS	1 Liter	36”	3”	1.9”
2-Liter HydraSleeve SS	2 Liters	60”	3”	1.9”
4-Inch HydraSleeves				
Standard 1.6-Liter HydraSleeve	1.6 Liters	30”	3.8”	2.3”
Custom 2-Liter HydraSleeve	2 Liters	36”	4”	2.7”

HydraSleeves can be custom-fabricated by the manufacturer in varying diameters and lengths to meet specific volume requirements. HydraSleeves can also be deployed in series (i.e., multiple HydraSleeves attached to one tether) to collect additional sample to meet specific volume requirements, as described below.

If you have questions regarding the availability of sufficient volume of sample to satisfy laboratory requirements for analysis, it is recommended that you contact the laboratory to discuss the minimum volumes needed for each suite of analytes. Laboratories often require only 10% to 25% of the volume they specify to complete analysis for specific suites of analytes, so they can often work with much smaller sample volumes that can easily be supplied by a HydraSleeve.

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HydraSleeve Deployment

Information Required Before Deploying a HydraSleeve

Before installing a HydraSleeve in any well, you will need to know the following:

- The inside diameter of the well
- The length of the well screen
- The water level in the well
- The position of the well screen in the well
- The total depth of the well

The inside diameter of the well is used to determine the appropriate HydraSleeve diameter for use in the well. The other information is used to determine the proper placement of the HydraSleeve in the well to collect a representative sample from the screen (see HydraSleeve Placement, below), and to determine the appropriate length of tether to attach to the HydraSleeve to deploy it at the appropriate position in the well.

Most of this information (with the exception of the water level) should be available from the well log; if not, it will have to be collected by some other means. The inside diameter of the well can be measured at the top of the well casing, and the total depth of the well can be measured by sounding the bottom of the well with a weighted tape. The position and length of the well screen may have to be determined using a down-hole camera if a well log is not available. The water level in the well can be measured using any commonly available water-level gauge.

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HydraSleeve Placement

The HydraSleeve is designed to collect a sample directly from the well screen, and it fills by pulling it up through the screen a distance equivalent to 1 to 1.5 times its length. This upward motion causes the top check valve to open, which allows the device to fill. To optimize sample recovery, it is recommended that the HydraSleeve be placed in the well so that the bottom weight rests on the bottom of the well and the top of the HydraSleeve is as close to the bottom of the well screen as possible. This should allow the sampler to fill before the top of the device reaches the top of the screen as it is pulled up through the water column, and ensure that only water from the screen is collected as the sample. In short-screen wells, or wells with a short water column, it may be necessary to use a top-weight on the HydraSleeve to compress it in the bottom of the well so that, when it is recovered, it has room to fill before it reaches the top of the screen.

Example

2” ID PVC well, 50’ total depth, 10’ screen at the bottom of the well, with water level above the screen (the entire screen contains water).

Correct Placement (figure 2): Using a standard HydraSleeve for a 2” well (2.6” flat width/1.5” filled OD x 30” long, 650 ml volume), deploy the sampler so the weight (an 8 oz., 4”-long weight with a 2”-long clip) rests at the bottom of the well. The top of the sleeve is thus set at about 36” above the bottom of the well. When the sampler is recovered, it will be pulled upward approximately 30” to 45” before it is filled; therefore, it is full (and the top check valve closes) at approximately 66” (5 ½ feet) to 81” (6 ¾ feet) above the bottom of the well, which is well before the sampler reaches the top of the screen. In this example, only water from the screen is collected as a sample.

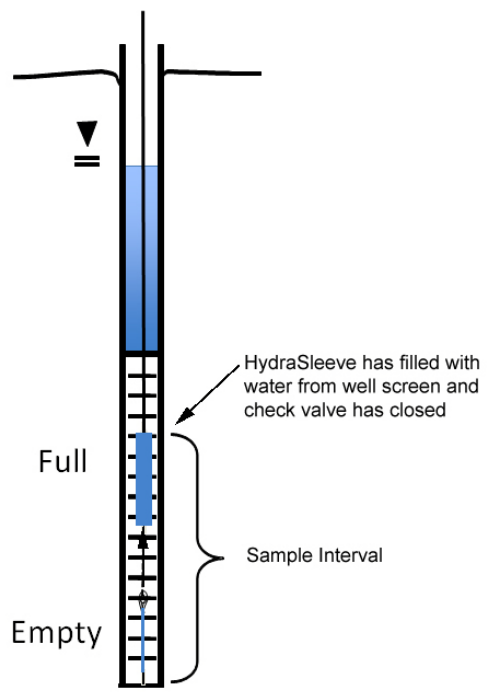

Figure 2. Correct placement of HydraSleeve.

Incorrect Placement (figure 3): If the well screen in this example was only 5' long, and the HydraSleeve was placed as above, it would not fill before the top of the device reached the top of the well screen, so the sample would include water from above the screen, which may not have the same chemistry.

The solution? Deploy the HydraSleeve with a top weight, so that it is collapsed to within 6" to 9" of the bottom of the well. When the HydraSleeve is recovered, it will fill within 39" (3 ¼ feet) to 54" (4 ½ feet) above the bottom of the well, or just before the sampler reaches the top of the screen, so it collects only water from the screen as the sample.

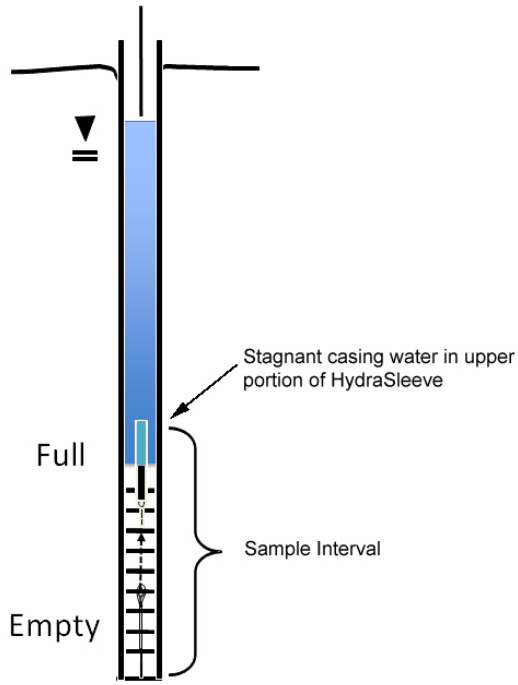

Figure 3. Incorrect placement of HydraSleeve.

This example illustrates one of many types of HydraSleeve placements. More complex placements are discussed in a later section.

Procedures for Sampling with the HydraSleeve

Collecting a ground-water sample with a HydraSleeve is a simple one-person operation.

Note: Before deploying the HydraSleeve in the well, collect the depth-to-water measurement that you will use to determine the preferred position of the HydraSleeve in the well. This measurement may also be used with measurements from other wells to create a ground-water contour map. If necessary, also measure the depth to the bottom of the well to verify actual well depth to confirm your decision on placement of the HydraSleeve in the water column.

Measure the correct amount of tether needed to suspend the HydraSleeve in the well so that the weight will rest on the bottom of the well (or at your preferred position in the well). Make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve

Note: Always wear sterile gloves when handling and discharging the HydraSleeve.

I. Assembling the HydraSleeve

1. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.
2. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.
3. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.
4. Attach the tether to the spring clip by tying a knot in the tether.

Note: Alternatively, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

5. Fold the flaps with the two holes at the bottom of the HydraSleeve together and slide the weight clip through the holes.
6. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

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II. Deploying the HydraSleeve

1. Using the tether, carefully lower the HydraSleeve to the bottom of the well, or to your preferred depth in the water column

   During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

Note: Make sure that it is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5'/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

2. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

Note: Alternatively, you can tie the tether to a hook on the bottom of the well cap (you will need to leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed at the next sampling event).

III. Equilibrating the Well

The equilibration time is the time it takes for conditions in the water column (primarily flow dynamics and contaminant distribution) to restabilize after vertical mixing occurs (caused by installation of a sampling device in the well).

- Situation: The HydraSleeve is deployed for the first time or for only one time in a well

  The HydraSleeve is very thin in cross section and displaces very little water (<100 ml) during deployment so, unlike most other sampling devices, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample.

  In most cases, the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours. In regulatory jurisdictions that impose specific requirements for equilibration times prior to recovery of no-purge sampling devices, these requirements should be followed.

- Situation: The HydraSleeve is being deployed for recovery during a future sampling event

  In periodic (i.e., quarterly or semi-annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event)

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deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

Thus, a long equilibration time is ensured and, at the next sampling event, the sampler can be recovered immediately. This means that separate mobilizations, to deploy and then to recover the sampler, are not required. HydraSleeves can be left in a well for an indefinite period of time without concern.

IV. HydraSleeve Recovery and Sample Collection

1. Hold on to the tether while removing the well cap.

2. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards)

3. Measure the water level in the well.

4. In one smooth motion, pull the tether up between 30” to 45” (36” to 54” for the longer HydraSleeve) at a rate of about 1’ per second (or faster).

   The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1 to 1.5 times the length of the HydraSleeve). This is analogous to coring the water column in the well from the bottom up.

   When the HydraSleeve is full, the top check valve will close. You should begin to feel the weight of the HydraSleeve on the tether and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

5. Continue pulling the tether upward until the HydraSleeve is at the top of the well.

6. Decant and discard the small volume of water trapped in the Hydrasleeve above the check valve by turning the sleeve over.

V. Sample Collection

Note: Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity.

1. Remove the discharge tube from its sleeve.

2. Hold the HydraSleeve at the check valve.

3. Puncture the HydraSleeve just below the check valve with the pointed end of the discharge tube

4. Discharge water from the HydraSleeve into your sample containers.

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Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both.

5. Continue filling sample containers until all are full.

Measurement of Field Indicator Parameters

Field indicator parameter measurement is generally done during well purging and sampling to confirm when parameters are stable and sampling can begin. Because no-purge sampling does not require purging, field indicator parameter measurement is not necessary for the purpose of confirming when purging is complete.

If field indicator parameter measurement is required to meet a specific non-purging regulatory requirement, it can be done by taking measurements from water within a HydraSleeve that is not used for collecting a sample to submit for laboratory analysis (i.e., a second HydraSleeve installed in conjunction with the primary sample collection HydraSleeve [see Multiple Sampler Deployment below]).

Alternate Deployment Strategies

Deployment in Wells with Limited Water Columns

For wells in which only a limited water column exists to be sampled, the HydraSleeve can be deployed with an optional top weight instead of a bottom weight, which collapses the HydraSleeve to a very short (approximately 6” to 9”) length, and allows the HydraSleeve to fill in a water column only 36” to 45” in height.

Multiple Sampler Deployment

Multiple sampler deployment in a single well screen can accomplish two purposes:

- It can collect additional sample volume to satisfy site or laboratory-specific sample volume requirements.
- It can accommodate the need for collecting field indicator parameter measurements.
- It can be used to collect samples from multiple intervals in the screen to allow identification of possible contaminant stratification.

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It is possible to use up to 3 standard 30” HydraSleeves deployed in series along a single tether to collect samples from a 10’ long well screen without collecting water from the interval above the screen.

The samplers must be attached to the tether at both the top and bottom of the sleeve. Attach the tether at the top with a stainless-steel clip (available from the manufacturer). Attach the tether at the bottom using a cable tie. The samplers must be attached as follows (figure 4):

- The first (attached to the tether as described above, with the weight at the bottom) at the bottom of the screen
- The second attached immediately above the first
- The third (attached the same as the second) immediately above the second

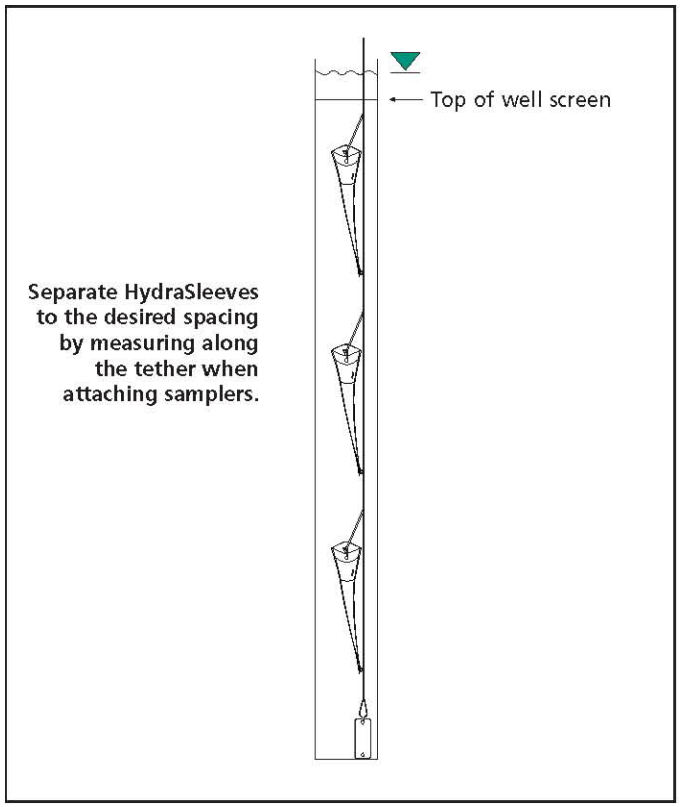

Figure 4. Multiple HydraSleeve deployment.

Alternately, the first sampler can be attached to the tether as described above, a second attached to the bottom of the first using a short length of tether (in place of the weight), and the third attached to the bottom of the second in the same manner, with the weight attached to the bottom of the third sampler (figure 5).

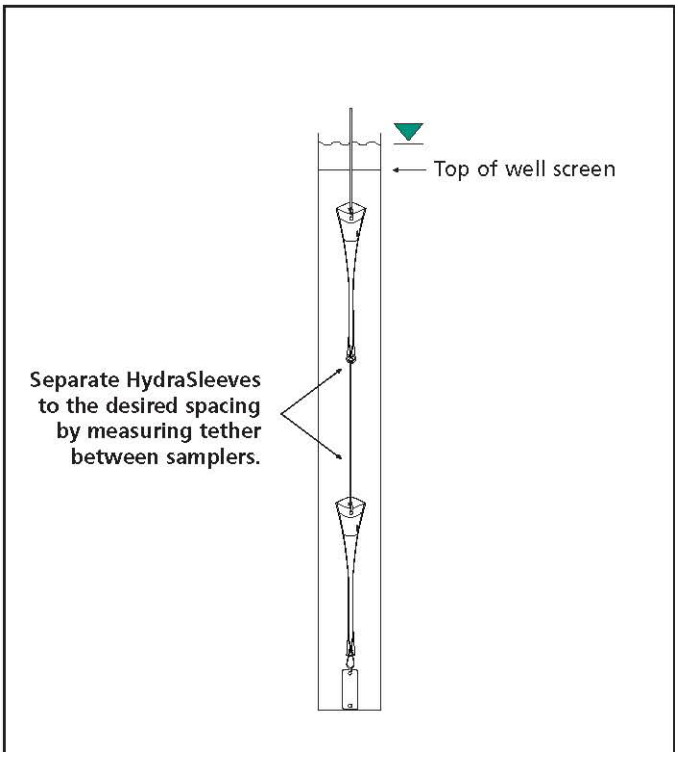

Figure 5. Alternative method for deploying multiple HydraSleeves.

In either case, when attaching multiple HydraSleeves in series, more weight may be required to hold the samplers in place in the well than would be required with a single sampler. Recovery of multiple samplers and collection of samples is done in the same manner as for single sampler deployments.

Post-Sampling Activities

The recovered HydraSleeve and the sample discharge tubing should be disposed as per the solid waste management plan for the site. To prepare for the next sampling event, a new HydraSleeve can be deployed in the well (as described previously) and left in the well until the next sampling event, at which time it can be recovered.

The weight and weight clip can be reused on this sampler after they have been thoroughly cleaned as per the site equipment decontamination plan. The tether may be dedicated to the well and reused or discarded at the discretion of sampling personnel.

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References

McAlary, T. A. and J. F. Barker, 1987, Volatilization Losses of Organics During Ground-Water Sampling From Low-Permeability Materials, Ground-Water Monitoring Review, Vol. 7, No. 4, pp. 63-68

Parsons, 2005, Results Report for the Demonstration of No-Purge Ground-Water Sampling Devices at Former McClellan Air Force Base, California; Contract F44650-99-D-0005, Delivery Order DKO1, U.S. Army Corps of Engineers (Omaha District), U.S. Air Force Center for Environmental Excellence, and U.S. Air Force Real Property Agency

Robin, M. J. L. and R. W. Gillham, 1987, Field Evaluation of Well Purging Procedures, Ground-Water Monitoring Review, Vol. 7, No. 4, pp. 85-93

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Field Investigation Planning Form

Billings, Montana

APPENDIX E

Appendix E - Field Investigation Planning Form

Project Name: Frank Properties

Project Number: 350.0181.000

Project Address: 301 N 13th St., 303 N 13th St., 1206 4th Ave N, City Block between N 13th and 14th Streets and 2nd and 3rd Avenues

Project City: Billings, Montana 59101

Date:

Investigation Date(s):

Site Contact: Todd Frank (406) 544-9331

Client Contact: Patrick Klugman (406) 869-8418

EPA / DEQ Manager: Wendy Thomi (406) 457-5037

Required Check Offs	Yes	No
DEQ/EPA Approved SAP		
SAP Reviewed by Field Staff		
Utility Locate Number		
Owner Notified		
Health & Safety Plan		
Sample Location Map		
Holding Times Work		
Project Budget Reviewed		

Overall Reason for Investigation: The purpose of this Phase II ESA is to evaluate whether the Energy One Stop LUST Release #3260 has impacted groundwater at the Site, and to evaluate whether the floor drains present and use of the Site and surrounding properties as automotive repair facilities have released contaminants to shallow soil and/or groundwater at the Site. In addition to subsurface assessment, investigation of potential asbestos-containing building materials (ACBM) and lead-based paint (LBP) associated with on-site structures will be completed.

Sampling Methods

Total # of Samples	Analytical Parameters	Media	Natural or QC Sample?	Analytical Method #	Sample Containers	Preservative	Hold/Extraction Time	Sample Locations
18	EPH	Soil	Natural + ERB	MDEP EPH	4oz Glass Jar	< 6°C	7/40 Days	Two samples from each borehole. 1 at groundwater interface, 1 at highest impacted area or 15ft bgs. ERB off of macro core sampler
18	VPH	Soil	Natural +ERB +TB	MDEP VPH	4-8oz Glass Jar	< 6°C, no headpace	7/28 Days	Two samples from each borehole. 1 at groundwater interface, 1 at highest impacted area or 15ft bgs. ERB off of macro core sampler
16	VOCs	Soil	Natural +ERB +TB	EPA 8260	5035 vial kit	$NaHSO_4$, MeOH, < 6°C	14 Days	Two samples from each borehole. 1 at groundwater interface, 1 at highest impacted area or 15ft bgs. ERB off of macro core sampler
16	SVOCs	Soil	Natural +ERB +TB	EPA 8270	8oz Glass Jar	< 6°C	14/40 Days	Two samples from each borehole. 1 at groundwater interface, 1 at highest impacted area or 15ft bgs. ERB off of macro core sampler
16	Metals (RCRA)	Soil	Natural +ERB	EPA 6010B/7471	8oz Glass Jar	< 6°C	180 Days (28 Days for Hg)	Two samples from each borehole. 1 at groundwater interface, 1 at highest impacted area or 15ft bgs. ERB off of macro core sampler
(up to) 9	EPH	Groundwater	Natural+ERB+DUP	MDEP EPH	1L Amber Glass	pH<2 HCl; < 6°C	14/40 Days	Potentially B-2 through B-9. 4 ft to 5ft below water table. ERB only if non-disposable sampling equipment used
(up to) 9	VPH	Groundwater	Natural+ERB+DUP+TB	MDEP VPH	40mL vials	pH<2 HCl; < 6°C	14 Days	Potentially B-2 through B-9. 4 ft to 5ft below water table. ERB only if non-disposable sampling equipment used
(up to) 8	VOCs	Groundwater	Natural+ERB+DUP+TB	EPA 8260	40mL vials	pH<2 HCl; < 6°C	14 Days	Potentially B-2 through B-9. 4 ft to 5ft below water table. ERB only if non-disposable sampling equipment used
(up to) 8	SVOCs	Groundwater	Natural+ERB+DUP+TB	EPA 8270	1L Amber Glass	< 6°C	14/40 Days	Potentially B-2 through B-9. 4 ft to 5ft below water table. ERB only if non-disposable sampling equipment used
(up to) 8	Metals (RCRA)	Groundwater	Natural+ERB+DUP+TB	EPA 6010B/7471	125 ml plastic/glass	HNO_3; < 6°C	180 Days (28 Days for Hg)	Potentially B-2 through B-9. 4 ft to 5ft below water table. ERB only if non-disposable sampling equipment used

Lab Pack:

Laboratory: Pace Analytical

Shipping by:

Other Instructions:

Project Manager: _____ Field Staff: _____

(Form to be finalized and signed prior to commencing field work.)

NewFields

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Pace Analytical™ www.pacelabs.com

Section A **Required** Client Information:	Section B **Required** Project Information:	Section C Invoice Information:
Company:	Report To:	Attention:
Address:	Copy To:	Company Name:
		Address:
Email To:	Purchase Order No.:	Pace Quote Reference:
Phone: / Fax:	Project Name:	Pace Project Manager:
Requested Due Date/TAT: **Standard**	Project Number:	Pace Profile #:

Page: **of**

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER

☐ UST ☐ RCRA ☐ OTHER _____

Site Location ***STATE:*** _____

Section D
Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED: COMPOSITE START DATE	COLLECTED: COMPOSITE START TIME	COLLECTED: COMPOSITE END/GRAB DATE	COLLECTED: COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test (Y/N)												Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1																															
2																															
3																															
4																															
5																															
6																															
7																															
8																															
9																															
10																															
11																															
12																															

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: **DATE Signed (MM/DD/YY):**

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

Building Materials Sampling & Analysis Plan

Billings, Montana

APPENDIX F

Programmatic Building Materials Inspection Sampling and Analysis Plan

Big Sky Economic Development Community Development Division Brownfields Program

Billings, Montana

BIG SKY ECONOMIC DEVELOPMENT

NewFields

October 2015

PROGRAMMATIC SAMPLING & ANALYSIS PLAN FOR BUILDING MATERIALS INSPECTIONS

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October 2015
Project No. 350.0181.000

PROGRAMMATIC SAMPLING & ANALYSIS PLAN FOR BUILDING MATERIALS INSPECTIONS

Version 1

Issued: October 31, 2015

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Ms. Wendy Thomi Brownfields Project Manager U.S. Environmental Protection Agency	Date
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1.0 INTRODUCTION

NewFields Companies, LLC (NewFields) prepared this Sampling & Analysis Plan (SAP) to describe the goals, technical approach, and procedures that apply to Building Materials Inspections (BMI) performed for the Big Sky Economic Development (BSED) Brownfields Program. This SAP was prepared on behalf of BSED using a U.S. Environmental Protection Agency (EPA) community-wide, hazardous substance grant.

Building materials investigations often require a standard investigative approach, allowing for the development of a standardized SAP, which saves time and money in the planning phases of a Brownfields project. This SAP describes how investigations will be conducted for activities that are common to many building materials investigations. This includes investigation of asbestos-containing building materials (ACBM), lead-based paint (LBP), leachable lead (if building is to be demolished), lead in surface soils (if LBP is discovered on the building exterior), light fixtures for polychlorinated biphenyl (PCB) containing light ballasts, caulk for PCB content, and thermostats for free-phase mercury. This SAP should accompany site-specific documents including a *Site-Specific Planning Worksheet* (Appendix A) for Building Materials Inspection (developed as part of this SAP), and a site-specific Health & Safety Plan (HASP).

1.1 BUILDING MATERIALS CONCEPTUAL SITE MODELS AND DATA GAPS

The construction age of a building has a significant role as to whether ACBM, LBP, mercury, or PCB-containing materials are potentially located in a building. As summarized in decision flowcharts for BMI (**Appendix B**), LBP was used in the U.S prior to 1978, after which a ban of lead in paint was promulgated by EPA. PCB light ballasts were used mainly in fluorescent lights until July 1979. Buildings built between 1950 and 1980 may contain high concentrations of PCBs in caulk. Likewise, buildings constructed after 1980 are less likely to have ACBM; however, many ACBM are still used legally today (EPA, 2015). **Table 1-1** presents possible release mechanisms, potential exposure pathways, and possible risk management strategies for ACBM, LBP, leachable lead, lead in surface soil, and light fixture ballasts containing PCBs.

1.2 GENERAL INVESTIGATION PURPOSE AND APPROACH

The purpose of BMI is to investigate building materials for ACBM, LBP, mercury in thermostats, and light fixtures and/or caulk for PCBs. If LBP is discovered on the building exterior, surface soils near the building should be tested to determine if soils are contaminated with lead at concentrations of concern. If the building is to be demolished, leachable lead testing should be completed to ensure that the demolition waste is disposed of in accordance with state and federal regulations.

Laboratory results of building material samples will be compared to the regulatory thresholds presented in the Decision Rules column of the Data Quality Objectives (DQOs, **Appendix C**). This comparison allows planners to make informed decisions regarding appropriate abatement actions and/or special waste handling during building demolition or renovation work, or during removal of debris associated with a building fire. As described in the Decision Rules column (**Appendix C**), labels on ballasts from a subset of

identical fluorescent light fixtures can be visibly inspected to determine if they contain PCB ballasts. However, no sampling of light ballasts for PCBs is necessary during a BMI.

Table 1-1 Contaminant Release Mechanisms, Exposure Pathways, and Management

Potential Contaminant	Potential Release Mechanism	Potential Exposure Pathway	Possible Risk Management Strategy
Asbestos Containing Building Materials (ACBM)	Release of friable asbestos to indoor air	Future inhalation by occupants of building or site construction workers Future abatement contractor exposure	Remove friable ACBM from the building. Remove other ACBM prior to demolition or disturbance to eliminate future exposures Dispose of ACBM in accordance with State and Federal laws regarding asbestos abatement
Lead / Lead-Based Paint (LBP)	Release of lead to indoor air during renovation or demolition of building Flaking of paint chips from LBP on interior surfaces and/or exterior soil surrounding building Leaching from bulk building wastes following disposal in landfill	Future construction worker inhalation Ingestion and inhalation of lead from dust on the hands, clothes and hair is readily ingested during eating or smoking Inhalation of lead in indoor air or in exterior soil adjacent to the existing building Leaching of lead from soil or bulk building wastes to groundwater and ingestion of groundwater	Use proper ventilation, possible air sampling, and use respirators if painted surfaces are disturbed Use Lead-Safe work practice, as outlined by The Lead-Safe Certified Guide to Renovate Right: : Important Lead Hazard Information for Families, Child Care Providers and Schools in 2011 Seal painted surfaces to encapsulate and prevent exposure If exterior paint contains lead that has contaminated nearby soil, remove soil containing lead concentrations above 400 mg/kg total lead Disposal of bulk building wastes as hazardous waste, as necessary
Polychlorinated Biphenyls (PCBs)	Release of PCBs from leaking ballasts Leaching of PCBs in light ballasts following disposal in landfill Release of PCBs to air from off-gassing of caulk, or in dust from disturbance of caulk.	Inhalation or dermal contact with PCBs from leaking ballasts or caulk Leaching to groundwater followed by ingestion of groundwater	Disposal of PCB-containing materials in accordance with State and Federal regulations

1.2.1 Data Quality Objectives

The EPA has developed a process to define Data Quality Objectives (DQOs) for site investigations (EPA, 2006). The EPA process will be used when environmental data are collected to evaluate the extent and magnitude of contamination and to identify remedial alternatives based on the site investigation. The DQOs for this SAP are based upon a conceptual understanding or site model of ACBM, LBP, and PCB-containing ballasts associated with buildings in the U.S. The seven-step DQO Approach identifies the information necessary to 1) provide the project manager and field staff with flexible performance guidelines, 2) ensure that data collected will be sufficient in both quality and quantity to support the goals of the investigation, and 3) support future decisions regarding management or abatement of building materials. The DQOs for this SAP are identified in **Appendix C**. DQO's for this Programmatic QAPP include:

- Defining the location and category of ACBMs and LBP in a building;
- Determining whether building materials contain asbestos at concentrations that are hazardous to construction workers or building occupants should these materials become friable;
- Determining whether painted surfaces contain lead at concentrations that would render it a LBP in accordance with state and federal regulations;
- Determining whether building wastes generated during renovation or demolition may be a characteristic hazardous waste;
- Determining whether soils near the building are contaminated with total lead at concentrations requiring cleanup (if exterior surfaces are found to have LBP); and/or
- Determining whether fluorescent lighting fixtures or caulk contain PCBs, and whether building thermostats contain free-phase mercury, thus requiring special waste handling for these ballasts during building renovation or demolition.

To determine whether there are ACBM associated with a building, ACBM sample results will be compared to the Montana Department of Environmental Quality (DEQ) action level of 1% by weight or volume.

Painted surfaces will be evaluated for LBP using a HUD-approved X-Ray Fluorescence (XRF) spectrometer or through laboratory analysis of paint chips. XRF results of painted surfaces greater than 1.0 milligram per square centimeter (mg/cm^2) or an analytical result of a paint chip sample above 0.5% lead (i.e., 5,000 milligrams per kilogram (mg/kg)) would deem the paint as a LBP. Demolition waste streams having a TCLP leachable lead result greater than 5.0 milligrams per liter (mg/L) are considered a characteristic hazardous waste. Surface soil is considered contaminated with lead above acceptable concentrations if the concentration of total lead is above 400 mg/kg (residential) or 800 mg/kg (commercial/industrial).

A fluorescent light-fixture ballast will be considered to not contain PCBs if the ballast is labelled with "No PCBs". Alternatively, fixtures are assumed to contain PCBs if they cannot be verified as PCB-free by either inspecting the label or contacting the manufacturer.

1.2.2 Triad Approach

The Triad Approach will be used during building material investigations. The Triad Approach helps manage uncertainty and employs innovative characterization tools and strategies to improve the site investigation process. The primary goal of the Triad Approach is to increase confidence in project decisions concerning contaminant presence, location, fate, exposure, and risk (EPA, 2004). The Triad Approach is comprised of three primary components:

1. Systematic Project Planning;
2. Dynamic Work Strategies; and
3. Real-Time Measurement Technologies.

The *Systematic Project Planning* elements of the Triad Approach identify key decisions to be made with the data. After goals are established, realistic objectives to reach these goals are identified. During the planning phase, a conceptual site model of the contamination problem is developed (including data gaps) to determine site assessment objectives.

Dynamic Work Strategies allow for changes to the assessment based on information obtained in the field. These strategies commonly involve communicating throughout the project, specifically between the field crew and project manager to ensure site investigation objectives are met and the assessment takes into account observations made in the field. Before the fieldwork is conducted, all parties should know their responsibilities, as well as the responsibilities of others in case questions or issues arise.

Real-Time Measurement Technologies provide data during the field activities. Example technologies often considered include direct sensing devices, instant field tests such as XRF for LBP, onsite laboratories, rapid laboratory turnaround times during long field campaigns, and electronic sharing of data. Data sharing can include the rapid dissemination of newly received electronic laboratory results to field personnel. Use of these technologies can improve the efficiency of the field investigation and can lead to cost-effective accomplishment of the overall goals of the assessment.

Elements of the Triad Approach to be used for BMI will include the following:

- Completion of a *Site-Specific Planning Worksheet* (**Appendix A**) that indicates the assessment will be completed in accordance with this Programmatic SAP, and that generally identifies the purpose and objectives of the investigations.
- Visual identification of suspect ACBM and LBP in the building prior to sampling of building materials.
- Field crew daily communication with the project manager during assessment to verify that appropriate Quality Assurance (QA) measures are being used, and modify the scope of assessment as necessary to fully characterize potentially hazardous building materials.
- Reporting laboratory analytical data via electronic format, which allows NewFields to evaluate and validate the data more efficiently.

2.0 SCOPE OF WORK

All BMI will be conducted in accordance with the Big Sky Economic Development Quality Assurance Project Plan (QAPP; NewFields, 2015), which is included as **Appendix D**. Standard Operating Procedures (SOPs) applicable to BMI are included in **Appendix E** of this SAP. Prior to conducting a BMI, the environmental contractor will obtain a site access agreement from the property owner.

2.1 List of Analyses Performed During BMI

Table 2-1 summarizes the laboratory analytical methods for quantifying asbestos in building materials, determining whether LBP is present on painted surfaces, determining whether bulk building wastes may be a characteristic hazardous waste, quantifying if soil near the building contains total lead at elevated concentrations (only necessary if exterior paint is found to be a LBP), and determining the PCB content of caulk. The methods of determining whether fluorescent light fixtures contain PCB-ballasts and whether thermostats contain free-phase mercury are also included in **Table 2-1**. A comparison of laboratory reporting limits to applicable screening levels for constituents of concern is included in **Appendix F**. All samples submitted for laboratory analysis will be analyzed using standard turnaround times.

Table 2-1 Laboratory Analytical Methods, Constituents of Potential Concern

Constituents of Potential Concern	Analytical Method
Asbestos	EPA 600/R-93/116 (Polarized Light Microscopy)
Lead-Based Paint (LBP) on Building Materials	HUD-approved X-Ray Fluorescence (XRF) spectrometer procedures for building demolition; or EPA Method 7420 – Flame Atomic Absorption (Flame AA), if laboratory testing of paint chip sample is completed
Leachable Lead in Building Materials	Extraction by EPA Method 1311; Analysis by EPA Method 6010
Total Lead in Soil	Extraction by EPA Method 3050; Analysis by EPA Method 6010
Polychlorinated Biphenyls (PCBs)	Fluorescent light fixtures are visually inspected for the presence of ballasts containing PCBs (ballasts labeled with "No PCBs"). Caulk is analyzed by EPA Method 8082.
Mercury	Thermostats are inspected to determine if they contain free-phase mercury.

2.2 Documentation of Field Activities

Detailed field notes will be recorded in a field log book during BMI activities, in accordance with SOP-1 (**Appendix E**). Information recorded in the log book will include details concerning locations and estimated quantities of suspect ACBM, locations of LBP as determined by XRF, and location and type of

light fixture ballasts inspected. All sample locations will be documented in the field log book using the nomenclature identified in the QAPP (NewFields, 2015). Should assessment identify LBP on exterior surfaces of a building, soil sample locations for total lead analysis will also be recorded in the log book. Site photographs of suspect ACBM and LBP will be obtained. Information recorded in the log book will be used to estimate the quantity of ACBM and LBP, and allow for the preparation of an abatement cost estimate.

2.3 Asbestos Inspection and Sampling

2.3.1 Asbestos Regulations

Asbestos is the name given to a group of naturally occurring minerals used in certain products, such as building materials and vehicle brakes to resist heat and corrosion. Asbestos types include chrysotile, amosite, crocidolite, tremolite, anthophyllite, actinolite, and any of these materials that have been chemically treated and/or altered. Increased incidence of illness including asbestosis (a debilitating lung disease), lung cancer, and mesothelioma (rare cancer of the lung or stomach cavity lining) have been observed in individuals who were persistently exposed to high levels of airborne asbestos in work environments such as mining, milling, shipbuilding, construction, and manufacturing. Asbestos-containing materials in buildings pose no risk to human health unless asbestos fibers become airborne and are inhaled. Intact, sealed, and undisturbed materials are not hazardous.

The Occupational Safety and Health Administration (OSHA) regulates the protection of workers from asbestos. These requirements are codified in several federal regulations, including 29 CFR Section 1926, which covers construction work such as alteration, repair, renovation, and demolition of structures containing asbestos.

Asbestos was one of the first hazardous air pollutants regulated under Section 112 of the Clean Air Act (CAA). In 1973, the EPA promulgated the National Emissions Standards for Hazardous Air Pollutants (NESHAP) found in 40 CFR Part 61. Building materials are classified as ACBM if they contain greater than 1% asbestos. If ACBM is present, EPA and DEQ asbestos regulations apply with respect to the management or abatement of the ACBM.

In Montana, requirements for asbestos inspection are detailed in the Administrative Rules of Montana (ARM) 17.74.354 (**Appendix G**), including visual/tactile inspection procedures and sampling frequencies based on the type of materials present. Asbestos inspection must be performed by a person accredited in accordance with the requirements of ARM 17.74.301 et seq. Current accreditations are provided in **Appendix H**.

2.3.2 Asbestos Sampling

As indicated on the *Site-Specific Planning Worksheet* (**Appendix A**), asbestos inspection and sampling of onsite buildings will be performed at the site. Prior to commencing the building inspection, as-built drawings will be reviewed, if available, to become familiar with the facility, mechanical/heating system layout, and general materials used in construction. Previous asbestos inspections that may have been conducted in the past will also be reviewed to identify suspect ACBM. Past inspections performed on

school buildings to meet the requirements of the Asbestos Hazard Emergency Response Act (AHERA) typically do not have the level of detail required to estimate cleanup costs and plan abatement activities in detail, but are useful in determining suspect materials.

Inspection and sampling for asbestos will be performed by an asbestos inspector accredited in Montana per requirements of the Montana Asbestos Control Program, using sampling frequencies stipulated in ARM 17.74.354 (**Appendix G**). The accredited asbestos inspector will perform a walkthrough of the entire building, or alternatively through only the proposed renovation areas, as indicated in the *Site-Specific Planning Worksheet* (**Appendix A**). A flowchart summarizing asbestos inspection activities, evaluation of results, and resulting building materials management actions is provided in **Appendix B** for demolition, renovation, and fire conditions. The inspector will identify all suspected ACBM based on professional judgement and information obtained through required accreditation trainings. Asbestos inspection will be performed in accordance with SOP-27 (**Appendix E**), including conducting the following activities:

- Informational meetings with facility personnel to learn more about the history of buildings and to inform them of what will transpire during the inspection.
- An initial walkthrough of the building accompanied by a maintenance person, if possible, to identify building construction phases, mechanical areas, pipe chases, pipe tunnels, crawl spaces, attics, and roof(s).
- Visual survey of all building materials to identify suspect homogeneous areas of ACBM.
- Subsequent collection of samples from homogeneous areas of suspect ACBM in accordance with SOP-27 (**Appendix E**). Building material samples of suspect ACBM will be submitted under chain-of-custody for analysis of asbestos by EPA Method 600/R-93/116 using polarized light microscopy (PLM). Building materials will be considered ACBM if they contain greater than 1% asbestos, as defined in the asbestos NESHAP under 40 CFR Part 61, Subpart M.
- Preparation of a report detailing results of the asbestos inspection, including the location, classification, and estimated quantity of ACBM. While not required by Montana law, the environmental consultant will identify potential abatement alternatives and costs for abatement in the Report of Findings.

In accordance with Montana law (**Appendix G**), the number of samples collected per homogeneous area will be dictated by the type of potential ACBM:

- A minimum of three bulk samples will be collected from non-friable suspect ACBM to determine whether the material is asbestos containing.
- The minimum number of samples collected from friable surfacing material will be three samples (1,000 square feet or less), five samples (1,000 to 5,000 square feet), or seven samples (over 5,000 square feet) depending on area of the material.
- Thermal system insulation will be sampled in a randomly distributed manner, with at least three bulk samples collected from each homogeneous material.

- Bulk samples will be collected from each insulated mechanical system where cement or plaster was used on fittings, such as tees, elbows, or valves.
- Bulk samples will not be collected from any homogeneous material where the inspector determines through professional judgment that the thermal system insulation is fiberglass, foam glass, rubber, or other non- asbestos containing building material.

2.3.3 Evaluation of Asbestos Results

In accordance with current EPA and Montana Department of Environmental Quality (MDEQ) Asbestos Control Program (ACP) regulations, building materials which contain greater than one percent (>1%) asbestos will be placed into one of the three following NESHAP categories:

- **Category I non-friable ACBM**, which includes any asbestos-containing packing, gasket, resilient floor covering, or asphalt roofing product which contains more than one percent (>1%) asbestos;
- **Category II non-friable ACBM**, which includes any material, excluding Category I non-friable ACM, containing more than one percent (>1%) asbestos, that when dry cannot be crumbled, pulverized, or reduced to powder by hand pressure such as cement asbestos board, asbestos-cement pipe, and window glazing materials; or,
- **Regulated Asbestos-Containing Materials (RACM)**, which includes friable materials, Category I non-friable ACBM that will or may be subjected to sanding, grinding, cutting, or abrading and Category II non-friable ACBM which has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by forces acting on it or expected to act upon it during the course of renovations and/or demolition activities.

2.4 Lead-Based Paint Inspection and Sampling

2.4.1 Lead Regulations for Building Materials

EPA defines LBP as paint containing greater than 0.5% lead by weight (i.e., 5,000 milligrams of lead per kilogram of paint chips). Disposal of lead-containing wastes is regulated under the Resource Conservation and Recovery Act (RCRA). Under RCRA, demolition debris is required to be tested using the TCLP method of analysis to determine whether the material exhibits the characteristics of hazardous waste. If so, the paint must be managed as a hazardous waste. Note that LBP waste from abatement or renovation of residential households is excluded from listing as hazardous waste (EPA 2000). Sampling for potential lead-based paint in residential structures or schools must be performed by an accredited inspector. Current accreditations are provided in **Appendix H**.

2.4.2 Sampling for Lead-Based Paint

As indicated on the *Site-Specific Planning Worksheet* (**Appendix A**), interior and exterior painted surfaces will be surveyed for LBP using an XRF spectrometer or by laboratory analysis of total lead if XRF results are inconclusive. XRF procedures will follow the recognized standard protocol developed by HUD, as described in SOP-28C (**Appendix E**). Paint chip sampling is described in SOP-28D (**Appendix E**). A

flowchart summarizing LBP inspection activities, evaluation of results, and resulting building materials management actions is provided in **Appendix B** for demolition, renovation, and fire conditions.

2.4.3 Instrument Calibration

Prior to initiating XRF testing, three calibration check readings will be collected using the XRF. The calibration check readings will also be repeated every four hours, every time the XRF is turned on, or at the conclusion of the sampling job, whichever is more frequent.

Large differences of calibration check reading averages may suggest problems in the instrument's performance. The calibration check reading averages should not differ from the instrument standard by more than the calibration check tolerance specified in the XRF Performance Characteristics Sheet for the specific instrument used. If the observed calibration check average minus the standard is greater than the calibration check tolerance, the instructions provided by the manufacturer should be followed in order to re-calibrate the instrument before any more XRF testing is done.

2.4.4 XRF Measurement

Prior to taking XRF measurements, the inspection staff will walk through the building to familiarize themselves with the building layout. During the walkthrough, a complete inventory of the painted surfaces in interior rooms, on exterior walls, and on surfaces in other exterior areas, such as fences, playground equipment, and garages, will be conducted. Paint combinations, equivalents, and combinations within rooms and on the exterior of the building will be identified. For the purpose of BMI, a paint equivalent is characterized by an identifiable part of a building, such as a room, hallway, stairways, or exterior area. Each paint equivalent is further divided up into components, which are then tested using the XRF. For example, components in a room may include the ceiling, floor, walls, door and its casing, window sash, and window casings.

At least one XRF reading of all components coated with paint, varnish, shellac, stain, or other coating will be collected. Readings will be repeated three times to ensure accuracy. XRF readings will also be recorded on the first bare substrate area. Readings will be classified as negative, positive, or inconclusive. XRF measurements classify paint as lead-based when the result is equal to or greater than 1.0 mg/cm^2 (**Appendix B**). For XRF results which fall into the inconclusive range, paint chip samples will be collected and sent under chain-of-custody to a laboratory for analysis of total lead in accordance with SOP-28D (**Appendix E**). Paint chip sampling will include collection of all paint layers, while minimizing collection of substrate. The locations, area (square feet), component, substrate, and color of paint found to be positive for lead or assumed to be positive for lead will be recorded in a field log book or on a sampling form.

2.5 TCLP Sampling of Building Materials for Leachable Lead

As indicated on the *Site-Specific Planning Worksheet* (**Appendix A**), painted and unpainted building materials will be sampled and analyzed using the TCLP analytical method for leachable lead. TCLP sampling is required if LBP is identified on any building material, and a demolition waste stream may be generated. If LBP is present, the TCLP sampling methods described in SOP-28E (**Appendix E**) will be

employed for the anticipated waste stream(s), taking into account any materials that may be salvaged and not disposed in the landfill. The goal of the TCLP analysis is to determine whether the waste stream will contain concentrations of leachable lead above the hazardous waste threshold limit of 5.0 mg/L (**Appendix B**). Should the XRF screening and/or analytical testing of paint chips determine there is no LBP present in the building, TCLP testing of the waste stream will not be conducted.

2.6 Surface Soil Sampling for Lead

As indicated in the flowchart for LBP inspection (**Appendix B**), should XRF or analytical testing identify LBP on exterior surfaces of building(s), surface soil samples will be collected along the base of each applicable building in proximity to the LBP to determine whether soil is contaminated with total lead. Surface soil samples will be collected at a frequency of one composite sample for every approximately 40 linear feet of exterior LBP in accordance with SOP-13 (**Appendix E**). If the total length of exterior painted surface is less than 40 feet, one composite sample will be collected.

Composite samples will be obtained by collecting and combining five subsamples of equal volume from depths of 0-6 inches below ground surface. The composite samples will be roughly equally spaced along the 40 linear feet. Composite soil samples will be collected approximately 18 inches from the building wall and submitted to the laboratory in coolers containing ice and under chain-of-custody for analysis of lead. Collection of each composite sample will be completed with reusable sampling equipment decontaminated between sampling as described in SOP-2 (**Appendix E**).

All samples submitted for laboratory analysis will be analyzed using standard turnaround times. Lead detected in soil at a concentration greater than 400 mg/kg (Residential Reuse) or 800 mg/kg (Commercial/Industrial Reuse) will require some form of corrective action, such as excavation and removal.

2.7 Light Ballast Inspection for PCBs

2.7.1 PCB Regulations for Disposal

The disposal of PCB wastes is regulated under the Toxic Substances and Control Act (TSCA). TSCA requires potential demolition debris to be inspected to determine if fluorescent light fixtures in a building have ballasts which contain PCBs. If light ballasts are labeled as containing PCBs, ballasts must be managed as a hazardous waste during building demolition or renovation work in accordance with TSCA. Details regarding inspection and management options for light ballasts are published by EPA at: http://www.epa.gov/epawaste/hazard/tsd/pcbs/pubs/ballasts.htm.

Solid waste landfills permitted by a state may accept some PCB-containing waste, provided the state permit conditions are met. As described in 40 CFR 761.62(b)(4)(ii)), if the concentration of PCBs in the waste is greater than 50 parts per million (ppm), written notice must be provided to the landfill prior to disposal.

2.7.2 PCB Inspection Activities

As indicated on the *Site-Specific Planning Worksheet* (**Appendix A**), field personnel will inspect for light ballasts of fluorescent lights to determine if they contain PCBs. Prior to inspection of fluorescent lights, field personnel will determine the location and type of lights present in the building and the total number of fluorescent lights. Based on this information, a minimum of 25% of each type of fluorescent light will be inspected to evaluate whether PCB ballasts are present. If ballast labels do not contain a statement regarding the presence or absence of PCBs, an assumption will be made that the ballasts contain PCBs. If the ballast identifies the manufacturer, the environmental consultant will attempt to contact the manufacturer to determine if the ballasts contain PCBs. A flowchart summarizing PCB inspection activities, evaluation of results, and resulting building materials management actions is provided in **Appendix B**.

2.7.3 Sampling Caulk for PCB Content

If disposal of materials from a building as solid waste is anticipated during site redevelopment, and the age of the building indicates PCBs may be present in caulk (i.e. the building was constructed between 1950 and 1980), a representative composite sample of the building materials waste stream will be sampled and analyzed for PCBs by EPA Method 8082. MDEQ personnel indicate that landfill requirements vary by municipality, therefore the proposed disposal facility will be contacted to determine sampling requirements.

2.8 Inspection of Thermostats for Free-Phase Mercury

During the initial walkthrough inspection, thermostats may be inspected for switches containing free-phase elemental mercury, which can lead to the following symptoms (as described by EPA at http://www.epa.gov/mercury/effects.htm):

> *…tremors; emotional changes (e.g., mood swings, irritability, nervousness, excessive shyness); insomnia; neuromuscular changes (such as weakness, muscle atrophy, twitching); headaches; disturbances in sensations; changes in nerve responses; performance deficits on tests of cognitive function.*

If the brand/model of thermostat present is not known to either contain or be free of mercury, the exterior cover of the thermostat will be removed to inspect for a mercury-containing glass ampoule. Mercury-containing thermostats will be identified to the building owner for removal and recycling.

2.9 Field and Laboratory Quality Control Procedures

The approved BSED Programmatic QAPP (NewFields, 2015; **Appendix D**) establishes specific quality assurance and quality control (QA/QC) policies and activities, including SOPs that will be followed during BMI.

Duplicate samples of asbestos will not be collected during BMI because several samples will be collected from each suspect ACBM. No laboratory testing is necessary following XRF analysis for LBP; however,

XRF testing will be completed for each substrate of paint as indicated in SOP-28C. If an XRF reading for a suspect paint is inconclusive, thus requiring paint chip sampling, one duplicate sample of the paint will be collected for every 20 paint chip samples. Duplicate paint chip results will be used to evaluate the laboratory precision. Field replicate soil samples for analysis of total lead will not be collected due to the inherent heterogeneity of the soil. Equipment rinse blank samples of equipment used to collect samples will be collected at a frequency of one sample per sampling event. If disposable sampling is used, no equipment rinse blank samples will be collected.

2.10 Project Reporting

Following receipt of all laboratory results for building materials samples, a Report of Findings will be prepared. The report will describe the methods of investigation, any deviations from the scope of work described in this SAP and the *Site-Specific Planning Worksheet* (**Appendix A**), and results of the field and laboratory investigation. Field notes, figures (including a site plan showing the building layout and sampling locations), laboratory analytical reports, and photographs will be appended to the report. If warranted, the report will present recommended material management strategies for asbestos, lead-containing materials, and/or light fixtures containing PCBs, including an abatement cost estimate.

3.0 APPROVAL OF INSPECTIONS USING THIS PROGRAMMATIC SAP

Prior to initiating a BMI in accordance with this building materials SAP, a *Site-Specific Planning Worksheet* (**Appendix A**) will be completed and submitted to the EPA for approval and signature. The worksheet contains an authorization signature page, and appended site-specific information identifying the site owner and contact information, general information concerning the buildings to be inspected, the purpose of the inspection and the types of samples to be collected, figures identifying the assessment area, site access agreement, and a health and safety plan. Inspection will be initiated after review and approval of the worksheet by the EPA. Once approved by EPA, the BMI will be initiated with two weeks. The Report of Findings will be prepared approximately four weeks following receipt of all laboratory analytical results.

4.0 REFERENCES

U.S. Environmental Protection Agency (EPA), 2015. *Federal Bans on Asbestos* webpage, accessed February 2015 at http://www2.epa.gov/asbestos/us-federal-bans-asbestos.

EPA, 2011. The Lead-Safe Certified Guide to Renovate Right: Important Lead Hazard Information for Families, Child Care Providers and Schools. EPA-740-K-10-001. September 2011.

EPA, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4. February 2006.

EPA, 2004. Summary of the Triad approach. White paper authored by Deana M. Crumbling. March 25, 2004.

EPA, 2000. Memorandum: Regulatory Status of Waste Generated by Contractors and Residents from lead-Based Paint Activities Conducted in Households. Accessed May 2015 at http://www2.epa.gov/sites/production/files/documents/hhwmemo-july00fnl.pdf.

NewFields, 2015. Quality Assurance Project Plan – Big Sky Economic Development-Community Development Division, Brownfields Program. September, 2015.

APPENDIX A

Example Site-Specific Planning Worksheet for Building Materials Inspection

[EXAMPLE]
Site-Specific Planning Worksheet
For Building Materials Inspection

Site Name:_____
Address:_____
Owner:_____
EPA Grantee:_____
Grantee Contact:_____
EPA Project Manager:_____

Project Type (mark all applicable)

☐ Planned Demolition
☐ Planned Renovation
☐ Burned Building

General Description of Property and Project

Number and Type of Buildings:
Construction Date:
Future Plan for Building/Site:
Assessment Schedule:
Other:

Inspection Tasks* (mark all applicable, include names of accredited personnel for assessment)

☐ Asbestos inspection
☐ Lead-Based Paint inspection, including surface soil sampling for lead (if LBP present)
☐ Sampling of building materials for leachable lead (if LBP present)
☐ Sampling of building materials for PCB content
☐ PCB light ballast inspection

*See Attachment 2 (Programmatic SAP), Appendix B - Decision Flowcharts for summary of sampling approach, evaluation thresholds, and resulting waste management decisions for each task.

Quality Assurance (QA) Manager: _____

Attachments:	**Figure 1**	Location Map
	Figure 2	Site Map
	Figure 3	Site Plan Detail - Renovation Areas [if known]
	Attachment 1	Site-Specific Health & Safety Plan (HASP)
	Attachment 2	Programmatic Sampling & Analysis Plan (SAP)

Distribution List: Wendy Thomi, EPA (one electronic copy)
Patrick Klugman, Big Sky Economic Development (one paper and one electronic copy)
_____, Site Owners (one paper and one electronic copy)

SAMPLING & ANALYSIS PLAN
FOR BUILDING MATERIALS INSPECTION
[Site Name]
[Street Address]
[City, State]

Version 1

Issued: [Date]

Mr. Patrick Klugman Community Development Project Manager Big Sky Economic Development	Date
Ms. Wendy Thomi Brownfields Project Manager U.S. Environmental Protection Agency	Date
Mr. Chris Cerquone, Project Manager Project Manager NewFields Companies, LLC	Date
Mr. Doug Rogness Program QA/QC Officer NewFields Companies, LLC	Date

[EXAMPLE]
Site-Specific Planning Worksheet
For Building Materials Inspection

Site Name:_____
Address:_____
Owner:_____
EPA Grantee:_____
Grantee Contact:_____
EPA Project Manager:_____

Project Type (mark all applicable)

☐ Planned Demolition
☐ Planned Renovation
☐ Burned Building

General Description of Property and Project

Number and Type of Buildings:
Construction Date:
Future Plan for Building/Site:
Assessment Schedule:
Other:

Inspection Tasks* (mark all applicable, include names of accredited personnel for assessment)

☐ Asbestos inspection
☐ Lead-Based Paint inspection, including surface soil sampling for lead (if LBP present)
☐ Sampling of building materials for leachable lead (if LBP present)
☐ Sampling of building materials for PCB content
☐ PCB light ballast inspection

*See Attachment 2 (Programmatic SAP), Appendix B - Decision Flowcharts for summary of sampling approach, evaluation thresholds, and resulting waste management decisions for each task.

Quality Assurance (QA) Manager: _____

Attachments:	**Figure 1**	Location Map
	Figure 2	Site Map
	Figure 3	Site Plan Detail - Renovation Areas [if known]
	Attachment 1	Site-Specific Health & Safety Plan (HASP)
	Attachment 2	Programmatic Sampling & Analysis Plan (SAP)

Distribution List: Wendy Thomi, EPA (one electronic copy)
Patrick Klugman, Big Sky Economic Development (one paper and one electronic copy)
_____, Site Owners (one paper and one electronic copy)

SAMPLING & ANALYSIS PLAN
FOR BUILDING MATERIALS INSPECTION
[Site Name]
[Street Address]
[City, State]

Version 1

Issued: [Date]

Mr. Patrick Klugman Community Development Project Manager Big Sky Economic Development	Date
Ms. Wendy Thomi Brownfields Project Manager U.S. Environmental Protection Agency	Date
Mr. Chris Cerquone, Project Manager Project Manager NewFields Companies, LLC	Date
Mr. Doug Rogness Program QA/QC Officer NewFields Companies, LLC	Date

APPENDIX B

Decision Flowcharts for Building Materials Inspection

Decision Flowchart for Building Materials Inspection

APPENDIX B-1 • ASBESTOS

NewFields

SAMPLE

EVALUATE RESULTS

REQUIRED ACTION

DEMOLITION

A. Perform visual survey to identify suspect materials
B. Group materials into Homogeneous Areas (HAs)
C. Collect samples for asbestos analysis in accordance with the National Emissions Standards for Hazardous Air Pollutants (NESHAP) as specified in Montana Rule (ARM 17.74.354)

Non-Detect → No Action Required

Less Than 1% (Confirm via Point Count) → OSHA Regulations Apply. Workers Disturbing Material Should Use Respitory Protection in Accordance with 29 CFR Section 1926.1101

Greater Than 1% →
- Remove Under DEQ Permit Using a Montana-Accredited Abatement Contractor and Supervisor.
- Dispose of at a Specialized Landfill Licensed to Accept Asbestos.
- Renovation Only: If Desired, Manage In-Place by Encapsulating, Enclosing, or Repair. Label All Asbestos Containing Materials.

RENOVATION

Is there a renovation plan indicating the building materials that will be disturbed?

YES → MATERIALS TO BE DISTURBED SAMPLE, EVALUATE, & MANAGE as described under Demolition

NO → ALL MATERIALS: SAMPLE, EVALUATE, & MANAGE as described under Demolition

FIRE

Sample ash and recognizable building components. EVALUATE AND MANAGE as described under Demolition

Note for Air Testing During Asbestos Abatement: Multiple threshold levels for concentrations of asbestos fibers in the air must be met during abatement, and at final clearance prior to reoccupation of the former abatement work zone. These thresholds are listed in **Appendix F**

Decision Flowchart for Building Materials Inspection

APPENDIX B-2 • LEAD - BASED PAINT

(Only necessary for buildings constructed prior to 1978)

NewFields

SAMPLE

EVALUATE RESULTS

REQUIRED ACTION

DEMOLITION

Collect one composite bulk material sample representative of entire waste stream and perform leachability testing for lead via the Toxicity Characteristic Leaching Procedure (TCLP)

- TCLP Less Than 5.0 mg/L → **Not Hazardous:** Disposal at Class II Landfill
- TCLP Greater Than 5.0 mg/L → **Potentially Hazardous:** Sample Individual Painted Surface To Identify Location of Lead Concern, or Perform Disposal of Entire Waste Stream

RENOVATION

Is renovation area small (i.e., less than 3,000 square feet)?

SMALL

Use Paint Chip Testing to Evaluate Individual Painted Surfaces for Lead Concentration

- Less Than 5,000 mg/kg → **LBP Not Present:** No Special Protection Necessary for Removal
- Greater Than 5,000 mg/kg → **LBP Present:**

LARGE

Use X-Ray Fluorescence (XRF) Field Meter for Lead Concentration

- Less Than 1.0 mg/cm² → **LBP Not Present:** No Special Protection Necessary for Removal
- Greater Than 1.0 mg/cm² → **LBP Present:**

LBP Present:

- Use OSHA Regulation 1926.62 for Safe Worker Exposure Practices During Renovation
- Perform TCLP Testing of the Entire Waste Stream, as Described Under Demolition
- Sample Surface Soil Near the Building Exterior for Total Lead Content; Will be Considered Contaminated if Greater Than 400 mg/kg Total Lead

FIRE

Perform leachability testing as with Demolition

Decision Flowchart for Building Materials Inspection

APPENDIX B-3 • PCB LIGHT BALLASTS

(Only necesary for buildings constructed prior to July 1979)

NewFields

INSPECT

A. Identify the location, type, and number of fluorescent light fixtures
B. Visually inspect the ballasts for 25% of each type of fixture

EVALUATE RESULTS

If Labeled as Not Containing PCBs

If Unlabeled

If Labeled as Containing PCBs

NO

OPTION 1: Contact Manufacturer to Determine if Ballasts Contain PCBs

OPTION 2: Assume Ballasts Contain PCBs

YES, or Unknown

REQUIRED ACTION

Ballasts Do Not Contain PCBs. No Replacement or Special Waste Handling of Ballasts is Necessary

Ballasts Contain PCBs. Leaking Ballasts Must Be Replaced. Any Disposal of PCB-Containing Ballasts Must Be As Special Waste In Accordance with the Toxic Substances Control Act (TSCA)

APPENDIX C

Data Quality Objectives/ Seven-Step Planning Approach

Appendix C: Data Quality Objectives

Programmatic Sampling and Analysis Plan (SAP)
for Building Materials Inspection (BMI)
Big Sky Economic Development

Step 1: Problem Statement	Step 2: Identifying the Decisions	Step 3: Decision Inputs	Step 4: Study Boundaries	Step 5: Decision Rules	Step 6: Tolerance Limits on Errors	Step 7: Optimization of Sample Design
Inadequate information is available to determine whether special waste handling and/or exposure controls are necessary to protect human health and the environment from hazardous building materials during renovation, demolition, or management of burned building debris at the site. To this end, the existing building or debris may require assessment to determine whether the following are present, as selected in the *Site-Specific Building Materials Inspection Planning Worksheet:* 1) asbestos containing building materials (ACBM), 2) lead-based paint (LBP), 3) surface soil containing elevated lead concentrations, or 4) light fixtures with ballasts containing Polychlorinated Biphenyls (PCBs).	As applicable based on the *Site-Specific Building Materials Inspection Planning Worksheet:* 1) Does the existing building contain asbestos above regulatory limits? 2 a) Is LBP present on interior and exterior surfaces of the building? and b) Will any renovation and/or demolition debris contain hazardous waste levels of leachable lead due to LBP? 3) If exterior surfaces are LBP, is surface soil near the building contaminated with elevated lead? 4) Do light fixtures have ballasts containing PCBs? 5) What are the estimated costs to abate ACBM, LBP, and PCB-containing ballasts in the building?	As applicable based on the *Site-Specific Building Materials Inspection Planning Worksheet:* 1) A visual survey and material sampling will be conducted for all suspect ACBM. 2 a) Painted surfaces will be measured for LBP using an XRF spectrometer, or paint chip samples will be analyzed for total lead, if XRF measurement is inconclusive. b) If LBP is present on the building, TCLP analysis will be performed on a sample representative of the waste stream to be generated during demolition. 3) If exterior surfaces contain LBP, surface soil near building will be analyzed for total lead. 4) A visual survey of the lighting fixtures will be conducted for ballasts containing PCBs.	See *Site-Specific Building Materials Inspection Planning Worksheet* with attached figures.	As applicable based on the *Site-Specific Building Materials Inspection Planning Worksheet:* 1) Building materials will be considered ACBM if they contain greater than one percent asbestos based on the sampling results (40 Code of Federal Regulations CFR] 61, Subpart M). 2 a) Painted surfaces will be considered LBP if XRF results are greater than 1.0 mg/cm^2, or if analytical results of paint chip samples are above 0.5% lead or 5,000 mg/kg lead. b) Waste streams having a TCLP lead result greater than 5.0 mg/L lead will be considered hazardous waste. 3) Surface soil will be considered contaminated if the concentration of total lead is above 400 mg/kg. 4) A flourescent light fixture ballast will be considered to not contain PCBs if the ballast is labelled with "No PCBs", or assumed to contain PCBs if it cannot be verified as PCB-free (by either inspecting the label or contacting the manufacturer).	Sampling frequency, as specified by Montana Law, will be used to obtain representative results, as described in SOP 27. Quality assurance and quality control procedures will be conducted and data validation will be performed in accordance with the programmatic QAPP (NewFields 2015).	As applicable based on the *Site-Specific Building Materials Inspection Planning Worksheet:* Building materials suspected of containing asbestos will be sampled in accordance with 40 CFR 763 and the Administrative Rules of Montana (ARM) 17.74.354. XRF spectrometer analysis will be performed in the field to identify LBP. One composite sample (consisting of at least 5 subsamples) will be analyzed for leachable lead following TCLP. Composite soil samples along exterior areas of LBP will be collected at a frequency of one sample per every 40 linear feet of painted surface. A subset of the flourescent lights (25% of each light type identified) will be inspected to evaluate whether light fixtures have ballasts containing PCBs.

Notes:

mg/cm^2 = milligrams per square centimeter

mg/kg = milligrams per kilogram

mg/L = milligrams per liter

APPENDIX D

Programmatic Quality Assurance Project Plan (QAPP)

NewFields
Perspective. Vision. Solutions.

September 9, 2015

Mr. Patrick Klugman
Community Development Project Manager
Big Sky Economic Development
222 N. 32nd St., Suite 200
Billings, Montana 59101

Subject: **Programmatic Quality Assurance Project Plan**
Brownfields Program – Big Sky Economic Development

Dear Patrick,

NewFields is pleased to submit a Programmatic Quality Assurance Project Plan (pQAPP) to the US Environmental Protection Agency (EPA) on behalf of the Big Sky Economic Development (BSED). The pQAPP documents the quality assurance and quality control procedures which will be used during the performance of Environmental Site Assessments.

We thank you for this opportunity and look forward to assisting the BSED with your Brownfields program.

Sincerely,
NewFields

Tyler Etzel
Senior Environmental Scientist

Encl: Programmatic Quality Assurance Project Plan
EPA Document Review Crosswalk

cc. Ms. Wendy Thomi, US Environmental Protection Agency
Mr. Jeff Kuhn, Montana Department of Environmental Quality

Programmatic Quality Assurance Project Plan

Big Sky Economic Development Community Development Division Brownfields Program

Billings, Montana

BIG SKY ECONOMIC DEVELOPMENT

NewFields

SEPTEMBER 2015

PROGRAMMATIC QUALITY ASSURANCE PROJECT PLAN

Big Sky Economic Development
Community Development Division
Brownfields Program

Version 2

Issued: September 2015

Patrick Klugman
Brownfields Coordinator
Big Sky Economic Development

9-8-15
Date

Wendy Thomi
Project Officer
U.S. Environmental Protection Agency

9/8/15
Date

Chris Cerquone
Project Manager
NewFields Companies, LLC

9-8-15
Date

for Doug Rogness

Doug Rogness, PG
Technical QA/QC Officer
NewFields Companies, LLC

9-8-15
Date

PROGRAMMATIC QUALITY ASSURANCE PROJECT PLAN

Big Sky Economic Development
Community Development Division
Brownfields Program

Prepared for:
Big Sky Economic Development
222 North 32nd Street, Suite 200
Billings, Montana 59101

Prepared by:
NewFields Companies, LLC
1120 Cedar Street
Missoula, Montana 59802

NewFields

September 2015
Project No. 350.0180 and 350.0181

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Appendix B Laboratory Quality Assurance Planning Documents
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Appendix D Sample Field Forms and Chain-of-Custody Forms
Appendix E Montana DEQ Data Validation Guidelines

DISTRIBUTION LIST

This Programmatic Quality Assurance Project Plan (PQAPP) will be distributed to the following representatives of Big Sky Economic Development (BSED), the Montana Department of Environmental Quality (MDEQ), and the Environmental Protection Agency (EPA).

The distribution of the PQAPP within these organizations will be the responsibility of designated representatives, below.

Big Sky Economic Development
Mr. Patrick Klugman
222 North 32nd Street, Suite 200
Billings, Montana 59101

U.S. Environmental Protection Agency
Ms. Wendy Thomi
Montana Operations Office
Federal Building
10 West 15th Street, Suite 3200
Helena, Montana 59626

Jeff Kuhn
Montana Department of Environmental Quality
P.O. Box 200901
Helena, Montana 59620

LIST OF ACRONYMS

ACBM	Asbestos-Containing Building Materials
APH	Air-phase Petroleum Hydrocarbons
ASA	American Society of Agronomy
ASTM	ASTM International
AVD	Absolute Value Difference
BSED	Big Sky Economic Development
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
CPR	Cardiopulmonary Resuscitation
DEQ	Montana Department of Environmental Quality
DO	Dissolved Oxygen
DQO	Data Quality Objective
EBURD	East Billings Urban Renewal District
EC	Electrical Conductivity
EDD	Electronic Data Deliverable
EPA	U.S. Environmental Protection Agency
EPH	Extractable Petroleum Hydrocarbons
ESA	Environmental Site Assessment
GC/MS	Gas Chromatography/Mass Spectroscopy
GIS	Geographic Information System
HAZWOPER	Hazardous Waste Operations and Emergency Response
HUD	Housing and Urban Development
LBP	Lead-Based Paint
LCS	Laboratory Control Sample
MADEP	Massachusetts Department of Environmental Protection
MBTEXN	Methyl Tertiary Butyl Ether, Benzene, Toluene, Ethylbenzene, Xylenes, and Naphthalene
MDL	Method Detection Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NESHAP	National Emission Standard for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCM	Phase Contrast Microscopy
PID	Photo-Ionization Detector
PQL	Practical Quantitation Limit
QA	Quality Assurance
QAO	Quality Assurance Officer
PQAPP	Quality Assurance Project Plan

QC	Quality Control
RBSL	Risk-based Screening Level
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SIM	Single Ion Monitoring
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
WDOE	Washington Department of Ecology
VCRA	Voluntary Cleanup and Redevelopment Act
VOC	Volatile Organic Compound
VPH	Volatile Petroleum Hydrocarbons
XRF	X-Ray Fluorescence

1.0 INTRODUCTION

NewFields Companies, LLC (NewFields) prepared this Programmatic Quality Assurance Project Plan (PQAPP) for Big Sky Economic Development (BSED) to guide quality assurance and quality control (QA/QC) activities during Phase II environmental site assessments (ESAs) and cleanup-related sampling at Brownfields sites identified within the City of Billings and the East Billings Urban Renewal District (EBURD) located east of downtown Billings in Yellowstone County, Montana (**Figure 1**).

The PQAPP describes data collection and evaluation procedures and ensures that data of appropriate quality are obtained during field sampling, testing, and laboratory analysis when conducting assessments and cleanup-related sampling. The procedures presented herein are proposed to 1) ensure the precision, accuracy, and completeness of data collected, and to 2) ensure that the minimum data requirements, data reduction, and validation procedures are followed. The PQAPP describes organizational objectives, functional activities, and quality control (QC) activities designed to achieve the data quality objectives (DQOs) for BSED's Brownfields Program.

This PQAPP is a programmatic document and will guide assessment and cleanup-related sampling on sites completed by BSED. The PQAPP was developed to satisfy the requirements of Title 44, Code of Federal Regulations, Part 31.45 (44 CFR 31.45) and was prepared in accordance with applicable U.S. Environmental Protection Agency (EPA) guidance (EPA 1998, 2001).

In addition to the PQAPP, a site-specific Sampling and Analysis Plan (SAP) will be prepared for each site to be assessed prior to performing sampling, and/or a site-specific Corrective Action Plan (CAP) will be developed prior to remediation on a site. Additional information specific to each property (definition of problem, description of property, and approach to investigation) will be included in each site-specific SAP and CAP. As a matter of consistency, this PQAPP will be appended to each site-specific SAP and CAP.

1.1 DOCUMENT ORGANIZATION

This document is divided into the following sections:

- **Section 2.0** presents a description of BSED's Brownfields Program, including the program organization and management framework for conducting Brownfields assessment and cleanup;
- **Section 3.0** discusses data quality objectives and criteria;
- **Section 4.0** describes sampling protocols and approaches for soil, water, sediment, soil vapor, air, building materials, and sludge;
- **Section 5.0** presents data measurement, acquisition, and management procedures for the program;
- **Section 6.0** describes the sampling and oversight procedures;

- **Section 7.0** summarizes the data verification and validation procedures for the program; and,
- Section 8.0 presents references cited in this report.

Figures for this PQAPP are compiled following **Section 8.0**. Standard operating procedures (SOPs) for field activities are provided in **Appendix A**. Laboratory quality assurance planning documents are included in **Appendix B**. A soil screening process used for the Montana Voluntary Cleanup and Redevelopment Act (VCRA) Program is presented as **Appendix C**. A list of sample field forms and chain-of-custody forms are included in **Appendix D**. A copy of the Montana Department of Environmental Quality (DEQ) Data Validation Guidelines for Evaluating Analytical Data is provided in **Appendix E.**

1.2 Programmatic QAPP Updates & Versions

Once the PQAPP is approved, a final copy will be distributed to the program participants listed on the distribution list. Copies of the PQAPP will be maintained for reference by BSED, MDEQ, and EPA. The PQAPP requires annual review and updates when new phases of work are performed or modifications to the data collection protocols are otherwise required. Under such circumstances, an amendment to the PQAPP (or new PQAPP) will be provided to all program participants listed on the distribution list by BSED who will be responsible for maintaining the official, approved PQAPP. It is anticipated that the Programmatic PQAPP will have a shelf-life of 5 years.

To avoid confusion, all QA documents will be published with a unique identifier that includes the two digit month, day, and year of publication noted in the header of each page, specifically "Programmatic QAPP, Version, day/month/year". Individual replacement pages will not be distributed as these pages can be easily lost or inserted incorrectly. When a new Programmatic QAPP is distributed, it will be accompanied with a cover letter clearly stating that it supersedes previous versions and that the earlier versions should be discarded. Other related project documents will clearly refer to the date of the current PQAPP to further reduce the potential for confusion.

2.0 PROGRAM DESCRIPTION & BACKGROUND

This section is designed to guide the organization and management of the BSED Brownfields Program. A detailed discussion of the program organization, including a definition of the responsibilities of the various program participants, is presented in the following sub-sections.

2.1 PROGRAM ORGANIZATION

Effective program management results in a well-defined project approach and goals that are agreed upon by all identified stakeholders. As the BSED Community Development Project Manager and Brownfields Coordinator, Mr. Patrick Klugman will have the overall responsibility of implementing and coordinating the Brownfields program. He will serve as the primary point of contact for the EPA and lead community outreach activities. Mr. Klugman will also serve as the Grantee QA Manager to review the overall quality of project deliverables generated by the Brownfields Contractor.

The Project Manager will oversee day-to-day management of the site assessment and cleanup activities as a contractor to BSED. The Project Manager will supervise contracted activities and work closely with project members to ensure the team meets scheduled milestones and the project remains on budget. The Project Manager will coordinate work in cooperation with EPA and the Montana DEQ as necessary.

Directly supporting the Project Manager will be staff responsible that will be involved in preparation of site-specific plans, oversight of field activities, data collection and evaluation, and QA/QC. All staff conducting assessment work and cleanup-related sampling will be required to have current 40-hour OSHA Hazardous Materials training in accordance with the requirements listed under 29 CFR 1910.120.

Program participants and their associated responsibilities are presented on **Figure 2**, and described below.

BSED Brownfields Coordinator / Grantee QA Manager – Patrick Klugman (BSED)

Responsibilities: Assurance of program performance, coordination of project team and assessment work; scheduling of program and public meetings; budgeting; grant management; review of overall project deliverable quality (independent of Brownfields contractor).

Agency Project Officer – Wendy Thomi (EPA)

Responsibilities: Review of all project planning documents and work plans; assessment of site eligibility; approval of project-specific Sampling and Analysis Plans (SAPs) on behalf of EPA; assistance with BSED's overall management of the program.

DEQ Liaison – Jason Seyler and Hayden Janssen (DEQ)

Responsibilities: Coordination of Brownfields assessment and cleanup work on sites where DEQ has regulatory interest and where petroleum fund reimbursement will be sought.

Project Manager – Contractor-specific (hired by BSED)

Responsibilities: Supervision of contracted work; primary liaison with BSED, EPA, and DEQ; assistance in planning field work; problem solving and decision making; oversight of field

personnel; compliance with project health and safety requirements; quality assurance of project documents.

Technical Quality Assurance Officer – Contractor-specific (hired by BSED)

Responsibilities: Assurance that analytical data quality objectives, standards for accuracy and precision, and project document quality are all met. The Quality Assurance Officer (QAO) will provide an objective review by remaining independent of direct project involvement and day-to-day operations, including site-specific data collection and evaluation tasks.

Health and Safety Officer – Contractor-specific (hired by BSED)

Responsibilities: Review and approval of all health and safety plans and compliance of field personnel with those plans.

Site Assessment – Contractor-specific (hired by BSED)

Responsibilities: Completion of Phase I ESAs, including identification of potential sources of contamination; development of SAPs for field investigations; performance of Phase II ESAs; and cleanup-related sampling.

2.2 Program Background

Land use in many areas of Billings is dominated by industrial, commercial, professional and residential lands uses. One of BSED's primary Brownfields target areas (the EBURD) has historically been home to a meat-packing plant, an oil and gas company, and other industrial and commercial enterprises that may have used or generated petroleum and hazardous substance contamination.

EPA has awarded BSED a $400,000 Brownfields Assessment Grant ($200,000 Hazardous Substance and $200,000 Petroleum grant). Brownfields Assessment Grants assist redevelopment through the completion of environmental assessments on eligible brownfield properties. Grant funds are used to identify the nature and severity of contamination on properties and allow for the planning and selection of cleanup remedies. The overall goal of BSED's Brownfields Program is to identify properties within the City of Billings, with a focus on the EBURD (**Figure 1**), where contamination (known or perceived) hinders site redevelopment and reuse, and to mitigate contamination concerns through site assessment and cleanup. BSED's program will strive to remove the environmental uncertainties associated with properties through the completion of environmental assessments, further clean-up planning, and facilitate sustainable development in Billings.

2.3 Program Approach

Assessment and cleanup-related sampling, in the context of this PQAPP, shall mean the investigative process used to characterize environmental conditions. Assessment information may also be used to evaluate and determine remedial options and costs and/or clarify redevelopment options at a site. In general, BSED's Brownfields Program approach will include:

- *Site Selection.* Ms. Wendy Thomi with the EPA and Jason Seyler of the MDEQ (petroleum sites) will be consulted to obtain EPA's eligibility approval on selected sites.
- *Phase I Environmental Site Assessment (or Transaction Screen).* BSED will retain an environmental contractor to complete Phase I ESAs or a Transaction Screens on eligible sites. The key elements for both Phase I ESAs and Transaction Screens will be site reconnaissance, interviews/questionnaires, and review of historic and current records, such as legal documents and database entries. Phase I ESAs will be completed in accordance with ASTM Standard E1527-13 (Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process). Transaction Screens will be completed in accordance with ASTM Standard E1528-06 (Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process).
- *Phase II Environmental Site Assessment.* Upon completion of either a Phase I ESA or a Transaction Screen, or done separately, BSED in cooperation with the selected environmental contractor and the site owner will determine whether a Phase II ESA is warranted at a site. If so, BSED will obtain Phase II eligibility concurrence from the EPA and develop a site-specific SAP and CAP to guide assessment and/or confirmation sampling. The SAP and CAP will describe actions to be employed to characterize known or suspected contaminants of concern at the site, including proposed sampling locations and parameters, analytical methods, laboratory reporting limits, and applicable screening levels or standards to which the data will be compared to make decisions with respect to the need for proposed or additional cleanup (i.e. for confirmation sampling. The site-specific SAP and CAP will contain an evaluation of the laboratory reporting limits compared to the appropriate screening levels to ensure the reporting limits are adequate for decision-making purposes.

  SAPs will also contain site-specific Data Quality Objectives (DQOs). SAPs will be considered dynamic work plans as defined by the EPA Triad Approach (EPA 2004), allowing for adjustments to the scope of work based on encountered field conditions. A work schedule indicating critical project points will be presented in SAPs to meet the needs of each unique site. Each SAP and CAP will require approval from EPA and potentially the MDEQ, depending on the regulatory framework for the site.
- *Cleanup/Redevelopment Planning.* BSED may perform site cleanup and remediation planning at sites assessed to identify potentially applicable remediation alternatives and to estimate the cost of implementing selected remediation alternatives. The degree to which a cleanup approach is developed will be dependent on the findings of the assessment. Should the assessment fully define the extent of contamination, a more robust conceptual Cleanup Plan and cost estimate may be developed. If the extent of contamination is not fully defined by the assessment, a conceptual Cleanup Plan will not be developed. Remediation planning activities may involve development of site-specific cleanup levels.

2.4 Staff Training

All staff associated with this project will have sufficient training to safely, effectively, and efficiently perform assigned tasks. A site-specific Health and Safety Plan will be developed for each project site

where an assessment or cleanup-related sampling is conducted. Field staff shall have an initial OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and an 8-hour annual refresher training. The Contractor's Project Manager and the Health and Safety Coordinator will ensure field staff, including subcontractors hired by the contractor, have appropriate training and maintain copies of training certificates. A record of the interval of staff training will be maintained by the environmental contractor.

3.0 DATA QUALITY OBJECTIVES & CRITERIA

Data quality objectives (DQOs) are both qualitative and quantitative statements that are developed during the project planning process to address specific project goals and evaluate project performance. DQOs identify the quality that the site data must meet to provide a basis for decision-making during various phases of the environmental project. Site-specific DQOs will be developed for each project and described in each SAP and/or Cleanup Plan to ensure that Phase II ESA activities provide data that satisfy the project objectives and follow EPA guidance provided in "Quality Assurance Guidance for Conducting Brownfields Sites Assessments" (EPA 1998). In all cases, DQOs will be developed to meet the needs of each unique site.

DQOs present in this PQAPP are more general and are common to the investigation of any site.

3.1 Problem Statement

For each site, a concise and complete description of the problem will be developed and presented in the SAP to define the reason for the sampling event. This statement generally determines the overall goals and scope of the sampling and the resources necessary to characterize the site.

3.2 Decision Statement

Samples will be collected to characterize the nature of known or suspected environmental impacts at select sites, evaluate the extent of contamination, evaluate potential remedial alternatives, develop conceptual cleanup plans, and verify the success of remedial actions. To evaluate potential remedial alternatives and conceptual cleanup plans, or to verify the success of remedial actions, site data will be reviewed to answer the following programmatic DQOs common to all sites assessed:

- Is the data sufficient in quantity and quality to determine whether environmental impacts affect the reuse of the site?
- Is the data sufficient in quality and quantity to determine the nature and extent of impacts, or is more assessment needed to 1) develop site-specific cleanup levels, 2) evaluate potential remedial alternatives, 3) prepare a cleanup plan, or 4) demonstrate remedial success?
- Is a human health risk assessment necessary to develop cleanup levels in various media or can a remedial plan be developed based on a comparison of site data to generic screening levels?
- Where cleanup has occurred, is human health adequately protected by the cleanup actions, or are additional remedial actions or supplemental controls (engineering/institutional) needed to prevent exposure to contaminants?

3.3 Decision Inputs

The data required to address the decision statement may include physical and/or chemical characteristics of air, soil, groundwater, surface water, sediment or building materials. Data requirements may also include estimation of the volume/aerial extent of impacted media, and in the

case of groundwater, contaminant plume spatial and temporal variability. Typical decision inputs are summarized in **Table 3-1**. Site-specific decision inputs will be developed to meet the needs of each unique site investigation completed by BSED in site-specific SAPs and/or Cleanup Plans.

Data collected during previous investigations, if available and still representative of site conditions, will also be utilized in project scoping and development of a site conceptual model for the site. Data from previous investigations will be used quantitatively if data validation shows the data are of high quality. Previous data not collected under an approved site-specific plan or validated in accordance with EPA guidance may be considered suspect. Data with limitations may be usable for scoping as long as appropriate limitations are considered. Professional judgment will be used by the contractor to assess the impact of data concerns on the overall quality and usability of the field data. Criteria for determining whether the data quality is acceptable for meeting the objectives of the BSED program without limitations is further described in **Section 7.0** (Data Validation and Usability).

3.4 Study Boundary

Assessments and cleanup-related sampling will be completed on sites within the City of Billings with a focus on the EBURD (**Figure 1)**. Site descriptions will be provided in the site-specific SAPs and/or Cleanup Plans. Practical constraints to data collection may include access restrictions, site physical constraints, and weather-related complications. Site restrictions will be described in the associated site-specific SAPs and/or Cleanup Plans. In addition, a work schedule indicating critical project milestones, site geographical locations and any resources and time constraints unique to each site will be described in site-specific SAPs and/or Cleanup Plans.

3.5 Decision Rules

Sampling data and the concentrations of contaminants in various media will be used to determine the potential risks to human health and environment. The media may include:

- *Surface and Sub-Surface Soil.* Detected concentrations in surface and subsurface soil samples will be used to estimate contaminant volumes, to assess the potential risks to human health through direct contact, inhalation, and ingestion of contaminants in the soil, and to evaluate the potential for contaminants to migrate to indoor or outdoor air, groundwater, and surface water.
- *Groundwater.* Detected concentrations of contaminants in groundwater will be used to evaluate risks associated with dermal, ingestion or inhalation of contaminants in groundwater.
- *Soil Vapor.* Soil vapor or indoor air data will be used to quantitatively evaluate health risks associated with inhalation of volatile compounds in existing or future structures on the site.
- *Surface Water.* Detected concentrations of contaminants in surface water will be used to evaluate risks associated with dermal and ingestion of contaminants by humans and acute/chronic risks to aquatic life in surface water.

- *Asbestos and Lead-Based Paint.* The presence and location of asbestos containing materials and lead-based paint will be used to quantify risks and to workers during building demolition or renovation or to individuals that would continue to use the structures.

Table 3-1. Sampling Media Decision Inputs and Associated Data Users

Media	Typical Decision Inputs	Data Uses
Surface water/ storm water	Flow, pH, conductivity, temperature, Extractable Petroleum Hydrocarbons (EPH), total Resource Conservation and Recovery Act (RCRA) metals, Volatile Petroleum Hydrocarbons (VPH), Volatile Organic Compounds (VOC), and Semi-Volatile Organic Compounds (SVOC)	Contaminant concentrations, loading, source areas, exceedance of regulatory screening levels or standards, and development of potential remedial alternatives and/or institutional controls.
Groundwater	Flow direction, pH, electrical conductivity (EC), dissolved oxygen (DO), temperature, EPH, VPH, Polycyclic Aromatic Hydrocarbons (PAH), VOC, SVOC, dissolved metals.	Contaminant concentrations, source areas, exceedance of screening levels or water quality standards, development of potential remedial alternatives and/or institutional controls.
Surface soil	Elevation, topography, material volumes, location, EPH, VPH, PAH, VOC, SVOC, pesticides and herbicides, and metals.	Identify source areas, volumes, pathways of exposure, including evaluating potential for contaminants to leach to groundwater. Contaminant concentrations will be compared to appropriate screening levels based on proposed land use. Develop potential remedial alternatives and/or institutional controls.
Subsurface soil	Material volumes, location, EPH, VPH, PAH, VOC, SVOC, pesticides and herbicides, and metals.	Identify source areas, volumes, pathways of exposure, including evaluating potential for contaminants to leach to groundwater. Soil concentrations will be compared to appropriate screening levels based on proposed land use. Develop potential remedial alternatives and/or institutional controls.
Sediment	Material volumes, location, EPH, VPH, PAH, VOC, SVOC, pesticides and herbicides, and metals.	Contaminant concentrations, pathways of exposure. Sediment concentrations will be compared to EPA Region 3, NOAA, and/or Washington Department of Ecology Freshwater Sediment Quality Values. Develop potential remedial alternatives and/or institutional controls.
Soil vapor or ambient air	Location, EPH, VPH, VOC, and SVOC	Contaminant concentrations, exposure pathways, exceedances of site-specific risk-based target levels, development of potential remedial alternatives and/or institutional controls.
Building materials	Material volumes, location, lead-based paint (LBP), asbestos-containing building material (ACBM), methamphetamine	Characterize suspected ACBM, LBP and methamphetamine in building and/or waste materials, and determine source volumes.

Potential risks to human health and the environment will be evaluated based on a comparison of detected contaminant concentrations in various media to screening levels and standards shown in **Table 3-2**. Depending upon the decision inputs, boundaries and decision rules identified for each unique site, the site-specific SAP or Cleanup Plan will incorporate a list of appropriate contaminants of concern, media to be sampled as well as the applicable screening levels and standards for comparison. A soil screening process for the Montana Voluntary Cleanup and Redevelopment Act (VCRA) is presented as reference in **Appendix C**. EPA Regional Screening Levels are updated every 6 months, and Montana screening levels are also periodically updated; therefore, updated screening levels will be presented in each site-specific SAP or Cleanup Plan prepared.

Table 3-2. Published Screening Levels and Standards

Media	Screening Levels and Standards
Soil	• Montana Voluntary Cleanup and Redevelopment Act (VCRA) Application Guide, Attachment C – Soil Screening Process (DEQ 2012, see **Appendix C** to this PQAPP), which includes by reference: o Montana Tier 1 Risk-Based Screening Levels (RBSL) for petroleum releases (DEQ 2009), and o Montana DEQ Action Level for Arsenic (DEQ 2005) • EPA Regional Screening Levels (EPA 2015) for sites outside DEQ jurisdiction
Groundwater and Surface Water	• Montana Numeric Water Quality Standards for groundwater and surface water (Circular DEQ-7; DEQ 2012) • EPA Primary and Secondary Maximum Contaminant Levels (EPA 2009) • Quality Criteria for Water titled "Quality Criteria for Water. Office of Water Regulations and Standards, EPA 440/5-86-001 ('Gold Book')" (EPA 1986)
Air	• Massachusetts Department of Environmental Protection (MADEP) Public Review Draft Vapor Intrusion Guidance - soil gas screening levels (MADEP 2011) • EPA Vapor Intrusion Screening Level (VISL) Users Guide and Calculator (EPA 2014) • EPA lead dust hazard levels in surface dust in a residential dwelling or child-occupied facility that contains a mass-per-area concentration of lead equal to or exceeding 40 micrograms per square foot ($\mu g/ft^2$) on floors or 250 $\mu g/ft^2$ on interior window sills based on wipe samples in 40 CFR Part 745. • OSHA Permissible Exposure Limit for Asbestos of 0.1 fiber per cubic centimeter (f/cc) of air, averaged over an 8-hour work shift. Short-term exposure must also be limited to not more than 1 f/cc, averaged over 30 minutes.
Sediment	• EPA Region 3 Biological Technical Assistance Group Freshwater Sediment Screening Benchmarks (EPA 2006); and/or • National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (Buchman 2008); and/or • Washington Department of Ecology (WDOE) Freshwater Sediment Quality Values (WDOE 1997)

Media	Screening Levels and Standards
Building or Waste Materials	• RCRA Toxicity Characteristic Leaching Procedure (TCLP) limits • HUD total lead concentration of 0.5% by weight or 5,000 milligrams per kilogram (mg/kg) (not risk based – identifies a lead-based paint) • EPA National Emission Standard for Hazardous Air Pollutants (NESHAP) for Asbestos (1% by weight) in 40 CFR 61.140-157 • Montana DEQ Methamphetamine Decontamination Standard (0.1 micrograms per 100 square centimeters [µg/100 cm^2])

In general, if contaminant concentrations for a particular media (soil, groundwater, air, etc.) at a site are less than the generic screening levels, no additional investigation or remedial action will be recommended. If detected concentrations exceed generic screening levels, additional investigation, risk assessment, remediation, or controls (engineering/ institutional) may be recommended.

In some instances, calculation of site-specific cleanup levels for soil may be preferable over active remediation, as generic screening levels are low, particularly for those screening levels based on the migration to groundwater pathway. In some instances, contaminants above generic screening levels may not require remediation if it can be shown through calculation of site-specific cleanup levels that the concentrations are protective of human health and the environment. The need for development of site-specific screening levels or cleanup levels will be determined on a site-specific basis. If contaminant concentrations exceed calculated site-specific screening or cleanup levels, some form of remediation will be recommended. Remediation may include use of active remedial actions or engineering controls (e.g., barriers) and institutional controls (e.g., deed restrictions) to prevent unacceptable exposures to contaminants of concern.

3.6 Decision Errors

Decision errors (i.e. incorrect conclusions concerning need for remedial actions at a site) are often caused by the use of data inappropriately with respect to site conditions. Some level of decision error is acceptable and decision error limits are typically established to control the cumulative impact of sampling and measurement errors on decisions to minimize the potential for erroneous decisions.

Formal limits on decision error are generally not necessary where the goal of the assessment is to define the extent of contamination at an impacted site (EPA 1998), and therefore, are not proposed in this PQAPP. That said, there are actions that will be employed during site assessment to limit decision errors. For example, sampling is often biased to characterize areas suspected to be impacted. This PQAPP and the site-specific SAPs are prepared to primarily identify specific field and laboratory methods and sampling strategies that, if followed, minimize sampling error. The site-specific SAP prepared for each site is designed to reduce error by specifying an adequate number and distribution of samples. Analytical methods and protocols are employed to reduce field and laboratory error. In addition, the PQAPP and site-specific SAPs require the collection of field quality control (QC) samples, as appropriate, to demonstrate data accuracy and precision, thereby revealing instances where lower quality data may lead to decision error.

3.7 Documentation and Records

All laboratory analytical data will be provided to the environmental contractor in both electronic and hard copy forms by the analytical laboratory. Electronic data deliverables (EDD) will be backed up weekly in accordance with the standard procedures for preservation and security of electronic data by the environmental contractor. Daily backups will be created prior to entry of new data to prevent loss of data during the data reduction process. Electronic survey data will be archived in the same manner as electronic laboratory data. Field descriptions of site lithology and other site data will be entered onto appropriate field forms and filed in designated project files by the environmental contractor.

The Contractor's Project Manager will be ultimately responsible for data management and provide direction to the field staff performing sampling activities on sample methods, locations, and requirements. This individual will be responsible for providing program participants the most current version of the PQAPP and the site-specific SAP developed for sites that are investigated.

The Laboratory Manager (Project Chemist) will be responsible for inspecting the laboratory data deliverables (hard copy and EDD files) for accuracy and completeness (See **Appendix B**).

The field staff will be responsible for preparing written documentation of sampling activities, completing chain-of-custody forms, and compiling any other relevant field documentation to provide a traceable record for data collection activities (See **Appendix A**). The field lead will review sampling forms to ensure samples are appropriately collected and submitted to the laboratory for analysis.

Proper documentation of sampling and analytical activities and good record keeping are essential for environmental investigations to ensure the integrity of the collected data and to maintain defensible data. Procedures specifically relating to field sampling activities are detailed in the SOPs (**Appendix A**), and sampling field forms are included in **Appendix D**. Procedures specifically relating to analysis activities are detailed in **Appendix B**.

Field notes and data collection forms will be scanned and archived electronically. Documents and site photographs where characterization is conducted will be retained for the duration of the project and saved in a unique electronic folder containing photographs, field notes, and analytical data. Each phase of site assessment and cleanup process will include the following deliverables:

- Phase I ESA Report (or Transaction Screen) for each property where a Phase I is completed;
- Draft and final site-specific SAP for each property where a Phase II assessment is proposed;
- Phase II ESA report for each site where a Phase II site assessment is performed; and
- Cleanup Plan and completion report for each remediation site.

Sample locations will be maintained in a GIS database along with local geographic data, to allow future users to identify the original sample locations. Computer acquired data will also be stored on magnetic tape, disks, or other media which can be assessed using industry-standard hardware and software for data processing, retrieval, or reporting.

The environmental contractor will manage all historical and future data collected for each site. All project files, documents, reports, and data will be retained for a minimum of 10 years. Final documents will be maintained in the project files of BSED and the environmental contractor. Field and raw data project files will be maintained by the selected environmental contractor. All data will be maintained for a minimum of 10 years post completion of work.

3.7.1 Field Documentation

All information concerning the sampling event will be recorded by field staff and kept in a field notebook (or appropriate field record forms) in accordance with SOP-1 "Field Log Book and Field Sampling Forms" (**Appendix A**). Field notebooks and records will contain sufficient information to reconstruct the sampling event, if necessary. Field notebooks and records will be kept in the possession of field staff or in a secure place during the period of the assessment. At the conclusion of work on a site, field records will become part of the project file. Sample field forms are included in **Appendix D**.

4.0 DATA COLLECTION & GENERATION

4.1 SAMPLING METHODS, HANDLING AND CUSTODY

SOPs to be followed during site assessments conducted as part of the BSED Brownfields Program are included in **Appendix A**. Each site-specific SAP or Cleanup Plan should append the appropriate sub-set of SOPs based on the unique characteristics of each site. Any field equipment not identified in the SOPs that are needed to support the investigation will be identified in the site-specific SAP or Cleanup Plan. In all cases, field activities will be documented in accordance with SOP-1. Pertinent field investigation and sampling information will be recorded on Daily Field Record forms and on appropriate sampling forms to provide a continual record of actions taken each day on the site. Example field forms are included in **Appendix D**. Decontamination of field equipment will be completed to prevent cross contamination between confirmation sampling locations in accordance with SOP-2 "Equipment Decontamination".

Samples will be labeled and packaged in accordance with SOP-3 "Sample Nomenclature, Documentation, and Chain-of-Custody Procedures" and SOP-4 "Sample Packaging and Shipping". Sample Chain-of-Custody forms are included in **Appendix D**. Laboratory turnaround times will be specified on individual Chain-of- Custody forms on a site-specific basis. Chain-of-custody forms will include, as necessary, special instructions regarding lab analysis turnaround times, required detection or reporting limits, or any information necessary to inform the laboratory of special analytical procedures.

Sampling protocols, including the location, types and numbers of samples, will be developed and described in the site-specific SAPs prepared for each site based on the review of Phase I ESAs for the site, review of previous sampling data, and/or site reconnaissance. Discussion of site access issues or sampling location difficulties, project schedules, sampling objectives and sources of variability will be developed to meet the needs of each unique site and will be described in site-specific SAPs, as appropriate. Media sampling methodologies will be consistent with ASTM, EPA and DEQ guidance.

Additional SOPs provided in **Appendix A** will be followed (as applicable) as described in site-specific SAPs or Cleanup Plans during field sampling activities. These SOPs include:

- SOP-5 "Field Measurement of Groundwater Level";
- SOP-6 "Field Measurement of LNAPL (Free Product)";
- SOP-7 "Field Measurement of Electric or Specific Conductance";
- SOP-8 "Field Measurement of pH";
- SOP-9 "Field Measurement of Dissolved Oxygen";
- SOP-10 "Field Measurement of Oxidation Reduction Potential";
- SOP-11 "Field Sample Filtration";
- SOP-12 "Groundwater Sampling";

- SOP-13 “Surface Soil Sampling”;
- SOP-14 “Subsurface Soil Sampling”;
- SOP-15 “Monitoring Well Construction”;
- SOP-16 “Monitoring Well Installation with Direct Push Equipment”;
- SOP-17 “Field Screening of Volatile Organic Compounds in Soil”;
- SOP-18 “Monitoring Well Development”;
- SOP-19 “Surface Water Sampling”;
- SOP-20 “Sediment Sample Collection”;
- SOP-21 “Soil Vapor Sampling (Summa canister with IPA tracer”;
- SOP-22 “Soil Vapor Sampling (Summa canister with Helium Leak Detection”;
- SOP-23 “Ambient Air Sampling”;
- SOP-24 “Quality Control Sampling”;
- SOP-25 “Management of Investigative-Derived Waste”;
- SOP-26 “ Using a PetroFlag® Hydrocarbon Analyzer”;
- SOP-27 “Asbestos Sample Collection”;
- SOP-28 “Lead-Based Paint Sample Collection”;
- SOP-29 “Air Sampling for Asbestos & Lead”;
- SOP-30 “Methamphetamine Sampling”;
- SOP-31 “Precursory Methcheck Sampling”;
- SOP-32 “Asbestos Fiber Air Sample Collection”;
- SOP-33 “Air Sampling with Sorbent Tube”; and,
- SOP-34 “Sampling Groundwater with a HydraSleeve”.

If either in-situ or continuous monitoring is employed, methods will be developed to meet the needs of each unique site and will be addressed in site-specific SAPs.

General sampling methods and SOPs for various media are described in **Table 4-1** below.

Table 4-1. Sampling Methods and Standard Operating Procedures by Sample Type

Sample Type	General Sampling Approach/Methods	Applicable SOPs
Surface Soil	Grab (discrete) or composite samples to be collected between 0 and 2 feet below ground surface, with focus on the upper 2 to 6 inches soil. Surface soil sampling for contaminants of concern not associated with a definitive source will be done on a random basis or grid pattern, and biased samples may be completed to evaluate a known source of contamination.	SOP-13
Subsurface Soil	Grab (discrete) or composite samples will be collected from depths greater than 2 feet below ground surface. A biased sampling method may be used to characterize known or suspect areas of contamination in soil.	SOP-14 (Sampling) and SOP-13 (Compositing)
Surface Water and Sediment	Samples will be collected from areas identified based on the results of previous investigations (if available) and Phase I ESAs.	SOP-19 (Surface Water Sampling), SOP-11 (Sample Filtration), and SOP-20 (Sediment Sampling)
Groundwater	Samples will be collected from representative existing domestic, industrial, or monitoring wells and temporary well points.	SOP-12 (Purging and Sampling), SOP-11 (Sample Filtration), SOP-34 (Sampling with HydraSleeve™). SOP-15 (Well Construction), SOP-16 (Well Installation via Direct Push), and SOP-18 (Well Development)
Soil Vapor and Air	Soil vapor, indoor air, or ambient air samples will be collected from existing or future structures when required by a site specific plan to evaluate health risks associated with inhalation of volatile compounds by site users.	SOP-21 (Soil Vapor Sampling via Summa/tracer), SOP-22 (Soil Vapor Sampling via Summa/leak detection), SOP-29 (Air Sampling for Asbestos & Lead), and SOP-23 (Ambient Air Sampling for VOCs)
Asbestos and Lead-Based Paint	Building material samples will be from suspect building materials based on site surveys to identify asbestos and lead-based paint. Final air clearance samples will be collected after an asbestos abatement for buildings in use. In general, an XRF will be used to screen homogenous painted surfaces to determine if they contain lead. Total lead samples of paint may be collected if the investigation is limited to a small area of a building. When building demolition is proposed, Toxicity Characteristic Leaching Procedure (TCLP) lead samples will be collected to determine if the waste materials are hazardous.	SOP-27 (Asbestos Sample Collection), SOP-28 (Lead-Based Paint Sample Collection), SOP-32 (Asbestos Fiber Air Sample Collection)
Methamphet-amine	If methamphetamine manufacture is suspected, a precursory methamphetamine wipe sample will be collected in areas of suspected cooking and disposal using a wipe immunoassay kit to detect for potential methamphetamine contamination. If positive for methamphetamine, a second wipe sample will be collected for methamphetamine analysis.	SOP-30 (Methamphetamine Sampling) and/or SOP-31 (Precursory Methcheck Sampling)

4.2 Analytical Methods

The most common laboratory analytical methods that will be used to determine concentrations of COPCs in media are summarized by constituent and medium in **Table 4-2**. These analytical methods are also referenced by media-type below in **Section 4.3**.

Table 4-2. Common Laboratory Analytical Methods

Constituents of Potential Concern	Analytical Method
Extractable Petroleum Hydrocarbons (EPH)	Water and Soil: MADEP EPH
Volatile Petroleum Hydrocarbons (VPH)	Water and Soil: MADEP VPH Air: MADEP APH
Volatile organic compounds (VOC)	Water: EPA 8260/524.2 Soil: EPA 8260 Air: TO-15
Semi-volatile Organic Compounds (SVOC)	Water: EPA 8270/525.2 Soil: EPA 8270
Metals (priority pollutants, except mercury)	Water and Soil: EPA 6010/6020
Mercury	Water: EPA 245.1, 1631E, EPA 7470 Soil: EPA 7471 and EPA 1631E
Polycyclic Aromatic Hydrocarbons (PAH)	Water and Soil: EPA 8270 with SIM
Organochlorine pesticides	Water and Soil: EPA 8081
Chlorinated herbicides, including pentachlorophenol	Water and Soil: EPA 8151
Nitrate/Nitrite	Water: EPA 353.2/300.0 Soil: ASA 33-3.2/33-8.3
Dioxins	Water and Soil: EPA 8290
Asbestos	Solid: EPA 600/R-93/116 Air: Phase Contrast Microscopy (PCM)
Lead (from lead-based paint)	EPA 6010
Methamphetamine	EPA Method 8270C-modified
Leachability	Solid: TCLP by EPA 1311/6010/7470

1. See **Appendix B** for holding times, laboratory reporting limits, and required sampling containers, sample volumes, and preservatives.
2. MADEP - Massachusetts Department of Environmental Protection
3. TCLP - Toxicity Characteristic Leaching Procedure extraction method, which is then followed by the constituent-specific analytical method.

Appendix B (Pace Analytical Quality Manual, Attachment VIII) provides additional details for individual parameters for analytical methods, containers, preservatives (if required), and maximum holding times for various parameters. **Appendix B** (Pace Reporting Limits) provides details for individual parameters on standard laboratory reporting limits.

4.3 Sample Analysis Design by Media

The following sub-sections describe potential laboratory analyses which may be performed on collected samples by media type.

4.3.1 Soil Analysis

Site-specific analytical parameters for surface and subsurface soil will be identified in the site-specific SAPs. In general, the following guidelines will be used to analyze soil samples:

- Soil samples collected from areas where known or potential petroleum contamination is identified will be analyzed for Extractable Petroleum Hydrocarbons (EPH) and Volatile Petroleum Hydrocarbons (VPH) in accordance with DEQ Tier 1 Risk-Based Screening Level (RBSL) guidance. VPH analysis will include hydrocarbon fractions, methyl tertiary butyl ether, benzene, toluene, ethyl benzene, total xylenes, and naphthalene (MBTEXN). In areas where leaded gasoline may have been used, samples will also be analyzed for total lead. In accordance with Montana Tier 1 RBSL guidance, if EPH screening results exceed the DEQ threshold value (200 mg/kg), samples will also be analyzed for petroleum hydrocarbon fractions and Polycyclic Aromatic Hydrocarbons (PAHs), as appropriate based on the source of contamination.
- Soil samples collected from areas with known or suspected impacts from used motor oil will be analyzed for EPH and Resource Conservation and Recovery Act (RCRA) metals (arsenic, barium, cadmium, chromium, mercury, lead, selenium, and silver). Based on the EPH threshold screening results, samples may also be analyzed for petroleum fractions and PAHs.
- In areas where solvent usage or storage is suspected, soil samples will be analyzed for Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs), EPH, and VPH.
- In areas where there is a potential risk of exposure to metals contamination, soil samples will be analyzed for total or RCRA metals.
- Toxicity Characteristic Leaching Procedure (TCLP) analysis of soils will be completed where there is a need to determine if soil is a characteristic hazardous waste.
- In areas where agriculture-related chemicals may have been stored or released, soil samples will also be analyzed for associated chemicals or inorganic substances (pesticides, herbicides, nitrate/nitrite, etc.), including metals, pentachlorophenol, and dioxins where there may have been a release of a wood preservative.
- Surface and subsurface soil samples may also be screened in the field for the presence of VOCs with a photo-ionization detector (PID) or Combustible Gas Indicator (CGI) to evaluate the extent of soil contamination and to assist in sample selection and submittal for laboratory analysis.

4.3.2 Groundwater and Surface Water Analysis

Site-specific SAPs developed for each site will identify the proposed groundwater and surface water analytical parameters based on the contaminants of concern for the site. With few exceptions, water samples will be analyzed for potential contaminants of concern as described in **Section 4.2.1** for soils. If the EPH screen concentration for a sample exceeds the DEQ groundwater threshold value (1,000

micrograms per liter [µg/L]), the groundwater sample will be analyzed for hydrocarbon fractions and possibly PAHs depending on source. If leaded gasoline use is suspected, groundwater samples will also be analyzed for dissolved lead. In addition, where used oil was released, groundwater and surface water samples will be analyzed for VOCs, SVOCs, and RCRA metals in addition to EPH. If metals analysis is performed, the following fractions will be analyzed: surface water samples will be analyzed for total or total recoverable metals, and groundwater monitoring well samples will be analyzed for dissolved metals.

4.3.3 Sediment Analysis

Sediment sampling will be conducted at sites where the site is proximal to a surface water body and where there is a risk of contamination migrating to the water body. Sediment samples would be analyzed for potential contaminants of concern as described in **Section 4.2.1** for soils. Sediment sampling protocol would follow SOP-20 "Sediment Sample Collection".

4.3.4 Soil Vapor or Ambient Air Analysis

Soil vapor or ambient air may be sampled to evaluate soil vapor intrusion or site safety. Analysis of air quality samples will be based on potential contaminants of concern at the site. The number, location, and analytical parameters to be tested for will be described in the site-specific SAP prepared prior to completing sampling.

4.3.5 Building or Waste Material Analysis

If asbestos containing building materials (ACBM) or lead-based paint (LBP) are suspected, testing of these materials would be completed during the Phase II site assessment in accordance with SOP-27 "Asbestos Sample Collection", SOP-28 "Lead Based Paint Sample Collection", and SOP-32 "Asbestos Fiber Air Sample Collection". Methamphetamine sampling would be completed in accordance with SOP-30 "Methamphetamine Sampling" and SOP-31 "Precursory Methcheck Sampling". If disposal of building materials is anticipated due to renovation or demolition of the building, Toxicity Characteristic Leaching Procedure (TCLP) lead analysis of building material waste stream will be completed to determine if the waste stream is a characteristic hazardous waste.

4.3.6 Storm/Process Water or Sludge Analysis

Process streams or storm water discharge points may be sampled. Analysis of sludge or water quality samples collected from these locations will be based on the potential contaminants of concern for the site.

4.4 Non-Direct Measurements

In addition to the collection and analysis of specific environmental samples to produce data suitable for site assessment, non-direct measurements may be used to assist in the research and understanding of site-specific issues. Non-direct data sources may include computer databases, literature files, or computer models such as the Montana Cadastral database, Montana Ground Water Information Center database, Montana Geographic Information Clearinghouse (Natural Resource Information System), U.S.

Department of Agriculture Web Soil Survey, and/or available site-specific literature obtained from regulatory agencies or property owners.

The use of non-direct measured data, rationale for their selection, and applicable acceptance criteria for the data will be determined on a site-specific basis, if warranted. Key resources utilized in the collection or use of the non-direct measured data will be discussed in the Report of Findings developed for each site. A discussion of QC requirements and procedures specific to database or model selection will also be included, along with the metrics used to evaluate validity of the data (beta testing, sensitivity analysis, internal checks, etc.), as needed.

5.0 DATA MEASUREMENT & ACQUISITION

This section presents procedures that will be used to obtain and manage the data collected at Brownfields sites assessed by BSED.

5.1 SAMPLING PROCESS

The type and quantity of samples and analytical methods required for the assessment of each individual property will be described in site-specific SAPs. SOPs for sample collection, sample handling, and chain-of-custody procedures are provided in **Appendix A**. In addition to sampling, non-direct field measurements will be used such as photography, field distance measurements, and visual descriptions. Specific types of and procedures for non-direct measurements will be included in each site-specific SAP.

5.2 QUALITY CONTROL

Quality control (QC) samples will be collected during each sampling event to evaluate analytical results and assess whether errors were introduced during sample collection, handling, transport, and analysis. QC samples will be collected in accordance with SOP-24 "Quality Control Sampling" (**Appendix A**). Each site-specific SAP will specify the types, number, and required analyses of the QC samples. Laboratory quality control procedures are provided in **Appendix B**.

QC samples which will be used to evaluate analytical data in terms of the quality criteria parameters are described below and are listed by sample type in **Table 5-1**. These include QC samples prepared both in the field and by the laboratory. Method-specific QC procedures are detailed in their respective SOP. Frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions are discussed below.

Table 5-1. Quality Control Samples

QC Sample		Description	Purpose	Collection Frequency
D	Field Duplicate	Two samples taken from the same media under similar conditions.	Measure analytical precision.	1 per 20 samples
ERB	Equipment Rinse Blanks	Deionized water run through or over decontaminated equipment.	Evaluate effectiveness of equipment decontamination and sample handling procedures.	1 per sampling event per media
TB	Trip Blank	Inert material (deionized water or diatomaceous earth) included in sample cooler.	Evaluate sample preservation, packing, shipping, and storage.	1 per sampling event with volatile constituents
MS / MSD	Matrix Spike/ Duplicate	Certified materials of known concentration are added to a sample to evaluate matrix affects.	Measure lab analytical precision and accuracy.	1 per 20 samples

5.2.1 Field Program

Field QC samples will be used to assess sample collection techniques and to assess environmental conditions during sample collection and transport. The selected field QC samples will depend upon each site, but may include duplicate samples, rinse blanks, and trip blanks.

Duplicate Samples. Duplicates (liquid media only) will be used to assess variability in the sample medium as well as sampling and analytical precision. A duplicate sample pair typically consists of a single grab sample that is split into two samples during collection. For surface water and groundwater sample collection, a duplicate sample pair will be a set of water samples that are collected consecutively from a running stream of water. For each duplicate sample pair, one of the samples is labeled with the investigative sample identification and the other is labeled with duplicate sample identification. This sample pair is then submitted to the same laboratory as two separate samples. Precision will be evaluated by calculating the relative percent difference (RPD) between the field duplicate sample pair.

Equipment Rinse Blanks. Rinse blanks will be used to evaluate the effectiveness of field decontamination procedures. Rinse blanks are clean, laboratory grade, organic-free water samples that are exposed to sampling procedures (i.e., exposed to decontaminated sampling equipment in a manner consistent with how investigative sample water contacts the equipment), and submitted to the laboratory for analysis. Rinse blanks will be collected at a frequency of one per day on days when field sampling equipment is decontaminated and reused.

Trip Blanks. Trip blanks will be used to evaluate representativeness. Trip blanks are clean water samples that are prepared in the laboratory using laboratory provided, organic-free water, transported to the sampling site, and accompany samples back to the laboratory for analysis without having been exposed to sampling procedures. The trip blank will remain in the sample cooler while sampling is in progress. Trip blanks will be submitted when soil or water VOC samples are submitted to the laboratory.

5.2.2 Laboratory Program

Laboratory QC consists of two distinct components, a laboratory component and a matrix component. The laboratory component measures the performance of the laboratory analytical process during sample analyses, while the matrix component measures the effects of a specific medium on the method performance. The QC samples that will be used to assess the laboratory component and the media component of analysis are described the following paragraphs. Corrective actions for instrument calibrations or QC sample data out of compliance are described in the laboratory-specific QA/QC program (**Appendix B**).

The general objectives of the internal laboratory QC program are to:

- Ensure that procedures are documented, including any changes in administrative or technical procedures;
- Ensure that analytical procedures are conducted according to method guidelines and laboratory SOPs;
- Monitor performance of the laboratory using a systematic inspection program; and,

- Ensure that data are properly reported and archived.

The laboratory will conduct internal QC checks for analytical methods in accordance with their SOPs, the individual method requirements, and this Programmatic PQAPP. When non-standard methods are required for specific projects or analytes of interest, or when the laboratory develops or modifies a method, the laboratory validates the method prior to applying it to customer samples. See **Appendix B** (Pace Analytical Quality Assurance Manual for list of laboratory SOPs). The laboratory will notify the Project Manager or Project Chemist in writing before making significant changes resulting from corrective actions to procedures described in this Programmatic PQAPP, or to the laboratory standard analytical methodology.

The laboratory will analyze internal QC samples at the frequency specified by the analytical method and in this Programmatic PQAPP. Method-specific QC procedures, frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions will be identified in the SOPs provided by the analytical laboratory, and will be in accordance with industry standards. The following paragraphs discuss holding times and the QC samples that the laboratory will use to assess data quality.

Sample Holding Time. Sample holding time refers to the length of time that a sample or sample extract remains representative of environmental conditions. For methods which do not require sample extraction, one holding time will be evaluated: the length of time from sample collection to analysis. For methods that require sample extraction prior to analysis, two holding times will be evaluated: the length of time from sample collection until sample extraction, and the length of time from sample extraction to sample analysis. These holding times will be compared to the holding times specified for these methods.

Method Blanks. Method blanks will be used to monitor the laboratory preparation and analytical systems for interferences and contamination from glassware, reagents, sample manipulations, and the general laboratory environment. The method blank is an analyte-free matrix (reagent grade water or laboratory grade sand) to which all reagents will be added in the same volumes or proportions as used in sample processing and will be taken through the entire sample reparation/extraction and analytical process. Method blanks will be analyzed at the frequency specified by the method and in the laboratory QA program and SOPs.

Internal Standards. Internal standards are compounds that behave similarly to the target analytes during analysis and will be used to assess accuracy for gas chromatography/mass spectroscopy (GC/MS) analysis. Internal standards will be prepared and added to the initial calibration standard, the continuing calibration verification standard, and both field and QC samples prior to analysis in accordance with the analytical method and laboratory's SOPs.

Matrix Spikes and Matrix Spike Duplicates. MS/MSDs measure matrix-specific method performance and will be used to assess accuracy and precision. MS/MSD samples will be used to assess the influence of the sample media (media interference) on the analysis. Samples for MS/MSD analysis will be site specific and analyzed at a frequency of five percent of the total number of samples for all analyses, if specified by the agency-approved method. Each MS/MSD sample will be spiked with the compounds

specified by the analytical method prior to sample extraction or analysis in accordance with the laboratory's SOPs.

5.2.3 Quality Control Review

When evaluation of a QC sample results (blank, spike, duplicate/replicate, or similar) indicates the analysis of a batch of samples is not within the established control limits, the designated QC staff (QAO, Project Manager, section leader, or similar) will be informed. This QC staff will determine whether the analysis can proceed, if selected samples should be reanalyzed, or if specific corrective action is necessary before analyzing additional samples. Out-of-control analyses and information justifying accuracy or precision outside acceptance criteria will be documented. The Project Manager will be notified to determine an appropriate corrective action for out-of-control events resulting in unacceptable data.

An evaluation of acceptance criteria (control limits) will be included in the conclusions section of data validation reports developed for each laboratory report. If control limits are exceeded, a discussion summarizing the cause of, and potential implication, of the exceedances will be included in the Report of Findings. The cause of the exceedances will be investigated to avoid future acceptance criteria (control limit) issues, if warranted.

5.3 Equipment Operation, Calibration, and Standardization

All field equipment will be operated, maintained, and calibrated in accordance manufacturer-recommended procedures that can be found in **Appendix B** (Pace Analytical Quality Assurance Manual, Attachment VB), and in EPA guidance. Field calibration results will be documented in a field logbook or field data form. SOPs for field activities that include procedures for the operation, maintenance, and calibration of field equipment are included in **Appendix A**. The site-specific SAPs will specify analytical methods, which in turn will dictate specific laboratory equipment operation, maintenance, and calibration procedures (**Appendix B**).

5.4 Equipment Testing, Inspection, and Maintenance

A preventive maintenance program is necessary to promote the timely and effective completion of a measurement effort for either field or laboratory programs. The preventive maintenance program will be designed to minimize the downtime of crucial sampling or analytical equipment due to unexpected component failure and focus on establishing maintenance responsibilities, maintenance schedules for major or critical instrumentation, and an adequate inventory of critical spare parts and equipment. Deficiencies in sampling and analytical equipment will be reported to the Project Manager for resolution. Re-inspection of the deficiency will be performed to evaluate the effectiveness of the corrective action and will be documented in instrument-specific logbooks kept with each instrument.

An adequate inventory of spare parts will be maintained to minimize equipment downtime. This inventory will include parts and supplies which are subject to frequent failure, require periodic replacement, or cannot be procured in a timely manner if failure occurs.

The field team leader will be responsible for ensuring that all required field equipment and supplies for performing routine sampling/monitoring, tracking field supply inventory, and for ordering, receiving, inspecting, and storing additional supplies, as needed. The Project Manager will be consulted regarding non-routine supply or equipment needs.

5.5 Data Management

All laboratory analytical data will be provided to the environmental contractor in both electronic and hard copy forms by the analytical laboratory. Electronic data deliverables (EDD) will be backed up weekly in accordance with the standard office procedures for preservation and security of electronic data. Daily backups will be created prior to entry of new data to prevent loss of data during the data reduction process

- The Contractor's Project Manager will be ultimately responsible for data management for this program and provide direction to the field staff performing field sampling activities on sample methods, locations, and requirements. The Project Manager will also review sampling forms to ensure samples are appropriately collected and submitted to the laboratory for analysis.
- The Laboratory Manager (Project Chemist) will be responsible for inspecting the laboratory data deliverables (hard copy and EDD files) for accuracy and completeness (See **Appendix B**).

The analytical laboratory will review data under the direction of the laboratory Project Manager or the laboratory QA officer in accordance with the laboratory QA manual (**Appendix B**). The laboratory will prepare and retain full analytical and QC documentation. Data will be reviewed prior to release by the laboratory. In general, laboratory data review will be conducted as described in the following paragraphs.

The laboratory analyst will conduct the initial data review based on established protocols specified in the laboratory SOPs, analytical method protocol, and project-specific data quality objectives. At a minimum, this review will include the following:

- An assessment of laboratory sample preparation and analysis procedures and documentation for accuracy and completeness;
- Assessments of whether the appropriate laboratory SOPs have been followed;
- An assessment of analytical results for accuracy and completeness; and,
- An assessment of whether QC samples are within established control limits and method blank data are acceptable.

5.5.1 Documentation and Records

Proper documentation of sampling and analytical activities and good record keeping are essential for environmental investigations to ensure the integrity of the collected data and to maintain scientific and legal defensibility of the data. Procedures specifically relating to analysis activities are detailed in **Appendix B**.

The environmental contractor will manage all historical and future data collected for each site. All project files, documents, reports, and data will be retained for a minimum of 10 years. Final documents will be maintained in the project files of both BSED and the environmental contractor. Field and raw data project files will be maintained by the environmental contractor

Each laboratory will maintain a project-specific file to facilitate reconstruction of the analytical process. The analytical laboratory will maintain a project file that includes formulas used for data reduction, computer programs, identification of data transfers as electronic or manual, and data review protocol. Each laboratory will include information regarding sample analyses (correspondence, sample custody forms, raw data, results, calibration records) in the project file. Data storage and documentation will be maintained using logbooks and data sheets that will be included in the project file (See **Appendix B**).

5.5.2 Laboratory Reporting

Laboratory data reports will be presented in Phase II ESA reports and cleanup completion reports. The laboratory report will include the following items:

- A cover letter or case narrative listing the samples submitted and analyses performed;
- Laboratory results summary listing sample identifications, analysis methods, results of analysis; detection limit/practical quantitation limits, and dates of sample collection, extraction and analysis for each analyte;
- A copy of the chain-of-custody (sample chain-of-custody forms are provided in **Appendix D**) showing acceptance by the laboratory; and,
- A QA/QC summary that presents applicable surrogate recoveries, blank results, MS/MSD, or LCS results along with the acceptable QC limits.

6.0 ASSESSMENT & RESPONSE ACTIONS

The Project Manager will be responsible for oversight of assessment activities and will review elements of the project-specific work plan and this PQAPP to ensure the objectives of the project are fulfilled. The Project Manager will also be responsible for making corrective action decisions should issues arise. Corrective actions will be taken immediately upon identification of potential problems with data acquisition or measurement. Field equipment malfunctions will be corrected by the field team leaders, and reported to the Project Manager. Corrective actions will be documented in the field notes.

6.1 FIELD PERFORMANCE AUDITS

An internal audit of field and laboratory activities may be conducted by the Project Manager, Quality Assurance Officer (QAO), or their qualified designee, on an annual basis or as site-specific projects permit to assess whether sampling and analysis protocols conform to the criteria specified in this Programmatic PQAPP, particularly if the investigation involves numerous samples of several different media. The audits will include examination of documents including field equipment calibration and documentation records; field instrument operation records; field measurement records; field sampling records, log books and field sampling forms; field documentation related to sample collection, handling, storage, and transportation procedures, including organization and minimization of potential contamination sources; and chain-of-custody records and procedures. Audits will be generally be used to evaluate whether the resulting data collected at a site will meet the project-specific data quality objectives, to assess whether the data will comply with QC requirements. If the auditor determines during an assessment that non-conformances are occurring which will significantly impact the usability of the data being collected, the auditor has the authority to stop work until the issues are resolved. If the auditor issues a stop work order to the field sampling team, the Project Manager will be notified immediately so that deficiencies may be resolved and work may resume.

6.2 LABORATORY PERFORMANCE AUDITS

Self-performance and regulatory agency audits of laboratory QA/QC procedures (as included in **Appendix B, Pace Analytical Quality Assurance Manual Section 8.0**) will be a regular part of the laboratory's QC program. Routine audits will be conducted by the laboratory's QAO, or designee. At a minimum, the review will include examination of sample receiving, log-in, storage, and chain-of-custody documentation procedures, sample preparation and analysis, and instrument procedures. Deficiencies and corrective action procedures will be clearly documented in the laboratory's audit report. Definitive data validation is also a quantitative check of the analytical process, where documentation and calculations are evaluated and verified. Data verification and validation procedures are discussed in **Section 7.0** of this PQAPP.

6.3 AUDIT REPORTING

After an internal audit is completed, a debriefing session will be held for participants to discuss the preliminary audit results. The auditor will prepare an audit evaluation report that includes observations of the deficiencies and the necessary recommendations for corrective actions. A draft audit evaluation

report will be provided to the Project Manager within 20 days after the field or performance audit is completed, and finalized no later than 45 days after the audit was performed. Conformance with the SOPs and this Programmatic PQAPP will be noted, and nonconformance or deviations will be addressed through corrective or preventative actions identified by the QAO and the project team and approved by the Project Manager. At the direction of the Project Manager, follow-up audits could be performed prior to completion of the project to ensure corrective actions have been implemented appropriately and completely by the field team.

7.0 DATA VALIDATION & USABILITY

Data validation of field data will be performed by the Project Manager, QAO, or their qualified designee through review of documentation of field procedures and comparison of the field measurements to the entire sample set. Data validation will be completed to determine if any data outliers are present, and if there are explanations for the outliers. Knowing the limitations of the data is critical when interpreting site data. Qualified data may be usable so long as the data limitations are considered. Professional judgment is often required and during the data validation process and will be used to evaluate the impact of data concerns on the overall quality and usability of the field data.

Data validation will be performed according to EPA guidelines for organics and inorganics (EPA 2008, 2010), and will be reported in accordance with Montana DEQ Data Validation Guidelines for Evaluating Analytical Data (DEQ 2010) (**Appendix E**). Data validation software will not be used. The objective of data validation is to identify any unreliable or invalid laboratory measurements and qualify those data for interpretive use. Laboratory data validation is reported by using data qualifiers and adjusting reporting limits. Typical data qualifiers are presented in **Table 7-1**.

Table 7-1. Data Qualifiers

Qualifier	Description
U	The analyte was not detected.
UJ	Estimated reporting limit (if direction of potential bias is indicated, UJ will be accompanied by + or -).
J	The associated value is an estimated quantity (if direction of potential bias is indicated, J will be accompanied by + or -).

The ability of data to meet DQOs will be summarized in a precision, accuracy, representativeness, completeness, and comparability (PARCC) statement. A PARCC statement is generated during data evaluation. The following subsections define the terms used in the PARCC statement.

7.1.1 Precision

Precision is the amount of scatter or variance that occurs in repeated measurements. Precision acceptance and rejection for each project will be based on the relative percent difference (RPD) of the field and laboratory duplicates. When both values of the field/duplicate pair are greater than five times the practical quantitation limit (PQL) for a given analyte, analytical results for the duplicate samples will be evaluated using RPD. RPD is obtained by dividing the absolute value difference (AVD) between the field and duplicate sample by the average of the two measurements, and multiplying by 100 to convert the value to percent. RPD will be calculated as follows:

$$RPD\ (\%) = \frac{A - B}{C} \text{ x } 100$$

Where:

A is the analyte concentration determined analytically from the primary sample

B is the analyte concentration determined analytically from the duplicate sample

C is the average analyte concentration determined analytically from the primary and duplicate samples

When field duplicate analysis results exceed 20% RPD for aqueous solutions and 35% RPD for soil/sediment, and the natural sample result is greater than five times the PQL, the result will be considered estimated (unless site-specific conditions indicate a high degree of heterogeneity is expected in the measured parameter). If no acceptable range of laboratory precision is established by the laboratory under EPA guidelines, the range of acceptable RPDs will be used from **Table 7-2**.

Table 7-2. Precision, Accuracy, and Completeness Requirements

Type	Precision (RPD)		Accuracy (%R)		Completeness
	}	Water	Solid	Water	
Field Duplicates	35%	20%	NA	NA	90%
Laboratory Duplicate	20%	20%	NA	NA	
Matrix Spike/Matrix Spike Duplicate	NA	NA	75 – 125%, or laboratory calculated	75 – 125%, or laboratory calculated	
Laboratory Control Sample (LCS)	NA	NA	75 – 125%, or laboratory calculated	80 – 120%, or laboratory calculated	

RPD = Relative Percent Difference
%R = Percent Recovery
PQL = Practical Quantitation Limit
NA = Not applicable

7.1.2 Accuracy (Bias)

Accuracy is the degree of agreement of a measurement or an average of measurements with an accepted reference or "true" value, and is a measure of bias in the system. The accuracy of a measurement system is affected by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques.

Accuracy acceptance or rejection will be based on the percent recovery of the laboratory matrix spike and the laboratory control sample (LCS). To determine accuracy, the percent recovery for each matrix spike and LCS will be compared to the acceptable range as specified in the applicable laboratory method. Accuracy will be evaluated using the percent recovery calculated using the following equation:

$$Percent\ Recovery\ (\%) = \frac{A - B}{C}\ \text{x}\ 100$$

Where:

A is the target analyte concentration determined analytically from the spiked sample

B is the background level determined by a separate analysis of the unspiked sample

C is the concentration of spike added

Field sample results associated with percent recoveries outside acceptable limits will be considered as estimated results. Field sample results associated with matrix spike percent recoveries outside of control limits will be considered as estimated or will be rejected, as appropriate in accordance with EPA matrix spike criteria (EPA 2008, 2010).

Although accuracy of the field program cannot be assessed quantitatively, the following criteria will be used for a qualitative accuracy assessment for this project: sample handling, shipping, preservation, and holding time. Laboratory accuracy will be assessed quantitatively through the analysis of MS/MSD samples and standard reference materials, which include surrogate spikes (organic analyses only) and response factors for calibration standards and internal standard recoveries. An overall assessment of accuracy will be made upon completion of the sampling and reporting at a site. Overall accuracy will be discussed in a narrative included in the data validation report.

7.1.3 Representativeness

The objective in addressing representativeness is to assess whether measurements obtained during the investigation reflect site conditions in the sampling unit or target area. Representativeness is evaluated by review of sampling design to confirm that areas reasonably suspected to have different characteristics were sampled separately. In addition, blank QC samples (laboratory blanks, trip blanks, and rinsate blanks) are used to evaluate representativeness. Field results associated with contaminated blanks will be considered estimated, with a high bias, when the field (natural) result is greater than the practical quantitation limit, but less than five times the blank contaminant concentration.

If a laboratory blank contains detectable levels of common laboratory contaminants, then natural sample results will be considered as positive only if the concentrations in the natural sample exceed ten times the maximum amount detected in any blank. If the concentration in the sample is less than ten times the blank concentration, a conclusion that the analyte was not detected in the sample will be made. Blank concentrations of the chemical will be considered to be the quantitation limit for the chemical in that sample. If all samples contain levels of a common lab contaminant at less than ten times the contamination noted in the blank, the analyte will be flagged as non-detect at the highest blank concentration and estimated biased high for the set of sample results.

7.1.4 Completeness

The objective in addressing completeness is to assess whether enough data have been collected and enough data are valid to meet the site characterization. Completeness is evaluated by comparing the

number of valid sample results to the number of samples collected, including required QA/QC samples, and will be calculated as follows.

$$Percent\ Complete\ (\%) = \frac{NA}{NI}\ \text{x}\ 100$$

Where:

NA is the actual number of valid analytical results obtained

NI is the theoretical number of results obtainable under ideal conditions

The completeness target goal for site investigations performed during each project is 90%, or higher, as presented in **Table 7-2** above.

7.1.5 Comparability

The objective in addressing comparability is to assess whether one set of data can be compared to another set of data. Comparability is assessed by determining if an EPA-approved analytical method was used, if values and units are sufficient for the database, if specific sampling points can be established and documented, and if field collection methods were standardized and documented.

7.1.6 Method Sensitivity

Field data sensitivity is dependent on the equipment maintenance, calibration, performance, and operator as well as collection methods and sample handling. For the parameters being measured in the field, standard equipment is readily available to ensure the data collected meet the project goals and are of adequate quality to be used in making decisions. The field team will follow procedures detailed in this PQAPP and SOPs to ensure usability of the data.

Like field data, laboratory data sensitivity is dependent on equipment maintenance, calibration, performance, and operator as well as collection or extraction methods and sample handling. However, laboratories usually can provide lower detection limits with a higher degree of confidence given the controlled environment for the equipment and technician. Laboratories report their MDLs and provide qualifiers if those values are uncertain.

7.1.7 Data Reconciliation

Data reconciliation is performed after data validation is complete. Data reconciliation is generation of the PARCC statement that describes whether the data met the project DQOs. If data user requirements are not met, the Project Manager and Quality Assurance Manager will confer with the data user and BSED on how issues will be resolved and how limitations of the data will be reported, and whether further QC investigation or documentation is required for the data user.

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APPENDIX A

Standard Operating Procedures for Field Activities

STANDARD OPERATING PROCEDURES
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SOP-1

FIELD LOG BOOK AND FIELD SAMPLING FORMS

Pertinent field investigation and sampling information should be recorded on a daily field log book and appropriate sampling forms to provide a continual record of actions taken each day on the site. Each employee is responsible for completing a record of the day's activities in a log book and field forms of sufficient detail such that someone can reconstruct the field activities without relying on the memory of the field crew. At a minimum, entries on the field log book shall include:

- Project and client name
- Purpose of the field effort
- Names of field crew leader and team members present on the site, and other site visitors
- Description of site conditions and any unusual circumstances, including weather conditions
- Details of actual work effort, particularly any deviations from the field work plan or standard operating procedures
- Location of sample site, including map reference, if relevant
- Field observations
- Field measurements made (e.g., PID readings, pH, temperature) on appropriate forms.
- Date and time of initiation and cessation of work.

Purpose

To provide guidance on how to document activities completed in the field by NewFields employees

Goal and Objective

To provide a record of our project work and the decisions made in the field

Equipment Needs

Field Note Book
Field Sampling Forms

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

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

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

SOP-2

EQUIPMENT DECONTAMINATION

Decontamination of field equipment is necessary to prevent cross contamination between sites and sampling locations. Decontamination should be performed on all non-dedicated and non-disposable sampling equipment that may contact potentially contaminated media. Field personnel must wear disposable gloves while decontaminating equipment to prevent cross contamination.

The following should be done to decontaminate field equipment:

- Set up a decontamination area, preferably upwind from your sampling area to reduce the potential for windborne contamination.
- Prior to initiating decontamination, visually inspect sampling equipment for evidence of contamination; use stiff brush to remove visible material.
- Once rough brushing is complete, decontaminate each piece of equipment following a sequential process of washing with Liquinox or an equivalent degreasing detergent; rinsing with distilled water; rinsing with 10% dilute nitric acid; and finally rinsing with distilled water three times. Best procedure is to set up wash tubs for each of the above processes.
- Rinse equipment with methanol instead of nitric acid if sampling for organic contamination.
- Decontaminated equipment that is used for sampling organics should be wrapped in aluminum foil or another inert material if not used immediately.

Field equipment can be decontaminated by steam cleaning as an alternative. If equipment is steam cleaned, it should still be rinsed with 10% dilute nitric acid and distilled water.

All disposable items (e.g., paper towels, latex gloves) should be deposited into a garbage bag and disposed of in a proper manner. Handling and disposal procedures for the rinse and wash water will depend on the likely presence and type of contaminant in the wash water. The project Sampling & Analysis Plan should be reviewed to determine the process for handling wash water.

Purpose

The purpose of this SOP is to describe general decontamination procedures for field equipment

Goal and Objective

To sufficiently clean field equipment to prevent cross contamination between sites and sample locations

Equipment Needs

5-gallon plastic tubs

Distilled water

1-gallon cube of 10% Nitric Acid

Spray Bottle of 10% Methanol

Liquinox Soap

Hard Bristle Brush

Garbage Bags

Disposable Gloves

Paper Towels

55-gallon drums (optional depending on need to containerize wash water)

A list of equipment for decontamination is provided below. The amount of dissolved water needed on site will depend on the number of samples to be collected and the sampling methods. For this reason, the you should evaluate the need prior to going in the field.

SOP-3

SAMPLE NOMENCLATURE, DOCUMENTATION, AND CHAIN-OF CUSTODY PROCEDURES

When completing sampling it is critical that the process used to label and transport samples to the laboratory for analysis is sufficient to demonstrate with confidence that the samples were collected from the location indicated, and that during transport to the lab no actions were taken to potentially alter the integrity of the samples. Without following strict sample labeling and chain-of-custody procedures, analytical data collected at a site has little to no value.

SAMPLE NOMENCLATURE

Samples should be labeled in such a way to allow a person unfamiliar with the site to understand where the samples were collected. Samples should be labeled sequentially as follows:

> Project site initials- sample type- sampling method- sample number-sample depth.

For example, the sample KR-SBSS-TP1-12', indicates the sample was collected at Knife River (KR), the sample was a sub-surface soil sample (SBSS), was from test pit 1 (TP-1), and was collected at 12 feet below ground. Samples numbers should be numerically sequential (TP1, TP2, etc.). Prior to initiating sampling, field personnel should familiarize themselves with the Sampling & Analysis Plan and the nomenclature to be used for the site. The character prefixes in the table below are recommended for sample types.

Purpose

To identify the specific requirements for labeling and documenting sample collection

Goal and Objective

To increase the confidence in sample locations and to submit samples to the laboratory without risk of integrity loss

Equipment Needs

Indelible ink pen

Chain-of-custody forms

Field Log Book

Field Sampling Form

SAMPLE DOCUMENTATION

In addition to the chain-of-custody forms discussed below, field person must keep a list of samples collected at the field in the field log book and on appropriate field sampling forms. This allows you to go back and verify sample locations and numbers should there be any confusion at a later time. Upon returning to the office, the field log book and forms should be kept in the project file and subsequent copies sent to the laboratory, or other designated parties, as needed.

Each person in the field is responsible for putting entries into the field log and sampling forms. Designating an individual from the sampling team for record keeping is fine, provided all field personnel come to an agreement as to who this will be, and the field crew leader is certain field personnel are familiar with the record keeping requirements. All entries on the log book and field sampling forms must be made in indelible ink.

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

CHAIN OF CUSTODY PROCEDURES

A chain-of-custody form must be generated for all samples collected in the field for laboratory analysis. Samples from more than one project should not be included on the same chain of custody; however, multiple samples from a specific project can be included on the same custody form.

Copies of the chain-of-custody form should be maintained in the project file. The sampler may use a NewFields' chain-of-custody form or a chain- of-custody form provided by the laboratory. Sample custody records must be maintained from the time of sample collection until the time of sample delivery to the analytical laboratory and should accompany the sample through analysis and final disposition. The information to be included on the chain-of-custody form will include, but is not limited to:

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

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

A sample is considered under a person's control when it is in their possession. When custody of a sample is relinquished by the sampler, the sampler will sign and date the chain-of-custody form and note the time that custody was relinquished. The person receiving custody of the sample will also sign and date the form and note the time that the sample was accepted into custody. The goal is to provide a complete record of control of the samples. Should the chain be broken (signed by the relinquisher but not receiver or vice versa), the integrity of the sample is lost and the resulting analytical data suspect. Samples must be shipped to the analytical laboratory following the procedures described in in SOP-4. If an overnight shipping service is used to transport the samples to the laboratory, custody of the samples must be relinquished to the shipping service. If possible, have the shipping service sign the chain-of-custody form prior to placing the chain of custody in the sample cooler. If this is not possible (i.e. form placed in the sealed cooler), a note should be included on the chain of custody that the shipping company has received the samples with the chain of custody inside the cooler.

SOP-4

SAMPLE PACKAGING AND SHIPPING

SAMPLE PACKAGING

Samples must be packaged to preclude breakage or damage to sample containers, and shipped to comply with shipper, U.S. EPA, and U.S. DOT regulations. When packaging samples:

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

Purpose

To ensure samples are properly packaged for shipment to the analytical laboratory

Goal and Objective

To have samples received by the analytical laboratory in good condition and within EPA temperature thresholds

Equipment Needs

Indelible ink pen

Chain-of-custody forms

Custody Seals

Sample Labels from Lab

Coolers and Ice

Field Sampling Form

SHIPPING HAZARDOUS MATERIALS/WASTE

Transportation regulations for shipping of hazardous substances and dangerous goods are defined by the U.S. DOT in 49 CFR, Subchapter C, Part 171 (October 1, 1988); IATA and ICAO. These regulations are accepted by Federal Express and other ground and air carriers.

According to DOT regulations, environmental samples are classified as Other Regulated Substances (ORS). ORS are articles, samples, or materials that are suspected or known to contain contaminants and/or are capable of posing a risk to health, safety, or property when transported by ground or air. Samples, substances, or materials from sources other than material drums, leachate streams, and sludges should be considered as ORS or environmental samples. Materials shipped under the classification of ORS must not meet any of the following definitions:

Class 1: Explosives; Class 2: Gases- compressed, liquefied, dissolved under pressure, or deeply refrigerated; Class 3 Flammable Liquids; Class 4: Substances susceptible to spontaneous combustion; Class 5: Oxidizing substances; Class 6: Poisonous (toxic and infectious); Class 7: Radioactive materials; Class 8: Corrosives.

If your samples might meet any of the above definitions, contact the project manager to obtain instructions on sample shipment.

SOP-5

FIELD MEASUREMENT OF GROUNDWATER LEVEL

FIELD PROCEDURE

- Verify the water level indicator is operating correctly prior to leaving for the field by placing probe in water to test the buzzer and light. Repair as necessary. Make certain the meter and extra batteries are in the carrying case.
- Prior to collecting a measurement, decontaminate the water level indicator, as appropriate, and calibrate the probe to a steel tape. Note any corrections to water level meter measurements on field forms.
- Measure all wells (monitoring and domestic) from the top of the well casing in the north quadrant or from a designated measuring point, as appropriate. Measure and record the distance from the measuring point to ground level. Make sure the measuring point is labeled on the well, so future measurements can be made from the same location.
- Measure the depth to water from the measuring point to the nearest hundredth of a foot.
- Record measurements on the appropriate field forms. Also record the presence/absence of free product on the field forms.
- Decontaminate the water level meter between each measurement following the procedures in SOP-2.
- If free product is known or suspected to be present in a well, an oil-water level indicator or other method should be used to measure the depth to water and the thickness of free product in the well, as described in SOP-6.

Purpose

To ensure groundwater levels are accurately measured in the field

Goal and Objective

To have samples received by the analytical laboratory in good condition and within EPA temperature thresholds

Equipment Needs

Water Level Indicator

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

SOP-6

FIELD MEASUREMENT OF GROUNDWATER LEVEL

Three different procedures are described in this SOP for measuring product thickness in a monitoring well. These include using a specialized probe, using a bailer, and using product and water finding paste.

Purpose

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

Goal and Objective

To employ a consistent measuring method for LNAPL in monitoring wells

Equipment Needs

Solinst LNAPL Probe or equivalent

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

Using a Solinst LNAPL Probe:

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

Using a Bailer:

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

Using Paste:

- • Using a steel tape, smear water finding paste over a 3-4 foot interval of one side of the tape. Smear product finding paste (or chalk) over the other side.
- • Lower the tape into the well until the bottom of the tape is roughly 2-3 feet below the top of the fluid in the well. Note the depth of the tape on the form.
- Remove the tape and note the reading indicated by the water finding paste or chalk, and the reading indicated by the product finding paste (both of these should be evident as a change in color, or a wet line in the case of chalk).

- The depth to water is calculated by subtracting the water reading from the total tape depth. The depth to product is calculated by subtracting the product reading from the total tape depth. Product thickness is calculated by subtracting depth to product from the depth to water.
- This may need to be repeated several times, especially if the depth to water is not known, or if the product thickness is greater than the depth the tape is lowered into the fluid. Previous depth to water and product thickness readings can be used as a guide.

SOP-7

FIELD MEASUREMENT OF ELECTRIC OR SPECIFIC CONDUCTANCE

INSTRUMENT CALIBRATION

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

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

FIELD MEASUREMENT PROCEDURE

Rinse a decontaminated glass container or plastic flow-through cell with sample water.

Fill the container or flow-through cell with sample water, with enough available space to insert the probe without undesired overflow.

Rinse the conductivity or multi-parameter probe with deionized water and place it in the beaker of sample water. Immerse the probe in sample and move it around to displace any air bubbles. Keep the probe tip off of the sides of the beaker. Record the conductivity reading. Be sure to recognize the units of the reading (i.e. microseimens/centimeter (µs/cm), micromhos/centimeter (µmhos/cm), or milliseimens/centimeter (ms/cm). Record the reading on the field sampling form and filed log book. If the reading is being taken in-situ or using a flow-through cell, wait until the reading stabilizes and record it on the sample field form.

Remove the probe from sample and decontaminate probe. Store the probe following the manufacturer's recommendations.

Purpose

To ensure measurement of specific conductance is done consistently and correctly in the field

Goal and Objective

To obtain accurate specific conductivity measurements in the field

Equipment Needs

Specific Conductivity Meter

Calibration standard

Measurement container

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

SOP-8

FIELD MEASUREMENT OF PH

Purpose

Provide guidelines for pH measurements in water samples

Goal and Objective

To obtain accurate pH measurements in the field

Equipment Needs

pH Meter

Calibration standards

Glass container or flow-through cell

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

INSTRUMENT CALIBRATION

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

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

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

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

FIELD MEASUREMENT PROCEDURE

- Rinse a decontaminated glass beaker or plastic flow-through cell sample water three times.
- Rinse the pH probe with deionized water.
- Fill the container with sample water.
- Immerse the probe in the sample and agitate it to provide thorough mixing. Continue to agitate until the reading has stabilized. Read the pH to the nearest 0.1 s.u. and record on the field sampling form. If the reading is being taken in-situ or using a flow-through cell, wait until the reading stabilizes and record it.
- Note any problems such as erratic readings. If previous readings are available, compare the current measurement to previous reading to check that the current reading is within reasonable limits.
- Rinse probe with deionized water and store according to the manufacturer's instructions.

SOP-9

FIELD MEASUREMENT OF DISSOLVED OXYGEN

FIELD MEASUREMENT PROCEDURE

Before each use, clean and rinse the electrode tip with distilled water. Verify that the membrane cap has been filled with DO electrolyte in accordance with manufacturers required maintenance schedule.

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

Place probe the directly into the stream or well to be measured. If not possible, place the probe into a flow-through cell receiving a continuous stream of water from the source being measured. Allow sufficient time for the probe to stabilize to sample temperature and dissolved oxygen concentration. Record the dissolved oxygen value on the appropriate field forms. Decontaminate probe when measurement is complete.

If sensor will not calibrate, becomes sluggish or erratic:

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

Purpose

Provide guidelines for Dissolved Oxygen measurements in water samples

Goal and Objective

To obtain accurate dissolved oxygen measurements in the field

Equipment Needs

Dissolved Oxygen Meter

Distilled water

Calibration cup

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

SOP-10

FIELD MEASUREMENT OF OXIDATION REDUCTION POTENTIAL (ORP)

FIELD MEASUREMENT PROCEDURE

- Calibrate the meter in accordance with the manufacturer's instructions prior to each sampling event.
- Decontaminate a plastic or glass container in accordance with SOP-2.
- Rinse the ORP electrode with distilled water and then with sample water prior to inserting it into the sample beaker.
- If possible, obtain an in situ measurement of ORP. If not possible, preferably use a flow-through cell receiving a constant stream of water from the well, or (least preferred) collect a sample of water. If obtaining a sample for ORP measurement, minimize agitation of the sample in an effort to limit exposure to oxygen.
- Immerse the ORP electrode in the sample and allow at least one minute for the probe to equilibrate with the water.
- Obtain a reading to the nearest ten millivolts.
- Record the reading on standardized field forms and the field book. Note any problems such as erratic or drifting readings.
- Decontaminate the probe following the SOP-2.

Purpose

Provide guidelines for Redox Potential measurements in water samples

Goal and Objective

To obtain accurate Redox Potential measurements in the field

Equipment Needs

Redox Potential Meter

Distilled water

Calibration solution with table of temperature adjustment information

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

SOP-11

FIELD SAMPLE FILTRATION

FIELD PROCEDURE

- Set up a system whereby water samples can be filtered, including a filter apparatus and hand-vacuum pump.
- To avoid the need for decontamination, use disposable tubing and equipment and a hand-vacuum pump.
- Place groundwater or surface water into a vessel that can be pressurized using the hand-vacuum pump. The filtered effluent from the pump can be placed directly into sample containers post filtering with a 0.45 micron filter.
- As appropriate, fill pre-preserved, laboratory supplied sample containers with filtered sample and cap.
- Invert sample container several times to insure complete sample-preservative mixing.
- Place sample into cooler; package and ship accordance with the SOP concerning shipping.
- If extremely turbid sample water is obtained, you may need to pre-filter the sample using 3.0 or 5.0 micron filter paper followed by 0.45 micron filtration.
- Decontaminate, if necessary, all equipment in accordance with the SOP concerning decontamination.

Purpose

Provide guidelines for filtering water samples in the field

Goal and Objective

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

Equipment Needs

0.4, 3.0, and 5.0 micron filters

Filter apparatus and Hand-vacuum pump

Preservatives, as required

Indelible Ink Pen

Field Sampling Form

SOP-12

GROUNDWATER SAMPLING

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

Field sampling forms must be completed for each well to document purging and sampling.

SAMPLING FROM TEMPORARY BOREHOLES

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

When sampling from a temporary well screen, use either new tubing (LDPE or Teflon) with a stainless steel foot valve, or use a new/decontaminated bailer. Note the physical appearance of the sample (color and qualitative turbidity) on the field sampling form. Where feasible, avoid sampling from the bottom 1-foot of the borehole or well screen to minimize entrainment of sediment into the sample.

WELL PURGING

Purging must be performed on all wells prior to sample collection.

Before purging each well, record the depth to water from the top of the well casing to the nearest 0.01 foot using a water level meter. If sampling at a site where there may be free product, wells shall be checked for the presence of free product prior to purging and sampling using an oil-interface probe.

Purpose

Provide guidelines for sampling groundwater

Goal and Objective

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

Equipment Needs

Five gallon bucket graduated in gallons

Purge/sampling pump(s)

Oil-Interface Probe, as necessary

Water Level Meter

pH, temperature, and conductivity meter

Filtering apparatus and hand pump (if filtering samples)

Sample Containers

Preservatives, as required

Field Sampling Forms

Decontamination equipment and fluids

Tubing, as needed

Generator or power supply

Coolers and Ice

Stop Watch

Rope and Bailer, for backup

Determine the saturated thickness by subtracting the total well depth from the depth to water.

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

1) V=3.14*(r2)*d*7.48 where V= volume (gallons)
r= well radius, feet
d= depth of water in well (feet)

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

Several general methods can be used for well purging. Well purging may be achieved using bailers, bladder pumps and submersible pumps. The specific pumping method shall be chosen based on depth to groundwater, diameter of well, existing well configuration and contaminant(s) of concern.

If the recovery of a low-yield well exceeds two hours after purging, a sample shall be extracted as soon as sufficient volume is available in the well. At no time should a monitoring well be pumped dry if the recharge rate causes formation water to cascade down the well casing causing an accelerated loss of volatiles and change in pH.

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

COLLECTING WATER QUALITY SAMPLES

Label each sample container with project number, sample location, well owner, date, military time, sampler's initials, preservative, and analysis required.

Don clean latex or nitrile gloves immediately prior to obtaining the sample.

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

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

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

Samples should be preserved as described in the table below.

Parameter	Number	Container	Preservation	Maximum Holding Time Extraction/ Analysis
VOCs	2	40 ml glass	4°C & HCL	14 days to analysis
SVOCs	1	1 liter glass	4°C	7 days/40days from extraction to analysis
Metals	1	500 ml HDPE	4°C & HNO_3	6 months to analysis,, Hg 28 days to analysis
Nutrients	1	500 ml HDPE	4°C & H_2SO_4	Varies – contact laboratory for additional information
Common Ions	1	1 liter HDPE	4°C	7 days/40 days from extraction to analysis

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

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

SOP-13

SURFACE SOIL SAMPLING

This SOP describes the field equipment and sampling methods for surface sampling of soil. Be sure to review the project specific Sampling and Analysis Plan (SAP) for additions or deletions to the methods noted below. These procedures may be modified in the field based on field and site conditions after appropriate annotations have been made in the field logbook and the project manager is consulted to discuss.

All sampling equipment shall be decontaminated before arriving on site.

Purpose

Provide guidelines for sampling of surface soil.

Goal and Objective

To employ a method of collecting surface soil samples representative of field conditions.

Equipment Needs

Stainless steel mixing bowl and sampling trowel

Hand lens (10) power

pH and electrical conductivity meters (if required)

Munsel color book (if required)

Latex or Nitrile gloves

Locating Flags

Coolers and Ice

GPS Unit

Field forms and field book

SURFACE SOIL SAMPLING

Commonly, there are two different methods of surface soil sampling completed on a site: Discreet or Grab Samples, and Composite Samples. The methods for each of these are described below.

For both methods, surface soil samples should be collected from the surface to a depth of six inches unless otherwise specified in the project specific SAP.

Soils should be described according to the procedures outlined in the United Soil Classification System (USCS; method ASTM D2487) or the Soil Conservation Service (SCS) classification system. Soil texture should be classified by either the USCS or the U.S. Department of Agriculture (USDA) classification. Descriptions shall be recorded in the field books or on standard morphological description logs as provided in the SAP.

Discrete or Grab Soil Samples

- Locate the site as directed in the appropriate sampling and analysis plan.
- Wearing disposable latex or nitrile gloves collect a sample by scraping the 0-6 inch interval of soil with a stainless steel spoon.
- Place the soil in a stainless steel bowl.
- Remove all coarse fragments greater than 0.5 inches from the bowl. If volatile organics analysis is not required, mix the remaining sample in the bowl with the stainless steel spoon.
- Transfer the soil sample directly into a glass sample jar with Teflon cap (4 or 8 ounce, depending on number of analyses required) and store in a cooler at 4 degrees Celsius or less. Retain approximately 30 grams of the sample in a plastic bag for field measurement of pH or PID screening, if required.

- Push flag into the ground at the sample location, which will allow for obtaining the coordinates of the sample location later with a GPS Unit, or take a coordinate reading of the location prior to moving to another sample location.
- Record information about the sample collection on the appropriate forms.

Composite Samples

Review the work plan or SAP to determine the location and spacing of sampling area grids for the collection of composite samples. When reviewing, determine the grids to be cordoned off in the field and the number of composite samples to be collected within the each grid. Follow the process below to collect the composite samples. **Composite soil samples should not be collected for analysis of volatile organic compounds.**

- Prior to collecting the composite samples, mark off the sampling grid as described in the SAP.
- Collect five to eight (as indicated in the SAP) surface soil samples of equal volume using a sampling trowel from discrete locations within a sampling area and place them in the mixing bowl. If a sod or duff layer is present, this layer should be peeled back to the top of the mineral soil.
- Remove all coarse fragments greater than 0.5 inches from the bowl.
- Mix the samples in the mixing bowl well and then a fill a laboratory supplied sample container with the mixed soil.
- Complete appropriate field sampling forms and the chain of custody. Store all samples in a cooler with ice.

SOP-14

SUBSURFACE SOIL SAMPLING

SUBSURFACE SOIL SAMPLING

Typically, subsurface sampling is completed using a hand auger, split spoon sampler, direct push drilling equipment, or backhoe or excavator. Sampling procedures for each type of equipment is described below.

Hand Auger

- Arrive on-site equipped with stainless steel auger rod and hand auger. If you intend to collect samples from different intervals below grade, bring several sizes of stainless steel augers (e.g. 2-inch, 4-inch, 6-inch, etc.).
- Hand auger holes can be drilled as one size or in a telescoping manner if you wish to collect discreet samples at intervals below grade and prevent risk of cross contamination between intervals. If a single depth sample is required, advance the auger bucket to the desired sampling interval depth and empty the contents of the auger in a stainless steel mixing bowl. Mix and place soil into appropriate sample containers.
- For the telescoping method, advance the largest auger first to the desired depth, collecting a specified depth increment sample as the auger bucket is advanced. Install temporary decontaminated PVC casing with a diameter slightly smaller than the borehole to keep the hole open and reduce possible cross-contamination between depth intervals. Using the next size smaller auger bucket, repeat the process.
- Fill out appropriate sample labels, field forms and chain-of-custody paperwork and place samples for lab analysis in a cooler with ice.
- Decontaminate all equipment between sample locations.

Purpose

Provide guidelines for sampling of subsurface soil.

Goal and Objective

To employ a method of collecting subsurface soil samples representative of field conditions.

Equipment Needs

Will depend on sampling method

Stainless steel mixing bowl and sampling trowel

Hand lens (10) power

Munsel color book (if required)

Latex or Nitrile gloves

Locating Flags

GPS Unit

Coolers and Ice

Field forms and field book

Split Spoon Sampler

- Arrive on-site equipped with at least two standard 1.4 inch inside diameter split spoon samplers. If geotechnical information is desired, a 140 pound drive hammer is required.
- Install split-spoon sampler into borehole and advance to the desired depth with the 140 pound drop hammer. Record number of blow counts to complete sampling over each 18-inch interval, as necessary.
- Retrieve sampler and place on work table. Using the other sampler, repeat this sequence.

- Record lithology and percent recovery from cores retrieved from split spoon sampler.
- If required by the project work plan or sampling and analysis plan, composite like core intervals by mixing in stainless steel bowl in a similar manner as described for surface sampling. When sampling for volatile organic compounds, the sample should not be mixed.
- Decontaminate sampling equipment between each interval sampled if required by the SAP.
- Decontaminate sampling equipment between sampling sites.

Direct Push Drilling Equipment

- Locate the site to be sampled and ensure that drilling equipment can safely access the site.
- Minimize off road travel to prevent off site damage to surrounding vegetation.
- Advance sampling rods lined with acetate sleeves to the prescribed depth. Retrieve the rods, remove the sample sleeves, and secure on the work table.
- Record lithology and percent recovery from the retrieved sample sleeve.
- If required by the project work plan or sampling and analysis plan, composite like core intervals by mixing in stainless steel bowl in a similar manner as described for surface sampling. When sampling for volatile organic compounds, the sample should not be mixed.
- Decontaminate sampling equipment between each interval sampled if required by the SAP.
- Decontaminate sampling equipment between sampling sites.

Backhoe or Hand Dug Excavations

- Locate the site to be sampled and ensure that equipment can safely access the site.
- Minimize off road travel to prevent off site damage to surrounding vegetation.
- Orient excavation to maximize use of the angle of the sun to illuminate the pit for photographs.
- Excavate to the prescribed depth. Place excavated material a sufficient distance from the excavation. If the pit exceeds five feet in depth, OSHA construction standards for shoring or sloping must be observed to prevent accidental burials. Sampling personnel should avoid entering any pit to collect samples, and if required to do so, strict adherence to all OSHA standards must be implemented.
- Soil profile descriptions shall be made from a hand cleaned surface along the pit wall.
- Complete profile descriptions and take photographs before pit is sampled.
- Soil samples shall be collected from depth intervals specified in the SAP. When a depth interval is sampled, an equal volume of soil should be collected from the entire interval exposed on the pit wall by the excavating bucket. When the bucket is brought to the surface, soil samples should be collected from the bucket with the stainless steel trowel and mixing bowl according to methods described for surface soil sampling. When sampling for volatile organic compounds, the sample should not be mixed.
- After sampling is completed, the pit should be backfilled with excavated material in the reverse order that it was excavated so that topsoil material is returned to the top of the pit. When backfilling is complete the area should be cleaned up to its original condition. If a test pit is left open overnight, temporary fencing and appropriate signs and flagging tape should be used to prevent access to the excavation.

- Decontaminate the excavator bucket and all sampling equipment between sampling sites. Excavation equipment should be cleaned between sites with water (where possible) or with a shovel to remove accumulated dirt and mud.

SAMPLE CONTAINERS AND PRESERVATION

Soil samples should be preserved as described in the table below.

Parameter	Number	Container	Preservation	Maximum Holding Time Extraction/ Analysis
VOCs	1	4 oz glass	4°C	14 days to analysis
VPH	1	4 oz glass	4°C	Preserve in methanol within 7 days/40 days from preservation to analysis
EPH	1	4 oz glass	4°C	14 days/40 days from extraction to analysis
SVOCs	1	4 oz glass	4°C	7 days/40days from extraction to analysis
Metals	1	4 oz glass or plastic	4°C	6 months to analysis,, Hg 28 days to analysis

SOP-15

MONITORING WELL CONSTRUCTION

- Arrive on site with the appropriate drilling equipment and materials for site conditions. Be sure to review the SAP to determine anticipated lithology. Filter pack and well-screen slotting should be based on the lithology. Ensure that the driller has properly decontaminate all drilling equipment and materials prior to arrival on- site.
- Many states now require certification and licensing for monitoring well drillers. Verify the driller is licensed in the State (if required) prior to beginning fieldwork.
- Safety equipment required on-site of the drill rig is mandatory. Personal protective equipment includes (at a minimum): hardhat, safety glasses, steel toed boots, gloves, first aid kit, and site safety plan-with routes to hospitals known by all personnel on-site.
- Acceptable drilling techniques for the installation of monitoring wells include air- rotary, cable tool, and hollow-stem auger. If unconsolidated material is encountered, it may be necessary to drive steel casing during drilling to maintain borehole integrity.
- Appropriate decontamination of the auger flights between boreholes is required.
- Drilling mud or drilling solutions of any kind are not to be used during drilling activities in conjunction with monitoring well construction. Hydraulic jacks or the drill rig can be used to pull back the steel casing following emplacement of plastic casing.
- Subsurface samples must be collected by the driller at intervals specified in the SAP. Down-hole soil samples should be collected using a standard 1.4-inch inside diameter split spoon sampler and a 140-pound drive hammer. The number of blows necessary to obtain an 18-inch length of sampler by the driller should be recorded on the boring log.
- A detailed lithologic boring log must be completed during drilling activities. Soils should be described on the log according to the procedures outlined in the United Soil Classification System (USCS; method ASTM D2487) or the Soil Conservation Service (SCS) classification system. Soil texture should be classified by either the USCS or the U.S. Department of Agriculture (USDA) classification. Water bearing characteristics of the formations should also be denoted on the log. In addition, details of monitoring well construction should be described on the well log including total depth, perforated interval, sizes

Purpose

Provide guidelines for installing monitoring wells in the field

Goal and Objective

To employ a standard method of installation monitoring wells, which will allow for collected of representative groundwater samples

Equipment Needs

Drilling system

Well completion material (screen, filter pack, borehole seal, and surface seal) consistent with anticipated lithology

Hand lens (10) power

USGS Soil Classification Chart and Munsel color book

Latex or Nitrile gloves

Boring Log and field book

and types of construction materials, etc.

- When completing the well, install factory slotted well screen (size dependent on lithology) and blank PVC (or stainless steel or PTFE for organics) well casing into the borehole. Emplace chemically inert silica sand at least 2 feet above and below any perforated sections and install a bentonite plug above the sand. Backfill remaining well annulus with bentonite slurry or grout to the ground surface. Develop the well prior to sample in accordance with the appropriate SOP.
- Place locking protective well cover over well casing(s) after outer steel casing has been removed from the borehole (if necessary). Place bentonite plug below bottom of well cover; grout cover in place and lock with high quality lock.

SOP-16

MONITORING WELL INSTALLATION WITH DIRECT PUSH EQUIPMENT

FIELD PROCEDURE

- Arrive on-site with the appropriate drilling equipment and materials for site conditions. Ensure drill has properly decontaminate all drilling equipment and materials prior to arrival on- site.
- Safety equipment required on-site is mandatory. Personal protective equipment includes (at a minimum): hard hat, safety glasses, steel toed boots, gloves, first aid kit, and site safety plan-with routes to hospitals known by all personnel on-site.
- Check SAP to determine if soil samples should be collected during advancement of direct push equipment. If so, follow methods described in SOP for subsurface soil sampling.
- Advance the direct push drill rods to the desired depth for monitoring well installation.
- Describe lithology encountered following method described in SOP for subsurface soil sampling. A detailed lithologic log should be completed. Water bearing characteristics of the formations should be denoted on the log. In addition, details of monitoring well construction should also be described on the well log including total depth, perforated interval, sizes and types of construction materials, etc.
- Construct the monitoring well of Schedule 40 or 80 PVC casing and factory- slotted well screen up to 1-inch in diameter. Once the drill rods are at the desired depth, lower the well screen and casing through the drill rods. Retract the drill rods out of the borehole while placing a chemically-inert silica sand around the screen interval to one foot above the well screen. Install a bentonite plug above the sand at least 2 feet in thickness. Above the bentonite, backfill the remaining well annulus with a bentonite slurry or grout to ground surface.
- Place locking protective well cover over the well casing after the drill rods have been removed from the borehole. Place bentonite plug below bottom of well cover; grout the cover in place and lock with high quality lock.

Purpose

Provide guidelines for installing monitoring wells using direct push techniques

Goal and Objective

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

Equipment Needs

Ink Pen

Well Completion materials, as necessary

Latex or Nitrile gloves

Field Log Book and Boring Well Log

SOP-17

FIELD SCREENING OF VOLATILE ORGANIC COMPOUNDS IN SOIL

- Field screening can be done using a flame ionization detector (FID), photoionization detector (PID), or combustible gas indicator (GCI). Which instrument is used will depend on the contaminants at the site and site conditions. The project SAP should be reviewed to identified the field screening instrument to be used at the site.
- If using a PID, ensure the instrument is equipped with the appropriate lamp for the compound(s) of interest (refer to table below). Use a filter to prevent moisture and dust from contacting the PID lamp.
- Calibrate the instrument prior to each field day following the manufacturer's instructions. Document the calibration on the appropriate field form or in the project field book.
- Obtain a soil sample from the interval of interest, place it in a new ziploc bag, and seal the bag. Shake the bag to thoroughly mix the sample with the air in the headspace.
- Allow the sample to come to room temperature (approximately 70 - 80° F) by placing it in a warm location (not in direct sunlight). In the winter, it may be necessary to place the sample bag under a vehicle heater vent.
- Insert the probe in the ziploc bag and record the maximum reading on the appropriate field forms.

Purpose

Provide guidelines for field screening of volatile organic compounds in soil

Goal and Objective

To employ a standard method of measuring the concentration of volatile organics in soil

Equipment Needs

FID, PID, or GCI, as required by SAP

Ink Pen

Zip Lock Bags

Latex or Nitrile gloves

Field Log Book and Sampling Forms

PID Lamp Selection

Lamp	Description	Typical Compounds Detected
9.8 eV	Most selective lamp	Benzene, aromatic compounds, amines
10.6 eV	Standard PID lamp	All compounds detected by 9.8 eV lamp and chlorinated compounds, including vinyl chloride, DCE, TCE, PCE, and chlorobenzene
11.7 eV	Detects broadest range of analytes	All compounds detected by 10.6 eV lamp, used to detect methylene chloride, carbon tetrachloride, chloroform, 1,1,1-trichloroethane

SOP-18

MONITORING WELL DEVELOPMENT

FIELD PROCEDURE

Prior to sampling of a monitoring well, the well must be developed to remove excess fines and set the filter pack installed during well construction.

Purpose

Provide guidelines for developing monitoring wells

Goal and Objective

To ensure wells are developed prior to sampling

Equipment Needs

Decontamination equipment and fluids

Latex or Nitrile gloves

Well Development Form

- Visually inspect all well development equipment for damage and repair as necessary.
- Decontaminate all stingers, air hoses, surge blocks following the SOP developed for decontamination of field equipment.
- If using compressed air method for well development, verify the compressor utilized does not produce air laden with hydraulic fluid for lubricating purposes. This may affect the integrity of the monitoring well for producing viable water quality data.
- Develop well by using surging techniques (surge block or bailer) followed by evacuation of water and sediment. Place the surge block or bailer in the well and lower to bottom. Move the surge block or bailer up and down over the entire length of the well screen several times. Remove and evacuate water from the well. Repeat this procedure until evacuated water is visibly clean and essentially sand-free. Record clarity of water after development on the well development form.
- Evacuated water should be disposed of following to the process defined in the SAP or project work plan.
- Report field observations and volume of water removed on well development form.

SOP-19

SURFACE WATER SAMPLING

Purpose

To provide field sampling methodologies for surface water

Goal and Objective

.To ensure surface water samples are collected consistently in the field

Equipment Needs

Decontamination equipment and fluids

Latex or Nitrile gloves

pH, conductivity, temperature meter

Coolers and ice

Sample bottles Preservatives

Indelible marker

Field sampling Form

Chain-of-custody

GRAB SAMPLING

- When collecting a grab sample of surface water attempt to collect the sample at the interval in the stream which exhibits the largest volume of flow and/or highest velocity. More than one interval may be sampled.
- Field parameters should be measured in accordance with applicable SOP prior to collect a sample for analytical testing. Take care to collect measurements from the sample locations in the stream as the grab sample.
- To collect a sample, submerge a pre-labeled sample bottle such that mouth of bottle is submerged below the water surface 2 to 3 inches, if possible. If sampling inorganics, allow bottle to fill partially; rinse bottle by shaking and discharge this water away from sample site. Repeat this procedure three times. Do not rinse sample bottles for organics analysis.
- Once the sample container is filled, add preservative (if necessary), and cap. If water is too shallow to fill directly to sample bottles use a decontaminated container to collect sample water. Transfer water from compositing container into pre-labeled sampling bottles.
- Fill out appropriate field form(s) documenting sample location, time, and other pertinent information prior to leaving sampling site.

SAMPLING FREE PRODUCT ON SURFACE WATER

This sampling procedure to be used when sampling for free phase organic constituents floating on top of water is described below.

- Decontaminate sample container in accordance with appropriate SOP.
- Using a wide mouth jar, submerge the sample container in such a manner that leaves the mouth of the container half-way out of the water. Wait for the container to fill.
- Transfer directly into sampling bottles.
- Fill out appropriate field form(s) documenting sampling location, time, and other pertinent information prior to leaving the sampling site.

SOP-20

SEDIMENT SAMPLE COLLECTION

This SOP describes the field equipment and sampling methods for collection of fresh-water sediment samples in shallow water (less than eight feet deep). Methods explained in this SOP may be different from those identified in the project specific Sampling and Analysis Plan (SAP) and the project specific SAP should be referenced for additions or deletions to the methods noted below.

Purpose

To describe field sampling methodology for sediment water

Goal and Objective

To ensure sediment samples are collected consistently in the field

Equipment Needs

Decontamination equipment and fluids

Latex or Nitrile gloves

Stainless steel scope, spoon, or trowel

Stainless steel mixing bowl

Sample jars with Teflon-lined lids

Sample jar labels

Cooler and ice

Field forms and field book

Chain-of-custody

SAMPLE COLLECTION

- Prior to sample collection and between samples, be sure to decontaminant all non-disposable sampling equipment in accordance with standard operating procedures.
- Label your sample containers in accordance with standard operating procedures.
- If you can wade into the surface water body, collect the sediment sample using a stainless steel scoop or spoon. Collect the sediment sample with the scoop or spoon while facing upstream. Excess water may be removed from the scoop or spoon; however, care should be exercised to avoid the loss of fines when decanting excess water.
- In surface water bodies that are too deep to wade, but less than eight feet deep, a stainless steel spoon or scope attached to a piece of pipe may be used from the banks if the surface water body is narrow or from a boat.
- Following collection, place the sample in a stainless steel mixing bowl, mix it thoroughly, and then place a portion of the sample in the sample container. When sampling soil for organics, do not mix the samples as this may release organics from the sediments. Place sample containers in a cooler with ice.
- Complete all out appropriate field sampling forms and chain-of-custody forms.

SOP-21

SOIL VAPOR SAMPLING

(SUMMA CANISTER WITH ISOPROPLY ALCOHOL TRACER)

GENERAL PROCEDURE – PURGING

Prior to sample collection, purging of soil vapor from the sampling probe must be performed. If previous purge testing has not been performed, a purge optimization test should be conducted to select an appropriate purge volume for the site. During purge optimization, remove 1, 3, and 7 volumes of dead space (tubing, probe, air within filter pack surrounding the probe). The number of purge volumes that yields the highest concentrations of target analytes as measured using a PID should be selected.

After selecting a purge volume, purging should be conducted using a pump (such as personal air sampling pump) or vacuum canister (either one-time use, such as a Summa canister, or electric canister maintaining a consistent vacuum). Constant flow rates during purge should be maintained by air flow meters with adjustable purge pumps or the use of flow controllers with vacuum canisters. The rate of purging (usually in mL/min), and the start and stop time of purging (recorded as hour:minute:second) should be recorded at each sampling location.

Following purging, and prior to soil vapor sampling, the sampling train should be sealed to influence from outside ambient air using valves or other closure mechanisms.

COLLECTING SOIL VAPOR SAMPLES

Generally, sampling locations shall be sampled from the least contaminated to the most contaminated, if known.

- Prior to initiating sampling, confirm that all connections from the vapor sampling point to the vacuum canister are tightly sealed, the flow controller is in-place in the sampling train, and that a pressure gauge is properly installed between the sampling canister and the flow controller (or that the flow controller has a built-in sampling gauge installed in the proper orientation).
- Place a weighted absorbent towel on the ground at the point where the sampling train enters the subsurface and beneath any connections in the sampling train, then soak the towel with liquid isopropyl alcohol.

Purpose

To describe field sampling methodology for soil vapor

Goal and Objective

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

Equipment Needs

Summa canister

Flow controller Pressure gauge

Flow controller-to-tubing and purge pump-to-tubing connections

Tubing

Other fittings for top of soil vapor probe (if necessary)

Tracer gas and absorbent towels

Purge pump

Stop watch

PID, or volatile organic meter that can detect both the target environmental analyte and the tracer gas

Field forms and field book

Chain-of-custody

- Open the valve on the summa canister, and record time, canister pressure (in negative inches of mercury), and the serial number of the canister in the field log book and field sampling form. If using a 6-liter Summa canister, the initial vacuum should be between -30 and -25 inches of mercury. If this is not the case, contact the laboratory and start the purging and sampling process over including use of a different Summa canister.
- Using a field instrument, also record organic vapor concentrations (dominated by isopropyl alcohol tracer compound) in the ambient air near the base of the sampling probe.
- At about ½ the time necessary to complete sampling, record time and canister pressure, and ambient organic vapor concentrations. The pressure on a 6-liter Summa canister should be between -20 and -12 inches of mercury at ½ of the sampling time. Determine whether the sampling time will have to be extended to obtain sufficient sample volume, and adjust accordingly.
- At the end of the designated time necessary to complete sampling with the flow controller used, record time and canister pressure, and ambient organic vapor concentrations.
- Continue to draw air from the soil vapor probe until the 6-liter Summa canister vacuum is reduced to between -10 and -5 inches of mercury. Record the time and canister pressure, then close the canister valve to end sampling.
- Remove the canister to a location distant from the soil vapor probe and tracer gas application, and prepare the canister for shipment to the laboratory
- Label each Summa canister with project name, project number, sampling location, date, military time (at the end of the sampling interval), sampler's initials, and analysis required.
- Ship the samples to the laboratory under chain-of-custody, include one copy of the chain of custody form with each package.

SOP-22

SOIL VAPOR SAMPLING

(SUMMA CANISTER WITH HELIUM LEAK DETECTION)

FIELD PROCEDURE

- Attach flow controller and pressure gauge to Summa canister.
- Seal the upstream end of controller/canister with a brass cap, then open the canister valve for approximately 5 seconds. Observe pressure gauge. Pressure should stay constant at an initial point between 30 and 23 inches of mercury. If the initial pressure is above or below this range, contact the laboratory and use a different Summa canister. If the pressure changes, re-tighten connections and repeat.
- Confirm that sample tubing (3 to 4 feet) is attached to the soil vapor probe, and also place a short section of tubing for helium monitoring adjacent to the soil vapor probe.
- Seal the distant ends of the helium monitoring tubing and sample tubing using a valve or clamped section of silicon tubing.
- Provide helium supply line to near the soil vapor probe entrance to the ground, and cover the probe and adjacent sections of helium supply line, helium monitoring line, and sample tubing with a shroud (plastic bag weighed down to the surrounding surface using a sand-filled hose).
- Open the helium monitoring line, turn on the helium meter, and connect the meter to the monitoring line.
- Add helium and until the concentration monitored under the shroud is 20%.
- Purge 3 dead-space volumes from the sample tubing and probe using a syringe, personal air sampling pump, or vacuum canister (either one-time use, such as a Summa canister, or electric canister maintaining a consistent pressure). Maintain constant flow rate during purging using an air flow meter with adjustable purge pump or flow controller with vacuum canister. The rate of purging (usually in mL/min), and the start and stop time of purging (recorded as hour:minute.second) should be recorded at each sampling location. If pump or canister is not used, a syringe can be used for purge, in which case simply record

Purpose

To describe field sampling methodology for soil vapor

Goal and Objective

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

Equipment Needs

Summa canister

Flow controller Pressure gauge

Flow controller-to-tubing and purge pump-to-tubing connections

Tubing (silicon and Teflon)

Other fittings for top of soil vapor probe (if necessary)

Syringe or pump for purge

Stop watch

PID

Shroud (clear plastic bag, hose filled with sand for weighing down bag)

Helium

Helium Meter

Field forms and field book

Chain-of-custody

total volume purged and time interval of purge.

- Detach the helium monitor from the monitoring line, close the helium monitoring line, and allow the helium monitor to return to a reading of zero. Attach the helium monitor to the sample tubing (note that some helium meters only function if placed in a open air stream, such as being loosely placed into a much larger rigid tube – rather than a tight connection).
- Record the stabilized helium concentration in the sample tubing, and the estimated purge volume, if any, removed by action of the helium monitoring device. The ratio of helium concentration in the sample tubing to the concentration previously monitored under the shroud should be no more than 0.1 (i.e. approximately 2%). If this condition is met, proceed. If the ratio is more than 0.1, remove the shroud, repair sampling train connections and seal of the probe to the ground, and repeat helium supply and purge.
- Connect PID to the sample port. Record the stabilized reading, and the estimated purge volume removed by action of the vapor detector, then close the sample tubing.
- Remove the shroud.
- Attach the sample tubing to the regulator/Summa canister train.
- Replace the shroud over the entire sampling train (including Summa canister) and over the helium supply and monitoring lines.
- Add helium and until the concentration monitored under the shroud is 20%.
- Open the valve on the Summa canister, and record time, canister pressure (in negative inches of mercury), and the serial number of the canister.
- Record the helium concentration during sampling at 2-minute intervals for the entire sampling period, if 15 minutes or less; or for the first 15 minutes if sampling for a longer period. Add helium as needed to maintain 20% inside the shroud.
- At approximately ½ the time necessary to complete sampling with the flow controller used, again record time, canister pressure, and helium concentration under the shroud. Make a preliminary evaluation of whether the sampling time will have to be extended or shortened to obtain appropriate sample volume (the pressure on a 6-liter Summa canister should be between -20 and -12 inches of mercury at ½ of the sampling time). Add helium as necessary.
- At the end of the designated time necessary to complete sampling with the flow controller used, record time, canister pressure, and helium concentration under the shroud. If using a 6-liter Summa canister, extend the sampling interval until the canister vacuum is between -10 and -5 inches of mercury; record time, canister pressure, and helium concentration, then close the canister valve to end sampling.
- Prepare the canister for shipment to the laboratory: replace the brass cap, label the Summa canister with project name, project number, sampling location, date, military time (at the end of the sampling interval), sampler's initials, and analysis required. Analysis must include helium.
- Make sure to record all data on appropriate field sampling form. Ship the samples to the laboratory, including one copy of the Chain of Custody form with each package.

SOP-23

AMBIENT AIR SAMPLING

PRIOR TO SAMPLING

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

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

SAMPLING PROCEDURES

Use 6-liter stainless-steel Summa canisters and flow controllers provided by the laboratory. Place indoor air sampling canisters such that the intake into the sampling train is at a height of approximately 4 to 5 feet above floor level (i.e., in the breathing zone of a standing worker).

At least three outdoor ambient air sampling locations should be used to provide background data at the time of the indoor air sampling. The outdoor locations should be upwind of the subject building(s), and one of the outdoor ambient air sampling locations should be on the roof near the intake of one of HVAC units, if present. Begin sampling of outdoor ambient air at least one hour before sampling indoor air, and continue collecting outdoor air until at least 30 minutes prior to the end of the indoor air sampling period.

Purpose

To describe a field sampling methodology for sediment water

Goal and Objective

To ensure sediment samples are collected consistently in the field

Equipment Needs

Summa canister

Flow controller

Tubing (and associated connections) Apparatus for setting height of air intake

Wind speed meter

Vapor detector (such as PID, if applicable)

Field forms and field book

Chain-of-custody

Collect one field duplicate quality control (QC) sample per sampling event, unless specifically exempted by the project manager. Record meteorological conditions, including temperature, barometric pressure, wind direction, and wind speed during the sampling period. Meteorological conditions may be estimated, and reported along with weather information from outside sources, if approved by the project manager. Take a photograph of each sample location.

Using pre-calibrated 8-hour flow controllers to fill each 6-liter Summa canister to within the pressure range recommended by the laboratory. For each sample, record times of the start and end of sampling. Record initial and final canister pressures. Label each canister with a unique sample number. Complete field sampling sheets (including canister serial number, pressure and time at the start and end of sampling) and chain-of-custody documents for all samples prior to shipment to the laboratory for analysis.

SOP-24

QUALITY CONTROL SAMPLING

Quality Control (QC) samples are submitted along with natural samples to provide supporting laboratory data to validate laboratory results. QC field samples are submitted blind to the lab with the exception of trip blanks. In general, field equipment and duplicate samples should be collected during every sampling event. Duplicate samples should be collected at a frequency of one sample for every 20 natural samples. Always check the SAP before going to the field to understand what QC samples are required for the sampling event, and at what frequency samples should be collected.

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

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

Purpose

To outline the quality control samples to be collected in the field

Goal and Objective

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

Equipment Needs

Field Forms and field book

Chain-of-custody

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

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

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

SOP-25

MANAGEMENT OF INVESTIGATIVE-DERIVED WASTE

Prior to the field sampling event, review the Sampling and Analysis Plan to understand how wastes generated during the investigation should be handled. This standard operating procedure is applicable to non-hazardous wastes. If hazardous wastes may be generated, please consult with the project manager.

Purpose

To outline the procedure for handling wastes generated during site investigation

Goal and Objective

To employ a method for appropriate handling investigative-derived wastes that limits contamination of the environment

Equipment Needs

PID

Field Forms and field book

DOT approved 55-gallon drums

Drum wrench

SOIL

Whenever possible, soils excavated from test pits should be placed back in the test pit in the reverse order that it was excavated.

To determine appropriate method for handing of drill cuttings from soil borings or monitoring well installation, soils exhumed from the borehole should be monitored for staining and field screened for VOCs using a PID in accordance with standard operating procedures. Based on the PID screening, cuttings with organic vapor concentrations greater than 100 ppm should be containerized in labeled 55-gallon drums (or roll-off containers if large volumes of cuttings are anticipated) pending further characterization. Alternatively, project personnel may elect to containerize all drill cuttings based on the presence of known contamination and contaminant concentrations. Containerized soil must be disposed of in accordance with state and federal regulations based on of soil analytical results.

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

GROUNDWATER

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

SOP-26

USING A PETROFLAG® HYDROCARBON ANALYZER

Purpose

Provide guidelines for operating the PetroFlag® test kit

Goal and Objective

To ensure field staff use the PetroFlag Test Kit correctly and consistently in the field.

Equipment Needs

PetroFlag Kit and manual

Field Forms and Field book

Calibration:

- The PetroFlag meter should be calibrated with each batch of 10 samples or, at least daily.
- The extraction solvent (vial with blue polypropylene top) is used as the blank solution and the calibration standard supplied with each 10 pack (vial with white polypropylene top) is used as the standard solution.
- A reagent calibration (rC) can be used or, if uncontaminated soil is available, a soil calibration (SC) can be used to prepare a site specific calibration.
- Either of the two calibrations, "rC" and "SC", can be selected from the main menu of the PetroFlag analyzer, then choose an appropriate response factor.

Preparing/Reading Blanks and Standards:

- Label two soil tubes (yellow caps) as "blank" and "standard", then pour contents of the extraction solvent into the 'blank' tube and the contents of the calibration standard into the 'standard' tube.
- Process the blank and standard tubes exactly as the unknown soil samples are pre- pared (described below). Once the blank and calibration standard have been read, discard them. They fade with time and cannot be reused.
- A soil calibration is prepared in the same way, with the additional step of adding 10 grams of uncontaminated native soil to each of the labeled calibration tubes.
- The blank is ready to be read after the response factor is chosen and the 'next' is pressed, causing the screen to prompt with "bL". Insert the blank vial and press "read".
- After 5 seconds the display should read "0" for 2 seconds, then a prompt of "Csd" for the calibration standard is given. Insert the calibration standard and press read. When 5 seconds have passed the meter should then verify a valid calibration and display "1000".
- If an error message is displayed, a recalibration must be completed.

Soil Testing Procedure:

- Label the soil tubes and developer vials (black caps, half filled with liquid) with the appropriate sample ID. Label either the top or bottom of the developer vial.
- Weigh 10 grams (±0.1 gram) of all unknown soils into labeled soil tubes.
- Set timer for 5 minutes. Add extraction solvent to first tube, start timer and shake tube for 15

seconds making sure all soil is saturated.

- Add extraction solvent to each of the remaining samples, allowing sufficient time intervals between samples to operate efficiently.
- Shake all tubes intermittently for a total of 4 minutes, then let stand for the re-maining 1 minute.
- Pour free liquid from the soil tube into the barrel of a filter-syringe assembly (make sure the filter disk is firmly attached). Discard the first few drops from the filter to a waste container, then filter into the properly labeled developer vial.
- Add extraction solvent drop-wise to developer solution until meniscus just enters the neck, shake for 10 seconds, start 10 minute timer and proceed to next sample.
- Begin reading the developer vials with the PetroFlag analyzer when 10 minutes have elapsed. Attempt to make each 'reading' at approximately the same elapsed time, as varying time intervals will result in a higher % of error.
- Turn meter on by pressing "read/on". Place sample vial into reader (make sure outside of vial is clean) and press "read/on", then record result.

Standard Analyzer Operation:

- When daily calibrations are run and the ambient temperature deviates from the calibration temperature by more than 10°C, an error condition will result. The analyzer will display "err4" which can be cleared by pressing "next" and recalibrating the meter.
- To take a standard reading, the last operation mode must have been in "read", the calibration data must be current, and the response factor last used must be valid.
- Turn meter on by pressing "read/on". The last reading is displayed for 2 seconds, followed by the calibration curve and response factor. The meter is now ready to read your sample. Insert vial and replace cap, then press "read/on". The display will show "calc" for seconds, the calibration curve, response factor, and finally the result.

SOP-27

ASBESTOS SAMPLE COLLECTION

PLANNING PHASE

Prior to commencing building inspection activities the following tasks should be performed:

- Contact management of the facility to inform them as to what will take place during the inspection.
- Develop a project schedule agreeable to the building owner including arrival time at the site and time of initial meeting with building personnel.
- Review existing as-built drawings, if available, to become familiar with the facility as to the mechanical system layout, and materials used in construction. Develop scaled drawings from as-built drawings, if provided by the building owner, for use in the inspection.
- Review any previous asbestos inspections that may have been conducted in the past.

INSPECTION PHASE

Inspections should be performed using the currently recognized standard protocol developed for schools under AHERA. General guidelines for conducting the inspection are as follows:

- Conduct on-site informational meetings with facility personnel to inform them of what will transpire during the inspection. Discuss bulk sampling protocol with maintenance personnel and determine sampling locations that will be acceptable to the owner.
- Perform an initial walk through of the building accompanied by a maintenance person if possible.
- Observe the building layout and whether the building was built in phases or all at once.
- Observe where the divisions are between construction phases.
- Locate all mechanical areas.
- Document location of and access to all pipe chases, pipe tunnels, crawl spaces, attics, and roof(s).

Purpose

To identify the specific requirements for asbestos sample collection in the field

Goal and Objective

To employ a method of asbestos sample collection to ensure staff safety and to prevent cross contamination between sites and sample locations

Equipment Needs

Ladder to access areas

Flashlight to aid in visibility

Air tight sampling containers (film canisters, centrifuge tubes, zip lock baggies)

Spray mister bottle with water to spray the area to be sampled

Plastic drop cloth to spread beneath the area to be sampled

Knife, linoleum cutter, cork borer, or other tool appropriate for extracting samples

Caulking gun and compound for filling holes once a sample has been extracted

Spray acrylic or adhesive to encapsulate sample extractions.

- Walk completely around the outside of the building.
- Fill out asbestos inspection checklist sheet.
- Fill out building information sheet.
- Fill out homogeneous area summary sheet.
- Fill out room by room sheets.
- Prepare a building diagram.

NUMBER OF SAMPLES

Nine samples per homogeneous sampling area are generally recommended. Cost or other constraints, may limit the number of samples that can be collected. If nine samples cannot be collected, use the following table to determine the minimum number as required by AHERA Rules.

Friable Surfacing Material

The number of samples collected from friable surfacing material was determined based on the following protocol developed under AHERA.

- 1,000 square feet or less: Three bulk samples
- 1,000 to 5,000 square feet: Five bulk samples
- Over 5,000 square feet: Seven bulk samples

Thermal System Insulation

Thermal system insulation should be sampled in a randomly distributed manner, with at least three bulk samples collected from each homogeneous material. At least one bulk sample should be collected from each homogeneous material of patched thermal system insulation that is not assumed to be ACBM.

Bulk samples should also be collected from each insulated mechanical system where cement or plaster was used on fittings, such as tees, elbows, or valves. The number of samples should be sufficient to determine whether the material is asbestos containing. Generally, a minimum of three samples should be collected from each homogenous area.

Bulk samples should not be collected from any homogeneous material where the inspector determined that the thermal system insulation is fiberglass, foam glass, rubber, or other non- asbestos containing building material.

Miscellaneous Material

Bulk samples should also be collected from each miscellaneous material. The number of samples should be sufficient to determine whether the material is asbestos containing. Generally, a minimum of three samples were collected from each homogenous area.

Equipment Needs
(Continued)

Duct tape for repairing thermal system insulation jackets

Cloth (pre-moistened) for cleaning up debris and tools

Vacuum cleaner equipped with high efficiency particulate air (HEPA) filters

Indelible ink pen for labeling sample containers

Camera for photographic documentation

Disposable protective clothing, gloves and bootees

Personal respirator, either a negative pressure full or half mask with HEPA cartridge.

Safety glasses for eye protection

Non-friable suspected ACBM.

The number of samples collected from non-friable suspect ACBM should be sufficient to determine whether the material is asbestos containing. Generally, a minimum of three samples should be collected from each homogenous area.

SELECTION OF SAMPLES

Sample locations should be selected so that they are representative of the sample area. Sample locations should be distributed evenly throughout the sampling area. If fewer than nine samples are collected, a random sampling scheme should be used to determine their location. Choosing sample locations according to personal judgment produces samples which may not be representative and can lead to a wrong decision about the presence or absence of asbestos. The sampling scheme described below should be used to avoid this problem.

> *Divide the sampling area into nine equally sized sub areas and label them 1 through 9. This can be done carefully by eye. Exact measurements are not needed. If three samples are going to be collected, randomly select three numbers from 1 to 9 and collect a sample from the corresponding subarea shown on map.*

For each sampling area, use a new diagram. If you have more than 18 sampling areas, start again at the top of the random number diagram (sample area #1) to determine sampling locations for sampling area 19.

IDENTIFICATION OF SAMPLES

Assign a unique sample ID number to each sample location. This ID number should be placed on the sampling container when shipped to the certified laboratory for analysis. Record the ID number and the sample location on the sample area diagrams and also on room by room summary sheets.

This must be done carefully so that there is no uncertainty about the location and identity of each sample collected. Make sure that no two samples have the same ID number. Non- sequential numbers are used to prevent the laboratories from knowing which samples come from the same sample areas or the same buildings. On the other hand, non-sequential ID numbers make organizing the analytical results by homogeneous area much more difficult.

SAMPLE COLLECTION

- Since inhalation of asbestos fibers during asbestos inspections and sampling projects may pose a health hazard, the use of personal protective equipment by building inspectors is required during the sampling process. As a minimum level of protection, inspectors should wear a respirator, either a negative pressure full or half mask with HEPA cartridges. Disposable clothing should be worn during sampling if the sampling operation is likely to dislodge pieces of suspect material or if the environment is extremely dusty. Inspectors should have plastic bags, twisters, and labels with them to handle the disposal of cartridges, protective clothing, wet cloths, and debris. These waste materials should be stored pending survey results. If laboratory results establish the presence of asbestos containing materials, these waste materials should be disposed of as asbestos containing waste.

- If possible, collect samples after hours or when the building is not in use.
- Spread the plastic drop cloth and set up other equipment.
- Put on protective equipment.
- Label containers with its ID, sample location, and type of material to be sampled on a sample data form. Always place the label on the container itself. If using ridged containers always place the ID on the container, not on the lid, as lids can be inadvertently switched by a laboratory when handling numerous sample containers.
- Mark the location of the sample on the sampling diagram and record the sample identification number on the plan diagram as well.
- Moisten the area to be sampled (spray the immediate area with water).
- Extract sample using a clean knife to cut or scrape off a small piece of the material. Be sure to penetrate all layers of material. Be careful not to disturb adjacent material.
- Place sample in a container and tightly seal it.
- Wipe the exterior of the container with a wet wipe to remove any material which may have adhered to it during sampling.
- Clean your tools with wet wipes and wet mop or vacuum sampling area with a HEPA vacuum to clean all debris.
- Fill hole with calking compound on highly friable material and/or spray with an encapsulant (to minimize subsequent fiber release).
- Repeat the above steps at each sample location. Place sample containers in plastic bags.
- Discard protective clothing, wet wipes and rags, filter cartridges, and drop cloth in a labeled plastic bag.

SAMPLE HANDLING

- After placing a sample in a container according to the procedures outlined earlier, enter the ID number on the Chain-of-Custody Sheet.
- Upon receipt of samples from the inspector, the laboratory should check and sign the Chain-of-Custody Sheet(s), copy same and return original(s) to the inspector. It is important that this, or a similar arrangement for sample accountability be agreed upon by the laboratory prior to sending samples for analysis.
- Each individual or laboratory engaged in asbestos identification shall participate in the American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) Program of quarterly external audits, the Asbestos Analyst Registry, or equivalent.
- Polarized light microscopy (PLM) according to EPA Method 600/R4-93-116 is the approved method for analyzing bulk materials for asbestos. PLM utilizes a light microscope equipped with polarizing filters. The identification of asbestos fiber bundles is determined by the visual properties displayed when the sample is treated with various dispersion staining liquids. Identification is substantiated by the actual structure of the fiber and the effect of polarized light on the filter, all of which is viewed by the trained technician. The limit of detection of asbestos by PLM is about 1% by area. Samples containing lower levels of asbestos are not reliable detected by this technique.

QUALITY ASSURANCE

After inspection is completed perform a field quality assurance program including the following tasks.

- Review all inspection forms for completeness. (Remember a physical street address is required by AHERA).
- Walk through building one last time to verify that you have identified all the suspect homogeneous areas.
- Review Chain-of-Custody document for completeness and verify the number of samples and sample numbers for the suspect materials collected during the inspection.

SOP-28

LEAD-BASED PAINT SAMPLE COLLECTION

PLANNING & PREPARATION

Prior to commencing building inspection activities the following tasks should be performed:

- Schedule the inspection with the site contact so adequate notice can be given to building occupants and/or tenants and review historical information regarding any previous lead-based paint activities at the site.
- Determine the hours of operation for the facility.
- Develop a project schedule agreeable with the building owner, including arrival time at the site and time of initial meeting with site personnel.
- Review any previous lead-based paint inspection reports, lead risk assessments, or lead-hazard screens.
- Collect all materials necessary for the inspection.
- Insure that all the XRF components are in its case. Equipment in the case should include; XRF with battery, spare battery, battery charger, charger cords, bar-code reader wand, XRF Computer interface cable, building component barcode pages, lead calibration pages, leak test documentation, and XRF source documentation.
- Insure that both batteries are fully charged and ready to go. Note that batteries will slowly lose a charge from sitting in the case and should be recharged before going into the field.
- Obtain the XRF Performance Characteristic Sheet for the instrument to be used for the inspection. Review it to determine the inconclusive range for the XRF.
- Follow radiation safety procedures when handling or using the XRF, as it is a potential source of radiation. Radiation dosimeter badges are assigned to personnel who routinely use the XRF instruments.
- For multi-family buildings, determine how many units can be considered homogeneous, based on the HUD Guidelines and determine the number of units required to be sampled.

Purpose

To identify the specific requirements for lead-based paint sample collection in the field

Goal and Objective

To employ a method of lead-based paint sample collection to ensure staff safety and to prevent cross contamination between sites and sample locations

Equipment Needs

X-Ray Fluorescence Spectrum Analyzer (XRF)

Ladder to access areas

Flashlight to aid in visibility

Air tight sampling containers (film canisters or centrifuge tubes)

Plastic drop cloth to spread beneath the area to be sampled

Heat gun, scraper or other tool appropriate for extracting samples

Required forms

Cloth (pre-moistened) for cleaning up debris and tools

Vacuum cleaner equipped with high efficiency particulate air (HEPA) filters

XRF INSPECTION PROCEDURE

Inspections should be performed using the currently recognized standard protocol developed by HUD. General guidelines for conducting the inspection for lead-based paint are described below:

Calibration of XRF

- Take at least three calibration check readings prior to the commencement of the lead-based paint inspection. These calibration check readings should be repeated every four hours, every time the XRF is turned on, or at the conclusion of the sampling job, which ever is more frequent.
- The XRF calibration check readings are taken on the red 1.02 mg/cm2 Standard Reference Material (SRM) paint film, developed by the National Institute of Standards and Technology (NIST). These films can be obtained by calling (301) 975-6776 and referencing SRM #2579.
- Calibration check readings should be taken through the red 1.02 mg/cm2 SRM paint film when the film itself is at least 12 inches away from any source of lead. For example, the red NIST SRM film should not be placed on a tool box or suitcase or on a surface coated with lead-based paint to take calibration check readings.
- The red NIST SRM film should be attached to a wooden board measuring about 6 inches long by 4 inches wide by 1 inch thick or attached directly to the XRF probe. Readings can then be taken while standing further than a foot from the wall. Alternatively, the red NIST SRM film can be placed on top of a 12 inch piece of Styrofoam or some other lead-free material as recommended by the manufacturer before taking readings.
- Each time calibration check readings are made, three nominal-time readings should be taken on the red NIST (1.02 mg/cm2) SRM film and the results recorded. The average of the three calibration check readings should be computed and also recorded.
- Large differences of calibration check reading averages from 1.02 mg/cm2 may alert the lead-based paint inspector to problems in the instrument's performance. The calibration check reading averages should not differ from 1.02 mg/cm2 by more than the calibration check tolerance specified in the XRF Performance Characteristics Sheet for the specific instrument used.
- If the observed calibration check average minus 1.02 is greater than the calibration check tolerance, the instructions provided by the manufacturer should be followed in order to bring the instrument back into control before any more XRF testing is done. All readings taken by the suspended instrument since the last successful calibration check test should be repeated. If a backup XRF instrument is used as a replacement, the backup instrument must successfully pass the initial calibration check test before retesting the affected test locations.

Equipment Needs

(Continued)

Pen and indelible ink pen for labeling sample containers and completing field forms

Camera for photographic documentation

Disposable protective clothing, gloves and bootees

Personal respirator, either a negative pressure full or half mask with HEPA cartridges

Safety equipment required for the particular site (safety glasses, hearing protection, hard hat, steel-toed boots, etc.)

Radiation Dosimeter Badre

Laptop for downloading XRF readings

Single-Family Housing

- Obtain a drawing of the building and exterior areas.
- Perform a walk-through of the building with building personnel to familiarize yourself with the layout of the building. An inventory of suspect paint in the house should be completed prior to any XRF testing. It may be also done on a room-by- room basis during testing.
- Determine the testing combinations in each room equivalent or on each exterior building component. An inventory of the painted surfaces in interior rooms, on exterior walls, and on surfaces in other exterior areas, such as fences, playground equipment, and garages, should be conducted.
- A testing combination is characterized by the room equivalent, component, substrate, and visible color of the paint. A completed inventory of the painted components in a room equivalent is a list of the testing combinations in that room equivalent.
- A room equivalent is an identifiable part of a residence, such as a room, a house exterior side, or an exterior area. Hallways, stairways, and exterior areas, such as porches, back yards, and each side of the house, are all examples of room equivalents. Closets or other adjoining areas to room equivalents should be designated room equivalents if large (for example, a walk-in closet) or if obviously dissimilar (for example, a different color) from the adjoining room equivalent. In most closets are not considered room equivalents.
- Each room equivalent is made up of components. Components can be located inside or outside the dwelling. For example, components in a bedroom could be the
- ceiling, floor, walls, a door and its casing, the window sash, and window casings. All components that are coated with paint, varnish, shellac, stain, or other coating should also be tested. Some components may be grouped if painting histories are identical as described below.
- Take at least one XRF Reading on each testing combination.
- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that testing combination. If necessary, determine the substrate correction value using the method specified in the HUD Guideline.
- XRF results are corrected for substrate bias by subtracting a correction value determined separately in each house for each type of substrate. The substrate is the material underneath the paint. Substrates are generally classified into one of six substrate types: brick, concrete, drywall, metal, plaster, and wood. These substrate types are intended to include a broad range of materials. For example, the concrete substrate type includes poured concrete, precast concrete, and concrete block. If the true substrate is not one of the six types, the substrate type that most closely matches the true substrate should be selected. For substrates on top of substrates, such as plaster over concrete, the substrate directly beneath the painted surface should be used.

  The correction value is an average of XRF readings taken from test locations that have been scraped clean of their paint covering to expose the substrate. A criterion for selecting these test locations is that their initial XRF results should be less than 2.5 mg/cm2. If test locations with XRF results equal to or greater than 2.5 mg/cm2 are selected, the outcome might "overcorrect" XRF results. Therefore, only test locations with initial XRF results less than 2.5 mg/cm2 should be chosen. If all initial readings on a substrate type are above 2.5 mg/cm2, the locations with the lowest initial reading should be chosen. This will help ensure that XRF readings taken from non-

representative portions of substrates and other underlying materials, such as hidden nails and pipes, are not used to compute the substrate correction. It is important to note that some XRF results may not need to be corrected for substrate bias depending on the specific instruments used and the specifications in the XRF Performance Characteristics Sheet.

Using the same XRF instrument, take a reading on the first bare substrate area. Record the substrate and XRF readings. Repeat this procedure for each bare substrate area and record the readings on the same form. A variant to this step is to first cover the bare area with an NIST SRM film prior to taking the readings. The need for this variation will be specified in the XRF Performance Characteristics

- Sheet for affected XRF instruments and instructions will be provided explaining how to compute the correction value when this variation is used. Compute the correction value for each necessary substrate type in the house by computing the average of all readings.
- Take at least one XRF Reading on each testing combination.
- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that testing combination. If necessary, determine the substrate correction value using the method specified in the HUD Guidelines.
- Classify the XRF results as negative, positive, or inconclusive. For inconclusive readings, collect a bulk sample of the inconclusive paint for laboratory analysis. If sampling is not desired, inconclusive readings must be assumed positive.
- Record the locations, component, substrate, and color of paint found to be positive for lead or assumed to be positive for lead. The recorded location of the material should include room and side of the room. Component should be the component being tested. Substrate should be one of the six substrate types described above. For practical purposes, paint is almost always differentiated by color. Since more than one color may be observed when paint is peeling or the substrate is damaged, both "white" and "blue over green" would be acceptable color entries.

Multi-Family Housing

- Obtain a list of all units, common areas, and exterior site areas.
- Obtain a drawing of the building and exterior areas.
- Perform a walk-through of the building with building personnel to familiarize yourself with the layout of the building.
- Determine, using the HUD Guidelines, the areas that can be grouped together and the minimum number of units to be inspected. The minimum number of units to be sampled can be determined by using Table 7.3 located in Chapter 7 of the HUD Guidelines.
- Select units to be inspected using the random technique explained in the HUD Guidelines.
- For each unit, common area, or exterior site to be tested, determine the testing combinations in each room equivalent.
- Take at least one XRF Reading on each testing combination.
- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that testing combination. If necessary, determine the substrate correction value using the method specified in the HUD Guidelines.

- Classify the XRF results as negative, positive, or inconclusive.
- Record location of materials found positive for lead or assumed to be positive for lead.

FIELD FORMS

Since the information required for a lead-based paint inspection report is gathered in the field, accurate and complete forms are required.

LABORATORY ANALYSIS OF PAINT CHIP SAMPLES

For XRF results that fall into the inconclusive range and for areas that cannot be tested using XRF instruments due to project budget constraints or other reasons, a paint-chip sample should be collected from suspect painted surfaces and sent to a laboratory for lead determination.

If the sampled portions of the building are to remain in-place, lead analysis should be conducted by EPA Method 6010, and results should be reported in mg/cm2, the primary unit of measure. Results may be reported as percent by weight if the dimensions of the surface area cannot be accurately measured or if all paint within the sampled area cannot be appropriately removed. In these cases, results should not be reported in mg/cm2, but in mg/kg or weight percent.

If the sampled portions of the building are to be demolished and disposed of, lead analysis should be conducted according to TCLP procedure (EPA Method 1311) for waste characterization purposes.

If it is necessary to remove a paint-chip sample for laboratory analysis, only one paint-chip sample is needed for each testing combination. The paint-chip sample location should be representative of the paint on the entire testing combination. If the testing combination is replicated, one representative paint-chip sample should be taken from one randomly selected replicate.

Collect at least four square inches of material to ensure that the laboratory has a sufficient sample to conduct the analysis and that it is representative of the testing material sampled. Samples collected should be placed in sealable rigid container such as screw top, plastic centrifuge tubes rather than plastic bags which generate static electricity. Paint-chip collection should include, as a priority, collection of all the paint layers, while minimizing any collection of actual substrate. If substantial substrate material is included, results should be reported in mg/cm2 to avoid a downward bias in results.

Assign a unique sample ID number to each bulk paint sample. This ID number should be placed on the sampling container when it goes to the certified laboratory for analysis. Record the ID number and the sample location on the sample area diagrams, the room by room summary sheets, and the chain-of-custody form. This must be done carefully so that there is no uncertainty about the location and identity of each sample collected. Make sure that no two samples have the same ID number.

QUALITY ASSURANCE

After inspection is completed perform a field quality assurance including the following tasks.

- Review all inspection forms for completeness.
- Walk through building one last time to verify that you have identified all the homogeneous areas of paint suspected to be lead-based.

- Review Chain-of-Custody documents for completeness and verify that the number of samples, the sample numbers for the bulk samples collected.

SOP-29

AIR SAMPLING FOR ASBESTOS AND LEAD

This SOP describes the field equipment and sampling methods for the collection of air samples for asbestos fibers and/or lead dust. This SOP is based on the SOP developed by Region 8 of the U.S. Environmental Protection Agency for the Sampling of Asbestos Fibers in Air.

GENERAL SAMPLING PROCEDURE

Samples are collected by drawing air through a fine-pore filter in order to trap suspended particulate matter, including asbestos and lead suspended in air. For asbestos, the filters are examined using an appropriate microscopic technique to observe, characterize, and quantify the number of asbestos fibers on the filter. For lead, the sample cassettes are packaged and shipped in accordance with SOP-4, and analyzed in accordance with NIOSH 7082 for detection of lead in air.

Sampling in dusty conditions should be avoided, if possible. High levels of dust and particulate may clog or overload the filter. Sampling flow rate and time should be adjusted to avoid filter overload in dusty conditions.

Air samples will be collected using filter cassettes pre-loaded with 0.8 micron mixed cellulose ester (MCE) filters. The crease between the cassette base and cowl should be sealed with a shrink band or adhesive tape to hold the cassette together and reduce the potential for contamination. Samples will be collected using an air sampling pump capable of maintaining a constant flow rate between 2 to 10 liters per minute.

AIR PUMP CALIBRATION

Prior to sampling, the flow rate of the air pump should be set to the flow rate specified in the project specific Sampling and Analysis Plan (SAP), as follows:

1. Turn on the pump and let it run for a minimum of 5 minutes before calibrating the pump.
2. Remove the end plugs on a new filter cassette. Attach one end of a length of tygon tubing to the cassette base and attach the other end of the tubing to the pump's air inlet. Use another length of tubing to connect a flow meter to the cassette cap.

Purpose

To identify the specific requirements for air sampling for asbestos and lead

Goal and Objective

To employ a method of air sampling for asbestos and lead to ensure staff safety and to employ a consistent measuring method for air sampling of asbestos and lead

Equipment Needs

Air sampling pump

Asbestos sample filter cassettes with 0.8 micron filters.

Lead sample filter cassettes with 37 mm filters.

Tripod and spring clips

Tygon tubing

Air pump calibration equipment

Quart and gallon size re-sealable bags

Indelible ink pen for labeling sample containers

Camera for photographic documentation

Sample coolers, packing material

3. Hold the flow meter so that it is vertical and note the flow rate.
4. Adjust the flow rate drawn by the pump until it meets the flow rate specified in the SAP (+/- 5%).

Three separate flow rate measurements will be obtained before and after sampling. The mean value of these six flow rate measurements will be used to calculate the volume of air drawn through the filter cassette during sampling.

Equipment Needs
(Continued)

Personal respirator, either a negative pressure full or half mask with HEPA cartridges

Safety glass's for eye protection

SAMPLE COLLECTION

Position a tripod in the location to be sampled. Set up the tripod so that the filter cassette will be positioned at a height of 4 to 6 feet above the ground (i.e., within a typical breathing zone). Secure the filter cassette to the tripod with a spring clip. The cassette should be oriented so the open face of the cowl is pointing downward to avoid particulate entering the filter by precipitation. Remove the protective cap over the open face of the cowl and turn on the calibrated pump. Record the starting time, sample identification, and initial flow rate on the field form. The pump should be periodically checked during the collection of any samples over a period longer than two hours to ensure the pump is working properly and that the flow rate is stable. After the specified sampling time has elapsed, measure the ending pump flow rate and record the time and flow rate on the field form. Turn off the pump and remove the cassette. Place the end caps on the cassette and place a seal over the end caps in a manner that will prevent the removal of the end caps without tearing the seal.

IDENTIFICATION OF SAMPLES

Assign a unique sample ID number to each sample location. This ID number should be placed on the filter cassette prior to shipment to the certified laboratory for analysis.

SAMPLE ANALYSIS, PACKAGING, & SHIPMENT

Lead sample cassettes will be packaged and shipped in accordance with SOP-4, and analyzed in accordance with NIOSH 7082 for detection of lead in air. In general, air sample analysis for asbestos will be completed utilizing Phase Contrast Microscopy (PCM) techniques for field verification of asbestos, in accordance with the National Institute for Occupational Safety and Health (NIOSH) Method 582. Results from the air sampling event will be reported in fibers per cubic centimeter of air (f/cc) and measured against current Occupational Safety and Health Administration (OSHA) permissible exposure limits (PEL) for asbestos. If the OSHA PEL for asbestos is exceeded, or if gross contamination is observed by accredited asbestos personnel, the air sample cassettes will be packaged and shipped under chain-of-custody procedures to a recognized laboratory participating in the National Voluntary Laboratory Accreditation Program (NVLAP) for analysis in accordance with the NIOSH Method 7402, utilizing Transmission Electron Microscopy (TEM).

QUALITY CONTROL

The following quality control samples will be submitted:

- Field Blank – One field blank will be collected per sampling event. Field blanks will be collected by removing the end caps on a new filter cassette at a representative sample location. Hold the

cassette open for approximately 30 seconds. Close and seal the cassette as described above and submit it for analysis with the other sample cassettes. Field blanks are not required for lead sample collection.

- Lot Blank – For final clearance air sampling in schools or for consulting firms not participating in the Industrial Hygiene Proficiency Testing Program (consulting firms capable of performing filed verification of asbestos), one filter or "lot" blank will be submitted to a NVLAP accredited laboratory for TEM analysis. Whereby, one new filter cassette will be randomly selected and submitted with the sample cassettes for analysis and all filter cassettes for the sampling event will be rejected if any asbestos fiber is detected on any filter. However, for field verification of asbestos in industrial type settings or office buildings, boiler rooms, mechanical rooms, etc. "lot" blanks are generally analyzed by the accredited asbestos personnel utilizing PCM techniques.

SOP-30

MATERIAL METHAMPHETAMINE SAMPLING

This SOP describes the process that should be used to evaluate the presence of methamphetamine (meth) on building materials. The procedure described below provides guidance on how to systematically evaluate for meth when there is an indication that meth cooking occurred at the facility. Meth-related sampling should only be completed by a certified Meth Cleanup Contractor Supervisor.

SITE RECONNAISSANCE

When completing initial sampling, a site reconnaissance of the property should be completed to identify chemical usage and potential discharge of chemicals. Items to be evaluated during on-site inspection of the property should include:

- Attics and crawlspace areas
- Outbuildings
- Bathrooms for evidence of dumping
- Presence/absence of septic systems
- Discarded chemicals in potential or confirmed cooking areas, burn piles and waste disposal areas onsite

Whether additional assessment of these areas in addition to building materials is warranted, will depend on what is found during the site reconnaissance. Sampling approaches for these areas is not addressed in this SOP. You should consult with the project manager to devise a sampling strategy for these other areas.

After it has been confirmed the property was used for meth cooking through review of DEQ, Health Department, or Police records, or by visual reconnaissance of the property, interior finishes should be considered as contaminated with meth. Wipe samples should be collected to confirm/or deny the presence of meth as described in SOP-28 MethChek Immunoassay, the results of this screening determining whether additional analytical testing for meth is required. If the MethCheck Immunoassay wipe samples are positive for the presence of meth, an additional wipe sample of the material should be collected and analyzed for meth using EPA Method

8270C-modified. The same wipe sampling process described in SOP-28 should be used to complete the sampling.

Purpose

To identify the specific requirements for methamphetamine sampling

Goal and Objective

To employ a method of methamphetamine sampling that ensures staff safety and consistent sampling procedures

Equipment Needs

Disposable Coveralls w/ bootees (Tyvek® suit or equivalent)

Latex gloves

Safety glasses

½-face air purifying respirator

Tape (duct or equivalent)

Wax paper or plastic sheeting to place equipment on

Gauze

Spray bottle of alcohol

Sample container/vial

Indelible ink pen for labeling sample

Disposable bag for waste

Photo ionization detector (PID) for testing plumbing (e.g. sink drains)

SOP-31

PRECURSORY METHCHECK SAMPLING

PRECURSORY SAMPLING PREPARATION

MethChek Immunoassay sampling may be utilized during an initial inspections to detect for potential meth contamination. MethChek Immunoassay sampling may also be utilized to check cleanliness of a work area prior to final clearance wipe sampling.

- Put on clean latex gloves supplied in kit. Use a new pair of clean gloves for each test.
- Place wax paper on level surface in close proximity to sample area.
- Place Step 2 Extractor bottle on wax paper.
- Remove plunger from syringe and place on wax paper.
- Place supplied template (100 cm2) on test surface. It is recommended to tape template to surface.
- Prepare Step 1 Wetting Agent by removing cap and replacing cap with spray nozzle.
- Prime spray bottle in a waste can (or equivalent).
- Remove supplied gauze pad from package and spray gauze pad 2-times with Step 1
- Wetting Agent at a distance of approximately 4-inches.

PRECURSORY SAMPLE COLLECTION

- Use firm hand pressure, collect the sample by wiping the surface inside the template with moistened gauze pad in a "W", then "Z", and then "W", pattern. Try not to trap of push residue from sampling area under template. Also, when wiping try to orient the to concentrate the sample in one area on the gauze, which will enhance extraction.
- Insert gauze pad containing sample into syringe.
- Insert syringe into plunger and gently push gauze pad toward base of syringe, remove plunger.
- Hold syringe over the plastic tray, then open and pour Step 2 Extractor into syringe.
- Continue holding syringe tip over the plastic tray and slowly insert plunger into syringe, depressing the plunger to compress and extract the sample into the plastic tray. Continue depressing the plunger onto the gauze pad until liquid no longer flows.

Purpose

To identify the specific requirements for precursory methcheck sampling

Goal and Objective

To employ a method of precursory methcheck sampling that ensures staff safety and consistent sampling procedures

Equipment Needs

Gloves

Templates (10 cm x 10 cm)

Tape (duct or equivalent)

Plastic "disposable" Trays

Wax paper

Gauze

Swabs

Pipettes

Vials

Latex Gloves

Safety Glasses

Disposable test packet bag

Personal protective equipment (use discretion based on condition of sampling area)

- Place syringe tip in liquid in the plastic tray and slowly pull plunger halfway to draw sample back into syringe.
- Repeat the process by depressing the plunger to compress the gauze pad until liquid no longer flows.
- Remove and place Step 3 Cartridge from packet and place on wax paper.
- Use supplied disposable pipette to extract liquid from the plastic tray and place 3-drops of the extracted liquid into the sample well (marked "S") on the Step 3 Cartridge.
- Observe Step 3 Cartridge. Lines will appear within one minute, results will develop completely within 5-minutes. Do not disturb cartridge during sample development.
- See Reading MethChek Results on page 7 of the Operating Instructions Manual.
- Record and report results for client.
- MethChek results are reported in 0.05, 0.1, 0.5, and 1.5 micrograms per 100 cm2 for the lower limit of identification (LLOI).

SOP-32

ASBESTOS FIBER AIR SAMPLE COLLECTION

FINAL CLEARANCE VISUAL & AIR SAMPLE COLLECTION

Following asbestos abatement operations, abatement personnel will communicate that the abatement work is completed and the following tasks will be performed:

- Asbestos accredited personnel will meet asbestos abatement contractor on site.
- Don disposable protective clothing and personal respirator.
- Conduct a final clearance visual inspection of the work area containment to insure that all asbestos-containing building materials (ACBM) have been abated from the work area.
- Once the final clearance visual inspection has been completed, the abatement contractor will apply a thin layer of encapsulant to lock-down any loose fibers from the abatement operation.
- Allow work area to dry for approximately 1-hour.
- Accredited personnel will calibrate sampling pumps, not to exceed 16 LPM.
- Accredited personnel will re-enter the work area containment with sampling equipment.
- Place tripod stand, sample pump, tubing, and TEM air sample cassette in 5-different locations within the work area containment.
- Remove cap on TEM air sample cassette and turn pump on. Allow pump to run long enough to insure a sample volume of no less than 1,199 and no more than 1,599 liters of air.
- Stop sample pumps at the appropriate time to insure no less than 1,199 liter of air have been collected.

SAMPLE PREPARATION FOR SHIPMENT

- Insure that all caps are in place on TEM air sample cassette (*Note – Laboratories scheduled to perform TEM analysis will not accept any sample cassette with missing or dislodged caps).
- Insure labels are filled out completely (e.g. date, sample number, pump ID, flow rate, start time, and stop time).

Purpose

To identify the specific requirements for Asbestos Fiber Air Sample Collection

Goal and Objective

To employ a method of asbestos fiber air sample collection to ensure staff safety and consistent sampling procedures

Equipment Needs

5-high flow vacuum pumps capable of collecting air samples from .5-16 liters per minute (LPM)

5-tripod stands

7-TEM air sample cassettes with mixed cellulose ester (MCE) filters of .045µm pore size. (5-air sample cassettes for sample collection, one field blank (open 30-seconds), and one lab blank)

Labels and indelible ink pen for labeling air sample cassettes

Calibration instrument to calibrate air sample pumps

Extension cords

Box fan

Duct Tape (or equivalent).

Chain-of-Custody

Disposable protective clothing with bootees

- Use two pieces of duct tape (one for the tips of the air sample cassettes and one for the bottoms of the cassettes). Insure that the length of the duct tape is long enough, such that the seven sample cassettes can be placed on the duct tape. Wrap the duct tape up the side of the cassettes to seal the caps. Use the second piece of duct tape to secure the tips of the sample cassettes.
- Completely fill out the chain-of-custody and ship to a NVLAP (National Voluntary Laboratory Accreditation Program) laboratory.

Equipment Needs
(continued)

Personal respirator, either a negative pressure full or half mask with HEPA cartridges

SAMPLE ANALYSIS & MEASUREMENT

Request laboratory analysis - Asbestos Fiber Analysis by Transmission Electron Microscopy, Performed by EPA 40 CFR Part 763 Appendix A to Subpart E.

QUALITY ASSURANCE/QUALITY CONTROL

Laboratories will have QA/QC guidelines.

SOP-33

AMBIENT AIR SAMPLING WITH SORBENT TUBE FOR TO-17 ANALYSIS

GENERAL PROCEDURE – ACTIVE METHOD

1. Determine the desired flow rate and sampling time in accordance with Table 1 shown below. If low detection limits are desired (parts per million to parts per trillion range) between 1000 and 6000 mL of sample should be collected.

Table 1. Sampling Time, Flow Rate, and Volume Guide

Time (Minutes)	Flow Rate (mL/min) 20	50	80	100
5	100	250	400	500
10	200	500	800	1000
15	300	750	1200	1500
20	400	1000	1600	2000
30	600	1500	2400	3000
60	1200	3000	4800	6000

= Will result in high to mid ppb reporting limits
= Mid to low ppb reporting limits
= Low ppb to ppt reporting limits

2. Calibrate the flow rate of the air pump with the calibration tube attached (do not attach the sampling tube for this step), then turn off the sampling pump.

3. Allow sample tubes to reach ambient temperature, including the tube to be used for a field blank.

4. Record the tube serial number on the chain of custody form. Do not mark on the tube or label the tube directly.

5. Place the sampling pump at the desired sampling location. If sampling from the center of the room at breathing height of 3 to 5 feet, use a tripod to suspend the pump at the appropriate location. Use inert straps, string, or chains to suspend the pump (do not use tape, which may off-gas contaminants).

6. Attach inert tubing to the pump as an adapter from the pump to the sampling tube.

Purpose

To describe field sampling methodology for ambient air using sorbent tube, including both active pumping and passive sorption techniques.

Goal and Objective

To ensure sorbent tube samples are collected correctly and consistently in the field.

Equipment Needs – Active Method

Sampling tube with wrenches for each end

Air sampling pump (20 to 100 mL/min)

Airflow calibrator

Tripod (optional)

Equipment Needs – Passive Method

Sampling cartridge with diffusive body, supporting plate, glass case, and stopper such as Radiello system by Supelco

Shipping Case for Tube

Sample ID Bag

Tripod (optional)

7. Using wrenches, remove the caps from the end of the tube (do not remove the identification clip from the tube).

8. Place the outlet end of the tube into the tubing connected to the pump. The grooved inlet end of the tube should be facing away from the pump.

9. Turn on the pump, and note the time and date.

10. Operate the pump for the pre-determined amount of time (see Step 1), then shut the pump off and note the time and date, total duration of sampling, and sampled volume. (Do not exceed the sampled volume recommended for the tube and analytical method, for example use a maximum volume of 6 L for typical conditions.)

11. Recap both ends of the tube using the original fittings from that tube. Turn caps only ¼ turn past finger-tight, otherwise tubes may become damaged and/or unusable.

12. Pack sample tubes (including field blank) in plastic shipping cases, then enclose each sample in a labeled plastic bag. Place the enclosed samples in a cooler with frozen ice packs or other sealed cooling media to keep the samples near 4°C. Place the chain of custody form in the cooler, seal the cooler, and ship the cooler to the laboratory.

GENERAL PROCEDURE – PASSIVE METHOD

1. Verify whether the expected overall concentration of all air contaminants exceed 2,000 micrograms per cubic meter. If no, use standard media such as Cabograph. If yes, use activated charcoal media.

2. When ready to sample, note the date and time on the Radiello label, and on the sample bag using a non-solvent marking instrument (i.e. do not use Sharpie pens or similar).

3. Remove the cartridge from the plastic shipping case and glass tube, and put it in the diffusive (yellow) body in an upright vertical position. (Do not touch the cartridge with exposed fingers. Do keep the associated parts together in one sample bag.)

4. Ensure that the cartridge is seated completely flush with the top of the diffusive body. If the cartridge is sticking out even a small amount such as a millimeter, tap on the bottom of the diffusive body to cause the cartridge to seat properly. (Do not touch the sides of the diffusive body.)

5. With the cartridge still in a vertical position to retain the seated cartridge, screw the diffusive body into the supporting plate.

6. Place the assembled device in the sampling location. (See Item 5 of Active Method for breathing zone sampling using a tripod. If outdoors, provide protection from precipitation.)

7. At the end of sampling, record the date and time on the Radiello label and sample bag, unscrew the diffusive body, transfer the cartridge into the glass tube, seal the tube with stopper. Put the glass tube in the plastic shipping case, then place the sample into the sample bag. Peel the label off the supporting plate and attach it to the sample bag. Fill out the chain of custody form in conformance with the accurate sampling interval listed on the label, and ship the sample(s) to the laboratory.

SOP-34

SAMPLING GROUNDWATER WITH A HYDRASLEEVE™

Before installing a HydraSleeve™ in any well, you will need to know the following:

- Inside diameter of the well
- Length of the well screen
- Water level in the well
- Position of the well screen in the well
- Total depth of the well

Non-disposable equipment to be placed down the well must be decontaminated.

Field sampling forms must be completed for each well to document sampling.

COLLECTING WATER SAMPLES

Label each sample container with the project number(s), sample location, well owner, date, military time, sampler's initials, preservative, and analysis required.

Always wear sterile gloves when handling and discharging the HydraSleeve™. Assemble the HydraSleeve™ using the manufacturer's instructions.

Before deploying the HydraSleeve™ in the well, obtain the depth-to-water measurement to establish the preferred position of the HydraSleeve™ in the well. Measure the precise amount of tether needed to suspend the sleeve in the well, make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve.

Deploy and retrieve the sampling unit per the attached instructions provided by GeoInsight.

The recovered HydraSleeve™ and the sample release tubing should be disposed as per the waste management plan for the site.

Purpose

To describe field sampling methodology for collection of ground-water samples directly from the screened interval of a well without having to purge the well prior to sample collection.

Goal and Objective

To ensure appropriate sample collection from within the screen using a single-use disposable) sampler.

Equipment Needs

HydraSleeve ™ and discharge tube (designed for one-time use only)

Spring Clip

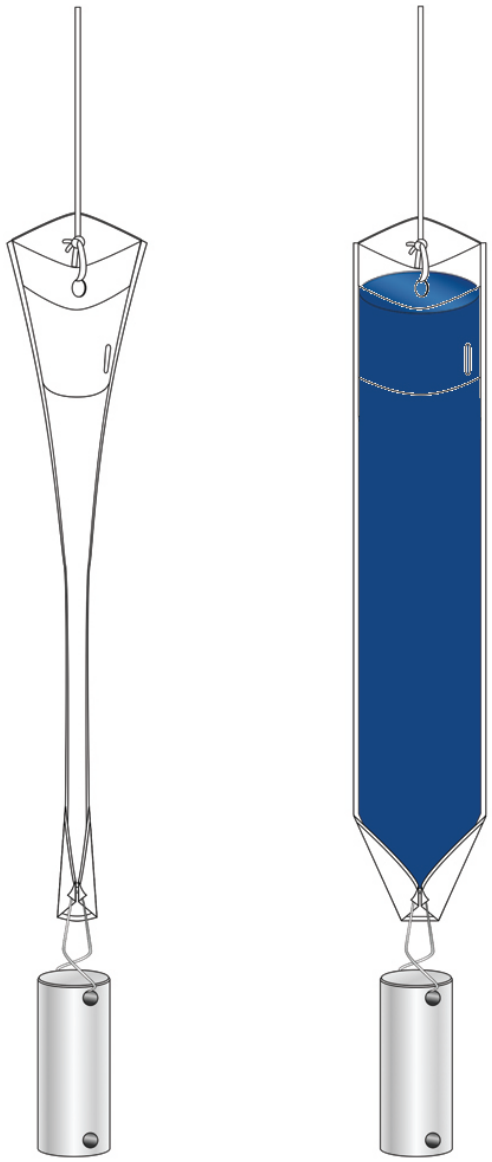
Weight and Weight Clip

Suspension cord, generally disposed after one use unless it is dedicated to the well.

HYDRASleeve™

Simple by Design US Patent No. 6,481,300; No. 6,837,120 others pending

Standard Operating Procedure: Sampling Ground Water with a HydraSleeve



This Guide should be used in addition to field manuals appropriate to sampling device (i.e., HydraSleeve or Super Sleeve).

Find the appropriate field manual on the HydraSleeve website at http://www.hydrasleeve.com.

For more information about the HydraSleeve, or if you have questions, contact: GeoInsight, 2007 Glass Road, Las Cruces, NM 88005, 1-800-996-2225, info@hydrasleeve.com.

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Introduction

The HydraSleeve is classified as a no-purge (passive) grab sampling device, meaning that it is used to collect ground-water samples directly from the screened interval of a well without having to purge the well prior to sample collection. When it is used as described in this Standard Operating Procedure (SOP), the HydraSleeve causes no drawdown in the well (until the sample is withdrawn from the water column) and only minimal disturbance of the water column, because it has a very thin cross section and it displaces very little water (<100 ml) during deployment in the well. The HydraSleeve collects a sample from within the screen only, and it excludes water from any other part of the water column in the well through the use of a self-sealing check valve at the top of the sampler. It is a single-use (disposable) sampler that is not intended for reuse, so there are no decontamination requirements for the sampler itself.

The use of no-purge sampling as a means of collecting representative ground-water samples depends on the natural movement of ground water (under ambient hydraulic head) from the formation adjacent to the well screen through the screen. Robin and Gillham (1987) demonstrated the existence of a dynamic equilibrium between the water in a formation and the water in a well screen installed in that formation, which results in formation-quality water being available in the well screen for sampling at all times. No-purge sampling devices like the HydraSleeve collect this formation-quality water as the sample, under undisturbed (non-pumping) natural flow conditions. Samples collected in this manner generally provide more conservative (i.e., higher concentration) values than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling (Parsons, 2005).

Applications of the HydraSleeve

The HydraSleeve can be used to collect representative samples of ground water for all analytes (volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], common metals, trace metals, major cations and anions, dissolved gases, total dissolved solids, radionuclides, pesticides, PCBs, explosive compounds, and all other analytical parameters). Designs are available to collect samples from wells from 1” inside diameter and larger. The HydraSleeve can collect samples from wells of any yield, but it is especially well-suited to collecting samples from low-yield wells, where other sampling methods can’t be used reliably because their use results in dewatering of the well screen and alteration of sample chemistry (McAlary and Barker, 1987).

The HydraSleeve can collect samples from wells of any depth, and it can be used for single-event sampling or long-term ground-water monitoring programs. Because of its thin cross section and flexible construction, it can be used in narrow, constricted or damaged wells where rigid sampling devices may not fit. Using multiple HydraSleeves deployed in series along a single suspension line or tether, it is also possible to conduct in-well vertical profiling in wells in which contaminant concentrations are thought to be stratified.

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As with all groundwater sampling devices, HydraSleeves should not be used to collect groundwater samples from wells in which separate (non-aqueous) phase hydrocarbons (i.e., gasoline, diesel fuel or jet fuel) are present because of the possibility of incorporating some of the separate-phase hydrocarbon into the sample.

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Description of the HydraSleeve

The HydraSleeve (Figure 1) consists of the following basic components:

- A suspension line or tether (A.), attached to the spring clip or directly to the top of the sleeve to deploy the device into and recover the device from the well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer.
- A long, flexible, 4-mil thick lay-flat polyethylene sample sleeve (C.) sealed at the bottom (this is the sample chamber), which comes in different sizes, as discussed below with a self-sealing reed-type flexible polyethylene check valve built into the top of the sleeve (B.) to prevent water from entering or exiting the sampler except during sample acquisition.
- A reusable stainless-steel weight with clip (D.), which is attached to the bottom of the sleeve to carry it down the well to its intended depth in the water column. Bottom weights available from the manufacturer are 0.75" OD and are available in three sizes: 5 oz. (2.5" long); 8 oz. (4" long); and 16 oz. (8" long). In lieu of a bottom weight, an optional top weight may be attached to the top of the HydraSleeve to carry it to depth and to compress it at the bottom of the well (not shown in Figure 1);
- A discharge tube that is used to puncture the HydraSleeve after it is recovered from the well so the sample can be decanted into sample bottles (not shown).
- Just above the self-sealing check valve at the top of the sleeve are two holes which provide attachment points for the spring clip and/or suspension line or tether. At the bottom of the sample sleeve are two holes which provide attachment points for the weight clip and weight.

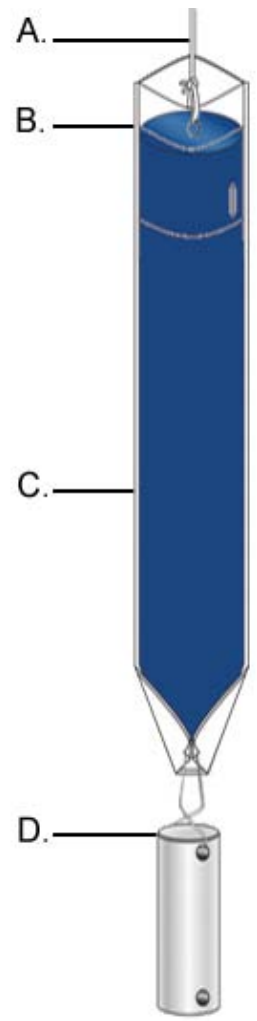

Figure 1. HydraSleeve components.

Note: The sample sleeve and the discharge tube are designed for one-time use and are disposable. The spring clip, weight and weight clip may be reused after thorough cleaning. Suspension cord is generally disposed after one use although, if it is dedicated to the well, it may be reused at the discretion of the sampling personnel.

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Selecting the HydraSleeve Size to Meet Site-Specific Sampling Objectives

It is important to understand that each HydraSleeve is able to collect a finite volume of sample because, after the HydraSleeve is deployed, you only get one chance to collect an undisturbed sample. Thus, the volume of sample required to meet your site-specific sampling and analytical requirements will dictate the size of HydraSleeve you need to meet these requirements.

The volume of sample collected by the HydraSleeve varies with the diameter and length of the HydraSleeve. Dimensions and volumes of available HydraSleeve models are detailed in Table 1.

Table 1. Dimensions and volumes of HydraSleeve models.

Diameter	Volume	Length	Lay-Flat Width	Filled Dia.
2-Inch HydraSleeves				
Standard 625-ml HydraSleeve	625 ml	< 30”	2.5”	1.4”
Standard 1-Liter HydraSleeve	1 Liter	38”	3”	1.9”
1-Liter HydraSleeve SS	1 Liter	36”	3”	1.9”
2-Liter HydraSleeve SS	2 Liters	60”	3”	1.9”
4-Inch HydraSleeves				
Standard 1.6-Liter HydraSleeve	1.6 Liters	30”	3.8”	2.3”
Custom 2-Liter HydraSleeve	2 Liters	36”	4”	2.7”

HydraSleeves can be custom-fabricated by the manufacturer in varying diameters and lengths to meet specific volume requirements. HydraSleeves can also be deployed in series (i.e., multiple HydraSleeves attached to one tether) to collect additional sample to meet specific volume requirements, as described below.

If you have questions regarding the availability of sufficient volume of sample to satisfy laboratory requirements for analysis, it is recommended that you contact the laboratory to discuss the minimum volumes needed for each suite of analytes. Laboratories often require only 10% to 25% of the volume they specify to complete analysis for specific suites of analytes, so they can often work with much smaller sample volumes that can easily be supplied by a HydraSleeve.

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HydraSleeve Deployment

Information Required Before Deploying a HydraSleeve

Before installing a HydraSleeve in any well, you will need to know the following:

- The inside diameter of the well
- The length of the well screen
- The water level in the well
- The position of the well screen in the well
- The total depth of the well

The inside diameter of the well is used to determine the appropriate HydraSleeve diameter for use in the well. The other information is used to determine the proper placement of the HydraSleeve in the well to collect a representative sample from the screen (see HydraSleeve Placement, below), and to determine the appropriate length of tether to attach to the HydraSleeve to deploy it at the appropriate position in the well.

Most of this information (with the exception of the water level) should be available from the well log; if not, it will have to be collected by some other means. The inside diameter of the well can be measured at the top of the well casing, and the total depth of the well can be measured by sounding the bottom of the well with a weighted tape. The position and length of the well screen may have to be determined using a down-hole camera if a well log is not available. The water level in the well can be measured using any commonly available water-level gauge.

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HydraSleeve Placement

The HydraSleeve is designed to collect a sample directly from the well screen, and it fills by pulling it up through the screen a distance equivalent to 1 to 1.5 times its length. This upward motion causes the top check valve to open, which allows the device to fill. To optimize sample recovery, it is recommended that the HydraSleeve be placed in the well so that the bottom weight rests on the bottom of the well and the top of the HydraSleeve is as close to the bottom of the well screen as possible. This should allow the sampler to fill before the top of the device reaches the top of the screen as it is pulled up through the water column, and ensure that only water from the screen is collected as the sample. In short-screen wells, or wells with a short water column, it may be necessary to use a top-weight on the HydraSleeve to compress it in the bottom of the well so that, when it is recovered, it has room to fill before it reaches the top of the screen.

Example

2” ID PVC well, 50’ total depth, 10’ screen at the bottom of the well, with water level above the screen (the entire screen contains water).

Correct Placement (figure 2): Using a standard HydraSleeve for a 2” well (2.6” flat width/1.5” filled OD x 30” long, 650 ml volume), deploy the sampler so the weight (an 8 oz., 4”-long weight with a 2”-long clip) rests at the bottom of the well. The top of the sleeve is thus set at about 36” above the bottom of the well. When the sampler is recovered, it will be pulled upward approximately 30” to 45” before it is filled; therefore, it is full (and the top check valve closes) at approximately 66” (5 ½ feet) to 81” (6 ¾ feet) above the bottom of the well, which is well before the sampler reaches the top of the screen. In this example, only water from the screen is collected as a sample.

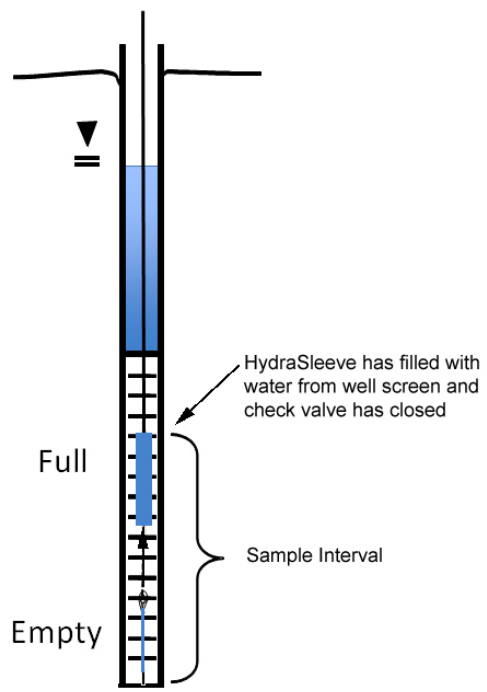

Figure 2. Correct placement of HydraSleeve.

Incorrect Placement (figure 3): If the well screen in this example was only 5' long, and the HydraSleeve was placed as above, it would not fill before the top of the device reached the top of the well screen, so the sample would include water from above the screen, which may not have the same chemistry.

The solution? Deploy the HydraSleeve with a top weight, so that it is collapsed to within 6" to 9" of the bottom of the well. When the HydraSleeve is recovered, it will fill within 39" (3 ¼ feet) to 54" (4 ½ feet) above the bottom of the well, or just before the sampler reaches the top of the screen, so it collects only water from the screen as the sample.

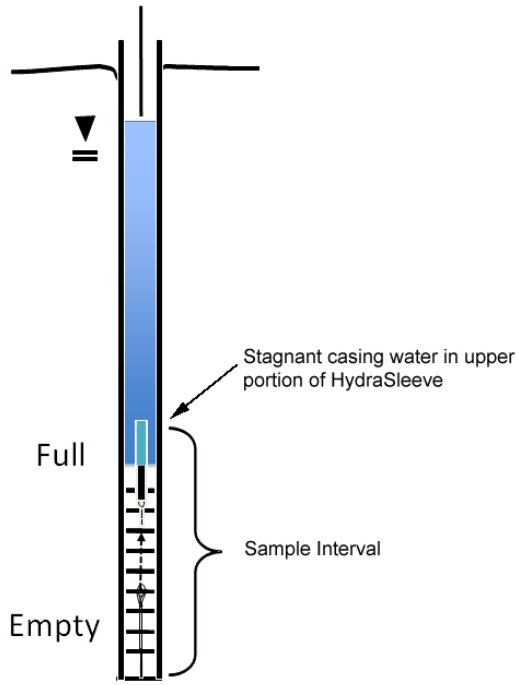

Figure 3. Incorrect placement of HydraSleeve.

This example illustrates one of many types of HydraSleeve placements. More complex placements are discussed in a later section.

Procedures for Sampling with the HydraSleeve

Collecting a ground-water sample with a HydraSleeve is a simple one-person operation.

Note: Before deploying the HydraSleeve in the well, collect the depth-to-water measurement that you will use to determine the preferred position of the HydraSleeve in the well. This measurement may also be used with measurements from other wells to create a ground-water contour map. If necessary, also measure the depth to the bottom of the well to verify actual well depth to confirm your decision on placement of the HydraSleeve in the water column.

Measure the correct amount of tether needed to suspend the HydraSleeve in the well so that the weight will rest on the bottom of the well (or at your preferred position in the well). Make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve

Note: Always wear sterile gloves when handling and discharging the HydraSleeve.

I. Assembling the HydraSleeve

1. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.
2. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.
3. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.
4. Attach the tether to the spring clip by tying a knot in the tether.

Note: Alternatively, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

5. Fold the flaps with the two holes at the bottom of the HydraSleeve together and slide the weight clip through the holes.
6. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

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II. Deploying the HydraSleeve

1. Using the tether, carefully lower the HydraSleeve to the bottom of the well, or to your preferred depth in the water column

   During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

Note: Make sure that it is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5'/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

2. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

Note: Alternatively, you can tie the tether to a hook on the bottom of the well cap (you will need to leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed at the next sampling event).

III. Equilibrating the Well

The equilibration time is the time it takes for conditions in the water column (primarily flow dynamics and contaminant distribution) to restabilize after vertical mixing occurs (caused by installation of a sampling device in the well).

- Situation: The HydraSleeve is deployed for the first time or for only one time in a well

  The HydraSleeve is very thin in cross section and displaces very little water (<100 ml) during deployment so, unlike most other sampling devices, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample.

  In most cases, the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours. In regulatory jurisdictions that impose specific requirements for equilibration times prior to recovery of no-purge sampling devices, these requirements should be followed.

- Situation: The HydraSleeve is being deployed for recovery during a future sampling event

  In periodic (i.e., quarterly or semi-annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event)

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deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

Thus, a long equilibration time is ensured and, at the next sampling event, the sampler can be recovered immediately. This means that separate mobilizations, to deploy and then to recover the sampler, are not required. HydraSleeves can be left in a well for an indefinite period of time without concern.

IV. HydraSleeve Recovery and Sample Collection

1. Hold on to the tether while removing the well cap.

2. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards)

3. Measure the water level in the well.

4. In one smooth motion, pull the tether up between 30” to 45” (36” to 54” for the longer HydraSleeve) at a rate of about 1’ per second (or faster).

   The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1 to 1.5 times the length of the HydraSleeve). This is analogous to coring the water column in the well from the bottom up.

   When the HydraSleeve is full, the top check valve will close. You should begin to feel the weight of the HydraSleeve on the tether and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

5. Continue pulling the tether upward until the HydraSleeve is at the top of the well.

6. Decant and discard the small volume of water trapped in the Hydrasleeve above the check valve by turning the sleeve over.

V. Sample Collection

Note: Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity.

1. Remove the discharge tube from its sleeve.

2. Hold the HydraSleeve at the check valve.

3. Puncture the HydraSleeve just below the check valve with the pointed end of the discharge tube

4. Discharge water from the HydraSleeve into your sample containers.

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Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both.

5. Continue filling sample containers until all are full.

Measurement of Field Indicator Parameters

Field indicator parameter measurement is generally done during well purging and sampling to confirm when parameters are stable and sampling can begin. Because no-purge sampling does not require purging, field indicator parameter measurement is not necessary for the purpose of confirming when purging is complete.

If field indicator parameter measurement is required to meet a specific non-purging regulatory requirement, it can be done by taking measurements from water within a HydraSleeve that is not used for collecting a sample to submit for laboratory analysis (i.e., a second HydraSleeve installed in conjunction with the primary sample collection HydraSleeve [see Multiple Sampler Deployment below]).

Alternate Deployment Strategies

Deployment in Wells with Limited Water Columns

For wells in which only a limited water column exists to be sampled, the HydraSleeve can be deployed with an optional top weight instead of a bottom weight, which collapses the HydraSleeve to a very short (approximately 6” to 9”) length, and allows the HydraSleeve to fill in a water column only 36” to 45” in height.

Multiple Sampler Deployment

Multiple sampler deployment in a single well screen can accomplish two purposes:

- It can collect additional sample volume to satisfy site or laboratory-specific sample volume requirements.
- It can accommodate the need for collecting field indicator parameter measurements.
- It can be used to collect samples from multiple intervals in the screen to allow identification of possible contaminant stratification.

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It is possible to use up to 3 standard 30” HydraSleeves deployed in series along a single tether to collect samples from a 10’ long well screen without collecting water from the interval above the screen.

The samplers must be attached to the tether at both the top and bottom of the sleeve. Attach the tether at the top with a stainless-steel clip (available from the manufacturer). Attach the tether at the bottom using a cable tie. The samplers must be attached as follows (figure 4):

- The first (attached to the tether as described above, with the weight at the bottom) at the bottom of the screen
- The second attached immediately above the first
- The third (attached the same as the second) immediately above the second

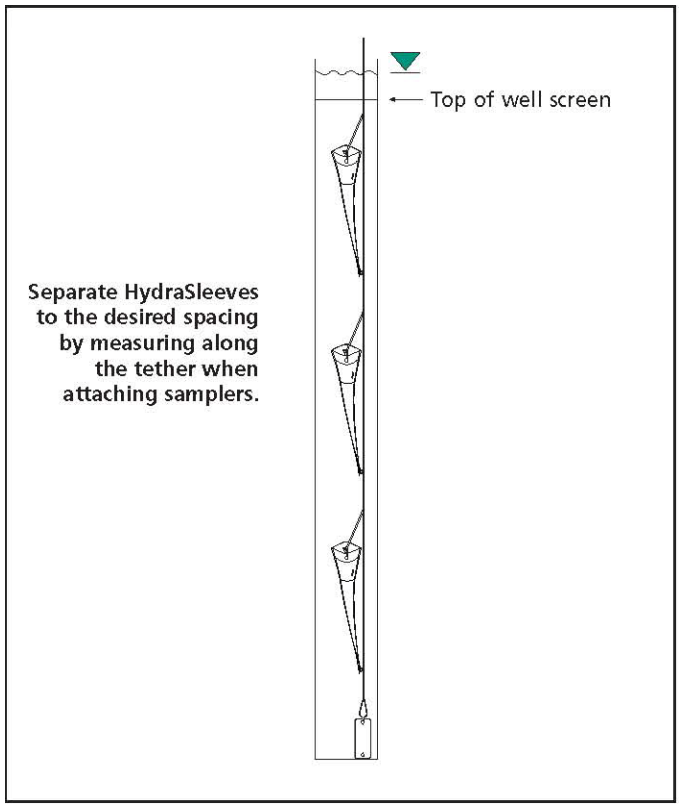

Figure 4. Multiple HydraSleeve deployment.

Alternately, the first sampler can be attached to the tether as described above, a second attached to the bottom of the first using a short length of tether (in place of the weight), and the third attached to the bottom of the second in the same manner, with the weight attached to the bottom of the third sampler (figure 5).

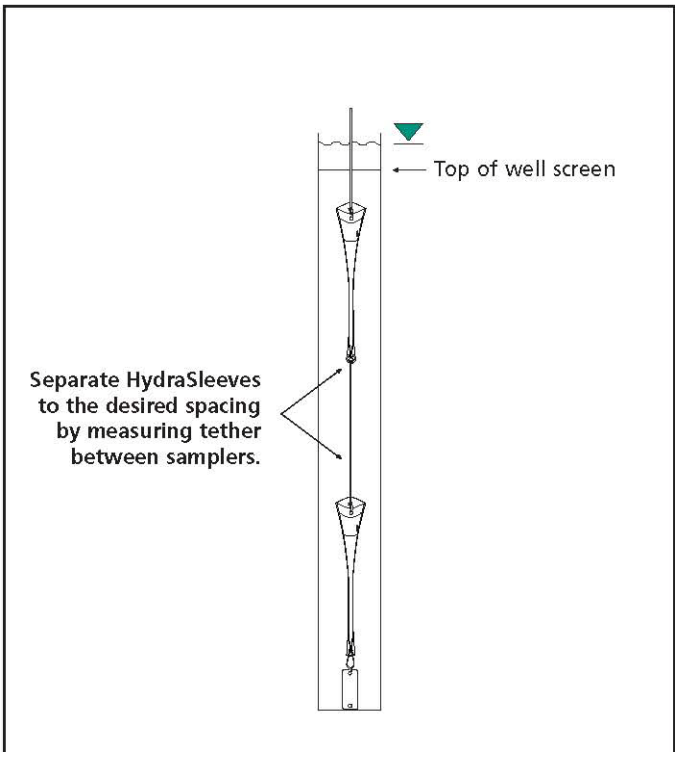

Figure 5. Alternative method for deploying multiple HydraSleeves.

In either case, when attaching multiple HydraSleeves in series, more weight may be required to hold the samplers in place in the well than would be required with a single sampler. Recovery of multiple samplers and collection of samples is done in the same manner as for single sampler deployments.

Post-Sampling Activities

The recovered HydraSleeve and the sample discharge tubing should be disposed as per the solid waste management plan for the site. To prepare for the next sampling event, a new HydraSleeve can be deployed in the well (as described previously) and left in the well until the next sampling event, at which time it can be recovered.

The weight and weight clip can be reused on this sampler after they have been thoroughly cleaned as per the site equipment decontamination plan. The tether may be dedicated to the well and reused or discarded at the discretion of sampling personnel.

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McAlary, T. A. and J. F. Barker, 1987, Volatilization Losses of Organics During Ground-Water Sampling From Low-Permeability Materials, Ground-Water Monitoring Review, Vol. 7, No. 4, pp. 63-68

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APPENDIX B

Laboratory Quality Assurance Planning Documents

CEI LABS, INC
STANDARD OPERATIONS AND PROCEDURES:

Method 400: Bulk Analysis by PLM

"Preparation and Analysis of Bulk Asbestos Material via Polarized Light Microscopy"

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Appendices:
Appendix I – Record Formats
Appendix II – Frequency of QC Activities and Laboratory Calibrations
Appendix III – CEI Labs, Inc. PLM Training Program

CEI Labs, Inc.
Method Number: PLM BULK SOP 400
Last Revision: February 2014
Revision: January 2015

1.0 Scope and Application

1.1 Bulk sample analysis by polarized light microscopy follows guidelines set forth in *40 CFR, Chapter 1 (7-1-87 Edition), Part 763, subpart F, Appendix A, pages 293-299*. Where applicable, procedures from *EPA/600/R-93/116 Method for the Determination of asbestos in Bulk Building Materials,* have been incorporated. No alternative methods shall be used without the approval of the Laboratory Director.

2.0 References

2.1 Primary sources for this method are 40 CFR, *Part 763, subpart F, Appendix A, pages 293-299,* along with *EPA 600/M4-82-020 Interim Method for the Determination of Asbestos in Bulk Insulation Samples*, and procedures from *EPA/600/R-93/116 Method for the Determination of asbestos in Bulk Building Materials*. The method is intended to comply with *the NIST Handbook, 150-3, Bulk Asbestos Specific Operations* Manual.

2.2 Other Laboratory Reference Materials:

2.2.1 40 CFR Part 763, Vol. 52, No. 210 *Asbestos Containing Materials in Schools; Final Rule and Notice*.

2.2.2 *Optical Mineralogy - Theory and Techniques. Volume 1*. 1987. Ernest G. Ehlers.

2.2.3 *Manual of Mineralogy*. 21st Edition. 1993 Cornelis Klein, Cornelius S. Hurlbut. After J.D. Dana

2.2.4 *Asbestos in Buildings - Bulk Sample Analysis*. 1990. The Environmental Institute.

2.2.5 EPA/600/R-93/116 July 1993. *Method for the Determination of Asbestos in Bulk Building Materials* R.L. Perkins and B.W. Harvey.

2.2.6 NIST Reference Manuals/Books 150 (rev. 2006-03-08) & 150-3, 150-13

3.0 Summary of Method

3.1 Trained analysts receive samples through the laboratory's procurement procedures.

3.2 Using a variety of techniques, and an examination of the material using a magnifying stereoscope, the analyst pulverizes, combusts, melts, or dissolves the sample to make a slide preparation.

3.3 After a slide preparation is prepared using solvent, refractive index oil, and/or dilute HCl, the analyst observes the preparation under the polarized light microscope.

3.4 The analyst determines, based on those optical properties obtained with a polarized light microscope, whether asbestos is present in the tested material, and at what percentage is present by a calibrated visual estimate.

3.5 Quantifying the percent asbestos in a sample by point count may occur at the customer's request.

3.6 Results for each sample are submitted to the customer in the form of a test report.

4.0 Sample Collection/Procurement

4.1 Samples that are collected by CEI Labs in accordance with 40 CFR Part 763, Vol. 52, No. 210 "Asbestos-Containing Materials in Schools; Final Rule and Notice".

4.2 Modifications of this method are used when sampling in areas not under the regulation of AHERA.

4.3 Samples received by the laboratory from its customers are sampled out of the laboratory's control, and analysis is performed only on samples submitted under the conditions the samples are received.

5.0 Sample Log-In and Distribution

5.1 Samples are received and logged for proper test type according to The CEI QA Manual Section 2A.5.8 "Technical Requirements: Handling of Test Items". Samples are received daily via courier, US Mail, or hand delivery. The items are opened in a negative air flow HEPA filtered acrylic hood, and prepared for login and distribution.

5.2 Procedures Specific Login and Distribution of Bulk Asbestos Samples:

5.2.1 Samples received in each sample lot are assigned a unique laboratory identification code and placed in a re-sealable plastic bag.

5.2.2 Information on each sample lot is to be recorded in the Bulk Asbestos Log Book kept available in the laboratory, on the chain of custody, and on the sample bag itself. This information will include the following:

5.2.2.1 Customer's name

5.2.2.2 Date of sample receipt,

5.2.2.3 Assigned project code

5.2.2.4 Total number of samples

5.2.2.5 Assigned laboratory identification numbers

5.2.2.6 The initials of the person making the above entries in the sample log book for each sample lot.

5.2.3 Criteria for sample rejection: In cases where incoming samples are rejected, clients are to be promptly notified. Reasons for rejection will be explained to the client and the client will be asked to resubmit the sample(s). Criteria for sample rejection are listed below:

5.2.3.1 Improperly packaged samples will not be accepted for analysis.

5.2.3.2 Sample containers that do not contain enough bulk material for accurate analysis should not be accepted.

5.2.3.3 Samples that are not properly identified with unique field identification numbers may not be accepted.

5.2.3.4 Samples that do not have the proper paperwork attached may not be accepted.

5.2.4 After samples are logged-in, they are to be placed in the polyethylene bin in the laboratory marked "Logged-in". These samples are now ready to be analyzed.

5.2.5 The Laboratory Manager / Quality Manager selects samples on a daily basis from the “Logged-in” bin for each analyst to analyze and places the samples in a polyethylene bin labeled “IN”. The

Manager will select less than the maximum capacity for each analyst on most occasions.

5.2.6 When the analyst completes his/her analyses on each work order, the samples are selected for Quality Control Analyses.

5.2.7 Quality Control Selection and Distribution

5.2.7.1 Prior to the submission of any customer report, the original analyst takes his/her samples to a designated QA/QC selector (non-analyst, or secondary analyst who is not duplicating the samples) who pulls ten percent of the samples to be reanalyzed as QC samples.

5.2.7.2 The original analyst delivers two thirds of the selected samples to their assigned QC analysts for duplication and keeps one third for replication.

5.2.7.3 Multiple QC analysts are assigned daily to each analyst by quality control staff.

5.2.7.4 In the event that neither assigned QC analyst is present or available to read QC samples, the original analyst is permitted to select their own QC analyst.

5.2.7.5 In the event that none of the assigned QC analysts are available (e.g. on weekends) then the analyst is permitted to to select his/her own QC analyst for duplicate analysis.

5.2.8 Once Quality Control is complete, and any non-conforming work is resolved via corrective action, the analyst may place the samples in a 30-gallon bin for disposal in accordance with Federal, State, and Local Regulations.

6.0 Facilities, Equipment, and Materials

6.1 PLM samples are analyzed at CEI Labs, Inc. (CEI). CEI occupies suites at 105, 107,109, 116, & 118 New Edition Court, Cary, NC 27511. The PLM department is located in Suites 107, and 109, with over 1500 sq. feet of tiled workspace devoted to PLM analysis.

6.2 An Equipment Manual is maintained by CEI for the PLM department. The manual describes major pieces of equipment and maintenance procedures and records as required by Section 2A.5.5 of the CEI Quality Assurance Manual.

6.2.1 CEI has a number of workstations for its PLM analysts. Each workstation is equipped with the following items:

6.2.1.1 A Nikon BH 2, Nikon BHS, or Leika DM EP polarized light microscope with 10x occulars w/ crosshair reticule, ≥530 nm wavelength retardation plate, bertrand lens, 10x, 20x(optional), 10x dispersion staining, and 40x objectives, rotating stage, internal or external light source, and substage condenser equipped with achromat;

6.2.1.2 Magnifying dissecting stereoscope (10x up to 40x) with external light source;

6.2.1.3 HEPA filtered negative air flow hood capable of pulling an average air velocity of 60 ft/ minute,

6.2.1.4 A counter-top hot plate capable of reaching at temperature of 100°C;

6.2.1.5 Cleaning supplies and low lint paper tissue.

6.2.1.6 Refractive Index Oils, HD1.550 series E, 1.680 series B, HD1.605 series E, HD1.640 series E;

6.2.1.7 NaCl, Reagent Grade;

6.2.1.8 Mortar and Pestle;

6.2.1.9 #4 Scalpel Blade Handles with #20 Scalpel Blades.

6.2.1.10 Jeweler's forceps, 2 pair;

6.2.1.11 Spatula;

6.2.1.12 25mm x 75mm plain glass slides;

6.2.1.13 22mm x 22mm 1.5 thickness cover glass;

6.2.1.14 Powder-free latex examination gloves (large, medium, or small;

6.2.1.15 Pencil eraser or laboratory "squash" tool;

6.2.1.16 Dilute (10%) HCl solution;

6.2.1.17 Microscope lens cleaner.

6.2.2 CEI labs also maintains the following for use by all laboratory employees as needed:

6.2.2.1 (2 sets) Refractive Index Oils, Maximum increments of 0.005 (or less) from 1.490-1.570 and 1.590-1.72

6.2.2.2 Optical Glass Standards. Cargille M-7 Reference set.

6.2.2.3 NIST Standard Reference Materials. (SRM 1866 Bulk Asbestos – Common & SRM 1867 Bulk Asbestos – Uncommon)

6.2.2.3 Muffle Furnace (capable of reaching 480°C).

7.0 Personnel and Training Requirements

7.1 Analysts typically are required to have a B.S. degree in the life or physical sciences and one year of laboratory experience. However, it is also recognized that accurate analysis of bulk asbestos requires attention to detail, common sense, diligent work practices, teamwork, and ethical conduct.

7.2 Exceptional applicants without a college degree, but with appropriate laboratory experience, may be considered for hire. Training schedules vary with the level of skill of each "New" Analyst; however, basic steps for in-house training are as follows:

7.2.1 "New" Analysts read the SOP/Quality Management System manual and become familiar with basic terminology and methodology. New employees are encouraged to ask questions as they are encountered.

7.2.2 "New" Analysts complete in-house instruction conducted by the Laboratory Manager as specified in appendix II. Classroom training follows a McCrone format, with special emphasis placed on the identification of asbestos in bulk materials.

7.2.3 "New" Analysts are then paired with experienced Analysts who assist them in analyzing a set of 50 In-house library samples. The library samples have established percentage components by volume. Results of the "New" Analyst are compared with established laboratory values. Discrepancies and outliers are discussed with the "New" Analyst.

7.2.4.1 "New" Analysts independently analyze a second set of 50 in-house library samples. Again the library samples have established percentage components by volume. Results of the "New" Analyst are compared with established laboratory

values. Discrepancies and outliers are discussed with the "New" Analyst.

7.2.4.2 The "New" Analyst is then permitted to analyze samples previously completed by approved CEI analysts. The “new” analyst continues with this analysis for a period of 3-4 weeks. During this time, the Quality Manager begins monitoring error rates on a weekly basis.

7.2.4.3 Based on the Quality Manager's evaluation of the "New" Analyst's overall competency, the Analyst may be allowed to begin independent analysis on a commercial basis. Experienced Analysts typically re-analyze 100% of the "New" Analyst's samples for the next 2-4 weeks.

7.2.5 The Quality Manager then selectively QC’s >10-50% of the “New” Analyst’s samples until such time that the “New” Analyst exhibits an error rate of <1% to 1.5% for samples that have been re-analyzed by an experienced analyst.

7.2.6 Depending on the "New" Analyst's educational background they may also be required to attend a McCrone Equivalency Course for asbestos identification or attend college level courses on optical mineralogy.

7.2.7 After the new analyst successfully completes the training, the Lab Director will issue an authorization letter to the new analyst stating that the new analyst is competent in analysis of bulk samples for asbestos using PLM and his/her samples are subject to CEI’s regular QC analysis. This authorization shall be signed, dated, and filed for future references.

7.2.8 The Quality Manager evaluates the training program after each new analyst is authorized to analyze commercial samples. The effectiveness of the training program is in part measured by whether or not a new analyst maintains a controllable, in range (<1%) error rate.

8.0 Microscope Alignment

8.1 The following should be performed daily, or as needed, to ensure the analysis is performed with the optimal resolution possible:

8.1.1 Center the Sub-stage Condenser.

8.1.1.1 Place a specimen (sample) on the microscope and observe the specimen at 100 power;

8.1.1.2 raise the sub-stage condenser lens to the “up” position;

8.1.1.3 close the field iris;

8.1.1.4 raise or lower the sub-stage condenser apparatus to focus the field iris image;
8.1.1.5 once focused, center the field iris image over the reticule cross-hairs;
8.1.1.6 open the field iris to edge of the field of view;
8.1.1.7 re-center the field iris image if not centered;
8.1.1.8 open the field iris so the image extends just beyond the field of view.

8.1.2 Center the rotating microscope stage to the 10x objective.
8.1.2.1 place specimen on microscope, focus, and search for a small round particle;
8.1.2.2 the analyst then manipulates the slide so the small particle is underneath the cross-hairs of the reticule;
8.1.2.3 the analyst rotates the stage a full 180 degrees;
8.1.2.4 if the particle comes off of the cross-hair, the analyst must use the *stage centering screws* to bring the particle linearly half-way back to the cross-hairs of the reticule;
8.1.2.5 manipulate the slide manually so that the same particle is under the cross-hairs of the reticule,
8.1.2.6 rotate the stage a full 180 degrees, if the particle is stationary on the cross-hairs of the reticule, the stage is centered;
8.1.2.7 if the particle comes off of the cross-hairs, repeat steps 8.1.2.1 to 8.1.2.6 until the stage is centered.

8.1.3 Center the remaining objectives (40x, 20x, 10x dispersion staining) to the rotating stage.
8.1.3.1 For each objective place specimen on microscope, focus, and search for a small round particle;
8.1.3.2 the analyst then manipulates the slide so the small particle is underneath the cross-hairs of the reticule;
8.1.3.3 the analyst rotates the stage a full 180 degrees;
8.1.3.4 if the particle comes off of the cross-hair, the analyst must use the *objective centering screws* to bring the particle linearly half-way back to the cross-hairs of the reticule;
8.1.3.5 manipulate the slide manually so that the same particle is under the cross-hairs of the reticule,
8.1.3.6 rotate the stage a full 180 degrees, if the particle is stationary on the cross-hairs of the reticule, the stage is centered;
8.1.3.7 if the particle comes off of the cross-hairs, repeat steps 8.1.3.1 to 8.1.3.6 until the stage is centered.

8.1.4 Center the central stop of the 10x dispersion staining objective.
8.1.4.1 With a specimen on the stage, switch to the 10x dispersion staining objective;

8.1.4.2 Place the sub-stage condenser lens in the “down” postion;
8.1.4.3 Open the achromat on the sub-stage condenser all the way;
8.1.4.4 Insert the Bertrand lens to observe the focal plane of the central stop;
8.1.4.5 Close the achromat;
8.1.4.6 If the image of the central stop completely covers the image of the achromat, the central stop is centered.
8.1.4.7 If the central stop does not cover the image of the achromat, use centering tools to adjust the central stop until this occurs.
8.1.4.8 The analyst may remove the Bertrand lens one this has been accomplished.

8.1.5 Ensure polarizing lenses are at a 90° angle to one another.
8.1.5.1 Place a specimen on the stage;
8.1.5.2 Insert the 530-550nm wave retardation plate;
8.1.5.3 Move the microscope analyzer to the “out” position;
8.1.5.4 Adjust the lower polarizing lens until the field is the darkest it can possibly become;

8.1.6 Ensure the reticule cross-hairs are aligned with the polarizing lenses.
8.1.6.1 Place a specimen of Anthophyllite from Reference Material 1867 Uncommon Asbestos in an HD1.605 refractive index oil on the stage and observe the specimen with the analyzer in the “out” position, and the 530-550nm wave retardation plate in the “in” position.
8.1.6.2 Observe the extinction angle of the anthophyllite; if it does not go extinct parallel to the reticule cross-hair lines, adjust the ocular until extinction parallel to the cross-hairs occurs.

8.1.7 Analysts document that the alignment procedure have been performed on a daily basis on the Daily Analyst Record Worksheet.

9.0 Sample Analysis (EPA 600)

9.1 Bulk sample analysis follows guidelines set forth in 40 CFR, Chapter 1 (7-1-87 Edition), Part 763, subpart F, Appendix A, pages 293-299. Where applicable, procedures from EPA/600/R-93/116 "Method for the Determination of asbestos in Bulk Building Materials", have been incorporated. No alternative methods shall be used without the approval of the Laboratory Director.

9.2 Stereoscopic Examination of Materials

9.2.1 All bulk asbestos samples are to be analyzed under a HEPA filtered hood with an airflow calibrated to at least 60 ft/minute.

9.2.2 A preliminary visual examination using a stereomicroscope is mandatory for all samples, but in itself does not provide positive identification of asbestos.

9.2.3 Each sample is carefully inspected for homogeneity, color, and fibrous and non-fibrous materials. This information, along with a brief description of the sample and the estimated suspect asbestos percentage of the sample is entered on the analyst Laboratory Worksheet. Any discrete layers of the sample should be analyzed and reported separately.

9.2.4 Stereoscope Magnification is increased as needed to confirm the presence or absence of suspected asbestos fibers. Fibrous bundles are isolated for Polarized Light Microscopy (PLM). Non-friable samples may require crushing with a mortar and pestle.

9.3 Polarized Light Microscopy

9.3.1 Fibers and fibrous bundles are isolated, stripped of any interfering material, and finally placed in an oil mount of refractive index as deemed appropriate by the analyst. If no fibers are visible, representative samples of the material are crushed and mounted in refractive index oil. The oil-mounted fibers are examined utilizing techniques outlined in the EPA "Interim Method" (document "EPA 600/M4-82-020"), and the EPA "Test Method" (document "EPA 600/R-93/116").

9.3.2 In Polarized Light Microscopy (PLM), a light microscope equipped with two polarizing filters is used to determine the optical properties of fibers and matrix materials in a bulk sample. These properties are then used to determine the refractive indices of materials relative to specific crystallographic orientations. In this manner, it is possible to distinguish possible asbestos components from others occurring in the sample.

9.3.3 Initial PLM examinations are made at 100X magnification. Examination at higher power, or by dispersion staining objectives may be required. Characteristics of the sample are noted on the Laboratory Report along with a visual estimate of the relative proportions of the constituents present. Visual estimation is calibrated by the use of Quality Control samples and by point count techniques.

9.3.4 Any discrete layers are reported separately on the analyst's Laboratory Worksheet. Percent asbestos will be estimated for each layer of a sample and a total-percent-asbestos (based on a composite of the sample) will be reported for samples that require a composite result.

9.3.5 The detection limit for PLM analysis is a function of the amount of material examined, the size of asbestos fibers present, the nature of any matrix materials and sample preparation.

9.3.6 Positive identification of asbestos requires the determination of the following optical properties: morphology, color, pleochroism, refractive indices, birefringence, extinction characteristics, and trace amounts should be identified as either asbestos or as non-asbestos. All optical properties listed above should be recorded for any component identified as asbestos.

9.3.7 Visual area estimates are based on a minimum of three slide mounts.

9.3.8 Trace amount of asbestos may be reported if the following conditions are met: 1) five or more positively identified asbestos fibers above laboratory's blank level are observed; 2) these fibers are spread over three or more slides; 3) no point landed on an asbestos fiber during the point count analysis.

9.3.9 For materials that are friable, and contain less than 10% asbestos by a calibrated visual estimation, a point count will be performed (at an increased cost), if the customer requests it.

9.3.10 Point Counting is accomplished using a cross-line reticule. The analyst will count a minimum of 400 nonempty points, encountered at the intersection of the cross-line during a series of random traverses through a maximum of eight slides at fifty points per slide to a minimum of two slides with 200 points per slide. The analyst will count any asbestos fibers which are among those 400 points, and the total percent asbestos will be the number of asbestos points divided by the total number of points (400). If no asbestos fibers are observed, the analyst will report "Asbestos not detected. (ND)" If the number of asbestos points counted $\leq$ three, the sample may be described as having "<1% asbestos". If the customer requires a specific percentage (i.e. even for samples with <1% asbestos), the percentage will be calculated to two significant digits. When a count is completed and asbestos is detected, but does not fall under a non-empty point, the sample should be reported as <0.25%.

9.3.11 For samples in which the fibers are heavily coated with tar or mastic that hinders analysis, using the following procedures:

9.3.11.1 Place a representative amount of sample on a slide;
9.3.11.2 Use a few drops of HD1.550 Cargille refractive index liquid to dissolve the binder;
9.3.11.3 Use forceps or needles to pick out the resulting fibers and put on a new slide;
9.3.11.4 Add 1.550 R.I. liquid and repeat steps 2 and 3 till the fibers are clean;
9.3.11.5 Mount the fibers for PLM analysis.

9.3.12 For samples in which the fibers are coated with calcite, gypsum, or titanium oxide, using the following procedures for analysis:

9.3.12.1 Place a representative amount of sample on a slide;
9.3.12.2 Place a few drops of dilute Hydrochloric Acid on the sample to dissolve or loosen binder;
9.3.12.3 Remove a few fibers from the dissolved sample with forceps and place them on a clean slide;l
9.3.12.4 Dry the fibers on a hot plate, then mount with appropriate R.I. liquid for PLM analysis

9.3.13 For non-friable cementitious samples, using the following procedures for sample analysis:

9.3.13.1 Use a hammer or anything equivalent to force the sample to break into pieces;
9.3.13.2 Pick up a few selective pieces of sample using tweezers and put in a pre-cleaned mortar;
9.3.13.3 Grind the sample into fine pieces;
9.3.13.4 Use pencil eraser to spread the powders on a slide for PLM identification;

9.3.14 For floor tile sample analysis, using the following procedures:

9.3.14.1 Using sharp tweezers to obtain a representative tile sample;
9.3.14.2 Add a drop of Cargille R.I. liquid on top of the sample and make sure that the sample is immersed in the liquid
9.3.14.3 Heat the sample on a hot plate for a few minutes to dissolve the sample
9.3.14.4 Use pencil eraser to smear out the sample evenly so that the asbestos fibers are exposed

9.3.15 Measure and record at least one optical property for non-asbestos fibers that serves to distinguish them from asbestos.

9.3.16 Opinions and Interpretations of data (those not based on known factual data) must clearly be marked as the analyst's opinion or interpretation. This is to be recorded in the "notes" section for that sample on the bench worksheet.

9.3.17 To ensure the accuracy of determined refractive index of each asbestos fiber, good temperature control of the laboratory is necessary. Therefore, a NIST traceable thermometer shall be used to record temperatures in the laboratory twice a day, once in the morning and once in the afternoon. The readings shall be recorded and kept. If the temperature conditions jeopardize the results of test, analysis shall be stopped immediately until the problem is corrected.

9.3.18 The nature of asbestos PLM analysis may preclude rigorous, metrologically and statistically valid calculation of uncertainty of measurement. However, the lab shall at least attempt to make a reasonable estimation based on point count method. The estimated uncertainties shall not be higher than the suggested acceptable errors for PLM analysis by EPA/600/R-93/116 method Table 1 lists some causes of uncertainty and how the laboratory seeks to minimize the uncertainty of measurement. These uncertainty estimates shall be reviewed and revised at least monthly to reflect the most recent point count data. Preferably, the estimates shall be attempted for three different percentage ranges, e.g., <1%, 1-10%, and >10%.

9.3.19 When gravimetric analysis is required, appropriate sample treatment such as combustion of samples (ashing) and/or acid dissolution is necessary.

9.3.20 For combustion of samples, the following procedures will be used:

9.3.20.1 Weigh approximately 0.200 to 0.500 grams (depends on the type of sample) of material;
9.3.20.2 place material in crucible, weigh, and cover with lid;
9.3.20.3 place crucible into a muffle furnace pre-heated to 480°C;
9.3.20.4 allow the samples to undergo combustion for 4-8 hours;
9.3.20.5 remove crucible from furnace, allow contents to adjust to room temperature and humidity, and weigh;
9.3.20.6 Divide residue weight by starting weight and multiply by 100 to determine weight % residue;
9.3.20.7 Analyze residue using PLM and/or proceed to acid dissolution procedure.

Table 1: Minimizing Uncertainty

Action		Procedure to Minimize Uncertainty
Cross contamination in transit to laboratory.		Careful examination of received samples to accept or reject based on missing samples or damaged sample containers.
Insufficient quantity of material.		The analyst rejects the sample and notes the insufficient quantity in the final report.
Refractive Index Liquid Contamination		Analysts investigate RI liquids daily to see they are free from debris. Analysts may use syringes to dispense RI liquids to the samples. Blanks for each liquid used are performed daily with an NaCl standard.
Accuracy		Monthly, analysts read randomly assigned NVLAP samples that have control limits and reference values. The laboratory also creates internal lab control limits for these samples.
Precision		Monthly, a precision value is calculated for each analyst to insure reproducibility of results.
Refractive Index Liquid Reliability		Refractive index liquids are calibrated at least quarterly to insure liquids are within the acceptable range for which to do analysis. Those that are not in the acceptable range are terminated from use.
Reproducibility of Results		10% of all samples are Replicated(by the original analyst) or Duplicated (by a second analyst) in order to determine the reproducibility of results. Errors are assessed and corrective actions taken on those analyst's that fail the test.
Non Friable Organically Bound Material		The sample is dissolve in oil or submitted for a gravimetric process to enhance quantitation.
Friable Particulate Obscures Field of View		Acid dissolution may be used to enhance quantitation of the material. If the material is not acid soluble multiple mounts are made in thinner cross sections.
Fibers of varying size		Multiple reference standards and visual aids are available in the lab to calibrate area and volume percentages.
Cross Contamination in the analysts work area.		Analysts only handle materials in their negative air flow hoods, thus reducing contamination of small airborne particulate. Areas where asbestos containing materials are used are wiped with damp cloths frequently.
Damaged Equipment		Microscopes and lighting sources are assessed by the analyst daily to determine if they are functioning properly. Damaged instruments are immediately repaired or adjusted for optimal performance.
Improper Preparation Techniques		Analysts are investigated upon hire or training to determine if they can adequately prepare and analyze a variety of material types.

9.3.21 The following procedures will be used when samples are treated with acid dissolution:

9.3.21.1 Weigh approximately 0.1-0.5 g of starting material, transfer to acid resistant container;
9.3.21.2 weigh filter (0.25 μm pore size);
9.3.21.3 add 10% HCL acid to sample in container, stir, and allow to sit for 5-10 minutes;
9.3.21.4 Filter solution;

9.3.21.5 Weigh dried filter and residue, subtract weight of filter from total;
9.3.21.6 Divide residue weight by starting weight and multiply by 100 to determine weight % residue;
9.3.21.7 analyze residue by using PLM;
9.3.21.8 calculate and report relative weight% asbestos in sample.

9.3.22 "Asbestiform" at CEI is defined as length/width aspect ratio of greater or equal to 10:1. Table 2 should be used to identify asbestos.

9.3.23 Table 3 shall be used to distinguish non-asbestos fibers from asbestos fibers.

Table 2 : Asbestos Fibers and Their Distinguishing Characteristics

Mineral	Morphology and Color	Refractive Indices	Birefringence	Extinction	Sign of Elongation
Chrysotile	Wavy fibers. Splayed ends and "kinks". Colorless.	α: 1.532-1.549 γ: 1.545-1.556	0.004-0.017	Parallel	+
Amosite	Straight to curved, rigid fibers. Colorless to brown. Non or weak pleochroism	α: 1.663-1.686 γ: 1.696-1.729	0.021-0.054	Usually parallel	+
Crocidolite	Straight to curved, rigid fibers. Blue to dark blue in color. Pleochroic.	α: 1.654-1.698 γ: 1.666-1.712	0.003-0.022	Usually parallel	–
Anthophy-llite	Straight to curved fibers and bundles. Colorless to light brown.	α: 1.606-1.648 γ: 1.626-1.670	0.013-0.028	Parallel	+
Tremolite	Straight to curved fibers and bundles. Colorless to pale green.	α: 1.603-1.620 γ: 1.627-1.642	0.017-0.028	Parallel to oblique	+
Actinolite	Straight to curved fibers and bundles. Colorless to pale green.	α: 1.620-1.667 γ: 1.642-1.686	0.017-0.028	Parallel to oblique	+

Table 3 : Non-asbestos Fibers and Properties that Distinguish Them From Asbestos

Non-asbestos fiber	Morphology and Color	Refractive Indices	Birefringence	Extinction	Sign of Elongation
Cellulose	Flat, ribbony fibers of variable width with cell walls and holes.		High	Undulose	+
Fibrous Glass	Clear fibers of uniform width		None	Isotropic, 100% extinct.	N/A
Wollastonite	Straight, blocky fibers		Mod. to High	Oblique	Both + & -
Synthetic	Straight or curvy fibers usually of uniform width, Usually will not break into smaller fibrils.		Mod to High.	variable	+ or -
Brucite	Straight, colorless brushlike fibers.			Parallel to oblique	Always -
Polyethylene	Curved fibers and bundles. Colorless. Melts with applied heat.		Low to Mod	Parallel to oblique	+
Talc	Straight, needlelike fibers.	<< 1.590 both parallel and perp.	Low to Mod	Parallel to oblique	+

10.0 Standard Work Procedures

10.1 Routine Laboratory Maintenance

10.1.1 The laboratory floor is to be cleaned and non-ACM trash disposed of at the end of each workday.

10.1.2 Analyst and login workstations are to be thoroughly cleaned using a HEPA vacuum at the end of each workday.

10.1.3 Bulk samples analyzed that workday are to be double-bagged in gallon size re-sealable baggies or equivalent and placed in the polyethylene bin located in the laboratory marked "Daily Out Box".

10.1.4 Once QC analysis has been completed, samples are to be stored in one of the 35-gallon plastic trash containers located within the laboratory.

10.1.5 Individual samples may only be removed from their container and handled in a negative airflow hood pulling the appropriate volume of air.

10.1.6 Individual sample containers are stored in a larger container (self-locking baggie) for all the samples in that sample batch. Sample batches are stored in a larger container (6 mil Garbage bag inside a polyethylene bin) for each analyst, prior to disposal.

10.2 Storage and Disposal of Asbestos-Containing Material (ACM)

10.2.1 Bulk samples submitted to our laboratory are considered to be asbestos containing material (ACM) and are handled accordingly. After laboratory analysis, bulk samples are double-wrapped in 6-mil polyethylene bags and stored in 35- gallon plastic trash bins, one bin for each analyst.

10.2.2 Bulk samples are stored in the laboratory. Before removal from the laboratory, samples and asbestos waste will be placed in disposal bags that have clearly labeled asbestos warnings. After 30 days, samples are disposed of at an EPA approved dumpsite or returned to the client upon request.

10.3 Calibration of Equipment and Standards

10.3.1 It is the responsibility of the Laboratory Director to insure that equipment is properly maintained, and is in good working order at the start of each workday. However, on a practical level all laboratory personnel are actively involved in the calibration and maintenance of polarized light microscopes, stereoscopes, and refractive index liquids.

10.3.2 All calibrations and results of all calibrations performed at CEI Labs are traceable to National Institute of Standards and Testing (NIST) standards. Those calibrations that are not directly traceable are calibrated according to consensus standards. For example, the Cargille glass standards used to calibrate oils are not

standards from NIST. However the oils can be confirmed as accurately calibrated by placing NIST asbestos standards in the oils and observing that the correct optical properties for those standards are present. The laboratory only uses thermometers with an NIST traceable certificate.

10.3.3 Calibration of Polarizing Light Microscopes - Microscopes found to be defective or malfunctioning must be returned to the distributor for repair or adjustment. Microscopes returning from the distributor will be checked before being placed into service to verify that it is working properly.

10.3.3.1 Polarizing Light Microscope: The polarizing light microscope will be adjusted by the microscopists any time they suspect it has become misaligned or is out of calibration. The procedure outlined in Section 8.0, Microscope alignment of this manual must be used to align the microscope.

10.3.3.2 Lenses on polarizing light microscopes are cleaned regularly and as needed to obtain optimal visibility of the sample specimens.

10.3.3.3 Any other adjustment required (i.e. changing the light bulb) or repairs required are to be recorded in the Equipment manual, and the Laboratory Director will be notified.

10.3.3.4 During the day, the analyst shall periodically perform intermediate checks to maintain confidence in the calibration status of the equipment. These checks shall be carried out according to the above procedures.

10.3.4 Magnifying Stereoscopes - Stereoscopes require little calibration other than insuring that they focus properly and that the lenses are cleaned daily. Any problems with the stereoscopes should be referred to the Laboratory Director.

10.3.5 Analytical Balance - The analytical balance shall be calibrated using standard weights at least 4 times per year.

10.3.6 Muffle Furnace: The muffle furnace shall be calibrated quarterly using a general-purpose thermometer that is measurable to 500° C. This is done to ensure that the temperature of the muffle furnace does not exceed 500° C during the reduction of combustible matrixes.

10.3.7 Calibration of Refractive Index Liquids

10.3.7.1 Refractive index liquids are not stored in direct sunlight or near heat sources which may accelerate their decomposition. The condition of asbestos-relevant R.I. liquids will be checked on a Quarterly basis.

10.3.7.2 Any new bottle of Refractive Index Liquids will be calibrated when opened.

10.3.7.3 Refractive index liquids are to be calibrated using the following method: "Refractive Index Liquid Calibration using Optical Glass Standards", by Shu-Chun Su,Ph.D.

10.3.7.4 The optical glass standards to be used for calibration are the set of Cargille M-7 Reference Set available in the laboratory. The oils will be calibrated with an accuracy of .004 and at an ambient temperature range of $22^{o}C + 1^{o}C$.

10.3.8 Use of Reference Standards/Materials

10.3.8.1 CEI analysts shall use NIST traceable reference standards or materials, such as NIST Standard Reference Material 1866 (common) and 1867 (uncommon) to perform calibrations. Cargille M-25 Reference Set Precision Calibrated Optical Glass (cat. # 34225) is used to calibrated refractive index liquids.

10.3.8.2 There are no NIST traceable asbestos testing samples. However, past NVLAP samples shall be used routinely by CEI analysts to improve their analytical accuracies. In combination with past NVLAP samples, point count method shall be used to determine uncertainties of routine asbestos analysis. In 2003 NIST began manufacturing the samples for NVLAP.

10.3.9 Safe Handling of of NIST Standard Reference Material - NIST Standard reference materials 1866 (common) and 1867 (uncommon) are kept in a library in the laboratory. If someone wishes to use the Standards, precision Calibrated Optical Glass (cat. #34225), or either of the two sets of Cargille refractive index oils he/she must use the following procedure:

10.3.9.1 Containers of standard reference material are to be opened *only* in areas designated for asbestos analysis, (i.e. only inside of a fully functional negative air flow hood pulling the appropriate volume of air).

10.3.9.2 Transport to and from the Library to the analyst's workstation will occur only if the reference containers are tightly sealed and the outside of the container is clean.

10.3.9.3 The analyst is only to touch standard reference materials with clean analytical instruments, and the analyst will clean their analytical instruments between switching from one standard to another.

10.3.9.4 The dates and times of use of the Standard Reference Materials will be recorded in a specific location in the lab, and then stored as a historical record at some time thereafter.

11.0 Quality Control Procedures

11.1 NVLAP requires a minimum QA/QC volume of 10% as outlined in the publication NIST 150 & 150-3 "Bulk Asbestos Handbook".

11.2 NVLAP's 10% QA/QC requirement is based on the laboratory's total sample volume at any given point and time and includes replicate QC, duplicate QC, and inter-laboratory QC, analysis of blank QC and NIST QA.

11.3 Quality Control (QC)

11.3.1 Replicate QC: Replicate QC samples are selected from each analyst's original work load for reanalysis. The objective of replicate QC analysis is to evaluate an Analyst's precision over time.

11.3.2 Duplicate QC: Duplicate QC samples are selected from another analysts original work load for a second independent analysis. The objective of duplicate QC analysis is to evaluate precision between analysts.

11.3.3 Blank QC: The objective of Blank QC is to verify a contamination-free environment. Blank QC samples are analyzed daily using reagent grade salt and are to be prepared as follows:

11.3.3.1 Grind reagent grade salt in mortar, or crush on a slide with clean instruments;
11.3.3.2 Mount with clean tweezers/scalpel on a cleaned microscope slide in refractive index liquid of choice;
11.3.3.3 Add clean coverslip;
11.3.3.4 Observe PLM plane polarized light; fibers are contaminates;

11.3.3.5 Observe PLM crossed polars; anisotropics are Contaminates;

11.3.3.6 Determine refractive index.

11.3.4 Inter-laboratory Round Robin: CEI is actively involved in inter-laboratory round robin programs with three other labs. Each quarter four round robin samples are analyzed by each analyst. The results are summarized by a host laboratory. The results may be used to estimate the variation among different labs.

11.3.5 NIST Sample Analysis: At least four samples from past NIST proficiency testing rounds are analyzed by each analyst each month. The results of the analyses are summarized and compared to NIST results and the precision and accuracy of each analyst may be determined.

11.3.6 Alternative Quantitative Methods - Each month, point count analyses and TEM analyses of samples previously found to contain asbestos by the PLM method should be compared and summarized.

11.4 Quality Assurance (QA)

11.4.1 NIST Proficiency Testing: NIST proficiency test samples will be analyzed by each analyst, although only a single result will be reported to NVLAP. In no case, are NIST proficiency samples to be contracted to an outside laboratory. NIST test samples will be retained for use as library reference materials.

11.4.1.1 The final data submitted to NIST for each round are chosen by a rotation of the analysts. A review of data is performed by the Laboratory Director and the Quality Manager. If the data is not suitable for submission to NIST, another analyst's data may be submitted.

11.4.1.2 Results of NIST Proficiency Testing exchanges will be recorded on the appropriate bulk worksheets and summarized on monthly QA/QC reports as appropriate. The Quality Manager will compare each analyst's data with the data provided for the samples by NIST. The Quality Manager will assess each analyst's results individually and will implement any necessary reviews or training for those analysts found to be deficient in their analysis of each NIST Proficiency Testing Round.

11.4.1.3 The primary objective of NIST Proficiency Testing is to: (1) evaluate the analytical precision and accuracy of our

laboratory on a relative basis; and (2) evaluate individual analyst's performance.

11.4.2 Maintaining a Contamination Free Work Area: Maintaining a contamination free laboratory is an important aspect of our Quality Management System.

11.4.2.1 The laboratory work area and equipment are to be cleaned on a daily.

11.4.2.2 In the event of an accidental ACM spill, the contaminated area should be HEPA vacuumed immediately. Air monitoring will then be used to clear that area.

11.4.2.3 Each analyst is responsible for checking his/her workstations on a daily basis to insure a contamination free environment during sample analysis. These checks will include: visual checks of bench space, petri dishes, sampling instruments, tweezers, glass slides, microscope stages, etc.

11.4.3 Ambient Air Monitoring: Ambient air monitoring will be performed in the laboratory on at least a semi-annual basis to verify laboratory cleanliness.

11.4.3.1 Sampling pumps may be placed at sampling work stations and also at representative points in the laboratory.

11.4.3.2 Air sampling volumes should exceed 240 liters for personal pumps and 1200 liters for high volume air pumps.

11.4.3.3 Samples are analyzed for fiber counts using the NIOSH 7400 method and phase contrast microscopy. Results are included in the Monthly QA/QC Report.

11.4.4 Blank QC Analysis: Each analyst is also responsible for analysis of Blank QC samples by preparing a sample of each common RI Liquid (1.550HD, 1.680HD, and 1.605HD) in a mount with reagent grade NaCl.

11.4.4.1 Blank QC samples will be analyzed at the beginning of each work day, or more often if deemed necessary.

11.4.4.2 If a Blank QC analysis is contaminated, the data from that entire sample lot will be considered invalid.

11.4.4.3 In cases where blank QC analysis indicates outside contamination, the Laboratory Director and/or Quality Manager is to be immediately notified.

11.4.5 Resolution of Discrepancies: The Quality Management standard for asbestos bulk analysis at CEI Labs, Inc. is as follows:

11.4.5.1 False positives and/or false negatives are always considered significant discrepancies.

11.4.5.2 The In-house standards for "outliers" for estimates of asbestos content are as follows:

11.4.5.2.1 In cases where Analyst 1 reports asbestos contents of <25%, the QC result reported by Analyst 2 will not exceed ±10%.

11.4.5.2.2 In cases where Analyst 1 reports asbestos contents of >25%, the QC result reported by Analyst 2 will not exceed ±25%.

11.4.5.3 In cases where asbestos percentages reported by Analyst 1(Original) and Analyst 2 (QC) significantly differ, the sample will be considered as an "outlier The sample in question will be reanalyzed by Analyst 1, Analyst 2, and a third party, if necessary to determine the "correct" asbestos percentage for that particular sample.

11.4.5.4 Discrepancies between Analyst 1 and Analyst 2 (QC) including false-positives, false-negatives and "outliers" will be promptly resolved by reanalyzing the samples in question. Corrected values will be determined and results discussed with the analysts. An attempt will be made to evaluate and correct the source of error such that the same mistake is not repeated in the future. If an analyst is identified as having a problem with a particular type of analysis, extra time and training may be required to assist that individual.

11.4.5.5 The analyst is responsible for initiating corrective action (i.e. calling the customer and generating amended reports) for his/her own errors. This process is supervised by the Quality Manager. The Quality Manager or a designee may initiate corrective action for any analyst not present when an error is discovered.

11.4.5.6 In cases where a false positive or negative was initially reported, the client will be notified in writing that a mistake was made. A corrected copy of the test report will be immediately forwarded to that client and all parties involved. Customers will not be notified for QC "outlier" discrepancies.

11.5 Summary of Monthly QA/QC Data

11.5.1 QA/QC data for each Analyst including Blank QC analysis, Replicate QC analysis, Duplicate QC analysis, inter-laboratory QC analysis, and NIST Proficiency Test data are summarized on a monthly basis by the Quality Manager and reviewed by the Laboratory Director. Monthly QA/QC results are discussed with staff in a formal meeting each month. Any deficiencies noted will be recorded and resolved immediately. The deficiency corrections for each analyst shall also be included in his/her personnel files.

11.5.2 Laboratory Quotas - No daily laboratory quota is required at CEI Labs. Analysts are cautioned to take the extra time they may need to insure quality analyses and to obtain second opinions on difficult or unusual samples.

11.5.3 Individual Analyst Review - An analyst's precision, accuracy and total failure rate are evaluated statistically each month as summarized in Analyst Monthly Review.

11.5.4 A replicate analysis of an actual sample submitted at a later date as a blind will be used to calculate percent range (R%).

11.5.4.1 R%= (X1-X2)/(X1+X2) * 200

Individual Analyst Review (Cont'd)

where R% - percent range;
X1 - first measurement;
X2 - second measurement.

11.5.4.2 The R% will be plotted on a QC chart with limits being determined from a calculation of standard deviation (SD).

SD = {sum (R%-R %)2/ (N-1)}0.5

where R% = average of replicate analysis
N = the number of replicate analysis

11.5.4.3 The control and warning limits can be determined as:

Control Limit = R% + 2.58 SD
Warning Limit = R% + 1.96 SD

11.5.5 An analyst's accuracy will be determined by analyzing previously submitted NIST or Library samples as blinds in the daily run of samples.

11.5.5.1 From those data a recovery calculation can be made after which a standard deviation is calculated for that sample.

11.5.5.2 P = EAV% / AAV% * 100

where P is percent recovery, EAV% the estimated asbestos percentage, and AAV% the actual asbestos percentage.

11.5.5.3 SD = {sum (P-P)2/(N-1)}0.5

where P is the average recovery, N the number of determinations. A control chart can then be generated for each analyst by plotting P with the following limits:

Warning Limit = P + 1.96 SD
Control Limit = P + 2.58 SD

11.5.6 An analyst's monthly total failure rate will be evaluated as the total number of errors divided by the total number of samples that undergo the quality control process.

12.0 Reporting the Results

12.1 Analyst's at CEI record their observations and results directly into a computer database. CEI has a laboratory information system developed with Filemaker Pro 13.0 software. Either through direct data entry, or through a series of drop-down menu choices, analysts can record their observations.

12.1.2 In the PLM database, analysts create bench worksheets using the Filemaker Pro Software.

12.1.3 For each batch of samples logged for analysis, the analyst will record the following information:

12.1.3.1 The CEI employee(s) that analyzed the samples;
12.1.3.2 The date the CEI employee analyzed the samples;
12.1.3.3 The number of samples the CEI employee analyzed in the sample batch (for billing and accounting purposes).

12.1.4 For each sample layer, the analyst will record the following information:
12.1.4.1 The customer's unique sample identification number;
12.1.4.2 The CEI unique sample identification number;
12.1.4.3 The preparation technique(s) used during analysis;
12.1.4.4 Any notes that may help the customer interpret the results.

12.1.5 For each sample layer, the analyst will record the following information obtained by magnifying stereoscopic analysis:
12.1.5.1 A layer identifier in relation to other sample layers;
12.1.5.2 The homogeneity of the sample layer;
12.1.5.3 A brief visual description of the sample layer;
12.1.5.4 Whether or not the sample layer contains fibrous components;
12.1.5.5 A general description of sample layer friability;
12.1.5.6 An estimated percentage of asbestos content;
12.1.5.7 The color of the sample layer analyzed.

12.1.6 For each sample layer, the analyst records the following information on the laboratory bench worksheet: obtained by magnifying stereoscopic analysis and polarized light microscopy:
12.1.6.1 The non-fibrous, non-asbestos components present;
12.1.6.2 The fibrous, non-asbestos components present;
12.1.6.3 The percent the fibrous and non-fibrous, non-asbestos components present that are determined by calibrated visual estimate;
12.1.6.4 A property of each fibrous, non-asbestos material found that distinguishes it from asbestos;
12.1.6.5 The asbestos type(s) present;
12.1.6.6 The percent of each asbestos type present as determined by calibrated visual estimate;
12.1.6.7 A description of morphology, the sign of elongation, pleochroism, birefringence, and extinction type or angle of extinction for each asbestos type present;
12.1.6.7 If no asbestos was present, a record that no asbestos was detected.

12.2 Generating a Test Report

12.2.1 For each batch of samples submitted to CEI, a test report must be generated after analysis is complete.

12.2.2 Using Filemaker Pro software, and Adobe PDF software, the analyst generates a draft report that contains the following information:

12.2.2.1 CEI's address, phone number, and other contact information;
12.2.2.2 The customer's name and address;
12.2.2.3 any batch identifiers or identification numbers provided by the customer;
12.2.2.4 The unique CEI lab code (in-house batch identifier);
12.2.2.5 Each sample; and its component layers; and their unique sample numbers created by CEI;
12.2.2.6 The customer's unique sample identification number for each sample reported;
12.2.2.7 The type and percentage of each non-fibrous, non-asbestos component observed, for each sample layer reported;
12.2.2.8 The type and percentage of each fibrous, non-asbestos component observed, for each sample layer reported;
12.2.2.9 The type and percentage of each asbestos component observed, for each sample layer reported;
12.2.2.10 A statement of "none detected" when asbestos is not present, for each sample layer reported;
12.2.2.11 Any notes generated by the analyst that might help the customer interpret the results;
12.2.2.12 The authorized signature(s) of the CEI employee(s) that analyzed the sample batch;
12.2.2.13 The test method used to test the samples, and a statement that shows that sample results apply only to the items tested;
12.2.2.14 The date the samples were received by the laboratory;
12.2.2.15 The date the samples were analyzed.

12.2.3 After the draft test report is generated, the test report is submitted to qualified personnel for data review.

12.3 Reporting the Results to the Customer

12.3.1 After the draft test report is approved for submittal to the customer, the draft is submitted to the laboratory secretary for reporting to the customer.

12.3.2 Using Adobe PDF software, the final test report is generated with the date of reporting to customer included, as well as an electronic scan of the customer's paperwork at the end of the test report.

12.3.3 The electronic test report is delivered to the customer via e-mail or facsimile.

12.3.4 CEI delivers test reports to its customers that require them by hand, courier, or U.S. Mail.

12.3.5 CEI delivers customer submitted paperwork to its customers that require them by hand, courier, or U.S Mail.

13.0 **Method Validation**

11.1.1 This method was validated by the EPA and adopted by CEI.

11.1.2 Method reviewed and approved by:

CEI Laboratory Director: _____ Date: 1/29/15
Tianbao Bai, PhD, CIH

PLM Technical Manager: _____ Date: 1/27/2015
Anna Malmberg, MS

CEI Quality Manager: _____ Date: 01/27/2015
Gary Swanson

11.1.3 Analysts/Technicians: All personnel involved with handling, receipt, preparation, reporting, and review of PLM samples must follow the PLM SOP Manual with regards to whatever involvement they have in the SOP procedures.

11.2.4 Employee Compliance Statement. I have read the *"CEI Labs, Inc. SOP 400 "Preparation and Analysis of Bulk Asbestos Material via Polarized Light Microscopy"*. I understand and will implement all portions of the SOP that apply to my authorized position.

Tianbao Bai	1/29/15 Date
Gary Swanson	01/27/2015 Date
Anna Malmberg	1/27/2015 Date
Megan Fisher	1/29/15 Date
Greg Ruff	1/27/15 Date
Susannah Small	01/27/15 Date
Samantha Card	1-27-15 Date
Daniel Liguori	1/27/15 Date
Candace Burrus	1/27/15 Date
Megan Rumble	01/27/15 Date
Elizabeth Godwin	1/27/15 Date

Taylor Metcalf	1-28-15 Date
Ritika Seal	1/27/15 Date
Ella Nguyen	1/27/15 Date
Sarah Talley	1-27-15 Date
Ryan Williams	1-27-15 Date
Shilpa Ladekar	01/28/15 Date
Lauren Mullenex	1/27/15 Date
Laura Bostwick	1-27-15 Date
Antonia Hoyland	1/27/15 Date

Additional Employees:

Printed Name	Signature	Date

Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date

END OF DOCUMENT

APPENDIX I

Record Formats

PLM
TEST REPORT

ASBESTOS LABORATORY REPORT

Prepared for

ABC Company

PROJECT: John Q. Public, House Abatement

CEI LAB CODE: A12-123456

DATE ANALYZED: 10/17/12

DATE REPORTED: 10/18/12

TOTAL SAMPLES ANALYZED: 5

 # SAMPLES >1% ASBESTOS: 4

TEL: 866-481-1412

www.ceilabs.com

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: John Q. Public, House Abatement **CEI LAB CODE:** A12-123456

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
1		B1231A	White	Floor Tile	Chrysotile 5% Amosite 3%
		B1231B	Black	Mastic	Chrysotile 5%
2		B1232	Off-white	Ceiling Tile	Amosite 2% Chrysotile <1%
3		B1233	Off-white,Blue	Linoleum	None Detected
4	Layer 1	B1234	Black,Grey	Shingle	None Detected
	Layer 2	B1234	Black	Tar	Chrysotile 10%
5		B1235	Off-white,Tan	Drywall/Joint Compound	Chrysotile <1%

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ABC Company
123 Maple Drive
Anytown, USA 12345

CEI Lab Code: A12-123456
Date Received: 07-17-12
Date Analyzed: 10-17-12
Date Reported: 10-18-12

Project: John Q. Public, House Abatement

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
1 B1231A	Floor Tile	Homogeneous White Non-fibrous Bound			92%	Vinyl	**5% Chrysotile** **3% Amosite**
B1231B	Mastic	Homogeneous Black Fibrous Bound	3%	Cellulose	92%	Mastic	**5% Chrysotile**
2 B1232	Ceiling Tile	Heterogeneous Off-white Fibrous Loosely Bound	68% 10%	Fiberglass Cellulose	20% <1%	Binder Paint	**2% Amosite** **<1% Chrysotile**
3 B1233	Linoleum	Heterogeneous Off-white,Blue Fibrous Bound	25% 10%	Cellulose Fiberglass	40% 25% <1%	Vinyl Binder Mastic	**None Detected**
4 Layer 1 B1234	Shingle	Heterogeneous Black,Grey Fibrous Bound	35%	Fiberglass	55% 10%	Tar Gravel	**None Detected**
Layer 2 B1234	Tar	Homogeneous Black Fibrous Bound	<1%	Cellulose	90%	Tar	**10% Chrysotile**
5 B1235	Drywall/Joint Compound	Heterogeneous Off-white,Tan Fibrous Bound	20%	Cellulose	75% 5% <1%	Gypsum Calc Carb Paint	**<1% Chrysotile**

Lab Notes: Chrysotile found only in joint compound; 2%. Sample contains <1% Chrysotile overall.

LEGEND: Non-Anth = Non-Asbestiform Anthophylite
Non-Trem = Non-Asbestiform Tremolite
Calc Carb = Calcium Carbonate

METHOD: **EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020**

The detection limit for the method is <1% by visual estimation and 0.25% by 400 point counts or 0.1% by 1,000 point counts.

Due to the limitations of the EPA 600 Method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarizing light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation.

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ANALYST: Anna Malmberg

APPROVED BY: Tianbao Bai, Ph.D.
Laboratory Director

NVLAP Lab Code 101768-0

PLM POINT COUNT
TEST REPORT

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ABC Company
123 Maple Drive
Anytown, USA 12345

CEI Lab Code: Q12-0006
Date Received: 02-22-12
Date Analyzed: 02-22-12
Date Reported:

Project: Point Count Report Test

ASBESTOS POINT COUNT PLM, EPA 600 METHOD

Client ID	Lab ID	Material Description	POINTS Total	POINTS Asbestos	ASBESTOS %	
Sample 1	Q1254575	Ceiling Tile	400	6	**1.5%**	**Chrysotile**
				3	**0.75%**	**Amosite**
Sample 2	Q1254576	Joint Compound	400	9	**2.25%**	**Chrysotile**
	Q1254576	Sr/jc Composite From Point Count			**0.23%**	**Chrysotile**

Lab Notes: Sample contains 10% JC overall.

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

The detection limit for the method is <1% by visual estimation and 0.25% by 400 point counts or 0.1% by 1,000 point counts.

Due to the limitations of the EPA 600 Method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarizing light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation.

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ANALYST: Anna Malmberg

APPROVED BY: Tianbao Bai, Ph.D.
Laboratory Director

NVLAP Lab Code 101768-0

PLM LABORATORY
BENCH
WORKSHEET

ASBESTOS BULK ANALYSIS

EPA / 600 / R-93 /116 and EPA /600/M4-82/020

Client: ABC Company
123 Maple Drive
Anytown , USA 12345

CEI Lab Code: A12-123456
CEI Client Code: 25876
Date Analyzed: 10/17/12
Date Reported: 10/18/12
Analyst: Anna Malmberg
2nd Analyst:
Lab ID: B1235

Sample Prep Technique:
- ☐ crushed/milled/sifted
- ☒ dissolved with solvent
- ☒ washed with 10% HCl
- ☒ heated/ashed

Client ID: 5 **ER Status Override**
ER ID: **ER Unqe ID:**
QC Location:

HOMOGENEITY DESCRIPTION

Homogeneity: Heterogeneous,
Sample Description: Drywall/Joint Compound
Layer:
Color: Off-white, Tan,
Texture: Fibrous,
Friability: Bound
% Asbestos: <1

NON-ASBESTOS COMPONENTS:

%Fibrous		%Non-fibrous	
CELL	20	GYPSUM	75
		CACO	5
		PAINT	<1

ASBESTOS COMPONENTS:

	Type 1	Type 2	Type 3
Morphology:	Kinked		
Refractive Index:	par.1.556 1.551 per.	par. per.	
R.I. Color:	magenta blue		
Pleochroism:	N		
Birefringence:	low		
Sign of Elongation:	+		
Extinction Angle:	ll		
Asbestos Type:	Chrysotile		
% Asbestos:	<1		
Total % Asbestos:	CHRY <1		

Optical Properties

Point Count

Total Points	Asbestos Points	Asbestos Type	Asbestos %
○ 400			
○ 1000			

Gravimetric Weigh

Comments

Final Report Notes Chrysotile found only in joint compound; 2%. Sample contains <1% Chrysotile overall.

REPORTS

POINT COUNT WORKSHEET

POINT COUNT WORKSHEET

CEI LAB CODE:_____ DATE_____ ANALYST: _____

SAMPLE #_____ SAMPLE #_____ SAMPLE #_____ SAMPLE #_____

CLIENT ID_____ CLIENT ID_____ CLIENT ID_____ CLIENT ID_____

SLIDE #	POINTS COUNTED	ASBESTOS POINTS	POINTS COUNTED	ASBESTOS POINTS	POINTS COUNTED	ASBESTOS POINTS	POINTS COUNTED	ASBESTOS POINTS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
TOTAL	400 / 1000		400 / 1000		400 / 1000		400 / 1000	

Asbestos%= _____ Asbestos%= _____ Asbestos%= _____ Asbestos%= _____

SAMPLE #_____ SAMPLE #_____ SAMPLE #_____ SAMPLE #_____

CLIENT ID_____ CLIENT ID_____ CLIENT ID_____ CLIENT ID_____

SLIDE #	POINTS COUNTED	ASBESTOS POINTS	POINTS COUNTED	ASBESTOS POINTS	POINTS COUNTED	ASBESTOS POINTS	POINTS COUNTED	ASBESTOS POINTS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
TOTAL	400 / 1000		400 / 1000		400 / 1000		400 / 1000	

Asbestos%= _____ Asbestos%= _____ Asbestos%= _____ Asbestos%= _____

Note: %ASBESTOS = (TOTAL Asbestos points/Total points counted) (100%)

DAILY
ANALYST RECORD

ASBESTOS BULK ANALYSIS
DAILY ANALYST RECORD

ANALYST_____ DATE _____/____/_____ PLM STATION _____

DAILY PROCEDURE CHECKLIST

BLANK ANALYSIS - Refractive Index Oils						COMMENTS
MICROSCOPE ALIGNMENT						
Substage:		Center Stage:		Center Obj.		Cross Hairs to Polars :

Daily Sample Total

PROJ CODE	CLIENT	PROJ TOTAL	ANALYZED	COMMENTS

Miscellaneous Tasks:

DAILY TOTAL	
QC Total	
Point Count Total	
PLM Equivalent	

QC DUPLICATE/REPLICATE WORKSHEET (Excel Format)

QC Duplicate/ Replicate Worksheet

Version EQCD.04.13.1/1.QM

QC 2013

ORIGINAL ANALYST	SAMPLE	DATE	QC TYPE A	QC RESULT A	ORIGINAL TYPE A	ORIGINAL RESULT A	TYPE ERROR	PERCENT ERROR	QC TYPE B	QC RESULT B	ORIGINAL TYPE B	ORIGINAL RESULT B	TYPE ERROR	PERCENT ERROR	QC TYPE C	QC RESULT C	ORIGINAL TYPE C	ORIGINAL RESULT C	TYPE ERROR	PERCENT ERROR
							OK	OK					OK	OK					OK	OK
							OK	OK					OK	OK					OK	OK
							OK	OK					OK	OK					OK	OK
							OK	OK					OK	OK					OK	OK
							OK	OK					OK	OK					OK	OK
							OK	OK					OK	OK					OK	OK
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							OK	OK					OK	OK					OK	OK
							OK	OK					OK	OK					OK	OK
							OK	OK					OK	OK					OK	OK

CORRECTIVE ACTION FOR NON-CONFORMING EVENTS (DUPLICATE/REPLICATE DISCREPENCY)

CEI LABS
Corrective Action Report for Non-conforming Events

Date: _____ **Incident Investigator _____**

Incident: Discrepancy between two analytical results.

Material: _____ Laboratory ID Number _____

	ORIGINAL	QC
ANALYST		
RESULT		

Root Cause Analysis:

Description of Error:

Cause of Error:

Outcome of Investigation:

Did the original analyst identify the error on reanalysis? Yes ☐ No ☐

Are additional analysts required to resolve discrepancy? Yes ☐ No ☐

If yes, fill out a laboratory consensus worksheet.

Were there additional errors in the project (of the same type)? Yes ☐ No ☐

List the Laboratory I.D. Number(s) of affected samples:

Were any quality control trends identified as a result of this error? Yes ☐ No ☐

Proposed Corrective Action:

Was the report changed? Yes ☐ No ☐

Was the report sent prior to error detection? Yes ☐ No ☐

Was the report amended? Yes ☐ No ☐

Was the customer notified of amended report? Yes ☐ No ☐

List any other Corrective Actions Implemented with regards to this specific error:

Date of Implementation of Corrective Action _____

Verification of Effectiveness of Corrective Action:

If a QC trend is identified, a separate Root Cause Analysis and Corrective Action Report should be completed for analysis of the QC trend.

PLM ROUND ROBIN REPORTING FORM

BULK PLM ROUND ROBIN WORKSHEET

LABORATORY NAME___CEI LABS_____

ROUND:_____ **Date Received:_ _____**

ANALYST NAME _____Date Reported: _____

SAMPLE #	Asbestos Type	Percent	Comments
xx-1			
xx-2			
xx-3			
xx-4			

VERSION :RRWS.01.06.1/1.QM

LABORATORY CONSENSUS WORKSHEET

PLM QC Laboratory Consensus Record

Lab ID #: _____ Project #: _____

Date: _____ Material: _____

Taken from Corrective Action Report:

	ORIGINAL	QC
ANALYST		
RESULT		

Consensus data: (Minimum three additional analysts)

ANALYST	RESULT

Is there a dominant consensus result? Yes ☐ No ☐

Sample result based on laboratory consensus data? _____

Did the discrepancy result in an error? Yes ☐ No ☐

If yes, please continue with Corrective Action Report for Non-conforming Events.

PLM TRAINING RECORD

PLM TRAINING CHECKLIST Trainee:

TASK	TRAINER	DATE
Trainee has received a copy of the Chemical Hygiene Plan and has received a tutorial on basic laboratory safety and practices.		
Trainee has been taught how to pull and distribute QC samples.		
Trainee has been taught and is proficient in how to align and center a PLM microscope.		
Trainee is has been taught and is proficient in all aspects of sample login and distribution.		
Trainee has been taught the 6 types of asbestos and their properties.		
Trainee has completed a property table using laboratory standards.		
Trainee has been taught the relationship between dispersion staining and refractive index.		
Trainee has completed a dispersion staining table using chrysotile asbestos.		
Trainee has been taught the relationship between Becke' lines and refractive index using glass standard.		
Trainee had correctly identified the refractive index of and unknown fibrous glass standard.		
Trainee studied and analyzed the sample library (knowns).		
Trainee has completed analysis sample library unknowns.		
Trainee is proficient to read laboratory QC samples.		
Trainee is proficient enough to analyze commercial client samples at a qc rate of 100%.		
Trainee is proficient enough to analyze commercial client samples at a qc rate of 50%.		
Trainee is proficient enough to analyze commercial client samples at a rate of 25%.		
Trainee is proficient enough to analyze commercial client samples at the standard qc rate of 10%.		
Trainee has been taught and is proficient at performing point count analysis.		
Trainee has been taught and is proficient at performing gravimetric reduction.		

PLM TRAINING ERROR RATE SUMMARY WORKSHEET

CEI TRAINING ERROR RATE SUMMARY

ANALYST :

Data Compiled by :

Week	Number of samples analyzed	Number of QC's analyzed	Number of Errors	Error Rate for the week

POINT COUNT RECORD WORKSHEET

POINT COUNT RECORD

SAMPLE #	ORIGINAL ANALYST	POINT COUNT ANALYST	ORIGINAL RESULTS	POINT COUNT RESULTS

NOTE: POINT COUNTS ONLY. NO GRAVIMETRICS. JOINT CMPD'S ONLY/ NO COMPOSITES

Version: PCRW.01.06.1/1.LD

MONTHLY NVLAP ANALYSIS WORKSHEET

MONTHLY NVLAP SAMPLE WORKSHEET

ANALYST:_____

MONTH: _____

SAMPLE NUMBER	RESULTS

Errors Detected (y or n)
Type of Error (explain)?

MUFFLE FURNACE CALIBRATION WORKSHEET

MONTHLY MUFFLE FURNACE TEMPERATURE WORKSHEET

YEAR: 2013

Temperature is to be taken monthly by inserting a thermometer into the exhaust port of the Muffle Furnace. The thermometer bulb is to rest in a crucible on the floor of the muffle furnace. If the temperature exceeds 500 degrees Celsius, the thermostat is to be adjusted downward until the muffle furnace temperature no longer exceeds 500 degrees Celsius.

MONTH	THERMO-STAT TEMP-ERATURE	ACTUAL TEMPER-ATURE	<500 DEGREES CELSIUS?	NEW THERMOSTAT SETTING (DEGREES CELSIUS)	ANALYST INITIALS
JAN					
FEB					
MAR					
APR					
MAY					
JUN					
JUL					
AUG					
SEP					
OCT					
NOV					
DEC					

MUFFLE FURNACE ACTIVITY WORKSHEET

DAILY MUFFLE FURNACE ACTIVITY

DATE	Batch #	Oven #	Project Code(s) for samples in batch	Start Time	Stop Time	Analyst Initials

ANALYTICAL BALANCE CALIBRATION WORKSHEET

Carolina Environmental, Inc. APX-60
ANALYTICAL BALANCE CALIBRATION WORKSHEET

DATE_____

ANALYST_____

1) CALIBRATE* WITH 50g CLASS 2 WEIGHT : ANALYST INITIALS_____

*** USE APX-60 OPERATION MANUAL FOR INSTRUCTIONS.**

2) WEIGH 0.200 g, 0.500g, 1.000, and 20.000g S-Weight and record the weights.

Reference S-Weight (g)	Recorded Weight (g)
0.200 g	
0.500 g	
1.000 g	
20.000g	

ANALYTICAL BALANCE DAILY WEIGHT VERIFICATION WORKSHEET

CEI DAILY BALANCE WEIGHT VERIFICATION

	Weight	Weight		
DATE	16g = 1g +10g+5g wts.	21g = 1g+20g wts.	Recalibration necessary? (WITHIN +/- 0.0005 TOTAL WEIGHT)	Analyst Initials

REFRACTIVE INDEX OIL CALIBRATION WORKSHEET

Date:

Monthly Calibration of RI Oils

CARGILLE GLASS

Station	N_D	Labeled RI	Lot #	Color	Wavelength	T_R	N_X	N_D-$N_{Corr.}$	Accept/Rej.
Stock	1.550	1.550	B						
	1.605	1.600	B						
	1.680	1.680	B						
	1.605	1.600	B						
	1.680	1.680	B						
	1.640	1.640	B						
	1.605	1.600	B						
	1.680	1.680	B						
	1.605	1.600	B						
	1.680	1.680	B						
	1.605	1.600	B						
	1.680	1.680	B						
	1.605	1.600	B						
	1.680	1.680	B						

N_D = The refracted index that the manufacturer calibrated for the Oil at 25 C.
T_R = Room temperature at the time of the calibration
N_X = The refractive index measured during calibration

QC Analyst:

version: RICR.01.06.1/1LD

REFERENCE MATERIAL SIGN-OUT RECORD

Reference Material Sign-out Sheet

VERSION RMSS.01.06.1/1.QM

ANALYST INNITIALS	REF. MATERIAL	DATE/TIME SIGNED OUT	DATE/TIME RETURNED	CONTAMINANTS? PROBLEMS?

LABORATORY TEMPERATURE MONITORING RECORD

CEI LAB TEMPERATURE MONITORING RECORD

DATE	MORNING TEMPERATURE	AFTERNOON TEMPERATURE	PERFORMED BY	NOTE

VERSION LTMR.01.06.1/1.QM

APPENDIX II

FREQUENCY OF QC ACTIVITIES AND LABORATORY CALIBRATIONS

CALIBRATION/QC ACTIVITY CHECKLIST (PLM)

Calibration / QC Activity	Frequency
Microscope Alignmnet	Daily
Contamination Checks (In-house Blanks)	Daily
Balance Calibration	Monthly
Analysis of previous NVLAP Samples (Accuracy)	Monthly
Intra-Analyst Precision	Monthly
In-house Microscope Cleaning	Monthly
Duplicate Analysis	Daily
Replicate Analysis	Daily
Refractive Index Calibration	Quarterly
Furnace Calibration	Monthly
*Round Robin Analysis	Quarterly
NVLAP Proficiency Testing	Semi-Annually
Hood Air Flow Test	Semi-Annually
Ambient Air Monitoring	Semi-Annually
Workbook Template Functionality of Formulas for QC Documentation (e.g. Excel Documents)	Quarterly
Internal Audit	Annually
Quality Management Review	Annually
Sub-contracted Microscope Cleaning	Annually

*Round Robins are done four times per year, but may not appear on a quarterly schedule because samples are hosted and handled by other participating laboratories.

Version: CQCA.01.15.1/1.QM

APPENDIX III

IN-HOUSE TRAINING PROGRAM FOR ANALYSIS OF PLM BULK SAMPLES

(EXCERPT FROM PLM TRAINING PROGRAM SYLLABUS 03/15/13)

ASBESTOS IDENTIFICATION USING POLARIZING LIGHT MICROSCOPY

COURSE OUTLINE FOR PLM ANALYST TRAINEES

1.0 WEEK 1

1.1 Introduction

1.1.1 Laboratory safety guidelines
1.1.1.1 Introduction to the Chemical Hygiene Plan
1.1.1.2 Basic Industrial Hygiene
1.1.2 Safety training
1.1.2.1 Use of HEPA Filtered Hood
1.1.2.2 Use of HEPA VAC in ACM spill
1.1.2.3 Cleaning the Work Area
1.1.3 Introduction to asbestos guidelines
1.1.3.1 Cross Contamination Prevention
1.1.3.2 Preparation of Friable NIST SRM 1866, SRM1867

1.2 The Polarized Light Microscope

1.2.1 Parts of the Polarized Light Microscope
1.2.2 Alignment of the Polarized Light Microscope

1.3 Basic Crystallography

1.3.1 Isotropic (Cubic) Structure
1.3.2 Serpentine Morphology
1.3.3 Triclinic (Amphibole) Structure
1.3.4 Fiber Orientation (∥ & ⊥)
1.3.5 RI Denotation (α & γ)

1.4 Optical Mineralogy

1.4.1 Analysts are shown how to obtain the following fiber properties using the Polarized Light Microscope:
1.4.1.1 Morphology
1.4.1.2 Sign of Elongation
1.4.1.3 Extinction
1.4.1.3.a Parallel Extinction
1.4.1.3.b Oblique/Inclined Extinction
1.4.1.3.c Undulose Extinction
1.4.1.3.d Isotropic Extinction
1.4.1.4 Pleochroism
1.4.1.5 Dispersion Staining

1.4.1.6 Becke' Lines
1.4.1.7 Birefringence

1.4.2 Dispersion Staining, Becke' Lines, and Refractive Index
1.4.2.1 Glass Standard 1.550 Mounted in 1.540 – 1.560 Refractive index Oil
1.4.2.2 Relationship between Becke' Lines, Dispersion Staining and Refractive Index

1.4.3 ASSIGNMENT
1.4.3.1 Trainee Completes Asbestos Properties Table
1.4.3.2 Trainee Completes Dispersion Staining Table and Chart
1.4.3.3 Trainee Determines Refractive Index of SRM 1866 Fiber Glass Standard

1.5 Optical Properties of Asbestos and Related Fibers

1.5.1 Chrysotile
1.5.2 Amosite
1.5.3 Crocidolite
1.5.4 Actinolite-Tremolite
1.5.5 Anthophyllite
1.5.6 Non-asbestos fibers
1.5.6.1 Fibrous Glass
1.5.6.2 Cellulose
1.5.6.3 Talc
1.5.6.4 Wollastonite
1.5.6.5 Synthetic Fiber
1.5.6.6 Hair
1.5.6.7 Brucite
1.5.6.8 Non-Asbestiform Actinolite, Tremolite, Anthophyllite

1.6 Examination of Bulk Samples Using Stereoscope

1.6.1 Examination of Samples
1.6.2 Identifying Layers

1.7 Basic Prep Techniques
1.7.1 Organic Materials
1.7.1.1 Dissolving Organic Matrix in R.I. Oil Using Hot Plate.
1.7.1.2 Ashing Organic Matrix with Butane Lighter
1.7.2 Soft Mineral Matrix (gypsum, calcium carbonate)
1.7.3 Hard Mineral Matrix (cementitious materials, silicate-heavy matrices)
1.7.4 Acid Soluble Mineral Matrix (calcium carbonate)

1.8 ASSIGNMENT – Trainee is to prepare and study library specimens that are labeled with the known components (approximately 80 samples). Trainee is encouraged to find and verify components listed on the sample label.

1.9 ASSIGNMENT – Trainee is to prepare and analyze library specimens that are not labeled with components (i.e. unknown samples). Results are checked by the trainer using an answer key (approximately 100 unknown samples). Trainee is responsible to list all components of a given sample and attempt to give a percentage of any asbestos components.

2.0 WEEK 2-4

2.1 Completion of Sample Library

2.2 Introduction to CEI Labs, Inc. Filemaker Pro 11 Software

2.3 Review of Bulk Building Materials
2.3.1 Wall Systems
2.3.2 Ceiling Systems
2.3.3 Flooring Systems
2.3.4 Insulation Systems
2.3.5 Roofing Systems
2.3.6 Miscellaneous Materials

2.4 ASSIGNMENT – Trainee is to prepare and analyze samples previously analyzed by authorized CEI personnel. Trainees shall enter their data directly onto electronic bench worksheets created with Filemaker Pro Software.

2.5 Results are checked daily. Trainees are urged to closely study original analyst observations.

2.6 Determining Percentages using Calibrated Visual Estimates

3.0 WEEK 5-8

3.1 Error Rates are calculated for the trainee from this point forward on a weekly basis.

3.2 Aspects of analysis with which the trainee has difficulty are identified and addressed through repetitive analysis.

4.0 WEEK 9-14

4.1 Trainees begin first-run commercial samples at 100% rate of re-analysis by authorized personnel.
4.1.1 Review of layering policy.
4.1.2 Identifying and implementing customer instructions.
4.1.3 Generating the draft report.
4.1.4 Organizing the test report and paperwork associated with the test report.

4.2 The re-analysis rate of trainees' samples is decreased at the trainer's discretion until the trainee's error rate is <1%.

4.3 A review of training records will be made by the Quality Manager and the Laboratory Director before authorizing the trainee to do first run samples with standard QC parameters (random 10% reanalysis of samples)

4.4 A letter and/or certificate will be issued upon this determination showing the analyst has been authorized as a CEI Labs, Inc. PLM Analyst.

4.5 NVLAP shall be contacted and the new Analyst shall be added to the list of authorized PLM Analysts.

CEI LABS, INC.
Quality Assurance Manual

CEI Labs, Inc.
107 New Edition Court
Cary, NC 27511

Tianbao Bai, Ph. D., CIH
Laboratory Director

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Gary A. Swanson, Quality Manager

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1.1 ACCREDITATION OVERVIEW

1.1.1 Fields of Testing.

1.1.1.1 CEI Labs, Inc. has selected AIHA IHLAP accreditation for Quantifying Asbestos and other Fiber types by Phase Contrast Microscopy.

1.1.1.2 CEI Labs, Inc. has selected AIHA EMLAP accreditation for Indoor Air Quality, Quantifying and Identifying Airborne Fungi Spores from Spore Traps.

1.1.1.3 CEI Labs, Inc. has selected NVLAP accreditation for Asbestos Air Analysis by AHERA rules using Transmission Electron Microscopy.

1.1.1.4 CEI Labs, Inc. has selected NVLAP accreditation for Asbestos Analysis of Bulk Building materials using Polarized Light Microscopy.

1.1.2. Quality Policy Statement.

1.1.2.1 It is the policy of CEI Labs, Inc. (CEI) to provide our customers with the best analytical results possible using the most appropriate industry methods and state-of-art equipment. We understand that all laboratory personnel affect data quality; therefore, complete understanding of the SOP and QA Manuals by all employees of CEI is imperative.

1.1.2.2 The purpose of CEI's management system is to ensure high quality of data for its customers, and to maintain and improve upon a quality assurance program that allows us to provide excellent results. All necessary quality control procedures are taken to achieve this goal. The CEI management system routinely undergoes review processes to maintain and improve the quality of CEI laboratory services, and to improve the effectiveness of the management system.

1.1.2.3 CEI will adhere to all pertinent NIST, NVLAP, AIHA, and ISO 17025-2005 policies and continue to improve the quality of analysis in the laboratory.

1.1.2.4 Methods used for PCM analysis are defined, established, and verified by National Institute for Occupational Safety and Health (NIOSH). Reporting limits are established by NIOSH methodology and implemented by strict adherence to the NIOSH 7400 Test Method.

1.1.2.5 Methods used for fungi spore trap analysis are defined, verified, and established by CEI.

1.1.2.6 Methods used for TEM AHERA analysis are defined, verified, and established by the Environmental Protection Agency (EPA).

1.1.2.7 Methods for PLM analysis of bulk building materials are defined, verified, and established by the EPA.

1.1.3 Review of Manual

1.1.3.1 I have reviewed the **CEI Labs, Inc. Quality Assurance Manual** and have found it to be appropriate for the scope of work performed at this laboratory facility.

1.1.3.2 I state that the laboratory complies with all applicable federal, state, and local regulations regarding safety and health.

1/29/15

Tianbao Bai, CIH, PhD, Laboratory Director, CEI Labs, Inc. Date

01/27/2015

Gary A. Swanson - Quality Manager, CEI Labs, Inc. Date

1.1.4 Employee Compliance Statement

1.1.4.1 Employees shall be required to sign a statement of compliance with the *CEI Labs, Inc. Quality Assurance Manual*, AIHA-LAP LLC Policies, *NIST Handbook 150*, and ISO 17025:2005 that states: "As an employee of CEI Labs, Inc., I have read the *CEI Labs, Inc. Quality Assurance Manual* and agree to comply with any and all statements contained within. I realize that deviation from the quality assurance procedures could result in a corrective action and reprimand, and further deviation could result in termination."

1.1.4.2 Statements of compliance are maintained in Appendix I of the CEI Quality Assurance Manual.

2A.4 MANAGEMENT SYSTEM REQUIREMENTS

2A.1 CEI Labs maintains a copy of ISO/IEC 17025:2005 Standard in its entirety within the confines of the laboratory.

2A.4.1 Management Requirements: Organization

2A.4.1.1 CEI Labs, Inc is the legal name of the laboratory where analyses are to be performed. CEI Labs, Inc. shall be held legally responsible for all laboratory work performed on its premises.

2A.4.1.2 CEI will perform testing according to requirements of the AIHA-LAP, LLC Policy Module and ISO/IEC 17025:2005, and also to satisfy the needs of the customer, and the regulatory authorities or organizations providing recognition.

2A.4.1.3 CEI's laboratory management system shall only cover work carried out in the laboratories facilities at 107 and 118 New Edition Court, Cary North Carolina, 27511. CEI does not perform laboratory services outside of this location.

2A.4.1.4 CEI does perform some sampling for which its own laboratories provide analyses.

2A.4.1.4.a CEI does not permit the field technician that generated the samples for the laboratory to perform the analyses of those samples.

2A.4.1.4.b CEI does not engage in contract analyses that create an incentive for biased results.

2A.4.1.4.c It is the goal of CEI to maintain an environment that encourages impartiality and operational integrity.

2A.4.1.5 Additional Requirements.

2A.4.1.5.a CEI maintains managerial and technical personnel who, irrespective of other responsibilities, have the authority and resources needed to carry out their duties, including the implementation, maintenance and improvement of the management system, and to identify the occurrence of departures from the management system or from the procedures for performing tests and/or calibrations and to initiate actions to prevent or minimize such departures. (Section 2A.5.2 will define these managers and technicians, their educational requirements, as well as their responsibilities).

2A.4.1.5.b At no point will the work load exceed 90% of the laboratories capacity. CEI produces an environment which analysts are free from commercial, financial, and other influences that might adversely affect the quality of their work.

2A.4.1.5.c CEI understands and has a duty to protect customer confidentiality and proprietary rights. All sample testing results shall be protected and kept confidential. No data will be released without prior written consent of the customer, including electronic data transmission via fax or email.

2A.4.1.5.c.(i) To protect customer confidentiality and proprietary rights, this notice is always on each fax cover page: “The contents contained in this fax are confidential and legally protected. If you received this fax by accident, please destroy immediately and call our office.

2A.4.1.5.c.(ii) Reports transmitted to the customer by email contain the following statement on the cover page: “The contents contained in this email are confidential and legally protected. If you received this email by accident, please delete it immediately and call our office”.

2A.4.1.5.d Analysts at CEI must explicitly follow only the approved procedures for the sample type and test they have been assigned for a given sample.

2A.4.1.5.d.(i) CEI employees do not engage in activity that will diminish confidence in its competence, impartiality, judgment, or operational integrity.

2A.4.1.5.d.(ii) CEI does not engage in contract analyses that create an incentive for biased results.

2A.4.1.5.e Organizational Structure

2A.4.1.5.e.(i). CEI is an industrial hygiene/indoor air quality analytical laboratory located at 107, 105, 109, 116, and 118 New Edition Court in Cary, North Carolina. The laboratory is accredited AIHA-LAP for analysis of fiber counts by NIOSH 7400 and mold spore trap counts by CEI developed methods. CEI is currently accredited by NVLAP (National Voluntary Laboratory Accreditation Program) for bulk asbestos analysis by PLM, and air samples by TEM AHERA protocols. Air, dust, bulk, swab, and direct tape lift samples are analyzed for the detection of mold contamination in indoor environments. CEI Maintains accreditation by the California Department of Health for asbestos analysis of bulk asbestos samples by PLM and also possesses certifications from other states to conduct asbestos analysis for bulk and air media. Other non-accredited asbestos testing (dust and bulk asbestos by TEM, etc.) are also performed by CEI at its facilities. The laboratory employs state-of-art equipment and methodologies in the analysis of customer samples.

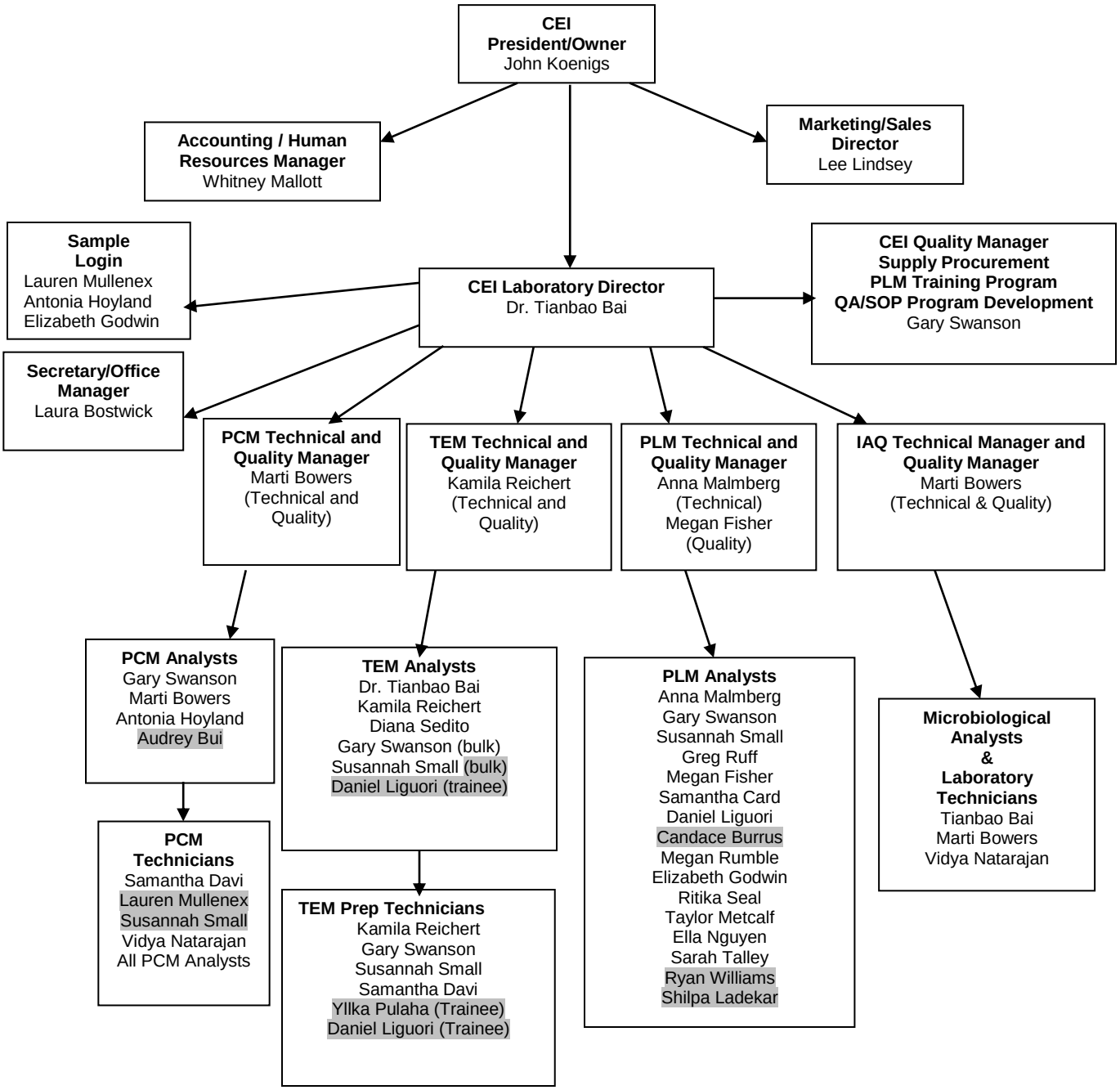
2A.4.1.5.e.(ii) As part of CEI's quality management system, the quality assurance and quality control of the laboratory is directly overseen by the Laboratory Director. The Quality Manager is in charge of everyday QA/QC activity. Analysts at CEI perform the actual QA/QC activities. The TABLE 1 conveys a chart showing the structure of CEI Labs, Inc.

2A.4.1.5.f Specific Laboratory Personnel – Laboratory positions are presented in section 2A.4.1.5.f to 2A.4.1.5.m.(ix). Appendix I of the CEI Quality Assurance Manual documents approval for their descriptions and duties, as well as statements of employee compliance with the CEI Quality Assurance Manual.

2A.4.1.5.f.(i) **Laboratory Director**

The Laboratory Director is responsible for all laboratory operations and the Quality Assurance Program. This includes, but is not limited to: laboratory accreditation status, the training of personnel, calibration of equipment, sample handling and login procedures, contamination control and worker safety in the laboratory, maintenance of appropriate records, implementation of Inter-and Intra-laboratory QC programs, overall accuracy/precision of laboratory data, and supervision of all personnel. The laboratory director is responsible for assuring all employees are compliant with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the AIHA-LAP, and *NIST Handbook 150*.

TABLE 1. Organizational Structure of CEI Labs, Inc.



2A.4.1.5.g. **Technical Managers** – CEI provides adequate supervision of testing staff, including trainees. Technical managers are familiar with methods and procedures, purpose of each test and/or calibration, and with the assessment of the test results.

2A.4.1.5.g.(i) **Laboratory Manager (PCM Laboratory)**
Laboratory Manager is the title given for the laboratory's technical manager. The Laboratory manager is responsible for

implementation of CEI's Quality Assurance Program. This includes, but is not limited to: sample handling and login, worker safety and contamination control in the laboratory, and supervision of all laboratory personnel. The Laboratory Manager oversees production-related planning and workload for the laboratory.

2A.4.1.5.g.(ii) **Laboratory Manager (IAQ Laboratory)**
Laboratory Manager is the title given for the laboratory's technical manager. The Laboratory Manager is responsible for implementing CEI's Quality Assurance Program. This includes, but is not limited to: sample handling and login, worker safety and contamination control in the laboratory, and supervision of all laboratory personnel. The Laboratory Manager oversees production related planning and workload for the laboratory. In order to meet the education and experience requirements required for this position, the Indoor Air Quality Laboratory employs two individuals to serve as co-managers for this position.

2A.4.1.5.g.(iii) **Laboratory Manager (PLM Laboratory)**
Laboratory Manager is the title given for the laboratory's technical manager. The Laboratory manager is responsible for implementing CEI's Quality Assurance Program. This includes, but is not limited to: sample handling and login, worker safety and contamination control in the laboratory, and supervision of all laboratory personnel. The Laboratory Manager oversees production-related planning and workload for the laboratory.

2A.4.1.5.g.(iv) **Laboratory Manager (TEM Laboratory)**
Laboratory Manager is the title given for the laboratory's technical manager. The Laboratory manager is responsible for implementing CEI's Quality Assurance Program. This includes, but is not limited to: sample handling and login, worker safety and contamination control in the laboratory, and supervision of all laboratory personnel. The Laboratory Manager oversees production-related planning and workload for the laboratory.

2A.4.1.5.h Technical managers have responsibility for the technical operations and the provision of resources needed to insure the required quality of laboratory operations.

2A.4.1.5.i **Quality Managers** – CEI appoints staff members to act as quality managers who, irrespective of other responsibilities, shall have defined responsibility and authority for ensuring that the management system, related to quality, is implemented and followed at all times. The quality managers shall have direct access to the highest level of management at which decisions are made on laboratory policy or practice.

2A.4.1.5.j **Quality Manager (PCM Laboratory), (IAQ Laboratory), (PLM Laboratory), (TEM Laboratory)**
The Quality Manager is responsible for implementing the Quality Assurance Program on a daily basis. This includes, but is not limited to: calibration of equipment, sample handling and login, worker safety and contamination control in the laboratory, analysis of QC data, resolution of analytical discrepancies, evaluation of the monthly QC data, and maintenance of appropriate records.

2A.4.1.5.k CEI appoints deputies for key personnel, to carry out their duties in their absence or under their authority, should the need arise. Appendix I of the CEI Quality Assurance Manual contains a summary of these key personnel and their deputies.

2A.4.1.5.l. Top management ensures that CEI personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the quality management system.

2A.4.1.5.l.(i) CEI conducts semi-annual performance reviews of all employees. The relevance and importance of the employees' performance activities to the laboratory and quality management system are emphasized and reviewed.

2A.4.1.5.l.(ii) Bi-weekly meetings are conducted with laboratory staff to disseminate information and emphasize short term projections and goals of CEI.

2A.4.1.5.m. **Non-management Positions and Personnel.**

2A.4.1.5.m.(i) **PCM Laboratory Analyst**
Laboratory Analysts perform analysis of PCM samples using the NIOSH 7400 method. They are responsible for the accuracy and precision of the work they perform. Laboratory Analysts routinely work under the supervision of the Laboratory Director and the Quality Manager in implementing QA/QC procedures on a daily basis. Responsibilities include, but are not limited to: daily calibration of equipment, sample handling and login, sample preparation and analysis, contamination control in the laboratory, implementing worker safety procedures, and report generation.

2A.4.1.5.m.(ii) **PCM Laboratory Technician**
Laboratory Technicians are responsible for sample login, sample preparation, daily cleaning of the sample preparation area, creating additional preparations in accordance with the Quality Assurance Program, entering data, and generating reports from that data.

2A.4.1.5.m.(iii) **Microbiological Analyst**
Microbiological Analysts are responsible for performing work submitted to the Indoor Air Quality Laboratory using methods approved by CEI. They are responsible for the accuracy and precision of the work they perform. Laboratory Analysts routinely work under the supervision of the Laboratory Director and the

Quality Manager in implementing QA/QC procedures on a daily basis. Responsibilities include, but are not limited to: daily calibration of equipment, sample handling and login, sample preparation and analysis, contamination control in the laboratory, implementation of worker safety procedures, and report generation.

2A.4.1.5.m.(iv) **IAQ Laboratory Technician**
Laboratory Technicians are responsible for sample login, sample preparation, media preparation, and daily cleaning of the sample preparation room.

2A.4.1.5.m.(v) **PLM Laboratory Analyst**
PLM analysts are responsible for performing work submitted to the PLM Laboratory using the approved EPA Methods. They are responsible for the accuracy and precision of the work they perform. Laboratory Analysts routinely work under the supervision of the Laboratory Director and the Quality Manager in implementing QA/QC procedures on a daily basis. Responsibilities include, but are not limited to: daily calibration of equipment, sample handling and login, sample preparation and analysis, contamination control in the laboratory, implementation of worker safety procedures, and report generation.

2A.4.1.5.m.(vi). **TEM Laboratory Analyst**
TEM analysts are responsible for performing work submitted to the TEM Laboratory using the approved EPA Methods. They are responsible for the accuracy and precision of the work they perform. Laboratory Analysts routinely work under the supervision of the Laboratory Director and the Quality Manager in implementing QA/QC procedures on a daily basis. Responsibilities include, but are not limited to: daily calibration of equipment, sample handling and login, sample preparation and analysis, contamination control in the laboratory, implementation of worker safety procedures, and report generation.

2A.4.1.5.m.(vii) **TEM Laboratory Prep Technician**
Laboratory Technicians are responsible for sample login, sample preparation according to approved methods, media preparation, and daily cleaning of the sample preparation room.

2A.4.1.5.m.(viii) **Laboratory Secretary/Office Manager**
The Laboratory Secretary is responsible for the preparation of final test reports forwarded to customers, maintenance of appropriate customer files, and customer relations.

2A.4.1.5.m.(ix) **Login Technician**
Login Technicians are responsible for sample receipt. They determine and record the condition and acceptability of samples submitted to CEI, and process and package the samples for delivery to the laboratory. Login technicians create internal chain of custody records and deliver them with the samples to the

laboratory, as well as assign unique sample identification numbers to all test items processed by the laboratory.

2A.4.1.6 Top management communicates with laboratory personnel through bi-weekly meetings, semi-annual performance reviews, and memoranda. A notice of communication concerning quality assurance and other relevant documents is kept by the quality manager to ensure all personnel are aware that those documents are available for inspection at any time. Employees may directly address their supervisory managers with concerns about any issue. Personnel are also able to address concerns they may have during the scheduled weekly management meeting.

2A.4.2 Management Requirements: Management System

2A.4.2.0 The quality management system established by CEI is designed to comply with the ISO/IEC 17025:2005 Standard, AIHA-LAP accreditation requirements and *NIST Handbook 150* requirements for the Fields of Testing for which we have applied or been accredited. The quality management system documentation is presided over by the Laboratory Director, and the Quality Manager. Quality Assurance activities are documented by all personnel, under the direction of the quality management system.

2A.4.2.0.a A policy statement has been issued under the authority of top management. It is located in section 1.1.2 of this manual (*CEI Quality Assurance Manual* (CEI QA Manual).

2A.4.2.0.b Yearly management reviews, including production summaries, quality control summaries, and other pertinent data are conducted in order to assess the effectiveness of the quality management system. Recommendations for improvement are included as part of this review. Monthly QC reports assess the effectiveness of the quality control procedures. The importance of meeting customer, as well as statutory and regulatory requirements is the primary goal of continued management review and improvements to the quality management system.

2A.4.2.0.c Primary analytical procedures are addressed in Standard Operations and Procedures for each laboratory. The QA Manual contains procedures for quality control / quality assurance for all of CEI's laboratories.

2A.4.2.0.d Quality Managers and Technical Managers have clearly defined duties so that a combination of quality and service can be optimized and delivered to CEI's customers.

2A.4.2.1 Documents contained within the QA Manual and any other referenced quality documents are consistent with the requirements of ISO/IEC 17025:2005, QA/QC requirements of the approved methods used, and other AIHA-LAP, LLC and NISTHandbook specific requirements detailed within section 2A Management System Requirements. The QA Manual addresses, but is not limited to the following elements:

2A.4.2.1.a Title Page
2A.4.2.1.b Table of Contents
2A.4.2.1.c Quality Manual Maintenance and Update Procedures

2A.4.2.1.d Customers' confidential information and proprietary rights
2A.4.2.1.e Impartiality and Operational Integrity
2A.4.2.1.f Organization and Responsibility
2A.4.2.1.g Quality Assurance Objectives and Policies
2A.4.2.1.h Document Control
2A.4.2.1.i. Review of Requests, Tenders and Contracts
2A.4.2.1.j Purchasing of Services and Supplies
2A.4.2.1.k Service to the Customer
2A.4.2.1.l Complaints
2A.4.2.1.m Control of Nonconforming Testing Work
2A.4.2.1.n Corrective Action
2A.4.2.1.o Preventive Action
2A.4.2.1.p Control of Records
2A.4.2.1.q Internal Audits
2A.4.2.1.r Personnel Qualifications and Training
2A.4.2.1.s Analytical Methods
2A.4.2.1.t Equipment Calibration and Maintenance Procedures
2A.4.2.1.u Reagents and Standards
2A.4.2.1.v Sampling Methods and Procedures
2A.4.2.1.w Handling of Test Items
2A.4.2.1.x Sample Retention and Disposal
2A.4.2.1.y Internal Quality Control Procedures
2A.4.2.1.z Data Reduction, Validation and Reporting
2A.4.2.1.aa Quality Assurance Reports
2A.4.2.1.bb Reference to other Management System Documentation

2A.4.2.2 The Quality Manual is be updated whenever necessary, but must be reviewed annually by the Quality Manager, and the Laboratory Director.

2A.4.3 Management Requirements: Document Control

2A.4.3.1 Procedures for the control of documents that form the quality management system (internally generated or from external sources), such as regulations, standards, other normative documents, test and/or calibration methods, as well as drawings, software, specifications, instructions and manuals must adhere to the procedures contained here with in.

2A.4.3.1a Document Approval and Issue – All documents issued by the laboratory as part of the management system are reviewed and approved by the Laboratory Director and the Quality Manager.

2A.4.3.1b A master list of documents is maintained by the Quality Manager. The latest revision status and current location of the document's use is recorded on this master list. When a document is approved that replaces an obsolete document, a copy of the document is kept as a master copy, and several duplicates are to be readily available to preclude use of invalid and/or obsolete documents.

2A.4.3.2.1 All documents created and approved by management must contain the following information: Date of issue, Issuing Authority, Issue and/or Revision #, Document Title, Page #, and the Total # of Pages. If it is not possible to demarcate the total number of pages, the phrase "END OF DOCUMENT" must be placed on the final page of the document to indicate its finality.

2A.4.3.2.2 General laboratory documents in large circulation may alternatively be coded with a document version presented in the following format:

AODT.MM.YY.P/N.IA

Where:
AODT = Abbreviation of the Document Title (not limited to 4 characters).
MM = Month of Document Revision/Approval.
YY = Year of Document Revision/Approval
P/N = Page Number of Total Number of Pages
IA = Issuing Authority; this will be "LD" for Laboratory Director, "QM" for the Quality Manager, "LM" for the Laboratory Manager

Adherence to this system allows each document to be uniquely identified from previous versions. All new documents and revisions must be submitted to the Laboratory Director and Quality Manager for review through use of the Document Approval Worksheet.

2A.4.3.2.2.a Authorized editions of appropriate documents are available at all locations where operations essential to the effective functioning of the laboratory are performed.

2A.4.3.2.2.b Documents are revised as needed, or examined annually during the quality management review in order to ensure continuing suitability and compliance with applicable requirements.

2A.4.3.2.2.c Invalid or obsolete documents are promptly removed from all points of issue or use, or otherwise assured against unintended use.

2A.4.3.2.2.d Obsolete documents, retained either for legal or knowledge preservation purposes, are suitably marked. Electronically stored management system documents that are obsolete are moved to an "obsolete documents" folder in the computer storage system and "obsolete" is included in the computerized document name.

2A.4.3.2.2.e For the PCM and IAQ laboratories: Any physical documents that are determined to be obsolete will be removed from all points of issue and immediately shredded.

2A.4.3.2.3 Adherence to this system allows each document to be uniquely identified from previous versions. All new documents and revisions must be submitted to the Laboratory Director and Quality Manager for review through use of the Document Approval Worksheet.

2A.4.3.3 Document Changes

2A.4.3.3.1 Changes to documents are reviewed and approved by the same function (section 2A.4.3.1 to 2A.4.3.2) that performed the original review unless specifically designated otherwise. The Laboratory Director and Quality

Manager have access to pertinent background information upon which to base their review and approval.

2A.4.3.3.2 Where practicable, the altered or new text shall be identified in the document or the appropriate attachments.

2A.4.3.3.2.a Altered or new is indicated by shading the text in a transparent gray color, still allowing for the text to be read. If the text has been altered by hand, a yellow or blue transparent highlighter felt tip pen can be used to indicate the altered text.

2A.4.3.3.2.b Indicators of altered text, including attachments, may be removed 1) after the text has been present for a period of one year, or 2) upon the next revision of the document.

2A.4.3.4 Control of Electronic Documents

2A.4.3.4.1 Electronic documents created and maintained by CEI Labs include but are not limited to: commercial website content, electronic copies of SOP's, Filemaker Pro versions, and Microsoft Excel templates for quality control.

2A.4.3.4.2 Electronic documents must contain as part of their contents, the following information: Date of issue, and/or date of revision, Issuing Authority, and Document Title.

2A.4.3.4.3 Electronic documents such as worksheets and operating procedures, that also are maintained in hard copy form, must be maintained using procedures outlined in 2A.4.3.1 to 2A.4.3.3.

2A.4.3.4.4 Security of Electronic Documents

2A.4.3.4.4.a Approved versions of documents, are placed into folders which have varying levels of access. Table 2 shows the level of access for different electronic document types.

2A.4.3.4.4.a.(i) Manager Access Only – These electronic documents are restricted to managers and their deputies. Records and supporting electronic scripts on these documents must not be changed without managerial approval.

2A.4.3.4.4.a.(ii) Read Only – Read only documents are documents which can not be changed, and must only be used if a hard copy is needed. These are documents that personnel should have access to for viewing or printing, but should only be altered through the document revision process.

2A.4.3.4.4.a.(iii) Full Access – These documents are intended to have their records be modifiable. Documents where frequent data entry is performed may be accessible to all personnel. Once data has been compiled, its status may be changed to one of the other electronic document categories.

2A.4.3.4.4.b CEI prefers documents that are created restricted modifiable content, except for the entry of records or data. If it is practicable to do so, CEI tries to use these types of electronic documents.

2A.4.3.5 Quality Assurance Manual - Maintenance and Updates

2A.4.3.5.1 The *CEI Quality Assurance Manual* is updated annually following the annual internal audit. This occurs in January and/or February of each year.

2A.4.3.5.2 The *CEI Quality Assurance Manual* may be updated at other intervals following additional internal audits, or external audits from CEI's accrediting agencies.

2A.4.3.5.3 *Quality Assurance Manual* updates require approval from the CEI Laboratory Director and the CEI Quality Manager.

2A.4.3.5.4 A statement of compliance to the manual's procedures must be obtained by all CEI employees that work under the domain of the *Quality Assurance Manual*.

2A.4.3.5.5 The CEI Quality Assurance Manual is maintained by the Quality Manager. The Quality Manager shall issue hard copies of the CEI Quality Assurance Manual to each of CEI's testing laboratories within 10 working days of any updates to the manual.

Table 2: Document Access

Category of Access:	Manager Access Only Documents	Read Only Documents	Full Access Documents
Examples of Files:	Quality Control Templates (e.g. calculation of Sr values), Documents that require long term protection, research and development files, reference material information. SOP manual master files, QA manual master file	Worksheets that are used in hard copy form, SOP electronic copies, QA manual electronic copies, recent QA/QC records.	QC Records for the current month, Filemaker Pro Data Base for creating new records, Data Entry Modules for test reports.

2A.4.4 Management Requirements: Review of Requests, Tenders, and Contracts

2A.4.4.1 Any contract, written or verbal, is reviewed by CEI management to ensure that the requested testing is within the laboratories capacity and resources, and that the laboratories personnel have the skills and expertise necessary for the requested testing.

2A.4.4.1.a The Customer Chain of Custody Worksheet acts as a written contract for request of testing to be performed at CEI. The Customer Chain of Custody Worksheet contains a list of possible tests, and the customer may choose the type of testing, defined by the method, to be performed.

2A.4.4.1.b After the type of testing is selected, a review is made by CEI management to determine if the laboratory has the capability and resources to meet the requirements.

2A.4.4.1.c A review of the Customer Chain of Custody Worksheet by CEI personnel is performed. If necessary information is missing from the Customer Chain of Custody Worksheet, the customer is contacted to retrieve the necessary information.

2A.4.4.1.c.(i) An attempt will be made to get the customer to respond, in writing if possible, to collect the necessary information to perform the work requested.

2A.4.4.1.c.(ii) CEI personnel document incomplete Customer Chain of Custody Worksheets by filling out the "Corrective Action Form". See Section 2A.5.8.2.c.(viii) for a detailed procedure for corrective action documentation of nonconforming Customer Chain of Custody Worksheets.

2A.4.4.1.c.(iii) Customers may submit samples for analysis on other worksheets, as long as the necessary information is provided by the customer to complete the requested testing.

2A.4.4.1.d Differences between the request or tender and the contract are resolved before any work commences. Each contract must be acceptable to both the laboratory and the customer.

2A.4.4.2 Records of reviews, including any significant changes in the contract must be maintained.

2A.4.4.2.a Records are also maintained of pertinent discussions with a customer relating to the customer's requirements or the result of the work during the period of execution of the contract.

2A.4.4.2.b CEI personnel document any significant contact with the customer over specific contracted work on the "Laboratory Chain of Custody Record" in the "Comments" section.

2A.4.4.3 The review of contracts extends to any work subcontracted by CEI to other laboratories.

2A.4.4.4 If a deviation from the contract becomes necessary, CEI personnel contacts the customer immediately. Work ceases until the deviation is approved by the customer and CEI management.

2A.4.4.5 If a contract needs to be amended after work has commenced, the same contract review process is repeated and any amendments are communicated to all affected personnel.

2A.4.4.6 Verbal contracts must be reviewed in the same manner as written contracts. Verbal contracts are usually completed by CEI Sales Representatives, and are recorded in the CEI Customer Data base until a written contract can be established between all affected parties.

2A.4.5 Management Requirements: Subcontracting of Tests and Calibrations

2A.4.5.1 When CEI subcontracts work, either because of unforeseen reasons or on a continuing basis, or because the work is not performed by CEI (i.e., non-approved test methods for the laboratory), this work shall be placed with a competent subcontractor. Whenever possible, the subcontractor shall comply with ISO/IEC 17025:2005. If the Field of Testing requested is covered by AIHA,-LAP, LLC, or NVLAP, and neither the customer nor other regulating agencies direct where the samples should be sent, CEI will send the subcontracted work to an accredited laboratory to which the field of testing CEI is also accredited(AIHA-LAP LLC or NVLAP).

2A.4.5.2 The laboratory advises the customer of the arrangement in writing, and when appropriate, gains the approval of the customer, preferably in writing.

2A.4.5.3 CEI is responsible to the customer for the subcontractor's work, except in the case where the customer or a regulatory authority specifies which subcontractor is to be used.

2A.4.5.4 CEI maintains a register of preferred subcontractors it uses for tests and/or calibrations, along with evidence of compliance with the International Standard for the work in question. A list of vendor/suppliers and subcontracted services is located in Appendix VI of the Quality Assurance Manual.

2A.4.5.4.a CEI does not subcontract test items when its own laboratory is accredited by AIHA-LAP, LLC, or NVLAP for the specific test.

2A.4.6 Management Requirements: Purchasing and Supplies

2A.4.6.1 CEI maintains a list of approved vendors. Materials procured for sample preparation and analysis are certified by the vendor that the purity and suitability of the material is appropriate for the testing method used. The following criteria are taken into consideration when approving a provider of services or materials:

2A.4.6.1a The vendor must provide Material Data Safety Sheets for standards and reagents purchased by CEI;

2A.4.6.1b a cost analysis is performed by the Laboratory Director to determine if the value / cost of the item or service is acceptable to CEI;

2A.4.6.1c when possible, the vendor providing the supplies, reagents, or standards must adhere to an International Standard.

2A.4.6.1.d products and/or services obtained by a vendor must be appropriate to CEI's needs and must not compromise the quality of CEI analytical services.

2A.4.6.2 The Quality Manage is designated to order and inspect supplies, reagents and standards for the laboratory.

2A.4.6.2.a The Quality Manager evaluates the suitability of a supply, reagent, or standard for the testing performed, and determines which vendor to procure the item(s).

2A.4.6.2.b The Quality Manager obtains permission from the Laboratory Director to purchase necessary item(s).

2A.4.6.2.c The Quality Manager places the order for the supply, reagent, or standard with the approved vendor, providing a purchase order number consisting of his/her initials, and the date the item(s) were purchased.

2A.4.6.2.d When possible, a packaging list and/or order confirmation shall be obtained from the approved vendor in order to inspect that the order was correctly placed.

2A.4.6.3 Purchasing documents for items affecting the quality of laboratory output must contain data describing the services and supplies ordered. The purchasing documents must be reviewed and approved for technical content prior to release.

2A.4.6.3.a CEI maintains a Laboratory Supplies Record Worksheet where critical information about supply purchases are recorded. The following information will be recorded when possible on the Laboratory Supplies Record Worksheet:

2A.4.6.3.a.(i) The date on which the supply, reagent or standard was ordered;
2A.4.6.3.a.(ii) the name of the supply, reagent or standard;
2A.4.6.3.a.(iii) the catalogue/item number of the supply, reagent or standard.
2A.4.6.3.a.(iv) the quantity of the supply, reagent or standard ordered;
2A.4.6.3.a.(v) the supplier/vendor name from which the supply, reagent or standard was ordered;
2A.4.6.3.a.(vi) initials of the staff member who received/checked/inspected the supply, reagent or standard ordered;
2A.4.6.3.a.(vii) the date the supply, reagent or standard was received;
2A.4.6.3.a.(viii) the lot/batch number of the supply, reagent or standard received;
2A.4.6.3.a.(ix) the condition in which the supply, reagent or standard was received.

2A.4.6.3.b CEI stores supplies, reagents, and standards according to manufacturers' specifications, and must provide adequate space for such items to be stored. Prior to storage or use, standard and solution preparations must be labeled with the following information:

2A.4.6.3.b.(i) Description of content;
2A.4.6.3.b.(ii) date of preparation;
2A.4.6.3.b.(iii) concentration/purity of the material;
2A.4.6.3.b.(iv) manufacture and lot number of parent material;
2A.4.6.3.b.(v) assigned expiration date;
2A.4.6.3.b.(vi) the initials of the technician that prepared the material.

2A.4.6.4 When possible, the vendor providing the supplies, reagents, or standards must adhere to an International Standard. If supplies, reagents, and/or standards obtained by CEI are found to adversely affect the quality of testing in the laboratory, the Laboratory Director and the Quality

Manager evaluate the vendor providing those materials or services, and determine if that vendor shall remain an approved supplier for CEI. This evaluation is documented.

2A.4.6.4.a An review of suppliers/vendors occurs annually. The Quality Manager and the Laboratory director go over the list of suppliers, evaluate if any have failed to meet criteria for approval as suppliers/vendors to CEI, then determine if any suppliers/vendors should be removed from the approved vendor list.

2A.4.6.4.b Any services rendered by those removed vendors should be sought out by the Quality Manager, and vendors for those supplies/services should be approved through the established approval process (2A.4.6.1. to 2A4.6.1d of this manual).

2A.4.6.4.c A list of vendor/suppliers and subcontracted services is located in Appendix VI of the Quality Assurance Manual.

2A.4.7 Management Requirements: Service to the Customer

2A.4.7.1 It is a goal at CEI that customers submitting samples for testing get the highest quality data. This means that CEI personnel are willing to cooperate with customers or their representatives in clarifying customers' requests and in monitoring the laboratory's performance in relation to the work performed. CEI ensures that its customers' information, and the testing performed, remains confidential. CEI performs its analyses, providing impartial, unbiased data.

2A.4.7.2 CEI seeks feedback, both positive and negative, from its customers. The feedback is used and analyzed to improve the management system, testing and calibration activities, and customer service.

2A.4.7.2.a CEI performs an annual survey of many of its customers to determine if the laboratory and personnel of CEI are providing outstanding service to its customers. The results of these surveys are reviewed and summarized in the annual Quality Management System Review.

2A.4.7.2.b CEI personnel address any customer complaint or question. All personnel are trained to re-issue original reports, and do basic computer system searches for customer information.

2A.4.7.2.c CEI personnel are trained to maintain customer confidentiality through the use of passwords to access electronic databases, as well as confirming the requestor's identity through the use of account numbers and other key information provided with customer chain of custody forms submitted with testing samples.

2A.4.8 Management Requirements: Customer Complaints

2A.4.8.1 Customer complaints are documented and addressed by the Laboratory Manager, the QC Manager, or the Laboratory Director. Customer complaints can fall under one of two categories:

2A.4.8.1.a <u>Nonconforming work, or suspected nonconforming work;</u>
Suspected nonconforming work is handled like all nonconforming work in the laboratory. Management personnel shall initiate an investigation of the suspected nonconforming work. If suspected nonconforming work is verified, a corrective action is taken, and the customer is assured that such work will be minimized in the future. CEI shall take necessary action to ensure this.

2A.4.8.1.b <u>Complaints *not related* to the quality of CEI's analytical capabilities or quality;</u>
Complaints of this nature are considered strictly personnel issues, and are addressed by CEI employees' adherence to the *CEI Company Policy Manual.*

2A.4.8.2 CEI's procedures for customer complaints are applied to all complaints made to CEI, including employee complaints, complaints from vendors, accrediting agencies and other parties.

2A.4.8.3 Procedure for Addressing Complaints:

2A.4.8.3.a Any complaint received by any party must be investigated.

2A.4.8.3.b A root cause analysis is conducted to verify the complaint.

2A.4.8.3.c Corrective action is issued, where necessary, and then monitored to determine if the corrective action was effective in resolving the complaint.

2A.4.8.3.d Complaints are documented on the "Corrective Action Report for Non-conforming Events" worksheet.

2A.4.8.4 CEI's goal is to resolve any complaints, from customers or other parties, in an ethical manner with impartiality, and to the satisfaction of the customer when possible.

2A.4.9 Management Requirements: Control of Nonconforming Testing

2A.4.9.1 If nonconforming testing or problems with the quality management system occur, including tests of inter-laboratory (Round Robin) or Proficiency Test samples, an investigation must be initiated by CEI.

2A.4.9.1.a An investigation is conducted by the Quality Manager, the Laboratory Manager, or the Laboratory Director.

2A.4.9.1.b If the nonconforming work is verified, and considered significant, the Laboratory Director then makes a decision of halting work and/or stop the issue of analytical reports.

2A.4.9.1.c An investigation team consisting of management and analysts investigates all aspects of the quality management system for potential deficiencies. Corrective actions are implemented

immediately, following appropriate steps specified in the QA Manual.

2A.4.9.1.d Where necessary, the customer is notified, and test results that do not conform are recalled.

2A.4.9.1.e If work has been halted, the Laboratory Director will determine at which time work shall resume.

2a.4.9.1.f. Investigations of nonconforming work are documented on the "Corrective Action Report for Non-conforming Events" worksheet.

2A.4.9.2 Where the evaluation indicates that the nonconforming work could recur, or that there is doubt about the compliance of the laboratories compliance with its own policies, the corrective action procedures in Section 2A.4.11 shall promptly be followed.

2A.4.9.2.a Any outlier from a Proficiency Test, Round Robin, or any other demonstration of competency is addressed as a non-conforming event.

2A.4.10 Management Requirements: Improvement

2A.4.10.1 The laboratory continually improves the effectiveness of its management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions, and management review.

2A.4.10.2 Audits of the laboratory may be conducted in addition to CEI's regularly scheduled times if the Laboratory Director sees the need for such an action necessary. The Laboratory Director may evaluate the quality management system through an audit or review process based on results from any investigation requiring corrective action.

2A.4.11 Management Requirements: Corrective Action

2A.4.11.1 CEI determines the corrective action of a particular nonconformity through use of <u>root cause analysis</u>. The Laboratory Director must approve all corrective actions that involve a change to the quality management system. Corrective actions that do not involve changes to the quality management system are documented by the Quality Manager and do not require approval by the Laboratory Director. All corrective actions and nonconforming events are documented in the Monthly QC Summary.

2.A.4.11.2 Prior to implementation of corrective action, an investigation must be made to determine the root cause(s) of the problem.

2A.4.11.2.a Cause analysis is performed in order to determine which actions resulted in nonconforming work and which actions did not result in nonconforming work.

2A.4.11.2.b All parties involved are consulted discuss a way to solve the problem.

2A.4.11.2.c Proficiency Tests or DOC rounds that lead to the “Not Proficient” status of a laboratory are addressed by the corrective action process.

2A.4.11.3 The investigative team selects the appropriate corrective action(s) to take, which may include, but are not limited to: reissue or amendment of an analytical report, retraining personnel, procurement of new equipment, or improving procedures to eliminate problems and prevent recurrence. The corrective action is to a degree appropriate to the magnitude and risk of the problem.

2A.4.11.4 The corrective action is implemented, and monitored to ensure it is an effective course of action.

2A.4.11.5 Where the identification of nonconformities or departures casts doubts on the laboratory’s compliance with its own policies and procedures, or on its compliance with this ISO/IEC 17025:2005, and/or AIHA-LAP, the laboratory ensures the appropriate areas of activity are audited as soon as possible.

2A.4.12 Management Requirements: Preventive Action

2A.4.12.1 The laboratory provides an environment where needed improvements and potential sources of nonconformities, either technical or concerning the management system, are identified. When improvement opportunities are identified or if preventive action is required, action plans are developed, implemented and monitored to reduce the likelihood of the occurrence of such nonconformities and to take advantage of opportunities for improvement.

2A.4.12.2 CEI takes several opportunities throughout the course of its regularly scheduled activities to address preventive action. Nonconformities may be identified through the following regularly occurring activities:

2A.4.12.2.a Daily Quality Control analysis;
2A.4.12.2.b monthly QC Summaries;
2A.4.12.2.c Annual Audit and Quality Management System Review;
2A.4.12.2.d Annual Customer Service Survey;
2A.4.12.2.e Daily contamination checks;
2A.4.12.2.f regularly scheduled calibration of equipment;
2A.4.12.2.g participation in Proficiency Testing and Round Robin programs;
2A.4.12.2.h daily cleaning and checks of equipment

2A.4.13 Management Requirements: Control of Records

2A.4.13.1 **General** - CEI maintains hard copy records of internal documents and analytical reports in a system of file cabinets at 107, and 118 New Edition Court, Cary, NC. Quality Management System Documents are maintained by the Quality Managers in their offices or work areas. Specific employee records are maintained by the Human Resources office, under the control of the President of CEI.

2A.4.13.1.2 CEI stores its records at room temperature (20-25°C) in file cabinets clearly labeled as to the contents or files present within. Analytical reports and other records are also backed up electronically should an unforeseen event cause damage or deterioration to hard copy records.

2A.4.13.1.2.a All CEI electronic and hardcopy records are maintained for a minimum period of 3 years.

2A.4.13.1.2.b. In addition to electronic records stored at the CEI location, electronic records are backed up to a disc format, and stored off site.

2A.4.13.1.3 CEI records are held secure and in confidence. CEI personnel are trained to maintain customer confidentiality through the use of passwords to access electronic databases, as well as confirming the requestor's identity through the use of account numbers and other key information provided with customer chain of custody forms submitted with testing samples.

2A.4.13.1.4 Protection of electronic data

2A.4.13.1.4.a CEI maintains in-house a file server, and a back-up file server.

2A.4.13.1.4.b Analytical reports, and original data (electronic bench worksheets), are backed up hourly to the file server and back-up file server.

2A.4.13.1.4.c All laboratory documents are backed up on a daily basis both to the file server, and the back-up file server.

2A.4.13.1.4.d Daily, laboratory documents are backed up to, and stored by, an external electronic data storage service vendor.

2A.4.13.1.4.e Annually, records are moved to an archive which may only be accessed by certain computers and key laboratory personnel.

2A.4.13.1.4.f A backup of archived data is also saved to a data storage disc and removed to an off site location.

2A.4.13.2 **Technical Records** - Technical laboratory records, such has original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each test report or calibration certificate issued, are maintained by CEI, either in hard copy or electronic format, for a minimum period of three years.

2A.4.13.2.1 Records for each test contain sufficient information to facilitate, if possible, identification of the factors affecting the uncertainty and to enable the test to be repeated under conditions as close as possible to the original. The records include the identity of personnel responsible for the sampling performance of each test and checking of results.

2A.4.13.2.1.a Records maintained by CEI for a minimum of three years shall include, but not be limited to, the following:

2A.4.13.2.1.a.(i) Customer Chain of Custody forms – to be completed by the customer;

2A.4.13.2.1.a.(ii) Laboratory Chain of Custody forms – to be completed by all who handle testing samples throughout the analytical process;

2A.4.13.2.1.a.(iii) Analytical Reports – to be completed by the analyst;

2A.4.13.2.1.a.(iv) Daily Analyst Record Books – to be completed by the analyst;
2A.4.13.2.1.a.(v) Monthly QC Reports – to be completed by the Quality Manager;
2A.4.13.2.1.b. CEI Maintains the following records for a minimum of 10 years, or as long as necessary:

2A.4.13.2.1.b.(i) Internal and External Audits – to be completed by the Laboratory Director and the QC Manager;

2A.4.13.2.1.b.(ii) Quality Management Review – To be completed by the Quality Manager;

2A.4.13.2.1.b.(iii) Proficiency Testing and Round Robin results – To be completed by the Quality Manager;

2A.4.13.2.1.b.(iv) Personnel Files – Maintained by the Laboratory Director containing the following information:

2A.4.13.2.1.b.(iv).(a) current Resume;
2A.4.13.2.1.b.(iv).(b) job description of each employee's job position;
2A.4.13.2.1.b.(iv).(c) appropriate training records;
2A.4.13.2.1.b.(iv).(d) summary of monthly QA/QC performances including resolution of discrepancies;
2A.4.13.2.1.b.(iv).(e) any other pertinent information regarding the analytical capability of that employee;

2A.4.13.2.1.b.(v) Equipment and Maintenance Records – Maintained by the Quality manager containing the following information:

2A.4.13.2.1.b.(v).(a) manufacturer;
2A.4.13.2.1.b.(v).(b) model number;
2A.4.13.2.1.b.(v).(c) serial number;
2A.4.13.2.1.b.(v).(d) calibration records;
2A.4.13.2.1.b.(v).(e) maintenance records;
2A.4.13.2.1.b.(v).(f) owner manuals;

2A.4.13.2.1.b.(vi) Customer Files – Maintained by the Laboratory Director containing the following information:

2A.4.13.2.1.b.(vi).(a) contracts;
2A.4.13.2.1.b.(vi).(b) key contacts and personnel;
2A.4.13.2.1.b.(vi).(c) billing and accounting information;
2A.4.13.2.1.b.(vi).(d) any pertinent information about the customer's preferences or needs that might be unique to that customer.

2A.4.13.2.2 Observations, data and calculations are recorded at the time they are made and shall be identifiable to the specific task.

2A.4.13.2.3 When mistakes occur in records, each mistake must be crossed out, not erased, made illegible or deleted, and the correct value entered alongside.

All such alterations to records must be signed or initialed by the person making the correction. In the case of records stored electronically, equivalent measures must be taken to avoid loss or change to original data.

2A.4.13.2.4 Correction to laboratory records must be dated.

2A.4.13.2.5 Records must be legible. Written records shall be created and maintained using indelible ink. No corrective fluids are used on original laboratory data records. Original records must be created using blue or black ink, unless the record requires a special color or highlight for the purpose of emphasis.

2A.4.13.2.6 Records may be disposed of after they have been held for their allotted period of time. The Master List of Documents contains an instruction for how those records are to be disposed of or destroyed.

2A.4.14 Management Requirements: Internal Audits

2A.4.14.1 Internal audits are conducted annually, and whenever the Laboratory Director wishes to evaluate the quality management system through an audit or review process based on results from any investigation requiring corrective action.

2A.4.14.1.a Audit objectives must be stated in the "Summary of Internal Audit".

2A.4.14.1.b Scheduled annual audits take place in January or February, and include assessments of data and analyses that occurred over the course of the previous year.

2A.4.14.1.c Additional audits may only examine part of the quality management system based on the particular need, as determined by the Laboratory Director, of a specific audit.

2A.4.14.1.d The Quality Manager plans and organizes the audits as required by the schedule and requested by management.

2A.4.14.1.e Audits must be carried out by trained and qualified personnel who are, wherever resources permit, independent of the activity to be audited.

2A.4.14.1.f The Quality Manager must be available to produce any records or documents investigated during the audit.

2A.4.14.1.g An audit response must be created to address any deficiencies or non-conforming events.

2A.4.14.1.h Corrective actions are included in the Audit Response.

2A.4.14.1.i The QA Manual and the SOP manuals are updated at this the time the audit is conducted.

2A.4.14.1.j All changes to the QA Manual and the SOP manuals must be documented in the Audit Response.

2A.4.14.2 Internal quality assurance audits must verify CEI's compliance with AIHA-LAP, LLC where accredited, NIST Handbook 150, 150-3, and 150-13 requirements where accredited by NVLAP, and with its own policies and procedures outlined in this manual and in applicable standard operating procedures manuals.

2A.4.14.2.a When audit findings cast doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test or calibration results, the laboratory takes timely corrective action, and notifies customers in writing if investigations show that the laboratory results may have been affected.

2A.4.14.2.b After corrective action(s) have been developed, a review shall take place within 30 days of issue to validate the effectiveness of the corrective action(s). The Quality Manager shall document the effectiveness of the corrective action(s).

2A.4.14.3 Audit results are shared, as appropriate, with laboratory personnel.

2A.4.15 Management Requirements: Management Reviews

2A.4.15.1 CEI performs management review annually in January or February. The review takes place after the annual audit, and the annual audit findings are cited in the Annual Quality Management Review Report. The Annual Quality Management Review Report is a review of the laboratory's management system and testing and calibration activities to ensure their continuing suitability and effectiveness, and to introduce necessary changes or improvements. The review includes, but not be limited to the following:

2A.4.15.1.a the suitability of policies and procedures;
2A.4.15.1.b reports from managerial and supervisory personnel;
2A.4.15.1.c the outcome of recent internal audits;
2A.4.15.1.d corrective and preventive actions;
2A.4.15.1.e assessments by external bodies;
2A.4.15.1.f the results of inter-laboratory comparisons and proficiency tests;
2A.4.15.1.g changes in volume and type of work;
2A.4.15.1.h customer feedback;
2A.4.15.1.i complaints;
2A.4.15.1.j recommendations for improvement;
2A.4.15.1.k other relevant factors, such as quality control activities, resources and staff training;
2A.4.15.1.l review of quality objectives and formulation of new quality objectives as needed.

2A.4.15.2 After completion of the Laboratory Management Review, top management (President/Owner, Laboratory Director, Laboratory Manager, and Quality Managers) shall convene to discuss if quality objectives have been met. They shall also investigate if current quality

objectives are sufficient, and if new quality objectives need to be achieved.

2A.4.15.3 Findings from management reviews and the actions that arise from them are recorded. The management ensures that those actions are carried out within an appropriate and agreed timescale. Results from management review are shared, as appropriate, with laboratory personnel.

2A.4.15.4 Each month, the Quality Manager provides reports to Laboratory Manager, and Laboratory Director regarding quality assurance matters. These reports include information on internal audits, proficiency program performance, nonconformities and corrective/preventive actions taken.

2A.5 TECHNICAL REQUIREMENTS

2A.5.1 Technical Requirements: General

2A.5.1.1 Many factors determine the correctness and reliability of the tests performed by CEI. These factors include:

2A.5.1.1.a human factors;
2A.5.1.1.b accommodation and environmental conditions;
2A.5.1.1.c test methods and method validation;
2A.5.1.1.d equipment;
2A.5.1.1.e measurement traceability;
2A.5.1.1.f sampling;
2A.5.1.1.g the handling of test items;

2A.5.1.2 The extent to which the factors contribute to the total uncertainty of measurement differs considerably between (types of) tests. CEI takes into account of these factors in developing test methods and procedures, in the training and qualification of personnel, and in the selection and calibration of the equipment it uses.

2A.5.2 Technical Requirements: Personnel

2A.5.2.1 CEI management ensures the competence of all who operate specific equipment, perform tests, evaluate results, and sign test reports. Personnel that are undergoing training are provided with appropriate supervision. Personnel performing specific tasks are qualified on the basis of appropriate education, training, experience and/or demonstrated skills, as required.

2A.5.2.1.1 Technical Manager – CEI shall provide day-to-day supervision of its technical operations by designating at least one Technical Manager per program. The Technical Manager must be an employee of the laboratory and present on site at least 20 hours per week or 50 percent of the laboratory's operating hours (whichever is less) to address technical issues for laboratory staff and customers. The Technical Manager documents that all analyses for which CEI are accredited are completed by personnel with appropriate education and/or technical background. The technical manager ensures that adequate supervision is provided for all laboratory technical personnel. The

Technical Manager or his/her deputy functions as the approved signatory. The Technical Manager must possess a bachelor's degree in an applicable physical or biological science.

2A.5.2.1.2 Quality Manager – The Quality Manager of the laboratory must possess a bachelor's degree in an applicable basic or applied science, and have at least one year of nonacademic analytical or quality control experience appropriate to the analyses performed by the laboratory. The Quality Manager must have documented training in statistics or laboratory quality assurance/quality policy.

2A.5.2.1.3 Analyst – Successful training in specific methodologies used in the laboratory are documented. Analysts must have demonstrated ability to produce reliable results through accurate analysis of certified reference materials, proficiency testing samples, or in-house quality control samples. Their performance is documented. Analysts are responsible for compliance with all quality assurance and quality control requirements pertaining to their technical functions.

2A.5.2.1.4 Combined Positions – The laboratory staff may consist of a Technical Manager, a Quality Manager, laboratory analyst(s), and technician(s) as needed. If a single individual serves more than one position, then this individual must meet all position qualifications and responsibilities. If this individual also performs analytical work, then his/her work must be reviewed by a second, qualified individual

2A.5.2.2 CEI management has created the following positions within the laboratory, each with different required duties and education levels. Positions, their descriptions, and education requirements are in Table 3.

2A.5.2.2.a CEI identifies the training needs and provides training of personnel. The training program is relevant to the present and anticipated tasks of the laboratory.

2A.5.2.2.a.(i) CEI management monitor production levels regularly to determine if the laboratory warrants the hire and/or training of laboratory personnel.

2A.5.2.2.a.(ii) CEI conducts semi-annual reviews of its employees. Training needs are identified through interview processes with employees during those review sessions.

2A.5.2.2.b.(iii) Discovery and identification of ongoing training needs can take place through internal and external audits, laboratory management reviews, and investigations (root cause analysis) of non-conforming work.

2A.5.2.2.c.(iv) When on-going training needs are identified, training commences for the identified need as soon as practicable.

2A.5.2.2.b CEI training processes are documented, and their effectiveness is monitored.

2A.5.2.2.c CEI has sufficient personnel to allow for all QA/QC to be performed. Qualified designees may fulfill the responsibilities of

the Quality Manager as needed and with proper documented training of personnel to fulfill that role.

2A.5.2.3 Job descriptions include required qualifications, experience, education, training and managerial duties.

TABLE 3. LABORATORY POSITIONS

Position Title	Description of Duties	Required Minimum Education Level
Laboratory Director	Responsible for the entire laboratory program. This includes, but is not limited to accreditation status, QA/QC program, report reviews, employee training, employee safety, calibrating equipment, record keeping, and the supervision of all personnel.	Doctorate in an applicable basic, or applied science.
Laboratory <Technical> Manager	Responsible for implementing the Quality Assurance Program. This includes, but is not limited to; sample handling and login, worker safety and contamination control, daily supervision of all laboratory personnel. Must be on-site a minimum of 20 hours per week or 50 percent of the CEI's operating hours.	Bachelor's degree in applicable, or applied science. Experience in applicable Fields of Testing.
Quality Manager	Responsible for implementing the Quality Assurance Program on a daily basis. This includes, but is not limited to calibration of equipment, sample handling and login, worker safety and contamination control in the laboratory, analysis of QC data, resolution of analytical discrepancies, evaluation of monthly QC data, and maintenance of appropriate records.	Bachelor's degree in applicable, or applied science. One year of non-academic analytical or quality control experience. Educational experience with statistics.
Laboratory Analyst (PCM, Microbiological, PLM, or TEM)	Responsible for the accuracy and precision of the work performed. Analysts routinely work under the supervision of the Quality Manager in implementing QA/QC procedures on a daily basis. Duties also include, but are not limited to daily calibration of equipment, sample handling and login, sample preparation and analysis, contamination control in the laboratory, implementation of worker safety procedures, report generation.	**PCM:** High School Diploma and completion of a NIOSH 582 equivalent training course. **Microbiological:** A bachelor's degree in microbiology or related field with at least one year of analytical experience. **PLM:** A bachelor's degree in applicable basic or applied science. In some cases laboratory experience may substitute this. A basic McCrone – equivalent Asbestos Identification Course in PLM Microscopy along with a CEI In-house Training Course. **TEM:** A bachelor's degree in applicable basic or applied science. In some cases laboratory experience may substitute this. A basic McCrone – equivalent Asbestos Identification Course in TEM Microscopy along with a CEI In-house Training Course.
Laboratory Technician	Responsible for sample login, sample preparation, daily inspection and cleaning of the sample preparation area, data entry and report generation.	Demonstrated ability to conduct the work assigned.

Secretary	Responsible for the preparation of final test reports forwarded to customers, maintenance of appropriate customer files, data entry, report generation, reception and customer relations.	Demonstrated ability to conduct the work assigned.

2A.5.2.4 Analysts must complete an external or internal training program for all applicable analyses or analytical techniques prior to performing unsupervised analyses on samples submitted by customers.

2A.5.2.5 CEI Management authorizes specific personnel to perform particular types of sampling and testing, to issue test reports, and to operate particular types of equipment.

2A.5.2.5.a CEI maintains records of the relevant authorizations(s), competence, educational and professional qualifications, training, skills and experience of all technical personnel, including contracted personnel. This information is readily available and shall include the date on which authorization and/or competence is confirmed.

2A.5.2.5.b Training is documented in laboratory records and include a description of the content and duration of the program.

2A.5.2.5.c All analysts and technicians are required to have a minimum of 20 business days of hands-on experience conducting analyses before initiation of independent work on customer test items.

2A.5.3 Technical Requirements: Accommodation and Environmental Conditions

2A.5.3.1 CEI maintains laboratory facilities for testing that have energy sources, lighting, and environmental conditions that facilitate correct performance of the tests.

2A.5.3.1.a The laboratory ensures that the environmental conditions do not invalidated the results or adversely affect the required quality of any measurement. The technical requirements for the accommodation and environmental conditions that can affect the test results are documented.

2A.5.3.2 The laboratory monitors, controls and records environmental conditions as required by the relevant specifications, methods and procedures or where they influence the quality of the results. Due attention is paid, for example to biological sterility, dust, humidity, electrical supply, and temperature, as appropriate to the technical activities concerned.

2A.5.3.2.a CEI must stop analysis of test items when environmental conditions jeopardize the results of the tests.

2A.5.3.3 CEI personnel ensure control of access to and use of areas affecting the quality of tests. The following conditions shall be met:

2.A.5.3.3.a There is effective separation between neighboring areas in which there are incompatible activities. Measures are taken to prevent cross contamination;

2A.5.3.3.b measures are taken to ensure good housekeeping in the laboratory. Special procedures must be prepared when necessary;

2A.5.3.3.c all chemicals, compressed gases, glassware and waste materials, etc. are appropriately stored and/or contained;

2A.5.3.3.d ventilation hood face velocities are appropriate and shall be measured and recorded semiannually;

2A.5.3.3.e lunch areas are separate from the testing areas. Consumption of food or beverages is not permitted in testing areas;

2A.5.3.3.f CEI is a non-smoking facility.

2A.5.3.3.g CEI personnel conduct monitoring of test areas for contamination of those areas by fibers or mold spores. If analysis of air samples taken from this monitoring show contamination by fibers or mold spores, the work in that area ceases until the work area is thoroughly cleaned. In such a case as a work area requires a cessation of work due to contamination, that area must be retested prior to approval for work to be resumed.

2A.5.4 Technical Requirements: Test Methods and Method Validation

2A.5.4.1 CEI ensures that all tests within its scope are performed using appropriate methods and procedures. These include sampling, handling, transport, storage and preparation of items to be tested, and where appropriate, an estimation of the measurement uncertainty as well as statistical techniques for analysis of test data.

2A.5.4.1.a The laboratory has instructions on the use and operation of all relevant equipment, and on the handling and preparation of items for testing, or both, where the absence of such instructions could jeopardize the results of tests.

2A.5.4.1.b All instructions, standards, manuals, and reference data relevant to the work of the laboratory are kept up to date and shall be made readily available to personnel.

2A.5.4.1.c Deviation from test methods occurs only if the deviation has been documented, technically justified, authorized, and accepted by the customer.

2A.5.4.2 CEI uses test methods, including methods for sampling, which meet the needs of the customer and which are appropriate for the tests it undertakes. Methods published in international, regional or national standards are preferably used.

2A.5.4.2.a The laboratory ensures that it uses the latest valid edition of a standard unless it is not appropriate to do so.

2A.5.4.2.b When necessary, the standard is supplemented with additional details to ensure consistent application.

2A.5.4.2.c When the customer does not specify the method to be used, the laboratory selects appropriate methods that have been published either in international, regional or national standards, or by reputable technical organizations, or in relevant scientific texts or journals, or as specified by the manufacturer of the equipment.

2A.5.4.2.d Laboratory-developed methods or methods adopted by the laboratory may also be used if they are appropriate for the intended use and if they are validated.

2A.5.4.2.e The laboratory informs the customer when the method proposed by the customer is considered to be inappropriate or out of date.

2A.5.4.3 When CEI develops a test method internally, the introduction of test methods developed by the laboratory for its own use are a planned activity and assigned to qualified personnel equipped with adequate resources. Plans are updated as a development proceeds and effective communication amongst all personnel involved is assured.

2A.5.4.4 When it is necessary to use methods not covered by standard methods, these are subject to agreement with the customer and must include a clear specification of the customer's requirements and the purpose of the test. The method developed must be validated appropriately before use. Method performance criteria (estimates of bias and precision) and acceptance limits must be stated.

2A.5.4.5 Validation of Methods – Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled. CEI validates non-standard methods, laboratory designed/developed methods, standard methods used outside of their intended scope, and amplifications and modifications of standard methods to confirm that the methods are fit for the intended use. The validation is as extensive as is necessary to meet the needs of a given application of field of application.

2A.5.4.5.a Standard methods, procedures, and modifications of standard methods and procedures are acceptable only if the laboratory has verified acceptable method performance applicable to the field of testing. Standard methods and procedures are recommended by the Environmental Protection Agency, the National Institute for Occupational Safety and Health, ASTM International, AOAC International, the American Public Health Association, the Occupational Safety and Health Administration, or other national or international agencies.

2A.5.4.5.b Laboratory-developed methods and non-standard methods are used only if:

2A.5.4.5.b.(i) 1) the laboratory had developed and documented procedures covering topics a-k contained in the note in ISO/IEC 17025:2005, Section 5.4.4, including, but not limited to:

2A.5.4.5.b.(i).(a) appropriate identification;
2A.5.4.5.b.(i).(b) scope;
2A.5.4.5.b.(i).(c) description of type of item to be tested;
2A.5.4.5.b.(i).(d) parameters or quantities and ranges to be determined;
2A.5.4.5.b.(i).(e) apparatus and equipment, including technical performance requirements;
2A.5.4.5.b.(i).(f) reference standards and reference materials required;
2A.5.4.5.b.(i).(g) environmental conditions required and any stabilization period needed;
2A.5.4.5.b.(i).(h) description of the procedure, including:

- affixing of identification marks, handling, transporting, storing and preparation of items,
- Checks to be made before the work is started,
- Checks that the equipment is working properly and, where required calibration and adjustment of the equipment before each use,
- the method of recording the observations and results,
- safety measures to be observed;

2A.5.4.5.b.(i).(i) criteria and/or requirements for approval/rejection;
2A.5.4.5.b.(i).(j) data to be recorded and method of analysis and presentation;
2A.5.4.5.b.(i).(k) the uncertainty or the procedure for estimating uncertainty; and

2A.5.4.5.b.(ii) 2) the laboratory has validated the method covering the following topics as appropriate: minimum acceptance criteria, analyte specificity, linearity, range, accuracy, precision, detection limit, quantification limit, stability of reagents, inter-laboratory precision, and analysis robustness.

2A.5.4.5.c The laboratory defines the process utilized in the adoption and revision of analytical procedures employed by the laboratory, including when and how these procedures are reviewed and/or revised.

2A.5.4.5.d The range and accuracy of values obtainable from validated methods (eg. The uncertainty of results, detection limit, selectivity of the method, linearity, limit of repeatability and/or reproducibility, robustness against external influences, and/or cross sensitivity against interference from the matrix of the sample/test object), as assessed for the intended use, are relevant to the customer's needs.

2A.5.4.6 Estimation of Uncertainty of Measurement – CEI is a laboratory that, from time to time, must perform its own calibrations. CEI maintains and applies a procedure to estimate the uncertainty of measurement for all calibrations and types of calibrations.

2A.5.4.6.1 In certain cases the nature of the test method may preclude rigorous, metrologically and statistically valid, calculation of uncertainty of measurement. In these cases CEI attempts to identify all components of uncertainty and make a reasonable estimation, ensures that form of reporting of the result does not give a wrong impression of uncertainty. Reasonable estimation must be based on knowledge of the performance of the method and on the measurement scope and makes use of, for example previous experience and validation data.

2A.5.4.6.2 When estimating the uncertainty of measurement, all uncertainty components which are of importance in the given situation must be taken into account using appropriate methods of analysis.

2A.5.4.6.3 When reporting measurement uncertainty, the test report includes the coverage factor and confidence levels used in estimations (typically k=approximately 2 at the 95% confidence level).

2A.5.4.6.4 When the test method has a known and uncorrected systematic bias, it is reported separately from the test result and uncertainty estimation, as a probable bias value.

Appendix II of the QA manual states specific methods for determination of measurement of uncertainty.

2A.5.4.7 Control of Data - CEI establishes and maintains a data review process beginning at sample receipt and extending through the report process. The data review process is an independent review conducted by a qualified individual other than the analyst.

2A.5.4.7.1 The data reduction and review process includes, but is not limited to: comparison of quality control data against established acceptance limits, computation verification, transcription of data and adherence to the procedures established in the laboratory management system documents. If more than one parameter in a sample is tested, then the correlation of results are reviewed.

2A.5.4.7.1.a The analyst is responsible to ensure that quality control analysis is performed on his/her work prior to release of results, and that the work performed is in compliance with current quality control practices.

2A.5.4.7.1.b Procedures are established for each test type to ensure quality control procedures are complete before reporting of results to the customer.

2A.5.4.7.1.c Qualified individuals perform data review on test results after the quality control practices have verified the test results adhere to established acceptance limits.

2A.5.4.7.1.d Individuals authorized to perform data review are qualified through ongoing training and demonstration of knowledge about the specific test type.

2A.5.4.7.2 Calculations and data transfers are subject to appropriate checks in a systematic manner.

2A.5.4.7.2.a Prior to release of test results, quality control charts, or any published record where mathematical calculations are part of the presentation, any formulas and results derived from those formulas must be routinely checked.

2A.5.4.7.2.b During data review, CEI personnel are trained to verify and document two test results weekly to see if formulas used to calculate test results are functioning properly. Unverified spot check calculations take place daily.

2A.5.4.7.2.c Workbook templates (e.g. Microsoft Excel documents) are checked monthly to determine that the formulas used for calculations in data tables and charts are functioning correctly. Results of these checks are recorded in the Monthly QC Report.

2A.5.4.7.2.d When a test report format, template, worksheet, or any other document, that has a programmed formula, is placed under restricted access or locked by management, and has repeatedly had its functionality validated, the document may be validated less frequently as determined by the Quality Manager.

2A.5.4.7.3 When computers are used for the acquisition, processing, recording, reporting, storage or retrieval of test data, the laboratory shall ensure that:

2A.5.4.7.3.a computer software developed by the user is documented in sufficient detail and is suitably validated as being adequate for use;

2A.5.4.7.3.b procedures are established and implemented for protecting the data; such procedures include, but are not be limited to, integrity and confidentiality of data entry or collection, data storage, data transmission and data processing;

2A.5.4.7.3.c computers are maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of test data.

2A.5.5 Technical Requirements: Equipment

2A.5.5.1 An equipment log is maintained for each major item of equipment. Records are maintained in the equipment log that document preventive maintenance and repair, including those performed by laboratory personnel. The name or initials of the person performing the maintenance or repair is recorded.

2A.5.5.1.a Each individual laboratory (e.g. IAQ Laboratory, PCM Laboratory, etc.) possesses an equipment log specific to that laboratory. The quality manager or his/her designee shall ensures preventive maintenance is performed on crucial equipment to the laboratory.

2A.5.5.1.b Each laboratory at CEI is furnished with all items of sampling, measurement and test equipment required for the correct performance of the tests (including sampling, preparation of test). In those cases where the laboratory needs to use equipment outside of its permanent control,

CEI ensures that the requirements of the QA Manual are met, thereby meeting the International Standard for which AIHA-LAP, LLC accredits.

2A.5.5.2 Equipment critical to the generation of the test results is subject to performance checks prior to use for analysis of samples. Such checks include evaluation of instrument sensitivity, alignment, linearity, versus historical values.

2A.5.5.2.a Equipment and its software used for testing, calibration and sampling must be capable of achieving the accuracy required and must comply with the specification relevant to the tests performed.

2A.5.5.2.b Calibration programs are established for key quantities or values of the instruments where these properties have a significant effect on results. Calibration procedures must be included in the Standard Operations and Procedures manual for each test method.

2A.5.5.2.c Before being placed into service, equipment (including that used for sampling) is calibrated or checked to establish that it meets the laboratory's specification requirements and complies with the relevant standard specifications.

2A.5.5.2.d Acceptance criteria for equipment checks are stated in the analytical method.

2A.5.5.2.e Up-to-date instruction on the use and maintenance of equipment (including any relevant manuals provided by the manufacturer of the equipment) are stored in proximity to the equipment log, and remain available for use by the appropriate laboratory personnel.

2A.5.5.2.f Each item of equipment and its software used for testing and significant to the result is, when practicable, be uniquely identified.

2A.5.5.2.g Records are maintained of each item of equipment and its software significant to the tests performed. The records shall include the following:

2A.5.5.2.g.(i) the identity of the item of equipment and its software;
2A.5.5.2.g.(ii) the manufacturer's name, type identification, and serial number or other unique identification;
2A.5.5.2.g.(iii) checks that the equipment complies with the specification;
2A.5.5.2.g.(iv) the current location of the equipment;
2A.5.5.2.g.(v) the manufacturer's instructions, if available, or reference to their location;
2A.5.5.2.g.(vi) dates, results and copies of reports and certificates of all calibrations, adjustments, acceptance criteria, and the due date of next calibration;
2A.5.5.2.g.(vii) the maintenance plan, where appropriate, and maintenance carried out to date.
2A.5.5.2.g.(viii) any damage, malfunction, modification or repair to the equipment.

2A.5.5.3 Control of Equipment – Equipment may be handled, jostled, moved, or used in a way that may lead it to be taken out of service. Handling and storage of equipment, in such a way as to alter its proper function, are crucial to correct performance of testing.

2A.5.5.3.1.a CEI personnel only handle equipment according to manufacturer's specification, or within the parameters of the intended use of the equipment.

2A.5.5.3.1.b Equipment is cleaned regularly or when necessary to ensure that it is functioning properly and in order to prevent contamination or deterioration.

2A.5.5.3.1.c Equipment that has been subjected to overloading or mishandling, gives specific results, or has been shown to be defective or outside of specified limits, is taken out of service. It is isolated to prevent its use or clearly labeled or marked as being out of service until it has been repaired and shown by calibration or test to perform correctly.

2A.5.5.3.1.d The laboratory examines the effect of the defect or departure from specified limits on previous test and/or calibrations and institutes the "Control of Non-conforming work" procedure (Section 2A.4.9.1 of this manual).

2A.5.5.3.1.e Whenever practicable, all equipment under control of the laboratory and requiring calibration is labeled, coded or otherwise identified to indicate the status of calibration, including the date when last calibrated and the date or expiration criteria when calibration is due.

2A.5.5.3.2 When, for whatever reason, equipment goes outside of the direct control of the laboratory, the laboratory ensures that the function and calibration status of the equipment are checked and shown to be satisfactory before the equipment is returned to service.

2A.5.5.3.3 Results of the function and calibration status checks required for equipment that goes outside of the direct control of the laboratory is documented.

2A.5.5.3.3.a Designated personnel document this in the equipment log

2A.5.5.3.3.b The following is documented:

2A.5.5.3.3.b.(i) condition of equipment prior to release outside of the laboratory;
2A.5.5.3.3.b.(ii) condition of equipment upon return to the laboratory;
2A.5.5.3.3.b.(iii) reason for use of equipment outside the laboratory;
2A.5.5.3.3.b.(iv) person or organization responsible for equipment while it was out of laboratory control;
2A.5.5.3.3.b.(v) calibration, checks, repairs, or other equipment maintenance performed prior to the equipment being submitted back into service in the laboratory.

2A.5.5.3.4 Calibration procedures and intermediate checks are carried out according to defined procedures for each article of equipment, so that confidence in the calibration status of the equipment may be maintained.

2A.5.5.4 Calibration procedures specify frequency of calibration checks.

2A.5.5.4.1 Where calibration procedures give rise to a set of correction factors, the laboratory has procedures to ensure all documents (hard copies or electronic copies) are correctly updated.

2A.5.5.5 When possible, any external calibration service must be a calibration laboratory accredited to ISO/IEC 17025:2005 by a recognized accreditation body.

2A.5.5.6 Where appropriate, cleaning procedures for glassware and apparatus are specified by the laboratory and shall be appropriate for the method specified.

2A.5.6 Technical Requirements: Measurement Traceability

2A.5.6.1 All equipment used for tests, including equipment for subsidiary measurements (e.g., for environmental conditions) having a significant effect on the accuracy or validity of the result of the test or sampling is calibrated before being put into service. The laboratory shall have an established program and procedure for the calibration of its equipment.

2A.5.6.2. Requirements for Calibration Laboratories used by CEI

2A.5.6.2.1.a The program for calibration of equipment is designed and operated so as to ensure that calibrations and measurements made by the laboratory are traceable to the International System of Units (SI).

2A.5.6.2.1.b Calibration laboratories establish traceability of its own management standards and measuring instruments to the SI by means of an unbroken chain of calibrations or comparisons linking them to relevant primary standards of the SI units of measurement. To link the SI units is achieved by reference to national measurement standards. National measurement standards may be primary standards, which are primary realizations of the SI units or agreed representations of SI units base on fundamental physical constants, or they may be secondary standards which are standards calibrated by another national metrology institute.

2A.5.6.2.1.c When using external calibration services, treaceability of measurement is assured by the use of calibration services from laboratories that can demonstrate competence, measurement capability and traceability.

2A.5.6.2.1.d The calibration certificates issued by these laboratories must contain the measurement results, including the measurement uncertainty and/or a statement of compliance with and identified metrological specification.

2A.5.6.2.1.e There are certain calibrations that currently cannot be strictly made in SI units. In these cases calibration shall provide confidence in measurements by establishing traceability to appropriate measurement standards as:

2A.5.6.2.1.e.(i) the use of certified reference materials provided by a competent supplier to give a reliable physical or chemical characterization of a material;

2A.5.6.2.1.e.(ii) the use of specified methods and/or consensus standards that are clearly described and agreed by all parties concerned.

2A.5.6.2.1.f Participation in a suitable program of inter-laboratory comparisons is required where possible.

2A.5.6.2.2 Testing Laboratory Requirements

2A.5.6.2.2.a The requirements given in 2A.5.6.2.1 apply for measuring and test equipment with measuring functions used, unless it has been established that the associated contribution from the calibration contributes little to the total uncertainty of the test result.

2A.5.6.2.2.b Where traceability of the measurements to SI units is not possible and/or not relevant, the same requirements for traceability to, for example, certified reference materials, agreed methods and/or consensus standards, are required as for calibration laboratories.

2A.5.6.3 Reference Standards

2A.5.6.3.1 Reference *standards* in the laboratory must be traceable to SI units whenever possible. Calibration of reference standards are conducted by a body that can provide traceability as described in section 2A.5.6.2.1.

2A.5.6.3.1.a Reference standards of measurement held by the laboratory shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

2A.5.6.3.1.a.(i) The laboratory shall demonstrate when possible, that calibrations of critical equipment and hence the measurement results generated by that equipment relevant to their scope of accreditation are traceable to the SI through and unbroken chain of calibrations.

2A.5.6.3.1.a.(ii) External calibration services shall wherever possible be obtained from providers accredited to ISO/IEC 17025 by an ILAC recognized laboratory. Calibration certificates must be endorsed by a recognized accreditation body symbol. Certificates must indicate treaceabilty to the SI or reference standard and include the measurement result with associated uncertainty of measurement.

2A.5.6.3.1.a.(iii) Where treaceability to the SI is not technically possible or reasonable, the laboratory uses certified reference materials provided by a competent supplier or use unspecified methods and/or consensus standards that are clearly described and agreed to by all parties concerned.

2A.5.6.3.2 Reference *materials*, where possible, must be traceable to SI units of measurement, or to certified reference materials. Internal reference materials are checked as far as is technically and economically practicable.

2A.5.6.3.2.a Reference materials must have a certificate of analysis that documents traceability to a primary standard or certified reference material and associated uncertainty, when possible. When applicable, the certificate must document the specific NIST SRM® or NMI certified reference material used for traceability.

2A.5.6.3.2.b Calibrations performed in-house are documented in a manner that demonstrates traceability via an unbroken chain of calibrations regarding the reference standard/material used, allowing for an overall uncertainty to be estimated for the in-house calibration.

2A.5.6.3.3 Intermediate checks are be performed on reference, primary, transfer or working standards and reference materials in order to maintain confidence in their calibration status. Checks are conducted according to regular schedules and procedures.

2A.5.6.3.3.a Calibrations are repeated at appropriate intervals, the length of which can be dependant on the uncertainty required, the frequency of use, the manner of use, stability of the equipment, and risk of failure considerations.

2A.5.6.3.3.b The Standard Operating Procedures (SOP) for each test type specify which reference standards and/or reference materials are suitable to that method. Procedures for calibration of reference standards and/or reference materials are defined in the specific SOP.

2A.5.6.3.3.c Each test method used by the laboratory defines the schedule of checks and calibrations for reference standards and/or reference material, and their frequency of such checks and calibrations.

2A.5.6.3.4 CEI personnel only handle reference standards according to manufacturer's specification, or within the parameters of the intended use of the reference standard.

2A.5.6.3.4.a Reference material and reference standards are stored according to manufacturers or calibration laboratory's specifications.

2A.5.6.3.4.b CEI makes an effort to provide storage space under the conditions the specific reference materials or reference standards require, including light, temperature and humidity, and other conditions required to minimize deterioration and protect the integrity of the reference materials or reference standards.

2A.5.6.4 Requirements for reagents and standards are specified by the laboratory to ensure the quality of testing.

2A.5.6.4.1 Reagents and standards are inspected, dated, and initialed upon receipt.

2A.5.6.4.2 Reagents are not used beyond assigned expiration dates. Materials designated for reevaluation, which are determined to have adequate purity upon reevaluation, are assigned a new expiration date.

2A.5.6.4.3 Strict control of reagent solutions and calibration standards are maintained.

2A.5.6.5 Documentation of standard and solutions preparations shall include a description of the content, the date of preparation, concentration and/or purity of the parent material, manufacturer and lot number of parent material, assigned expiration date, and the preparer's initials. Solutions shall be adequately identified to trace back to preparation documentation.

2A.5.7 Technical Requirements: Sampling

2A.5.7.1 The laboratory has a sampling plan and procedures for sampling when it carries out sampling of substances, materials or product for subsequent testing.

2A.5.7.1.a Sampling procedures are standardized and included or referenced in the SOP for the individual test method.

2A.5.7.1.b Equipment used for sampling follow the same control procedures as for laboratory equipment described in Section 2A5.5.3

2A.5.7.1.b.(i) The sampling process addresses the factors to be controlled to ensure the validity of the test results.

2A.5.7.1.c. The sampling plan as well as the sampling procedure is available at the location where sampling is undertaken. Sampling plans are, whenever reasonable, based on appropriate statistical methods.

2A.5.7.2 Where the customer requires deviations, additions or exclusions from the documented sampling procedure, these are recorded in detail with the appropriate sampling data and are included in all documents containing test results, and are communicated to the appropriate personnel.

2A.5.7.3 The laboratory maintains procedures for recording relevant data and operations relating to sampling that form part of the testing that is undertaken. These records include the sampling procedure used, the identification of the sampler, environmental conditions (if relevant) and diagrams or other equivalent means to identify the sampling location as necessary and, if appropriate, the statistics upon which the sampling procedures are based.

2A.5.7.4 Information regarding sampling materials, sampling containers, preservatives, and shipping instructions are available to the customers through the laboratory.

2A.5.7.5 Where appropriate, the laboratory requests that customers submit field blanks with their samples.

2A.5.8 Technical Requirements: Handling of Test Items

2A.5.8.1 The laboratory maintains procedures for the transportation, receipt, handling, protection, storage, retention and/or disposal of test items, including all provisions necessary to protect the integrity of the test item, and to protect the interest of the laboratory and the customer.

2A.5.8.2 Sample receipt. CEI receives samples either by courier (eg. FedEx, UPS, U.S. Mail), or by hand delivery.

2A.5.8.2.a Shipping containers are inspected for damage before acknowledging receipt. If any samples are damaged beyond the ability to test, the sample condition shall be documented and the customer shall be notified immediately.

2A.5.8.2.b Shipping containers are opened under an acrylic, HEPA-filtered negative air flow hood and test items are individually inspected. Submitted test items should be tightly sealed to prevent contamination, and should clearly be labeled with unique field identification numbers. Samples are inspected for their suitability for submission to the testing laboratory by Sample Receiving Technicians. Criteria for rejection of samples are addressed in the SOP Manuals for each test type.

2A.5.8.2.c CEI requests that its customers submit a “Customer Chain of Custody Form” with all test items. The Customer Chain of Custody Form must include the following information:

2A.5.8.2.c.(i) -the customer’s name;
2A.5.8.2.c.(ii) -a project name or project identification number;
2A.5.8.2.c.(iii) -the type of test(s) the customer intends to have performed;
2A.5.8.2.c.(iv) -purchase order numbers when necessary;
2A.5.8.2.c.(v) -the expected turn-around-time for the work performed;
2A.5.8.2.c.(vi) -a contact, address, or designee from the customer to whom the work should be delivered;
2A.5.8.2.c.(vii) -any testing parameters needed to deliver results for the test (sampling volumes, sampling areas, conditions of testing area, sampling durations, etc.)
2A.5.8.2.c.(viii) -a “Corrective Action Report for Non-conforming Events” must be filled out if all necessary information is not provided. The corrective action should be obtaining permission from the customer for work to commence by supplying the necessary information to CEI. This is achieved by identifying the information needed, reporting any conversations with customers, recording the conditions under which work can commence, and recording what information was obtained for work to commence from contact with the customer.

2A.5.8.2.d After the initial inspection of the test items, and the test items are deemed adequate for the requested test; the samples are processed by login technicians. Login technicians assign the following information to the test items and record the information in the “Sample Log Book”:

2A.5.8.2.d.(i) a unique batch number (the CEI Lab Code) for work intended to be reported on the same analytical report;

2A.5.8.2.d.(ii) a unique sample identification number for each sample in the batch, different from any previously used identification number;
2A.5.8.2.d.(iii) the number of test items submitted for a given batch;
2A.5.8.2.d.(iv) the initials of the Login Technician that received the samples.

2A.5.8.2.e The Customer Chain of Custody form is signed as received by CEI personnel, and the date and time the test items were received is documented on the Customer Chain of Custody form.

2A.5.8.2.f CEI Login Technicians create a "Laboratory Chain of Custody Form" from data obtained from the Customer Chain of Custody Form. The laboratory Chain of Custody Form documents custody of the test items as they travel to various locations of the laboratory. The Laboratory Chain of Custody Form contains, but is not limited to, the following information as it moves through the laboratory with the test items.

2A.5.8.2.f.(i) the customer's name;
2A.5.8.2.f.(ii) the CEI Lab Code;
2A.5.8.2.f.(iii) the CEI employee that received the samples;
2A.5.8.2.f.(iv) the test type(s) requested by the customer;
2A.5.8.2.f.(v) the time and date the samples were received by CEI
2A.5.8.2.f.(vi) the time and date the test results are due to the customer;
2A.5.8.2.f.(vii) the customer's project name and/or identification number;
2A.5.8.2.f.(viii) the name of the sampler and/or a contact who can be reached in case of questions regarding work submitted;
2A.5.8.2.f.(viii).ins the time and date test items were prepared;
2A.5.8.2.f.(ix) the time and date test items were analyzed;
2A.5.8.2.f.(x) the time and date test items test reports were generated;
2A.5.8.2.f.(xi) the date and time the analytical report was reviewed by an approved signatory;
2A.5.8.2.f.(xii) the date and time the analytical report was prepared for submission to the customer (scanning of documents, etc);
2A.5.8.2.f.(xiii) the date and time the project was reported to the customer (i.e. all analysis completed, and submitted to the customer);
2A.5.8.2.f.(xiv) notes regarding sample processing, analysis, or accounting based on a customer's particular needs;
2A.5.8.2.f.(xv) comments the analyst may have regarding the test items.

2A.5.8.3 Test items are then submitted to the appropriate laboratory for analysis.
2A.5.8.4 Laboratory technicians and laboratory analysts shall prepare and analyze test items appropriate to the test type requested. Laboratory technicians and analyst handle test items according to the SOP for the particular test type. Laboratory personnel generate analytical reports for the test items upon completion of requested work. This is documented on the Laboratory Chain of Custody Form.

2A.5.8.5 Test items are retained by the laboratory for a minimum period of thirty days, then disposed of according to federal, state and local regulations regarding environmental contamination and waste disposal.

2A.5.8.6 Stable samples may be retained for use in the laboratory's internal quality control program.

2A.5.8.7 The analytical report shall be delivered to the Laboratory Secretary. The Laboratory Secretary shall electronically scan Customer Chain of

Custody forms, then prepare the analytical report for delivery to the customer via fax, e-mail, or courier.

2A.5.9 Technical Requirements: Assuring the Quality of Test Results

2A.5.9.1 For each analytical test type the laboratory performs, the laboratory has quality control procedures for monitoring the validity of tests and calibrations undertaken. The resulting data is recorded in such a way that trends are detectable and, where practicable, statistical techniques are applied to the reviewing of the results. This monitoring is planned and reviewed and may include, but not be limited to, the following:

2A.5.9.1.a regular use of certified reference materials and/or internal quality control using secondary reference materials;

2A.5.9.1.b participation in inter-laboratory comparison or proficiency-testing programs;

2A.5.9.1.c replicate tests using the same or different methods;

2A.5.9.1.d retesting of retained items;

2A.5.9.1.e correlation of results for different characteristics of an item.

2A.5.9.1.1 Quality control data is analyzed and, where they are found to be outside pre-defined criteria, planned actions are taken to correct the problem and to prevent incorrect results from being reported. Deviations from standard quality control procedures are documented.

2A.5.9.1.1.a Deviations that result in nonconforming work are immediately evaluated.

2A.5.9.1.1.b At a minimum the following QC checks are performed per batch of samples:

2A.5.9.1.1.b.(i) Accuracy – Accuracy studies are performed to determine how close measurement comes to an actual or theoretical value. Regular use of certified reference materials is required.

2A.5.9.1.1.b.(ii) Precision – Precision is evaluated by the reproducibility of analyses. Precision is commonly expressed a standard deviation or relative percent difference can be evaluated by the analysis duplicate samples.

2A.5.9.1.1.c.(iii) Blanks – Blank sampling media and analytical reagents shall be analyzed, when applicable, with each batch of samples using the same procedure that is used for field samples. Customers of the laboratory should supply specimens of blank sampling media from the same source lot as was used for collecting the field samples.

2A.5.9.1.1.b.(iv) Acceptance Limits – Acceptance limits are established based on the statistical evaluation of the data generated by the analysis of quality control check samples, unless specific acceptance limits are established by the method. The calculation procedures for statistically derived acceptance limits shall be documented.

2A.5.9.1.1.b.(v) Control Charts – Control charts or quality control databases shall be used to record quality control data and compare them with acceptance limits. Procedures are in place to monitor trends and the validity of test results.

2A.5.9.1.2 Quality Control data is summarized on a monthly basis by the Quality Manager of each laboratory.

2A.5.9.1.3 Detection of Quality Control Data Trends

2A.5.9.1.3.a When using control charts that measure upper and lower control limits, as well as upper and lower warning limits, repetition of data points may indicate a trend.

2A.5.9.1.3.b Three consecutive data points by a single analyst near or outside of upper warning limits are recognized as trending data and are investigated through root cause analysis.

2A.5.9.1.3.c Three consecutive data points by more than one analyst near or outside of upper warning limits are recognized as trending data and are investigated through root cause analysis.

2A.5.9.1.3.d Three consecutive data points by a single analyst near or outside of lower warning limits are recognized as trending data and are investigated through root cause analysis.

2A.5.9.1.3.e Three consecutive data points by more than one analyst near or outside of lower warning limits are recognized as trending data and are investigated through root cause analysis.

2A.5.9.1.3.f If a cause for a trend is identified, procedures for corrective action are carried out by appropriate CEI personnel as outlined in Section 2A.4.11 of this manual.

2A.5.9.1.3.g Proficiency Testing and Inter-Laboratory (Round Robin proficiency testing) data are also examined for trends. Results that repeatedly fall near or outside of warning limits are investigated through root cause analysis, as outlined in section 2A.5.9.1.3.a.-f. of this manual.

2A.5.9.1.3.h When a cause for a trend is identified, procedures for corrective action are carried out by appropriate CEI personnel.

2A.5.9.1.3.i Individual data points falling outside of control limits do not constitute trending data, however they must be investigated as nonconforming work using procedures outlined in Section 2A.4.11 of this manual.

2A.5.10 Technical Requirements: Reporting the Results

2A.5.10.1 The results of each test or series of tests carried out by the laboratory is reported accurately, clearly, unambiguously objectively, and in accordance with any specific instructions in the test method.

2A.5.10.1.a The results are reported, usually in a test report, and include all the necessary information requested by the customer and necessary for the interpretation of the test results and all information required by the method used.

2A.5.10.1.b In the case of tests performed for internal customers, or in the case of written agreement with the customer, the results may be reported in a simplified way. Information not reported in the simplified format must be retained by the laboratory and are readily available should a need arise.

2A.5.10.2 Test Reports – Each test report includes at least the following information:

2A.5.10.2.a a title appropriate to the testing performed;

2A.5.10.2.b the name and address of the laboratory;

2A.5.10.2.c unique identification (CEI Lab Code) of the test report and on each page an identification in order to ensure that the page is recognized as part of the test report, and a clear identification of the end of the test report or calibration certificate.

2A.5.10.2.d page numbers on each page, and either *"x of y"* page numbering or a clear indication of the end of the report;

2A.5.10.2.e the name and address of the customer;

2A.5.10.2.f identification of the method used;

2A.5.10.2.g a description of, the condition of, and unambiguous identification of the item(s) tested;

2A.5.10.2.h the date of sample receipt;

2A.5.10.2.i the test results with, where appropriate, the units of measurement;

2A.5.10.2.j the name(s), function(s) and signatures(s) or equivalent identification of Person(s) authorizing the test report;

2A.5.10.2.k a statement to the effect that results relate only to the items tested.

2A.5.10.3 Test Reports – Test Reports also include the following information, where necessary for the interpretation of the test results:

2A.5.10.3.a deviations from, additions to, or exclusions from the test method, and information on specific test conditions, such as environmental conditions;

2A.5.10.3.b where relevant, a statement of compliance/non-compliance with requirements and/or specifications;

2A.5.10.3.c where applicable, a statement on the estimated uncertainty of measurement; information on uncertainty is needed in test

reports when it is relevant to the validity or application of the test results, when a customer's instructions so requires, or when the uncertainty affects compliance to a specification limit;

2A.5.10.3.d where appropriate and needed, opinions and interpretations;

2A.5.10.3.e additional information required by specific methods, customer, or groups of customers.

2A.5.10.4 Test reports that contain the results of sampling include the following, where necessary for the interpretation of results:

2A.5.10.4.a the date of sampling;

2A.5.10.4.b unambiguous identification of the substance, material or product sampled (including the name of the manufacturer, the model or type of designation and serial numbers as appropriate).

2A.5.10.4.c the location of sampling, including any diagrams, sketches or photographs;

2A.5.10.4.d a reference to the sampling plan and procedures used;

2A.5.10.4.e details of any environmental conditions during sampling that may affect the interpretation of the test results;

2A.5.10.4.f any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned.

2A.5.10.5 Opinions and Interpretations – When opinions and interpretations are included, the laboratory documents the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly be marked as such in a test report. Opinions and interpretations are not appropriate to AIHA LAP accredited fields of testing. No opinions or interpretations are issued on test reports for fields of testing covered by AIHA LAP.

2A.5.10.6 Testing and Calibration Results Obtained from Subcontractors – When the test report contains results of tests performed by subcontractors, these results must clearly be identified. The subcontractor must report the results in writing or electronically.

2A.5.10.7 Electronic Transmission of Results – In the case of transmission of test results by telephone, telex, facsimile or other electronic or electromagnetic means, the requirements of Section 2A.5.4.7 of the QA Manual must be met.

2A.5.10.8 Format of Reports – The format is designed to accommodate each type of test carried out to minimize the possibility of misunderstanding or misuse.

2A5.10.9 Amendments to Test Reports – Material amendments to a test report after issue shall be made only in the form of a further document, or data transfer, which makes clear that the amended document is a supplement to a previously issued document, and referencing the original document

identification code (CEI Lab Code). Amended test reports are issued in accordance with Section 2A.5.10.9.1 & 2A.5.10.9.2 of the QA Manual.

2A.5.10.9.1 Amended Report Procedure

2A.5.10.9.1.a If a laboratory record must be amended for whatever reason, the document is stamped “Amended”.

2A.5.10.9.1.b Documents amended by hand, until such time as a re-issue of the document becomes possible, are be marked clearly, initialed and dated. A revised document is formally re-issued as soon as practicable.

2A.5.10.9.2 Procedure for Amending Analytical Reports

2A.5.10.9.2.a Personnel creating changes to analytical reports must complete an “Amended Report Worksheet”, which identifies the nature and cause of the amendment. An explanation of the amendment must also be placed in the “Comments” section of the Laboratory Chain of Custody record.

2A.5.10.9.2.b A copy of the Amended Report Worksheet must be stored with the hard copy record of the original and amended reports. A copy of the Amended Report Worksheet must also be maintained by the Quality Manager.

2A.5.10.9.2.c The original analytical report is stamped “Obsolete”, clearly showing the document is no longer valid.

2A.5.10.9.2.d Electronic Storage of the amended analytical report requires that it be titled differently. For example, a report bearing the identifier of P13-1234, will now be stored as P13-1234A. If there are future amendments to the same analytical report, the amended reports are saved as P13-1234A.1, P3-1234A.2, etc.

2A5.10.10 Final test reports must include:

2A5.10.10.a reporting limit;

2A5.10.10.b any modification to test method, if applicable.

2A.5.10.11 The approved signatory is the Technical Manager or his/her designee.

2A.5.10.12 References to accreditation status on test reports

2A.5.10.12.a If CEI chooses to include a reference to its AIHA-LAP, LLC, accreditation (symbol/logo or accreditation number) on its test report, any test results not covered under AIHA-LAP, LLC accreditation is clearly identified on the report. If the laboratory chooses not to include a reference to AIHA-LAP, LLC accreditation on its test reports and performs both AIHA-LAP, LLC accredited testing with other non-recognized testing, these final test results must clearly show which results are recognized under AIHA-LAP, LLC accreditation, and which are not.

2A.5.10.12.b If CEI chooses to include a reference to its NVLAP accreditation (symbol/logo or accreditation number) on its test report, any test results not covered under NVLAP accreditation is clearly identified on the report. If the laboratory chooses not to include a reference to NVLAP accreditation on its test reports and performs both NVLAP accredited testing with other non-recognized testing, these final test results must clearly show which results are recognized under NVLAP accreditation, and which are not.

2A.5.10.13 Measurements below the method reporting limit are reported as "<" (less than) or "not detected" (ND) and reference the reportable limit. The reporting of zero concentration is not permitted.

2A.5.10.14 The final report states the measured quantitative result of the analysis of any blank samples submitted to the laboratory. Also, a statement must be made that discloses whether or not the sample results have been corrected for contamination based on the field blank or any other analytical blank.

2A.6 SAFETY AND HEALTH

2A.6.1 CEI follows applicable federal, state and local regulations regarding safety and health. As part of the application for accreditation or re-accreditation, on behalf of the organization seeking accreditation, the managers shall state that the laboratory complies with all applicable standards.

3.0 ACCREDITATION, MAINTENANCE AND RE-ACCREDITATION PROCESS

3.1 Proficiency Testing

3.1.1 Consistent with the scope of accreditation, CEI analyzes all proficiency test samples as defined in AIHA LAP, LLC Policy Module 6, by AIHA PAT Programs, LLC, or an equivalent proficiency testing program approved by AIHA-LAP, LLC.

3.1.2 Proficiency testing samples are analyzed on-site in a manner similar to customer samples.

3.1.3 Proficiency tests that require one set of results from the laboratory are performed in the following manner:

3.1.3.1 Samples are received and processed by CEI in accordance with all procedures outlined in the SOP and QA Manuals issued by CEI.

3.1.3.2 All analysts are required to read the proficiency test samples for the field(s) of testing for which they are authorized and report their results independently.

3.1.3.3 Upon first submission of results to the provider of the proficiency test, a single set of results is chosen at random from among participating analysts.

3.1.3.4 Afterward, analyst names are placed in a table in alphabetical order, starting with the first randomly chosen analyst, and results are chosen by assignment there after.

3.1.3.5 The table shall be maintained by the quality manager.

3.1.4 Results or analysis of proficiency samples are not discussed with other laboratories until the results have been publicly made available.

3.1.5 Round Robin Testing

3.1.5.1 For each of its accredited testing disciplines, CEI participates in a Round Robin (Inter-laboratory) proficiency program that is separate from the proficiency testing hosted by the accredited testing organizations.

3.1.5.2 Round Robins rounds shall take place greater than or equal to twice per year, no more than six months apart. A minimum of three laboratories must participate in each round.

3.1.5.3 Each round shall contain a minimum of four samples of varying concentrations of the analyte.

3.1.5.4 All analysts participate in each round of testing and generate results for each sample in the round separately. All analysts' results shall be used for data reduction and statistical analysis.

3.1.5.5 The units of the results are appropriate for the type of testing performed. Results are in units appropriate to the end use of the data, such as for comparison to target standards.

3.1.5.6 Acceptance criteria, data reduction and statistical analysis are appropriate for the testing discipline.

3.1.5.7 Identification and quantitation shall be taken into consideration for acceptance criteria.

3.1.5.8 If an analyst falls outside of acceptance criteria, the result(s) are considered to be a nonconforming event. Procedures found in *Section 2A.4.9 Control of Nonconforming Work* of this manual are implemented when nonconforming events occur.

3.2 Maintenance of Accreditation

3.1.1 For AIHA-LAP accredited field(s) of testing, CEI reports any changes in laboratory ownership, location, management, quality control personnel, or any other change that significantly affects the laboratory's capability, scope of accreditation, or ability to meet the policy requirements, in writing to the AIHA-LAP, LLC within twenty (20) business days of the change. Any absence of personnel for a period in excess of twenty (20) consecutive working days, that

impacts the laboratory's ability to perform its scope of testing, also is reported to AIHA-LAP, LLC within twenty (20) business days.

3.2.2 For NVLAP accredited field(s) of testing, CEI Labs must report to NVLAP within 30 days any major changes that affect the laboratory's Authorized Representative. This includes not only a change of the individual holding the position, but also the Authorized Representative's contact information, including address, phone number, and e-mail address.

3.2.3. Use of the AIHA-LAP logo

3.2.3.1 The AIHA-LAP, LLC accreditation logo may only be used by CEI Labs, Inc. subject to the limits described in 7.6 of the of the AIHA-LAP, LLC Policy Module. CEI shall only use the AIHA-LAP, LLC accreditation logo after signing the appropriate advertising/logo licensing agreement, detailing permissible usage. The AIHA-LAP, LLC accreditation advertising /logo signing agreement is provided at the time the accreditation certificate is issued. The laboratory signs and returns the advertising/logo licensing agreement to AIHA-LAP, LLC before AIHA-LAP, LLC will release the copy ready artwork of the logo to the CEI. All uses of the AIHA-LAP, LLC accreditation logo must be accompanied by the laboratory identification number (Laboratory ID: 103025). Which must appear directly beneath the accreditation logo.

3.2.4 Use of the NVLAP logo

3.2.4.1 The term NVLAP and the NVLAP logo shall not be used in a manner that brings NVLAP into disrepute or misrepresents CEI Labs' scope of accreditation or accredited status.

3.2.4.2 When the term NVLAP is used to reference CEI Labs' status, it shall be accompanied by the NVLAP Lab Code for Carolina Environmental Inc.

3.2.4.3 When the NVLAP logo is used to reference CEI Labs Inc.'s laboratory status, it shall be accompanied by the NVLAP Lab Code in an approved caption. The caption shall appear below and in close proximity to the logo. The following are the approved captions for CEI Labs, Inc.:

3.2.4.3.a "For the scope of accreditation under NVLAP Lab Code 101768-0"

3.2.4.3.b "NVLAP Lab Code 101768-0"

3.2.4.4 The form of the NVLAP logo shall stand by itself and shall not be combined with any other logo, symbol, or graphic.

3.2.4.5 The aspect ratio (height to width) of the form of the NVLAP logo shall be 1 : 2.25.

3.2.4.6. The NVLAP logo and the caption shall be of a size that allows the caption to be easily read. The size of the caption shall not exceed the size of the NVLAP logo.

3.2.4.7. The Logo shall appear in blue or black, or other color approved by NVLAP, and may be filled or unfilled. If the logo is filled, the same color shall be used for the outline and the fill.

3.2.4.8 The name of at least one Approved Signatory shall appear on a test report that displays the NVLAP logo or references NVLAP accreditation. The name shall be accompanied by the signature of the signatory.

3.2.4.9 The logo may only be used on test reports in which some, or all, of the data conforms to the scope of accreditation.

3.2.4.1.10 Test data that do not lie within the scope of accreditation, but are listed on a report that contains the NVLAP logo or reference of accreditation must be clearly identified as not being covered by the scope of accreditation. A report that contains data not covered by the scope of accreditation will contain the following statement: "This report contains data that are not covered by the NVLAP accreditation".

3.2.4.1.11 Each test report bearing the NVLAP term or logo shall include a statement that the report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

3.2.4.1.12 When the NVLAP term or logo is used in a contract or proposal, a description of CEI Labs' scope of accreditation and current accreditation status shall be given in writing.

3.3 Electronic Correspondence with NVLAP

3.3.1 NVLAP will use e-mail in lieu of paper communications where possible. The scope of this policy includes official NVLAP notices (NVLAP Policy Guides, NVLAP Lab Bulletins, and Assessor Bulletins) and other communications that can be accomplished effectively via this means.

3.3.2 CEI, Inc. will ensure that NVLAP is not filtered out by spam blocking software or classified as "junk" e-mail.

3.3.3 NVLAP electronic contacts:

3.3.3.1 Questions regarding receipt of applications or payments: http://ts.nist.gov/Standards/Accreditation/staff.cfm

3.3.3.2 Requests for scope expansion or scope changes http://ts.nist.gov/Standards/Accreditation/staff.cfm

3.3.3.3 Questions about applying for accreditation through the NVLAP Interactive Web Site (NIWS) – niwshelp@nist.gov

3.3.3.4 General customer service inquiries : nvlap@nist.gov

4.0 Quality System Documents

4.1 Indoor Air Quality Laboratory (IAQ Lab)

4.1.1 CEI's IAQ Lab maintains the current version of the following primary Quality System Documents:

4.1.1.1 *CEI Labs, Inc. Standard Operations and Procedures:*
Method 110: Quantifying and Identifying Airborne Fungi Spores From Spore Traps"Preparation and Analysis of Spore Trap Cassettes via Optical Microscopy"

4.1.2 The Quality Manager of the IAQ Lab controls all quality system documents that specifically pertain to IAQ Testing.

4.2 Phase Contrast Laboratory (PCM Lab)

4.2.1 CEI's PCM Lab maintains the current version of the following primary Quality System Documents:

4.2.1.1 *CEI Labs, Inc. Standard Operations and Procedures:*
Method 100: Quantifying Fibers by PCM "Preparation and Analysis of Fibers via Phase Contrast Microscopy"

4.2.2 The Quality Manager of the PCM Lab controls all quality system documents that specifically pertain to PCM Testing.

4.3 Transmission Electron Microscopy Laboratory (TEM Lab)

4.3.1 CEI's PCM Lab maintains the current version of the following primary Quality System Documents:

4.3.1.1 *CEI Labs, Inc. Standard Operations and Procedures:*
Method 300: Quantifying Fibers by TEM "Preparation and Analysis of Fibers via Transmission Electron Microscopy"

4.3.2 The Quality Manager of the TEM Lab controls all quality system documents that specifically pertain to TEM Testing.

4.4 Polarized Light Microscopy Laboratory (PLM Lab)

4.4.1 CEI's PCM Lab maintains the current version of the following primary Quality System Documents:

4.2.1.1 *CEI Labs, Inc. Standard Operations and Procedures:*
Method 400: Bulk Analysis by PLM "Preparation and Analysis of Bulk Asbestos Material via Polarized Light Microscopy"

4.2.2 The Quality Manager of the PLM Lab controls all quality system documents that specifically pertain to PLM Testing.

4.5 Supporting Quality System Documents

4.5.1 Each Department at CEI Labs contains a library of supporting documentation referenced in the methods utilized by those departments.

4.5.2 CEI maintains a Master List of Documents, of which includes all approved documents used by all of CEI's laboratories.

4.5.3 The Master List of Documents is updated annually and as needed. The Master List of Documents includes the most current version of each document used by CEI's laboratories.

4.5.4 Data reduction and validation elements of specific methods, calculations, and statistically-derived acceptance limits used to construct CEI Methods and Standard Operating Procedures are referenced in each specific procedure.

APPENDIX I: CEI STAFF

EMPLOYEE COMPLIANCE STATEMENT

STAFF AND RESPONSIBILITIES

DEPUTIES TO KEY PERSONNEL

STAFF AUTHORIZED FOR DATA REVIEW

Employee Compliance Statement:

As an employee of CEI Labs, Inc., I have read the *CEI Labs, Inc. Quality Assurance Manual* and/or sections that apply to my position within the company and agree to comply with any and all statements contained within. I realize that deviation from the quality assurance procedures could result in a corrective action and reprimand, and further deviation could result in termination.

Tianbao Bai, PhD., CIH, Laboratory Director	1/29/15 Date
Gary Swanson, CEI Quality Manager	01/27/2015 Date
Marti Bowers, IAQ/PCM Technical and Quality Manager	1/27/15 Date
Anna Malmberg, PLM Technical Manager	1/27/2015 Date
Kamila Reichert, TEM Technical and Quality Manager	1/28/2015 Date
Megan Fisher	1/29/15 Date
Megan Rumble	1/29/15 Date
Samantha Card	1-27-15 Date

Ritika Seal — 1/27/15 Date

Susannah Small — 01/27/15 Date

Shilpa Ladekar — 01/27/15 Date

Elizabeth Godwin — 1/27/15 Date

Sarah Talley — 1-27-15 Date

Ryan Williams — 1-27-15 Date

Candace Burrus — 1/27/15 Date

Ella Nguyen — 1/27/15 Date

Daniel Liguori — 1-27-15 Date

Greg Ruff	1/27/15 Date
Taylor Metcalf	1-28-15 Date
Laura Bostwick	1-27 Date
Vidya Natarajan	1/29/15 Date
Audrey Bui	1/27/15 Date
Diana Sedito	1/28/15 Date
Samantha Davi	1/27/15 Date
Yilka Pulaha	01/28/15 Date
Lauren Mullenex	1/27/15 Date
Antonia Hoyland	1/27/15 Date

Additional Employees

Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date
Printed Name	Signature	Date

CEI Labs, Inc.

Position Title: LABORATORY DIRECTOR

Designee: Tianbao Bai, PhD, CIH

Description of Responsibilities:

The Laboratory Director is responsible for all laboratory operations and the Quality Assurance Program. This includes, but is not limited to: laboratory accreditation status, the training of personnel, calibration of equipment, sample handling and login procedures, contamination control and worker safety in the laboratory, maintenance of appropriate records, implementation of Inter- and Intra-laboratory QC programs, overall accuracy/precision of laboratory data, and supervision of all personnel. The laboratory director is responsible for assuring all employees are compliant with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the AIHA.

Dr. Tianbao Bai may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

PCM Asbestos Air: NIOSH 7400, Issue 2
EPA 600 - PLM, Point Count, TEM
TEM Asbestos Air: AHERA, EPA Level II, NIOSH 7402
TEM Wipe and Microvac Dust Samples
Particle Identification
Mold Spore Trap Analysis – CEI Labs, Inc Method
Mold Wipe / Tape Lift Analysis – CEI Labs, Inc. Method
Data review for all test reports

Authorizing Signature_____ Date: 1/29/15
Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: QUALITY MANAGER, CEI LABS

Designee: Gary A. Swanson

Description of Responsibilities:

The Quality Manager is responsible for implementing the Quality Assurance Program on a daily basis. This includes, but is not limited to: calibration of equipment, sample handling and login, worker safety and contamination control in the laboratory, analysis of QC data, resolution of analytical discrepancies, evaluation of the monthly QC data, and maintenance of appropriate records. The quality manager is responsible for assuring all employees are compliant with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the AIHA. Mr. Swanson acts as the Trainer for PCM and PLM Laboratories. Develops SOP's, Quality Assurance, and Training Procedures. Oversees procurement of laboratory equipment and supplies.

Gary A. Swanson may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

PCM Asbestos Air: NIOSH 7400 Issue 2
Bulk Asbestos Analysis: EPA 600 - PLM, Point Count, TEM
TEM Asbestos Air: AHERA, EPA Level II, NIOSH 7402 (after re-training)
TEM Wipe and Microvac Dust Samples (after re-training)
Data review for PLM, PCM, TEM, subcontracted Metals Test Reports

Authorizing Signature_____ Date: 1/29/15

Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: QUALITY / LABORATORY <TECHNICAL> MANAGER (IAQ LAB & PCM LAB)

Designee: Marti Bowers

Description of Responsibilities:

The Quality Manager is responsible for implementing the Quality Assurance Program on a daily basis. This includes, but is not limited to: calibration of equipment, sample handling and login, worker safety and contamination control in the laboratory, analysis of QC data, resolution of analytical discrepancies, evaluation of the monthly QC data, and maintenance of appropriate records. The quality manager is responsible for assuring all employees are compliant with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the AIHA.

Laboratory Manager is the title given for the laboratory's technical manager. The Laboratory manager is responsible for implementing CEI's Quality Assurance Program. This includes, but is not limited to: sample handling and login, worker safety and contamination control in the laboratory, and supervision of all laboratory personnel. The Laboratory Manager oversees production-related planning and workload for the laboratory. The Laboratory Manager is responsible for assuring all employees are compliant with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the AIHA.

Marti Bowers may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

Mold Spore Trap Analysis – CEI Labs, Inc. Method
Mold Wipe / Tape Lift Analysis – CEI Labs, Inc. Method
PCM Asbestos Air: NIOSH 7400 Issue 2
Data Review for IAQ & PCM Laboratory Test Reports

Authorizing Signature_____ Date: 1/29/15
Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: QUALITY MANAGER (PLM LAB)

Designee: Gary Swanson

Description of Responsibilities:

The Quality Manager is responsible for implementing the Quality Assurance Program on a daily basis. This includes, but is not limited to: calibration of equipment, sample handling and login, worker safety and contamination control in the laboratory, analysis of QC data, resolution of analytical discrepancies, evaluation of the monthly QC data, and maintenance of appropriate records.

The Quality Manager is responsible for assuring all employees are compliant with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of NVLAP (NIST Handbook 150, and 150-3).

Megan Fisher may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

Bulk Asbestos Analysis: EPA 600 - PLM, Point Count

Authorizing Signature_____ Date: 1/29/15

Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: LABORATORY MANAGER (PLM LAB)
<TECHNICAL MANAGER>

Designee: Anna Malmberg, M.S.

Description of Responsibilities:

Laboratory Manager is the title given for the laboratory's technical manager. The Laboratory manager is responsible for implementing CEI's Quality Assurance Program. This includes, but is not limited to: sample handling and login, worker safety and contamination control in the laboratory, and supervision of all laboratory personnel. The Laboratory Manager oversees production-related planning and workload for the laboratory. The Laboratory Manager is responsible for assuring all employees are compliant with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the AIHA.

Anna Malmberg may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

PCM Asbestos Air: NIOSH 7400 Issue 2 (requires re-certification by laboratory)
Bulk Asbestos Analysis: EPA 600 - PLM, Point Count
Data review for PLM, PCM & Subcontracted Metals Reports

Authorizing Signature_____ Date: 1/29/15
Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: QUALITY / LABORATORY MANAGER
<TECHNICAL MANAGER> (TEM LAB)

Designee: Kamila Reichert

Description of Responsibilities:

The Quality Manager is responsible for implementing the Quality Assurance Program on a daily basis. This includes, but is not limited to: calibration of equipment, sample handling and login, worker safety and contamination control in the laboratory, analysis of QC data, resolution of analytical discrepancies, evaluation of the monthly QC data, and maintenance of appropriate records. The quality manager is responsible for assuring all employees are compliant with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of NVLAP (NIST Handbook 150, and 150-13).

Laboratory Manager is the title given for the laboratory's technical manager. The Laboratory manager is responsible for implementing CEI's Quality Assurance Program. This includes, but is not limited to: sample handling and login, worker safety and contamination control in the laboratory, and supervision of all laboratory personnel. The Laboratory Manager oversees production-related planning and workload for the laboratory. The Laboratory Manager is responsible for assuring all employees are compliant with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the NVLAP (NIST Handbook 150 and 150-13).

Kamila Reichert may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

EPA 600 - PLM, Point Count, TEM
TEM Asbestos Air: AHERA, EPA Level II, NIOSH 7402
TEM Wipe and Microvac Dust Samples
Data Review for TEM test reports.

Authorizing Signature_____ Date: 1/29/15
Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: LABORATORY ANALYST (PCM LAB)

Designee: Gary Swanson, Marti Bowers, Antonia Hoyland, Audrey Bui

Description of Responsibilities:

Laboratory Analysts perform analysis of PCM samples using the NIOSH 7400 method. They are responsible for the accuracy and precision of the work they perform. Laboratory Analysts routinely work under the supervision of the Laboratory Director and the Quality Manager in implementing QA/QC procedures on a daily basis. Responsibilities include, but are not limited to: daily calibration of equipment, sample handling and login, sample preparation and analysis, contamination control in the laboratory, implementation of worker safety procedures, and report generation. The Laboratory Analysts are responsible for complying with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the AIHA.

PCM Laboratory Analysts may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

PCM Asbestos Air: NIOSH 7400 Issue 2

Authorizing Signature_____ Date: 1/29/15

Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: MICROBIOLOGICAL ANALYST (IAQ LAB)

Designee: Marti Bowers, Vidya Natarajan, Tianbao Bai, PhD, CIH

Description of Responsibilities:

Microbiological Analysts are responsible for performing work submitted to the Indoor Air Quality Laboratory using methods approved by CEI. They are responsible for the accuracy and precision of the work they perform. Laboratory Analysts routinely work under the supervision of the Laboratory Director and the Quality Manager in implementing QA/QC procedures on a daily basis. Responsibilities include, but are not limited to: daily calibration of equipment, sample handling and login, sample preparation and analysis, contamination control in the laboratory, implementation of worker safety procedures, and report generation. The Laboratory Analysts are responsible for complying with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the AIHA.

Microbiological Analysts may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

Mold Spore Trap Analysis – CEI Labs, Inc. Method
Mold Wipe / Tape Lift Analysis – CEI Labs, Inc. Method

Authorizing Signature Tianbao Bai Date: 1/29/15
Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: LABORATORY ANALYST (PLM LAB)

Designee: Tianbao Bai, Gary Swanson, Anna Malmberg, Greg Ruff, Susannah Small, Megan Fisher, Samantha Card, Daniel Liguori, Candace Burrus, Megan Rumble, Elizabeth Godwin, Ritika Seal, Taylor Metcalf, Ella Nguyen, Sarah Talley, Ryan Williams, Shilpa Ladekar.

Description of Responsibilities:

Laboratory Analysts perform analysis of PLM samples using the EPA 600 method. They are responsible for the accuracy and precision of the work they perform. Laboratory Analysts routinely work under the supervision of the Laboratory Director and the Quality Manager in implementing QA/QC procedures on a daily basis. Responsibilities include, but are not limited to: daily calibration of equipment, sample handling and login, sample preparation and analysis, contamination control in the laboratory, implementation of worker safety procedures, and report generation. The Laboratory Analysts are responsible for complying with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the NVLAP (NIST Handbook 150 and 150-3)

PLM Laboratory Analysts may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

EPA 600 - PLM, Point Count

Authorizing Signature_____ Date: 1/29/15

Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: LABORATORY ANALYST (TEM LAB)

Designee: Tianbao Bai, Kamila Reichert, Gary Swanson, Diana Sedito, Susannah Small, Daniel Liguori (trainee), Yllka Pulaha (trainee)

Description of Responsibilities:

Laboratory Analysts perform analysis of TEM samples using the AHERA method. They are responsible for the accuracy and precision of the work they perform. Laboratory Analysts routinely work under the supervision of the Laboratory Director and the Quality Manager in implementing QA/QC procedures on a daily basis. Responsibilities include, but are not limited to: daily calibration of equipment, sample handling and login, sample preparation and analysis, contamination control in the laboratory, implementation of worker safety procedures, and report generation. The Laboratory Analysts are responsible for complying with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the NVLAP (NIST Handbook 150 and 150-13)

TEM Laboratory Analysts may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

All Analysts:
EPA 600 – TEM
All Analysts excluding Susannah Small, Daniel Liguori, Gary Swanson:
AHERA Method for Asbestos in Air
TEM Wipe and Microvac Dust Samples
NIOSH 7402 Method for Asbestos in Air
TEM Soil – ASTM D7521-13
TEM Vermiculite – Cincinnati Method.

Authorizing Signature _____ Date: 1/29/15
Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: LABORATORY TECHNICIAN (PCM LAB)

Designee: Samantha Davi, Lauren Mellenex, Susannah Small, Vidya Natarajan, All PCM Analysts

Description of Responsibilities:

Laboratory Technicians are responsible for sample login, sample preparation, daily cleaning of the sample preparation area, creating additional preparations in accordance with the Quality Assurance Program, and entering data and generating reports from that data. The Laboratory Technicians are responsible for complying with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the AIHA.

PCM Technicians may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

PCM sample preparation using NIOSH 7400 Issue 2 procedures
Generating Sample Reports using the CEI's PCM SOP

Authorizing Signature_____ Date: 1/29/15
Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: LABORATORY TECHNICIAN (IAQ LAB)

Designee: Tianbao Bai, Marti Bowers, Vidya Natarajan

Description of Responsibilities:

Laboratory Technicians are responsible for sample login, sample preparation, media preparation, and daily cleaning of the sample preparation room in accordance with the Quality Assurance Program. The Laboratory Technicians are responsible for complying with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the AIHA.

IAQ Lab Technicians may perform, but not be limited to performing, the following Approved Test Methods and Procedures:

Spore Trap sample preparation using the CEI Labs, Inc. Method
Bulk Mold preparation using CEI developed procedures

Authorizing Signature_____ Date: 1/29/15
Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: LABORATORY TECHNICIAN (TEM LAB)

Designee: Tianbao Bai, Kamila Reichert, Susannah Small, Gary Swanson, Samantha Davi, Yllka Pulaha (trainee), Daniel Liguori (trainee)

Description of Responsibilities:

Laboratory Technicians are responsible for sample login, sample preparation, media preparation, and daily cleaning of the sample preparation room in accordance with the Quality Assurance Program. The Laboratory Technicians are responsible for complying with ISO/IEC 17025, the CEI QA Manual, CEI SOP manuals and the pertinent policies of the NVLAP (NIST Handbook 150 and 150-13).

TEM Lab Technicians may perform, but not be limited to performing, the following Approved Test Methods And Procedures:

Preparation of air samples for TEM Analysis by AHERA rules.
Preparation of air samples for NIOSH 7402 Analysis
Preparation of bulk asbestos samples by EPA 600 method.
Preparation of dust microvac and wipe samples by ASTM methods.

Authorizing Signature_____ Date: 1/29/15
Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: LABORATORY SECRETARY / OFFICE MANAGER

Designee: Laura Bostwick, Elizabeth Godwin

Description of Responsibilities:

The Laboratory Secretary is responsible for the preparation of final test reports forwarded to customers, maintenance of appropriate customer files, and customer relations.

The Laboratory Secretary may not perform Test Methods or Procedures in the laboratory without first going through the training processes outlined in the Quality Assurance Manual and Laboratory SOP Manuals. He/she shall be trained in to have some knowledge of methodology and procedures so as to communicate vital information to CEI customers.

Authorizing Signature_____ Date: 1/29/15

Tianbao Bai, PhD, CIH
CEI Laboratory Director

CEI Labs, Inc.

Position Title: LOGIN TECHNICIAN

Designee: Antonia Hoyland, Lauren Mullenex, Elizabeth Godwin

Description of Responsibilities:

Login Technicians are responsible for sample receipt. They determine and record the condition and acceptability of samples submitted to CEI, and process and package the samples for analysis. Login technicians create internal chain of custody records and deliver them with the samples to the laboratory

The Login Technician may not perform Test Methods or Procedures in the laboratory without first going through the training processes outlined in the Quality Assurance Manual and Laboratory SOP Manuals. He/she shall be trained in to have some knowledge of methodology and procedures so as to communicate vital information to CEI customers.

Authorizing Signature_____ Date: 1/29/15

Tianbao Bai, PhD, CIH
CEI Laboratory Director

DEPUTIES TO KEY PERSONNEL

Employee	Job Title	Deputy
Tianbao Bai	Laboratory Director (CEI)	Gary Swanson
Gary Swanson	Quality Manager (CEI)	Susannah Small
Marti Bowers	Quality Manager (PCM)	Gary Swanson
Marti Bowers	Laboratory Manager (PCM)	Gary Swanson
Marti Bowers	Laboratory Manager (IAQ)	Tianbao Bai
Marti Bowers	Quality Manager (IAQ)	Tianbao Bai
Anna Malmberg	Laboratory Manager (PLM)	Susannah Small
Gary Swanson	Quality Manager (PLM)	Susannah Small
Kamila Reichert	Laboratory Manager (TEM)	Tianbao Bai
Kamila Reichert	Quality Manager (TEM)	Tianbao Bai

PERSONNEL AUTHORIZED FOR DATA REVIEW

Report Types	Asbestos Test Reports: PLM, PCM	Asbestos Test Reports: TEM	Lead, other Metals, Subcontracted Test Types	IAQ Reports: Spore Trap, Wipe, Tape Lift, Subcontracted Culturables
Authorized Personnel	Tianbao Bai Gary Swanson Anna Malmberg Megan Fisher Susannah Small Audrey Bui (PCM only)	Tianbao Bai Kamila Reichert Gary Swanson Anna Malmberg	Tianbao Bai Gary Swanson Anna Malmberg	Tianbao Bai Marti Bowers Vidya Natarajan

APPENDIX II:

CALCULATION OF UNCERTAINTY

Calculation of Uncertainty (PCM & SPORE TRAP)

In this manual, for spore counting the **measurand** is defined as fungal spores counted on a trace deposited on a glass slide by using spore trap sampling method. The **measureand** is also defined as the number of fibers counted on a prepared MCE filter using NIOSH 7400 method.

Determination of Acceptance of replicate or duplicate analysis: Acceptable levels of variation are determined by comparison of initial counts versus QC counts as follows:

If $ABS(SQRT_{intial} - SQRT_{QC}) \leq 2.77(AVGSQRT)$ (pooled CV/2),

the results are considered acceptable.

The pooled CV is determined by daily reading of reference slides and is determined by:

$CV_{pool} = SQRT\{(CV_1^2 + CV_2^2 + \ldots CV_n^2)/n\}$

This value can change daily based upon the increased or decreased accuracy of an analyst's readings of the reference slides. The reference slides are divided into three groups based upon how many spores or fibers are assumed to be present. These ranges are 10 to100, >100 to 350, and >350 spores per slide trace and 5-20, >20 to 50, and >50 to 100 fibers per 100 graticule fields. The above formula applies to both the spore counting and fiber counting methods.

Expanded Analytical Uncertainty and Bias for Spore Counting

The expanded measurement uncertainty at 95% confidence limit (k=2) equals CV_{pool} x 2. Therefore, the Expanded Analytical Uncertainty equals concentration x Expanded MU@ 95% C. L.

For Example: If the low range has a pooled CV of 0.2, the spore concentration of the sample was 100 Spores/M^3, Expanded analytical uncertainty = 100 Spores/M^3 x 0.2 x 2 = 40 Spores/M^3.

Example of reporting for air sample with 100 Spores/M^3:

100 Spores/M^3 with an analytical uncertainty of +/- 40 Spores/M^3 at the 95% confidence level.

The **Bias** for spore counts cannot be determined because no quantitative reference material is available.

Expanded Analytical Uncertainty and Bias for Fiber Counting

CEI adapt the uncertainty evaluations in the content of the NIOSH 7400 method. The 90% confidence interval can be calculated using the following equations:

$$U_{CL} = \frac{2X + 2.25 + [(2.25 + 2X)^2 - 4(1-2.25CV^2)X^2]^{1/2}}{2(1-2.25CV^2)} \quad \text{and}$$

$$L_{CL} = \frac{2X + 4 - [(4 + 2X)^2 - 4(1-4CV^2)X^2]^{1/2}}{2(1-4CV^2)}$$

Where CV = subject interlaboratory relative standard deviation, which is close to the total interlaboratory CV when approximately 100 fibers are counted,
X = total fibers counted on sample,
L_{CL} = lower 95% confidence limit, and
U_{CL} = upper 95% confidence limit.
The range between these two limits represents 90% of the total range.

Example: if a single filter fiber count is 100 and the CV = 0.2, the calculated U_{CL} = 148% and L_{CL} = 68%. Therefore, if the measured sample concentration is 0.2 fibers/cc, then the mean fiber count by a group of laboratories has a 95% chance of being less than 0.5; i.e., 0.2 + 1.48 x 0.2 = 0.5. Similarly, the mean fiber count by a group of laboratories has a 95% of chance of being greater than 0.06; i.e. 0.2 – 0.68 x 0.2 = 0.06.

The fiber counts are probably **biased** when counts are outside the recommended 100 – 1300 fiber/mm^2 range and should be reported as having “greater than optimal variability” and as being “probably biased”. At low levels, the fiber counts are generally overestimated when compared to results in the recommended analytical range of the method. The fiber counts are generally underestimated when the debris loading on the filter is high. However, a quantitative evaluation of the bias of the fiber counting is not available.

APPENDIX III:

FACTORS DETERMINING CORRECTNESS AND THE RELIABILITY OF RESULTS

Factors Determining the Correctness and Reliability of Results

Factor	Type	Description	Actions to Minimize
Human Factor	B	Errors that could result from mistakes made by personnel	Adequate and updated training. Read reference slides by multiple analysts.
Environmental Conditions	A/B	The presence of spores/fibers/debris in the air which could influence results	Semi-annual air sampling and proper use of fume hood to handle samples. Air sampling results are given a threshold which they must remain within for the laboratory to be a suitable environment for sample handling
Test and Calibration Methods/Validation	B	Methods and calibrations that are not approved or properly validated	Use of only approved methods and strict adherence to SOP Manual
Equipment	B	Equipment that is not functioning properly or is not being properly maintained	Routine checks of the functionality of equipment and analyze reference slides daily
Measurement Traceability	A/B	Measurements taken that cannot be obtained again by using the same methodology as the original test	QC performed on 10% of samples to assure results can be duplicated and replicated
Sampling	B	Improper collection of samples and the use of improper techniques and containers	Samples are collected by professionals and proper procedures are available to anyone with question regarding proper sampling
Handling of Test and Calibration Items	B	Improper handling that damages/changes the sample or equipment that could affect results	Samples and equipment are handled only by trained laboratory personnel
Sample Preparation	A/B	Slides & coverslip contamination	Analyze blanks daily.
Overlapping of Debris or Spores	B	Missed spores or undercounted spores	Clients are encouraged to pull an appropriate amount of air for the conditions present. The manufacturer provides recommendations for conditions and responsibility lies with the sampler to follow these recommendations.
Identification of Spore Types	B	Errors in identification	Errors are minimized by performance of regular QC by the same analyst and another analyst to verify that all genera were noted and properly identified.
Counts	A/B	Errors in counting	Errors are minimized by performance of regular QC by the same analyst and another analyst to verify that all genera/fibers were counted. A chart has been set up to verify by CV and 2.77 test for first kind errors that differences in counts are within acceptable limits. See Uncertainty Calculations.
Counts II	A/B	Errors in counting	Precision is maintained by the daily reading of reference slides. These slides have been read repeatedly to determine an analyst's ability to perform an analysis repeatedly with accuracy. The data are compiled on a graph and a CV determined based on the number of spores/fibers counted each time.
Spores not Present	B	Absence of a spore type	The absence of a genus on the lab report does not mean that is was not present; it simply states that an analyst did not detect it on that sample at the time of analysis or that it is present at a level below the limit of detection

APPENDIX IV
RECORD FORMATS

CUSTOMER CHAIN OF CUSTODY:

1) IAQ COC
2) ASBESTOS (PCM / PLM / TEM) COC
3) LEAD COC

MOLD
CHAIN OF CUSTODY

107 New Edition Court, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:
CEI Lab Code:
CEI Lab I.D. Range:

COMPANY INFORMATION	**PROJECT INFORMATION**
CEI CLIENT #:	Job Contact:
Company:	Email / Tel:
Address:	Project Name:
	Project ID#
Email:	PO #:
Tel: Fax:	**STATE SAMPLES COLLECTED IN:**

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

		TURN AROUND TIME						
MICROBIOLOGY	**METHOD**	**4 HR***	**8 HR***	**24 HR**	**2 DAY**	**3 DAY**	**5 DAY**	**7-10 DAY**
MOLD NON-VIABLE	TAPE LIFT, BULK, SWAB	☐	☐	☐	☐	☐	☐	
MOLD NON-VIABLE	SPORETRAP	☐	☐	☐	☐	☐	☐	
MOLD VIABLE	IMPACTOR							☐
MOLD VIABLE	BULK, SWAB, DUST							☐
DUST CHARACTERIZATION	PLM	☐	☐	☐	☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐	☐

FIELD ID #	**SAMPLE LOCATION**	**AREA (SQ. INCH)**	**VOLUME (LITRES)**

REMARKS:	☐ Accept Samples ☐ Reject Samples

Relinquished By:	**Date/Time**	**Received By:**	**Date/Time**

Samples will be disposed of 30 days after analysis

MOLD SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company:	Job Contact:
Project Name:	
Project ID #:	Tel:

FIELD ID #	SAMPLE LOCATION	AREA (SQ. INCH)	VOLUME (LITRES)

Page _____ of _____

ASBESTOS
CHAIN OF CUSTODY

107 New Edition Court, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:
CEI Lab Code:
CEI Lab I.D. Range:

COMPANY INFORMATION	PROJECT INFORMATION
CEI CLIENT #:	Job Contact:
Company:	Email / Tel:
Address:	Project Name:
	Project ID#
Email:	PO #:
Tel: Fax:	**STATE SAMPLES COLLECTED IN:**

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR	8 HR	24 HR	2 DAY	3 DAY	5 DAY
PLM BULK	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (400)	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (1000)	EPA 600	☐	☐	☐	☐	☐	☐
PLM GRAV w POINT COUNT	EPA 600		☐	☐	☐	☐	☐
PLM BULK	CARB 435		☐	☐	☐	☐	☐
PCM AIR	NIOSH 7400	☐	☐	☐	☐	☐	☐
TEM AIR AHERA	EPA AHERA	☐	☐	☐	☐	☐	☐
TEM AIR NIOSH	NIOSH 7402	☐	☐	☐	☐	☐	☐
TEM AIR ISO	ISO 13794	☐	☐	☐	☐	☐	☐
TEM AIR ASTM	ASTM 6281-09	☐	☐	☐	☐	☐	☐
TEM BULK	CHATFIELD		☐	☐	☐	☐	☐
TEM DUST WIPE	ASTM D6480-05	☐	☐	☐	☐	☐	☐
TEM DUST MICROVAC	ASTM D5755-09	☐	☐	☐	☐	☐	☐
TEM SOIL	ASTM D7521-13			☐	☐	☐	☐
TEM VERMICULITE	CINCINNATI METHOD			☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐

REMARKS / SPECIAL INSTRUCTIONS:	☐ Accept Samples ☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time

Samples will be disposed of 30 days after analysis

ASBESTOS SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company:	Job Contact:
Project Name:	
Project ID #:	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
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			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐

METALS
CHAIN OF CUSTODY

107 New Edition Court, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:
CEI Lab Code:
CEI Lab I.D. Range:

COMPANY INFORMATION	PROJECT INFORMATION
CEI CLIENT #:	Job Contact:
Company:	Email / Tel:
Address:	Project Name:
	Project ID#
Email:	PO #:
Tel: Fax:	**STATE SAMPLES COLLECTED IN:**

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR**	8 HR**	24 HR**	2 DAY	3 DAY	5 DAY
LEAD PAINT	EPA SW846 7000B				☐	☐	☐
LEAD WIPE	EPA SW846 7000B				☐	☐	☐
LEAD SOIL	EPA SW846 7000B				☐	☐	☐
LEAD AIR	NIOSH 7082				☐	☐	☐
LEAD TCLP	EPA SW846 7000B				☐	☐	☐
RCRA 8 METALS	EPA SW846 7000B				☐	☐	☐
RCRA 8 TCLP	EPA SW846 7000B				☐	☐	☐
OTHER:					☐	☐	☐

*****TAT IS NOT AVAILABLE. LEAD SAMPLES ARE SUBCONTRACTED FOR ANALYSIS TO AN ELLAP ACCREDITED LAB.***

REMARKS:			☐ Accept Samples ☐ Reject Samples
Relinquished By:	**Date/Time**	**Received By:**	**Date/Time**

Samples will be disposed of 30 days after analysis

METALS SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company:	Job Contact:
Project Name:	
Project ID #:	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/AREA	COMMENTS

Page _____of _____

CHAIN OF CUSTODY
LABORATORY

CHAIN OF CUSTODY

LABORATORY ANALYSIS

CLIENT:

VOICE:
FAX:
PURCHASE ORDER:
AMENDED: ☐

CLIENT CODE: SINCE: CONTACT:
PROJECT:

LAB CODE:
TURN AROUND:
CEI JOB #:

DATE/TIME REC'D: 11-01-12
DATE/TIME DUE:
RECEIVED BY:
ASSIGNEE:
CONFIRMATION SENT: No
FAX TO:
EMAIL TO:

SAMPLE TYPE	QTY	LAB ID Range

Mastic Layers
Total Layers ☐ Show on PLM Report?

	INITIALS	DATE	TIME
SAMPLE PREP BY:			
ANALYZED BY:			
REPORT GENERATED BY:			
SAMPLES SUBMITTED FOR TEM:	☐ Y ☐ N		
REVIEWED BY:			
SCANNED BY:			
REPORTED BY:			

On Time? Late (Min)

NOTES:

COMMENTS:

ASBESTOS TIER: MOLD TIER: TEM TIER: EMAIL INVOICES:

Version: LCOC.1012.1./1.LD

DOCUMENT APPROVAL WORKSHEET

CEI LABS
Document Approval Worksheet

Date Submittted: _____

Submitted by: _____

Document Name: _____

Document Version:_____

_____

Circle one: **Original** **/** **Revision**

_____

This document has been approved for use at CEI by the Laboratory Director, and the Quality Manager.

Laboratory Director (Dr. Tianbao Bai)_____

Quality Manager ( ) _____

Other Notes:

_____
_____
_____
_____
_____
_____
_____

QC/QA AMENDED REPORT WORKSHEET

QC / QA AMENDED REPORT WORKSHEET

REPORT #: A15-0[redacted] **DATE:** 1/22/2015

CLIENT: [redacted]

CLIENT CONTACT: [redacted]

REASON FOR AMENDED REPORT

CATEGORY: Client Wishes to Change Specifications for Analysis

TYPE: Composite Layers

AMENDMENT INFO

SAMPLE NUMBER: A1900781

RESOLUTION: Composited DW/JC

CEI COMMENT: Composited DW/JC

CLIENT COMMENT:

CUSTOMER SATISFACTION

CUSTOMER NOTIFIED OF CHANGE TO REPORT? Y

DID CUSTOMER EXPRESS SATISFACTION WITH CHANGE? Y

AMENDED BY: SS **DATE:** 1/22/2015 2:42:26 PM

CORRECTIVE ACTION REPORT

CEI LABS
Corrective Action Report for Non-conforming Events

Date: _____ Incident Investigator _____

Incident:

Root Cause Analysis:

Outcome of Investigation:

Proposed Corrective Action:

Date of Implementation of Corrective Action _____

Verification of Effectiveness of Corrective Action:

CORRECTIVE ACTION REPORT
Complaints

CEI LABS
Corrective Action Report for Non-conforming Events

Date: _____ Incident Investigator _____

Incident: Complaint from (circle) Customer CEI Employee Accred. Agency Other

Name of Entity/Person Issuing Complaint _____
Summarize the complaint below:

Root Cause Analysis: The following statement(s) were found to be true in the course of the investigation.

Outcome of Investigation:
Was the complaint validated by the investigation? Yes No

If no, describe in detail the circumstances that invalidated the complaint:

Proposed Corrective Action: Add additional pages if necessary.

Date of Implementation of Corrective Action _____

Verification of Effectiveness of Corrective Action:

CORRECTIVE ACTION REPORT
Customer COC Error

CEI LABS
Corrective Action Report for Non-conforming Events

Date: _____ Incident Investigator _____

Incident: The customer chain of custody form was incomplete.

Root Cause Analysis:
Which necessary information was incomplete on the custody form (circle)?

TAT Volume/Area Test Type Sample ID No COC Other (describe below)

Was the customer contacted? Yes No

Name of customer contact: _____

Outcome of Investigation:
Describe any conversation you had with the customer regarding incomplete COC form:

Proposed Corrective Action: Obtain information from customer to complete work.

Did the customer provide the information to complete the work? Yes No

Did the customer provide the information in writing? Yes No

Date of Implementation of Corrective Action:

Date and Time Work was Permitted to Commence: _____

CEI Project Code for Submitted Test Items _____

Verification of Effectiveness of Corrective Action: Work was able to commence on the submitted test items.

EQUIPMENT MANUAL/MAINENANCE LOG

1) EQUIPMENT DESCRIPTION WORKSHEET

2) EQUIPMENT MAINTENANCE RECORD

EQUIPMENT DESCRIPTION WORKSHEET

ITEM :

MANUFACTURER:

SERIAL NUMBER:

LABORATORY DESIGNATION:

LOCATION:

CALIBRATION SOURCE:

CALIBRATION PROTOCOL:

CALIBRATION FREQUENCY:

PURCHASE DATE:

INSTALLATION DATE:

MAINTENANCE CONTACT:

MAINTENANCE PROTOCOL:

LIGHT/ENERGY SOURCE:

EQUIPMENT MAINTENANCE RECORD

ITEM:

SERIAL NUMBER:

LABORATORY DESIGNATION:

ACTIONS: CL=CLEANING, R= REPLACE PART, O=OTHER ACTION, CA=CALIBRATION

Date	Action	Problem/Cause	Date returned to service.

VERSION: EQUB.09.12.1/1.QM

LABORATORY HOOD TEST RECORD

CEI LABS, INC.
LABORATORY HOOD TEST RECORD

DATE: _____

HOOD NUMBER: _____

HOOD LOCATION: _____

PERFORMED BY: _____

TEST EQUIPMENT: ALNOR Model 9880

FILTER CONDITION: Excellent, Good, Fair, Poor

CONDITIONS DURING TEST:_____

_____

READINGS: #1_____ #2_____ #3_____

#4_____ #5_____ #6_____

#7_____ #8_____ #9_____

AVERAGE:_____

I**S THE AVERAGE GREATER THAN 60 FPM?** YES NO

Witnessed by:_____ Date:_____

All readings are in feet per minute (fpm). Hood front opening is visually divided to 9 equal areas and readings are taken from the center of each area.

VERSION HTRW.01.06.1/1.LD

LABORATORY SUPPLIES RECORD

Laboratory Supplies Record

DATE	ITEM NAME	CATALOG / ITEM NO.	QUANTITY	SUPPLIER NAME	RECV'D BY	DATE RECEIVED	LOT NUMBER	CONDITION

REPORT REVIEW PROCEDURE

CEI LABS

STANDARD OPERATING PROCEDURES

Method 210: STANDARD PROCEDURES FOR REPORT REVIEW

"Reviewing CEI Test Reports to Ensure Quality Analysis"

0.0	Table of Contents	…….	1
1.0	Scope and Application	…….	2
2.0	Summary of Method	…….	2
3.0	Qualified Personnel	…….	2
4.0	All Reports		3
5.0	PLM Reports	…….	3
6.0	PCM Reports		3
7.0	TEM Reports	…….	3
8.0	IAQ Reports	…….	4
9.0	Reporting the Results	…….	4

CEI Labs, Inc.
Method Number: CEI 210
REPORT REVIEW SOP
Revision: February 2014

1.0 Scope and Application

1.1 CEI designates qualified personnel to review final reports. The CEI Quality Assurance Manual lists the qualified personnel for each department. The report review serves to ensure reports are released to the customer with data that are correct and applicable to the test performed.

2.0 Summary of Method

2.1 Reports are completed by qualified CEI personnel. Each department has a designated area where reports are to be submitted for review. After qualified CEI personnel review the reports, they are submitted to the laboratory's secretary for delivery to the customer.

3.0 Qualified Personnel

3.1 The Laboratory Director approves certain personnel, who have undergone training with regards to report review procedures, as "qualified" to review laboratory test reports. A record of this training is maintained by the Quality Manager. The personnel chosen may be approved for reviewing test reports of one or more disciplines practiced by the laboratory.

3.2 Only the Laboratory Director / Laboratory Manager / Quality Manager or their authorized designees with appropriate training are allowed to review reports.

3.3 A list of personnel authorized to implement data review procedures can be found in Appendix I of the *CEI Quality Assurance Manual*.

4.0 All Reports

4.1 Ensure that the project number matches the report and the client name on the report matches the client name on the Customer Chain of Custody;

4.2 Ensure that CEI project code on the report matches the Laboratory chain of custody;

4.3 Verify that all pages of the report are included;

4.4 Verify that all pertinent information is correctly transmitted to the report (sample volume, sample number, fiber counts, etc.);

4.5 Ensure that the data entry fields are clear if the sample is not analyzed;

4.6 Ensure that the total number of samples on the report matches the total number of samples logged-in;

5.0 PLM Reports

5.1 Ensure that the number of mastic layers and multiple samples are recorded;

5.2 Check for positive stop and other special requests and make sure they are followed;

5.3 Ensure that the actual number of samples analyzed is updated;

5.4 Ensure that no “copy/paste” errors are present.

5.5 Personnel that are responsible for data review must check the Project Due Now bin periodically (at least once per hour) so that CEI meets test report deadlines. Sort the Project Due later bin regularly to ensure somebody did not accidentally put a test report the wrong bin. In addition, all test reports due before 9:00 am the next day shall be reviewed and emailed before the end of the 2nd shift.

6.0 PCM Reports

6.1 Make sure customer is not charged for samples not prepped (filter damaged, too wet to prep).

6.2 Verify File Maker Pro’s programming and calculations weekly.

7.0 TEM Reports

7.1 Ensure proper number of prep charges and analytical charges are correct.

7.2 Ensure the calculations are correct.

7.2.1 Verify File Maker Pro’s programming and calculations quarterly.<<<

8.0 IAQ Reports

8.1 Verify counts on test report match up to the hard copy bench worksheets.

8.2 Verify all genus types identified on test report match up to the hard copy bench worksheets.

8.3 Verify File Maker Pro's programming and calculations weekly.

9.0 Send Test Report to the Customer

9.1 If all above information is verified correct, initial and provide the date and time of data review on the Laboratory Chain of Custody.

9.2 If test reports contain any errors, have them corrected by the party at fault, and then the reports must be resubmitted for data review.

9.3 Deliver reviewed test report to the Laboratory Secretary for scanning and reporting of test items to the customer.

9.4 Test Reports are delivered to the customer by e-mail, fax, courier, or U.S. Mail.

VERIFICATION OF ELECTRONIC DOCUMENT FUNCTIONALITY

CEI Labs, Inc.
Verification of Functionality of Computerized Spreadsheets and Calculations

Date _____ **Name of Calculation or Function**_____-

Platform Tested (Choose one) : Microsoft Excel Filemaker Pro Other _____

	Computer/Electronic Calculation	Hand Calculation
Equation	Write Electronically Programmed Equation Here:	Write Equation for Hand Calculation Here:
Result	Result Obtained by Electronic Calculation:	Result Obtained by Hand Calculation:

Was the computer result verified? Yes No
If no, complete a Corrective Action Report for Nonconforming Events.

This result was confirmed by _____ on _____
Name Date

Version VFCS.11.12.1/1.QM

VENDOR APPROVAL RECORD

CEI LABS
Authorization for Suppliers and Services

Date: _____

Authorization Requested by _____

Name of Supplier: _____
List goods and/or services requested by supplier/vendor below:

_____

Evaluation:

1. Goods and/or services provide by this vendor are appropriate to CEI's needs in purity, and purpose so as not to compromise the quality of CEI's analytical services.	Yes	No	
2. A cost analysis is performed by the Laboratory Director to determine if the value / cost of the item or service is acceptable to CEI Labs, Inc. Is the cost analysis acceptable to the Laboratory Director?	Yes	No	
3. When possible, the vendor providing the supplies, reagents, or standards must adhere to an International Standard. Does this vendor calibrate its standards, or products derived thereof, to an International Standard? (i.e. can they provide certificates of trace-ability?)	Yes	No	N/A
4. Does the supplier/vendor provide Material Safety Data Sheets (MSDS) for standards and reagents purchased by CEI?	Yes	No	N/A

I authorize this vendor/supplier for goods and/or services to CEI Labs, Inc. until such time as they are reviewed, and found unable to meet the evaluation criteria established by CEI Labs, Inc.

_____ _____
Lab Director Date

APPENDIX V

CHEMICAL HYGIENE PLAN

CEI LABS, INC.
Chemical Hygiene Plan

Prepared by: Tianbao Bai, Ph.D., CIH
Date Prepared: April 26, 2001
Revised by: Marti Bowers
Date Revised: November 13, 2014

107 New Edition Court
Cary, North Carolina 27511
Tel: 919-481-1413
Fax: 919-481-1442

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9.3 Medical Consultation and Examinations
9.4 Training
9.5 Equipment Inspection

10.0 Annual Chemical Hygiene Plan Review

Foreword

The protection of the safety and health of its employees, students and environment is a high priority of CEI Labs, Inc. On January 31, 1990, the Occupational Safety and Health Administration (OSHA) promulgated a rule for occupational exposure to hazardous chemicals in laboratories. This rule is designed to help protect laboratory workers from the hazards of the chemicals they use. Section 1 provides a definition of which workplaces are considered laboratories under this standard. Included in the standard is a requirement that all employers covered by the standard develop a Chemical Hygiene Plan (CHP). A CHP is a written program which sets forth work practices, equipment use and maintenance procedures, and personal protective equipment requirements that protect employees from the hazards presented by chemicals used in the lab. According to OSHA, the CHP must include standard operating procedures, criteria for the implementation of chemical control measures, measures to ensure proper operation of engineering controls, provisions for the training of workers, provisions for medical consultation in the case of exposure, designation of responsible people in the lab, and identification of procedures for the use of particularly hazardous substances or procedures. This document satisfies this requirement. It is up to the lab supervisor to supplement this plan with more detailed information about the proper use of the particular chemicals used in the lab. These supplements may be in the form of written procedures, literature libraries, video presentations, and/or group or individual training. The lab supervisor and Chemical Hygiene Officer, if one is appointed, are responsible for the interpretation and enforcement of policies described in this CHP.

Section 1: Responsibilities, Application, Coordination

1.0 Chemical Hygiene Responsibilities and Program Coverage

1.1 Chemical Hygiene Responsibilities

Environmental health and safety responsibilities at CEI Labs, Inc. (CEI), including chemical hygiene responsibilities, are described in the CEI's Environmental Health and Safety Policy. Duties specific to laboratory chemical use are described in this section.

A. Laboratory Manager

The laboratory manager has the ultimate responsibility for chemical hygiene throughout the laboratory, and, with the assistance of laboratory safety programs, supports the chemical hygiene efforts of lab workers.

Specifically, the lab manager shall:

• Develop and implement appropriate chemical hygiene policies and practices specific to the operations of the lab(s) they are responsible for.
• Perform regular, formal chemical hygiene inspections, including inspections of emergency equipment. The frequency of these will be set by the laboratory CHP, based on the professional judgment of the lab manager. Weekly housekeeping inspections and monthly equipment inspections are suggested.
• Develop Standard Operating Procedures specific to their lab's operations.
• Determine the proper level and type of personal protective equipment for lab operations.
• Ensure that appropriate training has been provided to employees.
• Maintain a current knowledge concerning the legal requirements of regulated substances in the laboratory.
• Review and improve the Chemical Hygiene Plan on an annual basis.

B. Chemical Hygiene Officer

The lab manager may name a Chemical Hygiene Officer (CHO) with appropriate training and experience to assist with the activities described above. If no person is named CHO, the lab manager will retain responsibility for all chemical hygiene activities.

C. Laboratory Workers

The laboratory workers are individually responsible for planning and conducting each laboratory operation in accordance with the Chemical Hygiene Plan and developing good personal chemical hygiene habits.

1.2. Scope and Application of this Plan

This standard applies where "laboratory use" of hazardous chemicals occurs. Laboratory use of

hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met:

• the handling or use of chemicals occurs on a "laboratory scale"; that is, the work involves containers which can easily and safely be manipulated by one person,
• multiple chemical procedures or chemical substances are used, and
• protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposures to hazardous chemicals.

At a minimum, this definition covers employees who handle or use chemicals at CEI. Certain non-traditional laboratory settings may be included under this standard at the option of individual departments within the company. Where the use of hazardous chemicals provides no potential for employee exposure, a Chemical Hygiene Plan is not required.

1.3. Coordination with Other Standards and Guidelines

Although this standard deals only with use of hazardous chemicals, employees may also encounter potential physical, biological or radioactive hazards in the laboratory. In the event that there is a conflict between provisions of various standards, the OSHA should be contacted to assist in resolving the discrepancy.

Section 2: Information and Training

2.0 Employee Information and Training

2.1 Information

It is essential that laboratory employees have access to information on the hazards of chemicals and procedures for working safely. Managers must ensure that laboratory employees are informed about and have access to the following information sources:

• The contents of the OSHA lab standard, Occupational Exposure to Hazardous Chemicals in Laboratories, and its appendices (29 CFR 1910.1450).
• CEI Labs, Inc. Chemical Hygiene Plan (this document) and local lab standard operating procedures.
• The Permissible Exposure Limits (PEL) for OSHA regulated substances.
• Material safety data sheets (MSDS) for laboratory chemicals. These are available from collections on the Internet, and are also located in many individual laboratories. Departments that receive MSDS's directly with chemical shipments will make such information available to the employees using the chemicals.

2.2 Training

Each laboratory manager is responsible for ensuring that laboratory employees are provided with training about the hazards of chemicals present in their laboratory work area, and methods to control exposure to such chemicals. Each employee shall receive training at the time of initial assignment to the laboratory, prior to assignments involving new exposure situations, and at a regular frequency.

A. Availability
Training is available in the form of:
• Literature describing proper lab practices (see Sections 5).
• Video libraries.
• Group and individual training, conducted by lab personnel.

B. Content
Employee training programs will include, at a minimum, the following subjects:
• Methods of detecting the presence of hazardous chemicals (observation, signage and labeling, odor, real-time monitoring, air sampling, etc.).
• Symptoms associated with exposures to hazardous chemicals.
• Good laboratory practice, including general techniques designed to reduce personal exposure and to control physical hazards, as well as specific protective mechanisms and warning systems used in individual laboratories.
• Emergency response actions appropriate to individual laboratories.
• Applicable details of the departmental Chemical Hygiene Plan, including general and laboratory-specific Standard Operating Procedures.

Section 3: Implementation of Control Measures

3.0 Criteria for Implementation of Control Measures

3.1 General Criteria

This Chemical Hygiene Plan is intended to limit laboratory workers' exposure to OSHA-regulated substances. Laboratory workers must not be exposed to substances in excess of the permissible exposure limits (PEL) specified in OSHA rule 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances or Threshold Limits Values set by the American Conference of Governmental Industrial Hygienists. PELs refer to airborne concentrations of substances and are averaged over an eight-hour day. A few substances also have "action levels". Action levels are air concentrations below the PEL which nevertheless require that certain actions such as medical surveillance and workplace monitoring take place.

Guidance: Pay particular attention to the following paragraph. If you, as a lab manager or CHO, suspect exposure concentrations exceed allowable levels, please contact the Management for technical assistance. An employee's workplace exposure to any regulated substance must be monitored if there is reason to believe that the exposure will exceed an action level or a PEL. If exposures to any regulated substance routinely exceed an action level or permissible exposure level, control measures must be implemented.

A. Professional Judgment

The lab manager can use professional judgment to assess the nature of chemical exposure resulting from a lab procedure and prescribe engineering controls and personal protective equipment to be used during the procedure. This judgment will be documented through use of Standard Operating and Laboratory Chemical Safety Summaries written for the chemicals in use.

B. Air Sampling

Air sampling for evaluating employee exposure to chemical substances shall be conducted on an as needed basis (to be determined by the lab supervisor). Conduct air sampling if there is reason to believe that exposure levels for regulated substances that require sampling routinely exceed the action level, or in the absence of an action level, the PEL. Air sampling will be conducted according to established industrial hygiene practices. It may be conducted by lab workers, chemical hygiene officer, or outside consultants. The results of air sampling studies performed in the laboratory should be sent to the chemical hygiene officer for records maintenance.

3.2 Criteria for Implementation of Specific Control Measures

Engineering controls, personal protective equipment, hygiene practices, and administrative controls each play a role in a comprehensive laboratory safety program. Implementation of specific measures must be carried out on a case-by-case basis, using the following criteria for guidance in making decisions.

A. When to Use Fume Hoods

The laboratory fume hood is the major protective device available to laboratory workers. It is designed to capture chemicals that escape from their containers or apparatus and to remove them from the laboratory environment before they can be inhaled. Characteristics to be considered in requiring fume hood use are physical state, volatility, toxicity, flammability, eye and skin irritation, odor, and the potential for producing aerosols. A fume hood should be used if a proposed chemical procedure exhibits any one of these characteristics to a degree that:

- (1) airborne concentrations might approach the action level (or permissible exposure limit),
- (2) flammable vapors might approach one tenth of the lower explosion limit,
- (3) materials of unknown toxicity are used or generated, or
- (4) the odor produced is annoying to laboratory occupants or adjacent units.

Procedures that can generally be carried out safely outside the fume hood (depending on the capacity of the general ventilation system to remove any airborne contaminants) include those involving:

- (1) water-based solutions of salts, dilute acids, bases, or other reagents,
- (2) very low volatility liquids or solids,
- (3) closed systems that do not allow significant escape to the laboratory environment, and
- (4) extremely small quantities of otherwise problematic chemicals.

The procedure itself must be evaluated for its potential to increase volatility or produce aerosols.

B. When to Use Safety Shields or Other Containment Devices

Safety shields, such as the sliding sash of a fume hood, are appropriate when working with highly concentrated acids, bases, oxidizers or reducing agents, all of which have the potential for causing sudden spattering or even explosive release of material. Reactions carried out at non-ambient pressures (vacuum or high pressure) also require safety shields, as do reactions that are carried out for the first time or are significantly scaled up from normal conditions. Other containment devices, such as glove boxes or vented gas cabinets, may be required when it is necessary to provide an inert atmosphere for the chemical procedure taking place, when capture of any chemical emission is desirable, or when the standard laboratory fume hood does not provide adequate assurance that overexposure to a hazardous chemical will not occur. The presence of biological or radioactive materials may also mandate certain special containment devices. Local exhaust ventilation may be required for equipment that exhausts toxic or irritating materials to the laboratory environment. Ventilated chemical storage cabinets or rooms should be used when the chemicals in storage may generate toxic, flammable or irritating levels of airborne contamination.

C. When to Use Personal Protective Equipment

Laboratory managers or CHO's shall designate areas, activities, and tasks which require specific types of personal protective equipment. Protective equipment shall not be worn in public areas, in order to prevent the spread of chemical or biological contamination from laboratory areas.

Eye Protection

Eye protection is required for all personnel and any visitors whose eyes may be exposed to chemical or physical hazards. Side shields on safety spectacles provide some protection against splashed chemicals or flying particles, but goggles or face shields are necessary when there is a greater than average danger of eye contact. A higher than average risk exists when working with highly reactive chemicals, concentrated corrosives, or with vacuum or pressurized glassware systems.

Protective Clothing

Lab coats or other similar clothing protectors are strongly encouraged for all laboratory personnel. Lab coats are required when working with select carcinogens, reproductive toxins, substances which have a high degree of acute toxicity, strong acids and bases, and any substance on the OSHA PEL list carrying a "skin" notation. Bare feet are not permitted in any laboratory. Sandals and open-toed shoes are strongly discouraged in all laboratories and are not permitted in any situation where lab coats or gloves are required.

Gloves

Gloves made of appropriate material are required to protect the hands and arms from thermal bums, cuts, or chemical exposure that may result in absorption through the skin or reaction on the surface of the skin. Gloves are also required when working with particularly hazardous substances where possible transfer from hand to mouth must be avoided. Gloves should be carefully selected using guides from the manufacturers. General selection guides are available; however, glove resistance to chemicals will vary with the manufacturer, model and thickness. Therefore, review a glove-resistance chart from the manufacturer you intend to buy from, before purchasing gloves.

Respiratory Protection

Respiratory protection is generally not necessary in the laboratory setting and must not be used as a substitute for adequate engineering controls. Availability of respiratory protection for emergency situations may be required when working with chemicals that are highly toxic and highly volatile or gaseous. If an experimental protocol requires exposure above the action level that cannot be reduced, respiratory protection will be required. All use of respiratory protective equipment is covered under the CEI’s Respiratory Protection Program.

Section 4: Management of Engineering Controls

4.0 Management of Engineering Controls

The engineering controls installed in the laboratory are intended to minimize employee exposure to chemical and physical hazards in the workplace. These controls must be maintained in proper working order for this goal to be realized. No modification of engineering controls will occur unless testing of the modification indicates that worker protection will continue to be adequate. Improper function of engineering controls must be reported to the lab manager immediately. The system shall be taken out of service until proper repairs have been executed.

4.1 Local Exhaust Ventilation

The following procedures shall apply to the use of local exhaust ventilation:

• Openings of local exhaust will be as close as possible to the source of the contaminants.
• Local exhaust fans shall be turned on when exhaust hoods are being used.
• After using local exhaust, operate the fan for an additional period of time sufficient to clear residual contaminants from the ductwork.
• The ventilation system shall be inspected annually by the chemical hygiene officer.
• Prior to a change in chemicals or procedures, the adequacy of the available ventilation systems shall be determined by the lab manager.

4.2 Laboratory Hoods
Work practices shall follow the Standard Operating Procedures. Prior to the introduction of new chemicals, the adequacy of hood systems available shall be determined by the lab manager. Ductless fume hoods re-circulate exhaust air through filters back into the room. Therefore, they can not be used for volatile toxic materials and should be posted as "Not for use with toxic materials." Consult the CHO before using these hoods to control lab vapors.

4.3 Chemical Storage Cabinets

Storage cabinets for flammable and hazardous chemicals will be ventilated as needed. They will provided with a spill containment system appropriate to the chemicals stored in them.

4.4 Emergency Equipment
Eye washes must be flushed monthly by the user. This will ensure that the eye wash is working, and that the water is clean, should emergency use become necessary. Fire extinguishers are checked annually by the local Fire Department.

Section 5: Standard Operating Procedures

5.0 Standard Operating Procedures for Laboratory Chemicals

Standard Operating Procedures are generally accepted practices for use of chemicals in particular situations. These SOPs can be overridden in specific instances when appropriate. It is advisable to document the reasons for such modifications. When SOPs are not available for a specific lab situation, the lab manager and CHP will develop them.

5.1 General Principles

A. Controlling Chemical Exposure

Each laboratory employee shall minimize personal and coworker exposure to the chemicals in the laboratory. General precautions which shall be followed to achieve this goal during the handling and use of all chemicals are as follows:

• A chemical mixture shall be assumed to be as toxic as its most toxic component. Possibilities for substitution will be investigated.
• Laboratory employees shall be familiar with the symptoms of exposure for the chemicals with which they work and the precautions necessary to prevent exposure.
• Eating, drinking, and smoking is prohibited in areas where laboratory chemicals are present. Hands shall be thoroughly washed after working with chemicals. Storage, handling and consumption of food or beverages shall not occur in chemical storage areas, nor refrigerators, nor with glassware or utensils also used for laboratory operations.
• Each employee shall keep the work area clean and uncluttered. All chemicals and equipment shall be labeled with appropriate hazard warnings. At the completion of each work day or operation, the work area shall be cleaned.
• Mouth suction for pipeting or starting a siphon is prohibited.
• Skin contact with all chemicals shall be avoided. Employees shall wash exposed skin prior to leaving the laboratory.
• Additional specific precautions based on the toxicological characteristics of individual chemicals shall be implemented as deemed necessary by the lab manager.

B. Laboratory Equipment

The following rules shall apply to the use of laboratory equipment:
• All laboratory equipment shall be used only for its intended purpose.
• All glassware will be handled and stored to minimize breakage; all broken glassware will be immediately disposed of in the broken glass container.
• All evacuated glass apparatus shall be shielded to contain chemicals and glass fragments should explosion occur.
• Waste receptacles shall be identified as such by signs attached to the receptacle.
• All laboratory equipment shall be inspected on a periodic basis and replaced or repaired as necessary.

C. Planning for Emergencies

Before work with laboratory chemicals begins, plans for various emergencies will be developed. The circumstances to be covered include fire, chemical spill, and personnel exposure. In addition, the following work practices will be observed:

• Spill containment will be established around areas in which more than one liter of liquid is used.
• Workers manipulating chemicals will always be in easy communication of other people while handling chemicals
• Emergency equipment (e.g., HEPA vacuum cleaner) will be checked on a daily basis for unusual conditions

5.2 General References

Laboratory operating procedures found in Prudent Practices in the Laboratory: Handling and Disposal of Chemicals (National Research Council, 1995) are adopted for general use at CEI Labs, Inc. The topics included in this reference are outlined in Section 11. A second useful manual is the American Chemical Society's Safety in Academic Chemistry Laboratories. This manual presents information similar to that found in Prudent Practices, but in a considerably condensed format.

5.3 Specific Policies for Safe Practices in Laboratories
Certain standard operating procedures have been adopted by CEI Labs, Inc. specifically for its own laboratories.

5.4 Lab Specific SOP'S
Laboratory specific Standard Operating Procedures are available in each lab where they are applicable. The SOP'S developed for a specific lab should be listed in the Lab CHP form.

Section 6: Particularly Hazardous Procedures

The OSHA Lab Standard requires that special consideration be given to use of chemicals or procedures with particular hazards. The definition of "particularly hazardous chemicals" is given in the OSHA lab standard. Examples of such chemicals are given in Chapter 3 of Prudent Practices. This consideration requires either the development of special operating procedures or prior approval of the laboratory supervisor as indicated by a written permit describing the conditions for the work to be done.

6.1 Work with Particularly Hazardous Substances

When laboratory procedures include the use of highly hazardous chemicals, special precautions shall be implemented as deemed necessary by the lab manager. These precautions will be developed for work with select carcinogens, reproductive toxins and substances which have a high degree of acute toxicity. Development of these precautions will consider including the following provisions in the special procedures:

- Establishment of a designated area for the use of the high hazard chemicals.
- Signage and access control to the work area where the chemical is used.
- Special precautions such as use of containment devices such as glove boxes; isolation of contaminated equipment; practicing good laboratory hygiene; and prudent transportation of very toxic chemicals.
- Planning for accidents and spills.
- Special storage and waste disposal practices.

Prudent Practices provides detailed recommendations for work with particularly hazardous substances.

6.2 Pre-approval of Particularly Hazardous Work

A permit system shall be utilized for all laboratory activities which do not follow standard or special operating procedures and which thus require pre-approval by the laboratory manager. These activities include off-hours work, sole occupancy of lab and unattended operations. The toxicity of the chemicals used, the hazards of the procedures to be done, and the knowledge and experience of the laboratory workers must be considered in deciding which work will be allowed with pre-approval. Off-Hours Work Procedures: Laboratory personnel are not permitted to work after hours in the lab, except when permit conditions are met.

Working Alone: Work shall not be performed in the laboratory when the only person in the room is the laboratory person performing the work. Under unusual conditions, crosschecks, periodic security guard checks, or other measures may be taken as established by a permit. Unattended Operations: When laboratory operations are performed which will be unattended by laboratory personnel (continuous operations, overnight reactions, etc.), the following procedures will be employed:

• An appropriate permit will be written and posted.
• A sign will be posted at all entrances to the laboratory.
• The overhead lights in the laboratory will be left on.
• Precautions shall be made for the interruption of utility service during the unattended operation (loss of water pressure, electricity, etc.).
• The person responsible for the operation will return to the laboratory at the conclusion of the operation to assist in the dismantling of the apparatus.

Section 7: Emergency Response

7.0 Chemical Spills, Releases and Accidents

7.1 Emergency Response

Telephone numbers of emergency personnel, managers and other workers as deemed appropriate are posted on the lab entrance. These signs will be checked annually for accuracy.

7.2 In Case of Fire

CEI's policy is that the first reaction to a fire is to evacuate the occupants of the building. Fire extinguishers are available in labs and are inspected annually. They may be used by trained personnel to fight small fires.

7.3 In Case of Spills

In the event of a chemical spill, release or other accident, lab workers will respond as outlined in the Emergency Response plan. The size of the spill and its hazards will guide the appropriate response. Note that proper emergency response depends upon a knowledge of the hazards present in the lab. For this reason, a companywide inventory of the hazardous chemicals in CEI labs is conducted annually.

7.4 In Case of Personnel Exposures

All employees shall be instructed in the location and proper usage of emergency eyewashes. The eyewash shall be inspected monthly. In case of medical emergency, call 911 immediately.

Section 8.0: Medical Consultations and Examinations

8.0 Medical Consultations and Examinations

8.1 Availability

All employees who work with hazardous chemicals will have an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

• Whenever an employee develops symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory.
• Where exposure monitoring reveals an exposure level routinely above the action level or PEL for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.
• Whenever an event takes place in the work area such as a spill, leak, explosion or other ccurrence resulting in the likelihood of a hazardous exposure.

The management will be contacted whenever the need for medical consultation or examination occurs, or when there is uncertainty as to whether any of the above criteria have been met.

8.2 Arranging for Exams

All medical examinations and consultations will be performed by or under the direct supervision of a licensed physician and will be provided through CEI, without loss of pay and at a reasonable time and place. In the event of a life-threatening illness or injury, dial 911 and request an ambulance.

8.3 Information

CEI Labs, Inc. will provide the examining physician with the following information:

• The identity of the hazardous chemical(s) to which the employee may have been exposed.
• A description of the conditions under which the exposure occurred including quantitative exposure data, if available.
• A description of the symptoms of exposure that the employee is experiencing, if any.

The above information will be collected and transmitted by the lab manager and will be submitted to the examining physician.

8.4 Report

The examining physician will provide to the lab manager a written report including the following:

• Any recommendation for further medical follow-up.
• The results of the medical examination and any associated tests.

• Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace.
• A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

The written opinion will not reveal specific findings of diagnoses unrelated to occupational exposure.

Section 9: Recordkeeping

9.0 Recordkeeping

CEI policy is to maintain safety records as required by OSHA at a minimum.

9.1 Accident Reports

Accident investigations will be conducted by the lab manager with assistance from the CHO as deemed necessary. Accident reports will be written and retained for 5 years.

9.2 Exposure Evaluations

Any records of exposure evaluation carried out by individual departments will be kept within the department. Raw data will be kept for one year and summary data for the term of employment plus 30 years.

9.3 Medical Consultation and Examinations

Results of medical consultations and examinations will be kept by CEI for a length of time specified by the appropriate medical records standard. This time will be at least the term of employment plus 30 years as required by OSHA.

9.4 Training

Individual employee training should be recorded kept in the individual's department for five years.

9.5 Equipment Inspection

Records of inspections of equipment will be maintained for 5 years. Data on annual fume hood monitoring will be kept in the individual laboratory. Fume hood monitoring data are considered maintenance records and as such the raw data will be kept for one year and summary data for 5 years.

Section 10: Annual Chemical Hygiene Plan Review

The laboratory manager and CHO will review the laboratory's Chemical Hygiene Plan every January. Results will be provided to the corporate management and the department laboratory manager. Laboratory managers are responsible for assigning responsibility for taking corrective action for any deficiency noted.

Section 11: Chemical Inventory

The following chemicals are found in the laboratory at CEI:

Asbestos Laboratory

- Baking Soda – Arm and Hammer
- 70% Isopropyl Rubbing Alcohol
- 1-1-1 Trichloroethane
- Silicone Spray by CRC
- 1.550 R.I. Dispersion Staining Oil (16 oz bottles)(Cargille)
- R.I. Liquids, Series A, Set A ½ 1.460-1.640 (Cargille)
- R.I. Liquids, Series B, Set B ½ 1.464-1.700 (Cargille)
- R.I. Liquids, Series 1.705, 1.710, 1.715, 1.720(Cargille)
- Cargille R.I. Melt Mount, 1.550, 1.680, and 1.605
- Hydrochloric Acid, Concentrated
- Hydrochloric Acid, 5%
- Distilled Water
- Dry-Right Dessicant
- Various types of asbestos
- Acetone
- Triacetin

Microbiology Laboratory

- Agar, Granulated
- Aniline Blue
- CiDecon
- Dextrose
- Dri-Clean
- Glycerin
- Lactic Acid
- Malt Extract Agar
- Peptone
- Phenol, crystals
- Potato Dextrose Agar
- Sabouraud Dextrose Agar
- SporGon
- Tartaric Acid, 10%
- Versa-Clean

APPENDIX VI

REVIEWED LABORATORY SUBCONTRACTORS AND SUPPLIERS

CEI Labs, Inc. Vendors & Suppliers 2015

Issuing Authority: Gary A. Swanson, Quality Manager
Date: January 27, 2015

Vendor Name	Contact	Phone Number	Product/Service	Original Approval Date	Review Status Acceptable / Further Review Needed / Unacceptable	Reason for Review Status
Thermo-Fisher Scientific	Dan Holiday	800-766-7000	Laboratory Equipment& Supplies	Before 2000	Acceptable	Previous experience / No dissatisfaction with products.
Environmental Monitoring Systems	Michael Knight	800-293-3003	Laboratory Equipment& Supplies	Before 2000	Acceptable	Previous experience / No dissatisfaction with products.
Triangle Environmental Service Center	Feng Jiang	804-739-1751	Laboratory Supplies (slides / cover slips)	Before 2000	Acceptable	Previous experience / No dissatisfaction with products.
Ted Pella, Inc.	Customer Service	800-237-3526	Laboratory Supplies	August 2011	Acceptable	Previous experience / No dissatisfaction with products.
Martin Microscope Company	Bob Martin	864-242-3424	Microscope Cleaning & Repair	Before 2000	Acceptable	Previous experience / No dissatisfaction with products.
Micro-Optics	Phillip Wiseman	718-961-8833	Microscope Parts	Before 2000	Acceptable	Previous experience / No dissatisfaction with products.
Miller Fabrications	Matt Miller	919-876-3848	Hoods / Ventilation	Before 2000	Acceptable	Previous experience / No dissatisfaction with products.
AIHA-LAP, LLC	Lauren Schnack	703-846-0716	Accreditation Organization	2003	Acceptable	Currently Maintaining Accreditation
Great Scopes, Inc.	John Lind	877-454-6364	Stereo Microscopes	2005	Acceptable	Previous experience / No dissatisfaction with products.
SanAir Technologies, Laboratory, Inc.	Sandra Sobrino	804-897-1177	Backup Laboratory Services	2009	Acceptable	Previous experience / No dissatisfaction with products.
Arc Micro Optics	Phil Hutcheson	859-498-1345	Microscopes	2010	Acceptable	Previous experience / No dissatisfaction with products.
SIA	Vitaly Feingold	770-232-7785	Laboratory Equipment & Digital Cameras	August 2011	Acceptable	Previous experience / No dissatisfaction with products.
Research Triangle Institute	Owen Crankshaw	919-541-7470	Proficiency Testing Samples, TEM, PLM; Laboratory Standards	Before 2000	Acceptable	Previous experience / No dissatisfaction with products.
Environmental Hazards Services	Customer Service	800-347-4010	Lead in Air, Paint, Soil; Metals	Before 2000	Acceptable	Previous experience / No dissatisfaction with products.
Schneider Laboratories, Inc.	Raja Abouzaki	804-353-6778	Metals, Organics Testing	Before 2000	Acceptable	Previous experience / No dissatisfaction with products.

Vendor Name	Contact	Phone Number	Product/Service	Original Approval Date	Review Status	Reason for Review Status
EMLab P&K	Customer Service	866-871-1984	Culturable Mold	2003	Acceptable	Previous experience / No dissatisfaction with products.
Galson Laboratories	Customer Service	888-4352-5227	Culturable Mold, Specialty Testing	2003	Acceptable	Previous experience / No dissatisfaction with products.
Indoor Biotechnologies	Customer Service	843-984-2304	Allergens, Pollen Testing	2010	Acceptable	Previous experience / No dissatisfaction with products.
EMSL	Customer Service	800-220-3675	Radon Testing	Before 2009	Acceptable	Previous experience / No dissatisfaction with products.
Electron Microscopy Sciences	Customer Service	215-412-8400	Electron Microscopy Supplies	2011	Acceptable	Previous experience / No dissatisfaction with products.
CAELAP	Fred Choske	510-620-3155	Accreditation Organization	2002	Acceptable	Currently Maintaining Accreditation
NVLAP	Hazel Richmond	301-975-4016	Accreditation Organization	Before 2000	Acceptable	Currently Maintaining Accreditation
Hogentogler & Co., Inc.	Nancy Acevedo	410-381-2390	Laboratory Furnaces and Ovens	March 2012	Acceptable	Previous experience / No dissatisfaction with products.
Rory Tabbatt	N/A	310-706-8733	TEM Consultant	Novmeber 2011	Acceptable	Previous experience / No dissatisfaction with services.
AIHA-PAT	Angela Oler	703-846-0792	Proficiency Test Provider	2003	Acceptable	Previous experience / No dissatisfaction with services
Klarmann Rulings, Inc.	Customer Service	800-252-2401	Calibrated Reticules & Slides	2003	Acceptable	Previous experience / No dissatisfaction with services
DIS	Mark Truelove	919-828-2300	Information Technology Services	2015	Acceptable	Knowledge of system data base
Carbonite	Customer Service	877-222-5488	Electronic Information backup and storage.	January 2015	Acceptable	Meets our need for backup information storage.
Thomas Scientific	Dede Hickman	dedeh@thomasci.com	Laboratory Equipment &Supplies	2012	Acceptable	Meets our need for laboratory supplies.

Reviewed By Tianbao Bai

Tianbao Bai, PhD, CIH, Laboratory Director, CEI Labs.

Date 1/27/15

QUALITY ASSURANCE MANUAL

Quality Assurance/Quality Control Policies and Procedures

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Any printed documents in use within a Pace Analytical Services, Inc. laboratory have been reviewed and approved by the persons listed on the cover page. They can only be deemed official if proper signatures are present.

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1.0. INTRODUCTION AND ORGANIZATIONAL STRUCTURE

"Working together to protect our environment and improve our health"
Pace Analytical Services Inc. - Mission Statement

1.1. Introduction to PASI

1.1.1. Pace Analytical Services, Inc. (PASI) is a privately held, full-service analytical testing firm operating a nationwide system of laboratories. PASI offers extensive services beyond standard analytical testing, including: bioassay for aquatic toxicity, air toxics, dioxins and coplanar PCB's by high resolution mass spectroscopy , radiochemical analyses, product testing, pharmaceutical testing, field services and mobile laboratory capabilities. PASI has implemented a consistent Quality System in each of its laboratories and service centers. In addition, the company utilizes an advanced data management system that is highly efficient and allows for flexible data reporting. Together, these systems ensure data reliability and superior on-time performance. This document defines the Quality System and QA/QC protocols.

1.1.2. Our goal is to combine our expertise in laboratory operations with customized solutions to meet the specific needs of our customers.

1.2. Statement of Purpose

1.2.1. To meet the business needs of our customers for high quality, cost-effective analytical measurements and services.

1.3. Quality Policy Statement and Goals of the Quality System

1.3.1. PASI management is committed to maintaining the highest possible standard of service for our customers by following a documented quality system that is fully compliant with the applicable NELAC or TNI standards. The overall objective of this quality system is to provide reliable data of known quality through adherence to rigorous quality assurance policies and quality control procedures as documented in this Quality Assurance Manual.

1.3.2. All personnel within the PASI network are required to be familiar with all facets of the quality system relevant to their position and implement these policies and procedures in their daily work. This daily focus on quality is applied with initial project planning, continued through all field and laboratory activities, and is ultimately included in the final report generation.

1.3.3. PASI management demonstrates its commitment to quality by providing the resources, including facilities, equipment, and personnel to ensure the adherence to these documented policies and procedures and to promote the continuous improvement of the quality system. All PASI personnel must comply with all current applicable state, federal, and industry standards (2003 NELAC Standard, 2009 TNI Standard, etc.), and are required to perform all tests in accordance with stated methods and customer requirements.

1.4. Core Values

1.4.1. **Integrity-** Pace personnel are required to abide by the PASI Code of Ethics and all Pace employees must go through Data Integrity/Ethics training upon initial orientation and as an annual refresher.

1.4.2. **Value Employees-** Pace management views employees as our most important asset and communicates to them the relevance and importance of their activities within their job functions and how they contribute to the achievement of the objectives of the quality management system.

1.4.3. **Know Our Customers-** Pace makes every effort to know our customers and address their sampling and analytical needs. More information on this item can be found in section 2.0.

1.4.4. **Honor Commitments-** Pace labs focus on making solid commitments with regards to quality, capacity, and agreed upon turnaround time to our customers.

1.4.5. **Flexible Response To Demand-** Pace labs are equipped with both the material and personnel resources to enable them to be responsive to the demands of customers when situations or projects need change.

1.4.6. **Pursue Opportunities-** Pace is committed to pursuing opportunities for the growth of the company by constantly exploring markets and areas where we can expand.

1.4.7. **Continuously Improve-** Pace has committed much time and effort into establishing a continuous improvement program where company personnel meet on a regular basis to share ideas in cost reduction, production improvement and standardization in order to develop best practices. This information, as well as company financial and production metrics, are tracked, evaluated, and shared with each Pace facility.

1.5. Code of Ethics

1.5.1. PASI's fundamental ethical principles are as follows:

1.5.1.1. Each PASI employee is responsible for the propriety and consequences of his or her actions;

1.5.1.2. Each PASI employee must conduct all aspects of Company business in an ethical and strictly legal manner, and must obey the laws of the United States and of all localities, states and nations where PASI does business or seeks to do business;

1.5.1.3. Each PASI employee must reflect the highest standards of honesty, integrity and fairness on behalf of the Company with customers, suppliers, the public, and one another.

1.5.1.4. Each PASI employee must recognize and understand that our daily activities in environmental laboratories affect public health as well as the environment and that environmental laboratory analysts are a critical part of the system society depends upon to improve and guard our natural resources:

1.5.2. Strict adherence by each PASI employee to this Code of Ethics and to the Standards of Conduct is essential to the continued vitality of PASI and to continue the pursuit of our common mission to protect our environment and improve our health.

1.5.3. Failure to comply with the Code of Ethics and Standards of Conduct will result in disciplinary action up to and including termination and referral for civil or criminal prosecution

where appropriate. An employee will be notified of an infraction and given an opportunity to explain, as prescribed under current disciplinary procedures.

1.5.4. Any Pace employee can contact corporate management to report an ethical concern by calling the anonymous hotline at 612-607-6431.

1.6. Standards of Conduct

1.6.1. Data Integrity

1.6.1.1. The accuracy and integrity of the analytical results and its supporting documentation produced at PASI are the cornerstones of the company. Lack of data integrity is an assault on our most basic values putting PASI and its employees at grave financial and legal risk and will not be tolerated. Therefore, employees are to accurately prepare and maintain all technical records, scientific notebooks, calculations, and databases. Employees are prohibited from making false entries or misrepresentations of data for any reason.

1.6.1.2. Managerial staff must make every effort to ensure that personnel are free from any undue pressures that may affect the quality or integrity of their work including commercial, financial, over-scheduling, and working condition pressures.

1.6.2. Confidentiality

1.6.2.1. PASI employees must not use or disclose confidential or proprietary information except when in connection with their duties at PASI. This is effective over the course of employment and for an additional period of two years thereafter.

1.6.2.2. Confidential or proprietary information, belonging to either PASI and/or its customers, includes but is not limited to test results, trade secrets, research and development matters, procedures, methods, processes and standards, company-specific techniques and equipment, marketing and customer information, inventions, materials composition, etc.

1.6.3. Conflict of Interest

1.6.3.1. PASI employees must avoid situations that might involve a conflict of interest or could appear questionable to others. The employee must be careful in two general areas:

1.6.3.1.1. Participation in activities that conflict or appear to conflict with the employees' PASI responsibilities.

1.6.3.1.2. Offering or accepting anything that might influence the recipient or cause another person to believe that the recipient may be influenced to behave or in a different manner than he would normally. This includes bribes, gifts, kickbacks, or illegal payments.

1.6.3.2. Employees are not to engage in outside business or economic activity relating to a sale or purchase by the Company. Other problematic activities include service on the Board of Directors of a competing or supplier company, significant ownership in a competing or supplier company, employment for a competing or supplier company, or participation in any outside business during the employee's work hours.

1.6.4. Compliance

1.6.4.1. All employees are required to read, understand, and comply with the various components of the standards listed in this document. As confirmation that they understand their responsibility, each employee is required to sign an acknowledgment form annually that then becomes part of the

employee's permanent record. Employees will be held accountable for complying with the Quality Systems as summarized in the Quality Assurance Manual.

1.7. Laboratory Organization

1.7.1. The PASI Corporate Office centralizes company-wide accounting, business development, financial management, human resources development, information systems, marketing, quality, safety, and training activities. PASI's Director of Quality is responsible for assisting the development, implementation and monitoring of quality programs for the company. See Attachment IIB for the Corporate Organizational structure.

1.7.2. Each laboratory within the system operates with local management, but all labs share common systems and receive support from the Corporate Office.

1.7.3. A Senior General Manager (SGM) oversees all laboratories and service centers in their assigned region. Each laboratory or facility in the company is then directly managed by an SGM, a General Manager (GM), an Assistant General Manager (AGM), or an Operations Manager (OM). Quality Managers (QM) or Senior Quality Managers (SQM) at each laboratory report directly to the highest level of local laboratory management, however named, that routinely makes day-to-day decisions regarding that facility's operations. The QMs and SQMs will also receive guidance and direction from the corporate Director of Quality.

1.7.4. The SGM, GM, AGM or OM, or equivalent functionality in each facility, bears the responsibility for the laboratory operations and serves as the final, local authority in all matters. In the absence of these managers, the SQM/QM serves as the next in command, unless the manager in charge has assigned another designee. He or she assumes the responsibilities of the manager, however named, until the manager is available to resume the duties of their position. In the absence of both the manager and the SQM/QM, management responsibility of the laboratory is passed to the Technical Director, provided such a position is identified, and then to the most senior department manager until the return of the lab manager or SQM/QM. The most senior department manager in charge may include the Client Services Manager or the Administrative Business Manager at the discretion of the SGM/GM/AGM/OM.

1.7.5. A Technical Director who is absent for a period of time exceeding 15 consecutive calendar days shall designate another full-time staff member meeting the qualifications of the technical director to temporarily perform this function. The laboratory SGM/GM/AGM/OM or SQM/QM has the authority to make this designation in the event the existing Technical Director is unable to do so. If this absence exceeds 35 consecutive calendar days, the primary accrediting authority shall be notified in writing.

1.7.6. The SQM/QM has the responsibility and authority to ensure the Quality System is implemented and followed at all times. In circumstances where a laboratory is not meeting the established level of quality or following the policies set forth in this Quality Assurance Manual, the SQM/QM has the authority to halt laboratory operations should he or she deem such an action necessary. The SQM/QM will immediately communicate the halting of operations to the SGM/GM/AGM/OM and keep them posted on the progress of corrective actions. In the event the SGM/GM/AGM/OM and the SQM/QM are not in agreement as to the need for the suspension, the Chief Operating Officer and Director of Quality will be called in to mediate the situation.

1.7.7. The technical staff of the laboratory is generally organized into the following functional groups:

- Organic Sample Preparation

- Wet Chemistry Analysis
- Metals Analysis
- Volatiles Analysis
- Semi-volatiles Analysis
- HRMS Analysis
- Radiochemical Analysis
- Microbiology

1.7.8. Appropriate support groups are present in each laboratory. The actual organizational structure for PASI – Minneapolis, Billing, Virginia and Duluth are listed in Attachment II. In the event of a change in SGM/GM/AGM/OM, SQM/QM, or any Technical Director, the laboratory will notify its accrediting authorities and revise the organizational chart in the Quality Assurance Manual (QAM) within 30 days. For changes in Department Managers or Supervisors or other laboratory personnel, no notifications will be sent to the laboratory's accrediting agencies; changes to the organizational chart will be updated during or prior to the annual review process. Changes or additions in these key personnel will also be noted by additional signatures on the QAM, as applicable. In any case, the QAM will remain in effect until the next scheduled revision.

1.8. Laboratory Job Descriptions

1.8.1. Senior General Manager

- Oversees all functions of all the operations within their designated region;
- Oversees the development of local GMs/AGMs/OMs within their designated region;
- Oversees and authorizes personnel development including staffing, recruiting, training, workload scheduling, employee retention and motivation;
- Oversees the preparation of budgets and staffing plans for all operations within their designated region;
- Ensures compliance with all applicable state, federal and industry standards;
- Works closely with Regional Sales Management.

1.8.2. General Manager

- Oversees all functions of their assigned operations;
- Authorizes personnel development including staffing, recruiting, training, workload scheduling, employee retention and motivation;
- Prepares budgets and staffing plans;
- Monitors the Quality Systems of the laboratory and advises the SQM/QM accordingly;
- Ensures compliance with all applicable state, federal and industry standards.

1.8.3. Assistant General Manager / Operations Manager

- In the absence of the SGM/GM, performs all duties as listed above for the SGM or GM;
- Oversees the daily production and quality activities of all departments;
- Manages all departments and works with staff to ensure department objectives are met;
- Works with all departments to ensure capacity and customer expectations are accurately understood and met;
- Works with SGM/GM to prepare appropriate budget and staffing plans for all departments;

- Responsible for prioritizing personnel and production activities within all departments;
- Performs formal and informal performance reviews of departmental staff.

1.8.4. Senior Quality Manager

- Provides quality oversight for multiple laboratories where there is not a local quality manager or for labs where there are multiple and separately distinct quality systems in the same facility;
- Responsible for implementing, maintaining and improving the quality system while functioning independently from laboratory operations. Reports directly to the highest level of local laboratory facility management, however named, that routinely makes day-to-day decisions regarding laboratory operations, but receives direction and assistance from the Corporate Director of Quality;
- Ensures that communication takes place at all levels within the lab regarding the effectiveness of the quality system and that all personnel understand their contributions to the quality system;
- Monitors Quality Assurance/Quality Control activities to ensure that the laboratory achieves established standards of quality (as set forth by the Corporate Quality office). The Quality Manager is responsible for reporting the lab's level of compliance to these standards to the Corporate Director of Quality on a quarterly basis;
- Maintains records of quality control data and evaluates data quality;
- Conducts periodic internal audits and coordinates external audits performed by regulatory agencies or customer representatives;
- Reviews and maintains records of proficiency testing results;
- Maintains the document control system;
- Assists in development and implementation of appropriate training programs;
- Provides technical support to laboratory operations regarding methodology and project QA/QC requirements;
- Maintains certifications from federal and state programs;
- Ensures compliance with all applicable state, federal and industry standards;
- Maintains the laboratory training records, including those in the Learning Management System (LMS), and evaluates the effectiveness of training;
- Monitors correctives actions;
- Maintains the currency of the Quality Manual.

1.8.5. Quality Manager

- Responsible for implementing, maintaining and improving the quality system while functioning independently from laboratory operations. Reports directly to the highest level of local laboratory facility management, however named, that routinely makes day-to-day decisions regarding laboratory operations, but receives direction and assistance from the Corporate Director of Quality. They may also report to a Senior Quality Manager within the same facility;
- Ensures that communication takes place at all levels within the lab regarding the effectiveness of the quality system and that all personnel understand their contributions to the quality system;
- Monitors Quality Assurance/Quality Control activities to ensure that the laboratory achieves established standards of quality (as set forth by the Corporate Quality office). The Quality Manager is responsible for reporting the lab's level of compliance to these standards to the Corporate Director of Quality on a quarterly basis;
- Maintains records of quality control data and evaluates data quality;

- Conducts periodic internal audits and coordinates external audits performed by regulatory agencies or customer representatives;
- Reviews and maintains records of proficiency testing results;
- Maintains the document control system;
- Assists in development and implementation of appropriate training programs;
- Provides technical support to laboratory operations regarding methodology and project QA/QC requirements;
- Maintains certifications from federal and state programs;
- Ensures compliance with all applicable state, federal and industry standards;
- Maintains the laboratory training records, including those in the Learning Management System (LMS), and evaluates the effectiveness of training;
- Monitors correctives actions;
- Maintains the currency of the Quality Manual.

1.8.6. Quality Analyst

- Assists the SQM/QM in the performance of quality department responsibilities as delegated by the SQM/QM;
- Assists in monitoring QA/QC data;
- Assists in internal audits;
- Assists in maintaining training records;
- Assists in maintaining the document control system;

1.8.7. Technical Director

- Monitors the standards of performance in quality assurance and quality control data;
- Monitors the validity of analyses performed and data generated;
- Reviews tenders, contracts and QAPPs to ensure the laboratory can meet the data quality objectives for any given project;
- Serves as the manager of the laboratory in the absence of the SGM/GM/AGM/OM and SQM/QM;
- Provides technical guidance in the review, development, and validation of new methodologies.

1.8.8. Administrative Business Manager

- Responsible for financial and administrative management for the entire facility;
- Provides input relative to tactical and strategic planning activities;
- Organizes financial information so that the facility is run as a fiscally responsible business;
- Works with staff to confirm that appropriate processes are put in place to track revenues and expenses;
- Provide ongoing financial information to the SGM/GM/AGM/OM and the management team so they can better manage their business;
- Utilizes historical information and trends to accurately forecast future financial positions;
- Works with management to ensure that key measurements are put in place to be utilized for trend analysis—this will include personnel and supply expenses, and key revenue and expense ratios;

- Works with SGM/GM/AGM/OM to develop accurate budget and track on an ongoing basis;
- Works with entire management team to submit complete and justified capital budget requests and to balance requests across departments;
- Works with project management team and administrative support staff to ensure timely and accurate invoicing.

1.8.9. Client Services Manager

- Oversees all the day to day activities of the Client Services Department which includes Project Management and, possibly, Sample Control;
- Responsible for staffing and all personnel management related issues for Client Services;
- Serves as the primary senior consultant to customers on all project related issues such as set up, initiation, execution and closure;
- Performs or is capable of performing all duties listed for that of Project Manager.

1.8.10. Project Manager

- Coordinates daily activities including taking orders, reporting data and analytical results;
- Serves as the primary technical and administrative liaison between customers and PASI;
- Communicates with operations staff to update and set project priorities;
- Provides results to customers in the requested format (verbal, hardcopy, electronic, etc.);
- Works with customers, laboratory staff, and other appropriate PASI staff to develop project statements of work or resolve problems of data quality;
- Responsible for solicitation of work requests, assisting with proposal preparation and project initiation with customers and maintain customer records;
- Mediation of project schedules and scope of work through communication with internal resources and management;
- Responsible for preparing routine and non-routine quotations, reports and technical papers;
- Interfaces between customers and management personnel to achieve customer satisfaction;
- Manages large-scale complex projects;
- Supervises less experienced project managers and provide guidance on management of complex projects;
- Arranges bottle orders and shipment of sample kits to customers;
- Verifies login information relative to project requirements and field sample Chains-of-Custody.

1.8.11. Project Coordinator

- Responsible for preparation of project specifications and provides technical/project support;
- Coordinates project needs with other department sections and assists with proposal preparation;
- Prepares routine proposals and invoicing;
- Responsible for scanning, copying, assembling and binding final reports;
- Other duties include filing, maintaining forms, process outgoing mail, maintaining training database and data entry.

1.8.12. Department Manager/Supervisor

- Oversees the day-to-day production and quality activities of their assigned department;
- Ensures that quality assurance and quality control criteria of analytical methods and projects are satisfied;
- Assesses data quality and takes corrective action when necessary;
- Approves and releases technical and data management reports;
- Ensures compliance with all applicable state, federal and industry standards.

1.8.13. Group Supervisor/Leader

- Trains analysts in laboratory operations and analytical procedures;
- Organizes and schedules analyses with consideration for sample holding times;
- Implements data verification procedures by assigning data verification duties to appropriate personnel;
- Evaluates instrument performance and supervises instrument calibration and preventive maintenance programs;
- Reports non-compliance situations to laboratory management including the SQM/QM.

1.8.14. Laboratory Analyst

- Performs detailed preparation and analysis of samples according to published methods and laboratory procedures;
- Processes and evaluates raw data obtained from preparation and analysis steps;
- Generates final results from raw data, performing primary review against method criteria;
- Monitors quality control data associated with analysis and preparation. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks;
- Reports data in LIMS, authorizing for release pending secondary approval;
- Conducts routine and non-routine maintenance of equipment as required;
- Performs or is capable of performing all duties associated with that of Laboratory Technician.

1.8.15. Laboratory Technician

- Prepares standards and reagents according to published methods or in house procedures;
- Performs preparation and analytical steps for basic laboratory methods;
- Works under the direction of a Laboratory Analyst on complex methodologies;
- Assists Laboratory Analysts on preparation, analytical or data reduction steps for complex methodologies;
- Monitors quality control data as required or directed. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks.

1.8.16. Sample Management Personnel

- Signs for incoming samples and verifies the data entered on the Chain of custody forms;
- Enters the sample information into the Laboratory Information Management System (LIMS) for tracking and reporting;

- Stages samples according to EPA requirements;
- Assists Project Managers and Coordinators in filling bottle orders and sample shipments.

1.8.17. Systems Administrator or Systems Manager

- Assists with the creation and maintenance of electronic data deliverables (EDDs);
- Coordinates the installation and use of all hardware, software and operating systems;
- Performs troubleshooting on all aforementioned systems;
- Trains new and existing users on systems and system upgrades;
- Maintains all system security passwords;
- Maintains the electronic backups of all computer systems.

1.8.18. Safety/Chemical Hygiene Officer

- Maintains the laboratory Chemical Hygiene Plan;
- Plans and implements safety policies and procedures;
- Maintains safety records;
- Organizes and/or performs safety training;
- Performs safety inspections and provides corrective/preventative actions;
- Assists personnel with safety issues.

1.8.19. Program Director/Hazardous Waste Coordinator (or otherwise named)

- Evaluates waste streams and helps to select appropriate waste transportation and disposal companies;
- Maintains complete records of waste disposal including waste manifests and state reports;
- Assists in training personnel on waste-related issues such as waste handling and storage, waste container labeling, proper satellite accumulation, secondary containment, etc.;
- Conducts a weekly inspection of the waste storage areas of the laboratory.

1.9. Training and Orientation

1.9.1. Training for Pace employees is managed through a web-based Learning Management System. After a new employee has been instructed in matters of human resources, they are given instructional materials for the LMS and a password for access.

1.9.2. A new hire training checklist is provided to the new employee that lists training items for the employee to work through either independently on LMS or with their supervisor or trainer. The training items that can be completed independently include:

- Reading through applicable Standard Operating Procedures;
- Reviewing the Quality Manual and Chemical Hygiene Plan;
- Core training modules such as quality control indicators, basic laboratory skills, etc.;
- Quality Systems training including traceability of measurements, method calibration, calibration verification, accuracy, precision and uncertainty of measurements, corrective actions, documentation, and root cause analysis;
- Data Integrity/Ethics training.

1.9.3. The new employee's Department Supervisor provides the employee with a basic understanding of the role of the laboratory within the structure of PASI and the basic elements of that individual's position. Supervised training uses the following techniques:

- Hands-on training
- Training checklists/worksheets
- Lectures and training sessions
- Method-specific training
- Conferences and seminars
- Short courses
- Specialized training by instrument manufacturers
- Proficiency testing programs.
- On-line courses

1.9.4. Group Supervisors/Leaders are responsible for providing documentation of training and proficiency for each employee under their supervision. The employee's training file indicates what procedures an analyst or a technician is capable of performing, either independently or with supervision. The files also include documentation of continuing capability, which are fully detailed in Section 3.4. Training documentation files for each person are maintained by the Quality Office either in hardcopy format or within the LMS.

1.9.5. All procedures and training records are maintained and available for review during laboratory audits. These procedures are reviewed/updated periodically by laboratory management. Additional information can be found in SOP S-ALL-Q-020 **Training and Employee Orientation** or its equivalent revision or replacement.

1.10. Data Integrity System

1.10.1. The data integrity system at PASI provides assurances to management that a highly ethical approach is being applied to all planning, training and implementation of methods. Data integrity is crucial to the success of our company and Pace Analytical is committed to creating and maintaining a culture of quality throughout the organization. To accomplish this goal, PASI has implemented a data integrity system that encompasses the following four requirements:

1.10.1.1. A data integrity training program: standardized training is given to each new employee and a yearly refresher is presented to all employees. Key topics addressed by this training include:

1.10.1.1.1. Need for honesty and transparency in analytical reporting
1.10.1.1.2. Process for reporting data integrity issues
1.10.1.1.3. Specific examples of unethical behavior and improper practices
1.10.1.1.4. Documentation of non-conforming data that is still useful to the data user
1.10.1.1.5. Consequences and punishments for unethical behavior
1.10.1.1.6. Examples of monitoring devices used by management to review data and systems

1.10.1.2. Signed data integrity documentation for all employees: this includes a written quiz following the Ethics training session and written agreement to abide by the Code of Ethics and Standards of Conduct explained in the employee manual.

1.10.1.3. In-depth, periodic monitoring of data integrity including peer data review and validation, internal raw data audits, proficiency testing studies, etc.

1.10.1.4. Documentation of any review or investigation into possible data integrity infractions. This documentation, including any disciplinary actions involved, corrective actions taken, and notifications to customers must be retained for a minimum of five years.

1.10.2. PASI management makes every effort to ensure that personnel are free from any undue pressures that affect the quality of their work including commercial, financial, over scheduling, and working condition pressures.

1.10.3. Corporate management also provides all PASI facilities a mechanism for confidential reporting of data integrity issues that ensures confidentiality and a receptive environment in which all employees are comfortable discussing items of ethical concern. The anonymous message line is monitored by the Corporate Director of Quality who will ensure that all concerns are evaluated and, where necessary, brought to the attention of executive management and investigated. Any Pace employee can contact corporate management to report an ethical concern by calling the anonymous hotline at 612-607-6431.

1.11. Laboratory Safety

1.11.1. It is the policy of PASI to make safety and health an integral part of daily operations and to ensure that all employees are provided with safe working conditions, personal protective equipment, and requisite training to do their work without injury. Each employee is responsible for his/her own safety as well as those working in the immediate area by complying with established company rules and procedures. These rules and procedures as well as a more detailed description of the employees' responsibilities are contained in the corporate Safety Manual and Chemical Hygiene Plan.

1.12. Security and Confidentiality

1.12.1. Security is maintained by controlled access to laboratory buildings. Exterior doors to laboratory buildings remain either locked or continuously monitored by PASI staff. Keyless door lock combinations and computer access codes/logins are changed periodically. Posted signs direct visitors to the reception office and mark all other areas as off limits to unauthorized personnel. All visitors, including PASI staff from other facilities, must sign the Visitor's Logbook maintained by the receptionist. A staff member will accompany them during the duration of their stay on the premises unless the SGM/GM/AGM/OM, SQM/QM, or Technical Director specify otherwise. In this instance, the staff member will escort the visitor back to the reception area at the end of his/her visit where he/she signs out. The last staff member to leave their department for the day must ensure that all outside access points to that area are secure.

1.12.2. Additional security is provided where necessary, (e.g., specific secure areas for sample, data, and customer report storage), as requested by customers, or cases where national security is of concern. These areas are lockable within the facilities, or are securely offsite. Access is limited to specific individuals or their designees. Security of sample storage areas is the responsibility of the Sample Custodian. Security of samples and data during analysis and data reduction is the responsibility of Group Supervisors. Security of customer report archives is the responsibility of the Client Services Manager. These secure areas are locked whenever these individuals or their designees are not present in the facility.

1.12.3. Access to designated laboratory sample storage locations is limited to authorized personnel only. Provisions for lock and key access are provided. No samples are to be removed without proper

authorization. If requested by customer or contract, samples are not to be removed from secure storage areas without filling out an associated internal chain of custody.

1.12.4. Standard business practices of confidentiality are applied to all documents and information regarding customer analyses. Specific protocols for handling confidential documents are described in PASI SOPs. Additional protocols for sample identification by internal laboratory identification numbers only are implemented as required under contract specific Quality Assurance Project Plans (QAPPs).

1.12.5. All information pertaining to a particular customer, including national security concerns will remain confidential. Data will be released to outside agencies only with written authorization from the customer or where federal or state law requires the company to do so.

1.13. Communications

1.13.1. Management within each lab bears the responsibility of ensuring that appropriate communication processes are established and that communication takes place regarding the effectiveness of the management/quality system. These communication processes may include email, regular staff meetings, senior management meetings, etc.

1.13.2. Corporate management bears the responsibility of ensuring that appropriate communication processes are established within the network of facilities and that communication takes place at a company-wide level regarding the effectiveness of the management/quality systems of all Pace facilities. These communication processes may include email, quarterly continuous improvement conference calls for all lab departments, and annual continuous improvement meetings for all department supervisors, quality managers, client services managers, and other support positions.

2.0. SAMPLE CUSTODY

2.1. Sampling Support

2.1.1. Each individual PASI laboratory provides shipping containers, properly preserved sample containers, custody documents, and field quality control samples to support field-sampling events. Guidelines for sample container types, preservatives, and holding times for a variety of methods are listed in Attachment VIII. Note that all analyses listed are not necessarily performed at all PASI laboratories and there may be additional laboratory analyses performed that are not included in these tables. Customers are encouraged to contact their local Pace Project Manager for questions or clarifications regarding sample handling. PASI - Minneapolis, Billings, Virginia and Duluth may provide pick-up and delivery services to their customers when needed.

2.2. Field Services

2.2.1. Pace Analytical has a large Field Services Division which is based in their Minneapolis facility as well as limited field service capabilities in some of our other facilities. Field Services provides comprehensive nationwide service offerings including:

- Stack Testing
- Ambient Air
- CEM Certification Testing
- Air Quality Monitoring
- Onsite Analytical Services- FTIR and GC
- Real-time Process Diagnostic/Optimization Testing
- Wastewater, Groundwater and Drinking Water Monitoring
- Storm Water and Surface Water Monitoring
- Soil and Waste Sampling
- Mobile Laboratory Services

2.2.2. Field Services operates under the PASI Corporate Quality System, with applicable and necessary provisions to address the activities, methods, and goals specific to Field Services. All procedures and methods used by Field Services are documented in Standard Operating Procedures and Procedure Manuals.

2.3. Project Initiation

2.3.1. Prior to accepting new work, the laboratory reviews its performance capability. The laboratory confirms that sufficient personnel, equipment capacity, analytical method capability, etc., are available to complete the required work. Customer needs, certification requirements, and data quality objectives are defined and the appropriate sampling and analysis plan is developed to meet the project requirements by project managers or sales representatives. Members of the management staff review current instrument capacity, personnel availability and training, analytical procedures capability, and projected sample load. Management then informs the sales and client services personnel whether or not the laboratory can accept the new project via written correspondence, email, and/or daily operations meetings.

2.3.2. The laboratory maintains records of all such reviews, including discussions with customers. Routine analytical project documentation of quotes, notes, dates, initials, and/or recordings is maintained in a project folder by project management. Conditions for new and more complex contracts are determined by the SGM/GM/AGM/OM and sales representatives. Quality Management is consulted on technical requirements and operations staff provides input on volume capacities. Evidence of these reviews is maintained in the form of awarded Request for Proposals (RFPs), signed quotes or contracts, and a Customer Relationship Management (CRM) database. If a review identifies a potential mismatch between customer requirements and laboratory capabilities and/or capacities, Pace will specify its level of commitment by listing these exceptions to the requirements within the RFP, quote or contract.

2.3.3. Additional information regarding specific procedures for reviewing new work requests can be found in SOP S-MN-Q-270 **Review of Analytical Requests** or its equivalent revision or replacement.

2.4. Chain of Custody

2.4.1. A chain of custody (COC) provides the legal documentation of samples from time of collection to completion of analysis. PASI has implemented Standard Operating Procedures to ensure that sample custody traceability and responsibility objectives are achieved for every project.

2.4.2. Field personnel or client representatives must complete a chain of custody for all samples that are received by the laboratory. The importance of completeness of COCs is stressed to the samplers and is critical to efficient sample receipt and to insure the requested methods are used to analyze the correct samples.

2.4.3. If sample shipments are not accompanied by the correct documentation, the Sample Receiving department notifies a Project Manager. The Project Manager then obtains the correct documentation/information from the customer in order for analysis of samples to proceed.

2.4.4. The sampler is responsible for providing the following information on the chain of custody form:

- Customer project name
- Project location or number
- Field sample number/identification
- Date and time sampled
- Sample matrix
- Preservative
- Requested analyses
- Sampler signature
- Relinquishing signature
- Date and time relinquished
- Sampler remarks as needed
- Custody Seal Number if present
- Regulatory Program Designation
- The state where the samples were collected to ensure all applicable state requirements are met
- Turnaround time requested
- Purchase order number

2.4.5. The COC is filled out completely and legibly with indelible ink. Errors are corrected by drawing a single line through the initial entry and initialing and dating the change. All transfers of samples are recorded on the chain of custody in the "relinquished" and "received by" sections. All information except signatures is printed.

2.4.6. Additional information can be found in S-MN-C-001 **Sample Management** or its equivalent revision or replacement.

2.5. Sample Acceptance Policy

2.5.1. In accordance with regulatory guidelines, PASI complies with the following sample acceptance policy for all samples received.

2.5.2. If the samples do not meet the sample receipt acceptance criteria outlined below, the laboratory is required to document all non-compliances, contact the customer, and either reject the samples or fully document any decisions to proceed with analyses of samples which do not meet the criteria. Any results reported from samples not meeting these criteria are appropriately qualified on the final report.

2.5.2.1. For Ohio VAP samples, the narrative for any report that includes qualified data must also include a discussion of any bias in the results.

2.5.3. All samples must:

- Have unique customer identification that is clearly marked with indelible ink on durable waterproof labels affixed to the sample containers that match the chain of custody.
- Have clear documentation on the chain of custody related to the location of the sampling site with the time and date of sample collection.
- Have the sampler's name and signature.
- Have all requested analyses clearly designated on the COC.
- Have clear documentation of any special analytical or data reporting requirements.
- Be in appropriate sample containers with clear documentation of the preservatives used.
- Be correctly preserved unless the method allows for laboratory preservation.
- Be received within holding time. Any samples with hold times that are exceeded will not be processed without prior customer approval.
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval.
- Be received within appropriate temperature ranges - not frozen but ≤6°C (See Note 1), unless program requirements or customer contractual obligations mandate otherwise (see Note 2). The cooler temperature is recorded directly on the COC and the SCUR. Samples that are delivered to the laboratory immediately after collection are considered acceptable if there is evidence that the chilling process has been started. For example, by the arrival of the samples on ice. If samples arrive that are not compliant with these temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer is contacted to avoid missing the hold time. Data associated with any deviations from the above sample acceptance policy requirements will be appropriately qualified.

Note 1: Temperature will be read and recorded based on the precision of the measuring device. For example, temperatures obtained from a thermometer graduated to 0.1°C will be read and recorded to

±0.1°C. Measurements obtained from a thermometer graduate to 0.5°C will be read to ±0.5°C. Measurements read at the specified precision are not to be rounded down to meet the ≤6°C limit

Note 2: Some microbiology methods allow sample receipt temperatures of up to 10°C. Consult the specific method for microbiology samples received above 6°C prior to initiating corrective action for out of temperature preservation conditions.

Note 3: Biological Tissue Samples must be received frozen at ≤0°C.

2.5.4. Upon sample receipt, the following items are also checked and recorded:

- Presence of custody seals or tapes on the shipping containers;
- Sample condition: Intact, broken/leaking, bubbles in VOA samples;
- Sample holding time;
- Sample pH and residual chlorine when required;
- Appropriate containers.

2.5.5. Samples for drinking water analysis that are improperly preserved, or are received past holding time, are rejected at the time of receipt, with the exception of VOA samples that are tested for pH at the time of analysis.

2.5.6. Additional information can be found in S-MN-C-001 **Sample Management** or its equivalent revision or replacement.

2.6. Sample Log-in

2.6.1. After sample inspection, all sample information on the chain of custody is entered into the Laboratory Information Management System (LIMS). This permanent record documents receipt of all sample containers including:

- Customer name and contact
- Customer number
- Pace Analytical project number
- Pace Analytical Project Manager
- Sample descriptions
- Due dates
- List of analyses requested
- Date and time of laboratory receipt
- Field ID code
- Date and time of collection
- Any comments resulting from inspection for sample rejection

2.6.2. All samples received are logged into the LIMS within one working day of receipt. Sample login may be delayed due to customer clarification of analysis needed, corrective actions for sample receipt non-conformance, or other unusual circumstances. If the time collected for any sample is unspecified and Pace is unable to obtain this information from the customer, the laboratory will use 00:00 as the time sampled. All hold times will be based on this sampling time and qualified accordingly if exceeded.

2.6.3. For DoD work, if the time of the sample collection is not provided, the laboratory must assume the most conservative time of day. This is defined as 12:01am.

2.6.4. The LIMS automatically generates a unique identification number for each sample created in the system. The LIMS sample number follows the general convention of BB-XXXXXX-YYY. The BB represents the laboratory identification within Pace's laboratory network. The 5 digit "X" number represents the project number followed by a 3 digit sample number. The project number is a sequential number that is assigned as a new project is created. The sample number corresponds to the number of samples submitted by the client. In addition to the unique sample ID, there is a sample container ID that consists of the sample number, the container type (e.g. BP1U), and bottle 1 of Y, where Y represents the total number of containers of that particular type. Together the sample LIMs number and sample container ID number create a unique barcode encryption that can be linked to the sample analysis requested by the client. This unique identification number is placed on the sample container as a durable label and becomes the link between the laboratory's sample management system and the customer's field identification; it will be a permanent reference number for all future interactions.

2.6.5. Current division codes are noted below. These division codes are used primarily for accounting purposes and LIMS sample identifications. For smaller facilities, these codes may be used primarily for accounting purposes. More division codes may be added, revised or removed without updating this document.

00 = Corporate
10 = Minnesota/Montana
12 = Virginia/Duluth MN
20 = New Orleans/Puerto Rico
30 = Pittsburgh
35 = Florida/South Florida
36 = South Florida (accounting only)
40 = Green Bay
50 = Indianapolis/Columbus
51 = Columbus (accounting only)
55/56 = Pace Energy Labs
60 = Kansas
65 = New York (Schenectady)
70 = Long Island
75 = Dallas
92 = Carolinas

2.6.6. Sample labels are printed from the LIMS and affixed to each sample container.

2.6.7. Samples with hold times that are near expiration date/time may be sent directly to the laboratory for analysis at the discretion of the Project Manager and/or SGM/GM/AGM/OM.

2.6.8. Additional information can be found in S-MN-C-001 **Sample Management** or its equivalent revision or replacement.

2.7. Sample Storage

2.7.1. Storage Conditions

2.7.1.1. Samples are stored away from all standards, reagents, or other potential sources of contamination. Samples are stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

2.7.1.2. Storage blanks, consisting of two 40mL aliquots of reagent water, are stored with volatile samples and are used to measure cross-contamination acquired during storage. If applicable, laboratories must have documented procedures and criteria for evaluating storage blanks, appropriate to the types of samples being stored.

2.7.1.3. Additional information can be found in S-MN-Q-263 **Monitoring Temperature Controlled Units.**

2.7.2. **Temperature Monitoring**

2.7.2.1. Samples are taken to the appropriate storage location immediately after sample receipt and check-in procedures are completed. All sample storage areas are located in limited access areas and are monitored to ensure sample integrity.

2.7.2.2. The temperature of each refrigerated storage area is maintained at $\leq 6^{\circ}$C (but above freezing) unless state or program requirements differ. The temperature of each freezer storage area is maintained at $<-10^{o}$C unless state or program requirements differ. The temperature of each storage area is checked and documented each day of use (each calendar day). If the temperature falls outside the acceptable limits, the following corrective actions are taken and appropriately documented:

- The temperature is rechecked after two hours to verify temperature exceedance. Corrective action is initiated and documented if necessary.
- The SQM/QM and/or laboratory management are notified if the problem persists.
- The samples are relocated to a proper environment if the temperature cannot be maintained after corrective actions are implemented.
- The affected customers are notified.
- Documentation is provided on analytical report.

Additional information can be found in S-MN-Q-263 **Monitoring Temperature Controlled Units.**

2.7.3. **Hazardous Materials**

2.7.3.1. Pure product or potentially heavily contaminated samples must be tagged as "hazardous" or "lab pack" and stored separately from other samples.

2.7.4. **Foreign/Quarantined Soils**

2.7.4.1. Depending on the soil disposal practices of the laboratory, foreign soils and soils from USDA regulated areas are adequately segregated to enable proper sample disposal. The USDA requires these samples to be incinerated or sterilized by an approved treatment procedure. Additional information regarding USDA regulations and sample handling can be found in applicable local laboratory SOPs.

2.7.4.2. Additional information on sample storage can be found in S-MN-C-001 **Sample Management** or its equivalent revision or replacement and in S-MN-S-003 **Waste Handling and Management**.

2.8. Sample Protection

2.8.1. PASI laboratory facilities are operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted at all times.

2.8.2. Samples are removed from storage areas by designated personnel and returned to the storage areas, if necessary, immediately after the required sample quantity has been taken.

2.8.3. Upon customer request, additional and more rigorous chain of custody protocols for samples and data can be implemented. For example, some projects may require internal chain-of-custody protocols.

2.8.4. Additional information can be found in S-MN-C-001 **Sample Management** or its equivalent revision or replacement.

2.9. Subcontracting Analytical Services

2.9.1. Every effort is made to perform all analyses for PASI customers within the laboratory that receives the samples. When subcontracting to a laboratory other than the receiving laboratory, whether inside or outside the PASI network, becomes necessary, a preliminary verbal communication with that laboratory is undertaken. Customers are notified in writing of the laboratory's intention to subcontract any portion of the testing to another laboratory. Work performed under specific protocols may involve special considerations.

2.9.2. Prior to subcontracting samples to a laboratory outside Pace Analytical, the potential sub-contract laboratory will be pre-qualified by verifying that the subcontractor meets the following criteria:

- All certifications required for the proposed subcontract are in effect,
- Sufficient professional liability and other required insurance coverage is in effect, and
- Is not involved in legal action by any federal, state, or local government agency for data integrity issues and has not been convicted in such investigation at any time during the past 5 years.

2.9.3. The contact and preliminary arrangements are made between the PASI Project Manager and the appropriate subcontract laboratory personnel. The specific terms of the subcontract laboratory agreement include:

- Method of analysis
- Number and type of samples expected
- Project specific QA/QC requirements
- Deliverables required
- Laboratory certification requirement
- Price per analysis
- Turn-around time requirements

2.9.4. Chain-of-custody forms are generated for samples requiring subcontracting to other laboratories. Sample receiving personnel re-package the samples for shipment, create a transfer chain of custody form and record the following information:

- Pace Analytical Laboratory Number
- Matrix
- Requested analysis
- Special instructions regarding turnaround, required detection or reporting limits, or any unusual information known about the samples or analytical procedure.
- Signature in "Relinquished By"

2.9.5. All subcontracted sample data reports are sent to the PASI Project Manager. Pace will provide a copy of the subcontractor's report to the client when requested.

2.9.6. Any Pace Analytical work sent to other labs within the PASI network is handled as subcontracted work and all final reports are labeled clearly with the name of the laboratory performing

the work. Any non-TNI work is clearly identified. PASI will not be responsible for analytical data if the subcontract laboratory was designated by the customer.

2.9.7. Additional information can be found in S-MN-C-004 **Subcontracting Samples** or its equivalent revision or replacement.

2.9.8. Subcontracted labs used for DoD work must be accredited by DoD or its designated representatives. Subcontracted labs must receive project specific approval from the DoD client before any samples are analyzed. These requirements also apply to the use of any laboratory under the same corporate umbrella, but at a different facility or location.

2.10. Sample Retention and Disposal

2.10.1. Samples, extracts, digestates, and leachates must be retained by the laboratory for the period of time necessary to protect the interests of the laboratory and the customer.

- Air canisters are submitted for cleaning upon data validation. Due to media capacity, air canister samples are not retained as standard environmental samples.

2.10.2. Unused portions of samples are retained by each laboratory based on program or customer requirements for sample retention and storage. The minimum sample retention time is 45 days from receipt of the samples. Samples requiring thermal preservation may be stored at ambient temperature when the hold time is expired, the report has been delivered, and/or allowed by the customer, program, or contract. Samples requiring storage beyond the minimum sample retention time due to special requests or contractual obligations may be stored at ambient temperature unless the laboratory has sufficient capacity and their presence does not compromise the integrity of other samples.

2.10.3. After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer. If it is not feasible to return samples, or the customer requires PASI to dispose of excess samples, proper arrangements will be made for disposal by an approved contractor.

2.10.4. Additional information can be found in S-MN-S-003 **Waste Handling and Management** and S-MN-C-001 or their equivalent revisions or replacements.

3.0. ANALYTICAL CAPABILITIES

3.1. Analytical Method Sources

3.1.1. PASI laboratories are capable of analyzing a full range of environmental samples from a variety of matrices, including air, surface water, wastewater, groundwater, soil, sediment, biota, and other waste products. The latest valid editions of methodologies are applied from regulatory and professional sources including EPA, ASTM, USGS, NIOSH, Standard Methods, and State Agencies. Section 11 is a representative listing of general analytical protocol references. PASI discloses in writing to its customers and regulatory agencies any instances in which modified methods are being used in the analysis of samples.

3.1.2. In the event of a customer-specific need, instrumentation constraint or regulatory requirement, PASI laboratories reserve the right to use valid versions of methods that may not be the most recent edition available.

3.2. Analytical Method Documentation

3.2.1. The primary form of PASI laboratory documentation of analytical methods is the Standard Operating Procedure (SOP). SOPs contain pertinent information as to what steps are required by an analyst to successfully perform a procedure. The required contents for the SOPs are specified in the company-wide SOP for Preparation of SOPs (S-ALL-Q-001).

3.2.2. The SOPs may be supplemented by other training materials that further detail how methods are specifically performed. This training material will undergo periodic, documented review along with the other Quality System documentation.

3.3. Analytical Method Validation and Instrument Validation

3.3.1. In some situations, PASI develops and validates methodologies that may be more applicable to a specific problem or objective. When non-standard methods are required for specific projects or analytes of interest, or when the laboratory develops or modifies a method, the laboratory validates the method prior to applying it to customer samples. Method validity is established by meeting criteria for precision and accuracy as established by the data quality objectives specified by the end user of the data. The laboratory records the validation procedure, the results obtained and a statement as to the usability of the method. The minimum requirements for method validation include evaluation of sensitivity, quantitation, precision, bias, and selectivity of each analyte of interest.

3.3.2. Additional information can be found in SOP S-MN-Q-252 **Method Validation and Modification Studies**, or equivalent replacement.

3.4. Demonstration of Capability (DOC)

3.4.1. Analysts complete an initial demonstration of capability (IDOC) study prior to performing a method or when there is a change in instrument type, personnel, or test method, or at any time that a method has not been performed by the laboratory or analyst in a 12-month period. The mean recovery and standard deviation of each analyte, taken from 4 replicates of a quality control standard is calculated and compared to method criteria (if available) or established laboratory criteria for evaluation of acceptance. Each laboratory maintains copies of all demonstrations of capability,

including those that fail acceptance criteria and corresponding raw data for future reference and must document the acceptance criteria prior to the analysis of the DOC. Demonstrations of capability are verified on an annual basis.

3.4.2. For Continuing Demonstrations of Capability, the laboratories may use Performance Testing (PT) samples in lieu of the 4-replicate approach listed above. For methods or procedures that do not lend themselves to the "4-replicate" approach, the demonstration of capability requirements will be specified in the applicable SOP. Drinking Water DOCs must be done at or below the MCL.

3.4.3. Additional information can be found in SOP S-ALL-Q-020 **Training and Employee Orientation** or its equivalent revision or replacement.

3.5. Regulatory and Method Compliance

3.5.1. PASI understands that expectations of our customers commonly include the assumption that laboratory data will satisfy specific regulatory requirements. Therefore PASI attempts to ascertain, prior to beginning a project, what applicable regulatory jurisdiction, agency, or protocols apply to that project. This information is also required on the chain of custody submitted with samples.

3.5.2. PASI makes every effort to detect regulatory or project plan inconsistencies, based upon information from the customer, and communicate them immediately to the customer in order to aid in the decision making process. PASI will not be liable if the customer chooses not to follow PASI recommendations.

3.5.3. It is PASI policy to disclose in a forthright manner any detected noncompliance affecting the usability of data produced by our laboratories. The laboratory will notify customers within 30 days of fully characterizing the nature of the nonconformance, the scope of the nonconformance and the impact it may have on data usability.

4.0. QUALITY CONTROL PROCEDURES

The method SOPs will define the following criteria in a more detailed procedures for the corrective actions as applicable to each analytical method. Quality control data is analyzed and where they are found to be outside pre-defined criteria, planned action is taken to correct the problem in order to prevent incorrect results from being reported. Quality control samples are to be processed in the same manner as client samples.

4.1. Method Blank

4.1.1. A method blank is used to evaluate contamination in the preparation/analysis system and is processed through all preparation and analytical steps with its associated samples.

4.1.2. A method blank is processed at a minimum frequency of one per preparation batch (see glossary section of this document for further clarification of the definition of batch). In the case of a method that has no separate preparation step, a method blank is processed with no more than 20 samples of a specific matrix performed by the same analyst, using the same method, standards, and reagents.

4.1.3. The method blank consists of a matrix similar to the associated samples that is known to be free of analytes of interest. Method blanks are not applicable for certain analyses, such as pH, conductivity, flash point and temperature.

4.1.4. Each method blank is evaluated for contamination. The source of any contamination is investigated and documented corrective action is taken when the concentration of any target analyte is detected above the reporting limit and is greater than 1/10 of the amount of that analyte found in any associated sample. Some labs, due to client requirements, etc., may have to evaluate their method blanks down to ½ the reporting limit or down to the method detection limit as opposed to the reporting limit itself. Corrective actions for blank contamination may include the re-preparation and re-analysis of all samples (where possible) and quality control samples. Data qualifiers must be applied to results that are considered affected by contamination in a method blank.

4.1.5. For DoD samples, the method blank will be considered to be contaminated if: 1) The concentration of any target analyte in the blank exceeds 1/2 the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit whichever is greater; 2) The concentration of any common laboratory contaminant in the blank exceeds the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit whichever is greater or 3) The blank result otherwise affects the sample results as per the test method requirements or the project-specific objectives. If the method blank is contaminated as described above, then the laboratory shall reprocess affected samples in a subsequent preparation batch, except when sample results are below the LOD. If insufficient sample volume remains for reprocessing, the results shall be reported with appropriate data qualifiers.

4.1.6. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.1.7. For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of method blank having any reportable contamination, the laboratory is required to reanalyze the associated samples with an acceptable method blank if there is sufficient sample remaining. Acceptable method blanks are those that are free of contamination below the reporting limit. The laboratory must make every effort to take the appropriate corrective actions and resolve any

anomalies regarding method blanks for Ohio VAP projects. The narrative for any report that includes qualified data must also include a discussion of any bias in the results.

4.2. Laboratory Control Sample

4.2.1. The Laboratory Control Sample (LCS) is used to evaluate the performance of the entire analytical system including preparation and analysis.

4.2.2. An LCS is processed at a minimum frequency of one per preparation batch. In the case of a method that has no separate preparation step, an LCS will be processed with no more than 20 samples of a specific matrix performed by the same analyst, using the same method, standards, and reagents.

4.2.3. The LCS consists of a matrix similar to the associated samples that is known to be free of the analytes of interest that is then spiked with known concentrations of target analytes.

4.2.4. The LCS contains **all** analytes specified by a specific method or by the customer or regulatory agency, which may include full list of target compounds, with certain exceptions. These exceptions may include analyzing only specific Aroclors when PCB analysis is requested or not spiking with all EPA Appendix IX compounds when a full Appendix IX list of compounds is requested. However, the lab must ensure that all target components in its scope of accreditation are included in the spike mixture for the LCS over a two (2) year period. In the absence of specified components, the laboratory will spike the LCS with the following compounds:

- For multi-peak analytes (e.g. PCBs, technical chlordane, toxaphene), a representative standard will be processed.
- For methods with long lists of analytes, a representative number of target analytes may be chosen. The following criteria is used to determine the number of LCS compounds used:
    - For methods with 1-10 target compounds, the laboratory will spike with all compounds;
    - For methods with 11-20 target compounds, the laboratory will spike with at least 10 compounds or 80%, whichever is greater;
    - For methods with greater than 20 compounds, the laboratory will spike with at least 16 compounds.

4.2.5. The LCS is evaluated against the method default or laboratory-derived acceptance criteria. For those methods that require laboratory-derived limits, method default control limits may be used until the laboratory has a minimum of 20, but preferably greater than 30, data points from which to derive internal acceptance criteria. Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Any associated sample containing an 'out-of-control' compound must either be re-analyzed with a successful LCS or reported with the appropriate data qualifier. When the acceptance criteria for the LCS are exceeded high, and there are associated samples that are non-detects, then those non-detects can be reported with data qualifiers, or when the acceptance criteria are exceeded low, those associated sample results may be reported if they exceed the maximum regulatory limit/decision level with data qualifiers.

4.2.6. For LCSs containing a large number of analytes, it is statistically likely that a few recoveries will be outside of control limits. This does not necessarily mean that the system is out of control, and therefore no corrective action would be necessary (except for proper documentation). TNI has allowed for a minimum number of marginal exceedances, defined as recoveries that are beyond the LCS control limits (3X the standard deviation) but less than the marginal exceedance limits (4X the standard deviation). The number of allowable exceedances depends on the number of compounds in the LCS. If more analyte recoveries exceed the LCS control limits than is allowed (see below) or if

any one analyte exceeds the marginal exceedance limits, then the LCS is considered non-compliant and corrective actions are necessary. The number of allowable exceedances is as follows:

- >90 analytes in the LCS- 5 analytes
- 71-90 analytes in the LCS- 4 analytes
- 51-70 analytes in the LCS- 3 analytes
- 31-50 analytes in the LCS- 2 analytes
- 11-30 analytes in the LCS- 1 analyte
- <11 analytes in the LCS- no analytes allowed out)

4.2.7. A matrix spike (MS) can be used in place of a non-compliant LCS in a batch as long as the MS passes the LCS acceptance criteria (this is a TNI allowance). When this happens, full documentation must be made available to the data user. If this is not allowed by a customer or regulatory body, the associated samples must be rerun with a compliant LCS (if possible) or reported with appropriate data qualifiers.

4.2.8. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.2.9. For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of LCS failures, the laboratory is required to reanalyze the associated samples with an acceptable LCS for all target compounds if there is sufficient sample remaining. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding LCSs for Ohio VAP projects. The narrative for any report that includes qualified data must also include a discussion of any bias in the results.

- For Ohio VAP projects, the MS cannot be used in place of the LCS.

4.2.10. For Department of Defense projects, the laboratory is not allowed to have any target analytes that exceed DoD LCS control limits. In the case of LCS failures, the laboratory is required to reanalyze the associated samples with an acceptable LCS for all target compounds if there is sufficient sample remaining. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding LCSs for Department of Defense projects. All LCS failures must be accounted for in project case narratives. See applicable method SOPs for further corrective action.

4.3. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

4.3.1. A matrix spike (MS) is used to determine the effect of the sample matrix on compound recovery for a particular method. The information from these spikes is sample or matrix specific and is not used to determine the acceptance of an entire batch unless the MS is actually used as the LCS.

4.3.2. A **Matrix Spike/Matrix Spike Duplicate** (MS/MSD) set is processed at a frequency specified in a particular method or as determined by a specific customer request. This frequency will be specified in the applicable method SOP or customer QAPP. In the absence of such requirements, an MS/MSD set is routinely analyzed once per every 20 samples per matrix per method.

4.3.3. The MS and MSD consist of the sample matrix that is then spiked with known concentrations of target analytes. Laboratory personnel spike customer samples that are specifically designated as MS/MSD samples or, when no designated samples are present in a batch, randomly select samples to

spike that have adequate sample volume or weight. Spiked samples are prepared and analyzed in the same manner as the original samples and are selected from different customers if possible.

4.3.4. The MS and MSD contain all analytes specified by a specific method or by the customer or regulatory agency. In the absence of specified components, the laboratory will spike the MS/MSD with the same number of compounds as previously discussed in the LCS section. However, the lab must ensure that all targeted components in its scope of accreditation are included in the spike mixture for the MS/MSD over a two (2) year period.

4.3.5. The MS and MSD are evaluated against the method or laboratory derived criteria. Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance, not on MS/MSD recoveries. The spike recoveries give the data user a better understanding of the final results based on their site specific information.

4.3.6. A matrix spike and sample duplicate will be performed instead of a matrix spike and matrix spike duplicate when specified by the customer or method.

4.3.7. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.3.8. For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of MS/MSD failures, the laboratory is required to reanalyze the associated samples only when the associated LCS also fails acceptance criteria and if there is sufficient sample remaining. When an LCS is acceptable and the MS results are outside of criteria, and no system anomaly is detected, the samples will be reported with appropriate data qualifiers indicating matrix interference. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding LCSs for Ohio VAP projects.

- For Ohio VAP projects MS/MSD are optional and will be directed by the Certified Professional.

4.3.9. For DoD work, each preparation batch of samples must contain an associated MS and MSD (or sample duplicate) using the same matrix collected for the specific DoD project. If adequate sample material is not available, then the lack of MS/MSDs shall be noted in the case narrative. Additional MS/MSDs may be required on a project-specific basis. The MS/MSD must be spiked with all target analytes with the exception of PCB analysis, which is spiked per the method. The concentration of the spiked compounds shall be at or below the midpoint of the calibration range or at the appropriate concentration of concern. Multiple spiked samples may need to be prepared to avoid interferences.

4.3.10. For DoD work, the results of all MS/MSD must be evaluated using the same acceptance criteria used for the LCS.

4.4. Sample Duplicate

4.4.1. A sample duplicate is a second portion of sample that is prepared and analyzed in the laboratory along with the first portion. It is used to measure the precision associated with preparation and analysis. A sample duplicate is processed at a frequency specified by the particular method or as determined by a specific customer.

- For Ohio VAP projects Sample duplicate is optional and will be directed by the Certified Professional.

4.4.2. The sample and duplicate are evaluated against the method or laboratory derived criteria for relative percent difference (RPD). Any duplicate that is outside of these limits is considered to be 'out of control' and must be qualified appropriately.

4.4.3. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.4.4. For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of duplicate samples exceeding the RPD criteria found in applicable analytical SOPs, the laboratory is required to reanalyze the associated sample and duplicate as long as no sampling error was detected if there is sufficient sample remaining. If the sample and duplicate still do not agree, a comment would be made stating there may be sample non-homogeneity. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding sample duplicates for Ohio VAP projects. The narrative for any report that includes qualified data must also include a discussion of any bias in the results.

4.5. Surrogates

4.5.1. Surrogates are compounds that reflect the chemistry of target analytes and are typically added to samples for organic analyses to monitor the effect of the sample matrix on compound recovery.

4.5.1.1. Surrogates are added to each customer sample (for applicable organics), method blank, LCS, MS, and calibration standard prior to extraction or analysis. The surrogates are evaluated against the method or laboratory derived acceptance criteria or against project-specific acceptance criteria specified by the client, if applicable. Any surrogate compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Samples with surrogate failures are typically re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error. An exception to this would be samples that have high surrogate values but no reportable hits for target compounds. These samples would be reported, with a qualifier, because the implied high bias would not affect the final results. For methods with multiple surrogates, documentation regarding acceptance and associated compounds will be found in the individual method SOPs.

4.5.1.2. For Ohio VAP samples, the narrative for any report that includes qualified data must also include a discussion of any bias in the results.

4.5.1.3. For the TO-15 method, surrogates are not evaluated for Ohio VAP samples.

4.5.2. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.6. Internal Standards

4.6.1. Internal Standards are method-specific analytes added to every standard, method blank, laboratory control sample, matrix spike, matrix spike duplicate, sample, and calibration standard at a known concentration, prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. At a minimum, the laboratory will follow method specific guidelines for the treatment of internal standard recoveries as they are related to the reporting of data. Deviations made from this policy must be approved by the SQM/QM prior to release of the data.

4.6.2. For Ohio VAP projects, samples with internal standard that are outside of method criteria must be reanalyzed to confirm sample matrix effect. The laboratory must make every effort to take

the appropriate corrective actions and resolve any anomalies regarding internal standards for Ohio VAP projects. The narrative for any report that includes qualified data must also include a discussion of any bias in the results.

4.7. Field Blanks

4.7.1. Field blanks are blanks prepared at the sampling site in order to monitor for contamination that may be present in the environment where samples are collected. These field quality control samples are often referenced as field blanks, rinsate blanks, or equipment blanks. The laboratory analyzes these field blanks as normal samples and informs the customer if there are any target compounds detected above the reporting limits.

4.8. Trip Blanks

4.8.1. Trip blanks are blanks that originate from the laboratory as part of the sampling event and are used to monitor for contamination of samples during transport. These blanks accompany the empty sample containers to the field and then accompany the collected samples back to the laboratory. These blanks are routinely analyzed for volatile methods where ambient background contamination is likely to occur.

4.9. Limit of Detection (LOD)

4.9.1. PASI laboratories are required to use a documented procedure to determine a limit of detection for each analyte of concern in each matrix reported. All sample processing steps of the preparation and analytical methods are included in this determination including any clean ups. For any test that does not have a valid LOD, sample results below the limit of quantitation (LOQ) cannot be reported.

4.9.2. The LOD is initially established for the compounds of interest for each method in a clean matrix with no target analytes present and no interferences at a concentration that would impact the results. The LOD is then determined every time there is a change in the test method that affects how the test is performed or when there has been a change in the instrument that affects the sensitivity. If required by customer, method or accreditation body, the LOD will be re-established annually for all applicable methods.

4.9.3. Unless otherwise noted, the method used by PASI laboratories to determine LODs is based on the Method Detection Limit (MDL) procedure outlined in 40 CFR Part 136, Appendix B. Where required by regulatory program or customer, the above referenced procedure will be followed.

4.9.4. Where specifically stated in the published method, LODs or MDLs will be performed at the listed frequency.

4.9.5. The validity of the LOD must be shown by detection (a value above zero) of the analytes in a QC sample in each quality system matrix. The QC sample must contain the analyte at no more than 3X the LOD for a single analyte test and 4X the LOD for multiple analyte tests. This verification must be performed on each instrument used for sample analysis and reporting of data. The validity of the LOD must be verified as part of the LOD determination process. This verification must be done prior to the use of the LOD for sample analysis.

4.9.6. An LOD study is not required for any analyte for which spiking solutions or quality control samples are not available such as temperature.

4.9.7. The LOD, if required, shall be verified annually for each quality system matrix, technology and analyte. In lieu of performing full LOD (MDL) studies annually, the laboratory can verify the LOD (MDL) on an annual basis, providing this verification is fully documented and does not contradict other customer or program requirements that the laboratory must follow. The requirements of this verification are:

- The spike concentration of the verification must be no more than 3X times the LOD for single analyte tests and 4X the LOD for multiple analyte tests.
- The laboratory must verify the LOD on each instrument used for the reporting of sample data.
- The laboratory must be able to identify all target analytes in the verification standard (distinguishable from noise).

4.9.8. For Ohio VAP projects, a valid MDL must be in place prior to sample analysis. MDLs must be spiked at or below the reporting limit and will not be accepted if it was spike higher than the reporting limit.

4.9.9. DoD definition for LOD- The smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate is 1%.

4.9.10. Additional information can be found in SOP S-MN-Q-269 **Determination of LOD and LOQ** or its equivalent revision or replacement.

4.10. Limit of Quantitation (LOQ)

4.10.1. A limit of quantitation (LOQ) for every analyte of concern must be determined. For PASI laboratories, this LOQ is referred to as the RL, or Reporting Limit. This RL is based on the lowest calibration standard concentration that is used in each initial calibration. Results below this level are not allowed to be reported without qualification since the results would not be substantiated by a calibration standard. For methods with a determined LOD, results can be reported out below the LOQ but above the LOD if they are properly qualified (e.g., J flag).

4.10.2. The LOQ must be higher than the LOD.

4.10.3. To verify the LOQ, the laboratory will prepare a sample in the same matrix used for the LCS. The sample will be spiked with each target analyte at a concentration equivalent to the RL or 2X the RL. This sample must undergo the routine sample preparation procedure including any routine sample cleanup steps. The sample is then analyzed and the recovery of each target analyte determined. The recovery for each target analyte must meet the laboratories current control limits for an LCS. The annual LOQ verification is not required if the LOD was determined or verified annually on that instrument.

4.10.4. For DoD approved methods, the LOQ and LOD shall be verified quarterly and valid LOQ must be in place prior to sample analysis.

4.10.5. Additional information can be found in SOP S-MN-Q-269 **Determination of LOD and LOQ** or its equivalent revision or replacement.

4.11. Estimate of Analytical Uncertainty

4.11.1. PASI laboratories can provide an estimation of uncertainty for results generated by the laboratory. The estimate quantifies the error associated with any given result at a 95% confidence interval. This estimate does not include bias that may be associated with sampling. The laboratory has a procedure in place for making this estimation. In the absence of a regulatory or customer-specific procedure, PASI laboratories base this estimation on the recovery data obtained from the Laboratory Control Spikes. The uncertainty is a function of the standard deviation of the recoveries multiplied by the appropriate Student's t Factor at 95% confidence. Additional information pertaining to the estimation of uncertainty and the exact manner in which it is derived are contained in the SOP S-MN-Q-255 **Estimation of Measurement Uncertainty** or its equivalent revision or replacement.

4.11.2. The measurement of uncertainty is provided only on request by the customer, as required by specification or regulation and when the result is used to determine conformance within a specification limit.

4.12. Proficiency Testing (PT) Studies

4.12.1. PASI laboratories participate in the TNI defined proficiency testing program. PT samples are obtained from TNI and state regulatory approved providers and analyzed and reported at a minimum of two times per year for the relevant fields of testing per matrix.

4.12.2. The laboratory initiates an investigation whenever PT results are deemed 'unacceptable' by the PT provider. All findings and corrective actions taken are reported to the SQM/QM or their designee. A corrective action plan is initiated and this report is sent to the appropriate state accreditation agencies for their review. Additional PTs will be analyzed and reported as needed for certification purposes.

4.12.3. PT samples are treated as typical customer samples, utilizing the same staff, methods, equipment, facilities, and frequency of analysis. PT samples are included in the laboratory's normal analytical processes and do not receive extraordinary attention due to their nature.

4.12.4. Comparison of analytical results with anyone participating in the same PT study is prohibited prior to the close of the study.

4.12.5. Additional information can be found in SOP S-MN-Q-258 **Proficiency Testing Program** or its equivalent revision or replacement.

4.13. Rounding and Significant Figures

4.13.1. In general, the PASI laboratories report data to no more than three significant digits. Therefore, all measurements made in the analytical process must reflect this level of precision. In the event that a parameter that contributes to the final result has less than three significant figures of precision, the final result must be reported with no more significant figures than that of the parameter in question. The rounding rules listed below are descriptive of the LIMS and not necessarily of any supporting program such as Excel.

4.13.2. Data is compared to the reporting limits and MDLs to determine if qualifiers are needed before the rounding step occurs.

4.13.3. **Rounding:** PASI- Minneapolis, Billings, Virginia and Duluth follow the odd / even guidelines for rounding numbers:

- If the figure following the one to be retained is less than five, that figure is dropped and the retained ones are not changed (with three significant figures, 2.544 is rounded to 2.54).
- If the figure following the ones to be retained is greater than five, that figure is dropped and the last retained one is rounded up (with three significant figures, 2.546 is rounded to 2.55).
- If the figure following the ones to be retained is five and if there are no figures other than zeros beyond that five, then the five is dropped and the last figure retained is unchanged if it is even and rounded up if it is odd (with three significant figures, 2.525 is rounded to 2.52 and 2.535 is rounded to 2.54).

4.13.4. **Significant Digits**

4.13.4.1. PASI- Minneapolis, Billings, Virginia and Duluth follow the following convention for reporting to a specified number of significant figures. Unless specified by federal, state, or local requirements or on specific request by a customer, the laboratory reports:

Values > 10 – Reported to 3 significant digits
Values ≤ 10 – Reported to 2 significant digits

4.14. Retention Time Windows

4.14.1. When chromatographic conditions are changed, retention times and analytical separations are often affected. As a result, two critical aspects of any chromatographic method are the determination and verification of retention times and analyte separation. Retention time windows must be established for the identification of target analytes. The retention times of all target analytes in all calibration verification standards must fall within the retention time windows. If an analyte falls outside the retention time window in an ICV or CCV, new absolute retention time windows must be calculated, unless instrument maintenance fixes the problem. When a new column is installed, a new retention time window study must be performed.

4.14.2. One process for the production of retention time windows: Make 3 injections of all single component or multi-component analytes over a 72-hour period. Record the retention time in minutes for each analyte and surrogate to 3 decimal places. Calculate the mean and standard deviation of the three absolute retention times for each target analyte and surrogate. For multi-component analytes, choose 3-5 major peaks and calculate the mean and standard deviation for each of the peaks. If the standard deviation of the retention times of a target analyte is 0.000, the lab may use a default standard deviation of 0.01. The width of the retention time window for each analyte and surrogate and major peak in a multi-component analyte is defined as +/- 3 times the standard deviation of the mean absolute retention time established during that 72-hour period or 0.03 minutes, whichever is greater.

4.14.3. The center of the retention time window is established for each analyte and surrogate by using the absolute retention times from the CCV at the beginning of the analytical shift. For samples run with an initial calibration, use the retention time of the mid-point standard of the initial calibration curve.

4.14.4. For more information, please reference the local facility's analytical SOPs.

5.0. DOCUMENT MANAGEMENT AND CHANGE CONTROL

5.1. Document Management

5.1.1. Additional information can be found in SOP S-MN-Q-258 **Document Control and Management** or its equivalent revision or replacement. Information on Pace's policy for electronic signatures can also be found in this SOP.

5.1.2. Pace Analytical Services, Inc. has an established procedure for managing documents that are part of the quality system. The list of managed documents includes, but is not limited to, Standard Operating Procedures (both technical and non-technical), Quality Assurance Manuals, quality policy statements, training documents, work-processing documents, charts, posters, memoranda, notices, forms, software, and any other procedures, tables, plans, etc. that have a direct bearing on the quality system (including applicable data records and non-technical documents).

5.1.3. A master list of all managed documents is maintained at each facility identifying the current revision status and distribution of the controlled documents. This establishes that there are no invalid or obsolete documents in use in the facility. All documents are reviewed periodically and revised if necessary. Obsolete documents are systematically discarded or archived for audit or knowledge preservation purposes. Copies of all quality systems documentation provided to DoD for review must be in English.

5.1.4. Each managed document is uniquely identified to include the date of issue, the revision identification, page numbers, the total number of pages and the issuing authorities. For complete information on document numbering, refer to SOP S-MN-Q-258 **Document Numbering**.

5.1.5. SOPs, specifically, are available to all laboratory staff via the Learning Management System (LMS) which is a secure repository that is accessed through an internet portal. As a local alternative to the hard copy system of controlled documents, secured electronic copies of controlled documents may be maintained on the laboratory's local server. These document files must be read-only for all personnel except the Quality Department and system administrator. Other requirements for this system are as follows:

- Electronic documents must be readily accessible to all facility employees.
- Electronic documents must be locked from printing. All hardcopy SOPs must be obtained from the Quality Department.

5.1.6. **Quality Assurance Manual (QAM):** The Quality Assurance Manual is the company-wide document that describes all aspects of the quality system for PASI. The base QAM template is distributed by the Corporate Quality Department to each of the SQMs/QMs. The local management personnel modify the necessary and permissible sections of the base template and submit those modifications to the Corporate Director of Quality for review. Once approved and signed by both the CEO and the Director of Quality; the SGM/GM/AGM/OM, the SQM/QM, and any Technical Directors sign the Quality Assurance Manual. Each SQM/QM is then in charge of distribution to employees, external customers or regulatory agencies and maintaining a distribution list of controlled document copies. The Quality Assurance Manual template is reviewed on an annual basis by all of the PASI SQMs/QMs and revised accordingly by the Director of Quality.

5.1.7. Standard Operating Procedures (SOPs)

5.1.7.1. SOPs fall into two categories: company-wide documents and facility specific documents. Company-wide SOPs start with the prefix S-ALL- and local SOPs start with the individual facility prefix.

5.1.7.2. The purpose of the company-wide SOPs is to establish policies and procedure that are common and applicable to all PASI facilities. Company-wide SOPs are document-controlled by the corporate quality office and signed copies are distributed to all of the SQMs/QMs. The local management personnel sign the company-wide SOPs. The SQM/QM is then in charge of distribution to employees, external customers, or regulatory agencies and maintaining a distribution list of controlled document copies.

5.1.7.3. Local PASI facilities are responsible for developing facility-specific SOPs applicable to their respective facility. The local facility develops these facility-specific SOPs based on the corporate-wide SOP template. This template is written to incorporate a set of minimum method requirements and PASI best practice requirements. The local facilities may add to or modify the corporate-wide SOP template provided there are no contradictions to the minimum method or best practice requirements. Facility-specific SOPs are controlled by the applicable SQM/QM according to the corporate document management policies.

5.1.7.4. SOPs are reviewed every two years at a minimum although a more frequent review may be required by some state or federal agencies or customers. If no revisions are made based on this review, documentation of the review itself is made by the addition of new signatures on the cover page. If revisions are made, documentation of the revisions is made in the revisions section of each SOP and a new revision number is applied to the SOP. This provides a historical record of all revisions.

5.1.7.5. All copies of superseded SOPs are removed from general use and the original copy of each SOP is archived for audit or knowledge preservation purposes. This ensures that all PASI employees use the most current version of each SOP and provides the SQM/QM with a historical record of each SOP.

5.1.7.6. Additional information can be found in SOP S-MN-Q-273 **Preparation of SOPs** or its equivalent revision or replacement.

5.1.7.7. For Ohio VAP certification, it is required by the Ohio Administrative Code that the laboratory must seek Ohio VAP review and approval of all SOPs and Quality Manual subsequent modifications prior to implementation.

5.1.7.8. For DoD approval, all technical SOPs are reviewed for accuracy and adequacy annually and whenever method procedures change and updated as appropriate. All such reviews are documented and made available for assessment. Non-technical SOPs that are not required elements of the quality system are considered administrative SOPs and are not required to be reviewed annually.

5.2. Document Change Control

5.2.1. Changes to managed documents are reviewed and approved in the same manner as the original review. Any revision to a document requires the approval of the applicable signatories. After revisions are approved, a revision number is assigned and the previous version of the document is officially retired. Copies may be kept for audit or knowledge preservation purposes.

5.2.2. All controlled copies of the previous document are replaced with controlled copies of the revised document and the superseded copies are destroyed or archived. All affected personnel are advised that there has been a revision and any necessary training is scheduled.

5.3. Management of Change

5.3.1. The process for documenting necessary changes within the laboratory network are not typically handled using the corrective or preventive action system as outlined in section 9.0. Management of Change is a proactive approach to dealing with change to minimize the potential negative impact of systematic change in the laboratory and to ensure that each change has a positive desired outcome. This process will primarily be used for the implementation of large scale projects and information system changes as a means to apply consistent systems or procedures within the laboratory network. The request for change is submitted by the initiator and subsequently assigned to an individual or team for development and planning. The final completion of the process culminates in final approval and verification that the procedure was effectively implemented. Additional information can be found in SOP S-MN-Q-257 **Management of Change** or its equivalent revision or replacement.

6.0. EQUIPMENT AND MEASUREMENT TRACEABILITY

Each PASI facility is equipped with sufficient instrumentation and support equipment to perform the relevant analytical testing or field procedures performed by each facility. Support equipment includes chemical standards, thermometers, balances, disposable and mechanical pipettes, etc. This section details some of the procedures necessary to maintain traceability and to perform proper calibration of instrumentation and support equipment. See Attachment III for a list of equipment currently used at the (Minneapolis, Billings, Virginia and Duluth) PASI facility.

6.1. Standards and Traceability

6.1.1. Each PASI facility retains all pertinent information for standards, reagents, and chemicals to assure traceability to a national standard. This includes documentation of purchase, receipt, preparation, and use.

6.1.2. Upon receipt, all purchased standard reference materials are recorded into a standard logbook or database and assigned a unique identification number. The entries include the facility's unique identification number, the chemical name, manufacturer name, manufacturer's identification numbers, receipt date, and expiration date. Vendor's certificates of analysis for all standards, reagents, or chemicals are retained for future reference.

6.1.3. Subsequent preparations of intermediate or working solutions are also documented in a standard logbook or database. These entries include the stock standard name and lot number, the manufacturer name, the solvents used for preparation, the solvent lot number and manufacturer, the preparation steps, preparation date, expiration dates, preparer's initials, and a unique PASI identification number. This number is used in any applicable sample preparation or analysis logbook so the standard can be traced back to the standard preparation record. This process ensures traceability back to the national standard.

6.1.4. All prepared standard or reagent containers include the PASI identification number, the standard or chemical name, the date of preparation, the date of expiration, the concentration with units, and the preparer's initials. This ensures traceability back to the standard preparation logbook or database.

6.1.5. For containers that are too small to accommodate labels that list all of the above information associated with a standard, the minimum required information will be PASI standard ID, concentration, and expiration date. This assures that no standard will be used past its assigned expiration date.

6.1.6. If a second source standard is required to verify an existing calibration or spiking standard, this standard must be obtained from a different manufacturer or from a different lot unless client specific QAPP requirements state otherwise.

6.1.7. Additional information concerning standards and reagent traceability can be found in the SOP S-MN-Q-275 **Standard and Reagent Management and Traceability** or its equivalent revision or replacement.

6.2. General Analytical Instrument Calibration Procedures (Organic and Inorganic)

6.2.1. All support equipment and instrumentation are calibrated or checked before use to ensure proper functioning and verify that the laboratory's requirements are met. All calibrations are performed by, or under the supervision of, an experienced analyst at scheduled intervals against either certified standards

traceable to recognized national standards or reference standards whose values have been statistically validated.

6.2.2. Calibration standards for each parameter are chosen to establish the linear range of the instrument and must bracket the concentrations of those parameters measured in the samples. The lowest calibration standard is the lowest concentration for which quantitative data may be reported. Data reported below this level is considered to have less certainty and must be reported using appropriate data qualifiers or explained in a narrative. The highest calibration standard is the highest concentration for which quantitative data may be reported. Data reported above this level is considered to have less certainty and must be reported using appropriate data qualifiers or explained in the narrative. Any specific method requirement for number and type of calibration standards supersedes the general requirement. Instrument and method specific calibration criteria are explained within the specific analytical standard operating procedures for each facility.

- For Ohio VAP projects, samples must be reanalyzed to obtain results within the linear range unless there is insufficient sample volume for reanalysis

6.2.3. Results from all calibration standards analyzed must be included in constructing the calibration curve with the following exceptions:

6.2.3.1. The lowest level calibration standard may be removed from the calibration as long as the remaining number of concentration levels meets the minimum established by the method and standard operating procedure. For multi-parameter methods, this may be done on an individual analyte basis. The reporting limit must be adjusted to the lowest concentration included in the calibration curve;

6.2.3.2. The highest level calibration standard may be removed from the calibration as long as the remaining number of concentration levels meets the minimum established by the method and standard operating procedure. For multi-parameter methods, this may be done an individual analyte basis. The upper limit of quantitation must be adjusted to the highest concentration included in the calibration curve;

6.2.3.3. Multiple points from either the high end or the low end of the calibration curve may be excluded as long as the remaining points are contiguous in nature and the minimum number of levels remains as established by method or standard operating procedure. The reporting limit or quantitation range, whichever is appropriate, must be adjusted accordingly;

6.2.3.4. Results from a concentration level between the lowest and highest calibration levels can only be excluded from an initial calibration curve for a documentable and acceptable cause with approval from the responsible department supervisor and the local SQM/QM or their designee. An acceptable cause is defined as an obvious sample introduction issue that resulted in no response, documentation of an incorrectly prepared standard, or a documented response of a single standard that is greater than 2X the difference from the expected value of that standard. The results for all analytes are to be excluded and the point must be replaced by re-analysis. Re-analysis of this interior standard must occur within the same 12-hour tune time period for GC/MS methodologies and within 8 hours of the initial analysis of that standard for non-GC/MS methodologies. All samples analyzed prior to the re-analyzed calibration curve point must be re-analyzed after the calibration curve is completed and re-processed against the final calibration curve.

6.2.4. Instrumentation or support equipment that cannot be calibrated to specification or is otherwise defective is clearly labeled as out-of-service until it has been repaired and tested to demonstrate it meets the laboratory's specifications. All repair and maintenance activities including service calls are

documented in the maintenance log. Equipment sent off-site for calibration testing is packed and transported to prevent breakage and is in accordance with the calibration laboratory's recommendations.

6.2.5. In the event that recalibration of a piece of test equipment indicates the equipment may have been malfunctioning during the course of sample analysis, an investigation is performed. The results of the investigation along with a summary of the information reviewed are documented and maintained by the quality manager. Customers must be notified within 30 days after the data investigation is completed and the impact to final results is assessed. This allows for sufficient investigation and review of documentation to determine the impact on the analytical results. Instrumentation found to be consistently out of calibration is either repaired and positively verified or taken out of service and replaced.

6.2.6. Raw data records are retained to document equipment performance. Sufficient raw data is retained to reconstruct the instrument calibration and explicitly connect the continuing calibration verification to the initial calibration.

6.2.7. **General Organic Calibration Procedures**

6.2.7.1. Calibration standards are prepared at a minimum of five concentrations for organic analyses (unless otherwise stipulated in the method).

6.2.7.2. Initial calibration curves are evaluated against appropriate statistical models as required by the analytical methods. Curves that do not meet the appropriate criteria require corrective action that may include re-running the initial calibration curve. Rounding to meet initial calibration criteria is not allowed, that is, 15.3 cannot be rounded down to meet a $\leq$ 15% RSD requirement. This also applies to linear and non-linear fit requirements. All initial calibrations are verified with an initial calibration verification standard (ICV) obtained from a second manufacturer or second lot from the same manufacturer if that lot can be demonstrated as prepared independently from other lots prior to the analysis of samples. Sample results are quantitated from the initial calibration unless otherwise required by regulation, method, or program.

6.2.7.3. The calibration curve is periodically verified by the analysis of a mid-level continuing calibration verification (CCV) standard during the course of sample analysis. This standard is from the same source as the initial calibration unless otherwise specified in the source method to be from an alternate source material. Rounding to meet continuing calibration criteria is not allowed. Continuing calibration verification is performed at the beginning and end of each analytical batch except if an internal standard is used, then only one verification at the beginning of the batch is needed, whenever it is expected that the analytical system may be out of calibration, if the time period for calibration has expired, or for analytical systems that have specific calibration verification requirements. This verification standard must meet acceptance criteria in order for sample analysis to proceed.

6.2.7.4. In the event that the CCV does not meet the acceptance criteria, a second CCV may be injected as part of the diagnostic evaluation and corrective action investigation. If the second CCV is acceptable, the analytical sequence may be continued. If both CCVs fail, the analytical sequence is terminated and corrective action is initiated. Sample analysis cannot begin until after documented corrective action has been completed and either two consecutive passing CCVs have been analyzed or the instrument has successfully passed a new initial calibration. All samples analyzed since the last compliant CCV are re-analyzed for methodologies utilizing external calibration.

6.2.7.4.1. For DoD labs: the lab must re-analyze CCVs and all samples analyzed since the last successful calibration verification. If re-analysis is not possible, the lab must notify the client prior to reporting data associated with a non-compliant CCV. If these data are reported, the

data must be qualified and explained in the case narrative. If the lab routinely analyzes two CCVs, then both CCVs must be evaluated. If either CCV fails, the lab must perform all required corrective actions and re-analyze all samples since the last acceptable calibration verification.

6.2.7.5. When instruments are operating unattended, autosamplers may be programmed to inject consecutive CCVs as a preventative measure against CCV failure with no corrective action. In this case, both CCVs must be evaluated to determine potential impact to the results. A summary of the decision tree and necessary documentation are listed below:

- If both CCVs meet the acceptance criteria, the analytical sequence is allowed to continue without corrective action. The 12 hour clock begins with the injection of the second CCV.
- If the first CCV does not meet the acceptance criteria and the second CCV is acceptable, the analytical sequence is continued and the results are reported.
- If the first CCV meets the acceptance criteria and the second CCV is out of control, the samples after the out of control CCV must be re-analyzed in a compliant analytical sequence.
- If both CCVs are out of control, all samples since the last acceptable CCV must be re-analyzed in a compliant analytical sequence.

6.2.7.6. Some analytical methods require that samples be bracketed by passing CCVs analyzed both before and after the samples. This is specific to each method but, as a general rule, all external calibration methods require bracketing CCVs. Most internal standard calibrations do not require bracketing CCVs.

6.2.7.7. Some analytical methods require verification based on a time interval; some methods require a frequency based on an injection interval. The type and frequency of the calibration verifications is dependent on both the analytical method and possibly on the quality program associated with the samples. The type and frequency of calibration verification will be documented in the method specific SOP employed by each laboratory.

6.2.8. General Inorganic Calibration Procedures

6.2.8.1. The instrument is initially calibrated with standards at multiple concentrations to establish the linearity of the instrument's response. A calibration blank is also included. Initial calibration curves are evaluated against appropriate statistical models as required by the analytical methods. Rounding to meet initial calibration criteria is not allowed. This also applies to linear and non-linear fit requirements. The number of calibration standards used depends on the specific method criteria or customer project requirements, although normally a minimum of three standards is used.

6.2.8.2. The ICP and ICP/MS can be standardized with a zero point and a single point calibration if:

- Prior to analysis, the zero point and the single point calibration are analyzed and a linear range has been established,
- Zero point and single point calibration standards are analyzed with each batch
- A standard corresponding to the LOQ is analyzed with the batch and meets the established acceptance criteria
- The linearity is verified at the frequency established by the method or manufacturer.

6.2.8.3. All initial calibrations are verified with an initial calibration verification standard (ICV) obtained from a second manufacturer or second lot from the same manufacturer if the lot can be demonstrated as prepared independently from other lots prior to the analysis of samples. Sample

results are quantitated from the initial calibration unless otherwise required by regulation, method, or program.

6.2.8.4. During the course of analysis, the calibration curve is periodically verified by the analysis of calibration verification standards (CCV). A calibration verification standard is analyzed within each analytical batch at method/program specific intervals to verify that the initial calibration is still valid. The CCV is also analyzed at the end of the analytical batch.

6.2.8.5. A calibration blank is also run with each calibration verification standard to verify the cleanliness of the system. All reported results must be bracketed by acceptable CCVs. Instrument and method specific calibration acceptance criteria are explained within the specific analytical standard operating procedures for each facility.

6.2.8.6. Interference check standards are also analyzed per method requirements and must meet acceptance criteria for metals analyses.

6.3. Support Equipment Calibration Procedures

6.3.1. All support equipment is calibrated or verified at least annually using NIST traceable references over the entire range of use. The results of calibrations or verifications must be within the specifications required or the equipment will be removed from service until repaired. The laboratory maintains records to demonstrate the correction factors applied to working thermometers.

6.3.2. On each day the equipment is used, balances, ovens, refrigerators (those used to keep samples and standards at required temperatures), freezers, and water baths are checked in the expected use range with NIST traceable references in order to ensure the equipment meets laboratory specifications and these checks are documented appropriately.

6.3.3. **Analytical Balances**

6.3.3.1. Each analytical balance is calibrated or verified at least annually by a qualified service technician. The calibration of each balance is verified each day of use with weights traceable to NIST bracketing the range of use. Calibration weights are ASTM Class 1 or other class weights that have been calibrated against a NIST standard weight and are re-certified every 5 years at a minimum against a NIST traceable reference. Some accrediting agencies may require more frequent checks. If balances are calibrated by an external agency, verification of their weights must be provided. All information pertaining to balance maintenance and calibration is recorded in the individual balance logbook and/or is maintained on file in the Quality department.

6.3.4. **Thermometers**

6.3.4.1. Certified, or reference, thermometers are maintained for checking calibration of working thermometers. Reference thermometers are provided with NIST traceability for initial calibration and are re-certified, at a minimum, every 3 years with equipment directly traceable to NIST.

6.3.4.2. Working thermometers are compared with the reference thermometers annually according to corporate metrology procedures. Each thermometer is individually numbered and assigned a correction factor based on the NIST reference source. In addition, working thermometers are visually inspected by laboratory personnel prior to use and temperatures are documented.

6.3.4.3. Laboratory thermometer inventory and calibration data are maintained in the Quality department.

6.3.5. **pH/Electrometers**

6.3.5.1. The meter is calibrated before use each day, using fresh buffer solutions. See the analytical method SOP for more specific information.

6.3.6. **Spectrophotometers**

6.3.6.1. During use, spectrophotometer performance is checked at established frequencies in analysis sequences against initial calibration verification (ICV) and continuing calibration verification (CCV) standards.

6.3.7. **Mechanical Volumetric Dispensing Devices**

6.3.7.1. Mechanical volumetric dispensing devices including bottle top dispensers (those that are critical in measuring a required amount of reagent), pipettes, and burettes, excluding Class A volumetric glassware, are checked for accuracy on a quarterly basis.

6.3.7.2. Additional information regarding calibration and maintenance of laboratory support equipment can be found in SOP S-MN-Q-264 **Support Equipment** or its equivalent revision or replacement.

6.4. Instrument/Equipment Maintenance

6.4.1. The objectives of the Pace Analytical maintenance program are twofold: to establish a system of instrument care that maintains instrumentation and equipment at required levels of calibration and sensitivity, and to minimize loss of productivity due to repairs.

6.4.2. The Operations Manager and/or department manager/supervisors are responsible for providing technical leadership to evaluate new equipment, solve equipment problems, and coordinate instrument repair and maintenance. Analysts have the primary responsibility to perform routine maintenance.

6.4.3. To minimize downtime and interruption of analytical work, preventative maintenance is routinely performed on each analytical instrument. Up-to-date instructions on the use and maintenance of equipment are available to staff in the department where the equipment is used.

6.4.4. Department manager/supervisors are responsible for maintaining an adequate inventory of spare parts required to minimize equipment downtime. This inventory includes parts and supplies that are subject to frequent failure, have limited lifetimes, or cannot be obtained in a timely manner should a failure occur.

6.4.5. All major equipment and instrumentation items are uniquely identified to allow for traceability. Equipment/instrumentation is, unless otherwise stated, identified as a system and not as individual pieces. The laboratory maintains equipment records that include the following:

- The name of the equipment and its software
- The manufacturer's name, type, and serial number
- Approximate date received and date placed into service
- Current location in the laboratory
- Condition when received (new, used, etc.)
- Copy of any manufacturer's manuals or instructions
- Dates and results of calibrations and next scheduled calibration (if known)
- Details of past maintenance activities, both routine and non-routine
- Details of any damage, modification or major repairs

6.4.6. All instrument maintenance is documented in maintenance logbooks that are assigned to each particular instrument or system.

6.4.7. The maintenance log entry must include a summary of the results of that analysis and verification by the analyst that the instrument has been returned to an in-control status. In addition, each entry must include the initials of the analyst making the entry, the dates the maintenance actions were performed, and the date the entry was made in the maintenance logbook, if different from the date(s) of the maintenance.

6.4.8. Any equipment that has been subjected to overloading or mishandling, or that gives suspect results, or has been shown to be defective, is taken out of service and clearly identified. The equipment shall not be used to analyze customer samples until it has been repaired and shown to perform satisfactorily. In the event of instrumentation failure, to avoid hold time issues, the lab may subcontract the necessary samples to another Pace lab or to an outside subcontract lab if possible.

7.0. CONTROL OF DATA

Analytical results processing, verification, and reporting are procedures employed that result in the delivery of defensible data. These processes include, but are not limited to, calculation of raw data into final concentration values, review of results for accuracy, evaluation of quality control criteria and assembly of technical reports for delivery to the data user.

All analytical data undergo a well-defined, well-documented multi-tier review process prior to being reported to the customer. This section describes procedures used by PASI for translating raw analytical data into accurate final sample reports as well as PASI data storage policies.

7.1. Analytical Results Processing

7.1.1. When analytical, field, or product testing data is generated, it is either recorded in a bound laboratory logbook (e.g., Run log or Instrument log) or copies of computer-generated printouts that are appropriately labeled and filed. These logbooks and other laboratory records are kept in accordance with each facility's Standard Operating Procedure for documentation storage and archival. If the laboratory chooses to minimize or eliminate its paper usage, these records can be kept on electronic media. In this case, the laboratory must ensure that there are sufficient redundant electronic copies so no data is lost due to unforeseen computer issues.

7.1.2. The primary analyst is responsible for initial data reduction and review. This includes confirming compliance with required methodology, verifying calculations, evaluating quality control data, noting non-conformances in logbooks or as footnotes or narratives, and uploading analytical results into the LIMS. The primary analyst must be clearly identified in all applicable logbooks, spreadsheets and LIMS fields.

7.1.3. The primary analyst then compiles the initial data package for verification. This compilation must include sufficient documentation for data review. It may include standard calibrations, chromatograms, manual integration documentation, electronic printouts, chain of custody forms, and logbook copies.

7.1.4. Some agencies or customers require different levels of data reporting. For these special levels, the primary analyst may need to compile additional project information, such as initial calibration data or extensive spectral data, before the data package proceeds to the verification step.

7.2. Data Verification

7.2.1. Data verification is the process of examining data and accepting or rejecting it based on pre-defined criteria. This review step is designed to ensure that reported data are free from calculation and transcription errors, that quality control parameters are evaluated, and that any non-conformances are properly documented.

7.2.2. Analysts performing the analysis and subsequent data reduction have primary responsibility for quality of the data produced. The primary analyst initiates the data verification process by reviewing and accepting the data, provided QC criteria have been met for the samples being reported. Data review checklists, either hardcopy or electronic, are used to document the data review process. The primary analyst is responsible for the initial input of the data into the LIMS. The primary analyst and reviewer must be clearly identified on all applicable data review checklists.

7.2.3. The completed data package is then sent to a designated qualified reviewer (this cannot be the primary analyst). The following criteria have been established to qualify someone as a data reviewer. To perform secondary data review, the reviewer must:

7.2.3.1. Have a current Demonstration of Capability (DOC) study on file and have an SOP acknowledgement form on file for the method/procedure being reviewed; or, See Note

7.2.3.2. Have a DOC on file for a similar method/technology (i.e., GC/MS) and have an SOP acknowledgment form on file for the method/procedure being reviewed; or, See Note

7.2.3.3. Supervise or manage a Department and have an SOP acknowledgment form on file for the method/procedure being reviewed; or,

7.2.3.4. Have significant background in the department/methods being reviewed through education or experience and have an SOP acknowledgment form on file for the method/procedure being reviewed.

7.2.4. **Note:** Secondary reviewer status must be approved personally by the SQM/QM or SGM/GM/AGM/OM in the event that this person has no prior experience on the specific method or general technology.

7.2.5. This reviewer provides an independent technical assessment of the data package and technical review for accuracy according to methods employed and laboratory protocols. This assessment involves a quality control review for use of the proper methodology and detection limits, compliance to quality control protocol and criteria, presence and completeness of required deliverables, and accuracy of calculations and data quantitation. The reviewer validates the data entered into the LIMS and documents approval of manual integrations.

7.2.6. Once the data have been technically reviewed and approved, authorization for release of the data from the analytical section is indicated by initialing and dating the data review checklist or otherwise initialing and dating the data (or designating the review of data electronically). The Operations or Project Manager examines the report for method appropriateness, detection limits and QC acceptability. Any deviations from the referenced methods are checked for documentation and validity, and QC corrective actions are reviewed for successful resolution. Alternately, final reports can be set to auto email to the client after the analytical results are final and have been run through the Data Checker program for errors. These are set up on a case-by-case basis.

7.2.7. Additional information regarding data review procedures can be found in SOP S-MN-L-132 **Data Review** or its equivalent revision or replacement, as well as in SOP S-MN-Q-214 **Manual Integration** or its equivalent revision or replacement.

7.2.8. The Data Checker program will process validated data for a given project against a set of pre-determined requirements and known chemistry relationships. The program creates a report that includes a series of warnings and errors for any requirement or condition determined to be suspect or incorrect. These warnings and error counts are displayed on the "Project Inquiry by Client" screen and on the final Data Checker reports. For projects that have any number of warnings or errors, the Data Checker report will provide a message that identifies the source and condition of the error or warning.

7.2.9. Some reports and/or data packages may be reviewed by the QM or SQM or designee based on program requirements (e.g., DoD) or client requirements. In this case a thorough review for completeness and accuracy may include a compilation of raw data and QC summaries in addition to the final report to produce a full deliverable package. In the case of DoD, 100% of all packages must have a final administrative review (to confirm that primary and secondary reviews were completed and documented and that data packages are complete) and 10% of all data packages must be reviewed by the

Quality Manager for technical completeness/accuracy. This 10% review can be done after the data packages have been submitted to the clients. See SOP S-MN-Q-271 (or equivalent replacement), **Audits and Inspections**, for full Quality department final report and raw data review requirements.

7.3. Data Reporting

7.3.1. Data for each analytical fraction pertaining to a particular PASI project number are delivered to the Project Manager for assembly into the final report. All points mentioned during technical and QC reviews are included in data qualifiers on the final report or in a separate case narrative if there is potential for data to be impacted.

7.3.2. Final reports are prepared according to the level of reporting required by the customer and can be transmitted to the customer via hardcopy or electronic deliverable. A standard PASI final report consists of the following components:

7.3.2.1. A title which designates the report as “Final Report”, “Laboratory Results”, “Certificate of Results”, etc.;

7.3.2.2. Name and address of laboratory (or subcontracted laboratories, if used);

7.3.2.3. Phone number and name of laboratory contact to where questions can be referred;

7.3.2.4. A unique identification number for the report. The pages of the report shall be numbered and a total number of pages shall be indicated;

7.3.2.5. Name and address of customer and name of project;

7.3.2.6. Unique identification of samples analyzed as well as customer sample IDs;

7.3.2.7. Identification of any sample that did not meet acceptable sampling requirements of the relevant governing agency, such as improper sample containers, holding times missed, sample temperature, etc.;

7.3.2.8. Date and time of collection of samples, date of sample receipt by the laboratory, dates of sample preparation and analysis, and times of sample preparation and analysis when the holding time for either is 72 hours or less;

7.3.2.9. Identification of the test methods used;

7.3.2.10. Identification of sampling procedures if sampling was conducted by the laboratory;

7.3.2.11. Deviations from, additions to, or exclusions from the test methods. These can include failed quality control parameters, deviations caused by the matrix of the sample, etc., and can be shown as a case narrative or as defined footnotes to the analytical data;

7.3.2.12. Identification of whether calculations were performed on a dry or wet-weight basis;

7.3.2.13. Reporting limits used;

7.3.2.14. Final results or measurements, supported by appropriate chromatograms, charts, tables, spectra, etc.;

7.3.2.15. A signature and title, electronic or otherwise, of person accepting responsibility for the content of the report;

7.3.2.16. Date report was issued;

7.3.2.17. A statement clarifying that the results of the report relate only to the samples tested or to the samples as they were received by the laboratory;

7.3.2.18. If necessary, a statement indicating that the report must not be reproduced except in full, without the written approval of the laboratory;

7.3.2.19. Identification of all test results provided by a subcontracted laboratory or other outside source;

7.3.2.20. Identification of results obtained outside of quantitation levels.

In addition to the requirements listed above, final reports shall also contain the following items when necessary for the interpretation of results:

7.3.2.21. Deviations from, additions to, or exclusions from the test method, and information on specific test conditions, such as environmental conditions;

7.3.2.22. Where relevant, a statement of compliance/non-compliance with requirements and/or specifications (e.g., the TNI standard);

7.3.2.23. Where applicable, a statement on the estimated uncertainty of measurement; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a customer's instruction so requires, or when the uncertainty affects compliance to a specification limit;

7.3.2.24. Where appropriate and needed, opinions and interpretations, which may include opinions on the compliance/non-compliance of the results with requirements, fulfillment of contractual requirements, recommendations on how to use the results, and guidance to be used for improvement;

7.3.3. Additional items may be required per Client QAPPs or different state regulations. Ohio VAP requires an Affidavit that must summarize if there are any exceptions to what has been reported, this includes, but is not limited to, itemizing any analytes that the laboratory is not approved for under the VAP program. Any analytes reported that are not part of a scope of accreditation or approval program must be clearly indicated on the final report and associated paperwork such as an Affidavit.

7.3.4. For DoD labs, in reference to item 7.3.2.8 listed above, both date and time of preparation and analysis are considered essential information, regardless of the length of the holding time, and shall be included as part of the laboratory report.

7.3.5. Any changes made to a final report shall be designated as "Revised" or equivalent wording. The laboratory must keep sufficient archived records of all laboratory reports and revisions. For higher levels of data deliverables, a copy of all supporting raw data is sent to the customer along with a final report of results. When possible, the PASI facility will provide electronic data deliverables (EDD) as required by contracts or upon customer request.

7.3.6. Customer data that requires transmission by telephone, telex, facsimile or other electronic means undergoes appropriate steps to preserve confidentiality.

7.3.7. The following positions are the only approved signatories for PASI final reports:

- Senior General Manager
- General Manager
- Assistant General Manager
- Senior Quality Manager
- Quality Manager

- Client Services Manager
- Project Manager
- Project Coordinator

7.4. Data Security

7.4.1. All data including electronic files, logbooks, extraction/digestion/distillation worksheets, calculations, project files and reports, and any other information used to produce the technical report are maintained secured and retrievable by the PASI facility.

7.5. Data Archiving

7.5.1. All records compiled by PASI are maintained legible and retrievable and stored secured in a suitable environment to prevent loss, damage, or deterioration by fire, flood, vermin, theft, and/or environmental deterioration. Records are retained for a minimum of five years unless superseded by federal, state, contractual, and/or accreditation requirements. These records may include, but are not limited to, customer data reports, calibration and maintenance of equipment, raw data from instrumentation, quality control documents, observations, calculations, and logbooks. These records are retained in order to provide for possible historical reconstruction including sampling, receipt, preparation, analysis, and personnel involved. TNI-related records will be made readily available to accrediting authorities. Access to archived data is documented and controlled by the SQM/QM or a designated Data Archivist.

7.5.2. Records that are computer generated have either a hard copy or electronic write protected backup copy. Hardware and software necessary for the retrieval of electronic data is maintained with the applicable records. Archived electronic records are stored protected against electronic and/or magnetic sources.

7.5.3. In the event of a change in ownership, accountability or liability, reports of analyses performed pertaining to accreditation will be maintained by the acquiring entity for a minimum of five years. In the event of bankruptcy, laboratory reports and/or records will be transferred to the customer and/or the appropriate regulatory entity upon request.

7.6. Data Disposal

7.6.1. Data that has been archived for the facility's required storage time may be disposed of in a secure manner by shredding, returning to customer, or utilizing some other means that does not jeopardize data confidentiality. Records of data disposal will be archived for a minimum of five years unless superseded by federal, contractual, and/or accreditation requirements. Data disposal includes any preliminary or final reports that are disposed.

7.6.2. For Ohio VAP labs, all documents and data prepared or acquired in connection to VAP work must be retained for a period of 10 years after the data of reporting. After 10 years, if the laboratory wishes to dispose of the records, the laboratory must notify the VAP agency by certified mail of such intent and provide the agency an opportunity to request the materials from Pace. The documents must not be disposed of until notification has been received in response to the Pace request for disposal.

8.0. QUALITY SYSTEM AUDITS AND REVIEWS

8.1. Internal Audits

8.1.1. Responsibilities

8.1.1.1. The SQM/QM is responsible for designing and/or conducting internal audits in accordance with a predetermined schedule and procedure. Since internal audits represent an independent assessment of laboratory functions, the auditor must be functionally independent from laboratory operations to ensure objectivity. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation. The SQM/QM evaluates audit observations and verifies the completion of corrective actions. In addition, a periodic corporate audit will be conducted. The corporate audits will focus on the effectiveness of the Quality System as outlined in this manual but may also include other quality programs applicable to an individual laboratory.

8.1.2. Scope and Frequency of Internal Audits

8.1.2.1. The complete internal audit process consists of the following four sections:

- Raw Data Review audits- conducted according to a schedule per local SQM/QM. A certain number of these data review audits are conducted per quarter to accomplish this yearly schedule;
- Quality System audits- considered the traditional internal audit function and includes analyst interviews to help determine whether practice matches method requirements and SOP language;
- Final Report reviews;
- Corrective Action Effectiveness Follow-up.

8.1.2.2. Internal systems audits are conducted yearly at a minimum. The scope of these audits includes evaluation of specific analytical departments or a specific quality related system as applied throughout the laboratory.

8.1.2.3. Where the identification of non-conformities or departures cast doubt on the laboratory's compliance with its own policies and procedures, the lab must ensure that the appropriate areas of activity are audited as soon as possible. Examples of system-wide elements that can be audited include:

- Quality Systems documents, such as Standard Operating Procedures, training documents, Quality Assurance Manual, and all applicable addenda
- Data records and non-technical documents
- Personnel and training files.
- General laboratory safety protocols.
- Chemical handling practices, such as labeling of reagents, solutions, and standards as well as all associated documentation.
- Documentation concerning equipment and instrumentation, calibration/maintenance records, operating manuals.
- Sample receipt and management practices.
- Analytical documentation, including any discrepancies and corrective actions.

- General procedures for data security, review, documentation, reporting, and archiving.
- Data integrity issues such as proper manual integrations.

8.1.2.4. When the operations of a specific department are evaluated, a number of additional functions are reviewed including:

- Detection limit studies
- Internal chain of custody documentation
- Documentation of standard preparations
- Quality Control limits and Control charts

8.1.2.5. Certain projects may require an internal audit to ensure laboratory conformance to site work plans, sampling and analysis plans, QAPPs, etc.

8.1.2.6. A representative number of data audits are completed annually. Findings from these data audits are handled in the same manner as those from other internal and external audits.

8.1.2.7. The laboratory, as part of their overall internal audit program, ensures that a review is conducted with respect to any evidence of inappropriate actions or vulnerabilities related to data integrity. Discovery and reporting of potential data integrity issues are handled in a confidential manner. All investigations that result in findings of inappropriate activity are fully documented, including the source of the problem, the samples and customers affected the impact on the data, the corrective actions taken by the laboratory, and which final reports had to be re-issued. Customers must be notified within 30 days after the data investigation is completed and the impact to final results is assessed.

8.1.3. Internal Audit Reports and Corrective Action Plans

8.1.3.1. Additional information can be found in SOP S-MN-Q-271 **Internal and External Audits** or its equivalent revision or replacement.

8.1.3.2. A full description of the audit, including the identification of the operation audited, the date(s) on which the audit was conducted, the specific systems examined, and the observations noted are summarized in an internal audit report. Although other personnel may assist with the performance of the audit, the SQM/QM writes and issues the internal audit report identifying which audit observations are deficiencies that require corrective action.

8.1.3.3. When audit findings cast doubt on the effectiveness of the operations or on the correctness of validity of the laboratory's environmental test results, the laboratory will take timely corrective action and notify the customer in writing within three business days, if investigations show that the laboratory results may have been affected.

8.1.3.4. Once completed, the internal audit report is issued jointly to the SGM/GM/AGM/OM and the manager(s)/supervisor(s) of the audited operation at a minimum. The responsible manager(s)/supervisor(s) responds within 14 days with a proposed plan to correct all of the deficiencies cited in the audit report. The SQM/QM may grant additional time for responses to large or complex deficiencies (not to exceed 30 days). Each response must include timetables for completion of all proposed corrective actions.

8.1.3.5. The SQM/QM reviews the audit responses. If the response is accepted, the SQM/QM uses the action plan and timetable as a guideline for verifying completion of the corrective action(s). If

the SQM/QM determines that the audit response does not adequately address the correction of cited deficiencies, the response will be returned for modification.

8.1.3.6. To complete the audit process, the SQM/QM performs a re-examination of the areas where deficiencies were found to verify that all proposed corrective actions have been implemented. An audit deficiency is considered closed once implementation of the necessary corrective action has been audited and verified. This is usually within 60-90 days after implementation. If corrective action cannot be verified, the associated deficiency remains open until that action is completed.

8.2. External Audits

8.2.1. PASI laboratories are audited regularly by regulatory agencies to maintain laboratory certifications and by customers to maintain appropriate specific protocols.

8.2.2. Audit teams external to the company review the laboratory to assess the effectiveness of systems and degree of technical expertise. The SQM/QM and other QA staff host the audit team and assist in facilitation of the audit process. Generally, the auditors will prepare a formalized audit report listing deficiencies observed and follow-up requirements for the laboratory. In some cases, items of concern are discussed during a debriefing convened at the end of the on-site review process.

8.2.3. The laboratory staff and supervisors develop corrective action plans to address any deficiencies with the guidance of the SQM/QM. The SGM/GM/AGM/OM provides the necessary resources for staff to develop and implement the corrective action plans. The SQM/QM collates this information and provides a written response to the audit team. The response contains the corrective action plan and expected completion dates for each element of the plan. The SQM/QM follows-up with the laboratory staff to ensure corrective actions are implemented and that the corrective action was effective.

8.3. Quarterly Quality Reports

8.3.1. The SQM/QM is responsible for preparing a quarterly report to management summarizing the effectiveness of the laboratory Quality Systems. This status report will include:

- Overview of quality activities for the quarter
- Certification status
- Proficiency Testing study results
- SOP revision activities
- Internal audit (method/system) findings
- Manual integration audit findings (Mintminer)
- Raw Data and Final Report review findings
- MDL activities
- Other significant Quality System items

8.3.2. The Corporate Director of Quality utilizes the information from each laboratory to make decisions impacting the quality program compliance of the company as a whole. Each SGM/GM/AGM/OM utilizes the quarterly report information to make decisions impacting Quality Systems and operational systems at a local level.

8.3.3. Additional information can be found in SOP S-ALL-Q-014 **Quality System Review** or its equivalent revision or replacement.

8.4. Annual Managerial Review

8.4.1. A managerial review of Management and Quality Systems is performed on an annual basis at a minimum. This allows for assessing program effectiveness and introducing changes and/or improvements.

8.4.2. The managerial review must include the following topics of discussion:

- Suitability of quality management policies and procedures
- Manager/Supervisor reports
- Internal audit results
- Corrective and preventive actions
- External assessment results
- Proficiency testing studies
- Sample capacity and scope of work changes
- Customer feedback, including complaints
- Recommendations for improvement,
- Other relevant factors, such as quality control activities, resources, and staffing.

8.4.3. This managerial review must be documented for future reference by the SQM/QM and copies of the report are distributed to laboratory staff. Results must feed into the laboratory planning system and must include goals, objectives, and action plans for the coming year. The laboratory shall ensure that any actions identified during the review are carried out within an appropriate and agreed upon timescale.

8.5. Customer Service Reviews

8.5.1. As part of the annual managerial review listed previously, the sales staff is responsible for reporting on customer feedback, including complaints. The acquisition of this information is completed by performing surveys.

8.5.2. The sales staff continually receives customer feedback, both positive and negative, and reports this feedback to the laboratory management in order for them to evaluate and improve their management system, testing activities and customer service.

8.5.3. In addition, the labs must be willing to cooperate with customers or their representatives to clarify customer requests and to monitor the laboratory's performance in relation to the work being performed for the customers. This cooperation may include providing the customer reasonable access to relevant areas of the lab for the witnessing of tests being performed; or the preparation of samples or data deliverables to be used for verification purposes.

8.5.4. Customer service is an important aspect to Pace's overall objective of providing a quality product. Good communication should be provided to the customer's throughout projects. The lab should inform the customer of any delay or major deviations in the performance of analytical tests.

9.0. CORRECTIVE ACTION

Additional information can be found in SOP S-MN-Q-262 **Corrective and Preventive Actions** or its equivalent revision or replacement.

During the process of sample handling, preparation, and analysis, or during review of quality control records, or during reviews of non-technical portions of the lab, certain occurrences may warrant the necessity of corrective actions. These occurrences may take the form of analyst errors, deficiencies in quality control, method deviations, or other unusual circumstances. The Quality System of PASI provides systematic procedures for the documentation, monitoring, completion of corrective actions, and follow-up verification of the effectiveness of these corrective actions. This can be done using PASI's LabTrack system or other system that lists among at a minimum, the deficiency by issue number, the deficiency source, responsible party, root cause, resolution, due date, and date resolved.

9.1. Corrective Action Documentation

9.1.1. The following items are examples of sources of laboratory deviations or non-conformances that warrant some form of documented corrective action:

- Internal Laboratory Non-Conformance Trends
- PE/PT Sample Results
- Internal and External Audits
- Data or Records Review (including non-technical records)
- Client Complaints
- Client Inquiries
- Holding Time violations

9.1.2. Documentation of corrective actions may be in the form of a comment or footnote on the final report that explains the deficiency (e.g., matrix spike recoveries outside of acceptance criteria) or it may be a more formal documentation (either paper system or computerized spreadsheet). This depends on the extent of the deficiency, the impact on the data, and the method or customer requirements for documentation.

9.1.3. The person who discovers the deficiency or non-conformance initiates the corrective action documentation on the Non-Conformance Corrective/ Preventive Action report and/or LabTrack. The documentation must include the affected projects and sample numbers, the name of the applicable Project Manager, the customer name, and the sample matrix involved. The person initiating the corrective action documentation must also list the known causes of the deficiency or non-conformance as well as any corrective/preventative actions that they have taken. Preventive actions must be taken in order to prevent or minimize the occurrence of the situation.

9.1.4. In the event that the laboratory is unable to determine the cause, laboratory personnel and management staff will start a root cause analysis by going through an investigative process. During this process, the following general steps must be taken into account: defining the non-conformance, assigning responsibilities, determining if the condition is significant, and investigating the root cause of the nonconformance. General non-conformance investigative techniques follow the path of the sample through the process looking at each individual step in detail. The root cause must be documented within LabTrack or on the Corrective/Preventive Action Report.

9.1.5. After all the documentation is completed, the routing of the Corrective/Preventive Action Report and /or LabTrack will continue from the person initiating the corrective action, to their immediate supervisor or the applicable Project Manager and finally to the SQM/QM, if applicable, who may be responsible for final review and signoff of corrective/preventive actions.

9.1.6. In the event that analytical testing or results do not conform to documented laboratory policies or procedures, customer requirements, or standard specifications, the laboratory shall investigate the significance of the non-conformance and document appropriate corrective actions. The proper level of laboratory management will review any departure from these requirements for technical suitability. These departures are permitted only with the approval of the SGM/GM/AGM/OM or the SQM/QM. Where necessary, Project Management will notify the customer of the situation and will advise of any ramifications to data quality (with the possibility of work being recalled). The procedures for handling non-conforming work are detailed in SOP S-MN-Q-262 **Corrective and Preventive Actions** or its equivalent revision or replacement.

9.2. Corrective Action Completion

9.2.1. Internal Laboratory Non-Conformance Trends

9.2.1.1. There are several types of non-conformance trends that may occur in the laboratory that would require the initiation of a corrective action report. Laboratories may choose to initiate a corrective action for all instances of one or more of these categories if they so choose, however the intent is that each of these would be handled according to its severity; one time instances could be handled with a footnote or qualifier whereas a systemic problem with any of these categories may require an official corrective action process. These categories, as defined in the Corrective Action SOP are as follows:

- Login error
- Preparation Error
- Contamination
- Calibration Failure
- Internal Standard Failure
- LCS Failure
- Laboratory accident
- Spike Failure
- Instrument Failure
- Final Reporting error

9.2.2. PE/PT Sample Results

9.2.2.1. Any PT result assessed as “not acceptable” requires an investigation and applicable corrective actions. The operational staff is made aware of the PT failures and they are responsible for reviewing the applicable raw data and calibrations and list possible causes for error. The SQM/QM reviews their findings and initiates another external PT sample or an internal PT sample to try and correct the previous failure. Replacement PT results must be monitored by the SQM/QM and reported to the applicable regulatory authorities.

9.2.3. Internal and External Audits

9.2.3.1. The SQM/QM is responsible for documenting all audit findings and their corrective actions. This documentation must include the initial finding, the persons responsible for the

corrective action, the due date for responding to the auditing body, the root cause of the finding, and the corrective actions needed for resolution. The SQM/QM is also responsible for providing any back-up documentation used to demonstrate that a corrective action has been completed.

9.2.4. **Data Review**

9.2.4.1. In the course of performing primary and secondary review of data or in the case of raw data reviews (e.g., by the SQM/QM), errors may be found which require corrective actions. Any finding that affects the quality of the data requires some form of corrective action, which may include revising and re-issuing of final reports.

9.2.5. **Client Complaints**

9.2.5.1. Project Managers are responsible for issuing corrective action forms, when warranted, for customer complaints. As with other corrective actions, the possible causes of the problem are listed and the form is passed to the appropriate analyst or supervisor for investigation. After potential corrective actions have been determined, the Project Manager reviews the corrective action form to ensure all customer needs or concerns are being adequately addressed.

9.2.6. **Client Inquiries**

9.2.6.1. When an error on the customer report is discovered, the Project Manager is responsible for initiating a formal corrective action form that describes the failure (e.g., incorrect analysis reported, reporting units are incorrect, or reporting limits do not meet objectives). The Project Manager is also responsible for revising the final report if necessary and submitting it to the customer.

9.2.7. **Holding Time Violations**

9.2.7.1. In the event that a holding time has been missed, the analyst or supervisor must complete a formal corrective action form. The Project Manager and the SQM/QM must be made aware of all holding time violations.

9.2.7.2. The Project Manager must contact the customer in order that appropriate decisions are made regarding the hold time excursion and the ultimate resolution is then documented and included in the customer project file.

9.3. Preventive Action Documentation

9.3.1. Pace laboratories can take advantage of several available information sources in order to identify needed improvements in all of their systems including technical, managerial, and quality. These sources may include:

- Management Continuous Improvement Plan (CIP) metrics which are used by all production departments within Pace. When groups compare performance across the company, ways to improve systems may be discovered. These improvements can be made within a department or laboratory-wide.
- Annual managerial reviews- part of this TNI-required and NVLAP-required review is to look at all processes and procedures used by the laboratory over the past year and to determine ways to improve these processes in the future.
- Quality systems reviews- any frequent checks of quality systems (monthly logbook reviews, etc.) can uncover issues that can be corrected or adjusted before they become a larger issue.

9.3.2. When improvement opportunities are identified or if preventive action is required, the laboratory can develop, implement, and monitor preventive action plans.

10.0. GLOSSARY

The source of some of the definitions is indicated previous to the actual definition (e.g., TNI, DoD).

Terms and Definitions	
3P Program	The Pace Analytical continuous improvement program that focuses on Process, Productivity, and Performance. Best Practices are identified that can be used by all PASI labs.
Acceptance Criteria	TNI and DoD- Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accreditation	TNI and DoD- The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.
Accreditation Body	DoD- Authoritative body that performs accreditation.
Accuracy	TNI and DoD- The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Aliquot	DoD- A discrete, measured, representative portion of a sample taken for analysis.
Analysis	A combination of sample preparation and instrument determination.
Analysis Code (Acode)	All the set parameters of a test, such as Analytes, Method, Detection Limits and Price.
Analysis Sequence	A compilation of all samples, standards and quality control samples run during a specific amount of time on a particular instrument in the order they are analyzed.
Analyst	TNI and DoD- The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.
Analyte	DoD- The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family and are analyzed together.
Analytical Uncertainty	TNI- A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Assessment	TNI - The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its system to defined criteria (to the standards and requirements of laboratory accreditation). DoD- The evaluation process used to measure the performance or effectiveness of a system and its elements against specific criteria. Note: In this standard (DoD), assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection, or surveillance.
Atomic Absorption Spectrometer	Instrument used to measure concentration in metals samples.
Atomization	DoD -A process in which a sample is converted to free atoms.

Audit	TNI- A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. DoD- A systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity.
Batch	TNI and DoD- Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed 20 samples. South Carolina- same definition as TNI except 24 hours should be changed to 8 hours.
Bias	TNI- The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).
Blank	TNI and DoD- A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.
Blind Sample	DoD-A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
BNA (Base Neutral Acid compounds)	A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment.
BOD (Biochemical Oxygen Demand)	Chemical procedure for determining how fast biological organisms use up oxygen in a body of water.
Calibration	TNI and DoD- A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve	TNI- The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. DoD- The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Method	DoD- A defined technical procedure for performing a calibration.
Calibration Range	DoD- The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range.
Calibration Standard	TNI- A substance or reference material used for calibration. DoD- A substance or reference material used to calibrate an instrument.
Certified Reference Material (CRM)	TNI- Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. DoD- A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body.
Chain of Custody	DoD- An unbroken trail of accountability that verifies the physical security of samples, data, and records.
Chain of custody Form (COC)	TNI and DoD- Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and type of containers; the mode of collection, the collector, time of collection; preservation; and requested analyses.
Chemical Oxygen Demand (COD)	A test commonly used to indirectly measure the amount of organic compounds in water.
Client (referred to by ISO as Customer)	DoD- Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations.
Code of Federal Regulations (CFR)	A codification of the general and permanent rules published in the Federal Register by agencies of the federal government.
Comparability	An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques.
Completeness	The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is: % Completeness = (Valid Data Points/Expected Data Points)*100
Confirmation	TNI and DoD- Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to: second-column confirmation; alternate wavelength; derivatization; mass spectral interpretation; alternative detectors; or additional cleanup procedures.
Conformance	DoD- An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.

Congener	DoD- A member of a class of related chemical compounds (e.g., PCBs, PCDDs).
Consensus Standard	DoD- A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof.
Continuing Calibration Blank (CCB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method.
Continuing Calibration Check Compounds (CCC)	Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column.
Continuing Calibration Verification	DoD- The verification of the initial calibration. Required prior to sample analysis and at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models.
Continuing Calibration Verification (CCV) Standard	Also referred to as a CVS in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method.
Continuous Emission Monitor (CEM)	A flue gas analyzer designed for fixed use in checking for environmental pollutants.
Contract Laboratory Program (CLP)	A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality.
Contract Required Detection Limit (CRDL)	Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts.
Contract Required Quantitation Limit (CRQL)	Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts.
Control Chart	A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit)
Control Limit	A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data.
Correction	DoD- Action taken to eliminate a detected non-conformity.
Corrective Action	DoD- The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence. A root cause analysis may not be necessary in all cases.
Corrective and Preventative Action (CAPA)	The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes.
Customer	DoD- Any individual or organization for which products or services are furnished or work performed in response to defined requirements and expectations.

Data Quality Objective (DQO)	Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user.
Data Reduction	TNI- The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more usable form.
Definitive Data	DoD- Analytical data of known quantity and quality. The levels of data quality on precision and bias meet the requirements for the decision to be made. Data that is suitable for final decision-making.
Demonstration of Capability	TNI- A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. DoD- A procedure to establish the ability of the analyst to generate analytical results by a specific method that meet measurement quality objectives (e.g., for precision and bias).
Detection Limit (DL)	DoD- The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration at the 99% confidence. At the DL, the false positive rate (Type 1 error) is 1%. A DL may be used as the lowest concentration for reliably reporting a detection of a specific analyte in a specific matrix with a specific method with 99% confidence.
Diesel Range Organics (DRO)	A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific).
Digestion	DoD- A process in which a sample is treated (usually in conjunction with heat and acid) to convert the sample to a more easily measured form.
Document Control	DoD- The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.
Documents	DoD- Written components of the laboratory management system (e.g., policies, procedures, and instructions).
Dry Weight	The weight after drying in an oven at a specified temperature.
Duplicate (also known as Replicate or Laboratory Duplicate)	DoD- The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.
Electron Capture Detector (ECD)	Device used in GC methods to detect compounds that absorb electrons (e.g., PCB compounds).
Electronic Data Deliverable (EDD)	A summary of environmental data (usually in spreadsheet form) which clients request for ease of data review and comparison to historical results.
Eluent	DoD- A solvent used to carry the components of a mixture through a stationary phase.
Elute	DoD- To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent.
Elution	DoD- A process in which solutes are washed through a stationary phase by movement of a mobile phase.
Environmental Data	DoD- Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology.

Environmental Monitoring	DoD- The process of measuring or collecting environmental data.
Environmental Sample	A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows: • Non Potable Water (Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts) • Drinking Water - Delivered (treated or untreated) water designated as potable water • Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents • Sludge - Municipal sludges and industrial sludges. • Soil - Predominately inorganic matter ranging in classification from sands to clays. • Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes
Equipment Blank	A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures.
Facility	A distinct location within the company that has unique certifications, personnel and waste disposal identifications.
False Negative	DoD- A result that fails to identify (detect) an analyte or reporting an analyte to be present at or below a level of interest when the analyte is actually above the level of interest.
False Positive	DoD- A result that erroneously identifies (detects) an analyte or reporting an analyte to be present above a level of interest when the analyte is actually present at or below the level of interest.
Field Blank	A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken.
Field Measurement	Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and space to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory.
Field of Accreditation	TNI- Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.
Finding	TNI- An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement. DoD- An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive, negative, or neutral and is normally accompanied by specific examples of the observed condition. The finding must be linked to a specific requirement (e.g., this standard (DoD QSM), ISO requirements, analytical methods, contract specifications, or laboratory management systems requirements).

Flame Atomic Absorption Spectrometer (FAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame.
Flame Ionization Detector (FID)	A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured.
Gas Chromatography (GC)	Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times.
Gas Chromatograph/ Mass Spectrometry (GC/MS)	In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra).
Gasoline Range Organics (GRO)	A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific).
Graphite Furnace Atomic Absorption Spectrometry (GFAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes.
High Pressure Liquid Chromatography (HPLC)	Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase.
Holding Time	TNI- The maximum time that can elapse between two specified activities. 40 CFR Part 136- The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised. For sample prep purposes, hold times are calculated using the time of the start of the preparation procedure. DoD- The maximum time that may elapse from the time of sampling to the time of preparation or analysis, or from preparation to analysis, as appropriate.
Homogeneity	The degree to which a property or substance is uniformly distributed throughout a sample.
Homologue	DoD- One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. For instance, methanol, ethanol, propanol, butanol, etc., form a homologous series.
Improper Actions	DoD- Intentional or unintentional deviations from contract-specified or method-specified analytical practices that have not been authorized by the customer (e.g., DoD or DOE).
Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)	Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths.
Inductively Coupled Plasma- Mass Spectrometry (ICP/MS)	An ICP-AES that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice.

Infrared Spectrometer (IR)	An instrument that uses infrared light to identify compounds of interest.
Initial Calibration (ICAL)	The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method.
Initial Calibration Blank (ICB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. This blank is specifically run in conjunction with the Initial Calibration Verification (ICV) where applicable.
Initial Calibration Verification (ICV)	DoD- Verifies the initial calibration with a standard obtained or prepared from a source independent of the source of the initial calibration standards to avoid potential bias of the initial calibration.
Inspection	DoD- An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic.
Instrument Blank	DoD- A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.
Instrument Detection Limits (IDLs)	Limits determined by analyzing a series of reagent blank analyses to obtain a calculated concentration. IDLs are determined by calculating the average of the standard deviations of three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day.
Interference, spectral	DoD- Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible.
Interference, chemical	DoD- Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte.
Internal Standards	TNI and DoD- A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.
Intermediate Standard Solution	Reference solutions prepared by dilution of the stock solutions with an appropriate solvent.
International System of Units (SI)	DoD- The coherent system of units adopted and recommended by the General Conference on Weights and Measures.
Ion Chromatography (IC)	Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules.
Isomer	One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. For example, hexane (C6H14) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane.
Laboratory	DoD- A body that calibrates and/or tests.

Laboratory Control Sample (LCS)	TNI and DoD- (however named, such as laboratory fortified blank (LFB), spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of all or a portion of the measurement system.
Laboratory Duplicate	DoD- Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.
Laboratory Information Management System (LIMS)	A computer system that is used to maintain all sample information from sample receipt, through preparation and analysis and including sample report generation.
LabTrack	Database used by Pace Analytical to store and track corrective actions and other laboratory issues.
Learning Management System (LMS)	A web-based database used by the laboratories to track and document training activities. The system is administered by the corporate training department and each laboratory's learn centers are maintained by a local administrator.
Legal Chain-of-Custody Protocols	TNI- Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain-of-Custody (COC) Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.
Limit(s) of Detection (LOD)	TNI- A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. DoD- The smallest concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate is 1%.
Limit(s) of Quantitation (LOQ)	TNI- The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. DoD- The smallest concentration that produces a quantitative result with known and recorded precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard and within the calibration range.
Linear Dynamic Range	DoD- Concentration range where the instrument provides a linear response.
Liquid chromatography/ tandem mass spectrometry (LC/MS/MS)	Instrumentation that combines the physical separation techniques of liquid chromatography with the mass analysis capabilities of mass spectrometry.
Lot	A quantity of bulk material of similar composition processed or manufactured at the same time.
Management	DoD- Those individuals directly responsible and accountable for planning, implementing, and assessing work.

Management System	DoD- System to establish policy and objectives and to achieve those objectives.
Manager (however named)	DoD- The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual.
Matrix	TNI and DoD- The substrate of a test sample.
Matrix Duplicate	TNI- A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.
Matrix Spike (MS) (spiked sample or fortified sample)	TNI- A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. DoD- A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate)	TNI and DoD- A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.
Measurement Performance Criteria (MPC)	Criteria that may be general (such as completion of all tests) or specific (such as QC method acceptance limits) that are used by a project to judge whether a laboratory can perform a specified activity to the defined criteria.
Measurement System	TNI and DoD- A test method, as implemented at a particular laboratory, and which includes the equipment used to perform the sample preparation, test and the operator(s).
Measurement Uncertainty	An estimate of the error in a measurement often stated as a range of values that contain the true value, within a certain confidence level. The uncertainty generally includes many components which may be evaluated from experimental standard deviations based on repeated observations or by standard deviations evaluated from assumed probability distributions based on experience or other information. For DoD/DOE, a laboratory's Analytical Uncertainty (such as use of LCS control limits) can be reported as the minimum uncertainty.
Method	TNI- A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.
Method Blank	TNI and DoD- A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit (MDL)	DoD- One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
Method of Standard Additions	DoD- A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration.
MintMiner	Program used by Pace Analytical to review large amounts of chromatographic data to monitor for errors or data integrity issues.
Mobile Laboratory	TNI- A portable enclosed structure with necessary and appropriate accommodation and environmental conditions for a laboratory, within which testing is performed by analysts. Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel.
National Institute of Standards and Technology (NIST)	TNI- A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI).
National Pollutant Discharge Elimination System (NPDES)	A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters.
Negative Control	DoD- Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.
Nitrogen Phosphorus Detector (NPD)	A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon.
Nonconformance	DoD- An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements.
Not Detected (ND)	The result reported for a compound when the detected amount of that compound is less than the method reporting limit.
Operator Aid	A technical posting (such as poster, operating manual, or notepad) that assists workers in performing routine tasks. All operator aids must be controlled documents (i.e., a part of the laboratory management system).
Performance Based Measurement System (PBMS)	An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner.
Photo-ionization Detector (PID)	An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions.
Polychlorinated Biphenyls (PCB)	A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity.
Positive Control	DoD- Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.
Post-Digestion Spike	A sample prepared for metals analyses that has analytes spike added to determine if matrix effects may be a factor in the results.
Power of Hydrogen (pH)	The measure of acidity or alkalinity of a solution.

Practical Quantitation Limit (PQL)	Another term for a method reporting limit. The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions.
Precision	TNI and DoD- The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.
Preservation	TNI- Any conditions under which a sample must be kept in order to maintain chemical, physical, and/or biological integrity prior to analysis. DoD- Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.
Procedure	TNI- A specified way to carry out an activity or process. Procedures can be documented or not.
Proficiency Testing	TNI and DoD- A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.
Proficiency Testing Program	TNI and DoD- The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories.
Proficiency Testing Sample (PT)	TNI- A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria. DoD- A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.
Protocol	TNI and DoD- A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed.
Qualitative Analysis	DoD- Analysis designed to identify the components of a substance or mixture.
Quality Assurance (QA)	TNI- An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client. DoD- An integrated system of activities involving planning, quality control, quality assessment, reporting, and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.
Quality Assurance Manual (QAM)	A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality Assurance Project Plan (QAPP)	DoD- A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.

Quality Control (QC)	TNI- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. DoD- The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of the users.
Quality Control Sample (QCS)	TNI- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. DoD- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking.
Quality Manual	TNI and DoD- A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality System	TNI and DoD- A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control activities.

Quality System Matrix	TNI and DoD- These matrix definitions are to be used for purposes of batch and quality control requirements: • **Air and Emissions**: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device • **Aqueous**: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts. • **Biological Tissue**: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin. • **Chemical Waste**: A product or by-product of an industrial process that results in a matrix not previously defined. • **Drinking Water**: Any aqueous sample that has been designated a potable or potentially potable water source. • **Non-aqueous liquid**: Any organic liquid with <15% settleable solids • **Saline/Estuarine**: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake. • **Solids**: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.
Quantitation Range	DoD- The range of values (concentrations) in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard. The quantitation range lies within the calibration range.
Quantitative Analysis	Analysis designed to determine the amounts or proportions of the components of a substance.
Random Error	The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases.
Raw Data	TNI- The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. DoD- Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.
Reagent Blank (method reagent blank)	DoD- A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.

Reagent Grade	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
Records	DoD- The output of implementing and following management system documents (e.g., test data in electronic or hand-written forms, files, and logbooks).
Reference Material	TNI- Material or substance one or more of whose property values are sufficiently homogenized and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. DoD- A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.
Reference Standard	TNI- Standard used for the calibration of working measurement standards in a given organization or at a given location. DoD- A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.
Reference Toxicant	DoD- The toxicant used in performing toxicity tests to indicate the sensitivity of a test organism and to demonstrate the laboratory's ability to perform the test correctly and obtain consistent results.
Relative Percent Difference (RPD)	A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements.
Reporting Limit (RL)	The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e., statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL. DoD- A customer-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.
Reporting Limit Verification Standard (or otherwise named)	A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level.
Representativeness	A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan.
Requirement	DoD- Denotes a mandatory specification; often designated by the term "shall".
Retention Time	DoD- The time between sample injection and the appearance of a solute peak at the detector.
Sample	DoD- Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis.
Sample Condition Upon Receipt Form (SCURF)	Form used by Pace Analytical sample receiving personnel to document the condition of sample containers upon receipt to the laboratory (used in conjunction with a COC).

Sample Delivery Group (SDG)	A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently.
Sample Receipt Form (SRF)	Letter sent to the client upon login to show the tests requested and pricing.
Sample Tracking	Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a Chain of custody Form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples.
Sampling	TNI- Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.
Selective Ion Monitoring (SIM)	A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector.
Selectivity	TNI- The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. DoD- The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances.
Sensitivity	TNI and DoD- The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.
Serial Dilution	The stepwise dilution of a substance in a solution.
Shall	DoD- Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification as long as the requirement is fulfilled.
Should	DoD- Denotes a guideline or recommendation whenever noncompliance with the specification is permissible.
Signal-to-Noise Ratio (S/N)	DoD- S/N is a measure of signal strength relative to background noise. The signal carries information about the analyte, while noise is made up of extraneous information that is unwanted because it degrades the accuracy and precision of an analysis and also places a lower limit on the amount of analyte that can be detected. The average strength of the noise of most measurements is constant and independent of the magnitude of the signal. Thus, as the quantity being measured (producing the signal) decreases in magnitude, S/N decreases and the effect of the noise on the relative error of a measurement increases.
Spike	DoD- A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.
Standard (Document)	TNI and DoD- The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.

Standard (Chemical)	DoD- Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method.
Standard Blank (or Reagent Blank)	A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background.
Standard Method	DoD- A test method issued by an organization generally recognized as competent to do so.
Standard Operating Procedure (SOP)	TNI- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. DoD- A written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.
Standard Reference Material (SRM)	DoD- A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method.
Statement of Qualifications (SOQ)	A document that lists information about a company, typically the qualifications of that company to compete on a bid for services.
Stock Standard	A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source.
Storage Blank	DoD- A sample of analyte-free media prepared by the laboratory and retained in the sample storage area of the laboratory. A storage blank is used to record contamination attributable to sample storage at the laboratory.
Supervisor	DoD- The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses.
Surrogate	DoD- A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.
Systems Audit	An on-site inspection or assessment of a laboratory's quality system.
Target Analytes	DoD- Analytes or chemicals of primary concern, identified by the customer on a project-specific basis.
Technical Director	DoD- Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory.
Technology	TNI- A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Test	DoD- A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate.
Test Method	DoD- A definitive procedure that determines one or more characteristics of a given substance or product.
Test Methods for Evaluating Solid Waste, Physical/ Chemical (SW-846)	EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations.
Total Petroleum Hydrocarbons (TPH)	A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc.
Toxicity Characteristic Leaching Procedure (TCLP)	A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill.
Traceability	TNI- The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. DoD- The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.
Training Document	A training resource that provides detailed instructions to execute a specific method or job function.
Trip Blank	This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples.
Tuning	DoD- A check and/or adjustment of instrument performance for mass spectrometry as required by the method.
Ultraviolet Spectrophotometer (UV)	Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds.
Uncertainty Measurement	The parameter associated with the result of a measurement that characterized the dispersion of the values that could be reasonably attributed to the measurand (i.e. the concentration of an analyte).
Unethical actions	DoD- Deliberate falsification of analytical or quality control results, where failed method or contractual requirements are made to appear acceptable.
Unregulated Contaminate Monitoring Rule (UCMR)	EPA program to monitor unregulated contaminates in drinking water.

Validation	DoD- The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
Verification	TNI and DoD- Confirmation by examination and objective evidence that specified requirements have been met. Note: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.
Whole Effluent Toxicity (WET)	The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent).
Work Cell	DoD- A well-defined group of analysts that together perform the method analysis. The members of the group and their specific functions within the work cell must be fully documented.

11.0. REFERENCES

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11.3. "Methods for Chemical Analysis of Water and Wastes", EPA 600-4-79-020, 1979 Revised 1983, U.S. EPA.

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11.11. Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.

11.12. Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079C.

11.13. Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February, 1992.

11.14. Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July, 1990.

11.15. Requirements for Quality Control of Analytical Data for the Environmental Restoration Program, Martin Marietta, ES/ER/TM-16, December, 1992.

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11.17. National Environmental Laboratory Accreditation Conference, Constitution, Bylaws, and Standards. Most recent version.

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11.19. Department of Defense Quality Systems Manual (QSM), version 5.0, March 2013.

11.20. TNI (The NELAC Institute) Standards; most recent version.

11.21. UCMR3 Laboratory Approval Requirements and Information Document, version 2.0, January 2012.

12.0. REVISIONS

The PASI Corporate Quality Office files both a paper copy and electronic version of a Microsoft Word document with tracked changes detailing all revisions made to the previous version of the Quality Assurance Manual. This document is available upon request. All revisions are summarized in the table below.

Document Number	Reason for Change	Date
Quality Assurance Manual 17.0	Section 1.77: Added HRMS to the breakdown of the laboratory department Section 2.6.5: Updated facility codes. Section 2.10: Added exception to Air canisters for sample retention Section 6.2.3.4: Reworded language regarding calibrations. Section 6.2.7.8: Removed OhioVAP as it is no longer pertain to the lab Section 6.3.7.1: Removed last sentence about syringes. Section 6.4.8: Added sentence about instrumentation failure. Section 7.2.6: Added language regarding auto email function. Section 7.5.1.1: Added red letter section for special data retention requirements. Section 9.2.7.2: Removed sentence regarding hold time reporting by QMs. Section 10: Updated DoD definitions per DoD/DOE QSM, revision 5.0. Also added definitions for LC/MS/MS and UCMR. Section 11: Revised DoD reference and added UCMR3 reference. Attachment VIII: added several drinking water methods and added note 4 regarding hexavalent holding time and preservation. Section 4.0: included a statement that refers the reader to the SOPs for detail Section 4.2.9: clarified MS cannot be used in place of the LCS for Ohio VAP project Section 4.3.8 and 4.4.1: indicated that the results are optional for Ohio VAP project Section 4.5.1.3: added that TO-15 surrogates are not evaluated for Ohio VAP samples 6.2.2: added exception for Ohio VAP sample Section 7.3.3: added Ohio VAP requirement for affidavit Attachment IIA-IIC: updated to current version Attachment III: updated to contain the most current information Attachment IVB: updated to new address floor plan Attachment V: updated list of SOPs to reflect the current use Attachment VI: updated expiration date Attachment VIII: added Additional Volume for MS/MSD column Included Pace-Virginia and Duluth information for a regional quality manual throughout the document.	13May2014
Quality Assurance Manual 17.1	Section 4.12.1: Changed NIST PT providers to TNI and state regulatory Attachment V-VI: Separated Virginia and Duluth to have its own individual tables Attachment II-III, V-VI: Updated to most current version Attachment IVC- Removed Duluth	18June2014

ATTACHMENT I- QUALITY CONTROL CALCULATIONS

PERCENT RECOVERY (%REC)

$$\%REC = \frac{(MSConc - SampleConc)}{TrueValue} * 100$$

NOTE: The SampleConc is zero (0) for theLCS and Surrogate Calculations

PERCENT DIFFERENCE (%D)

$$\%D = \frac{MeasuredValue - TrueValue}{TrueValue} * 100$$

where:
TrueValue = Amount spiked (can also be the $\overline{CF}$ or $\overline{RF}$ of the ICAL Standards)
Measured Value = Amount measured (can also be the CF or RF of the CCV)

PERCENT DRIFT

$$\%Drift = \frac{CalculatedConcentration - TheoreticalConcentration}{TheoreticalConcentrtion} * 100$$

RELATIVE PERCENT DIFFERENCE (RPD)

$$RPD = \frac{|(R1 - R2)|}{(R1 + R2)/2} * 100$$

where:
R1 = Result Sample 1
R2 = Result Sample 2

CORRELATION COEFFICIENT (R)

$$CorrCoeff = \frac{\sum_{i=1}^{N} W_i * (X_i - \overline{X}) * (Y_i - \overline{Y})}{\sqrt{\left(\sum_{i=1}^{N} W_i * (X_i - \overline{X})^2\right) * \left(\sum_{i=1}^{N} W_i * (Y_i - \overline{Y})^2\right)}}$$

With:		
	N	Number of standard samples involved in the calibration
	i	Index for standard samples
	Wi	Weight factor of the standard sample no. i
	Xi	X-value of the standard sample no. i
	X(bar)	Average value of all x-values
	Yi	Y-value of the standard sample no. i
	Y(bar)	Average value of all y-values

ATTACHMENT I- QUALITY CONTROL CALCULATIONS (CONTINUED)

STANDARD DEVIATION (S)

$$S = \sqrt{\sum_{i=1}^{n} \frac{(X_i - \overline{X})^2}{(n-1)}}$$

where:
n = number of data points
X_i = individual data point
$\overline{X}$ = average of all data points

AVERAGE ($\overline{X}$)

$$\overline{X} = \frac{\sum_{n=1}^{i} X_i}{n}$$

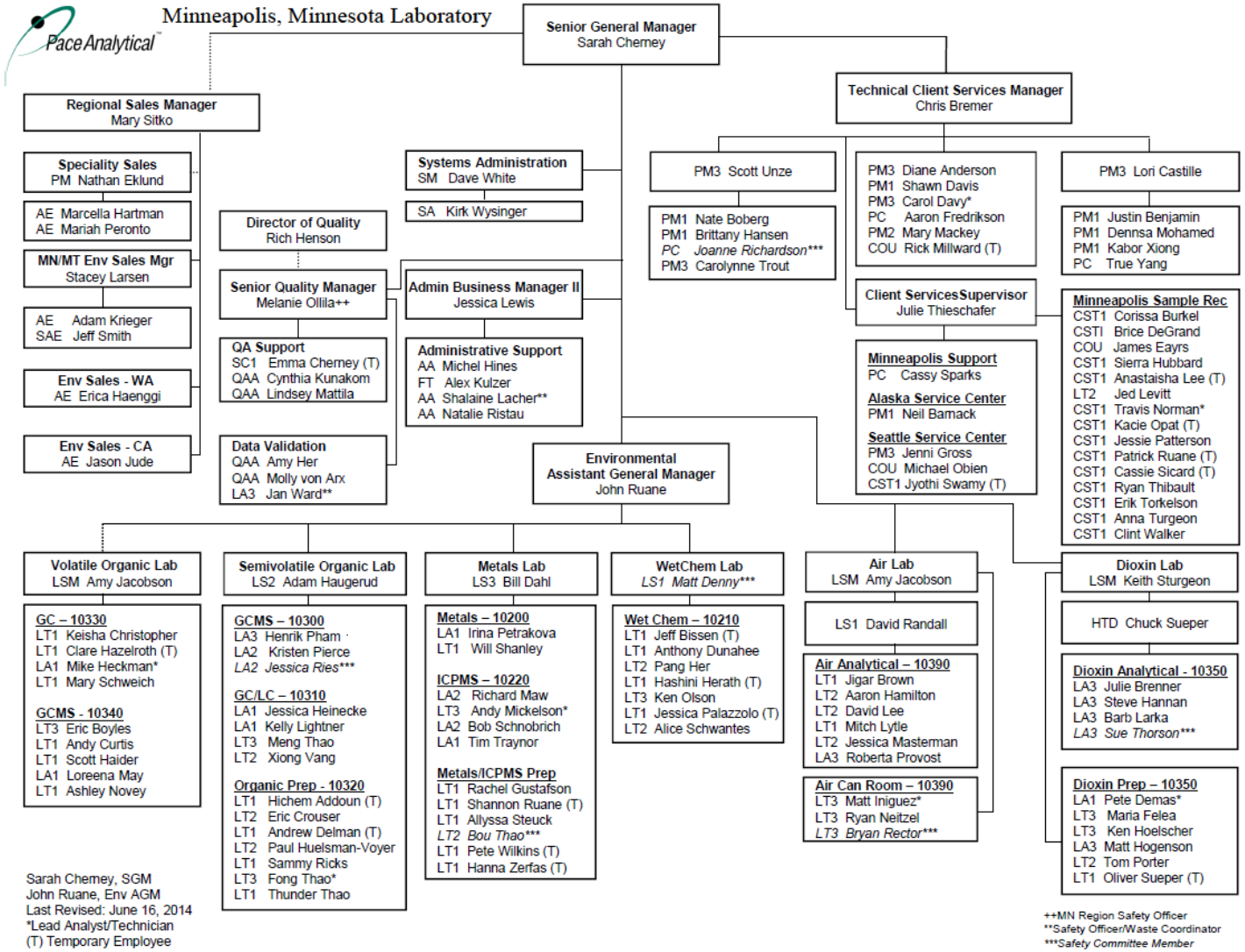
where:
n = number of data points
X_i = individual data point

RELATIVE STANDARD DEVIATION (RSD)

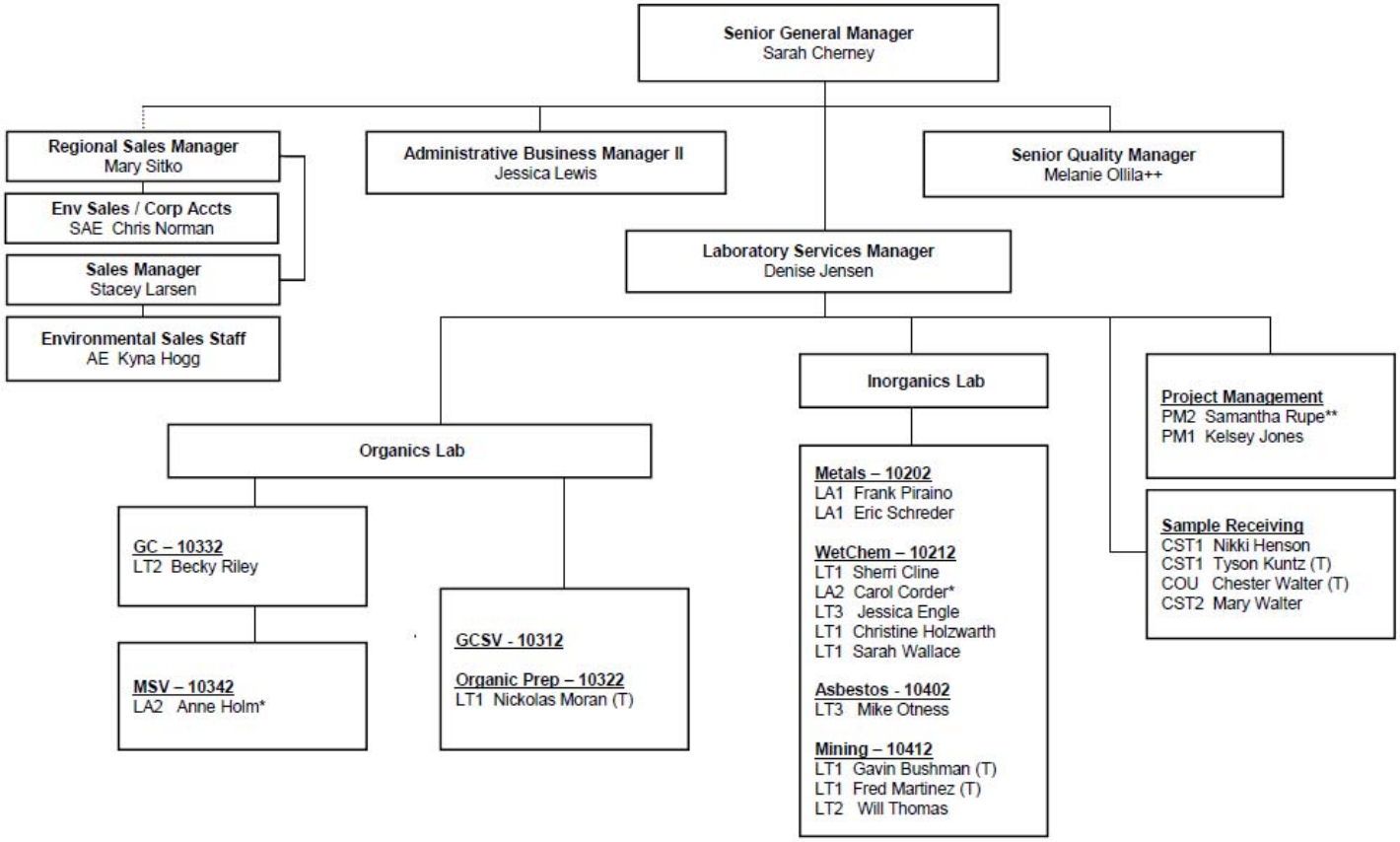
$$RSD = \frac{S}{\overline{X}} * 100$$

where:
S = Standard Deviation of the data points
$\overline{X}$ = average of all data points

ATTACHMENT IIA- MINNEAPOLIS LABORATORY ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)



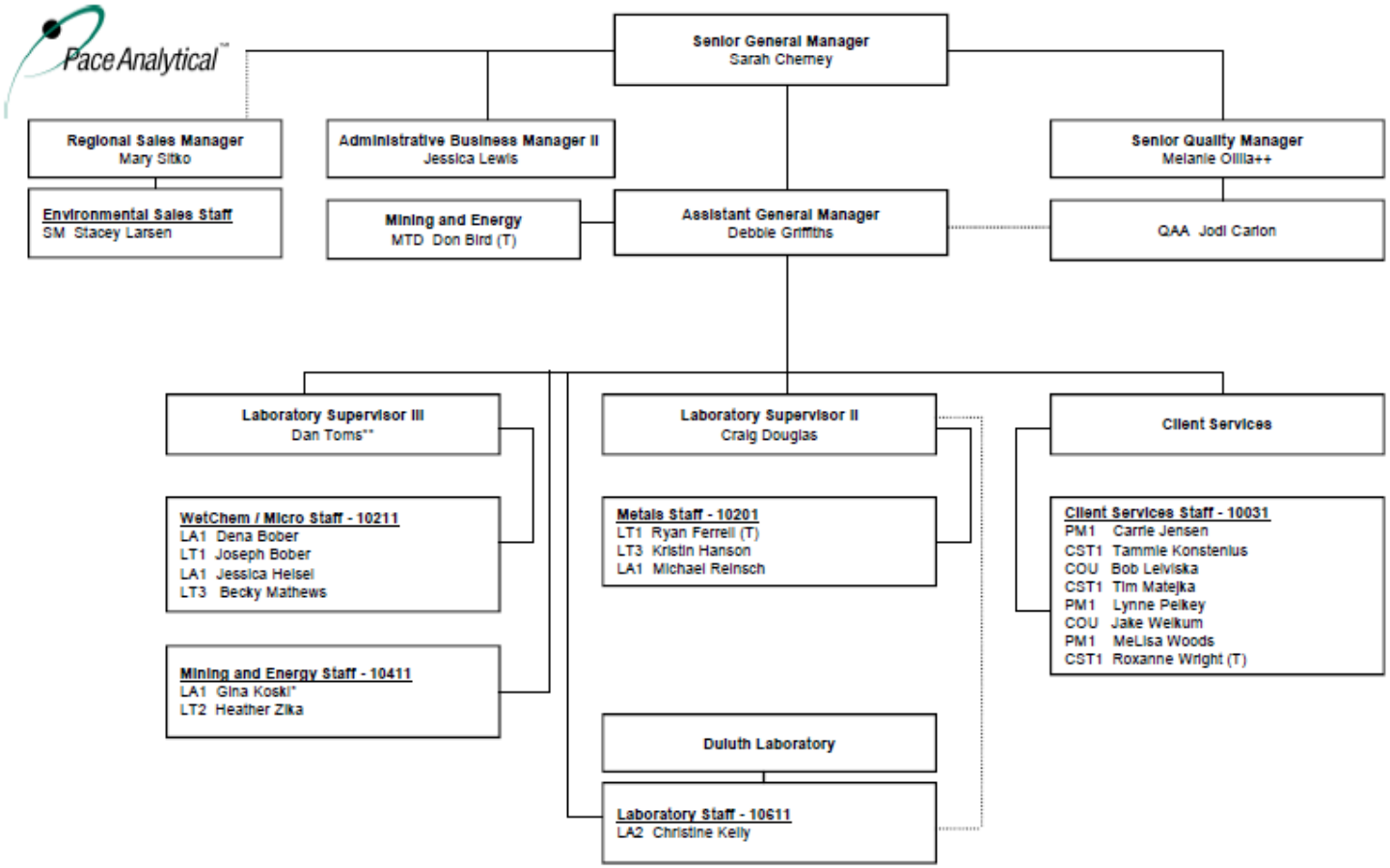
ATTACHMENT IIB- MONTANA LABORATORY ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)



Sarah Cherney, General Manager
Last Revised: June 06, 2014
*Lead Analyst/Technician
**Safety Officer
(T) Temporary Employee

Billings, Montana Laboratory

ATTACHMENT IIC- VIRGINIA AND DULUTH LABORATORY ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)



Sarah Cherney, Senior General Manager
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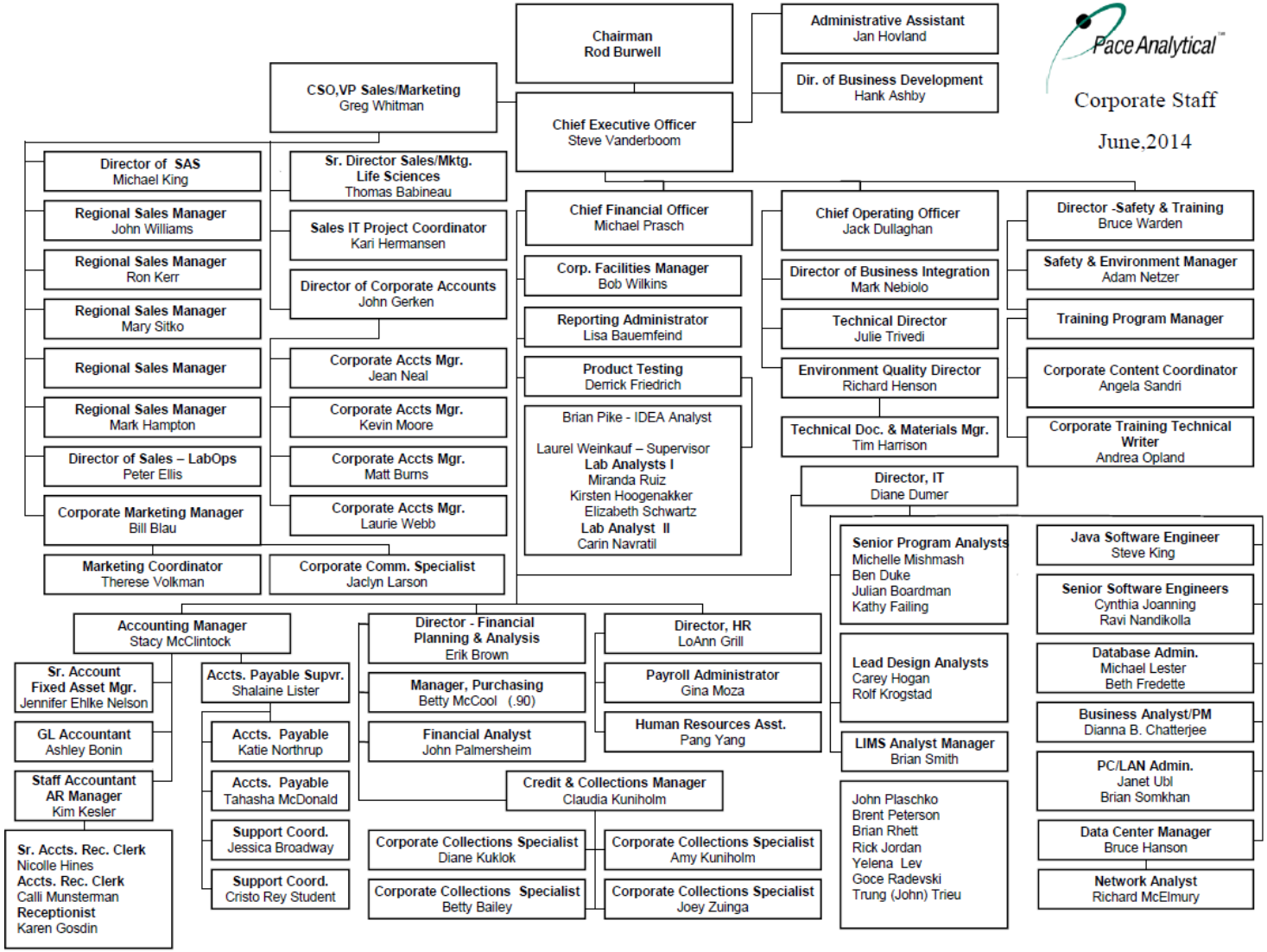
Last Revised: May 29, 2014
*Lead Analyst/Technician
++MN Region Safety Officer
**Safety Officer
****Safety Committee Member*
(T) Temporary Employee

Virginia and Duluth, Minnesota Laboratories

ATTCHMENT IID- CORPORATE ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)



ATTACHMENT IIIA- MINNEAPOLIS EQUIPMENT LIST (CURRENT AS OF ISSUE DATE)

DEPT	INSTRUMENT	ID	MANUFACTURER	MODEL	ANALYSIS
Air	GC	10AIR0	Agilent Technologies	6890N	TO-15
Air	MS	10AIR0	Agilent Technologies	5973 Network	TO-15
Air	Concentrator	10AIR0	Entech Instruments, Inc.	7100A	TO-15
Air	GC	10AIR5	HP	5890	3C
Air	GC	10AIR7	Agilent Technologies	6890N	TO-15
Air	MS	10AIR7	Agilent Technologies	5973 Network	TO-15
Air	Concentrator	10AIR7	Entech Instruments, Inc.	7100A	TO-15
Air	GC	10AIR9	Agilent Technologies	G1530A	RSK 175
Air	Headspace Sampler	10AIR9	Agilent Technologies	G1888	RSK 175
Air	GC	10AIRA	ALS Ready	6890A	TO3 BTEX
Air	Concentrator	10AIRA	Entech Instruments, Inc.	7100A	TO3 BTEX
Air	MS	10AIRB	Agilent Technologies	5973 inert	TO-15
Air	GC	10AIRB	Agilent Technologies	6890	TO-15
Air	Concentrator	10AIRB	Markes	Unity2	TO-15
Air	Autosampler	10AIRB	Markes	CIA Advantage/CIA Satellite	TO-15
Air	GC	10AIRD	Agilent Technologies	7890A	TO14/15
Air	MS	10AIRD	Agilent Technologies	5975C	TO14/15
Air	Concentrator	10AIRD	Entech Instruments, Inc.	7100A	TO14/15
Air	Autosampler	10AIRE	Agilent Technologies	7693	TO17
Air	MS	10AIRE	Agilent Technologies	5975C	TO17
Air	GC	10AIRE	Agilent Technologies	7890A	TO17
Air	Thermal Desorber	10AIRE	Perkin Elmer	Turbomatrix 650	TO17
Air	GC	10AIRF	Perkin Elmer	Clarus 680	Method Development
Air	MS	10AIRF	Perkin Elmer	Clarus SQ 8 C	Method Development
Air	Thermal Desorber	10AIRF	PerkinElmer	Turbomatrix 650	Method Development
Air	Canister Autosampler	AIR7T1	Entech Instruments, Inc.	7016 CA	TO-15
Air	Canister Autosampler	AIR7T2	Entech Instruments, Inc.	7016 CA	TO-15
Air	Canister Autosampler	AIRBT1	Entech Instruments, Inc.	7016 CA	TO-15
Air	Canister Autosampler	AIRBT2	Entech Instruments, Inc.	7016 CA	TO-15
Air	Canister Autosampler	AIR0T1	Entech Instruments, Inc.	7016 CA	TO-15
Air	Canister Autosampler	AIR0T3	Entech Instruments, Inc.	7016 CA	TO-15
Air	Canister Autosampler	AIRD	Entech Instruments, Inc.	7016 CA	TO-15
Air	Canister Autosampler	AIRD	Entech Instruments, Inc.	7016 CA	TO-15
Air	Can Cleaning Rack	Rack 1	Pace	na	

ATTACHMENT IIIA- MINNEAPOLIS EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Air	Can Cleaning Rack	Rack 2	Pace	na	
Air	Can Cleaning Rack	Rack 3	Pace	na	
Air	Oven	10AIR10	Despatch	LDB Series	General-Air
Air	Pirani and Diaphragm Gauge	10AIR12	Vacuum Research Corp	902034	
Air	Pirani and Diaphragm Gauge	10AIR13	Vacuum Research Corp	902034	
Air	Pirani and Diaphragm Gauge	10AIR20	Vacuum Research Corp	902034	
Air	Pirani and Diaphragm Gauge	10AIR11	Vacuum Research Corp	902034	
HRMS	GCMS	10MSHR09	Agilent	6890N	1613/8290/Mthd 23,29/TO9/DW
HRMS	GCMS	10MSHR09	Waters/Micromass	Autospec Premier	1613/8290/Mthd 23,29/PCB
HRMS	GCMS	10MSHR06	Agilent	6890A	1613/8290/Mthd 23,29/1614
HRMS	GCMS	10MSHR06	Waters/Micromass	Autospec Ultima	1613/8290/Mthd 23,29
HRMS	GCMS	10MSHR10	Thermo Scientific	Trace GC Ultra	1613 DW
HRMS	GCMS	10MSHR10	Thermo Scientific	Trace GC Ultra	1613 DW
HRMS	GCMS	10MSHR10	Thermo Scientific	DFS High Resolution Magnetic Sector MS	1613 DW
HRMS	GCMS	10MSHR11	Thermo Scientific	Trace GC Ultra	1613 DW
HRMS	GCMS	10MSHR11	Thermo Scientific	Trace GC Ultra	1613 DW
HRMS	GCMS	10MSHR11	Thermo Scientific	DFS High Resolution Magnetic Sector MS	1613 DW
HRMS	GCMS	10MSHR05	Agilent	6890A	1613/8290/Mthd 23,29/DW/PCB
HRMS	GCMS	10MSHR05	Waters/Micromass	Autospec Ultima	1613/8290/Mthd 23,29
Dioxin DW	balance	10BAL1	Denver Inst	MXX-5001	1613
Dioxin Prep	balance	10BAL2	A&D	EK4100i	8290, 1613, 1668, 1614
Dioxin Prep	Micro 100 Turbidimeter	10HR14	Scientific Inc.	Micro 100 Turbidimeter	Turbidity
Dioxin Prep	Microwave	10HR13	CEM	MarsXpress	8290/1613 Solid & wipes, 1668A short list & 209 solids
Dioxin Prep	N-EVAP	N-EVAP 1	Organomation	112	General - HRMS prep
Dioxin Prep	N-EVAP	N-EVAP 2	Organomation	112	General - HRMS prep
Dioxin Prep	N-EVAP	N-EVAP 3	Organomation	112	General - HRMS prep
Dioxin Prep	Accelerated Solvent Extractor	10HR12	ACE	200	General - HRMS prep
Dioxin Prep	N-EVAP	DW1	Organomation	8125	General - HRMS prep
Dioxin Prep	N-EVAP	DW2	Organomation	8125	General - HRMS prep
Dioxin Prep	N-EVAP	N-EVAP 4	Organomation	8125	General - HRMS prep
Dioxin Prep	N-EVAP	N-EVAP 5	Organomation	8125	General - HRMS prep
Dioxin Prep	N-EVAP	N-EVAP 6	Organomation	8125	General - HRMS prep
Dioxin Prep	Oven	DP4	Lindberg Blue	GO1340A-1	General - HRMS prep
Metals	ICPMS	10ICM3	Thermo Scientific	Xseries 2	Metals

ATTACHMENT IIIA- MINNEAPOLIS EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Metals	ICPMS	10ICM4	Thermo Scientific	XII	Metals
Metals	ICPMS	10ICM5	Thermo Scientific	XII	Metals
Metals	ICPMS	10ICM8	Aglient 7700	G3281A	6020, 200.8
Metals	ICPMS	10ICM9	Aglient 7700	G3281A	
Metals	ICP	10ICP2	Perkin Elmer Instruments	Optima 4300 DV	Metals
Metals	ICP	10ICP3	Perkin Elmer Instruments	Optima 4300 DV	Metals
Metals	Mercury Analyzer	10HG3	Cetac Quick Trace	M-7500	Mercury
Metals	Mercury Autosampler	10HG3	ASX-520	MAS Ver w/Diluter	Mercury
Metals	Mercury Analyzer	10HG4	Cetac	M7600	Mercury
Metals	Heat Plate	10MET25	Cole Parmer	HS19 C-P	
Metals	Hot Block	10MET02	Environmental Express	SC154	6010/Mercury/6020/200.8/method 29
Metals	Hot Block	10MET03	Environmental Express	na	6010/Mercury/6020/200.8/method 29
Metals	Hot Block	10MET04	Environmental Express	na	6010/Mercury/6020/200.8/method 29
Metals	Hot Block	10MET05	Thomas Cain Inc.	Deena 60	Metals Prep
Metals	Hot Block	10MET08	Environmental Express	NA	Metals Prep
Metals	Hot Block	10MET09	Environmental Express	NA	Metals Prep
Metals	Hot Block	10MET10	Environmental Express	NA	Metals Prep
Metals	Hot Block	10MET22	Environmental Express	SC154	
Metals	Hot Block	10MET23	Environmental Express	SC154	6010, 6020, 200.7 and 200.8
Metals	Hot Block	10MET26	Environmental Express	SC154	
Metals	Tumbler	10MET06	Associated Design & Mfg. Co.	3740-24**BRE**	TCLP Prep
Metals	Tumbler	10MET20	Environmental Express	na	Metals Prep
Metals	balance	10BALD	Mettler	PM600	various soil methods
Metals	balance	10BAL4	A&D	EK-610i	6010, 200.7, 200.8, 6020, 7470, 7471, 245.1
Metals	balance	10WETD	Mettler-Toledo	PB602-5	6010, 200.7, 200.8, 6020
Metals	balance	10BAL3	Sartorius	BP 110 S	equipment calibrations
Metals	balance	10BAL5	A&D	FX1200i	1311, 1312
O-Prep	UltraSonicator	10OP17	Branson	8510	General - Oprep
O-Prep	Sonicator	10OP01	Misonix	XL 2020	3550
O-Prep	Sonicator	10OP02	Misonix	XL 2015	3550
O-Prep	Sonicator	10OP03	Misonix	Sonicator 3000	3550
O-Prep	Sonicator	10OP04	Misonix	Sonicator 3000	3550
O-Prep	Soxtherm	10OP06	Gerhardt	na	8082
O-Prep	Soxtherm	10OP07	Gerhardt	na	8082

ATTACHMENT IIIA- MINNEAPOLIS EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

O-Prep	Soxtherm	10OP08	Gerhardt	na	8082
O-Prep	Soxtherm	10OP09	Gerhardt	na	8082
O-Prep	N-EVAP	10OP10	Organomation	112	General - Oprep
O-Prep	N-EVAP	10OP11	Organomation	112	General - Oprep
O-Prep	Centrifuge	10OP13	IEC	Centra GP8	General - Oprep
O-Prep	Centrifuge	10OP14	Damon/IEC Division	na	General - Oprep
O-Prep	Centrifuge	10OP15	International Clinical Centrifuge	CL28899M	General - Oprep
O-Prep	balance	10BAL6	A&D	EK-410i	soil prep: AK, 8270, PAH, DRO, 625, 8015, 8081
O-Prep	balance	10BAL7	Denver Inst	MXX-612	soil prep: AK, 8270, PAH, DRO, 625, 8015, 8081
SVOA	GC System	10MSSA	Agilent	7890A	SIM
SVOA	Autosampler Tower	10MSSA	Agilent/HP	7693 Series	SIM
SVOA	Autosampler Tray	10MSSA	Agilent/HP	7693 Series	SIM
SVOA	MS Detector	10MSSA	Agilent/HP	5975C	SIM
SVOA	Peltier Cooling System	10MSSA	Gersel	CIS 4	SIM
SVOA	AutoSampler Tower	10MSSB	Agilent	7863B	SIM, TO13, High Volume Injection
SVOA	GC/Oven	10MSSB	Agilent	7890	SIM, TO13, High Volume Injection
SVOA	MS Detector	10MSSB	Agilent	5975C	SIM, TO13, High Volume Injection
SVOA	AutoSampler Tray	10MSSB	Agilent	7683	SIM, TO13, High Volume Injection
SVOA	Peltier Cooling System	10MSSB	Gersel	CIS 4	SIM, TO13, High Volume Injection
SVOA	GC	10MSSD	Agilent	6890N	8270, PCP SIM
SVOA	MS	10MSSD	Agilent	5975	8270, PCP SIM
SVOA	Autosampler	10MSSD	Agilent	G2614 A	8270, PCP SIM
SVOA	Tower 7683B	10MSSD	Agilent	62915A	8270, PCP SIM
SVOA	MS	10MSS3	HP	5973	CPAH, PCP
SVOA	GC	10MSS3	HP	6890	CPAH, PCP
SVOA	Autosampler Tray	10MSS3	Agilent/HP	7683	CPAH, PCP
SVOA	Injector Tower	10MSS3	Agilent/HP	7683	CPAH, PCP
SVOA	Autosampler Tray	10MSS3	Agilent/HP	7683	CPAH, PCP
SVOA	GC	10MSS6	Agilent	6890N	SIM, PCP
SVOA	Autosampler Tower	10MSS6	Agilent/HP	7683	SIM, PCP
SVOA	MS	10MSS6	Agilent/HP	5973N	SIM, PCP
SVOA	Autosampler Tray	10MSS6	Agilent/HP	7683	SIM, PCP
SVOA	GC	10MSS7	Agilent	6890N	8280
SVOA	Tower 7683	10MSS7	Agilent	62613A	8280
SVOA	Turret 7683	10MSS7	Hewlet Packard	62614A	8280

ATTACHMENT IIIA- MINNEAPOLIS EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

SVOA	Mass Spec 5973	10MSS7	Agilent	62579A	8280
SVOA	AutoSampler Tower	10MSS8	Agilent/HP	7683	Sulfolane, 8270, 625
SVOA	GC/Oven	10MSS8	Agilent	6890 N	Sulfolane, 8270, 625
SVOA	MS Detector	10MSS8	Agilent	5973 N	Sulfolane, 8270, 625
SVOA	AutoSampler Tray	10MSS8	Agilent/HP	7683	Sulfolane, 8270, 625
SVOA	GC/Oven	10MSS9	Agilent	6890 A	8270, 625
SVOA	AutoSampler Tower	10MSS9	Agilent	18593B	8270, 625
SVOA	MS Detector	10MSS9	Agilent	5973 N	8270, 625
SVOA	AutoSampler Tray	10MSS9	Agilent	18596C	8270, 625
SVOA	Dual Microcell ECD	10GCSA	Agilent	6890N	8081
SVOA	Autosampler	10GCSA	Agilent	G2614 A	8081
SVOA	Tower	10GCSB	Agilent	64513A	8081
SVOA	Tray	10GCSB	Agilent	64514A	8081
SVOA	GCECD	10GCSB	Agilent	7890A	8081
SVOA	GC Oven	10GCS4	HP	5890	WIDRO
SVOA	AutoSampler /Tower	10GCS4	HP	7673A	WIDRO
SVOA	AutoSampler Tray	10GCS4	HP	7673A	WIDRO
SVOA	GCECD	10GCS7	Agilent	6890 N	PCB
SVOA	AutoSampler Tray	10GCS7	Agilent/HP	64514A	PCB
SVOA	Tower	10GCS7	HP N279	N279	PCB
SVOA	GC Oven	10GCS8	Agilent	6890 N	8015, NwTPH, AK102, AK103
SVOA	AutoSampler	10GCS8	Agilent/HP	7683	8015, NwTPH, AK102, AK103
SVOA	Tower	10GCS8	Agilent/HP	7683	8015, NwTPH, AK102, AK103
SVOA	GC	10GCS9	Agilent	7890	DRO
SVOA	Tower	10GCS9	Agilent	64513A	DRO
SVOA	Autosampler Tray	10GCS9	Agilent	64514A	DRO
SVOA	GC Oven	10GCSC	Agilent	6890 N	8015, NwTPH, AK102, AK103, WIDRO
SVOA	AutoSampler	10GCSC	Agilent/HP	62614A	8015, NwTPH, AK102, AK103, WIDRO
SVOA	Tower	10GCSC	Agilent/HP	62614A	8015, NwTPH, AK102, AK103, WIDRO
SVOA	balance	10MPR2	Mettler	AE200	Dry Weight Analysis
VOA	AutoSampler	10MSV1	Environmental Sample Tech, Inc.	na	UST, BTEX
VOA	Concentrator	10MSV1	Tekmar	3000	UST, BTEX
VOA	GC	10MSV1	HP	6890	UST, BTEX
VOA	MS	10MSV1	HP	5973	UST, BTEX
VOA	GC	10MSV3	Agilent	6890	8260 Med. Lvl Soil
VOA	AutoSampler	10MSV3	EST Analytical	Centurion	8260 Med. Lvl Soil
VOA	Concentrator	10MSV3	Encon Evolution	na	8260 Med. Lvl Soil

ATTACHMENT IIIA- MINNEAPOLIS EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

VOA	MS	10MSV3	Agilent	5973	8260 Med. Lvl Soil
VOA	AutoSampler	10MSV5	EST Analytical	Centurion	8260/624/TCLP/UST
VOA	Concentrator	10MSV5	Encon Evolution	na	8260/624/TCLP/UST
VOA	GC	10MSV5	HP	6890	8260/624/TCLP/UST
VOA	MS	10MSV5	HP MS	5973	8260/624/TCLP/UST
VOA	AutoSampler	10MSV6	Varian Archon	na	524/8260/624
VOA	Concentrator	10MSV6	Tekmar	3000	524/8260/624
VOA	GC	10MSV6	Agilent	6890A	524/8260/624
VOA	MS	10MSV6	Agilent	5973	524/8260/624
VOA	AutoSampler	10MSV7	Environmental Sample Tech, Inc.	na	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST
VOA	GC	10MSV7	Agilent Technologies	6850	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST
VOA	Concentrator	10MSV7	Tekmar	3000	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST
VOA	MS	10MSV7	Agilent Technologies	5975C	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST
VOA	GC	10MSV8	5975C	5975C	8260/624/TCLP/UST
VOA	AutoSampler	10MSV8	EST Analytical	Centurion	8260/624/TCLP/UST
VOA	Concentrator	10MSV8	Encon Evolution	na	8260/624/TCLP/UST
VOA	MS	10MSV8	Agilent	5975C	8260/624/TCLP/UST
VOA	Concentrator	10MSV9	Tekmar	14-3100-OEL	8260 - oxygenates
VOA	GC	10MSVA	Agilent	6890	
VOA	MS	10MSVA	Agilent	5973	
VOA	autosampler/concentrator	10MSVA	Tekmar	Atomx 15-0000-100	
VOA	Concentrator	10MSVB	EST	Evolution	
VOA	GC	10MSVC	Agilent	6890N	
VOA	AutoSampler	10MSVC	O-I-Analytical Eclipse	Archon 4552	
VOA	Concentrator	10MSVC	O-I-Analytical Eclipse	4660	
VOA	AutoSampler	10GCV1	Environmental Sample Tech, Inc.	na	
VOA	Concentrator	10GCV1	Tekmar Dohrmann	3100	
VOA	AutoSampler	10GCV3	EST Analytical	Centurion	8021, WIGRO
VOA	Concentrator	10GCV3	Tekmar Dohrmann	3000	8021, WIGRO
VOA	GC	10GCV3	HP	5890 Series II	8021, WIGRO
VOA	AutoSampler	10GCV5	Environmental Sample Tech, Inc.	na	8015/NWTPH-Gx/AK101
VOA	Concentrator	10GCV5	Tekmar	3100	8015/NWTPH-Gx/AK101
VOA	GC	10GCV5	HP	G1530A	8015/NWTPH-Gx/AK101
VOA	AutoSampler	10GCV6	EST Analytical	Archon 8100	8021/8015/GRO/NwTPH
VOA	Concentrator	10GCV6	Tekmar	14-3100-EOL	8021/8015/GRO/NwTPH
VOA	GC	10GCV6	Agilent/HP	HP 6890	8021/8015/GRO/NwTPH

ATTACHMENT IIIA- MINNEAPOLIS EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

VOA	AutoSampler	10GCV7	Environmental Sample Technology	Archon	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST
VOA	Concentrator	10GCV7	Tekmar 3000	14-3000-000	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST
VOA	GC	10GCV7	HP	Series II 5890	SIM/8260/624/Low & Med Lvl Soil/TCLP/UST
VOA	AutoSampler	10GCV8	Environmental Sample Technology	Archon	
VOA	Concentrator	10GCV8	Tekmar	3000	
VOA	GC	10GCV8	HP	Series II 5890	
VOA	Oven	10VOA03	Thermo Scientific	NA	General - VOA
VOA	Sonicator	10VOA04	Fisher Scientific	FS220	8260/8021/8015/GRO
VOA	Concentrator	Unassigned	O I Analytical	Eclipse 4660	
VOA	Autosampler	Unassignged	Archon	5100A	
VOA	balance	10BAL9	A&D	FX-3200	
VOA	balance	10BALA	A&D	EK-300i	
VOA	balance	10BALE	Mettler	AE200	
Wet Chem	Incubator	10WET16	Fisher Scientific	Isotemp Incubator	BOD
Wet Chem	Incubator	10WET22	Fisher Scientific	307	BOD
Wet Chem	Incubator	10WET35	Fisher Scientific	307C	BOD
Wet Chem	Incubator	10WET60	Thermo Forma	3940	BOD
Wet Chem	Autotitrator	10WET6	Metrohm	888 Titrando Titrator	Alkalinity SM2320B
Wet Chem	Autosampler	10WET6	Metrohm	778 Sample Processor	Alkalinity SM2320B
Wet Chem	Diss. Oxy Meter	10WET51	YSI	5000	BOD
Wet Chem	Oven	10WET17	Precision Scientific	130 DM	General - Wet Chem
Wet Chem	Oven	10WET20	Fisher Scientific	Isotemp Oven	General - Wet Chem
Wet Chem	AutoClave	10WET29	Harvey	na	General - Wet Chem
Wet Chem	pH Meter	10WET7	Orion	na	pH
Wet Chem	pH Meter	10WET31	IQ Scientific Instruments	na	pH
Wet Chem	Thermoreactor	10WET26	Neutec Group Inc.	ECO 25	COD
Wet Chem	COD Reactor	10WET11	Bioscience, Inc.	na	COD
Wet Chem	KoneLab Discrete Analyzer	10WET3	Thermo Fisher Scientific	Konelab 20	Colormetric - Cl, HexChrom, Cyanide, ophos, NO2, phenol, SO4
Wet Chem	Conductivity meter	10WET9	Oaktom	Con 110 Series	Specific Conductivity
Wet Chem	Colony Counter	10WET30	Gallenkamp	Colony Counter	HPC
Wet Chem	Colony Counter	10WET38	Darkfield Quebec	Colony Counter	HPC
Wet Chem	Water Bath	10WET27	Fisher Scientific	Isotemp 210	General - Wet Chem
Wet Chem	Distillation Block	10WET12	Environmental Express	na	SM4500-P-E
Wet Chem	Distillation Block	10WET13	MIDI-STIL	na	SM4500-P-E

ATTACHMENT IIIA- MINNEAPOLIS EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Wet Chem	Spectrometer	10WETA	Hach	DR 2700	COD
Wet Chem	Hot Plate	10WET34	Presto	Tilt'n Drain Big Griddle	General - Wet Chem
Wet Chem	Smart Chem Discrete Analyzer	10WT36	West Co Scientific Instruments	Smart Chem 200	Colormetric - NH3, NO3, Tphos, cyanide
Wet Chem	Hot Plate	10WET40	Corning	na	General - Wet Chem
Wet Chem	Stir Plate	10WET41	Fisher Scientific	na	General - Wet Chem
Wet Chem	Stir Plate	10WET42	Barnstead/Thermolyne	S46725/Cimarec 2	General - Wet Chem
Wet Chem	Stir Plate	10WET43	Fisher Scientific	na	General - Wet Chem
Wet Chem	Vortex Mixer	10WET44	American Scientific Prod.	S8223-1	General - Wet Chem
Wet Chem	Extractor	10WET45	Horizon Technology	Spe-dex 4790	Oil & Grease
Wet Chem	Extractor	10WET46	Horizon Technology	Spe-dex 4791	Oil & Grease
Wet Chem	Extractor	10WET47	Horizon Technology	Spe-dex 4792	Oil & Grease
Wet Chem	Extractor	10WET48	Horizon Technology	Spe-dex 4793	Oil & Grease
Wet Chem	Closed Cup - Penske	10WT49	Precision Scientific	na	Flash Point
Wet Chem	pH/BOD meter	10WT54	Hach	LBOD10101	BOD
Wet Chem	pH/BOD meter	10WT53	Hach	HQ40d	BOD
Wet Chem	Hot Block	10WET55	Environmental Express	na	COD
Wet Chem	Oven	10WT56	Lindberg/Blue M	MO1450PSA-1	General - Wet Chem
Wet Chem	Oven	10WET65	Fisher Scientific	13-247-650G(6905)	General - Wet Chem
Wet Chem	pH Probe	11662571034	Hach	PHC301	pH
Wet Chem	pH Probe	121952571033	Hach	PHC301	pH
Wet Chem	pH Probe	122143032067	Hach	LBOD101	pH
Wet Chem	pH Probe	712202002	Switchcraft	PHW77-SS	pH
Wet Chem	Turbidity Meter	10WT59	Hach	2100Q	Turbidity
Wet Chem	Hand Held Brix Refractometer	10WT60	Fisher	na	
Wet Chem	Oven	10WET19	VWR Scientific	1370F	General - Wet Chem
Wet Chem	Quanti-Tray Sealer Model 2x	10WET56	Quanti-Tray	89-10894-02	SM9223B
Wet Chem	IC	10WT61	Metrohm	881 Compact IC	EPA Method 300.0
Wet Chem	Lachat	10WT62	Quick Chem	8500	SM4500Cl-E, SM4500P-E, SM3500CrB, EPA 420.4
Wet Chem	Autotitrator	10WT63	Metromn	905 USB Sample Processor	Alkalinity SM2320B
Wet Chem	Fluoride Probe	10WET64	Hanna Instruments	HI 98402	Fluoride
Wet Chem	JT Backer Speedisk Expanded Extration Station	10WET66	J.T. Baker	Speedisk Expanded Extraction Station	
Wet Chem	COD/Cyanide Block (dual reactor, two heat blocks)	10WET67	Hach	DRB 200	COD
Wet Chem	Desiccator	10WET68	Sanplatec Corp	DryKeeper	

ATTACHMENT IIIA- MINNEAPOLIS EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Wet Chem	Desiccator	10WET69	Boekel	na	
Wet Chem	Desiccator	10WET70	Boekel	na	
Wet Chem	Desiccator	10WET71	Boekel	na	
Wet Chem	Desiccator	10WET72	Boekel	na	
Wet Chem	Desiccator	10WET73	Boekel	na	
Wet Chem	Desiccator	10WET74	Boekel	na	
Wet Chem	Desiccator	10WET75	Boekel	na	
Wet Chem	Meter	10WETE	Hach	HQ440d	ph, conductivity, redox
Wet Chem	Oven	10WET77	Fisher Isotemp Oven	6905	General - Wet Chem
Wet Chem	Oven	10WET78	Fisher Isotemp Oven	6905	General - Wet Chem
Wet Chem	balance	10WETB	Sartorius	RC 210 P	9071, 1664
Wet Chem	balance	10BALF	Mettler	AJ100	various
Wet Chem	balance	10BALG	ExplorerPro	EP114C	TSS/TDS
Wet Chem	balance	10BALH	Denver Instrument	MXX-612	various
Wet Chem	balance	10BALB	Ohaus	Scout Pro (SPE 202)	9045, 9071
Wet Chem	balance	10WETC	Sartorius	AC 210 S	TSP, PM10
Wet Chem	balance	10WET4	Mettler-Toledo	AB135-S	2540
Wet Chem	balance	10BALC	Sartorius	LA3200D	humidity cell analysis

ATTACHMENT IIIB- MONTANA EQUIPMENT LIST (CURRENT AS OF ISSUE DATE)

PACE ID	INSTRUMENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER
2048	NIST Thermometer	Ertco	-1 to 100 C	2048
2201	NIST Thermometer	ThermoFisher	-1 to 201 C	2201
111877001	NIST Thermometer	Fisher Scientific	15-077-55; 255NK; FB50262	111855001
133	Thermometer			
1065	Thermometer			
3114	Thermometer			
3146	Thermometer			
2348	Thermometer			
5527	Thermometer			
6000	Thermometer			
6578	Thermometer			
7656	Thermometer			
22734	Thermometer			
10344	Thermometer			
Z180878	Thermometer	Extech Instruments	421502	Z180878
14211	Thermometer	Ertco	-30 - 0 °C	14211
14336	Thermometer	Ertco	-30 - 0 °C	14336
80524569	Thermometer			-
20507	Thermometer	Ertco	-30 - 0 °C	20507
1383045	IR Gun	Oakton	InfraPro	1383045
11BAL0 (24353410)	Balance	Denver	MXX-212	24353410
11BAL1 (14138)	Balance	Fisher	7227DA	14138
11MT09 (40020019)	Balance	Sartorius	LC620S	40020019
11MT07 (B027060)	Balance	Fisher	A200DS	B027060
11BAL2 (G3251202300491)	Balance	Ohaus	ARC120	G3251202300491
11BAL3 (E86392)	Balance	Mettler	AE100	E86392
1000062197	2kg Weight	Troemner	2kg	1000062197
6433380081	5mg Weight	Mettler Toledo	5mg	6433380081
01-J54434-46	Weight Set	Denver Instrument	10 gram	01-J54434-46
01-J54881-26	Weight Set	Denver Instrument	50 gram	01-J54881-26
01-J54942-47 and 01-J54223-43	Weight Set	Denver Instrument	1g & 5g	01-J54942-47 and 01-J54223-43
01-J55139-14	Weight Set	Denver Instrument	100 gram	01-J55139-14
18156	Weight Set	Christian Becker		
99-J51026-14	Weight Set	Denver Instrument	500 gram	99-J51026-14
7628	Weight Set	Troemner	50g,2-20g, 10g, 5g, 2-2g	7628
40111	Weight Set	Troemner	100g, 50g, 2-20g, 10g, 5g, 2-2g, 1g, 100mg, .01mg	40111
99-10964	Weight Set	Denver Instrument	50g, 30g, 20g, 10g, 5g, 3g, 2g, 1g	99-10964
1000016506	0.01 g Weight	Troemner	0.01g	1000016506
11MT03	SVOA GC	Hewlett-Packard	5890A	3235A46830
11MT03	Autosampler	Hewlett-Packard	7673	3120A27948

ATTACHMENT IIIB- MONTANA EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

11MT03	Autosampler	Hewlett-Packard	7673	3048A24383
11MT04	Autosampler	Hewlett-Packard	7673	3225A31213
11MT04	Autosampler	Hewlett-Packard	7673	3120A28856
11MT04	SVOA GC	Hewlett-Packard	5890	275A16778
11MT05	IC Autosampler	Dionex	AS40-1	7101378
11MT05	Ion Chromatograph	Dionex	ICS1000	05120175
11MT06	Autoanalyzer Autosampler	Astoria Pacific	311	311162
11MT06	Autoanalyzer Detector	Astoria Pacific	305A	305352
11MT06	Autoanalyzer Heater Unit	Astoria Pacific	303A	303437
11MT06	Autoanalyzer Photometer	Astoria Pacific	350	350376
11MT06	Autoanalyzer Power Supply	Astoria Pacific	304A	304224
11MT06	Autosampler power supply	Perstorp	509	5766
11MT06	Autosampler pump	Perstorp	502	818?5??-212
11MT08	Spectrophotometer	Spectronic	Aquamate	104218
11MT10	Oven	Fisher	Isotemp 255D	1451
11MT11	Oven	Fisher	Isotemp 630F	20900168
11MT12	Muffle Furnace	Sybron	Thermolyne	32400731
11MT13	Concentrator	Zymark	TurboVap II	TB9814N8062
11MT14	Concentrator	Zymark	TurboVap II	4082
11MT15	Furnace	Sybron Thermolyne	1300	0479 16654
11MT16	N-Evap	Organomation	112	11771
11MT17	Waterbath	Northwest Fixtures	I5505	246T
11MT18	pH meter	Fisher	AR50	81207936
11MT19	Sonicator	Fisher	FS60	RUA080390744
11MT20	Centrifuge	Fisher	Centific	406N0169
11MT22	Furnace	Leco	S-144DR	3167
11MT23	Turbidimeter	HF Scientific	Micro 1000	610064
11MT24	Sonicator	Heat Systems	Sonicator XL	Can't read
11MT25	Sonicator	Branson	Sonfier 450	B1090019
11MT28	Microscope*	Olympus	BH-2	217295
11MT29	Microscope*	Olympus	BH-2	230579
11MT30	Stereoscope	Fisher	8711	
11MT31	Steroscope	Olympus	G10X	340704
11MT32	Microscope*	Olympus	BH-2	242833
11MT33	Concentrator	Tekmar/Dohrmann	Tekmar 3000 Purge and Trap concentrator	96312005
11MT33	VOA GC	Aglient	6890	US00009537
11MT33	Autosampler	EST	Centurion	CENT-W-417042312
11MT34	Block Digestor	Lachat	BD-46	1800-733
11MT35	Oven	Precison	NA	603041552
11MT38	AutoSampler	O-I-Analytical	4552	
11MT38	Concentrator	Tekmar Dohrmann	3100	99274012
11MT38	GC System	Agilent	6890	US00032765
11MT38	MS Detector	Agilent	5973	US94240027
11MT39	Thermoreacter	VELP Scientifica	F101A0125	197853
11MT40	pH meter	Accumet	AR50	81207936

ATTACHMENT IIIB- MONTANA EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

11MT41	Oven	Fisher	Isotemp 630F	
11MT42	Oven	Precision Scientific	Thelco 130 DM	9212-016
11MT43	GC System	Agilent	6890	US00021845
11MT43	Concentrator	EST	Evolution	EV431073112
11MT43	AutoSampler	EST	Centurion	CENT-W-416041012
11MT44	Flow Analyzer	Lachat	8500	120400001407
11MT47	Sieve Shaker	Gilson	SS-15	6290
11MT48	Sieve Shaker	W.S. Tyler	RX_29	10-2394
11MT49	Sieve Shaker	Gilson	SS-15	6289
11MT50	Sieve Shaker	Gilson	SS-84	1587
11MT51	Concentrator	Zymark	Turbo Vap II	4254
11MT52	GC System	HP	5890 series 2	336A53379
11MT52	Autoinjectors (2)	HP	7673	3120A27091 & 3249A33250
11MT53	Concentrator	Zymark	TurboVap II	TV1012N15747
11MT54	Ion Chromatograph	Dionex	LC20	10748
11MT54	IC Conductivity Detector	Dionex	CD25	04040488
11MT54	IC Isocratic pump	Dionex	IP25	04030145
11MT55	Custom Shaker	Custom	NA	NA
11MT56	Oven	Fisher516G		801N0068
11MT57	Autoclave	ThermoFisher	ST75925	1277081210300
11MT58	Metals Block Digester	Environmental Express	Hot Block	S388CEC2479
11MT59	UV VIS Spectophotometer	Varian	Cary50BIO	EL98033269
11MT60	ICP	ThermoFisher	ICAP6500 Duo	20071505
11MT60	Autosampler	CETAC	ASX-520	71011378
11MT60	Chiller	ThermoFisher	ThermoFlex900	51520175
11MT61	Centrifuge	Damon	IEC HN-S	34721368
11MT62	Block Digestor	Lachat	BD-46	1800-296
11MT64	Handheld pH	Thermo Scientific	Star A121	H00013
11MT65	Spectrophotometer	Thermo Scientific	Evolution 201	5A4S008017
FSA4	Autopipette	Hamilton	1000 uL Adj. Vol.	078490
FSA5	Autopipette	Hamilton	999 uL Adj. Vol.	078778
FSA6	Autopipette	Hamilton	300 uL Adj. Vol.	078528
IN-1103 - WC4	Autopipette	Oxford	1000-5000uL	E02008781
IN-1104 - IC2	Autopipette	Eppendorf	500-2000uL	4609456
IN-1106 - IC3	Autopipette	Gilson	50-2000uL	Z54657M
WC2	Autopipette	Eppendorf	0.1-1mL	4035876
WC3	Autopipette	Eppendorf	0.1-1mL	4038286
WC6	Autopipette	Eppendorf	20-200uL	4078539
WC7	Autopipette	Finnpipette	1-10mL	GJ45632
WC5	Autopipette	Hamilton	1-101-10mL	33269
MET1	Autopipette	Hamilton	.05-.3mL	80395
MET2	Autopipette	Hamilton	0.1-1mL	80953
IC4	Autopipette	Hamilton	0.1-1mL	81405
IC5	Autopipette	Finnpipette	0.5-5mL	KH11148
N/A	Pulverizer	Retsch	RS100	

ATTACHMENT IIIB- MONTANA EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

N/A	Vacuum Pump	Edwards	E2M2	41032
N/A	Vacuum Pump	Dayton	SA55NXGTB-4142	E22922
DocuTemp	Automated Temperature Monitoring System	DocuTemp	2.0.365	

*All microscopes cleaned 10-25-10

ATTACHMENT IIIC- VIRGINIA EQUIPMENT LIST (CURRENT AS OF ISSUE DATE)

DESCRIPTION	MANUFACTURER	MODEL #/SN#
CVAA Mercury Analyzer	Cetac	M-6100/060402 QT6
Autosampler	Cetac	ASX-400/070401 ASX-4
Hardware	Venture Systemax	SYX PHM800PRO/106381144
Software	Cetac	Quicktrace Hg Analyzer System Version 1.2.1
Graphite Furnace AA	Perkin Elmer	A/S 800/8444
Autosampler	Perkin Elmer	ASX 520 / 090511A520-06
FIAS 400 Hydride Chemifold	Perkin Elmer	400511051103
Hardware	Dell	Optiplex GX1/06UQ4
Software	Perkin Elmer	AA Winlab Instrument Control Software Ver3.9
ICP Atomic Emission Spectrometer	Perkin Elmer	Optima 3000XL/069N4081202
Autosampler	Cetac	ASX-520/090511A520-new in 2006
Hardware	Compudyne	X86 Model 7/4747
Software	Perkin Elmer	Winlab 32 ICP Optical Emission Software Ver2.2
ICPMS Atomic Emission Spectrometer	Perkin Elmer	ELAN 9000 / AJ11920712
Autosampler/Pump	Perkin Elmer	S10/102S8010517
Recirculator	Polyscience	NA
Software	Perkin Elmer	Version 3.4
Hardware	Dell XP	X12-51522
Lachat	Zellweger Analytics	Lachat Quikchem FIA+ 8000 Series/A83000-1480
Lachat Reagent Pump	Zellweger Analytics	RP-150 Series/A82000-1527 replacement 2005
Autosampler	Cetac	ASX-500 Model No 510/109932ASX
Autodilutor	Zellweger Analytics	8000 Series/A81010-277 Out of service ~2002
Micro Distillation Equipment (Ammonia)	Lachat MicroDist 5/09	081200001033
Block Digester	Lachat	BD-46/1800-408
Hardware	Midwest Comp Depot	3035
Software	Omnion	FIA Data System
Ion Chromatograph 12WTA2	Metrohm	861 Advanced Compact IC/48614011
Regenerant Dispenser	Metrohm	None
Autosampler	Metrohm	Model 838 Advanced Sample Processor
Hardware	Dell	SN#CBDUC284-70821-553-OGIP
Software	Metrohm	IC Net 2.3
Ion Chromatograph 12WTA7	Metrohm	Model 881 Advanced Compact IC 1881000122119
Regenerant Dispenser	Metrohm	800 Dosino
Autosampler	Metrohm	Model 858 Advanced Sample Processor
Hardware	Dell	Optiplex 790
Software	Metrohm	IC Net 2.3
BOD Warmer #1	Thermo Precision	60541072
BOD Incubator #1	VWR	Model 2020/09065105
BOD Incubator #2	VWR	Model 2020/0902090

ATTACHMENT IIIC- VIRGINIA EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

BOD Incubator #3	VWR	Model 2020/2107705
BOD Reader	Thermo Electron Corp	BOD Auto EZ BOD Reader 10060020/A0074
BOD Hardware	Hewlett Packard/Compaq	24A41601N8
BOD Software	Thermosystems	BOD Auto EZ 2001
TOC 12WTA3	OI Analyzer	SN H129732449E
TOC	OI Autosampler	SN E129788451
TOC	OI Solids Analyzer	SN A129733824
Autosampling Module	OI Corporation	No Model/621290637-92120
IR Detector	OI Corporation	No Model/2A0002T
Hardware	HP	Compaq
Software	OI Corporation	V1.4.2
TOC 12WTA8	OI Analyzer	SN P407730312P
Autosampling Module	OI Corporation	Model 1088 AS
IR Detector	OI Corporation	Model 1030
Hardware	Lenovo	Thinkcentre
Software	OI Corporation	1.4.2
Drying Oven 1996	Blue M	OV-18C
Furnace 2005	Barnstead/Thermolyne	62700/BT010507A
Solids Balance	ADA	71/L/AE04260556
Hardware 2004	ABS	52X MTRP/10085322
Software 2004	EZ Solids	EZ_Solids Program June 23, 2004
Expandable Ion Analyzer	Orion	940/6673
Autosampler	Orion	AS 3000/B0019
Bacteria Incubator	Shel Lab / New 3/07	1545/11052906
Coliform Incubator Bath	ThermoFisher/New 4/07	253/SN202682-185
Microscope 10X/30X	National Optical/New 2/07	446TBL-10
Bacteria Incubator	Shel Lab 1996 (Sterility chk)	1520
Quanti Tray Sealer	IDEXX	89-10894-02 4788
Oven 2005	VWR	1330GM/05039804
Oven	TEMPCON	P10734
Water Bath	Fisher Scientific	FS140/FS010507
Metals Digestion Blocks (HB1; HB2)	CPI	05-C0530/000424 1005-CPI ModBlock Inst
Balance (Metals) 12BAL3	AND	GF 1200 / 10318953
Balance	Sartorius	LA 3200D / 13407528
Balance	Sartorius	Genius / 13003773
Stir Plate	Thermoline Type 7200	903971255007
Refrigerator 2R (Metals)	Sanyo	SR-362OK/051105496-new 6/30/06
Refrigerator #3	True Mfg Co.	T-49/1-2953805
Refrigerator #5	True Mfg Co.	T-49/1-3060851
Refrigerator #8	True Mfg Co	T-35/I-3016399
Refrigerator #10	Gibson	NTS Fridge #10 at 526 NTS
Refrigerator #12	Beverage-Air	9029136/KR481AS
Refrigerator #13	US Cooler Walk-in	29716
Mixer	Thermolyne	M37615/376950140798
Stir/Hotplate	VWR	12365-392 / 050914023

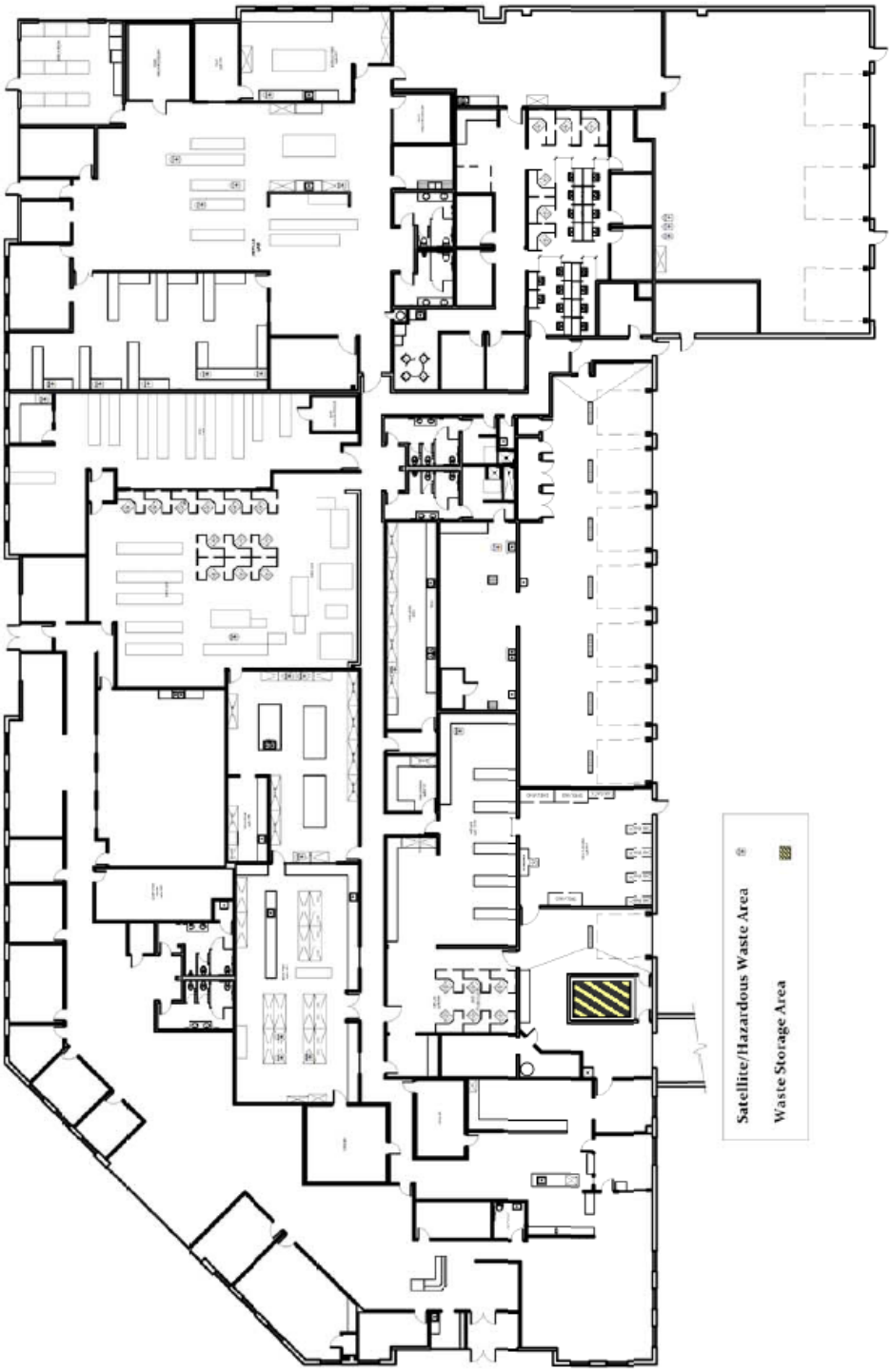
ATTACHMENT IIIC- VIRGINIA EQUIPMENT LIST CONTINUED (CURRENT AS OF ISSUE DATE)

COD Reactor-Hot block	HACH	45600-00/920600007477
COD Reactor- Hot block	HACH	16500-10/5944
Dessicator	Labconco	55300/171400
Dessicator	Labconco	55300/232878
Mixer	Fisher Scientific	Model 15/103
Rotator	Lab-Line	Model 1345/1002-1791
Balance Extraction/Solids	Acculab	VI 600/027UC1079
Autoclave	Tuttnauer/Brinkmann	3545EP
pH Meter	Orion	550A / 016948
Turbidimeter 12WET4	HF Scientific	39957 / 10621
Dissolved Oxygen Meter	YSI	5100
BOD Software	YSI	5120 BODANALYST
Spectrophotometer	HACH	DR 5000
Water Purification System, DI	Barnstead	E-Pure
Water Purification System, RO pure LP Low pressure RO System	Barnstead Thermolyne	Model D2622 SN 496000209600 Cartridge Changes noted in log book
Resistivity Meter for RO system	Sybron Barnstead	Model 02770 Resistivity Log Sheet is posted by system

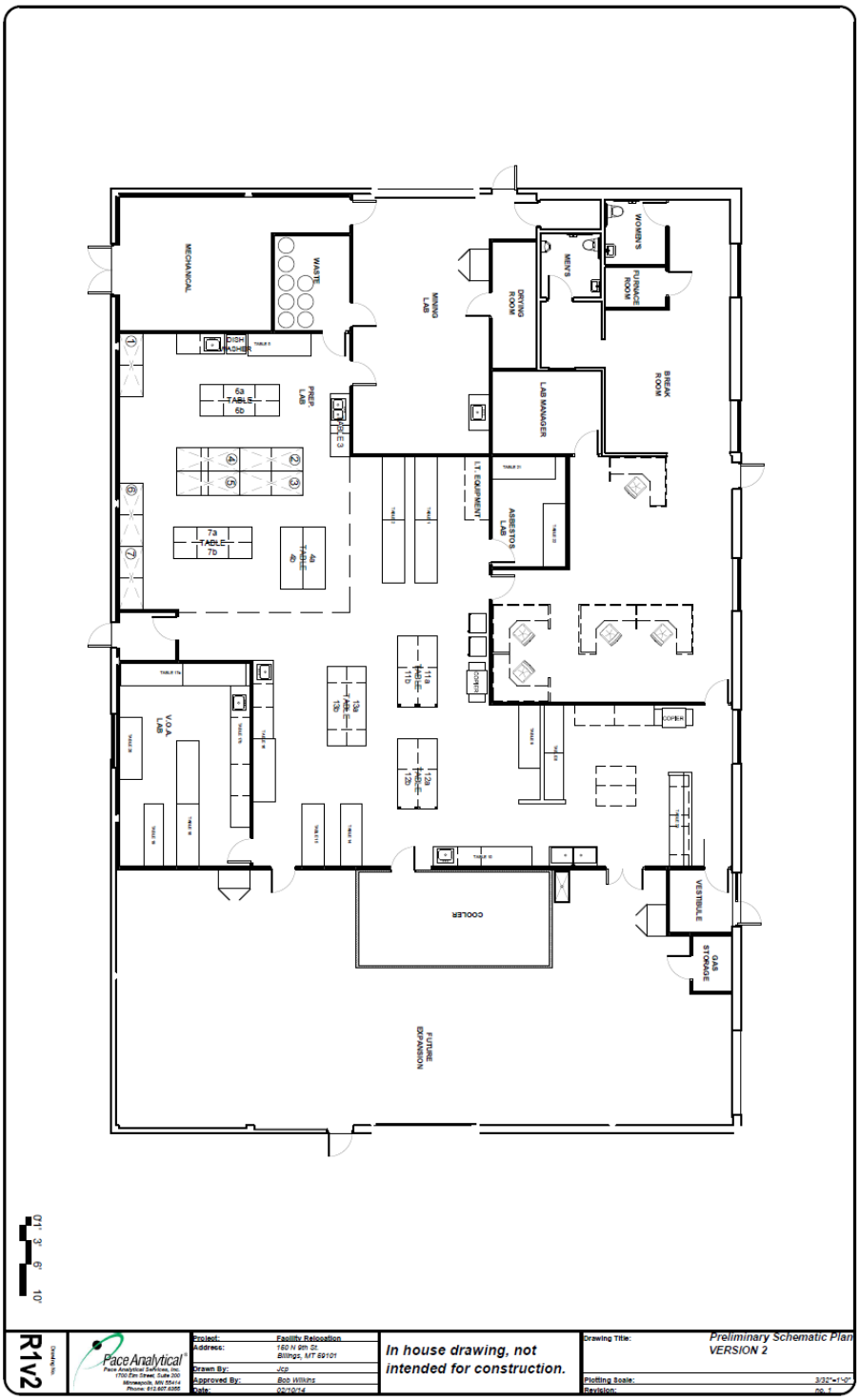
ATTACHMENT IIID- DULUTH EQUIPMENT LIST (CURRENT AS OF ISSUE DATE)

DESCRIPTION	MANUFACTURER	MODEL #/SN#
Water Purification System	Barnstead D4641	1090090938202
Refrigerator D-1	Admiral	LTS2112ARW
Refrigerator D-2	Estate Whirlpool	TT18AK
Mercury Analyzer CVAFS	Brooks Rand Model III	11026201
Autosampler	Brooks Rand PS	4936A14632
Total Hg Purge and Trap	Brooks Rand Merx	11078001
Hg Speciation Purge and Trap	Brooks Rand Merx	41107301
Hardware	XPRO Systems	
Software	Mercury Guru	4.1
Balance	Sartorius ME14145	13003775
Hood DB-1	Esco	04ESC
Hood DB-2	Esco	04ESC
Hood 3 DE-1 Perchloric Acid Hood	Labconco	
Bacteria Incubator	Thermco Precision	605031678

ATTACHMENT IVA- MINNEAPOLIS LABORATORY FLOOR PLAN (CURRENT AS OF ISSUE DATE)



ATTACHMENT IVB- MONTANA LABORATORY FLOOR PLAN (CURRENT AS OF ISSUE DATE)



R1v2

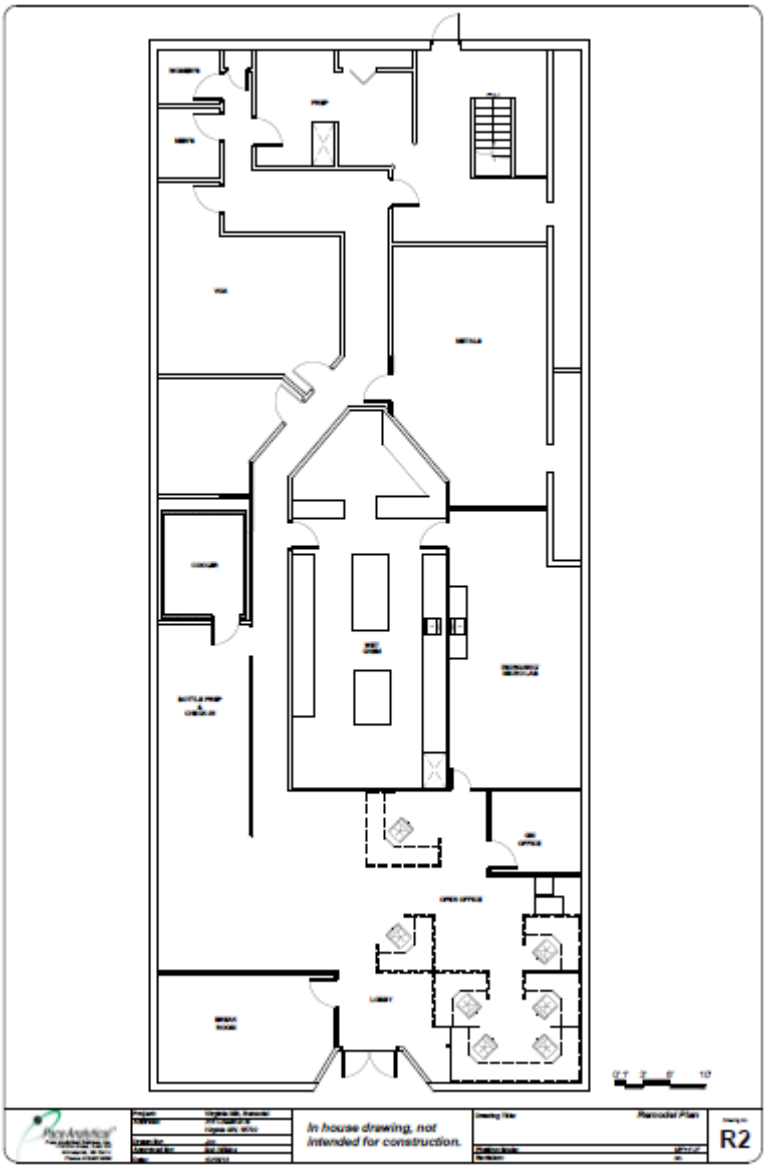
Pace Analytical
Pace Analytical Services, Inc.
1700 5th Street, Suite 200
Minneapolis, MN 55414
Phone: 612.607.6395

Project:	Facility Relocation
Address:	160 N 8th St Billings, MT 59101
Drawn By:	JCD
Approved By:	Bob Wilkins
Date:	02/10/14

In house drawing, not intended for construction.

Drawing Title:	*Preliminary Schematic Plan VERSION 2*
Plotting Scale:	3/32"=1'-0"
Revision:	no. 1

ATTACHMENT IVC- VIRGINIA LABORATORY FLOOR PLANS (CURRENT AS OF ISSUE DATE)



ATTACHMENT VA- MINNEAPOLIS SOP LIST (CURRENT AS OF ISSUE DATE)

Title	SOP Number
Determination of Methane, Ethane, and Ethene in Air Modified TO-3	S-MN-A-002
Analysis of Air Samples for Volatile Organic Compounds by Gas Chromatography/PID-FID method TO-3	S-MN-A-003
Cleaning, Certification, Leak Checking and Preparation for Shipment of SUMMA Passivated Canisters	S-MN-A-004
Determination of Fixed Gases in Air by Modified 3C	S-MN-A-005
Methane, Ethane, Ethene, and Propane in Water by GCFID mod. 3810 and RSK 175	S-MN-A-007
Analysis of Whole Air Sample for Volatile Organic Compound by GC/MS EPA TO15/TO14	S-MN-A-013
Determination of Hydrocarbons in Air using Radiello Passive Sample Tubes	S-MN-A-017
Analysis of TO17 Active Air Samples	S-MN-A-018
Analysis of BTEX and PAHs in Whole Air Using Thermal Desorption Tubes and GC/MS	S-MN-A-019
The Determination OF Hydrocarbons in Air Samples via RAD145 RADIELLO® Passive Sample Tubes	S-MN-A-020
Sample Management	S-MN-C-001
Bottle Preparatation	S-MN-C-003
Subcontracting Samples	S-MN-C-004
Internal Chain of Custody	S-MN-C-005
Percent Solids (Moisture)	S-MN-I-367
The Determination of Specific Aromatic Compounds and Gasoline Range Organic in Water and Soils	S-MN-O-427
Purgeable Total Petroleum Hydrocarbons in Water (8015 Mod / CA LUFT)	S-MN-O-525
Purgeable Total Petroleum Hydrocarbons in Water (NWTPH)	S-MN-O-555
Determination of Gasoline Range Organices by Method AK101	S-MN-O-556
Volatiles Water Sample Compositing Procedure	S-MN-O-541
Analysis of Polychlorinated Biphenyls in Oil, Soil, Water, Wipe and Air Matrixes	S-MN-O-432
Determination of Diesel Range Organics in Water and Soil (Wisconsin modified DRO)	S-MN-O-466
Ethylene glycol, Propylene Glycol, Triethylene Glycol by Modified 8015	S-MN-O-533
Saturated Hydrocarbons (Alkanes/Isoprenoids Compounds) and Total Extractable Hydrocarbons	S-MN-O-567
Determination of Pesticides in Water and Soil	S-MN-O-574
Determination of EDB and DBCP in Aqueous Samples	S-MN-O-576
The Determination of Diesel Range Organics, Residual Range Organics and Total Extractable Hydrocarbons	S-MN-O-578
Preparation and Analysis of Samples for the Determination of Dioxins and Furans by USEPA Method 8290/8290A	S-MN-H-001
Preparation and Analysis of Samples for the Determination of 2,3,7,8-TCDD using USEPA Method 1613B, Drinking Water	S-MN-H-003
Preparation and Analysis of Samples for the Determination of PCDDs, PCDFs, and PCBs by modified USEPA Method 23, TO9, or NY State Guidelines	S-MN-H-005
Method 1668, PCB Congenger (WHO List)	S-MN-H-009
Preparation and Analysis of Samples for the Determination of Dioxins and Furans by 8280M	S-MN-H-013
Preparation and Analysis of Samples for the Determination of Chlorinated Biphenyl Congeners	S-MN-H-014
Preparation and Analysis of Samples for the Determination of Polybrominated Diphenyl Ether Congeners	S-MN-H-016
TCLP/SPLP	S-MN-I-312

ATTACHMENT VA- MINNEAPOLIS SOP LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Inductively Coupled Plasma Atomic Emission Spectroscopy (RCRA)	S-MN-I-313
Hardness by Calculation	S-MN-I-338
Mercury in Liquid and Solid/Semis-Solid Waste	S-MN-I-359
Digest Procedure for Aqueous Samples to be Analyzed by Induct Coupled Plasma (SW-846)	S-MN-I-458
Metals Preparation for Solid samples, Wipes and Filters	S-MN-I-460
Metals Analysis by ICP/MS - Method 6020 and 200.8	S-MN-I-492
Preparation of Aqueous Samples for ICPMS Analysis	S-MN-I-523
Extractable Base/Neutral and Acid Organic Compounds in Liquid, Solid, and TCLP Matrices by Gas Chromatography/Mass Spectrometry Capillary Column Technique	S-MN-O-436
8270-L Extractable Base/Neutral and Acid Organic Compounds in Water and Liquid Matrices by GC/MS Capillary Column Technique w/Selective Ion Monitoring	S-MN-O-507
Extractable Base/Neutral and Acid Organic Compounds in Liquid by EPA Method 625	S-MN-O-532
Determination of Parent and Alkylated PAH Compounds in Solid and Liquid Matrices by GC/MS SIM	S-MN-O-561
Analysis of Air samples by GC/MS - Method TO-13	S-MN-O-534
Sulfolane Extraction and Analysis in Liquid Matrices by GCMS	S-MN-O-569
High Volume Injection for 8270C SIM	S-MN-O-570
Analysis of Volatile Organic Compounds by GC/MS Method 8260	S-MN-O-521
Analysis of Volatile Organic Compounds by GC/MS Method 624	S-MN-O-529
Analysis of Volatile Organic Compounds in Water Method 524.2	S-MN-O-546
Method For Sonicator Tuning	S-MN-O-414
Cleaning Glassware in the Organic Laboratory	S-MN-O-465
Sonication Extraction Technique for Base/Neutral and Acid Compounds (3550C Modified)	S-MN-O-495
Continuous Liquid-Liquid Extraction (SW3520) for Base/Neutral and Acid Compounds	S-MN-O-496
Spike Verification in the Organic Prep Lab	S-MN-O-497
Preparation of Anhydrous Sodium Sulfate for Extraction Purposes	S-MN-O-500
Nitrogen Evaporation Technique	S-MN-O-503
Sample Concentration Technique	S-MN-O-504
Separatory Funnel Extraction for Polyaromatic Hydrocarbons by 8270-SIM	S-MN-O-506
Solvent Exchange into Hexane	S-MN-O-509
Continuous Liq/Liq extraction for Method 8270C (Dual pH) by SW 3520C	S-MN-O-539
Soil Extraction for PAH Analysis by GC/MS:SIM (3550C)	S-MN-O-540
Separatory Funnel Extraction	S-MN-O-566
Data Archiving and Retrieval	S-MN-L-106
Reagent Water Quality	S-MN-L-110
Generation of EDD	S-MN-L-112
Preventative, Routine, and Non-routine Maintenance	S-MN-L-114
Receipt and Storage of Laboratory Supplies	S-MN-L-117
Data Review Process	S-MN-L-132
Syringe Technique	S-MN-L-139

ATTACHMENT VA- MINNEAPOLIS SOP LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Procedure for Handling Aqueous Organic Extractable Samples Containing Sediment	S-MN-L-142
Purchasing Laboratory Supplies	S-MN-L-143
Laboratory Housekeeping	S-MN-L-145
Sample Homogenization and Sub-Sampling	S-MN-L-147
Quality Manual	17.1
Control Chart Generation and Trend Analysis	S-MN-Q-205
Manual Integration	S-MN-Q-214
Control of Hazardous Energy Program - Lockout/Tagout	S-MN-Q-249
Method Validation and Modification Studies	S-MN-Q-252
Procedure for Handling of USDA regulated soils	S-MN-Q-253
Estimation of Measurement Uncertainty	S-MN-Q-255
Management of Change	S-MN-Q-257
Proficiency Testing Program	S-MN-Q-258
Evaluation and Qualification of Vendors	S-MN-Q-259
Use of A2LA Terms and Symbols	S-MN-Q-260
Conflict of Interest Plan	S-MN-Q-261
Corrective and Preventative Actions	S-MN-Q-262
Monitoring Temperature Controlled Units	S-MN-Q-263
Support Equipment	S-MN-Q-264
Document Control and Management	S-MN-Q-268
Determination of Limit of Detection and Limit of Quantitation	S-MN-Q-269
Review of Analytical Requests	S-MN-Q-270
Internal and External Audits	S-MN-Q-271
MCL Violation Reporting	S-MN-Q-272
Preparation of Standard Operating Procedures	S-MN-Q-273
Spreadsheet Validation	S-MN-Q-274
Standard and Reagent Management and Traceability	S-MN-Q-275
Use of the Pacelink System	S-MN-Q-276
Chemical Hygiene Plan/Safety Manual	S-MN-S-001
Waste Management Training Requirements	S-MN-S-002
Waste Handling and Management	S-MN-S-003
MN Contingency Plan	2014
Air Quality Monitoring and Fume Hood Monitoring	S-MN-S-004
Biochemical Oxygen Demand (BOD) and Carbonaceous Biochemical Oxygen Demand (CBOD)	S-MN-I-348
Determination of Hexane Extractable material (HEM) and Silica Gel Treated – Hexane Extractable Material (SGT-HEM) in Solids	S-MN-I-357
Hexavalent Chromium in Water and Wastewater	S-MN-I-358
Alkalinity, Titrimetric	S-MN-I-365
Fluoride in Water and Wastewater	S-MN-I-470

ATTACHMENT VA- MINNEAPOLIS SOP LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Determination of Total Phosphorus in Aqueous Samples by SmartChem	S-MN-I-473
Specific Conductivity	S-MN-I-474
Ortho Phosphorus in Water by the Konelab, Ascorbic Acid Method	S-MN-I-477
Settleable Solids	S-MN-I-486
Standard Test Method for Screening Apparent Specific Gravity and Bulk Density Waste	S-MN-I-493
Determination of Total Recoverable Phenolics by Flow Injection Colorimetry	S-MN-I-494
Turbidity	S-MN-I-501
Chlorine, Total Residual in Water	S-MN-I-502
Use and Maintenance of the Konelab	S-MN-I-507
Determination of Nitrate/Nitrite in Surface and Wastewater by SmartChem Colorimetric Analysis	S-MN-I-508
Determination of Chloride by Konelab	S-MN-I-509
Determination of Sulfate by Konelab	S-MN-I-510
Determination of Nitrite by Konelab (Spectrophotometric Method)	S-MN-I-514
Paint Filter Liquids Test	S-MN-I-516
Determination of Hexane Extractable material (HEM) and Silica Gel Treated – Hexane Extractable Material (SGT-HEM) in Water	S-MN-I-520
Dissolved Oxygen	S-MN-I-524
Measurement of pH in Water, Soil, and Waste	S-MN-I-526
Determination of TSP and PM 10	S-MN-I-527
Measurement of Solids in Water and Wastewater	S-MN-I-528
Total CN in Water - Macro Distillation	S-MN-I-529
Weak Acid Disociable Cyanide in Water - Macro Distillation	S-MN-I-530
Total Coliform Bacteria	S-MN-MB-001
Fecal Coliform by MF	S-MN-MB-002
Heterotrophic Plate Count	S-MN-MB-003
Total Coliform Bacteria by Membrane Filtration	S-MN-MB-005
Sample Container Sterility Verification	S-MN-MB-006
Total Coliform Bacteria and E. Coliform Bacteria	S-MN-MB-007
The Determination of Ammonia by SmartChem	S-MN-I-559
Determination of NO3/NO2 by SmartChem	S-MN-I-560
Data Correctness Calculations	S-MN-I-562
COD by Hach 2700	S-MN-I-563
Total Recoverable Cyanide and Amenable Cyanide in Water	S-MN-I-564
Delta Airlines Anodizing Line	S-MN-I-582
Determination of Inorganic Anions by Ion Chromatography	S-MN-I-583
Determination of Nitrate/Nitrite on the Lachat by Cadmium Reduction	S-MN-I-584
Determination of Sulfate on the Lachat	S-MN-I-585
Sample Appearance	S-MN-I-586
Net Acid Generation (NAG)	S-MN-I-589

ATTACHMENT VA- MINNEAPOLIS SOP LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Humidity Cells	S-MN-I-590
Determination of Phenolic Compounds by Flow Injection Analysis Colorimetry	S-MN-I-591
Determination of Chloride by Flow Injection Analysis Colormetry	S-MN-I-592
Determination of Ortho Phosphate in Waters by Flow Injection Analysis Colorimetry	S-MN-I-593
Determination of Hexavalent Chromium by Flow Injection Analysis	S-MN-I-594
Drierite Regeneration Procedure	S-MN-O-557
Bottle Order Database	S-ALL-C-002
Operation of Paceport Customer Feedback Form	S-ALL-C-005
Document Numbering	S-ALL-Q-003
EPIC PRO: Acode Addition/Modification	S-ALL-Q-008
Laboratory Documentation	S-ALL-Q-009
Quarterly Quality Report	S-ALL-Q-014
Review of Laboratory Management System	S-ALL-Q-015
Training Procedures	S-ALL-Q-020
3P Program: CIP	S-ALL-Q-022
Use and Operation of Lab Track System	S-ALL-Q-028
Mint Miner Data File Review	S-ALL-Q-029
Operation of Data Checker For Epic Pro	S-ALL-Q-030
Data Recall	S-ALL-Q-035
Processing Tentatively Identified Compounds (TICS) for GC/MS	S-ALL-O-038
Hazard Assessments	S-ALL-S-001
LMS Sub-Learn Center System and Training Administrator Responsibilities	S-ALL-T-002
Anonymous Hotline Procedure	S-COR-Q-034

ATTACHMENT VB- MONTANA SOP LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Title	SOP Number
Microscope Adjustment - Phase Contrast	S-MT-ASB-015
Microscope Alignment - Polarized Light Microscope	S-MT-ASB-016
Bulk Analysis Using Polarized Light Microscopy	S-MT-ASB-023
Asbestos Data Review	S-MT-ASB-026
Fiber Counts By NIOSH 7400 Using Excel Spreadsheet	S-MT-ASB-027
Quality Control for Asbestos Analysis	S-MT-ASB-028
The Determination of Extractable Petroleum Hydrocarbons by Method MA-EPH	S-MT-O-001
Petroleum Hydrocarbons as Diesel in Water and Soil	S-MT-O-002
Purgeable Total Petroleum Hydrocarbons in Water and Soil	S-MT-O-003
Volatile Petroleum Hydrocarbons (VPH)	S-MT-O-005
Coarse Fragment	S-MT-ME-035
Acid-Base Accounting - Sobek	S-MT-ME-004
pH Paste	S-MT-ME-006
Soil Sieve for Black Eagle	S-MT-ME-017
Organic Matter	S-MT-ME-001
Available Nitrate and Ammonia	S-MT-ME-022
Particle Size Analysis	S-MT-ME-024
Volatile Organic Compounds by 8260B	S-MT-O-004
Preparation of Anhydrous Sodium Sulfate for Extraction Purposes	S-MT-O-008
Referencing NVLAP Accreditation	S-MT-Q-001
MT Contingency plan	2014
Waste Handling and Management	S-MT-S-001
Nitrite by SM4500 NO2B	S-MT-I-036
Acidity	S-MT-I-032
Turbidity	S-MT-I-034
Phosphorus, Ortho and Total	S-MT-I-002
Sulfides	S-MT-I-005
Specific Conductivity SW2510B	S-MT-I-007
Measurement of Solids in Water and Wastewater	S-MT-I-008
The Determination of Nitrate-Nitrite by Flow Analyzer	S-MT-I-009
TKN By Colorimetry	S-MT-I-010
Total Sufur by LECO	S-MT-ME-012
Water Soluble Sulfate and Chloride	S-MT-I-013
The Determination of Percent Moisture in Soil and Solid Samples	S-MT-I-014
Determination of Inorganic Anions by Ion Chromatography	S-MT-I-018
Determination of Ammonia Nitrogen by Automated Phenate	S-MT-I-019
Chlorophyll-a	S-MT-I-020

ATTACHMENT VB- MONTANA SOP LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Measurement of pH in Water, Soil, and Waste	S-MT-I-021
Determination of Oxidation-Reduction Potential in Water	S-MT-I-029
Settleable Solids	S-MT-I-030
Determination of Dissolved Oxygen	S-MT-I-031
Multi Increment Soil Sampling	S-MT-I-033
Soil Agronmy Metals Extraction Procedures	S-MT-M-032
Inductively Coupled Plasma Atomic Emission Spectroscropy	S-MT-M-033

ATTACHMENT VC- VIRGINIA SOP LIST (CURRENT AS OF ISSUE DATE)

Title	SOP Number
Sample Management	S-VM-C-001
Bottle Preparation	S-VM-C-002
Subcontracting Samples	S-VM-C-003
Alkalinity, Titrimetric (Automated Titration)	S-VM-I-002
Acidity Titration Method	S-VM-I-003
Conductivity	S-VM-I-005
Turbidity	S-VM-I-006
Color	S-VM-I-007
Total Residual Chlorine	S-VM-I-008
Chlorine Automated Ferricyanide Method	S-VM-I-009
pH	S-VM-I-010
Measurement of Solids in Water and Wastewater	S-VM-I-011
Determination of Hexavalent Chrome by Colorimetric Analysis	S-VM-I-012
Determination of Phosphorus by Automated Colorimetry	S-VM-I-013
Determination of Orthophosphate by Colorimetry	S-VM-I-014
Ammonia-Nitrogen by Semi-Automated Colorimetry	S-VM-I-015
Total Kjeldahl Nitrogen by Semi-Automated Colorimetry	S-VM-I-016
Nitrogen, NO3+NO2 and NO2 by EPA 353.2 Colorimetric, Automated	S-VM-I-017
Determination of Anions by Ion Chromatography	S-VM-I-018
Total Organic Carbon and Dissolved Organic Carbon	S-VM-I-019
Determination of Chemical Oxygen Demand in Water, Wastewater and Industrial Wastes Using the Hach Spectrophotometer	S-VM-I-020
Biochemical Oxygen Demand and Carbonaceous Biochemical Oxygen Demand	S-VM-I-021
Total and Fecal Coliform Bacteria Membrane Filter	S-VM-I-022
Total Coliform Bacteria	S-VM-I-023
Heterotropic Plate Count Simplate Procedure	S-VM-I-024
Sample Container Sterility Verification	S-VM-I-025
Total Coliform Bacteria and E Coliform Bacteria	S-VM-I-026
Chlorophyll A	S-VM-I-027
Formaldehyde	S-VM-I-028
The Determination of Cation Anion Balance	S-VM-I-029
Determination of Percent Total Solids	S-VM-I-031
Total Amine Analysis in Water by Spectrometry	S-VM-I-032
Total Sulfide, Iodometric Titration	S-VM-I-033
The Determination of Oxidation Reduction Potential (ORP)	S-VM-I-034
Determination of Metals by Inductively Coupled Plasma (ICP) Spectroscopy	S-VM-M-001
Mercury in Liquid and Solid/Semi-Solid Waste	S-VM-M-004
Metals Analysis by ICP/MS	S-VM-M-006

ATTACHMENT VC- VIRGINIA SOP LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Determination of Selenium, Total and Speciated, in Liquid and Soil by Hydride Generation	S-VM-M-008
The Determination of Moisture, Ash, and Organic Matter of Peat and Other Organic Soils (Mining)	S-VM-MIN-001
Size Analysis Using Sieves (Mining)	S-VM-MIN-002
Mechanical Hydrometer / Grain Size Analysis (Mining)	S-VM-MIN-003
Filtering Slurry Samples for Metals Analysis (Mining)	S-VM-MIN-004
Digestion of Samples for Metals Analysis ASTM E507-93(Mining)	S-VM-MIN-005
Digestion of Samples for Metals Analysis Internal Digestion Method(Mining)	S-VM-MIN-006
The Pulverization of Ore and Solid Matrices (Mining)	S-VM-MIN-007
Atterberg Limits (Mining)	S-VM-MIN-008
Determination of Ferrous Iron in D.R.I. Iron Ore and Concentrates Dichromate Method Manual Titration (Mining)	S-VM-MIN-010
Flashpoint: Closed Cup (Mining)	S-VM-MIN-011
Visual Soil Classification (Mining)	S-VM-MIN-012
Moisture in the Analysis Sample of Coal and Coke (Mining)	S-VM-MIN-013

ATTACHMENT VD- DULUTH SOP LIST (CURRENT AS OF ISSUE DATE)

Title	SOP Number
Mercury Analysis by Cold Vapor Atomic Fluorescence Spectrometry	S-VM-M-003
Methyl Mercury Analysis by Aqueous Ethylation, Purge and Trap GC with CVAFS Detection	S-VM-M-007
Mercury Analysis by Cold Vapor Atomic Fluorescence Spectrometry of Solid Samples	S-VM-M-010

ATTACHMENT VIA- MINNEAPOLIS CERTIFICATION LIST (CURRENT AS OF ISSUE DATE)

SCOPE AND APPLICATION CERTIFICATES ARE MAINTAINED AND FILED IN THE LOCAL QUALITY DEPARTMENT

EPA ID: MN00064				
State	**Agency**	**Program**	**Cert #**	**Expiration**
A2LA	A2LA	DW – Dioxin, WW, HZ; Envi – WW. HZ; Air; DOD	2926.01	10/31/2015
Alabama	Dept of Environmental Mgmt	Dioxin - DW	40770	12/31/2014
Alaska	Dept. of Environmental Conservation	Contaminated Sites (6010B, 6020, 8260B, PCBs, PAHs)	UST-078	8/10/2014
Alaska	Dept. of Environmental Conservation	Dioxin - DW	MN00064	6/30/2014
Arizona	Dept of Health Services	Dioxin/Envi -DW, WW, HW; Air	AZ0014	12/14/2014
Arkansas	Dept of Environmental Quality	Dioxins/Env	88-0680	6/19/2014
California	Dept of Health Services	Dioxin/Envi -DW, WW, HW	01155CA	8/31/2014
Colorado	Dept. of Public Health & Environment	Dioxins/Envi – DW	Pace Analytical	12/31/2014
Connecticut	Dept of Public Health	Dioxin/Envi -DW, WW, HW	PH-0256	12/31/2014
EPA Region 8 - Wyhoming	Water Division	Dioxins/Envi – DW	8TMS	12/31/2014
Florida (NELAP)	Dept of Health Services	Dioxin/Envi -DW, WW, HW; Air	E87605	6/30/2014
Georgia	Environmental Protection Division	Dioxin/Envi - WW, HW	Pace	12/31/2014
Georgia	Dept of Natural Resources	Dioxin - DW	959	12/31/2014
Guam	Guam EPA	Dioxin - DW	Pace Analytical	10/21/2014
Idaho	Dept. of Health & Welfare	Dioxins/Envi – DW	MN00064	12/31/2014
Hawaii	Dept of Health	Dioxins/Envi – DW	MN00064	12/31/2014
Illinois	Illinois EPA	Dioxin/Envi - DW, HW, WW	200011	12/11/2014
Indiana	Dept of Health	Dioxin - DW	C-MN-01	12/31/2014
Iowa	Dept.of Natural Resources	Dioxin - DW	368	6/1/2015
Kansas	Dept of Health and Environment	Dioxin/Envi - DW, WW, HW	E-10167	10/31/2014
Kentucky	Dept of Environmental Protection	Dioxin – DW	90062	12/31/2014
Kentucky	Dept of Environmental Protection	Dioxin – WW	90062	12/31/2014
Louisiana DEQ	Department of Environmental Quality	Dioxin/Envi - WW, HW; Air	3086	6/30/2014
Louisiana DHH	Department of Health and Hospitals	Dioxin – DW	LA140001	12/31/2014
Maine	Dept of Human Services	Dioxin/Envi - DW	2013011	5/27/2015
Maryland	Dept. of Heath and Mental Hygiene	Dioxin/Envi - DW	322	6/30/2015
Michigan	Dept. of Public Health	Dioxin/Envi - DW	9909	12/31/2014
Minnesota	Dept of Health	Envi - DW, WW, HW	027-053-137	12/31/2014
Minnesota	Department of Commerce	Petrofund	1240	4/16/2014

ATTACHMENT VIA- MINNEAPOLIS CERTIFICATION LIST CONTINUED (CURRENT AS OF ISSUE DATE)

Mississippi	Dept. of Health and Environmental Control	Dioxin - DW	Pace	12/31/2014
Montana	Dept of Health	Dioxin/Envi - DW	92	1/1/2015
Nebraska	Dept. of Health & Human Services.	Dioxin /Envi - DW	Pace	12/31/2014
Nevada	Health Division	Dioxin/Envi - DW, WW, HW	MN_00064_2000_72	7/31/2014
New Jersey	Dept of Environmental Protection	Dioxin/Envi - DW, WW, HW	MN002	6/30/2014
New York	Dept of Health	Dioxin - DW, WW, Air	11647	4/1/2015
North Carolina	Dept of Environment, Health and Natural Resources	Envir - WW, HW	530	12/31/2014
North Carolina	State Public Health Laboratory	Dioxin - DW	27700	7/31/2014
North Dakota	Dept of Health and Consolidated Labs	Dioxin/Envi - DW, WW, HW	R-036	12/31/2014
Ohio	Ohio EPA	Dioxin - DW	4150	12/31/2014
Ohio Vap	VAP	Air	CL101	1/29/2016
Oklahoma	Dept of Environmental Quality	Dioxin/Envi - DW	9507	8/31/2014
Oregon	ELAP	Dioxin - DW, WW, HW; Air	MN200001-005	8/14/2015
Oregon	ELAP	NwTPH	MN300001-001	5/25/2015
Pennsylvania	Dept of Environmental Protection	Dioxin/Envi - DW, WW, HW	68-00563	3/31/2015
Puerto Rico	Departamento de Salud	Dioxin /Envi – DW		1/30/2015
Saipan (CNMI)	Div. Of Environmental Quality	Dioxin - DW	MP0003	12/31/2014
South Carolina	Dept. of Health and Environmental Control	Dioxin - DW, WW, HW	74003001	12/31/2014
Texas	Department of Health	Dioxin/Envi -DW, WW, HW; Air	T104704192	2/28/2015
Tennessee	Dept of Health	Dioxin/Envi -DW	TN02818	12/31/2014
Utah	Department of Health	Dioxin/Envi - DW, WW, HW	MN00064	6/30/2014
Virginia	Dept of General Services	Dioxin- DW	251	6/30/2014
Virginia - ELAP	VELAP	Dioxin/Envi - DW, WW, HW	460163	6/14/2015
Washington	Dept of Ecology	Dioxin/Envi -DW, WW, HW; Air	C486	2/18/2015
Wisconsin	Dept of Natural Resources	Dioxin/Envi - DW, WW, HW	999407970	8/31/2014
Wyoming	Via EPA Region 8	Dioxin/Envir - DW	8TMS-L	12/31/2014
West Virginia	Dept of Env. Protection	Envi/Dioxin - HW, WW	382	8/31/2014
West Virginia	Dept of Health and Human Resources	Dioxin - DW	9952C	12/31/2014

ATTACHMENT VIB- MONTANA CERTIFICATION LIST (CURRENT AS OF ISSUE DATE)

EPA ID: MT00012				
State	**Agency**	**Program**	**Cert #**	**Expiration**
A2LA	A2LA	Envi – DW, WW. HZ	2926.01	10/31/2015
Colorado	Dept. of Public Health & Environment	Asbestos Registration	17119	3/15/2015
EPA Region 8	Water Division	DW	8TMS-L	12/31/2014
Idaho	Dept. of Health & Welfare	DW	MT00012	12/31/2014
Minnesota	Dept of Health	Envi-DW, WW	11610AA	12/31/2014
Montana	Dept of Health	DW	40	12/31/2015
North Dakota	Dept of Health and Consolidated Labs	Envi-DW, WW, HW	R-209	12/31/2014
NVLAP	NVLAP	Asbestos	101292-0	3/31/2015
Washington	Dept. of Ecology	DW, NPW,SCM	C993	11/15/2014

ATTACHMENT VIC-VIRGINIA CERTIFICATION LIST (CURRENT AS OF ISSUE DATE)

EPA ID: MN01084				
State	**Agency**	**Program**	**Cert #**	**Expiration**
Alaska	Dept. of Environmental Conservation	Contaminated Sites (6010B, 6020)	UST-078	8/10/2014
Alaska	Dept. of Environmental Conservation	DW	MN01084	6/30/2014
Arizona	Dept. of Health Services	Envi-DW, WW, HW (TOC)	AZ0785	9/9/2014
Minnesota	Dept. of Health	Envi-DW, WW, HW	027-137-445	12/31/2014
North Dakota	Dept. of Health	Envi-DW, WW, HW	R-203	12/31/2014
Washington	Dept. of Ecology	WW, HZ - TOC	C1007	3/23/2015
Wiscousin	Dept. of Natural Resources	Envi-WW, HW	998027470	8/31/2014

ATTACHMENT VID- DULUTH CERTIFICATION LIST (CURRENT AS OF ISSUE DATE)

EPA ID: MN01085				
State	**Agency**	**Program**	**Cert #**	**Expiration**
Minnesota	Dept. of Health	Dioxin-WW; Micro-SDW	027-137-446	12/31/2014
Wisconsin	Dept. of Natural Resources	Envi-WW (Hg)	399066580	8/31/2014

ATTACHMENT VII- PACE CHAIN-OF-CUSTODY (CURRENT AS OF ISSUE DATE)

Pace Analytical™
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: of

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:
Company:	Report To:	Attention:
Address:	Copy To:	Company Name:
		Address:
Email To:	Purchase Order No.:	Pace Quote Reference:
Phone: Fax:	Project Name:	Pace Project Manager:
Requested Due Date/TAT:	Project Number:	Pace Profile #:

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER _____

Site Location STATE: _____

Requested Analysis Filtered (Y/N)

Section D Required Client Information

Matrix Codes (MATRIX / CODE): Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Tissue TS; Other OT

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED COMPOSITE START DATE	COLLECTED COMPOSITE START TIME	COLLECTED COMPOSITE END/GRAB DATE	COLLECTED COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test (Y/N)												Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1																															
2																															
3																															
4																															
5																															
6																															
7																															
8																															
9																															
10																															
11																															
12																															

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: DATE Signed (MM/DD/YY):

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

ATTACHMENT VIII- METHOD HOLD TIME, CONTAINER AND PRESERVATION GUIDE (CURRENT AS OF ISSUE DATE)

THE HOLDING TIME INDICATED IN THE CHART BELOW IS THE MAXIMUM ALLOWABLE TIME FROM COLLECTION TO EXTRACTION AND/OR ANALYSIS PER THE ANALYTICAL METHOD. FOR METHODS THAT REQUIRE PROCESSING PRIOR TO ANALYSIS, THE HOLDING TIME IS DESIGNATED AS 'PREPARATION HOLDING TIME/ANALYSIS HOLDING TIME'.

Parameter	Method	Matrix	Container	Preservative	Max Hold Time	Additional Volume for MS/MSD
Acidity	SM2310B	Water	Plastic/Glass	≤ 6°C	14 Days	
Actinides	HASL-300	Water		pH<2 HNO_3	180 Days	
Actinides	HASL-300	Solid		None	180 Days	
Alkalinity	SM2320B/310.2	Water	Plastic/Glass	≤ 6°C	14 Days	
Alkylated PAHs		Water		≤ 6°C; pH<2 1:1 HCl (optional)	14/40 Days preserved; 7/40 Days unpreserved	Yes
Alkylated PAHs		Solid		≤ 10°C	1 Year/40 Days	
Total Alpha Radium (see note 3)	9315/903.0	Water	Plastic/Glass	pH<2 HNO_3	180 days	
Total Alpha Radium (see note 3)	9315	Solid		None	180 days	
Anions (Br, Cl, F, NO_2, NO_3, o-Phos, SO_4, bromate, chlorite, chlorate)	300.0/300.1/SM 4110B	Water	Plastic/Glass	≤ 6°C; EDA if bromate or chlorite run	All analytes 28 days except: NO_2, NO_3, o-Phos (48 Hours); chlorite (immediately for 300.0; 14 Days for 300.1). NO_2/NO_3 combo 28 days.	Yes
Anions (Br, Cl, F, NO_2, NO_3, o-Phos, SO_4, bromate, chlorite, chlorate)	300.0	Solid	Plastic/Glass	≤ 6°C	All analytes 28 days except: NO_2, NO_3, o-Phos (48 hours); chlorite (immediately). NO_2/NO_3 combo 28 days.	
Anions (Br, Cl, F, NO_2, NO_3, o-Phos, SO_4	9056	Water/ Solid	Plastic/Glass	≤ 6°C	28 days	
Aromatic and Halogenated Volatiles (see note 1)	8021	Solid	5035 vial kit	See note 1	14 days	Yes
Aromatic and Halogenated Volatiles	602/8021	Water	40mL vials	pH<2 HCl; ≤ 6°C; $Na_2S_2O_3$ if Cl present	14 Days (7 Days for aromatics if unpreserved)	
Acid Volatile Sulfide	Draft EPA 1629	Solid	8oz Glass	≤ 6°C	14 Days	
Bacteria, Total Plate Count	SM9221D	Water	Plastic/WK	≤ 6°C; $Na_2S_2O_3$	24 Hours	Yes
Base/Neutrals and Acids	8270	Solid	8oz Glass	≤ 6°C	14/40 Days	

Parameter	Method	Matrix	Container	Preservative	Max Hold Time	Additional Volume for MS/MSD
Base/Neutrals and Acids	625/8270	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days	Yes
Base/Neutrals, Acids & Pesticides	525.2	Water	1L Amber Glass	pH<2 HCl; ≤ 6°C; Na sulfite if Cl present	14/30 Days	Yes
Biomarkers		Water	≤ 6°C; pH<2 1:1 HCl (optional)	14/40 Days preserved; 7/40 Days unpreserved	≤ 6°C; pH<2 1:1 HCl (optional)	Yes
Biomarkers		Solid	≤ 10°C	1 Year/40 Days	≤ 10°C	
BOD/cBOD	SM5210B	Water	Plastic/Glass	≤ 6°C	48 hours	Yes
BTEX/Total Hydrocarbons	TO-3	Air	Summa Canister	None	14 Days	
BTEX/Total Hydrocarbons	TO-3	Air	Tedlar Bag or equivalent	None	48 Hours	
Carbamates	531.1	Water	Glass	$Na_2S_2O_3$, Monochloroacetic acid pH <3; ≤ 6°C	28 Days	
Cation/Anion Balance	SM1030E	Water	Plastic/Glass	None	None	
Cation Exchange	9081	Solid	8oz Glass	None	unknown	
Chloride	SM4500Cl-C,E	Water	Plastic/Glass	None	28 Days	Yes
Chlorine, Residual	SM4500Cl-D,E,G/330.5/Hach 8167	Water	Plastic/Glass	None	15 minutes	
Chlorophyll	SM10200H	Water	Opaque bottle or aluminum foil	≤ 6°C	48 Hours to filtration	
COD	SM5220C, D/410.4/Hach 8000	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days	Yes
Coliform, Fecal	SM9222D	Water	100mL Plastic	≤ 6°C	8 Hours	
Coliform, Fecal	SM9222D	Solid	100mL Plastic	≤ 6°C	8 Hours	
Coliform, Fecal	SM9221E	Water	100mL Plastic	≤ 6°C	8 Hours	
Coliform, Fecal	SM9221E	Solid	100mL Plastic	≤ 6°C	24 Hours	
Coliform, Total	SM9222B	Water	100mL Plastic	≤ 6°C	8 Hours	
Coliform, Total	SM9221B	Solid	100mL Plastic	≤ 6°C	8 Hours	
Coliform, Total and E. coli	SM9223B	Drinking Water	100mL Plastic	≤ 10°C	30 Hours after collection	
Color	SM2120B,E	Water	Covered Plastic/Acid Washed Amber Glass	≤ 6°C	24 Hours	
Condensable Particulate Emissions	EPA 202	Air	Solutions	None	180 Days	
Cyanide, Reactive	SW846 chap.7	Water	Plastic/Glass	None	28 Days	
Cyanide, Reactive	SW846 chap.7	Solid	Plastic/Glass	None	28 Days	
Cyanide, Total and	SM4500CN-	Water	Plastic/Glass	pH≥12 NaOH;	14 Days	Yes

Parameter	Method	Matrix	Container	Preservative	Max Hold Time	Additional Volume for MS/MSD
Amenable	A,B,C,D,E,G,I, N/9010/ 9012/335.4			≤ 6°C; ascorbic acid if Cl present	(24 Hours if sulfide present- applies to SM4500CN only)	
Diesel Range Organics- Alaska DRO	AK102	Solid	8oz Glass	≤ 6°C	14/40 Days	
Diesel Range Organics- Alaska DRO	AK102	Water	1L Glass	pH<2 HCl; ≤ 6°C	14/40 Days	Yes
Diesel Range Organics- TPH DRO	8015	Solid	8oz Glass Jar	≤ 6°C	14/40 Days	
Diesel Range Organics- TPH DRO	8015	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days	Yes
Diesel Range Organics- TPH DRO	8015	Tissue	1L Amber Glass	≤ - 10°C	1 Year if frozen/40 Days	
Diesel Range Organics- NwTPH-Dx	Nw-TPH-Dx	Solid	8oz Glass Jar	≤ 6°C	14/40 Days	
Diesel Range Organics- NwTPH-Dx	Nw-TPH-Dx	Water	250mL Amber Glass	pH <2 HCl; ≤ 6°C	14/40 Days; 7 Days from collection to extraction if unpreserved	Yes
Diesel Range Organics- Wisconsin DRO	WI MOD DRO	Solid	Tared 4oz Glass Jar	≤ 6°C	10/47 Days	
Diesel Range Organics- Wisconsin DRO	WI MOD DRO	Water	1L Amber Glass	≤ 6°C; pH <2 HCl	14/40 Days	Yes
Dioxins and Furans	1613B	Solid	8oz Glass	≤ 6°C	1 year	Yes
Dioxins and Furans	1613B	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	1 year	
Dioxins and Furans	1613B	Fish/ Tissue	Aluminum foil	≤ 6°C	1 year	
Dioxins and Furans	8290	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	30/45 Days	Yes
Dioxins and Furans	8290	Solid	8oz Glass	≤ 6°C	30/45 Days	Yes
Dioxins and Furans	8290	Fish/ Tissue	Not specified	< -10°C	30/45 Days	
Dioxins and Furans	TO-9	Air	PUF	None	30/45 Days	
Diquat/Paraquat	549.2	Water	Amber Plastic	≤ 6°C; $Na_2S_2O_3$	7/21 Days	
EDB/DBCP (8011) EDB/DBCP/1,2,3-TCP (504.1)	504.1/8011	Water	40mL vials	≤ 6°C; $Na_2S_2O_3$ if Cl present	14 Days	Yes
Endothall	548.1	Water	Amber Glass	≤ 6°C; $Na_2S_2O_3$	7/14 Days	
Enterococci	EPA 1600	Water	100mL Plastic	≤ 6°C	8 Hours	
Explosives	8330/8332	Water	1L Amber Glass	≤ 6°C	7/40 Days	Yes
Explosives	8330/8332	Solid	8oz Glass Jar	≤ 6°C	14/40 Days	

Parameter	Method	Matrix	Container	Preservative	Max Hold Time	Additional Volume for MS/MSD
Extractable Petroleum Hydrocarbons (aliphatic and aromatic)	MA-EPH	Water	1L Amber Glass	pH<2 HCl; ≤ 6°C	14/40 Days	
Extractable Petroleum Hydrocarbons (aliphatic and aromatic)	MA-EPH	Solid	4oz Glass Jar	≤ 6°C	7/40 Days	
Fecal Streptococci	SM9230B	Water	100mL Plastic	≤ 6°C	8 Hours	
Ferrous Iron	SN3500Fe-D; Hach 8146	Water	Glass	None	Immediate	
Flashpoint/ Ignitability	1010	Liquid	Plastic/Glass	None	28 Days	
Florida PRO	FL PRO DEP (11/1/95)	Liquid	Glass, PTFE lined cap	≤ 6°C; pH <2 H_2SO_4 or HCl	7/40 Days	
Fluoride	SM4500Fl-C,D	Water	Plastic	None	28 Days	Yes
Gamma Emitting Radionuclides	901.1	Water	Plastic/Glass	pH<2 HNO_3	180 days	
Gasoline Range Organics	8015	Water	40mL vials	pH<2 HCl	14 Days	Yes
Gasoline Range Organics	8015	Solid	5035 vial kit	See note 1	14 days	
Gasoline Range Organics- Alaska GRO	AK101	Solid	5035 vial kit	See 5035 note*	28 Days if GRO only (14 Days with BTEX)	Yes
Gasoline Range Organics- Alaska GRO	AK101	Water	40mL vials	pH<2 HCl; ≤ 6°C	14 Days	Yes
Gasoline Range Organics- NwTPH-Gx	Nw-TPH-Gx	Water	40mL vials	pH<2 HCl; ≤ 6°C	7 Days unpreserved; 14 Days preserved	Yes
Gasoline Range Organics- NwTPH-Gx	Nw-TPH-Gx	Solid	40mL vials	≤ 6°C; packed jars with no headspace	14 Days	Yes
Gasoline Range Organics- Wisconsin GRO	WI MOD GRO	Water	40mL vials	pH<2 HCl; ≤ 6°C	14 Days	
Gasoline Range Organics- Wisconsin GRO	WI MOD GRO	Solid	40mL MeOH vials	≤ 6°C in MeOH	21 Days	
Glyphosate	547	Water	Glass	≤ 6°C; $Na_2S_2O_3$	14 Days (18 Months frozen)	
Gross Alpha (NJ 48Hr Method)	NJAC 7:18-6	Water	Plastic/Glass	pH<2 HNO_3	48 Hrs	
Gross Alpha and Gross Beta	9310/900.0	Water	Plastic/Glass	pH<2 HNO_3	180 Days	
Gross Alpha and Gross Beta	9310	Solid	Glass	None	180 Days	

Parameter	Method	Matrix	Container	Preservative	Max Hold Time	Additional Volume for MS/MSD
Haloacetic Acids	552.1/552.2	Water	40mL Amber vials	NH_4Cl; ≤ 6°C	14/7 Days if extracts stored ≤ 6°C or 14/14 Days if extracts stored at ≤ -10°C	Yes
Hardness, Total ($CaCO_3$)	SM2340B,C/ 130.1	Water	Plastic/Glass	pH<2 HNO_3	6 Months	
Heterotrophic Plate Count (SPC/HPC)	SM9215B	Water	100mL Plastic	≤ 6°C	24 Hours	
Heterotrophic Plate Count (SPC/HPC)	SimPlate	Water	100mL Plastic	≤ 6°C	8 Hours	
Herbicides, Chlorinated	8151	Solid	8oz Glass Jar	≤ 6°C	14/40 Days	
Herbicides, Chlorinated	8151	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days	Yes
Herbicides, Chlorinated	515.1/515.3	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	14/28 Days	Yes
Hexavalent Chromium	7196/218.6/ SM3500Cr-B, C, D	Water	Plastic/Glass	≤ 6°C	24 Hours (see note 4)	Yes
Hexavalent Chromium	7196/218.6/ SM3500Cr-B, C, D	Water	Plastic/Glass	Ammonium Buffer pH 9.3-9.7	28 Days (see note 4)	Yes
Hexavalent Chromium	218.6/218.7	Drinking Water	Plastic/Glass	Ammonium Buffer pH >8	14 Days (see note 4)	
Hexavalent Chromium	7196 (with 3060A)	Solid		≤ 6°C	24 Hours after extraction	
Hydrogen Halide and Halogen Emissions	EPA 26	Air	Solutions	None	6 Months	
Ignitability of Solids	1030	Non-liquid Waste	Plastic/Glass	None	28 Days	
Lead Emissions	EPA 12	Air	Filter/Solutions	None	6 Months	
Lipids	Pace Lipids	Tissue	Plastic/Glass	≤ -10°C	1 Year if frozen	
Mercury, Low-Level	1631E	Solid	Glass	None	28 Days	
Mercury, Low-Level	1631E	Water	Fluoropolymer bottles (Glass if Hg is only analyte being tested)	12N HCl or BrCl	48 Hours for preservation or analysis; 28 Days to preservation if sample oxidized in bottle; 90 Days for analysis if preserved	Yes
Mercury, Low-Level	1631E	Tissue	Plastic/Glass	≤ - 10°C	28 Days if frozen	
Mercury, Methyl	1630	Water	Teflon/fluoropolymer or Glass	4 mL/L HCl for fresh water, 2 mL/L H2SO4 for saline samples, or fill to the top	6 months if preserved; Distillate – one week if refrigerated; Ethylated distillate –	Yes

Parameter	Method	Matrix	Container	Preservative	Max Hold Time	Additional Volume for MS/MSD
				with sample so there is no headspace and maintain 0-4 oC until preservation	analyze within 48 hours; Or the samples must be acid preserved within 48 hours of sampling	
Mercury	7471	Solid	8oz Glass Jar	≤ 6°C	28 Days	
Mercury	7470/245.1/ 245.2	Water	Plastic/Glass	pH<2 HNO_3	28 Days	Yes
Mercury	7471/245.6	Tissue	Plastic/Glass	≤ - 10°C	28 Days if frozen	
Metals (GFAA)	7000/200.9	Water	Plastic/Glass	pH<2 HNO_3	180 Days	
Metals (ICP)	NIOSH 7300A/7303	Air	Filters	None	180 Days	
Metals (ICP/ICPMS)	6010/6020	Solid	8oz Glass Jar	None	180 Days	
Metals (ICP/ICPMS)	6010/6020/ 200.7/200.8	Water	Plastic/Glass	pH<2 HNO_3	180 Days	
Metals (ICP/ICPMS)	6020	Tissue	Plastic/Glass	≤ -10°C	180 Days if frozen	
Methane, Ethane, Ethene	8015 modified	Water	40mL vials	HCl	14 Days	Yes
Methane, Ethane, Ethene	RSK-175	Water	40mL vials	unpreserved	7 Days	Yes
Methane, Ethane, Ethene	EPA 3C	Air	Summa Canister	None	14 Days	
Methane, Ethane, Ethene	EPA 3C	Air	Tedlar Bag or equivalent	None	48 Hours	
Methanol, Ethanol	8015 modified	Water	40mL vials	≤ 6°C	14 Days	Yes
Methanol, Ethanol	8015 modified	Solid	2oz Glass	≤ 6°C	14 Days	
Nitrogen, Ammonia	SM4500NH3/ 350.1	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days	Yes
Nitrogen, Kjeldahl (TKN)	351.2	Solid	Plastic/Glass	≤ 6°C	28 Days	
Nitrogen, Kjeldahl (TKN)	SM4500-Norg/351.2	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days	Yes
Nitrogen, Nitrate	SM4500-NO3/ 352.1	Water	Plastic/Glass	≤ 6°C	24 Hours preferred	Yes
Nitrogen, Nitrate & Nitrite combination	353.2	Solid	Plastic/Glass	≤ 6°C	28 Days	
Nitrogen, Nitrate & Nitrite combination	SM4500-NO3/ 353.2	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days	Yes
Nitrogen, Nitrite or Nitrate separately	SM4500-NO2/ 353.2	Water	Plastic/Glass	≤ 6°C	48 Hours	Yes
Nitrogen, Organic	SM4500-Norg/ 351.2	Water	Plastic/Glass	pH<2 H_2SO_4; ≤ 6°C	28 Days	Yes
Non-Methane Organics	EPA 25C	Air	Summa Canister	None	14 Days	
Non-Methane Organics	EPA 25C	Air	Tedlar Bag or equivalent	None	48 Hours	

Parameter	Method	Matrix	Container	Preservative	Max Hold Time	Additional Volume for MS/MSD
Odor	SM2150B	Water	Glass	≤ 6°C	24 Hours	
Oil and Grease/HEM	1664A/ SM5520B/9070	Water	Glass	pH<2 H_2SO_4 or HCl; ≤ 6°C	28 Days	Yes
Oil and Grease/HEM	9071	Solid	Glass	≤ 6°C	28 Days	
PBDEs	1614	Water	1L Amber Glass	≤ 6°C	1 Year/1 Year	Yes
PBDEs	1614	Solid	Wide Mouth Jar	≤ 6°C	1 Year/1 Year	
PBDEs	1614	Tissue	Aluminum Foil	≤ -10°C	1 Year/1 Year	
PCBs and Pesticides, Organochlorine (OC)	TO-4/TO-10	Air	PUF	None	7/40 Days	
PCBs and Pesticides, Organochlorine (OC)	608	Water	1L Amber Glass		Pest: 7/40 Days; PCB: 1 Year/1 Year	
PCBs, Pesticides (OC), Herbicides	508.1	Water	Glass	Na2SO3; pH<2 HCl; < 6°C	14/30 Days	
Perchlorate	331	Water	Plastic/Glass	>0-6°C	28 Days	
Pesticides, Organochlorine (OC)	8081	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days	
Pesticides, Organochlorine (OC)	8081	Solid	8oz Glass Jar	≤ 6°C	14/40 Days	
Pesticides, Organochlorine (OC)	8081	Tissue	8oz Glass Jar	≤ -10°C	1 Year if frozen/40 Days	
Pesticides, Organophosphorous (OP)	8141	Solid	8oz Glass Jar	≤ 6°C	14/40 Days	
Pesticides, Organophosphorous (OP)	8141	Water	1L Amber Glass	pH 5-8 with NaOH or H_2SO_4; ≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days	Yes
PCBs (Aroclors)	8082	Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	1 Year/1 Year	Yes
PCBs (Aroclors)	8082	Solid	8oz Glass Jar	≤ 6°C	1 Year/1 Year	
PCBs (Aroclors)	8082	Tissue	Plastic/Glass	≤ -10°C	1 Year if frozen/1 Year	
PCB Congeners	1668A	Water	1L Amber Glass	≤ 6°C but above freezing	1 Year/1 Year	Yes
PCB Congeners	1668A	Solid	4-8oz Glass Jar	≤ 6°C but above freezing	1 Year/1 Year	
PCB Congeners	1668A	Tissue	4-8oz Glass Jar	≤ -10°C	1 Year/1 Year	
Oil Range Organics-ORO		Solid	8oz Glass Jar	≤ 6°C	14/40 Days	
Oil Range Organics-ORO		Water	1L Amber Glass	≤ 6°C; $Na_2S_2O_3$ if Cl present	7/40 Days	Yes
Oxygen, Dissolved	SM4500-O	Water	Glass	None	15 minutes	

Parameter	Method	Matrix	Container	Preservative	Max Hold Time	Additional Volume for MS/MSD
(Probe)						
Paint Filter Liquid Test	9095	Water	Plastic/Glass	None	N/A	Yes
Particulates	PM-10	Air	Filters	None	180 Days	Yes
Permanent Gases	EPA 3C	Air	Summa Canister	None	14 Days	
Permanent Gases	EPA 3C	Air	Tedlar Bag or equivalent	None	48 Hours	
pH	SM4500H+B/ 9040	Water	Plastic/Glass	None	15 minutes	Yes
pH	9045	Solid	Plastic/Glass	None	Contact local lab	Yes
Phenol, Total	420.1/420.4/ 9065/9066	Water	Glass	pH<2 H_2SO_4; $\leq 6^oC$	28 Days	Yes
Phosphorus, Orthophosphate	SM4500P/ 365.1/365.3	Water	Plastic	Filter; $\leq 6^oC$	Filter within 15 minutes, Analyze within 48 Hours	Yes
Phosphorus, Total	SM4500P/ 365.1/365.3/ 365.4	Water	Plastic/Glass	pH<2 H_2SO_4; $\leq 6^oC$	28 Days	Yes
Phosphorus, Total	365.4	Solid	Plastic/Glass	$\leq 6^oC$	28 Days	Yes
Polynuclear Aromatic Hydrocarbons (PAH)	TO-13	Air	PUF	None	7/40 Days	
Polynuclear Aromatic Hydrocarbons (PAH)	8270 SIM	Solid	8oz Glass Jar	$\leq 6^oC$	14/40 Days	
Polynuclear Aromatic Hydrocarbons (PAH)	8270 SIM	Water	1L Amber Glass	$\leq 6^oC$; $Na_2S_2O_3$ if Cl present	7/40 Days	Yes
Polynuclear Aromatic Hydrocarbons (PAH)	8270 SIM	Tissue	Plastic/Glass	$\leq -10^oC$	1 Year if frozen/ 40 Days	
Radioactive Strontium	905.0	Water	Plastic/Glass	pH<2 HNO_3	180 days	
Radium-226	903.0/903.1	Water	Plastic/Glass	pH<2 HNO_3	180 days	
Radium-228 (see note 3)	9320/904.0	Water	Plastic/Glass	pH<2 HNO_3	180 days	
Radium-228 (see note 3)	9320	Solid				
Residual Range Organics- Alaska RRO	AK103	Solid	8oz Glass	$\leq 6^oC$	14/40 Days	
Saturated Hydrocarbons	SOP S-MN-O-567	Water	$\leq 6^oC$; pH<2 1:1 HCl (optional)	14/40 Days preserved; 7/40 Days unpreserved	$\leq 6^oC$; pH<2 1:1 HCl (optional)	Yes

Parameter	Method	Matrix	Container	Preservative	Max Hold Time	Additional Volume for MS/MSD
Saturated Hydrocarbons	SOP S-MN-O-567	Solid	≤ 10°C	1 Year/40 Days	≤ 10°C	
Silica, Dissolved	SM4500Si-D	Water	Plastic	≤ 6°C	28 Days	
Solids, Settleable	SM2540F	Water	Glass	≤ 6°C	48 Hours	Yes
Solids, Total	SM2540B	Water	Plastic/Glass	≤ 6°C	7 Days	Yes
Solids, Total	SM2540G	Solid	Plastic/Glass	≤ 6°C	7 Days	
Solids, Total (FOC, OM, Ash)	ASTM D2974	Solid	Plastic/Glass	≤ 6°C	7 Days	
Solids, Total Dissolved	SM2540C	Water	Plastic/Glass	≤ 6°C	7 Days	Yes
Solids, Total Suspended	SM2540D/USGS I-3765-85	Water	Plastic/Glass	≤ 6°C	7 Days	Yes
Solids, Total Volatile	160.4/SM2540E	Water	Plastic/Glass	≤ 6°C	7 Days	Yes
Solids, Total Volatile	160.4	Solid	Plastic/Glass	≤ 6°C	7 Days	Yes
Specific Conductance	SM2510B/9050/120.1	Water	Plastic/Glass	≤ 6°C	28 Days	Yes
Stationary Source Dioxins and Furans	EPA 23	Air	XAD Trap	None	30/45 Days	
Stationary Source Mercury	EPA 101	Air	Filters	None	180 Days, 28 Days for Hg	
Stationary Source Metals	EPA 29	Air	Filters	None	180 Days, 28 Days for Hg	
Stationary Source PM10	EPA 201A	Air	Filters	None	180 Days	
Stationary Source Particulates	EPA 5	Air	Filter/Solutions	None	180 Days	
Sulfate	SM4500SO4/9036/9038/375.2/ASTM D516	Water	Plastic/Glass	≤ 6°C	28 Days	Yes
Sulfide, Reactive	SW-846 Chap.7	Water	Plastic/Glass	None	28 Days	
Sulfide, Reactive	SW-846 Chap.7	Solid	Plastic/Glass	None	28 Days	
Sulfide, Total	SM4500S/9030	Water	Plastic/Glass	pH>9 NaOH; ZnOAc; ≤ 6°C	7 Days	
Sulfite	SM4500SO3	Water	Plastic/Glass	None	15 minutes	
Surfactants (MBAS)	SM5540C	Water	Plastic/Glass	≤ 6°C	48 Hours	Yes
Total Organic Carbon (TOC)	SM5310B,C,D/9060	Water	Glass	pH<2 H_2SO_4 or HCl; ≤ 6°C	28 Days	
Total Organic Carbon (TOC)	9060/Walkley Black	Solid	Glass	≤ 6°C	14 Days	
Total Organic Halogen (TOX)	SM5320/9020/9021	Water	Glass; no headspace	≤ 6°C	14 Days	Yes
Tritium	906.0	Water	Glass	None	180 days	
Turbidity	SM2130B/180.1	Water	Plastic/Glass	≤ 6°C	48 Hours	Yes
Total Uranium	908.0/ASTM D5174-97	Water	Plastic/Glass	pH<2 HCl	180 days	
Volatile Petroleum	MA-VPH	Water	40mL vials	pH<2 HCl;	14 Days preserved	Yes

Parameter	Method	Matrix	Container	Preservative	Max Hold Time	Additional Volume for MS/MSD
Hydrocarbons (aliphatic and aromatic)				≤ 6°C		
Volatile Petroleum Hydrocarbons (aliphatic and aromatic)	MA-VPH	Solid	4-8oz Glass Jar	≤ 6°C; packed jars with no headspace	7/28 Days	
Volatiles	TO-14	Air	Summa Canister	None	30 Days	
Volatiles	TO-14	Air	Tedlar Bag or equivalent	None	48 Hours	
Volatiles	TO-15	Air	Summa Canister	None	30 Days	
Volatiles	TO-18/8260	Air	Tedlar Bag or equivalent	None	72 Hours	
Volatiles	8260	Solid	5035 vial kit	See note 1	14 days	Yes
Volatiles	8260	Water	40mL vials	pH<2 HCl; ≤ 6°C; $Na_2S_2O_3$ if Cl present	14 Days	Yes
Volatiles	8260	Conc. Waste	5035 vial kit or 40mL vials	≤ 6°C	14 Days	
Volatiles	624	Water	40mL vials	pH<2 HCl; ≤ 6°C; $Na_2S_2O_3$ if Cl present	14 Days (7 Days for aromatics if unpreserved)	Yes
Volatiles (see note 2)	524.2	Water	40mL vials (in duplicate)	pH<2 HCl; ≤ 6°C; Ascorbic acid or $Na_2S_2O_3$ if Cl present[2]	14 Days	Yes
UCMR3 Metals	200.8	Water	Plastic or glass	pH<2 HNO_3	28 Days	
UCMR3 Hexavalent Chromium	218.7	Water	HDPE or propylene	Na_2CO_3/$NaHCO_3$/$(NH_4)_2SO_4$; pH>8	14 Days	
UCMR3 Chlorate	300.1	Water	Plastic or glass	EDA	28 Days	
UCMR3 Hormones	539	Water	Amber glass	$Na_2S_2O_3$, 2-mercaptopyridine-1-oxide, sodium salt	28 Days	
UCMR3 Perfluorinated Compounds	537	Water	Polypropylene	Trizma	14 Days	
UCMR3 Volatiles	524.3	Water	40 mL amber glass vials	Ascorbic acid. Maleic acid pH~2	14 Days	
UCMR3 1, 4 Dioxane	522	Water	Glass	Na_2SO_3, $NaHSO_4$; pH<4	28 Days	
UV254	SM5910B	Water	Glass	≤ 6°C	48 Hours	

[1] **5035/5035A Note**: 5035 vial kit typically contains 2 vials water, preserved by freezing **or**, 2 vials aqueous sodium bisulfate preserved at 4°C, **and** one vial methanol preserved at ≤6°C **and** one container of unpreserved sample stored at ≤6°C.

[2] Method 524.2 lists ascorbic acid as the preservative when residual chlorine is suspected, unless gases or Table 7 compounds are NOT compounds of interest and then sodium thiosulfate is the preservative recommended.

[3] Methods 9315 and 9320 both state that if samples are unpreserved, the samples should be brought to the lab within 5 days of collection, preserved in the lab, and then allowed to sit for a minimum of 16 hours before sample preparation/analysis.

[4] The holding time for hexavalent chromium may be extended by the addition of the ammonium buffer listed in EPA 218.6 per the 2012 EPA Method Update Rule.Although Method 218.6 stipulates a different pH range (9.0 to 9.5) for buffering, this method requirement was modified in the Method Update Rule to a pH range of 9.3 to 9.7.For non-potable waters, adjust the pH of the sample to 9.3 to 9.7 during collection with the method required ammonium sulfate bufferto extend the holding time to 28 days. For potable waters, addition of the buffer during collection will extend the holding time for 14 days per EPA 218.7 and the EPA UCMR3 program.

Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 6010 Water

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Aluminum	7429-90-5	18.41	200	80	120	20	75	125	20	20
Antimony	7440-36-0	3.14	20	80	120	20	75	125	20	20
Arsenic	7440-38-2	3.15	20	80	120	20	75	125	20	20
Barium	7440-39-3	5.00	10	80	120	20	75	125	20	20
Beryllium	7440-41-7	2.50	5	80	120	20	75	125	20	20
Boron	7440-42-8	75.00	150	80	120	20	75	125	20	20
Cadmium	7440-43-9	0.251	3	80	120	20	75	125	20	20
Calcium	7740-70-2	250.00	500	80	120	20	75	125	20	20
Chromium	7440-47-3	5.00	10	80	120	20	75	125	20	20
Cobalt	7440-48-4	5.00	10	80	120	20	75	125	20	20
Copper	7440-50-8	1.20	10	80	120	20	75	125	20	20
Iron	7439-86-6	4.83	50	80	120	20	75	125	20	20
Lead	7439-92-1	1.78	10	80	120	20	75	125	20	20
Magnesium	7439-95-4	250.00	500	80	120	20	75	125	20	20
Manganese	7439-96-5	2.50	5	80	120	20	75	125	20	20
Molybdenum	7439-98-7	2.26	15	80	120	20	75	125	20	20
Nickel	7440-02-0	10.00	20	80	120	20	75	125	20	20
Potassium	7440-70-2	1250.00	2500	80	120	20	75	125	20	20
Selenium	7782-49-2	6.65	20	80	120	20	75	125	20	20
Silver	7440-22-4	0.628	10	80	120	20	75	125	20	20
Sodium	7740-23-5	500.00	1000	80	120	20	75	125	20	20
Sulfur	7704-34-9	86.00	1000	80	120	20	75	125	20	20
Thallium	7440-28-0	2.58	20	80	120	20	75	125	20	20
Tin	7440-31-5	37.50	75	80	120	20	75	125	20	20
Titanium	7440-32-6	12.50	25	80	120	20	75	125	20	20
Vanadium	7440-62-2	1.20	15	80	120	20	75	125	20	20
Zinc	7440-66-6	4.61	20	80	120	20	75	125	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 6010 Solid

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (mg/Kg)**	**PRL (mg/Kg)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Aluminum	7429-90-5	2.543	10	80	120	20	75	125	20	20
Antimony	7440-36-0	0.195	1.00	80	120	20	75	125	20	20
Arsenic	7440-38-2	0.291	1.00	80	120	20	75	125	20	20
Barium	7440-39-3	0.055	0.50	80	120	20	75	125	20	20
Beryllium	7440-41-7	0.125	0.25	80	120	20	75	125	20	20
Boron	7440-42-8	0.821	7.50	80	120	20	75	125	20	20
Cadmium	7440-43-9	0.017	0.15	80	120	20	75	125	20	20
Calcium	7740-70-2	7.559	25	80	120	20	75	125	20	20
Chromium	7440-47-3	0.065	0.50	80	120	20	75	125	20	20
Cobalt	7440-48-4	0.052	0.50	80	120	20	75	125	20	20
Copper	7440-50-8	0.250	0.50	80	120	20	75	125	20	20
Iron	7439-86-6	0.801	2.50	80	120	20	75	125	20	20
Lead	7439-92-1	0.074	1.00	80	120	20	75	125	20	20
Magnesium	7439-95-4	2.671	25	80	120	20	75	125	20	20
Manganese	7439-96-5	0.125	0.25	80	120	20	75	125	20	20
Molybdenum	7439-98-7	0.103	0.75	80	120	20	75	125	20	20
Nickel	7440-02-0	0.103	1.00	80	120	20	75	125	20	20
Potassium	7440-70-2	14.797	125	80	120	20	75	125	20	20
Selenium	7782-49-2	0.340	0.75	80	120	20	75	125	20	20
Silver	7440-22-4	0.050	0.50	80	120	20	75	125	20	20
Sodium	7740-23-5	5.159	50	80	120	20	75	125	20	20
Sulfur	7704-34-9	5.100	50	80	120	20	75	125	20	20
Thallium	7440-28-0	0.265	1.00	80	120	20	75	125	20	20
Tin	7440-31-5	0.479	3.75	80	120	20	75	125	20	20
Titanium	7440-32-6	0.137	1.25	80	120	20	75	125	20	20
Vanadium	7440-62-2	0.154	0.75	80	120	20	75	125	20	20
Zinc	7440-66-6	0.342	1.00	80	120	20	75	125	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 6020 Solid

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (mg/kg)**	**PRL (mg/kg)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Aluminum	7429-90-5	1.432	10.00	80	120	20	75	125	20	20
Antimony	7440-36-0	0.077	0.50	80	120	20	75	125	20	20
Arsenic	7440-38-2	0.120	0.50	80	120	20	75	125	20	20
Barium	7440-39-3	0.104	0.30	80	120	20	75	125	20	20
Beryllium	7440-41-7	0.070	0.20	80	120	20	75	125	20	20
Bismuth	7440-69-9	0.250	0.50	80	120	20	75	125	20	20
Boron	7440-42-8	1.064	5.00	80	120	20	75	125	20	20
Cadmium	7440-43-9	0.039	0.08	80	120	20	75	125	20	20
Calcium	7740-70-2	8.343	40.00	80	120	20	75	125	20	20
Chromium	7440-47-3	0.173	0.50	80	120	20	75	125	20	20
Cobalt	7440-48-4	0.250	0.50	80	120	20	75	125	20	20
Copper	7440-50-8	0.500	1.00	80	120	20	75	125	20	20
Iron	7439-86-6	25.000	50.00	80	120	20	75	125	20	20
Lead	7439-92-1	0.018	0.10	80	120	20	75	125	20	20
Lithium	7439-93-2	0.136	0.50	80	120	20	75	125	20	20
Magnesium	7439-95-4	1.559	10.00	80	120	20	75	125	20	20
Manganese	7439-96-5	0.075	0.50	80	120	20	75	125	20	20
Molybdenum	7439-98-7	0.113	0.50	80	120	20	75	125	20	20
Nickel	7440-02-0	0.134	0.50	80	120	20	75	125	20	20
Potassium	7440-70-2	4.760	50.00	80	120	20	75	125	20	20
Selenium	7782-49-2	0.250	0.50	80	120	20	75	125	20	20
Silica	7631-86-9	53.5	107	80	120	20	75	125	20	20
Silicon	7740-21-3	8.212	50.00	80	120	20	75	125	20	20
Silver	7440-22-4	0.250	0.5	80	120	20	75	125	20	20
Sodium	7740-23-5	11.973	50.00	80	120	20	75	125	20	20
Strontium	7440-24-6	0.072	0.50	80	120	20	75	125	20	20
Thallium	7440-28-0	0.011	0.10	80	120	20	75	125	20	20
Tin	7440-31-5	0.185	2.00	80	120	20	75	125	20	20
Titanium	7440-32-6	0.405	1.00	80	120	20	75	125	20	20
Vanadium	7440-62-2	0.036	1.00	80	120	20	75	125	20	20
Uranium-238	7440-61-1	0.250	0.50	80	120	20	75	125	20	20
Zinc	7440-66-6	1.189	5.00	80	120	20	75	125	20	20

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Method Detection Limits and Reporting Limits
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pt/at
PT/at
pT/at
pt
PT
29/at

6020				LCS/LCSD			MS/MSD			DUP
Analyte	CAS#	MDL (ug/L)	PRL (ug/L)	Lower	Upper	RPD	Lower	Upper	RPD	RPD
Aluminum	7429-90-5	1.150	10	80	120	20	75	125	20	20
Antimony	7440-36-0	0.250	0.5	80	120	20	75	125	20	20
Arsenic	7440-38-2	0.250	0.5	80	120	20	75	125	20	20
Barium	7440-39-3	0.141	0.3	80	120	20	75	125	20	20
Beryllium	7440-41-7	0.066	0.2	80	120	20	75	125	20	20
Bismuth	7440-69-9	0.250	0.5	80	120	20	75	125	20	20
Boron	7440-42-8	1.020	5	80	120	20	75	125	20	20
Cadmium	7440-43-9	0.033	0.08	80	120	20	75	125	20	20
Calcium	7740-70-2	8.385	40	80	120	20	75	125	20	20
Chromium	7440-47-3	0.225	0.5	80	120	20	75	125	20	20
Cobalt	7440-48-4	0.250	0.5	80	120	20	75	125	20	20
Copper	7440-50-8	0.216	1	80	120	20	75	125	20	20
Iron	7439-86-6	8.015	50	80	120	20	75	125	20	20
Lead	7439-92-1	0.046	0.1	80	120	20	75	125	20	20
Lithium	7439-93-2	0.121	0.5	80	120	20	75	125	20	20
Magnesium	7439-95-4	2.846	10	80	120	20	75	125	20	20
Manganese	7439-96-5	0.137	0.5	80	120	20	75	125	20	20
Molybdenum	7439-98-7	0.238	0.5	80	120	20	75	125	20	20
Nickel	7440-02-0	0.233	0.5	80	120	20	75	125	20	20
Palladium	7440-05-3	0.053	0.5	80	120	20	75	125	20	20
Platinum	7440-06-4	0.250	0.5	80	120	20	75	125	20	20
Potassium	7440-70-2	8.342	50	80	120	20	75	125	20	20
Selenium	7782-49-2	0.250	0.5	80	120	20	75	125	20	20
Silica	7631-86-9	53.5	107	80	120	20	75	125	20	20
Silicon	7740-21-3	14.706	50	80	120	20	75	125	20	20
Silver	7440-22-4	0.056	0.5	80	120	20	75	125	20	20
Sodium	7740-23-5	18.240	50	80	120	20	75	125	20	20
Strontium	7440-24-6	0.057	0.5	80	120	20	75	125	20	20
Thallium	7440-28-0	0.025	0.1	80	120	20	75	125	20	20
Tin	7440-31-5	0.250	0.5	80	120	20	75	125	20	20
Titanium	7440-32-6	0.330	1	80	120	20	75	125	20	20
Vanadium	7440-62-2	0.212	1	80	120	20	75	125	20	20
Zinc	7440-66-6	2.500	5	80	120	20	75	125	20	20
Uranium-238	7440-61-1	0.250	0.5	80	120	20	75	125	20	20

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cb/cb

Solid by 7471				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (mg/kg)**	**PRL (mg/kg)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Mercury	7439-97-6	0.006	0.02	80	120	20	75	125	20	20

ca/ca

Water by 7470				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Mercury	7439-97-6	0.026	0.2	80	120	20	75	125	20	20

Ca/15

TCLP by 7470				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Mercury	7439-97-6	0.078	0.6	80	120	20	75	125	20	20

15/15

SPLP by 7470				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Mercury	7439-97-6	0.078	0.6	80	120	20	75	125	20	20

an/an

Water by EPA 245.1				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Mercury	7439-97-6	0.026	0.2	85	115	20	70	130	20	20

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Method Detection Limits and Reporting Limits
for EPA 300.0

Water			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Sulfate	0.6	1.20	90	110	20	90	110	20	20
Bromide	0.00576	0.08	90	110	20	90	110	20	20
Chloride	0.6	1.20	90	110	20	90	110	20	20
Fluoride	0.006	0.05	90	110	20	90	110	20	20
Nitrite	0.05	0.100	90	110	20	90	110	20	20
Nitrate	0.05	0.100	90	110	20	90	110	20	20

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Method Detection Limits and Reporting Limits
for SM 3500-Cr B,D

Water

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS #**	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Chromium, hexavalent	18540-29-9	0.00275	0.01	90	110	20	85	115	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
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Water

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS #**	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Total Residual Chlorine	7782-50-5	0.0186	0.075	90	110	20	80	120	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 4500 Cl-E

Water

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS #**	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Chloride	16887-00-6	0.5	1.0	90	110	20	80	120	30	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 4500 F

Water

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS #**	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Fluoride	16984-48-8	0.5	1.0	90	110	20	80	120	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 4500 Nitrate

Water

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS #**	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Nitrate	78989-43-2	0.05	0.10	90	110	20	80	120	30	30
Nitrite	78989-43-2	0.05	0.10	90	110	20	80	120	30	30

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 4500 Nitrite

Water

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS #**	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Nitrite	1594-56-5	0.05	0.10	80	120	30	80	120	30	30

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Method Detection Limits and Reporting Limits
for SM 4500 CN-E

Method Codes:
CN = ro
MACRO = RO

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Cyanide	57-12-5	0.005	0.010	90	110	30	80	120	30	30

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Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Phosphorus	0.0250	0.05	90	110	20	80	120	30	30
Low Level Phosphorus	0.0050	0.01	90	110	20	80	120	30	30
Low Level Phosphate, ortho	0.0025	0.005	90	110	20	80	120	30	30

Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for ASTM D516 Sulfate

Water

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS #**	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Sulfate	14808-79-8	1.25	2.50	80	120	20	80	120	30	30

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Water

Analyte	MDL (mg/L)	PRL (mg/L)	DUP RPD
Dissolved Oxygen	0.05	1	20

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Method Detection Limits and Reporting Limits
for SM 2320B Alkalinity

Water

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS #**	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Carbonate		2.5	5	90	110	30	80	120	30	30
hydroxide	84625-61-6	2.5	5	90	110	30	80	120	30	30
CaCO3	72608-12-9	2.5	5	90	110	30	80	120	30	30
Bicarbonate	71-52-3	2.5	5	90	110	30	80	120	30	30

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Water

			LCS/LCSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**RPD**
BOD*	1	2	85	115	20	20
Carbonaceous BOD	1	2	85	115	20	20
BOD, Soluble	1	2	85	115	20	20

*Reporting Limit for BOD assumes a sample volume of 300mls.

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Method Detection Limits and Reporting Limits
for SM 5220D

Water

SM5220D/EPA 410.4			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Chemical Oxygen Demand	11.2	50	90	110	20	80	120	20	20

Low Level

SM5220D			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Chemical Oxygen Demand	3.64	10	90	110	20	80	120	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 120.1

Water

			LCS/LCSD			DUP
Analyte	**MDL (uohms/cm)**	**PRL (uohms/cm)**	**Lower**	**Upper**	**RPD**	**RPD**
Specific Conductivity	1.00	1.00	90	110	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 350.1

Water

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS #**	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Ammonia	8013-59-0	0.02	0.04	90	110	20	90	110	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 353.2

Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Nitrate	0.01	0.02	90	110	20	90	110	20	20
Nitrite	0.01	0.02	90	110	20	90	110	20	20
Nitrate+Nitrite	0.01	0.02	90	110	20	90	110	20	20

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Method Detection Limits and Reporting Limits
for EPA Phenols

Water by EPA 420.4

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Phenols	2.78	10.00	90	110	20	90	110	20	20

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Method Detection Limits and Reporting Limits
for SM 1664A/9071B

Solid by 9071B			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/kg)**	**PRL (mg/kg)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
oil and grease	63.8	250	78	114	18	78	114	18	18
TPH	72.9	250	64	132	34	64	132	34	34

Water by 1664A - Liquid/Liquid Hand Shake Method			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
oil and grease	0.877	5	78	114	18	78	114	18	18
TPH	1.360	5	64	132	34	64	132	34	34

Water by 1664A by SPE/Hotplate			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
oil and grease	0.877	5	78	114	18	78	114	18	18
TPH	1.360	5	64	132	34	64	132	34	34

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 4500-H pH

			LCS/LCSD		
Analyte	**MDL (std.units)**	**PRL (std. units)**	**Lower**	**Upper**	**RPD**
pH			98	102	10
pH at 25 °C	0.1	0.1	98	102	10

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 9045

			LCS/LCSD		
Analyte	**MDL (std.units)**	**PRL (std. units)**	**Lower**	**Upper**	**RPD**
pH			98	102	10
pH at 25 °C	0.1	0.1	98	102	10

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Method Detection Limits and Reporting Limits
for EPA 160.4

Solid

			LCS/LCSD			DUP
Analyte	**MDL % (w/w)**	**PRL % (w/w)**	**Lower**	**Upper**	**RPD**	**RPD**
Total Volatile solids	0.5	1	80	120	10	10

Water

			LCS/LCSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**RPD**
Total Volatile solids	5.0	10	80	120	10	10

Water

			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**RPD**
Total Volatile Suspended solids	5.0	10	20

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Water

Analyte	MDL (mL/L/hr)	PRL (mL/L/hr)	DUP RPD
Total Settleable solids	0.1	0.2	10

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Method Detection Limits and Reporting Limits
for SM 2540C

			LCS/LCSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**RPD**
Total Solids	5	10	80	120	10	10

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Method Detection Limits and Reporting Limits
for SM 2540C

			LCS/LCSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**RPD**
Total Dissolved Solids	5	10	80	120	10	10

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 2540D

Water

			LCS/LCSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**RPD**
Total Suspended Solids (TSS)	5.0	10.0	80	120	10	10
TSS - Low Level	1.0	2.0	80	120	10	10

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 180.1

Water

			LCS/LCSD			DUP
Analyte	**MDL (NTU)**	**PRL (NTU)**	**Lower**	**Upper**	**RPD**	**RPD**
Turbidity	0.053	0.3	90	110	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 300.0

Water			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Sulfate	0.500	1.00	90	110	20	90	110	20	20
Bromide	0.013	0.05	90	110	20	90	110	20	20
Chloride	0.500	1.00	90	110	20	90	110	20	20
Fluoride	0.0403	0.10	90	110	20	90	110	20	20
Nitrite	0.0044	0.010	90	110	20	90	110	20	20
Nitrate+Nitrite	0.0085	0.020	90	110	20	90	110	20	20
Nitrate	0.00407	0.010	90	110	20	90	110	20	20

Soil			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/kg)**	**PRL (mg/kg)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Sulfate	12.5	25.00	90	110	20	90	110	20	20
Chloride	12.5	25.00	90	110	20	90	110	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM2310

Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Acidity	2.5	5.0	90	110	20	90	110	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 350.1

Solid

			LCS/LCSD			DUP
Analyte	**MDL (mg/kg)**	**PRL (mg/kg)**	**Lower**	**Upper**	**RPD**	**RPD**
Avail Ammoni	2.5	5.000	66	150	20	20

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Method Detection Limits and Reporting Limits
for EPA 350.1

Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Ammonia	0.0189	0.050	90	110	20	90	110	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 351.2

Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
TKN	0.0651	0.200	90	110	20	90	110	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 353.2

Solid

			LCS/LCSD			DUP
Analyte	**MDL (mg/kg)**	**PRL (mg/kg)**	**Lower**	**Upper**	**RPD**	**RPD**
Available nitrate	0.41	5.00	75	125	20	20

***Method detection limit studies are performed annually or more often as needed per method requirements.**

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Method Detection Limits and Reporting Limits
for EPA 353.2

Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Nitrite	0.0016	0.01	90	110	20	90	110	20	20
Nitrate+Nitrite	0.002	0.01	90	110	20	90	110	20	20

***Method detection limit studies are performed annually or more often as needed per method requirements.**

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 4500 NO2 B Nitrite

Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Nitrite	0.00093	0.01	87	117	20	76	120	20	20

***Method detection limit studies are performed annually or more often as needed per method requirements.**

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 4500 P-E

Solid

			LCS/LCSD			DUP
Analyte	**MDL (mg/L**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**RPD**
Available Phosphorus	0.336	1.000	68	136	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 4500 P E

Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Phosohorus, Total	0.0010	0.005	80	120	20	80	120	20	20
Dissolved Phosphorus	0.0010	0.005	80	120	20	80	120	20	20

Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Phosphate, ortho	0.00032	0.001	80	120	20	80	120	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 4500 S2-D

Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Sulfide	0.00819	0.10	80	120	20	80	120	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for TON (EPA 351.2 - EPA 350.1)

Water

Analyte	MDL (mg/L)	PRL (mg/L)
Total Organic Nitrogen (TON)	0.1	0.200

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM 10200H

Water

			LCS/LCSD			DUP
Analyte	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**RPD**
Chlorophyll A	0.947	2.0	80	120	20	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM2540D

Water

			LCS/LCSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**RPD**
Total Suspended Solids	0.5	1.0	75	125	10	10

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM2540C

Water

			LCS/LCSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**RPD**
Total Dissolved Solids	10	20.0	80	120	10	10

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM2540B

Water

			LCS/LCSD			DUP
Analyte	**MDL (mg/L)**	**PRL (mg/L)**	**Lower**	**Upper**	**RPD**	**RPD**
Total Solids	5	10.0	80	120	10	10

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for SM2540F

Water

			DUP
Analyte	**MDL (mL/L/hr)**	**PRL (mL/L/hr)**	**RPD**
Settleable Solids	0.1	0.2	20

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Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 8260

Med Lvl Soil

				LCS/LCSD			MS/MSD			DUP
Analyte	CAS#	MDL (ug/kg)	PRL (ug/kg)	Lower	Upper	RPD	Lower	Upper	RPD	RPD
1,1,1,2-Tetrachloroethane	630-20-6	25.00	50	75	125	20	62	150	30	30
1,1,1-Trichloroethane	71-55-6	25.00	50	66	125	20	58	150	30	30
1,1,2,2-Tetrachloroethane	79-34-5	6.86	50	69	125	20	30	150	30	30
1,1,2-Trichloroethane	79-00-5	8.46	50	75	125	20	61	149	30	30
1,1,2-Trichlorotrifluoroethane	76-13-1	20.90	200	55	125	20	45	150	30	30
1,1-Dichloroethane	75-34-3	6.99	50	67	125	20	56	150	30	30
1,1-Dichloroethene	75-35-4	9.99	50	62	125	20	48	150	30	30
1,1-Dichloropropene	563-58-6	8.17	50	65	125	20	58	150	30	30
1,2,3-Trichlorobenzene	87-61-6	11.9	50	58	132	20	55	150	30	30
1,2,3-Trichloropropane	96-18-4	6.64	200	71	125	20	57	148	30	30
1,2,4-Trichlorobenzene	120-82-1	9.09	50	63	128	20	61	150	30	30
1,2,4-Trimethylbenzene	95-63-6	25.00	50	74	125	20	64	150	30	30
1,2-Dibromo-3-chloropropane	96-12-8	26.5	500	55	142	20	40	150	30	30
1,2-Dibromoethane (EDB)	106-93-4	6.16	50	75	125	20	62	147	30	30
1,2-Dichlorobenzene	95-50-1	25.0	50	75	125	20	73	133	30	30
1,2-Dichloroethane	107-06-2	11.8	50	71	125	20	63	132	30	30
1,2-Dichloropropane	78-87-5	8.03	50	74	125	20	69	127	30	30
1,3,5-Trimethylbenzene	108-67-8	25.00	50	72	125	20	63	137	30	30
1,3-Dichlorobenzene	541-73-1	25.00	50	75	125	20	69	133	30	30
1,3-Dichloropropane	142-28-9	25.00	50	75	125	20	70	130	30	30
1,4-Dichlorobenzene	106-46-7	25.00	50	75	125	20	69	130	30	30
2,2-Dichloropropane	594-20-7	6.68	200	45	125	20	54	135	30	30
2-Butanone (MEK)	78-93-3	125	250	39	136	20	49	145	30	30
4-Chlorotoluene	106-43-4	25.00	50	74	125	20	67	134	30	30
4-Methyl-2-pentanone (MIBK)	108-10-1	125	250	55	132	20	60	150	30	30
Acetone	67-64-1	500	1000	55	131	20	65	135	30	30
Allyl chloride	107-05-1	6.56	200	53	125	20	55	126	30	30
Benzene	71-43-2	10.00	20	69	125	20	63	126	30	30
Bromobenzene	108-86-1	8.67	50	75	125	20	68	133	30	30
Bromochloromethane	74-97-5	6.81	50	75	125	20	66	130	30	30

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Bromodichloromethane	75-27-4	8.90	50	75	125	20	68	129	30	30
Bromoform	75-25-2	100.0	200	71	125	20	63	135	30	30
Bromomethane	74-83-9	250.0	500	42	150	20	30	150	30	30
Carbon tetrachloride	56-23-5	8.08	50	62	125	20	56	140	30	30
Chlorobenzene	108-90-7	7.69	50	75	125	20	69	130	30	30
Chloroethane	75-00-3	12.6	500	41	150	20	46	150	30	30
Chloroform	67-66-3	7.62	50	72	125	20	70	127	30	30
Chloromethane	74-87-3	9.12	200	50	125	20	51	125	30	30
cis-1,2-Dichloroethene	156-59-2	10.2	50	73	125	20	68	125	30	30
cis-1,3-Dichloropropene	10061-01-5	6.28	50	74	125	20	67	126	30	30
Dibromochloromethane	124-48-1	10.8	50	75	125	20	66	135	30	30
Dibromomethane	74-95-3	14.01	50	75	125	20	68	132	30	30
Dichlorodifluoromethane	75-71-8	23.1	200	30	125	20	30	138	30	30
Dichlorofluoromethane	75-43-4	250.0	500	30	150	20	30	150	30	30
Diethyl ether (Ethyl ether)	60-29-7	10.6	200	58	125	20	56	135	30	30
Ethylbenzene	100-41-4	6.28	50	72	125	20	69	126	30	30
Hexachloro-1,3-butadiene	87-68-3	125.00	250	59	138	20	50	150	30	30
Isopropylbenzene (Cumene)	98-82-8	25.0	50	72	125	20	65	135	30	30
m-Xylene (coelute) p-Xylene	108-38-3 106-42-3	13.70	100	73	125	20	69	130	30	30
Methyl-tert-butyl ether	1634-04-4	25.0	50	72	125	20	66	129	30	30
Methylene Chloride	75-09-2	100.0	200	71	125	20	64	125	30	30
Naphthalene	91-20-3	100.0	200	55	139	20	62	150	30	30
Styrene	100-42-5	7.47	50	75	125	20	70	132	30	30
Tetrachloroethene	127-18-4	18.05	50	69	125	20	61	142	30	30
Tetrahydrofuran	109-99-9	63.90	2000	62	129	20	68	138	30	30
Toluene	108-88-3	6.80	50	72	125	20	66	128	30	30
Trichloroethene	79-01-6	6.22	50	72	125	20	52	150	30	30
Trichlorofluoromethane	75-69-4	8.90	200	30	150	20	39	150	30	30
Vinyl chloride	75-01-4	7.42	20	53	125	20	50	125	30	30
Xylene (Total)	1330-20-7	19.64	150	74	125	20	70	130	30	30
n-Butylbenzene	104-51-8	6.07	50	65	125	20	62	141	30	30
n-Propylbenzene	103-65-1	6.06	50	71	125	20	65	135	30	30

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Method Detection Limits and Reporting Limits
for EPA 8260

o-Xylene	95-47-6	5.94	50	75	125	20	70	129	30	30
p-Isopropyltoluene	99-87-6	7.25	50	69	125	20	62	139	30	30
sec-Butylbenzene	135-98-8	5.89	50	68	125	20	64	137	30	30
tert-Butylbenzene	98-06-6	25.00	50	70	125	20	65	136	30	30
trans-1,3-Dichloropropene	10061-02-6	7.04	50	74	125	20	67	132	30	30
trans-1,2-Dichloroethene	156-60-5	9.92	50	68	125	20	63	129	30	30
				LCS/LCSD						
Surrogates				**Lower**	**Upper**					
1,2-Dichloroethane-d4 (S)	17060-07-0			55	150					
4-Bromofluorobenzene (S)	460-00-4			54	131					
Toluene-d8 (S)	2037-26-5			61	125					

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Method Detection Limits and Reporting Limits
for EPA 8260

Low Lvl Soil

				LCS/LCSD			MS/MSD			DUP
Analyte	CAS#	MDL (ug/kg)	PRL (ug/kg)	Lower	Upper	RPD	Lower	Upper	RPD	RPD
1,1,1,2-Tetrachloroethane	630-20-6	1.000	4	75	125	20	37	150	30	30
1,1,1-Trichloroethane	71-55-6	0.776	4	67	125	20	40	150	30	30
1,1,2,2-Tetrachloroethane	79-34-5	0.453	4	70	125	20	32	150	30	30
1,1,2-Trichloroethane	79-00-5	0.707	4	75	125	20	60	138	30	30
1,1,2-Trichlorotrifluoroethane	76-13-1	0.855	4	59	127	20	30	150	30	30
1,1-Dichloroethane	75-34-3	0.699	4	62	128	20	47	146	30	30
1,1-Dichloroethene	75-35-4	0.769	4	60	132	20	56	146	30	30
1,1-Dichloropropene	563-58-6	0.630	4	63	126	20	36	150	30	30
1,2,3-Trichlorobenzene	87-61-6	2.000	4	58	125	20	30	150	30	30
1,2,3-Trichloropropane	96-18-4	0.525	4	72	125	20	42	150	30	30
1,2,4-Trichlorobenzene	120-82-1	2.000	4	61	125	20	30	150	30	30
1,2,4-Trimethylbenzene	95-63-6	1.000	4	73	125	20	30	150	30	30
1,2-Dibromo-3-chloropropane	96-12-8	2.500	10	58	126	20	30	150	30	30
1,2-Dibromoethane (EDB)	106-93-4	0.716	4	74	125	20	44	146	30	30
1,2-Dichlorobenzene	95-50-1	0.465	4	74	125	20	30	150	30	30
1,2-Dichloroethane	107-06-2	0.576	4	69	125	20	47	145	30	30
1,2-Dichloroethene (Total)	540-59-0	4.000	8	73	125	20	34	150	30	30
1,2-Dichloropropane	78-87-5	0.636	4	69	125	20	48	145	30	30
1,3,5-Trimethylbenzene	108-67-8	1.000	4	70	125	20	30	150	30	30
1,3-Dichlorobenzene	541-73-1	1.000	4	74	125	20	30	150	30	30
1,3-Dichloropropane	142-28-9	1.000	4	75	125	20	48	141	30	30
1,4-Dichlorobenzene	106-46-7	1.000	4	72	125	20	30	150	30	30
2,2-Dichloropropane	594-20-7	0.594	10	56	131	20	42	147	30	30
2-Butanone (MEK)	78-93-3	10.000	20	46	133	20	30	150	30	30
2-Chlorotoluene	95-49-8	0.660	4	71	125	20	30	150	30	30
4-Chlorotoluene	106-43-4	1.000	4	73	125	20	30	150	30	30
4-Methyl-2-pentanone (MIBK)	108-10-1	10.000	20	57	125	20	43	150	30	30
Acetone	67-64-1	10.000	20	64	130	20	62	150	30	30
Allyl chloride	107-05-1	0.903	10	52	132	20	42	141	30	30
Benzene	71-43-2	0.615	4	66	125	20	37	150	30	30

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Bromobenzene	108-86-1	0.422	4	71	125	20	31	150	30	30
Bromochloromethane	74-97-5	0.555	4	71	125	20	59	139	30	30
Bromodichloromethane	75-27-4	0.518	4	74	125	20	45	149	30	30
Bromoform	75-25-2	10.000	20	73	125	20	31	150	30	30
Bromomethane	74-83-9	10.000	20	58	150	20	35	150	30	30
Carbon tetrachloride	56-23-5	0.958	4	66	125	20	36	150	30	30
Chlorobenzene	108-90-7	0.694	4	75	125	20	32	150	30	30
Chloroethane	75-00-3	0.792	10	59	144	20	41	150	30	30
Chloroform	67-66-3	0.650	4	71	125	20	50	144	30	30
Chloromethane	74-87-3	0.730	10	48	140	20	38	142	30	30
cis-1,3-Dichloropropene	10061-01-5	0.555	4	66	127	20	42	150	30	30
Dibromochloromethane	124-48-1	0.219	4	75	125	20	40	150	30	30
Dibromomethane	74-95-3	0.407	4	71	125	20	49	147	30	30
Dichlorodifluoromethane	75-71-8	5.000	10	30	139	20	30	150	30	30
Dichlorofluoromethane	75-43-4	0.767	4	30	150	20	30	150	30	30
Diethyl ether (Ethyl ether)	60-29-7	0.615	10	53	140	20	49	145	30	30
Ethylbenzene	100-41-4	0.500	4	68	125	20	30	150	30	30
Hexachloro-1,3-butadiene	87-68-3	5.000	10	57	128	20	30	150	30	30
Isopropylbenzene (Cumene)	98-82-8	1.000	4	70	125	20	30	150	30	30
Methyl-tert-butyl ether	1634-04-4	1.000	4	65	125	20	53	143	30	30
Methylene Chloride	75-09-2	10.000	20	67	125	20	57	131	30	30
Naphthalene	91-20-3	5.000	10	58	125	20	30	150	30	30
Styrene	100-42-5	0.481	4	72	125	20	30	150	30	30
Tetrachloroethene	127-18-4	0.899	4	73	125	20	30	150	30	30
Tetrahydrofuran	109-99-9	7.902	40	63	140	20	45	150	30	30
Toluene	108-88-3	2.000	4	68	125	20	32	150	30	30
Trichloroethene	79-01-6	0.752	4	75	125	20	34	150	30	30
Trichlorofluoromethane	75-69-4	0.679	10	55	140	20	30	150	30	30
Vinyl chloride	75-01-4	1.110	4	56	130	20	46	135	30	30
Xylene (Total)	1330-20-7	6.000	12	71	125	20	30	150	30	30
cis-1,2-Dichloroethene	156-59-2	0.824	4	72	125	20	69	132	30	30
m-Xylene (coelute) p-Xylene	108-38-3 106-42-3	1.209	8	69	125	20	30	150	30	30

n-Butylbenzene	104-51-8	2.000	4	68	125	20	30	150	30	30
n-Propylbenzene	103-65-1	1.000	4	70	125	20	30	150	30	30
o-Xylene	95-47-6	0.697	4	73	125	20	30	150	30	30
p-Isopropyltoluene	99-87-6	1.000	4	70	125	20	30	150	30	30
sec-Butylbenzene	135-98-8	1.000	4	69	125	20	30	150	30	30
tert-Butylbenzene	98-06-6	1.000	4	70	125	20	64	135	30	30
trans-1,3-Dichloropropene	10061-02-6	0.507	4	74	125	20	47	142	30	30
trans-1,2-Dichloroethene	156-60-5	0.565	4	72	125	20	51	143	30	30

				LCS/LCSD		
Surrogates				**Lower**	**Upper**	
1,2-Dichloroethane-d4 (S)	17060-07-0			30	150	
4-Bromofluorobenzene (S)	460-00-4			30	150	
Toluene-d8 (S)	2037-26-5			30	150	

Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 8260

8260 Water				LCS/LCSD			MS/MSD			DUP
Analyte	CAS#	MDL (ug/L)	PRL (ug/L)	Lower	Upper	RPD	Lower	Upper	RPD	RPD
1,1,1,2-Tetrachloroethane	630-20-6	0.500	1	75	125	20	68	141	30	30
1,1,1-Trichloroethane	71-55-6	0.264	1	75	125	20	52	150	30	30
1,1,2,2-Tetrachloroethane	79-34-5	0.500	1	75	125	20	61	143	30	30
1,1,2-Trichloroethane	79-00-5	0.127	1	75	125	20	65	140	30	30
1,1,2-Trichlorotrifluoroethane	76-13-1	0.500	1	60	135	20	51	150	30	30
1,1-Dichloroethane	75-34-3	0.159	1	69	125	20	49	150	30	30
1,1-Dichloroethene	75-35-4	0.199	1	68	125	20	40	150	30	30
1,1-Dichloropropene	563-58-6	0.500	1	74	125	20	50	150	30	30
1,2,3-Trichlorobenzene	87-61-6	0.500	1	69	136	20	59	148	30	30
1,2,3-Trichloropropane	96-18-4	1.220	4	75	125	20	65	141	30	30
1,2,4-Trichlorobenzene	120-82-1	0.500	1	73	127	20	61	140	30	30
1,2,4-Trimethylbenzene	95-63-6	0.500	1	75	125	20	47	149	30	30
1,2-Dibromo-3-chloropropane	96-12-8	2.000	4	65	145	20	53	150	30	30
1,2-Dibromoethane (EDB)	106-93-4	0.148	1	75	125	20	65	137	30	30
1,2-Dichlorobenzene	95-50-1	0.160	1	75	125	20	66	133	30	30
1,2-Dichloroethane	107-06-2	0.131	1	73	125	20	54	138	30	30
1,2-Dichloropropane	78-87-5	0.142	4	75	125	20	59	142	30	30
1,3,5-Trimethylbenzene	108-67-8	0.500	1	75	125	20	47	149	30	30
1,3-Dichlorobenzene	541-73-1	0.500	1	74	125	20	66	132	30	30
1,3-Dichloropropane	142-28-9	0.500	1	75	125	20	66	134	30	30
1,4-Dichlorobenzene	106-46-7	0.500	1	75	125	20	65	129	30	30
2,2-Dichloropropane	594-20-7	0.174	4	59	139	20	40	150	30	30
2-Butanone (MEK)	78-93-3	2.500	5	63	130	20	39	150	30	30
2-Chlorotoluene	95-49-8	0.138	1	72	125	20	58	147	30	30
4-Chlorotoluene	106-43-4	0.083	1	73	125	20	64	138	30	30
4-Methyl-2-pentanone (MIBK)	108-10-1	2.500	5	71	126	20	59	143	30	30
Acetone	67-64-1	10.000	20	69	131	20	52	150	30	30
Allyl chloride	107-05-1	0.446	4	67	125	20	34	150	30	30
Benzene	71-43-2	0.150	1	42	143	20	30	150	30	30

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Bromobenzene	108-86-1	0.132	1	75	125	20	66	136	30	30
Bromochloromethane	74-97-5	0.115	1	75	125	20	62	140	30	30
Bromodichloromethane	75-27-4	0.202	1	75	125	20	62	143	30	30
Bromoform	75-25-2	2.000	4	70	125	20	59	136	30	30
Bromomethane	74-83-9	2.000	4	30	150	20	30	150	30	30
Carbon tetrachloride	56-23-5	0.159	1	75	126	20	51	150	30	30
Chlorobenzene	108-90-7	0.066	1	75	125	20	65	133	30	30
Chloroethane	75-00-3	0.241	1	65	134	20	48	150	30	30
Chloroform	67-66-3	0.161	1	75	125	20	54	149	30	30
Chloromethane	74-87-3	0.341	4	35	150	20	30	150	30	30
cis-1,2-Dichloroethene	156-59-2	0.133	1	72	125	20	49	150	30	30
cis-1,3-Dichloropropene	10061-01-5	0.127	4	75	125	20	64	130	30	30
Dibromochloromethane	124-48-1	0.500	1	75	125	20	68	138	30	30
Dibromomethane	74-95-3	0.185	4	75	125	20	67	134	30	30
Dichlorodifluoromethane	75-71-8	0.500	1	50	134	20	39	150	30	30
Dichlorofluoromethane	75-43-4	0.202	1	69	125	20	51	150	30	30
Diethyl ether (Ethyl ether)	60-29-7	0.141	4	72	125	20	50	145	30	30
Ethylbenzene	100-41-4	0.165	1	75	125	20	55	139	30	30
Hexachloro-1,3-butadiene	87-68-3	0.500	1	70	138	20	49	150	30	30
Isopropylbenzene (Cumene)	98-82-8	0.500	1	75	125	20	61	146	30	30
Methyl-tert-butyl ether	1634-04-4	0.169	1	73	125	20	50	144	30	30
Methylene Chloride	75-09-2	2.000	4	73	125	20	54	136	30	30
Naphthalene	91-20-3	2.000	4	70	127	20	46	150	30	30
Styrene	100-42-5	0.063	1	75	125	20	68	134	30	30
Tetrachloroethene	127-18-4	0.157	1	74	125	20	44	150	30	30
Tetrahydrofuran	109-99-9	1.990	10	62	133	20	59	145	30	30
Toluene	108-88-3	0.110	1	74	125	20	52	148	30	30
Trichloroethene	79-01-6	0.091	0.4	75	125	20	52	150	30	30
Trichlorofluoromethane	75-69-4	0.216	1	74	127	20	50	150	30	30
Vinyl chloride	75-01-4	0.082	0.4	66	132	20	43	150	30	30
Xylene (Total)	1330-20-7	0.404	3	75	125	20	54	144	30	30
m-Xylene (coelute) p-Xylene	108-38-3 106-42-3	0.310	2	75	125	20	57	141	30	30

n-Butylbenzene	104-51-8	0.500	1	72	133	20	55	150	30	30
n-Propylbenzene	103-65-1	0.500	1	72	126	20	59	142	30	30
o-Xylene	95-47-6	0.094	1	75	125	20	54	147	30	30
p-Isopropyltoluene	99-87-6	0.500	1	72	132	20	60	149	30	30
sec-Butylbenzene	135-98-8	0.500	1	73	132	20	60	150	30	30
tert-Butylbenzene	98-06-6	0.500	1	73	128	20	62	146	30	30
trans-1,2-Dichloroethene	156-60-5	0.231	1	69	125	20	45	150	30	30
trans-1,3-Dichloropropene	10061-02-6	0.185	4	75	125	20	68	132	30	30

				LCS/LCSD		
Surrogates				**Lower**	**Upper**	
1,2-Dichloroethane-d4 (S)	17060-07-0			75	125	
4-Bromofluorobenzene (S)	460-00-4			75	125	
Toluene-d8 (S)	2037-26-5			75	125	

Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 524 Water

			LCS/LCSD		MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/L)**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
1,1,1,2-Tetrachloroethane	630-26-6	0.104	130	20	70	130	20	20
1,1,1-Trichloroethane	71-55-6	0.169	130	20	70	130	20	20
1,1,2,2-Tetrachloroethane	79-34-5	0.0753	130	20	70	130	20	20
1,1,2-Trichloroethane	79-00-5	0.102	130	20	70	130	20	20
1,1-Dichloroethane	75-34-3	0.0767	130	20	70	130	20	20
1,1-Dichloroethene	75-35-4	0.133	130	20	70	130	20	20
1,1-Dichloropropene	563-58-6	0.112	130	20	70	130	20	20
1,2,3-Trichlorobenzene	87-61-6	0.250	130	20	70	130	20	20
1,2,3-Trichloropropane	96-18-4	1.220	130	20	70	130	20	20
1,2,4-Trichlorobenzene	120-82-1	0.250	130	20	70	130	20	20
1,2,4-Trimethylbenzene	95-63-6	0.250	130	20	70	130	20	20
1,2-Dibromo-3-chloropropane	96-12-8	2.000	130	20	70	130	20	20
1,2-Dibromoethane (EDB)	106-93-4	0.0973	130	20	70	130	20	20
1,2-Dichlorobenzene	95-50-1	0.082	130	20	70	130	20	20
1,2-Dichloroethane	107-06-2	0.0927	130	20	70	130	20	20
1,2-Dichloropropane	78-87-5	0.101	130	20	70	130	20	20
1,3,5-Trimethylbenzene	108-67-8	0.250	130	20	70	130	20	20
1,3-Dichlorobenzene	541-73-1	0.250	130	20	70	130	20	20
1,3-Dichloropropane	142-28-9	0.250	130	20	70	130	20	20
1,4-Dichlorobenzene	106-46-7	0.250	130	20	70	130	20	20
2,2-Dichloropropane	594-20-7	0.174	130	20	70	130	20	20
2-Butanone (MEK)	78-93-3	2.500	130	20	70	130	20	20
2-Chlorotoluene	95-49-8	0.0644	130	20	70	130	20	20
2-Hexanone	591-78-6	2.500	130	20	70	130	20	20
2-Nitropropane	79-46-9	5.52	130	20	70	130	20	20
4-Chlorotoluene	106-43-4	0.104	130	20	70	130	20	20
4-Methyl-2-pentanone (MIBK)	108-10-1	2.500	130	20	70	130	20	20
Acetone	67-64-1	10.00	130	20	70	130	20	20
Acrylonitrile	107-13-1	1.01	130	20	70	130	20	20
Allyl chloride	107-05-1	0.446	130	20	70	130	20	20
Benzene	71-43-2	0.073	130	20	70	130	20	20

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Bromobenzene	108-86-1	0.0938	130	20	70	130	20	20
Bromochloromethane	74-97-5	0.146	130	20	70	130	20	20
Bromodichloromethane	75-27-4	0.113	130	20	70	130	20	20
Bromoform	75-25-2	2.000	130	20	70	130	20	20
Bromomethane	74-83-9	2.000	130	20	70	130	20	20
Carbon disulfide	75-15-0	0.121	130	20	70	130	20	20
Carbon tetrachloride	56-23-5	0.166	130	20	70	130	20	20
Chlorobenzene	108-90-7	0.0661	130	20	70	130	20	20
Chloroethane	75-00-3	0.171	130	20	70	130	20	20
Chloroform	67-66-3	0.198	130	20	70	130	20	20
Chloromethane	74-87-3	0.340	130	20	70	130	20	20
Dibromochloromethane	124-48-1	0.086	130	20	70	130	20	20
Dibromomethane	74-95-3	0.185	130	20	70	130	20	20
Dichlorodifluoromethane	156-59-2	0.500	130	20	70	130	20	20
Diethyl ether (Ethyl ether)	60-29-7	0.169	130	20	70	130	20	20
Ethyl methacrylate	97-63-2	1.21	130	20	70	130	20	20
Ethylbenzene	100-41-4	0.0962	130	20	70	130	20	20
Hexachloro-1,3-butadiene	87-68-3	0.500	130	20	70	130	20	20
Iodomethane	74-88-4	2.000	130	20	70	130	20	20
Isopropylbenzene (Cumene)	98-82-8	0.0681	130	20	70	130	20	20
Methacrylonitrile	126-98-7	0.0697	130	20	70	130	20	20
Methyl methacrylate	80-62-6	0.937	130	20	70	130	20	20
Methyl-tert-butyl ether	1634-04-4	0.078	130	20	70	130	20	20
Methylene Chloride	75-09-2	2.000	130	20	70	130	20	20
Naphthalene	91-20-3	0.500	130	20	70	130	20	20
Propionitrile	107-12-0	1.3	130	20	70	130	20	20
Styrene	100-42-5	0.0638	130	20	70	130	20	20
Tetrachloroethene	127-18-4	0.099	130	20	70	130	20	20
Tetrahydrofuran	109-99-9	0.985	130	20	70	130	20	20
Toluene	108-88-3	0.114	130	20	70	130	20	20
Total Trihalomethanes (Calc.)			130	20	70	130	20	20
Trichloroethene	79-01-6	0.084	130	20	70	130	20	20
Trichlorofluoromethane	75-69-4	0.119	130	20	70	130	20	20

Vinyl chloride	75-01-4	0.082	130	20	70	130	20	20
Xylene (Total)	1330-20-7	0.196	130	20	70	130	20	20
cis-1,2-Dichloroethene	156-59-2	0.108	130	20	70	130	20	20
cis-1,3-Dichloropropene	10061-01-5	0.088	130	20	70	130	20	20
m&p-Xylene	108-38-3 106-42-3	0.123	130	20	70	130	20	20
n-Butylbenzene	104-51-8	0.106	130	20	70	130	20	20
n-Propylbenzene	103-65-1	0.0769	130	20	70	130	20	20
o-Xylene	95-47-6	0.0726	130	20	70	130	20	20
p-Isopropyltoluene	99-87-6	0.250	130	20	70	130	20	20
sec-Butylbenzene	135-98-8	0.250	130	20	70	130	20	20
tert-Butylbenzene	98-06-6	0.250	130	20	70	130	20	20
trans-1,2-Dichloroethene	10061-02-6	0.151	130	20	70	130	20	20
trans-1,3-Dichloropropene	156-60-5	0.107	130	20	70	130	20	20
trans-1,4-Dichloro-2-butene	110-57-6	0.332	130	20	70	130	20	20

			LCS/LCSD					
Surrogates			Upper					
1,2-Dichloroethane-d4 (S)	17060-07-0		125					
4-Bromofluorobenzene (S)	460-00-4		125					
Dibromofluoromethane (S)	1868-53-7		125					
Toluene-d8 (S)	2037-26-5		125					

Solid-3550

				LCS/LCSD			MS/MSD			DUP
Analyte	CAS #	MDL (ug/kg) (Prep 3550)	PRL (ug/kg)	Lower	Upper	RPD	Lower	Upper	RPD	RPD
1,2,4-Trichlorobenzene	120-82-1	36.05	330	41	125	20	43	125	30	30
1,2-Dichlorobenzene	95-50-1	165.00	330	38	125	20	36	125	30	30
1,2-Diphenylhydrazine	122-66-7	165.00	330	58	125	20	30	125	30	30
1,3-Dichlorobenzene	541-73-1	165.00	330	36	125	20	34	125	30	30
1,4-Dichlorobenzene	106-46-7	38.54	330	36	125	20	33	125	30	30
1-Methylnaphthalene	90-12-0	38.77	330	49	125	20	48	125	30	30
2,4,5-Trichlorophenol	95-95-4	36.59	330	56	125	20	30	141	30	30
2,4,6-Trichlorophenol	88-06-2	165.00	330	57	125	20	30	143	30	30
2,4-Dichlorophenol	120-83-2	165.00	330	51	125	20	30	139	30	30
2,4-Dimethylphenol	105-67-9	58.00	330	48	125	20	47	125	30	30
2.4-Dinitrophenol	51-28-5	165.00	330	30	125	20	30	125	30	30
2,4-Dinitrotoluene	121-14-2	165.00	330	58	125	20	50	125	30	30
2.6-Dinitrotoluene	606-20-2	63.81	330	58	125	20	48	125	30	30
2-Chloronaphthalene	91-58-7	165.00	330	53	125	20	49	125	30	30
2-Chlorophenol	95-57-8	41.23	330	44	125	20	30	125	30	30
2-Methylnaphthalene	91-57-6	165.00	330	49	125	20	47	125	30	30
2-Methylphenol(o-Cresol)	95-48-7	165.00	330	48	125	20	43	125	30	30
2-Nitroaniline	88-74-4	165.00	330	58	125	20	57	125	30	30
2-Nitrophenol	88-75-5	165.00	330	43	125	20	30	150	30	30
3&4-Methylphenol	106-44-5	165.00	660	53	125	20	51	125	30	30
3,3'-Dichlorobenzidine	91-94-1	93.52	330	42	125	20	30	132	30	30
3-Nitroaniline	99-09-2	73.29	330	47	125	20	30	132	30	30
4,6-Dinitro-2-methylphenol	534-52-1	850.00	1700	38	125	20	30	130	30	30
4-Bromophenylphenyl ether	101-55-3	165.00	330	59	125	20	57	125	30	30
4-Chloro-3-methylphenol	59-50-7	165.00	330	58	125	20	30	139	30	30
4-Chloroaniline	106-47-8	84.47	330	30	125	20	30	125	30	30
4-Chlorophenylphenyl ether	7005-72-3	165.00	330	59	125	20	30	130	30	30
4-Nitroaniline	100-01-6	165.00	330	54	125	20	30	150	30	30
4-Nitrophenol	100-02-7	165.00	330	53	125	20	30	145	30	30
Acenaphthene	83-32-9	165.00	330	56	125	20	55	125	30	30
Acenaphthylene	208-96-8	64.52	330	56	125	20	56	125	30	30
Anthracene	120-12-7	165.00	330	58	125	20	57	125	30	30
Benzo(a)anthracene	56-55-3	165.00	330	59	125	20	52	125	30	30
Benzo(a)pyrene	50-32-8	165.00	330	59	125	20	51	125	30	30
Benzo(b)fluoranthene	205-99-2	41.83	330	60	125	20	40	125	30	30
Benzo(g,h,i)perylene	191-24-2	40.13	330	59	125	20	48	125	30	30
Benzo(k)fluoranthene	207-08-9	165.00	330	59	125	20	56	125	30	30
Butylbenzylphthalate	85-68-7	165.00	330	60	125	20	55	125	30	30
Carbazole	86-74-8	165.00	330	59	125	20	56	125	30	30
Chrysene	218-01-9	44.34	330	59	125	20	50	125	30	30
Di-n-butylphthalate	84-74-2	45.76	330	61	125	20	58	125	30	30
Di-n-octylphthalate	117-84-0	165.00	330	60	125	20	59	125	30	30
Dibenz(a,h)anthracene	53-70-3	165.00	330	59	125	20	55	125	30	30
Dibenzofuran	132-64-9	165.00	330	58	125	20	57	125	30	30
Diethylphthalate	84-66-2	165.00	330	60	125	20	58	125	30	30
Dimethylphthalate	131-11-3	165.00	300	60	125	20	59	125	30	30
Fluoranthene	206-44-0	165.00	330	58	125	20	49	125	30	30
Fluorene	86-73-7	165.00	330	58	125	20	57	125	30	30
Hexachloro-1,3-butadiene	87-68-3	33.46	330	38	125	20	39	125	30	30
Hexachlorobenzene	118-74-1	43.37	330	57	125	20	55	125	30	30
Hexachloroethane	67-72-1	165.00	330	54	125	20	30	125	30	30
Indeno(1,2,3-cd)pyrene	193-39-5	165.00	330	59	125	20	51	125	30	30
Isophorone	78-59-1	165.00	330	52	125	20	49	125	30	30
N-Nitroso-di-n-propylamine	621-64-7	165.00	330	48	125	20	30	140	30	30
N-Nitrosodimethylamine	62-75-9	165.00	330	31	125	20	30	125	30	30
N-Nitrosodiphenylamine	86-30-6	165.00	330	59	125	20	57	125	30	30
Naphthalene	91-20-3	23.54	330	44	125	20	44	125	30	30
Nitrobenzene	98-95-3	37.20	330	46	125	20	30	139	30	30
Pentachlorophenol	87-86-5	165.00	670	47	125	20	30	148	30	30

Phenanthrene	85-01-8	47.19	330	59	125	20	50	125	30	30
Phenol	108-95-2	165.00	330	48	125	20	48	125	30	30
Pyrene	129-00-0	41.63	330	60	125	20	56	125	30	30
bis(2-Chloroethoxy)methane	111-91-1	165.00	330	48	125	20	46	125	30	30
bis(2-Chloroethyl) ether	111-44-4	165.00	330	39	125	20	34	125	30	30
bis(2-Chloroisopropyl)ether	108-60-1	165.00	330	33	125	20	33	125	30	30
bis(2-Ethylhexyl)phthalate	117-81-7	56.42	330	61	125	20	60	125	30	30

				LCS/LCSD						
Surrogates				**Lower**	**Upper**					
2,4,6-Tribromophenol (S)	118-79-6			40	125					
2-Fluorobiphenyl (S)	321-60-8			51	125					
2-Fluorophenol (S)	367-12-4			45	125					
Nitrobenzene-d5 (S)	4165-60-0			34	125					
Phenol-d6 (S)	13127-88-3			44	125					
Terphenyl-d14 (S)	98904-43-9			55	125					

Water-3510
Separatory Funnel

				LCS/LCSD			MS/MSD			DUP
Analyte	CAS #	MDL (ug/L)	PRL (ug/L)	Lower	Upper	RPD	Lower	Upper	RPD	RPD
1,2,4-Trichlorobenzene	120-82-1	0.97	10	37	128	20	70	130	30	30
1,2-Dichlorobenzene	95-50-1	1.00	10	30	143	20	70	130	30	30
1,2-Diphenylhydrazine	122-66-7	0.76	10	70	125	20	70	130	30	30
1,3-Dichlorobenzene	541-73-1	1.16	10	30	143	20	70	130	30	30
1,4-Dichlorobenzene	106-46-7	1.18	10	30	144	20	70	130	30	30
1-Methylnaphthalene	90-12-0	0.73	10	59	125	20	70	130	30	30
2,4,5-Trichlorophenol	95-95-4	0.95	10	67	125	20	70	130	30	30
2,4,6-Trichlorophenol	88-06-2	1.01	10	67	125	20	70	130	30	30
2,4-Dichlorophenol	120-83-2	1.05	10	61	125	20	70	130	30	30
2,4-Dimethylphenol	105-67-9	5.00	10	62	125	20	70	130	30	30
2,4-Dinitrotoluene	121-14-2	1.04	10	71	125	20	70	130	30	30
2,4-Dinitrophenol	51-28-5	5.00	10	30	150	20	70	130	30	30
2,6-Dinitrotoluene	606-20-2	1.01	10	70	125	20	70	130	30	30
2-Chloronaphthalene	91-58-7	1.16	10	61	125	20	70	130	30	30
2-Chlorophenol	95-57-8	1.16	10	51	125	20	70	130	30	30
2-Methylnaphthalene	91-57-6	0.73	10	37	136	20	70	130	30	30
2-Methylphenol(o-Cresol)	95-48-7	1.49	10	46	125	20	70	130	30	30
2-Nitroaniline	88-74-4	1.10	10	72	125	20	70	130	30	30
2-Nitrophenol	88-75-5	25.00	50	61	125	20	70	130	30	30
3&4-Methylphenol	108-39-4 106-44-5	5.00	10	39	125	20	70	130	30	30
3,3'-Dichlorobenzidine	91-94-1	25.00	50	45	150	20	70	130	30	30
3-Nitroaniline	99-09-2	5.00	10	55	150	20	70	130	30	30
4,6-Dinitro-2-methylphenol	534-52-1	1.41	10	30	150	20	70	130	30	30
4-Bromophenylphenyl ether	101-55-3	1.07	10	68	125	20	70	130	30	30
4-Chloro-3-methylphenol	59-50-7	0.97	10	68	125	20	70	130	30	30
4-Chloroaniline	106-47-8	1.36	10	45	150	20	70	130	30	30
4-Chlorophenylphenyl ether	7005-72-3	0.92	10	65	125	20	70	130	30	30
4-Nitroaniline	100-01-6	1.09	10	71	125	20	70	130	30	30
4-Nitrophenol	100-02-7	5.00	10	30	125	20	70	130	30	30
Acenaphthene	83-32-9	0.82	10	65	125	20	70	130	30	30
Acenaphthylene	208-96-8	1.12	10	65	125	20	70	130	30	30
Anthracene	120-12-7	0.83	10	72	125	20	70	130	30	30
Benzo(a)anthracene	56-55-3	0.90	10	71	125	20	70	130	30	30
Benzo(a)pyrene	50-32-8	0.90	10	70	125	20	70	130	30	30
Benzo(b)fluoranthene	205-99-2	0.89	10	71	125	20	70	130	30	30
Benzo(g,h,i)perylene	191-24-2	0.87	10	71	125	20	70	130	30	30
Benzo(k)fluoranthene	207-08-9	1.05	10	66	125	20	70	130	30	30
bis(2-Chloroethoxy)methane	111-91-1	1.08	10	64	125	20	70	130	30	30
bis(2-Chloroisopropyl)ether	108-60-1	1.11	10	57	125	20	70	130	30	30
bis(2-Ethylhexyl)phthalate	117-81-7	1.08	10	73	125	20	70	130	30	30
bis(2-Chloroethyl) ether	111-44-4	5.00	10	57	125	20	70	130	30	30
Butylbenzylphthalate	85-68-7	1.04	10	75	125	20	70	130	30	30
Carbazole	86-74-8	0.92	10	71	125	20	70	130	30	30
Chrysene	218-01-9	0.87	10	70	125	20	70	130	30	30
Dibenz(a,h)anthracene	53-70-3	0.89	10	70	125	20	70	130	30	30
Dibenzofuran	132-64-9	0.74	10	66	125	20	70	130	30	30
Diethylphthalate	84-66-2	0.78	10	69	125	20	70	130	30	30
Dimethylphthalate	131-11-3	0.80	10	69	125	20	70	130	30	30
Di-n-butylphthalate	84-74-2	0.89	10	73	125	20	70	130	30	30
Di-n-octylphthalate	117-84-0	4.18	10	73	125	20	70	130	30	30
Fluoranthene	206-44-0	0.86	10	70	125	20	70	130	30	30
Fluroene	86-73-7	0.89	10	68	125	20	70	130	30	30
Hexachloro-1,3-butadiene	87-68-3	0.98	10	30	137	20	70	130	30	30
Hexachlorobenzene	118-74-1	1.05	10	66	125	20	70	130	30	30
Hexachloroethane	67-72-1	1.37	10	30	136	20	70	130	30	30
Indeno(1,2,3-cd)pyrene	193-39-5	0.93	10	70	125	20	70	130	30	30

Isophorone	78-59-1	1.09	10	66	125	20	70	130	30	30
Naphthalene	91-20-3	0.86	10	47	125	20	70	130	30	30
Nitrobenzene	98-95-3	1.47	10	58	125	20	70	130	30	30
N-Nitrosodimethylamine	62-75-9	5.00	10	32	125	20	70	130	30	30
N-Nitroso-di-n-propylamine	621-64-7	0.78	10	60	125	20	70	130	30	30
N-Nitrosodiphenylamine	86-30-6	0.84	10	71	125	20	70	130	30	30
Pentachlorophenol	87-86-5	1.32	20	57	132	20	70	130	30	30
Phenanthrene	85-01-8	0.90	10	71	125	20	70	130	30	30
Phenol	108-95-2	5.00	10	30	125	20	70	130	30	30
Pyrene	129-00-0	0.93	10	74	125	20	70	130	30	30

				LCS/LCSD	
Surrogates				**Lower**	**Upper**
2,4,6-Tribromophenol (S)	118-79-6			64	125
2-Fluorobiphenyl (S)	321-60-8			55	125
2-Fluorophenol (S)	367-12-4			30	125
Nitrobenzene-d5 (S)	4165-60-0			51	125
Phenol-d6 (S)	13127-88-3			30	125
p-Terphenyl-d14 (S)	98904-43-9			73	125

Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 8270 PAH SIM Solid

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/kg)**	**PRL (ug/kg)**	**Lower**	**Upper**		**Lower**	**Upper**	**RPD**	**RPD**
Acenaphthene	83-32-9	5.00	10	53	125	20	39	125	30	30
Acenaphthylene	208-96-8	5.00	10	53	125	20	30	150	30	30
Anthracene	120-12-7	5.00	10	61	125	20	30	150	30	30
Benzo(a)anthracene	56-55-3	5.00	10	62	125	20	30	150	30	30
Benzo(a)pyrene	50-32-8	5.00	10	64	125	20	30	150	30	30
Benzo(b)fluoranthene	205-99-2	0.28	10	66	125	20	30	150	30	30
Benzo(e)pyrene	192-97-2	5.00	10	63	125	20	30	150	30	30
Benzo(g,h,i)perylene	191-24-2	5.00	10	59	125	20	30	150	30	30
Benzo(k)fluoranthene	207-08-9	5.00	10	61	125	20	30	150	30	30
Chrysene	218-01-9	5.00	10	63	125	20	30	150	30	30
Dibenz(a,h)anthracene	53-70-3	5.00	10	59	125	20	30	150	30	30
Fluoranthene	206-44-0	5.00	10	64	125	20	30	150	30	30
Fluorene	96-73-7	5.00	10	57	125	20	30	146	30	30
Indeno(1,2,3-cd)pyrene	193-39-5	5.00	10	58	125	20	30	150	30	30
Naphthalene	91-20-3	5.00	10	52	125	20	30	131	30	30
Phenanthrene	85-01-8	5.00	10	60	125	20	30	150	30	30
Pyrene	129-00-0	0.23	10	63	125	20	30	150	30	30
Surrogate										
2-Fluorobiphenyl (S)	321-60-8			55	125					
Terphenyl-d14 (S)	1718-51-0			30	150					

***Method detection limit studies are performed annually or more often as needed per method requirements.**

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Method Detection Limits and Reporting Limits
for EPA 8270 PAH SIM Water

Method Prep Code it/cf
T2/cf

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Acenaphthene	83-32-9	0.0054	0.04	44	125	20	44	125	30	30
Acenaphthylene	208-96-8	0.0055	0.04	44	125	20	52	125	30	30
Anthracene	120-12-7	0.0052	0.04	55	125	20	56	125	30	30
Benzo(a)anthracene	56-55-3	0.0069	0.04	56	125	20	51	125	30	30
Benzo(a)pyrene	50-32-8	0.0066	0.04	61	125	20	64	125	30	30
Benzo(b)fluoranthene	205-99-2	0.0064	0.04	60	125	20	61	125	30	30
Benzo(e)pyrene	192-97-2	0.0051	0.04	67	125	20	58	125	30	30
Benzo(g,h,i)perylene	191-24-2	0.0058	0.04	53	125	20	53	125	30	30
Benzo(k)fluoranthene	207-08-9	0.0069	0.04	59	125	20	59	125	30	30
Chrysene	218-01-9	0.0063	0.04	61	125	20	56	125	30	30
Dibenz(a,h)anthracene	53-70-3	0.0056	0.04	51	125	20	42	125	30	30
Fluoranthene	206-44-0	0.0121	0.04	64	125	20	54	125	30	30
Fluorene	96-73-7	0.0050	0.04	52	125	20	45	125	30	30
Indeno(1,2,3-cd)pyrene	193-39-5	0.0051	0.04	54	125	20	44	125	30	30
Naphthalene	91-20-3	0.0084	0.04	35	125	20	51	125	30	30
Phenanthrene	85-01-8	0.0083	0.04	55	125	20	61	125	30	30
Pyrene	129-00-0	0.0128	0.04	59	125	20	63	125	30	30
Surrogate										
2-Fluorobiphenyl (S)	321-60-8			52	125					
Terphenyl-d14 (S)	1718-51-0			62	125					

***Method detection limit studies are performed annually or more often as needed per method requirements.**

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				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
4,4'-DDD	72-54-8	0.025	0.10	65	125	20	70	130	20	20
4,4'-DDE	72-55-9	0.033	0.10	68	125	20	70	130	20	20
4,4'-DDT	50-29-3	0.022	0.10	64	125	20	70	130	20	20
Aldrin	309-00-2	0.009	0.05	62	125	20	70	130	20	20
alpha-BHC	319-84-6	0.010	0.05	65	125	20	70	130	20	20
alpha-chlordane	5103-71-9	0.010	0.05	67	125	20	70	130	20	20
beta-BHC	319-85-7	0.012	0.05	66	125	20	70	130	20	20
Chlordane, Technical	12789-03-6	0.250	0.50	70	130	20	70	130	20	20
delta-BHC	319-86-8	0.009	0.05	63	125	20	70	130	20	20
Dieldrin	60-57-1	0.018	0.10	70	130	20	70	130	20	20
Endosulfan I	959-98-8	0.021	0.05	63	125	20	70	130	20	20
Endosulfan II	33213-65-9	0.027	0.10	67	125	20	70	130	20	20
Endosulfan sulfate	1031-07-8	0.024	0.10	60	127	20	70	130	20	20
Endrin	72-20-8	0.016	0.10	67	125	20	70	130	20	20
Endrin Aldehyde	7421-36-3	0.020	0.10	68	125	20	70	130	20	20
Endrin Ketone	53494-70-5	0.041	0.10	66	125	20	70	130	20	20
gamma-BHC (Lindane)	58-89-9	0.009	0.05	64	125	20	70	130	20	20
gamma-chlordane	5103-74-2	0.009	0.05	66	125	20	70	130	20	20
Heptachlor	76-44-8	0.010	0.05	63	125	20	70	130	20	20
Heptachlor expoxide	1024-57-3	0.010	0.05	64	125	20	70	130	20	20
Methoxychlor	72-43-5	0.147	0.50	71	125	20	70	130	20	20
Toxaphene	8001-35-2	0.750	1.5	70	130	20	70	130	20	20

Surrogate					
Decachlorobiphenyl (S)	2051-24-3			30	137
Tetrachloro-m-xylene (S)	877-09-8			59	125

Pace Analytical Services, Inc.
Method Detection Limits and Reporting Limits
for EPA 8081B Soil

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/kg)**	**PRL (ug/kg)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
4,4'-DDD	72-54-8	0.797	3.30	62	125	20	50	135	20	20
4,4'-DDE	72-55-9	0.874	3.30	62	125	20	45	146	20	20
4,4'-DDT	50-29-3	0.883	3.30	52	134	20	50	145	20	20
Aldrin	309-00-2	0.322	1.70	61	125	20	52	127	20	20
alpha-BHC	319-84-6	0.388	1.70	58	125	20	33	150	20	20
alpha-chlordane	5103-71-9	0.321	1.70	64	125	20	30	150	20	20
beta-BHC	319-85-7	0.369	1.70	60	125	20	30	150	20	20
Chlordane, Technical	12789-03-6	3.376	17.00	70	130	20	70	130	20	20
delta-BHC	319-86-8	0.357	1.70	59	125	20	30	150	20	20
Dieldrin	60-57-1	0.599	3.30	70	130	20	70	130	20	20
Endosulfan I	959-98-8	0.556	1.67	60	125	20	52	126	20	20
Endosulfan II	33213-65-9	0.835	3.30	57	125	20	38	150	20	20
Endosulfan sulfate	1031-07-8	0.580	3.30	54	133	20	36	150	20	20
Endrin	72-20-8	0.556	3.30	64	125	20	53	130	20	20
Endrin Aldehyde	7421-36-3	0.878	3.30	65	125	20	39	150	20	20
Endrin Ketone	53494-70-5	0.677	3.30	57	129	20	44	148	20	20
gamma-BHC (Lindane)	58-89-9	0.329	1.70	58	125	20	51	129	20	20
gamma-chlordane	5103-74-2	0.318	1.70	62	125	20	41	142	20	20
Heptachlor	76-44-8	0.362	1.70	60	125	20	30	150	20	20
Heptachlor expoxide	1024-57-3	0.316	1.70	59	125	20	48	137	20	20
Methoxychlor	72-43-5	2.376	17.00	63	125	20	59	127	20	20
Toxaphene	8001-35-2	25.000	50.0	70	130	20	70	130	20	20

Surrogate					
Decachlorobiphenyl (S)	2051-24-3			30	150
Tetrachloro-m-xylene (S)	877-09-8			30	150

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Method Detection Limits and Reporting Limits
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				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
PCB-1016 (Aroclor 1016)	12674-11-2	0.0388	0.1	52	125	20	37	139	30	30
PCB-1221 (Aroclor 1221)	11104-28-2	0.0318	0.1	70	130	20	70	130	30	30
PCB-1232 (Aroclor 1232)	11141-16-5	0.0477	0.1	70	130	20	70	130	30	30
PCB-1242 (Aroclor 1242)	53469-21-9	0.0495	0.1	70	130	20	70	130	30	30
PCB-1248 (Aroclor 1248)	12672-29-6	0.0311	0.1	70	130	20	70	130	30	30
PCB-1254 (Aroclor 1254)	11097-69-1	0.0450	0.1	70	130	20	70	130	30	30
PCB-1260 (Aroclor 1260)	11096-82-5	0.0272	0.1	47	125	20	37	135	30	30
PCB-1262 (Aroclor 1262)	37324-23-5	0.0282	0.1	70	130	20	70	130	30	30
PCB-1268 (Aroclor 1268)	11100-14-4	0.0316	0.1	70	130	20	70	130	30	30

Surrogate					
Decachlorobiphenyl (S)	2051-24-3			30	145
Tetrachloro-m-xylene (S)	877-09-8			30	126

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Method Detection Limits and Reporting Limits
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Method/Prep Code mx/ch
mX

3550

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (mg/Kg) Mtd 3550**	**PRL (mg/kg)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
PCB-1016 (Aroclor 1016)	12674-11-2	0.015	0.033	62	125	20	52	125	30	30
PCB-1221 (Aroclor 1221)	11104-28-2	0.005	0.033	70	130	20	70	130	30	30
PCB-1232 (Aroclor 1232)	11141-16-5	0.008	0.033	70	130	20	70	130	30	30
PCB-1242 (Aroclor 1242)	53469-21-9	0.006	0.033	70	130	20	70	130	30	30
PCB-1248 (Aroclor 1248)	12672-29-6	0.007	0.033	70	130	20	70	130	30	30
PCB-1254 (Aroclor 1254)	11097-69-1	0.007	0.033	70	130	20	70	130	30	30
PCB-1260 (Aroclor 1260)	11096-82-5	0.015	0.033	62	125	20	49	125	30	30
PCB-1262 (Aroclor 1262)	37324-23-5	0.006	0.033	70	130	20	70	130	30	30
PCB-1268 (Aroclor 1268)	11100-14-4	0.005	0.033	70	130		70	130	30	30

Surrogate					
Decachlorobiphenyl (S)	2051-24-3			49	125
Tetrachloro-m-xylene (S)	877-09-8			48	125

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				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
DBCP	96-12-8	0.0015	0.010	60	140	20	60	140	20	20
EDB	106-93-4	0.0045	0.010	60	140	20	60	140	20	20
Surrogate										
4-Bromofluorobenzene (S)	460-00-4			30	150					

Pace Analytical Services, Inc.
Method Detection Limit and Reporting Limit
for Dioxin/Furans by USEPA Method 8290/8290A

Analyte		Solids by SW3540		Wipes by SW3540		Tissues		Waters		Control limit	
	CAS#	MDL (ng/Kg)	PRL (ng/Kg)	MDL (ng/m2)	PRL (ng/m2)	MDL (ng/Kg)	PRL (ng/Kg)	MDL (pg/L)	PRL (pg/L)	Lower	Upper
2,3,7,8-TCDF	51207-31-9	0.499	1.0	0.499	1.0	0.160	1.0	3.841	10	70	130
2,3,7,8-TCDD	1746-01-6	0.471	1.0	0.471	1.0	0.176	1.0	4.494	10	70	130
1,2,3,7,8-PeCDF	57117-41-6	2.500	5.0	2.500	5.0	0.164	5.0	6.681	50	70	130
2,3,4,7,8-PeCDF	57117-31-4	0.250	5.0	0.250	5.0	0.192	5.0	4.985	50	70	130
1,2,3,7,8-PeCDD	40321-76-4	0.290	5.0	0.290	5.0	1.250	5.0	3.594	50	70	130
1,2,3,4,7,8-HxCDF	70648-26-9	0.551	5.0	0.551	5.0	0.291	5.0	7.533	50	70	130
1,2,3,6,7,8-HxCDF	57117-44-9	0.579	5.0	0.579	5.0	0.226	5.0	4.488	50	70	130
2,3,4,6,7,8-HxCDF	60851-34-5	0.459	5.0	0.459	5.0	0.276	5.0	6.972	50	70	130
1,2,3,7,8,9-HxCDF	72918-21-9	0.380	5.0	0.380	5.0	1.250	5.0	7.221	50	70	130
1,2,3,4,7,8-HxCDD	39227-28-6	0.821	5.0	0.821	5.0	1.250	5.0	6.370	50	70	130
1,2,3,6,7,8-HxCDD	57653-85-7	0.938	5.0	0.938	5.0	0.341	5.0	5.373	50	70	130
1,2,3,7,8,9-HxCDD	19408-74-3	0.675	5.0	0.675	5.0	0.463	5.0	6.633	50	70	130
1,2,3,4,6,7,8-HpCDF	67562-39-4	0.650	5.0	0.650	5.0	0.164	5.0	7.176	50	70	130
1,2,3,4,7,8,9-HpCDF	55673-89-7	0.560	5.0	0.560	5.0	1.250	5.0	6.162	50	70	130
1,2,3,4,6,7,8-HpCDD	35822-46-9	0.948	5.0	0.948	5.0	1.250	5.0	6.032	50	70	130
OCDF	39001-02-0	1.302	10.0	1.302	10.0	2.500	10.0	12.869	100	70	130
OCDD	3268-87-9	1.456	10.0	1.456	10.0	2.500	10.0	20.603	100	70	130
Total TCDF	55722-27-5	0.499	1.0	0.499	1.0	0.160	1.0	3.841	10	70	130
Total TCDD	41903-57-5	0.471	1.0	0.471	1.0	0.176	1.0	4.494	10	70	130
Total PeCDF	30402-15-4	2.750	10.0	2.750	10.0	0.357	10.0	11.666	100	70	130
Total PeCDD	36088-22-9	0.290	5.0	0.290	5.0	1.250	5.0	3.594	50	70	130
Total HxCDF	55684-94-1	1.968	20.0	1.968	20.0	2.043	20.0	26.213	200	70	130
Total HxCDD	34465-46-8	2.435	15.0	2.435	15.0	2.054	15.0	18.377	150	70	130
Total HpCDF	38998-75-3	1.210	10.0	1.210	10.0	1.414	10.0	13.338	100	70	130
Total HpCDD	37871-00-4	0.948	5.0	0.948	5.0	1.250	5.0	6.032	50	70	130

Labelled Analyte		Control limits	
		Lower	Upper
$^{13}C_{12}$-2,3,7,8-TCDF		40	135
$^{13}C_{12}$-2,3,7,8-TCDD		40	135
$^{13}C_{12}$-1,2,3,7,8-PeCDF		40	135
$^{13}C_{12}$-2,3,4,7,8-PeCDF		40	135
$^{13}C_{12}$-1,2,3,7,8-PeCDD		40	135
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF		40	135
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF		40	135
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF		40	135

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$^{13}C_{12}$-1,2,3,7,8,9-HxCDF		40	135
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD		40	135
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD		40	135
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD		40	135
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF		40	135
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF		40	135
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD		40	135
$^{13}C_{12}$-OCDD		40	135
$^{37}Cl_4$-2,3,7,8-TCDD		40	135

Pace Analytical Services, Inc.
Method Detection Limit and Reporting Limit
for Dioxin/Furans by USEPA Method 8290/8290A

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Pace Analytical Services, Inc.
Method Detection Limit and Reporting Limit
for Dioxins and Furans by USEPA Method 1613B

Analyte		Solids by SW3540		Wipes by SW3540		Tissues		Waters		Control limits		
	CAS#	MDL (ng/Kg)	PRL (ng/Kg)	MDL (ng/m2)	PRL (ng/m2)	MDL (ng/Kg)	PRL (ng/Kg)	MDL (pg/L)	PRL (pg/L)	Lower	Upper	RPD
2,3,7,8-TCDF	51207-31-9	0.499	1.0	0.499	1.0	0.160	1.0	3.841	10	70	130	20
2,3,7,8-TCDD	1746-01-6	0.471	1.0	0.471	1.0	0.176	1.0	4.494	10	70	130	20
1,2,3,7,8-PeCDF	57117-41-6	2.500	5.0	2.500	5.0	0.164	5.0	6.681	50	70	130	20
2,3,4,7,8-PeCDF	57117-31-4	0.250	5.0	0.250	5.0	0.192	5.0	4.985	50	70	130	20
1,2,3,7,8-PeCDD	40321-76-4	0.290	5.0	0.290	5.0	1.250	5.0	3.594	50	70	130	20
1,2,3,4,7,8-HxCDF	70648-26-9	0.551	5.0	0.551	5.0	0.291	5.0	7.533	50	70	130	20
1,2,3,6,7,8-HxCDF	57117-44-9	0.579	5.0	0.579	5.0	0.226	5.0	4.488	50	70	130	20
2,3,4,6,7,8-HxCDF	60851-34-5	0.459	5.0	0.459	5.0	0.276	5.0	6.972	50	70	130	20
1,2,3,7,8,9-HxCDF	72918-21-9	0.380	5.0	0.380	5.0	1.250	5.0	7.221	50	70	130	20
1,2,3,4,7,8-HxCDD	39227-28-6	0.821	5.0	0.821	5.0	1.250	5.0	6.370	50	70	130	20
1,2,3,6,7,8-HxCDD	57653-85-7	0.938	5.0	0.938	5.0	0.341	5.0	5.373	50	70	130	20
1,2,3,7,8,9-HxCDD	19408-74-3	0.675	5.0	0.675	5.0	0.463	5.0	6.633	50	70	130	20
1,2,3,4,6,7,8-HpCDF	67562-39-4	0.650	5.0	0.650	5.0	0.164	5.0	7.176	50	70	130	20
1,2,3,4,7,8,9-HpCDF	55673-89-7	0.560	5.0	0.560	5.0	1.250	5.0	6.162	50	70	130	20
1,2,3,4,6,7,8-HpCDD	35822-46-9	0.948	5.0	0.948	5.0	1.250	5.0	6.032	50	70	130	20
OCDF	39001-02-0	1.302	10.0	1.302	10.0	2.500	10.0	12.869	100	70	130	20
OCDD	3268-87-9	1.456	10.0	1.456	10.0	2.500	10.0	20.603	100	70	130	20
Total TCDF	55722-27-5	0.499	1.0	0.499	1.0	0.160	1.0	3.841	10	70	130	20
Total TCDD	41903-57-5	0.471	1.0	0.471	1.0	0.176	1.0	4.494	10	70	130	20
Total PeCDF	30402-15-4	2.750	10.0	2.750	10.0	0.357	10.0	11.666	100	70	130	20
Total PeCDD	36088-22-9	0.290	5.0	0.290	5.0	1.250	5.0	3.594	50	70	130	20
Total HxCDF	55684-94-1	1.968	20.0	1.968	20.0	2.043	20.0	26.213	200	70	130	20
Total HxCDD	34465-46-8	2.435	15.0	2.435	15.0	2.054	15.0	18.377	150	70	130	20
Total HpCDF	38998-75-3	1.210	10.0	1.210	10.0	1.414	10.0	13.338	100	70	130	20
Total HpCDD	37871-00-4	0.948	5.0	0.948	5.0	1.250	5.0	6.032	50	70	130	20

Labelled Analyte		Control limits	
		Lower	Upper
$^{13}C_{12}$-2,3,7,8-TCDF		24	169
$^{13}C_{12}$-2,3,7,8-TCDD		25	164
$^{13}C_{12}$-1,2,3,7,8-PeCDF		24	185
$^{13}C_{12}$-2,3,4,7,8-PeCDF		21	178
$^{13}C_{12}$-1,2,3,7,8-PeCDD		25	181
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF		26	152
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF		26	123
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF		28	136
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF		29	147
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD		32	141
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD		28	130
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD		23	140
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF		28	143
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF		26	138
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD		23	140
$^{13}C_{12}$-OCDD		34	313
$^{37}Cl_4$-2,3,7,8-TCDD		35	197

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							LCS		DUP
Analyte	CAS #	MDL (ppbv)	PRL (ppbv)	MW	MDL (ug/m^3)	PRL (ug/m^3)	Lower	Upper	RPD
1,1,1-Trichloroethane	71-55-6	0.0250	0.2	133.4047	0.139	1.11	72	140	25
1,1,2,2-Tetrachloroethane	79-34-5	0.0334	0.1	167.8498	0.233	0.70	68	137	25
1,1,2-Trichloroethane	79-00-5	0.0437	0.1	133.4047	0.243	0.55	66	138	25
1,1,2-Trichlorotrifluoroethane	76-13-1	0.0205	0.2	187.3762	0.160	1.56	70	132	25
1,1-Dichloroethane	75-34-3	0.0341	0.2	98.9596	0.140	0.82	68	137	25
1,1-Dichloroethene	75-35-4	0.0255	0.2	96.9438	0.103	0.81	73	138	25
1,2,4-Trichlorobenzene	120-82-1	0.0482	0.2	181.4487	0.364	1.51	48	150	25
1,2,4-Trimethylbenzene	95-63-6	0.0244	0.2	120.1938	0.122	1.00	75	134	25
1,2-Dibromoethane	106-93-4	0.0300	0.2	187.8616	0.234	1.56	75	132	25
1,2-Dichlorobenzene	95-50-1	0.0230	0.2	147.0036	0.141	1.22	71	129	25
1,2-Dichloroethane	107-06-2	0.0289	0.1	98.9596	0.119	0.41	73	139	25
1,2-Dichloropropane	78-87-5	0.0323	0.2	112.9864	0.152	0.94	70	130	25
1,3,5-Trimethylbenzene	108-67-8	0.0414	0.2	120.1938	0.207	1.00	75	133	25
1,3-Butadiene	106-99-0	0.0376	0.2	54.0914	0.085	0.45	66	135	25
1,3-Dichlorobenzene	541-73-1	0.0379	0.2	147.0036	0.232	1.22	75	131	25
1,4-Dichlorobenzene	106-46-7	0.0324	0.2	147.0036	0.198	1.22	69	135	25
2-Butanone (MEK)	78-93-3	0.0912	0.2	72.1066	0.273	0.60	67	131	25
2-Hexanone	591-78-6	0.0512	0.2	100.1602	0.213	0.83	72	130	25
2-Propanol	67-63-0	0.0374	0.5	60.1	0.093	1.25	66	133	25
4-Ethyltoluene	622-96-8	0.0349	0.2	120.1938	0.174	1.00	75	130	25
4-Methyl-2-pentanone (MIBK)	108-10-1	0.0411	0.2	100.1602	0.171	0.83	68	134	25
Acetone	67-64-1	0.5000	1	58.0798	1.207	2.41	63	144	25
Benzene	71-43-2	0.0362	0.1	78.1134	0.118	0.32	64	139	25
Benzyl Chloride	100-44-7	0.1000	0.2	126.58	0.526	1.05	75	129	25
Bromodichloromethane	75-27-4	0.0268	0.2	163.8289	0.182	1.36	75	134	25
Bromoform	75-25-2	0.0307	0.2	252.7309	0.323	2.10	72	130	25
Bromomethane	74-83-9	0.0685	0.2	94.9387	0.270	0.79	71	132	25
Carbon Disulfide	75-15-0	0.0228	0.2	76.131	0.072	0.63	56	139	25
Carbon tetrachloride	56-23-5	0.0500	0.1	153.823	0.320	0.64	75	150	25
Chlorobenzene	108-90-7	0.0227	0.2	112.5585	0.106	0.94	71	132	25
Chloroethane	75-00-3	0.0600	0.2	64.5145	0.161	0.54	71	129	25
Chloroform	67-66-3	0.0360	0.1	119.3779	0.179	0.50	73	136	25
Chloromethane	74-87-3	0.0917	0.2	50.4877	0.192	0.42	52	143	25
cis-1,2-Dichloroethene	156-59-2	0.0487	0.2	96.9438	0.196	0.81	64	137	25
cis-1,3-Dichloropropene	10061-01-5	0.0295	0.2	110.9706	0.136	0.92	75	128	25
Cyclohexane	110-82-7	0.0360	0.2	84.1608	0.126	0.70	62	143	25
Dibromochloromethane	124-48-1	0.1000	0.2	208.2799	0.866	1.73	75	136	25
Dichlorodifluoromethane	75-71-8	0.0216	0.2	120.9138	0.109	1.01	70	141	25
Dichlorotetrafluoroethane	76-14-2	0.0351	0.2	170.9216	0.249	1.42	71	139	25
Ethanol	64-17-5	0.1646	0.5	46.07	0.315	0.96	60	144	25
Ethyl Acetate	141-78-6	0.0345	0.2	88.106	0.126	0.73	64	137	25
Ethyl Benzene	100-41-4	0.0405	0.2	106.167	0.179	0.88	71	136	25
Hexachlorobutadiene	87-68-3	0.0379	0.2	260.762	0.411	2.17	51	150	25
m&p-Xylene	106-42-3	0.0318	0.4	106.167	0.140	1.77	71	134	25
Methyl Tert Butyl Ether	1634-04-4	0.0243	0.2	88.1492	0.089	0.73	73	134	25
Methylene chloride	75-0902	0.0653	1	84.9328	0.231	3.53	64	130	25
Naphthalene	91-20-3	0.0483	0.5	128.1732	0.258	2.66	43	150	25
n-Heptane	142-82-5	0.0390	0.2	100.2034	0.162	0.83	63	135	25
n-Hexane	110-54-3	0.0281	0.2	86.1766	0.101	0.72	69	135	25
o-Xylene	95-47-6	0.1000	0.2	106.167	0.441	0.88	75	134	25

Propylene	115-07-1	0.0628	0.2	42.0804	0.110	0.35	58	135	25
Styrene	100-42-5	0.0313	0.2	104.1512	0.135	0.87	75	133	25
Tetrachloroethene	127-18-4	0.0273	0.1	165.834	0.188	0.69	66	137	25
Tetrahydrofuran	109-99-9	0.0464	0.2	72.1066	0.139	0.60	58	135	25
Toluene	108-88-3	0.0351	0.2	92.1402	0.135	0.77	70	129	25
trans-1,2-dichloroethene	156-60-5	0.0404	0.2	96.9438	0.163	0.81	61	140	25
trans-1,3-Dichloropropene	10061-02-6	0.0328	0.2	110.9706	0.151	0.92	75	134	25
Trichloroethene	79-01-6	0.0326	0.1	131.3889	0.178	0.55	70	134	25
Trichlorofluoromethane	75-69-4	0.0242	0.2	137.3684	0.138	1.14	67	140	25
Vinyl Acetate	108-05-4	0.0971	0.2	86.0902	0.348	0.72	60	139	25
Vinyl chloride	75-01-4	0.0359	0.1	62.4987	0.093	0.26	72	129	25

EXTRA ANALYTES (available upon request at an additional cost)

							LCS		DUP
Analyte	**CAS #**	**MDL (ppbv)**	**PRL (ppbv)**	**MW**	**MDL (ug/m^3)**	**PRL (ug/m^3)**	**Lower**	**Upper**	**RPD**
1,2,3-Trimethylbenzene	108-67-8	0.0355	0.2	120.19	0.177	1.00	75	133	25
Chlorodifluoromethane	75-45-6	0.0539	0.2	86.47	0.194	0.72	73	130	25
Di-isopropyl Ether	108-20-3	0.0497	0.2	102.18	0.211	0.85	70	130	25
Ethyl Tert-Butyl Ether	637-92-3	0.1000	0.2	102.17	0.425	0.85	70	130	25
Isopentane	78-78-4	0.0588	0.2	72.15	0.176	0.60	70	130	25
Methylcyclohexane	108-87-2	0.0652	0.2	98.186	0.266	0.82	70	130	25
p-Isopropyltoluene	99-87-6	0.0287	0.2	134.22	0.160	1.12	69	137	25
Tert Amyl Methyl Ether	994-05-8	0.0484	0.2	88.15	0.177	0.73	70	130	25
Tert-Butyl Benzene	98-06-6	0.0244	0.2	166.217	0.168	1.38	70	130	25
1,4-Dioxane	123-91-1	0.0587	1	88.1	0.215	3.66	65	154	25
2,2,4-Trimethylpentane	540-84-1	0.0286	0.5	114.22	0.136	2.37	75	130	25
Acrolein	107-02-8	0.0981	0.5	56.06	0.229	1.17	65	143	25
Acrylonitrile	107-13-1	0.0632	0.5	53.06	0.139	1.10	72	144	25
Allyl Chloride	107-05-1	0.0879	0.5	76.52	0.280	1.59	66	145	25
N-Butylbenzene	104-51-8	0.0240	0.5	134.2206	0.134	2.79	66	142	25
N-Propylbenzene	103-65-1	0.0323	0.5	120.1938	0.162	2.50	70	134	25
Sec- Butylbenzene	135-98-8	0.1000	0.5	134.2206	0.558	2.79	67	134	25
Tert Butyl Alcohol (TBA)	75-65-0	0.0737	0.5	74.12	0.227	1.54	70	130	25
Vinyl Bromide	593-60-2	0.0429	0.5	106.95	0.191	2.22	70	130	25
Isopropylbenzene	98-82-8	0.1000	0.5	120.194	0.500	2.50	72	139	25
THC as gas		8.2000	16.4		30.400	60.80	66	135	25
Xylene (Total)	1330-20-7	0.1243	0.6	106.17	0.548	2.65	50	125	25

Surrogates								
1,4-Dichlorobenzene-d4 (S)	3855-82-1						30	150
Hexane-d14 (S)	21666-38-6						30	150
Toluene-d8 (S)	2037-26-5						30	150

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Method Detection Limits and Reporting Limits
for EPA TO3

				LCS		DUP
Analyte	CAS#	MDL (ppmv)	PRL (ppmv)	Lower	Upper	RPD
Methane	74-82-8	0.17	1	70	130	30
Ethene	74-85-1	0.14	1	70	130	30
Ethane	74-84-0	0.14	1	70	130	30
Propane		0.16	1	70	130	30

EXTRA ANALYTES (available upon request at an additional cost)

				LCS		DUP
Analyte	CAS#	MDL (ppmv)	PRL (ppmv)	Lower	Upper	RPD
THC as C1-C4		0.34	3	70	130	30

Surrogates					
a,a,a-Trifluorotoluene (S)				30	150

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				LCS		DUP
Analyte	CAS#	MDL (ppmv)	PRL (ppmv)	Lower	Upper	RPD
Methyl-tert-butyl Ether	1634-04-4	0.050	0.10	70	130	30
Benzene	71-43-2	0.050	0.10	70	130	30
Toluene	108-88-3	0.050	0.10	70	130	30
Ethylbenzene	100-41-4	0.008	0.10	70	130	30
m&p-xylene	106-42-3	0.016	0.20	70	130	30
o-Xylene	95-47-6	0.009	0.10	70	130	30
1,3,5-Trimethylbenzene	108-67-8	0.017	0.10	70	130	30
THC as Gas		0.128	1.00	70	130	30
1,2,4-Trimethylbenzene	95-63-6	0.020	0.10	70	130	30

Surrogates					
a,a,a-Trifluorotoluene (S)				75	125

EXTRA ANALYTES (available upon request at an additional cost)

				LCS		DUP
Analyte	CAS#	MDL (ppmv)	PRL (ppmv)	Lower	Upper	RPD
n-Hexane	110-54-3	0.006	0.10	70	130	30
Xylene (Total)	1330-20-7	0.025	0.3	70	130	30
Total BTEX		0.133	0.6	70	130	30

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Method Detection Limits and Reporting Limits
for Method 3C

				LCS		DUP
Analyte	**CAS#**	**MDL (%)**	**PRL (%)**	**Lower**	**Upper**	**RPD**
Carbon Monoxide	630-08-0	0.1453	0.4	70	130	30
Carbon Dioxide	124-38-9	0.2591	2	70	130	30
Nitrogen	7727-37-9	0.0531	8	70	130	30
Oxygen	7782-44-7	0.0641	2	70	130	30
Methane	74-82-8	0.4801	4	70	130	30

EXTRA ANALYTES (available upon request at an additional cost)

				LCS		DUP
Analyte	**CAS#**	**MDL (%)**	**PRL (%)**	**Lower**	**Upper**	**RPD**
Helium	7440-59-7	0.7554	3.6	70	130	30

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Method Detection Limits and Reporting Limits
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				LCS		DUP	Actual MS		MS	
Analyte	CAS#	MDL (ug/L)	PRL (ug/L)	Lower	Upper	RPD	Lower	Upper	Lower	Upper
Methane	74-82-8	3.30	6.6	85	115	20	-1859.75	2260.489	30	150
Ethene	74-85-1	3.100	6.2	85	115	20	49.519	152.356	50	150
Ethane	74-84-0	3.100	6.2	85	115	20	54.234	147.641	54	148

EXTRA ANALYTES (available upon request at an additional cost)				LCS		DUP	Actual MS		MS	
Analyte	CAS#	MDL (ug/L)	PRL (ug/L)	Lower	Upper	RPD	Lower	Upper	Lower	Upper
Propane	74-98-6	0.889	18.1	85	115	20	23.146	187.154	30	150

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Analyte	CAS #	MDL (ng)	PRL (ng)	LCS Lower	LCS Upper	DUP RPD	ug/m3 (1 Liter sample)	ug/m3 (10 Liter sample)	ug/m3 (100 Liter sample)
1,1,2-Trichlorotrifluoroethane	76-13-1	1.191	5	75	139	30	5	0.5	0.05
1,1-Dichloroethene	75-35-4	0.563	2	75	137	30	2	0.2	0.02
1,2-Dichlorobenzene	95-50-1	0.680	5	51	150	30	5	0.5	0.05
1,3-Butadiene	106-99-0	0.515	5	69	134	30	5	0.5	0.05
1,1,1-Trichloroethane	71-55-6	1.329	5	74	136	30	5	0.5	0.05
1,1,2,2-Tetrachloroethane	79-34-5	1.219	5	70	146	30	5	0.5	0.05
1,1,2-Trichloroethane	79-00-5	1.288	5	75	125	30	5	0.5	0.05
1,1-Dichloroethane	75-34-3	0.657	10	78	135	30	10	1	0.1
1,2,4-Trichlorobenzene	120-82-1	1.678	5	30	150	30	5	0.5	0.05
1,2,4-Trimethylbenzene	95-63-6	0.706	5	72	137	30	5	0.5	0.05
1,2-Dibromoethane (EDB)	106-93-4	1.023	5	70	128	30	5	0.5	0.05
1,2-Dichloroethane	107-06-2	0.504	2	75	126	30	2	0.2	0.02
1,2-Dichloropropane	78-87-5	1.003	5	69	134	30	5	0.5	0.05
1,3- Dichlorobenzene	541-73-1	0.779	5	63	142	30	5	0.5	0.05
1,3,5-Trimethylbenzene	108-67-8	0.852	5	73	134	30	5	0.5	0.05
1,4-Dichlorobenzene	106-46-7	0.709	5	58	150	30	5	0.5	0.05
1,4-Dioxane	123-91-1	0.499	2	75	125	30	2	0.2	0.02
2-Butanone (MEK)	78-93-3	0.557	5	53	145	30	5	0.5	0.05
2-Hexanone	591-78-6	0.560	2	69	134	30	2	0.2	0.02
4-Ethyltoluene	622-96-8	0.847	5	74	140	30	5	0.5	0.05
4-Methyl-2- Pentanone (MIBK)	108-10-1	0.648	2	74	137	30	2	0.2	0.02
Acetone	67-64-1	0.622	5	57	142	30	5	0.5	0.05
Acrylonitrile	107-13-1	0.505	5	60	142	30	5	0.5	0.05
Benzene	71-43-2	0.598	2	54	138	30	2	0.2	0.02
Benzyl chloride	100-44-7	0.695	5	50	135	30	5	0.5	0.05
Bromodichloromethane	75-27-4	0.362	5	75	133	30	5	0.5	0.05
Bromoform	75-25-2	1.487	5	68	140	30	5	0.5	0.05
Bromomethane	74-83-9	0.918	2	72	150	30	2	0.2	0.02
Carbon Disulfide	75-15-0	0.504	5	38	140	30	5	0.5	0.05
Carbon Tetrachloride	56-23-5	0.651	5	75	134	30	5	0.5	0.05
Chlorobenzene	108-90-7	0.419	2	75	125	30	2	0.2	0.02
Chlorodibromomethane	124-48-1	1.179	5	73	125	30	5	0.5	0.05
Chloroethane	75-00-3	0.640	2	75	140	30	2	0.2	0.02
Chloroform	67-66-3	0.779	5	75	126	30	5	0.5	0.05
Chloromethane	74-87-3	0.745	2	70	127	30	2	0.2	0.02
cis 1,3-Dichloropropene	10061-01-5	0.810	5	74	129	30	5	0.5	0.05
cis-1,2-Dichloroethene	156-59-2	0.667	2	70	139	30	2	0.2	0.02
Cyclohexane	110-82-7	0.614	2	62	135	30	2	0.2	0.02
Dichlorodifluoromethane	75-71-8	0.723	5	75	134	30	5	0.5	0.05
Ethyl Acetate	141-78-6	0.818	5	52	146	30	5	0.5	0.05
Ethyl benzene	100-41-4	0.397	2	63	140	30	2	0.2	0.02
Hexachlorobutadiene	87-68-3	0.892	5	30	150	30	5	0.5	0.05
Isopropyl alcohol (2-propanol)	67-63-0	0.389	2	58	152	30	2	0.2	0.02
Isopropylbenzene (cumene)	98-82-8	0.478	5	75	135	30	5	0.5	0.05
m,p-Xylene	179601-23-1	0.346	5	65	137	30	5	0.5	0.05
Methyl tert-Butyl Ether	1634-04-4	0.952	2	41	150	30	2	0.2	0.02
Methylene chloride	75-09-2	3.340	20	30	150	30	20	2	0.2
Naphthalene	91-20-3	0.749	5	30	150	30	5	0.5	0.05
n-Butylbenzene	104-51-8	0.663	5	49	150	30	5	0.5	0.05
n-Heptane	142-82-5	0.570	2	65	132	30	2	0.2	0.02
n-Hexane	110-54-3	0.999	2	57	136	30	2	0.2	0.02
n-Propylbenzene	103-65-1	0.271	5	75	136	30	5	0.5	0.05
o-Xylene	95-47-6	0.414	2	64	139	30	2	0.2	0.02
Propylene	115-07-1	0.186	2	30	150	30	2	0.2	0.02
sec-Butylbenzene	135-98-8	0.375	5	67	141	30	5	0.5	0.05
Styrene	100-42-5	0.476	10	69	128	30	10	1	0.1
Tetrachloroethene	127-18-4	0.820	5	64	141	30	5	0.5	0.05
Tetrahydrofuran (THF)	109-99-9	0.460	2	69	140	30	2	0.2	0.02
Toluene	108-88-3	0.569	2	57	133	30	2	0.2	0.02
trans 1,3-Dichloropropene	10061-02-6	10.000	10	74	125	30	10	1	0.1
trans-1,2-Dichloroethene	156-60-5	0.505	2	70	130	30	2	0.2	0.02
Trichloroethene	79-01-6	0.696	5	73	136	30	5	0.5	0.05
Trichlorofluoromethane	75-69-4	0.878	5	75	126	30	5	0.5	0.05
Vinyl acetate	108-05-4	1.307	10	41	150	30	10	1	0.1
Vinyl Chloride	75-01-4	0.389	5	59	150	30	5	0.5	0.05
tert-Amyl Methyl Ether		0.604	2	70	130	30	2	0.2	0.02
tert-Butyl Alcohol (TBA)	75-65-0	0.910	2	70	130	30	2	0.2	0.02
tert-Butylbenzene	98-06-6	0.354	5	70	130	30	5	0.5	0.05
Vinyl Bromide	593-60-2	0.600	2	70	130	30	2	0.2	0.02
p-Isopropyltoluene (p-Cymene)	99-87-6	1.043	5	70	130	30	5	0.5	0.05
Methylcyclohexane	108-87-2	0.675	2	70	130	30	2	0.2	0.02
Ethyl-tert-Butyl Ether	637-92-3	0.582	2	70	130	30	2	0.2	0.02
Isopentane	92046-46-3	0.530	2	70	130	30	2	0.2	0.02
Isopropyl Ether	108-20-3	0.708	2	70	130	30	2	0.2	0.02
Dichlorotetrafluoroethane	76-14-2	0.943	5	75	125	30	5	0.5	0.05
Ethanol	64-17-5	0.438	2	30	150	30	2	0.2	0.02
Chlorodifluoromethane	75-45-6	1.023	5	70	130	30	5	0.5	0.05
Allyl Chloride (3-Chloropropene	107-05-1	0.532	2	70	130	30	2	0.2	0.02
Acrolein	107-02-8	0.471	2	70	130	30	2	0.2	0.02
2,2,4-Trimethylpentane	540-84-1	0.983	5	59	144	30	5	0.5	0.05
1,2,3-Trimethylbenzene	108-67-8	1.031	5	70	130	30	5	0.5	0.05
THC as Gas (C4-C12)		165.200	330.4	70	130	30	330.4	33.04	3.304

DRO (PAHs)

Acenaphthene	83-32-9	0.211	2	53	143	30	2.00	0.20	0.02
Acenaphthylene	208-96-8	0.153	2	39	148	30	2.00	0.20	0.02
Fluorene	86-73-7	0.558	2	57	147	30	2.00	0.20	0.02
1-Methylnaphthalene	90-12-0	0.551	2	62	138	30	2.00	0.20	0.02
2- Methylnapththalene	91-57-6	0.556	2	53	142	30	2.00	0.20	0.02
Phenanthrene	85-01-8	0.420	2	32	150	30	2.00	0.20	0.02
Diesel Fuel #2		44.409	250	54	142	30	250.00	25.00	2.50

APH

Aliphatic (C05-C08)			41.9	70	130	30	0.00	0.00	0.00
Aliphatic (C09-C12)		28.2	71.7	70	130	30	28.20	2.82	0.28
Aromatic (C09-C10)		2.37	20.5	70	130	30	2.37	0.24	0.02

				LCS/LCSD Lower	LCS/LCSD Upper
Surrogate					
aaa-Trifluorotoluene				70	130

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Method Detection Limits and Reporting Limits
for MaVPH

Solid

				LCS/LCSD			MS/MSD			DUP
Analyte	**CAS#**	**MDL (mg/kg)**	**PRL (mg/kg)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Total Purgeable Hydrocarbons		0.160	10	70	130	25	70	130	30	50
Aliphatic (C5-C8)		0.096	5	70	130	25	70	130	30	50
Aliphatic (C9-C12)		0.281	5	70	130	25	70	130	30	50
Aromatic (C9-C10)		0.221	1	70	130	25	70	130	30	50
Aliphatic (C5-C8), adjusted		0.096	5	70	130	25	70	130	30	50
Aliphatic (C9-C12), adjusted		0.281	5	70	130	25	70	130	30	50
Benzene	71-43-2	0.013	0.025	70	130	25	70	130	30	50
Ethylbenzene	100-41-4	0.015	0.05	70	130	25	70	130	30	50
Methyl-tert-butyl ether	1634-04-4	0.018	0.05	70	130	25	70	130	30	50
Naphthalene	91-20-3	0.099	0.6	70	130	25	70	130	30	50
Toluene	108-88-3	0.014	0.05	70	130	25	70	130	30	50
Xylene (Total)	1330-20-7	0.044	0.2	70	130	25	70	130	30	50
m&p-Xylene (co-elute)	108-38-3 106-42-3	0.030	0.1	70	130	25	70	130	30	50
o-Xylene	95-47-6	0.014	0.1	70	130	25	70	130	30	50
Surrogate										
a,a,a-Trifluorotoluene (S)				70	130					

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Method Detection Limits and Reporting Limits
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Water

				LCS/LCSD			MS/MSD			DUP
Analyte		**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Total Purgeable Hydrocarbons		2.578	20	70	130	25	70	130	30	50
Aliphatic (C5-C8)		2.715	20	70	130	25	70	130	30	50
Aliphatic (C9-C12)		1.666	20	70	130	25	70	130	30	50
Aromatic (C9-C10)		10.000	20	70	130	25	70	130	30	50
Aliphatic (C5-C8), adjusted		2.715	20	70	130	25	70	130	30	50
Aliphatic (C9-C12), adjusted		1.666	20	70	130	25	70	130	30	50
Benzene	71-43-2	0.192	0.5	70	130	25	70	130	30	50
Ethylbenzene	100-41-4	0.154	0.5	70	130	25	70	130	30	50
Methyl-tert-butyl ether	1634-04-4	0.491	1	70	130	25	70	130	30	50
Naphthalene	91-20-3	0.250	5	70	130	25	70	130	30	50
Toluene	108-88-3	0.084	0.5	70	130	25	70	130	30	50
Xylene (Total)	1330-20-7	0.389	2	70	130	25	70	130	30	50
m&p-Xylene (co-elute)	108-38-3 106-42-3	0.141	1	70	130	25	70	130	30	50
o-Xylene	95-47-6	0.248	1	70	130	25	70	130	30	50

Surrogate

2,5-Dibromotoluene (PID) (S)			70	130					
a,a,a,-Trifluorotoluene (S)			70	130					

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Method Detection Limits and Reporting Limits
for MaEPH

Solid

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (mg/kg)**	**PRL (mg/kg)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Total Extractable Hydrocarbons	2.61	10	40	140	25	40	140	50	50
Surrogate									
1-Chloro-octadecane (S)			40	140					

Water

			LCS/LCSD			MS/MSD			DUP
Analyte	**MDL (ug/L)**	**PRL (ug/L)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**
Total Extractable Hydrocarbons	69.1	200	40	140	25	40	140	50	50
Surrogate									
1-Chloro-octadecane (S)			40	140					

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Detection Limits

PASI Minnesota Laboratory

For Acode: APH AL APH

ID	Limits Type	Matrix	Analytical Method	Preparation Method	Sample Type	Instr. Name	Effective Date	Stop Date
19665	PRL	Air	TO-15 APH				/2011 1:35:49	

#	Analyte	CAS Number	PRL	Units
1	Benzene	71-43-2	0.325	ug/m3
2	Toluene	108-88-3	0.77	ug/m3
3	Ethylbenzene	100-41-4	0.88	ug/m3
4	m&p-Xylene	179601-23-1	1.76	ug/m3
5	o-Xylene	95-47-6	0.88	ug/m3
6	Aliphatic (C05-C08).Unadjusted		24	ug/m3
7	Aliphatic (C09-C12).Unadjusted		28	ug/m3
8	1,3-Butadiene	106-99-0	0.45	ug/m3
9	Methyl-tert-butyl ether	1634-04-4	0.73	ug/m3
10	Naphthalene	91-20-3	2.7	ug/m3
11	Aromatic (C09-C10)		24	ug/m3
12	Aliphatic (C05-C08), Adjusted		24	ug/m3
13	Aliphatic (C09-C12), Adjusted		28	ug/m3

Other Criteria

Pace Analytical®
The Right Chemistry, The Right Solution®

USEPA Method TO-17 offers an active sampling method that will report both volatile organic compounds (VOC) and Diesel range compounds (DRO) with one set of collection media. Separation and detection is achieved by using a thermal desorption (TD) tube technology developed by Perkin Elmer called SVI™ Soil Vapor Intrusion. This patent pending product utilizes a multi-bed construction that extends into the DRO range while maintaining the lighter VOC components. In addition to the thermal desorption (TD) tubes, a calibrated sampling pump is necessary to collect a sample. For ease of use, the laboratory provides SKC pocket pumps™ that can be rented and supplied with pre-set flow rates.

The reporting limit achieved with this technique is based on sample collection volume. The calibrated flow rate in mls/min and the collection time in minutes are used to determine the total liters of sample collected. The final sample concentration is determined from the GC/MS output (in total nanograms) and the volume of sample collected (in liters). The final concentration in ng/L is equivalent to ug/m3.

The following sampling scenarios illustrate approximate screening levels in relation to volume of sample (air) collected (based on 2 NG on column reporting limit):

Total Volume Collected 1L (similar to soil screening levels)

Setting	Total Time	
10cc/mn	100 min	All settings will collect one liter of sample and achieve the 2ug/m3 RL
20cc/mn	50 min	
50cc/mn	20 min	
100cc/mn	10 min	
200cc/mn	5 min	

Total Volume Collected 10L (similar to TO-15 type levels)

Setting	Total Time	
10cc/mn	1000 min / 16.67hr	All settings will collect 10 liter of sample and achieve the 0.2ug/m3 RL
20cc/mn	500 min / 8.33hr	
50cc/mn	200 min / 3.33hr	
100cc/mn	100 min / 1.67hr	
200cc/mn	50 min	

Total Volume Collected 100L (similar to TO-15 SIM type levels)

Setting	Total Time	
69.4 cc/mn	1440 min / 24 hr	All settings will collect 100 liter of sample and achieve the 0.02ug/m3 RL
100cc/mn	1000 min / 16.67hr	
200cc/mn	500 min / 8.33hr	

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TO-17 Active Compound List 03/16/2014

nelac

VOCs

	CAS #	Compound	NG Total	ug/m3 (1 Liter sample)	ug/m3 (10 Liter sample)	ug/m3 (100 Liter sample)
1	115-07-1	Propylene	2	2	0.2	0.02
2	75-71-8	Dichlorodifluoromethane	5	5	0.5	0.05
3	74-87-3	Chloromethane	2	2	0.2	0.02
4	76-14-2	Tetrafluoroethane, 1,2-Dichloro-1,1,2,2-	5	5	0.5	0.05
5	75-01-4	Vinyl Chloride	5	5	0.5	0.05
6	106-99-0	Butadiene, 1,3-	5	5	0.5	0.05
7	74-83-9	Bromomethane	2	2	0.2	0.02
8	75-00-3	Chloroethane	2	2	0.2	0.02
9	67-64-1	Acetone	5	5	0.5	0.05
10	75-69-4	Trichlorofluoromethane	5	5	0.5	0.05
11	67-63-0	Isopropyl alcohol (2-propanol)	2	2	0.2	0.02
12	107-13-1	Acrylonitrile	5	5	0.5	0.05
13	75-35-4	Dichloroethylene, 1,1-	2	2	0.2	0.02
14	75-09-2	Methylene chloride	10	10	1	0.1
15	76-13-1	Trichlorotrifluoroethane, 1,1,2-	5	5	0.5	0.05
16	75-15-0	Carbon Disulfide	5	5	0.5	0.05
17	75-34-3	Dichloroethane, 1,1-	10	10	1	0.1
18	1634-04-4	Methyl tert-Butyl Ether	2	2	0.2	0.02
19	108-05-4	Vinyl acetate	10	10	1	0.1
20	78-93-3	Butanone, 2- (MEK)	5	5	0.5	0.05
21	156-59-2	Dichloroethene, cis-1,2-	2	2	0.2	0.02
22	141-78-6	Ethyl Acetate	5	5	0.5	0.05
23	110-54-3	Hexane, n-	2	2	0.2	0.02
24	67-66-3	Chloroform	5	5	0.5	0.05
25	109-99-9	Tetrahydrofuran (THF)	2	2	0.2	0.02
26	107-06-2	Dichloroethane, 1,2-	2	2	0.2	0.02
27	71-55-6	Trichloroethane, 1,1,1-	5	5	0.5	0.05
28	71-43-2	Benzene	2	2	0.2	0.02
29	56-23-5	Carbon Tetrachloride	5	5	0.5	0.05
30	110-82-7	Cyclohexane	2	2	0.2	0.02
31	78-87-5	Dichloropropane, 1,2-	5	5	0.5	0.05
32	75-27-4	Bromodichloromethane	5	5	0.5	0.05
33	79-01-6	Trichloroethene	5	5	0.5	0.05
34	123-91-1	Dioxane 1,4-	2	2	0.2	0.02
35	142-82-5	Heptane, n-	2	2	0.2	0.02
36	10061-01-5	Dichloropropene, cis 1,3-	5	5	0.5	0.05
37	108-10-1	Pentanone, 4-Methyl-2- (MIBK)	2	2	0.2	0.02
38	10061-02-6	Dichloropropene, trans 1,3-	5	5	0.5	0.05
39	79-00-5	Trichloroethane, 1,1,2-	5	5	0.5	0.05
40	108-88-3	Toluene	2	2	0.2	0.02
41	591-78-6	Hexanone, 2-	2	2	0.2	0.02
42	124-48-1	Chlorodibromomethane	5	5	0.5	0.05
43	106-93-4	Dibromoethane, 1,2- (EDB)	5	5	0.5	0.05
44	127-18-4	Tetrachloroethene	5	5	0.5	0.05
45	108-90-7	Chlorobenzene	2	2	0.2	0.02
46	100-41-4	Ethyl benzene	2	2	0.2	0.02
47	179601-23-1	Xylene, m,p-	5	5	0.5	0.05
48	75-25-2	Bromoform	5	5	0.5	0.05
48	100-42-5	Styrene	10	10	1	0.1
50	95-47-6	Xylene, o-	2	2	0.2	0.02
51	156-60-5	Dichloroethene, trans-1,2-	2	2	0.2	0.02
52	79-34-5	Tetrachloroethane, 1,1,2,2-	5	5	0.5	0.05
53	98-82-8	Isopropylbenzene (cumene)	5	5	0.5	0.05
54	103-65-1	Propylbenzene, n-	5	5	0.5	0.05
55	622-96-8	Ethyltoluene, 4-	5	5	0.5	0.05
56	108-67-8	Trimethylbenzene, 1,3,5-	5	5	0.5	0.05
57	95-63-6	Trimethylbenzene, 1,2,4-	5	5	0.5	0.05
58	100-44-7	Benzyl chloride	5	5	0.5	0.05
59	541-73-1	Dichlorobenzene, 1,3-	5	5	0.5	0.05
60	106-46-7	Dichlorobenzene, 1,4-	5	5	0.5	0.05
61	95-50-1	Dichlorobenzene, 1,2-	5	5	0.5	0.05
62	120-82-1	Trichlorobenzene, 1,2,4-	5	5	0.5	0.05
63	91-20-3	Naphthalene	5	5	0.5	0.05
64	87-68-3	Hexachlorobutadiene	5	5	0.5	0.05
65	104-51-8	n-Butylbenzene	5	5	0.5	0.05
66	135-98-8	sec-Butylbenzene	5	5	0.5	0.05

DRO (PAHs)

67	83-32-9	Acenaphthene	5	5	0.5	0.05
68	208-96-8	Acenaphthylene	5	5	0.5	0.05
69	86-73-7	Fluorene	5	5	0.5	0.05
70	90-12-0	1-Methylnaphthalene	5	5	0.5	0.05
71	91-57-6	2- Methylnapththalene	5	5	0.5	0.05
72	85-01-8	Phenanthrene	5	5	0.5	0.05
73		DRO Diesel Fuel #2	250	250	25	2.5

TO-17 Active Sampling Instructions

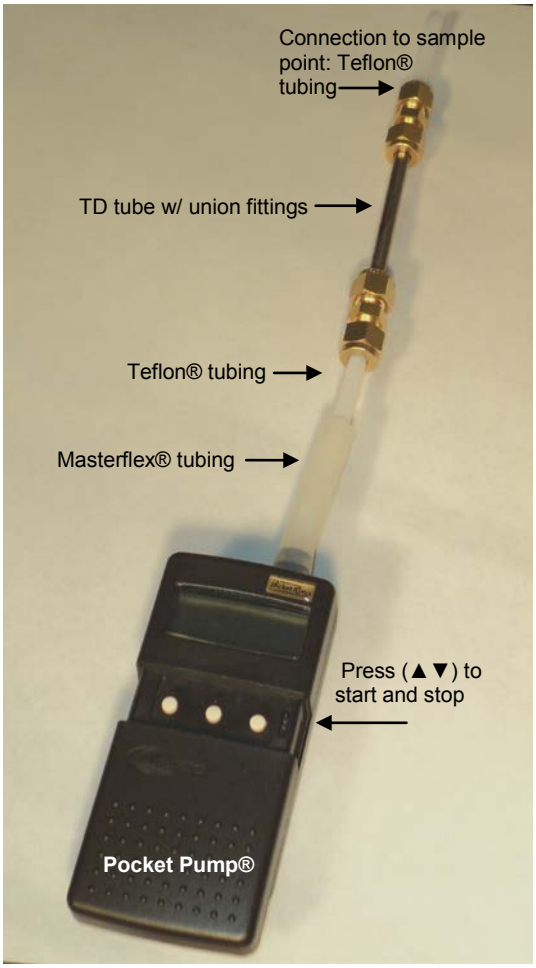
Inspect your media

- Each sampling assembly will require the following parts:
  - Pocket Pump® sampling pumps
  - SVI™ thermal desorption tubes (TD)
  - Swagelok® ¼ " x ¼" union fittings
  - Teflon® tubing 5/32 " ID x ¼" OD
  - Masterflex® tubing ¼"ID tubing.
- Compare the content with the packing slip, and notify Pace Analytical of any discrepancy or damage. Please note: *The sampling pumps have been pre-calibrated for your convenience.*

SVI™ thermal desorption tube (TD)

Prepare for sampling

- Familiarize yourself with the diagrams on the right.
- Using nitrile gloves, remove the end cap fittings from the TD tube with adjustable wrenches.
- Securely connect the TD tube to the union fittings. Fittings should be fastened ¼ turn past finger tight.
- **Please DO NOT OVER TIGHTEN TUBES**. Tubes will become compromised.
- Connect the remaining tubing to complete the sample assembly. Please note: *The directional arrow of the TD tube should always be pointing towards the sampling pump.*



TO-17 Active Assembly

Sample Collection

- The SKC pocket pump comes charged and calibrated.
- Refer to the media request form to match the pump serial number, flow rate and collection time for its intended use.
- Press (▲▼) buttons on the pump at the same time to start the pump and begin the sampling process.
- Be sure to record the start times on the Chain of Custody.
- Reference the serial numbers of the TD tubes to the chain of custody.
- Do not write on or attach labels or tape to the tubes.

Sample Completion

- At the conclusion of the run time press (▲▼) buttons at the same time to stop the pump.
- Record the end time on the Chain of Custody.
- Disconnect the TD tubes using adjustable wrenches and reinstall the end caps.
- Tighten ¼ turn past "finger tight". **DO NOT OVER TIGHTEN.** Wrap in aluminum foil and place the sample tubes in a clear plastic bag for return shipment.

Return Samples & Pumps

- Send the TD tubes back to the laboratory on ice for overnight delivery. If you are unable to ship the samples back the same day, store the samples at 4 degrees C.
- Carefully pack and return the pumps to the laboratory in the container they were shipped in.
- Upon receipt, the laboratory will verify the calibration of the pumps used to collect samples.

Questions? Call the Air Technical Hotline at 612-607-6386
Pace Analytical Services Air Lab 1700 Elm Street, Mpls., MN 55414

Pace Analytical®
The Right Chemistry, The Right Solution®

TO-17 PAH
Compound List
4/29/2013

	Analyte	CAS #	PRL (ng)	1L Sample (ug/m3)	5L Sample (ug/m3)	10L Sample (ug/m3)	50 L Sample (ug/m3)	100 L Sample (ug/m3)
1	Benzene	71-43-2	2	2	0.4	0.2	0.04	0.02
2	Ethyl benzene	100-41-4	2	2	0.4	0.2	0.04	0.02
3	m,p-Xylene	179601-23-1	2	5	1	0.5	0.1	0.05
4	o-Xylene	95-47-6	2	2	0.4	0.2	0.04	0.02
5	Toluene	108-88-3	2	2	0.4	0.2	0.04	0.02
6	1-Methylnaphthalene	90-12-0	0.1	0.1	0.02	0.01	0.002	0.001
7	2-Methylnaphthalene	91-57-6	0.1	0.1	0.02	0.01	0.002	0.001
8	Acenaphthene	83-32-9	0.1	0.1	0.02	0.01	0.002	0.001
9	Acenaphthylene	208-96-8	0.1	0.1	0.02	0.01	0.002	0.001
10	Anthracene	120-12-7	0.1	0.1	0.02	0.01	0.002	0.001
11	Benzo(a)anthracene	56-55-3	0.1	0.1	0.02	0.01	0.002	0.001
12	Benzo(a)pyrene	50-32-8	0.1	0.1	0.02	0.01	0.002	0.001
13	Benzo(b)fluoranthene	192-97-2	0.1	0.1	0.02	0.01	0.002	0.001
14	Benzo(e)pyrene	192-97-2	0.1	0.1	0.02	0.01	0.002	0.001
15	Benzo(g,h,i)perylene	191-24-2	0.1	0.1	0.02	0.01	0.002	0.001
16	Benzo(k)fluoranthene	207-08-9	0.1	0.1	0.02	0.01	0.002	0.001
17	Chrysene	218-01-9	0.1	0.1	0.02	0.01	0.002	0.001
18	Dibenz(a,h)anthracene	53-70-3	0.1	0.1	0.02	0.01	0.002	0.001
19	Fluoranthene	206-44-0	0.1	0.1	0.02	0.01	0.002	0.001
20	Fluorene	96-73-7	0.1	0.1	0.02	0.01	0.002	0.001
21	Indeno(1,2,3-cd)pyrene	193-39-5	0.1	0.1	0.02	0.01	0.002	0.001
22	Naphthalene	91-20-3	0.1	0.1	0.02	0.01	0.002	0.001
23	Phenanthrene	85-01-8	0.1	0.1	0.02	0.01	0.002	0.001
24	Pyrene	129-00-0	0.1	0.1	0.02	0.01	0.002	0.001

APPENDIX C

Montana DEQ Soil Screening Process

Montana Department of
ENVIRONMENTAL QUALITY

Voluntary Cleanup and Redevelopment Act Application Guide

April 2012

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Figure 1 – VCRA Process Flowchart

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LIST OF ACRONYMS

AAI – All Appropriate Inquiry
ARM – Administrative Rules of Montana
CECRA – Comprehensive Environmental Cleanup and Responsibility Act
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
CFR – Code of Federal Regulations
COC – contaminant of concern
DAF – dilution attenuation factor
DEQ – Montana Department of Environmental Quality
DEQ-7 – Montana Numeric Water Quality Standards Circular DEQ-7
EPA – U.S. Environmental Protection Agency
ERCLs – environmental requirements, criteria, or limitations
IC – Institutional control
MCA – Montana Code Annotated
MCL – federal maximum contaminant level
O&M – operation and maintenance
QA/QC – Quality assurance/quality control
RAGS – Risk Assessment Guidance for Superfund
RBCA – Risk-Based Corrective Action
RBSL – Risk-Based Screening Level
RCRA – Resource Conservation and Recovery Act
RSL – EPA Regional Screening Level
SCEM – site-conceptual exposure model
SSL – Soil Screening Level
VCRA – Voluntary Cleanup and Redevelopment Act

BACKGROUND

The State of Montana has many facilities where soils, surface waters, sediment, air, or groundwater have become contaminated. These facilities can range in size from small spills involving a few square feet of surface contamination to facilities where contaminants have impacted several square miles of land. The Montana Department of Environmental Quality (DEQ) oversees cleanup of most of these facilities.

Assuming the facility is not being addressed by another regulatory program such as DEQ's Hazardous Waste Program, there are two ways under Montana's state Superfund law to address a facility. Both ways must fulfill all the requirements found in the Comprehensive Environmental Cleanup and Responsibility Act (CECRA) § 75-10-701 through § 75-10-757, MCA:

1) The more traditional method is where the cleanup of a facility is actively managed by DEQ's Site Response Section (SRS).

2) The voluntary process was established in 1995 by the Voluntary Cleanup and Redevelopment Act (VCRA) §§ 75-10-730 through 75-10-738, MCA, with less active management by DEQ's SRS.

DEQ prepared this guide to assist potential applicants in meeting the requirements outlined in VCRA. The legislature intended this voluntary program provide for the protection of the public health, welfare, and safety and of the environment; foster the cleanup, transfer, reuse, or redevelopment of facilities; permit and encourage voluntary cleanup of facilities; encourage and facilitate prompt cleanup activities; eliminate impediments to the sale or redevelopment of facilities where releases or threatened releases of hazardous or deleterious substances exist; and minimize administrative processes and costs (Section 75-10-731, MCA).

In 2009, the Montana Legislature modified VCRA and divided a Voluntary Cleanup Plan (VCP) into two components:

1) The Environmental Assessment – When conducting the Environmental Assessment, all facility and operational history must be investigated. CECRA defines the facility to include "any site or area where a hazardous or deleterious substance has been deposited, stored, disposed of, placed, or otherwise come to be located." Therefore, it is critical to adequately investigate and identify the nature and extent of contamination, which is not limited to property boundaries. Historically, DEQ deemed many VCPs incomplete due to the VCP applicant focusing only on the area of known contamination and not investigating other areas that may be impacted at the facility. The Environmental Assessment is discussed further in Section 2.0 of the VCRA Guide.

2) The Remediation Proposal – Once DEQ determines that the Environmental Assessment is complete, the VCP applicant may submit a Remediation Proposal for DEQ review. The Remediation Proposal addresses how the facility will be remediated so that it will be protective of public health, safety, and welfare and the environment and meet applicable or relevant state and federal environmental requirements, criteria, or limitations (ERCLs). The Remediation Proposal is discussed further in Section 3.0 of the VCRA Guide.

A flowchart outlining the VCRA process is provided in Figure 1.

Purpose

DEQ prepared this guide to assist VCP applicants in meeting the requirements outlined in VCRA. This guide identifies the requirements of VCRA and provides a suggested format for VCPs. The primary target audience for this guide is the qualified environmental professional who is preparing the VCP. However, the guide is also designed to provide information to all applicants or potential applicants regarding the VCRA process.

This guide is presented in five sections: 1) the Introduction; 2) the Environmental Assessment; 3) the Remediation Proposal; 4) Completion of the VCP; and 5) the References. Sections 2.0 and 3.0 of the guide are meant to represent sections of the VCP. VCPs that follow this format are more likely to contain the information necessary for DEQ to determine both components of a VCP are complete under VCRA. Section 4 identifies requirements for completing and closing the VCP and Section 5 addresses references to include in the VCP. This guide is also available on DEQ's website at www.deq.state.mt.us/StateSuperfund/vcraguide.mcpx and can be provided in alternative formats if requested.

Adherence to the requirements outlined in VCRA is mandatory; however, adherence to this guide is not. This guidance does not create any requirements or obligations on the regulated community. These recommendations do not supersede any statutory or regulatory requirements, are subject to change, and are not independently binding on DEQ. Additionally, if a conflict exists between this guidance and the statutory or regulatory requirements, the conflict must be resolved in favor of the statute or regulation. DEQ has developed this guidance using its scientific and technical expertise, a review of relevant Montana-specific information, as well as other technical documents.

A VCP must include the information specified in § 75-10-734, MCA, and be adequate and accurate for DEQ to consider it complete. Applicants must provide enough information in sufficient detail for DEQ to make a completeness determination. The type and amount of information provided in a VCP is facility-specific. DEQ recognizes that certain types of information may not be relevant or essential to a particular facility. However, where VCRA specifies legal requirements of a VCP, those requirements must be met for the VCP to be complete. If certain information is not applicable to the facility, the applicant may provide an explanation as to why specifically required information is not applicable.

Helpful Information

In the past, DEQ has determined many VCPs incomplete because of a lack of detail in the plan. DEQ encourages the applicant to consult with DEQ when questions arise about the type and level of detail required before submitting the VCP to DEQ for review. DEQ maintains examples of approved VCPs in its records, which are available upon request. Additional information can be found at DEQ's VCRA website http://deq.mt.gov/StateSuperfund/vcra.asp, including links to Frequently Asked Questions (FAQs), regulations, and an online searchable mapper/database service. If some information is unobtainable, the applicant must clearly document all attempts to obtain the required information. If DEQ determines a VCP component incomplete, it is in the best interest of the applicant to revise the document as quickly as possible in order to help ensure conditions have not changed at the facility.

- **Checklist** – A checklist is attached to assist the applicant in providing the level of detail required to determine a VCP complete. The checklist is provided in Appendix A.

- **Frequently Asked Questions** – Prior to starting the Environmental Assessment, DEQ recommends that the qualified environmental professional become familiar with DEQ's FAQs found at the following webpage: http://deq.mt.gov/StateSuperfund/FrequentlyAskedQuestions.mcpx. Topics addressed range from soil sampling requirements to examples of restrictive covenants.

Submittals

DEQ requires that the applicant submit three hard copies and a compiled PDF version of each VCP component.

All Appropriate Inquiry for Brownfields

On November 1, 2005 the U.S. Environmental Protection Agency (EPA) finalized the regulations implementing Subtitle B of Title II of the Brownfields Amendments to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 101(35), which clarifies the requirements necessary to establish protection from CERCLA liability for innocent landowners, bona fide prospective purchasers, and contiguous property owners. Among other requirements, persons claiming the liability protections must perform an All Appropriate Inquiry (AAI) on or before the date on which the person acquired the property. The Brownfields amendments also require that parties receiving a federal Brownfields grant awarded under CERCLA section 104(k)(2)(B) must also perform site characterizations that fulfill the requirements for AAI. Please note that while performing an AAI may provide protection from CERCLA liability, it does not provide protection from liability under CECRA.

Additional information regarding Brownfields' AAI requirements can be found on EPA's All Appropriate Inquiry webpage at the following link: http://www.epa.gov/brownfields/aai/. For a complete explanation of all AAI requirements please reference 40 CFR Part 312.

VCRA Registry

DEQ maintains a registry of VCRA facilities. This registry includes facilities for which a VCP has been submitted. In addition, the registry includes facilities for which DEQ has received a written indication of an applicant's intent to conduct a voluntary cleanup under VCRA. The registry is available upon request and on DEQ's website at http://deq.mt.gov/stateSuperfund/PDFs/Registry.pdf.

1.0 INTRODUCTION TO VOLUNTARY CLEANUP

1.1 VCP Submittal

Section 75-10-733(1), MCA, allows any person to submit an application for the approval of a VCP to DEQ under the provisions of VCRA for any eligible facility with a release or threatened release of a hazardous or deleterious substance, regardless of whether or not the facility is on the CECRA Priority List. The statutory exceptions are discussed in Section 1.4.

1.2 Liability Protection

As stated in § 75-10-736(13), MCA, if a person who would otherwise not be a liable person under § 75-10-715(1), MCA, elects to undertake a voluntary cleanup under VCRA, the person may not become a liable person under § 75-10-715(1), MCA, by undertaking a voluntary cleanup if the person materially complies with the VCP approved by DEQ pursuant to VCRA. However, § 75-10-736(14), MCA, indicates that immunity from liability under this section does not apply to a release that is caused by conduct that is negligent or grossly negligent or that constitutes intentional misconduct. In addition, if a person is liable under § 75-10-715(1), MCA, conducting a voluntary cleanup under VCRA does not change that liability.

1.3 Eligibility

Section 75-10-732(1)**,** MCA, provides that a facility where there has been a release or threatened release of a hazardous or deleterious substance that may present an imminent and substantial endangerment to the public health, welfare, and safety and of the environment may be eligible for voluntary cleanup procedures under VCRA. A potential imminent and substantial endangerment to public health, welfare, and safety and of the environment generally means contaminant concentrations in the environment exist or have the potential to exist above risk-based screening levels (See ARM 17.55.102). DEQ-approved generic screening levels are discussed in Section 2.9.2 of this guide.

Under § 75-10-732(1), MCA, the following facilities are **not** eligible to be addressed under VCRA:

- **a)** A facility that is listed or proposed for listing on the national priorities list pursuant to 42 U.S.C. 9601, et seq.;
- **b)** A facility for which an order has been issued or consent decree has been entered into pursuant to CECRA;
- **c)** A facility that is the subject of an agency order or an action filed in district court by any state agency that addresses the release or threatened release of a hazardous or deleterious substance;
- **d)** A facility where the release or threatened release of a hazardous or deleterious substance is regulated by the Montana Hazardous Waste Act and regulations under that act; or
- **e)** A facility that is the subject of pending action under this part because the facility has been issued a notice commencing a specified period of negotiations on an administrative order on consent.

1.4 Eligibility Exceptions

Two exceptions to the general eligibility requirements discussed in Section 1.3 are included in § 75-10-732, MCA.

First, DEQ has discretion as to whether to accept and approve an application for a VCP for a facility that falls within criteria (b) through (e). Second, DEQ may determine that a facility qualifying under the eligibility criteria for voluntary cleanup would be better addressed under an administrative order or consent decree due to complexities regarding protection of public health, welfare, and safety and of the environment. Examples of facilities that may be too complex for voluntary cleanup include those with extensive groundwater or free product contamination. However, DEQ would make this determination after reviewing the relevant, specific facts for a particular facility.

If a potential applicant disagrees with DEQ's decision to reject the filing of a VCP application because DEQ deems the facility ineligible for voluntary cleanup, the applicant may appeal to the Board of Environmental Review within 30 days of receipt of DEQ's decision.

1.5 Time Limitations

Only facilities that can be remediated within 60 months, excluding operation and maintenance (O&M), can be addressed through VCRA (§ 75-10-736(6), MCA). This typically excludes facilities with extensive groundwater contamination.

1.6 Phased VCPs

Section 75-10-733(4), MCA, indicates that DEQ may approve a VCP that provides for phases of remediation or that addresses only a portion of the facility. The Remediation Proposal of the VCP should clearly state whether the VCP addresses the entire facility or only a portion of the facility. Phased VCPs can either address specific areas (such as a particular parcel of property) or media (such as soil). If only a portion of the facility is being addressed by the VCP, a statement should be included stating how the remainder of the facility will be addressed. In addition, this section should reference any previous VCPs upon which the current VCP relies. To the extent that the original Environmental Assessment required under § 75-10-734, MCA, addresses subsequent phases of remediation, the applicant may rely on that assessment when submitting VCPs for subsequent phases of remediation.

1.7 "No Further Action" VCPs

Generally, a VCP is submitted and DEQ approval of the cleanup plan is obtained prior to the cleanup being conducted. On occasion, a VCP applicant conducts cleanup without the benefit of an approved VCP and then seeks a determination from DEQ that "no further action" is needed at the facility.

There are at least two situations where DEQ approval of a "no further action" VCP is necessary to obtain a closure letter (and delisting from the CECRA Priority List, if applicable) from DEQ:

- a facility where cleanup has occurred outside of a legal order, consent decree or without formal DEQ oversight; and
- a facility that relies on a facility-specific risk analysis (as opposed to comparison to generic screening levels discussed in Section 2.9.2) to determine that cleanup is not necessary.

A "no further action" VCP must meet all the requirements of VCRA just as a VCP requiring action; however, some requirements may not be as extensive (e.g., alternatives analysis). In particular, the public participation requirements of VCRA apply (i.e. a public comment period is still required).

1.8 Reimbursement of DEQ's Remedial Action Costs

Section 75-10-733(3), MCA, states that the applicant shall reimburse DEQ for any remedial action costs the State incurs in the review and oversight of a VCP. This section of the VCP should include a statement that the applicant agrees to reimburse DEQ for these remedial action costs. It is not possible to identify with specificity the amount of DEQ's oversight costs. DEQ costs have ranged from $2,000 to $100,000 depending upon the number of VCP submittals required and the complexity of the facility and cleanup. "No further action" VCPs generally have lower oversight costs than VCPs requiring cleanup. As provided for in § 75-10-738(2)(c), MCA, DEQ cannot issue a closure letter on a VCP until all billed costs associated with the VCP have been paid.

If the VCP applicant does not pay the State's remedial action costs when payment is due, as provided for in § 75-10-722, MCA, the applicant is also responsible for statutory interest on the overdue amount. In addition, DEQ may (1) discontinue the review or approval process of the VCP; (2) void its approval of the VCP; and (3) take action to recover the outstanding remedial action costs (Section 75-10-733, MCA).

1.9 Voluntary Action to Preclude Remedial Action by DEQ

Section 75-10-737, MCA, provides that if a VCP applicant has elected to undertake an approved voluntary cleanup and is diligently proceeding to implement the VCP, DEQ may not, except as provided in § 75-10-712, MCA, take remedial action under § 75-10-711, MCA, with regard to those releases or threatened releases of hazardous or deleterious substances that are addressed by the approved VCP.

1.10 VCP Preparation

Section 75-10-734(1), MCA, states that DEQ may only accept VCPs that are prepared by a qualified environmental professional. A qualified environmental professional is a person with education, training, and experience in preparing environmental studies and assessments. This section of the VCP should include information about who is preparing the VCP and reference an appendix that includes a statement of qualifications or resume for the environmental professional. Typically, applicants hire an environmental consultant to prepare the VCP and may have the same consultant conduct the cleanup. Some applicants may have staff environmental professionals who are qualified to prepare a VCP while others may have staff available to operate the equipment required to conduct the cleanup.

1.11 DEQ Review

Section 75-10-736, MCA, outlines the VCP review process and time limits. Section 75-10-736, MCA, requires DEQ to review each component of the VCP for completeness, including adequacy and accuracy, and provide a written completeness notice to the applicant within 30 days after receipt of a VCP component. The completeness notice must note all deficiencies identified in the information submitted. To date, no VCP has been determined complete upon initial submittal. DEQ suggests that applicants plan for at least two submittals to DEQ. Section 75-10-736(5), MCA, states that consistent with the provisions of § 75-10-707, MCA, DEQ may access the facility during review of the application and implementation of the VCP to confirm information provided by the applicant and verify that the cleanup is being conducted consistent with the approved VCP.

1.12 Public Comment

Section 75-10-735, MCA, outlines the public participation requirements of VCRA. As stated in §§ 75-10-735 (1) and (2), MCA, upon determination by DEQ that both components of a VCP are complete, DEQ must publish notice and a brief summary of the VCP in a daily newspaper of general circulation in the area affected and make the VCP available to the public. There will only be one public notice that covers both components of a VCP. The notice must provide 30 days for submission of written comments to DEQ regarding the plan. Upon written request by 10 or more persons, by a group composed of 10 or more members, or by a local governing body of a city, town, or county within the comment period, DEQ shall conduct a public meeting at or near the facility regarding the proposed VCP. The meeting must be held within 45 days of DEQ's completeness determination. Section 75-10-735 (3), MCA, requires DEQ to consider and respond to relevant written or verbal comments submitted during the comment period or at the public meeting. Although not required by VCRA, DEQ may also request that local city/county health departments review VCPs to identify any concerns of the local community.

1.13 VCP Approval

Following the one public comment period covering both components of a VCP, DEQ may require changes to the VCP based on the comments received. As stated in § 75-10-736(6), MCA, DEQ has 60 days to provide formal written notification that the VCP has been approved or disapproved. As stated in § 75-10-736(6), MCA, DEQ shall approve a VCP if it meets the requirements specified in § 75-10-734, MCA, and will attain a degree of cleanup and control of hazardous or deleterious substances that complies with the requirements of § 75-10-721, MCA. Except for the period necessary for the O&M of the approved remediation proposal, DEQ may not approve a VCP that would take longer than 60 months after DEQ approval to complete. Once DEQ approves of the VCP, § 75-10-735, MCA, requires DEQ to publish notice of its decision to approve the VCP and the reasons for any significant modification of the final VCP in a daily newspaper of general circulation in the area affected and make the final VCP available to the public. Section 75-10-736(7), MCA, provides that if DEQ does not approve a VCP, DEQ shall promptly provide the applicant with a written statement of the reasons for denial. The denial may be appealed to the Board of Environmental Review in accordance with the provisions of § 75-10-732(4), MCA, or the VCP may be revised to address the reasons for its denial and resubmitted.

1.14 VCP Modification

Section 75-10-736(9), MCA, provides for amendment of approved VCPs. This section states that if during implementation of a VCP, conditions that were not identified in the Environmental Assessment are discovered, affect the risk to public health, welfare, and safety and of the environment, and change the scope of the approved plan, the applicant shall notify DEQ within ten days of discovery. DEQ may require the applicant to submit an amendment to the approved VCP to address the unforeseen conditions or may determine that a VCP is no longer appropriate.

Section 75-10-736(10) outlines certain conditions that may result in DEQ voiding its approval of the VCP. Failure of the applicant or the applicant's agents to materially comply with the VCP approved by DEQ renders the approval void. Submission of materially misleading information by the applicant or the applicant's agents in the application or during implementation of the VCP also renders DEQ's approval void. Finally, failure to report to DEQ within ten days any new information regarding releases or threatened releases of hazardous or deleterious substances discovered during the application

process or implementation of the VCP renders the approval of the VCP void. Examples of conditions that must be reported to DEQ and that may require a VCP amendment include but are not limited to; the discovery of additional contaminated media; the discovery of additional contaminated areas; the discovery of a much greater volume of contaminated material than anticipated; a change in the remedy or disposal facility; or a change in the anticipated future use of the facility.

1.15 VCP Closure

As indicated in § 75-10-736(11), MCA, within 60 days after completion of the entire approved VCP, the applicant shall provide to DEQ a certification from a qualified environmental professional that the VCP has been fully implemented, including initiation of any required O&M and all documentation necessary to demonstrate the successful implementation of the plan, such as confirmation sampling or filed restrictive covenants, if necessary. This documentation should be provided in the form of a construction completion report including construction diagrams, disposal manifests, sampling results, and any other documentation necessary for DEQ to determine whether the VCP has been fully implemented. Construction completion reports may only be submitted after all remedial actions are complete (including established revegetation). DEQ will not accept/review construction completion reports for partially completed VCPs.

Sections 75-10-738(1) and (2), MCA, indicate that after completion of the VCP, an applicant may petition DEQ for closure of the facility. Within 60 days of receipt of a petition for closure, weather permitting, DEQ shall conduct a review to determine that the releases or threatened releases addressed in the VCP do not pose a significant threat to public health, welfare, and safety and of the environment as determined in accordance with § 75-10-721, MCA, and that the applicant has:

1. Implemented all appropriate remedial actions;
2. If necessary, provided for long-term funding for facility maintenance or monitoring; and
3. Reimbursed DEQ for all remedial action costs of the voluntary cleanup.

Section 75-10-738(4), MCA, indicates that after completion of cleanup for a portion of a facility addressed in the VCP, DEQ shall issue a letter of completion notice to the applicant if DEQ determines that the applicant has satisfied the requirements of § 75-10-738(2), MCA. If remediation of the entire facility is addressed in the VCP and it is on the CECRA Priority List, the petition for closure may also include a petition for delisting of the facility. If appropriate, DEQ will initiate the delisting process described in ARM 17.55.114 upon issuing a closure letter for the facility.

"No further action" VCPs should include language requesting closure of the facility or portion of the facility addressed in the VCP following approval of the VCP. The following is suggested language for inclusion in the VCP:

> "As the VCP indicates that no further action is required for the [Facility Name or Portion of the Facility Name] to assure present and long-term protection of public health, welfare, and safety and of the environment, [Applicant] hereby petitions for closure and delisting of the facility. All remedial action costs billed by DEQ to date have been paid, and [Applicant] will pay any outstanding bills sent by DEQ."

As indicated in § 75-10-738(3), MCA, in the event that the petition for closure is not approved, DEQ shall promptly provide the applicant with a written statement of the reasons for denial.

This section of VCRA also states that DEQ's written notification of approval must contain the following language:

> "Based upon the information provided by [insert name(s) of applicant(s)] concerning property located at [insert address], it is the opinion of the Montana Department of Environmental Quality that upon completion of the voluntary cleanup plan, no further action is required to ensure that this facility, when used for [insert purposes identified], is protective of existing and proposed uses and does not pose a significant risk to public health, welfare, and safety and of the environment at the facility with regard to releases or threatened releases addressed in the voluntary cleanup plan. The department reserves the right to conduct or require further remedial action at this facility if a new release occurs or if the department receives new or different information than presented in the approved voluntary cleanup plan."

1.16 Financial Assurance

Section 75-10-738, MCA, states that DEQ may require long-term funding for facility maintenance or monitoring from the VCP applicant if necessary. If DEQ determines such financial assurance is necessary, DEQ will work with the VCP applicant to obtain financial assurance by any one method or combination of methods satisfactory to DEQ, including but not limited to insurance, guarantee, performance or other surety bond, letter of credit, qualification as a self-insurer, or other demonstration of financial capability as described in Section 75-10-721(7), MCA.

2.0 ENVIRONMENTAL ASSESSMENT

Section 75-10-734(2), MCA, identifies the information required for the Environmental Assessment component of the VCP. This section of the VCP should include the requirements provided in § 75-10-734(2), MCA, and described in sections 2.1 through 2.10 of this guide.

> DEQ has deemed many Environmental Assessments incomplete because the VCP applicant addressed only areas of known contamination and did not consider other information about the operational history or actions that may have impacted the facility. A broad investigation into the entire operational history is essential to ensuring the Environmental Assessment is complete. Once all potential sources of contamination at the facility have been identified, the proper sampling must be performed to ensure that the Environmental Assessment accurately depicts the nature and extent of hazardous or deleterious substances present at the Facility.

2.1 Introduction

The first section in the Environmental Assessment component of the VCP should include the facility name, general location, and the name and address of the VCP applicant. It should also include a statement as to whether the facility is on the CECRA Priority List, a general description of the type and source of contamination, and a description of eligibility as described in Section 1.3. In addition, the Introduction should state that, as required by § 75-10-733(3), MCA, the applicant agrees to reimburse DEQ for the State's remedial action costs.

2.2 Legal Description and Facility Map

Section 75-10-734(2)(a), MCA, requires that the VCP include the legal description of the facility and a map of the facility identifying the location and size of the facility and relevant features of the facility, such as property boundaries, surface topography, surface and subsurface structures, and utility lines. This section of the VCP should include comprehensive maps drawn to scale that show relevant features of the facility. The following location information should be provided:

- County,
- Distance to the nearest city or town,
- Street address if the facility is in town,
- Township, range, section, and ¼, ¼, ¼ of the section, and
- Latitude and longitude in decimal degrees World Geodetic System 1984 (WGS 84).

In addition to the legal descriptions of all property within the facility, the VCP should contain copies of these property deeds as an appendix.

2.2.1 Written Consent of Current Owners

Section 75-10-733(2)(c), MCA, requires that both the Environmental Assessment and the Remediation Proposal components include written consent of current owners of the facility or property for both the

Environmental Assessment and the Remediation Proposal of the VCP as well as access to the facility by the applicant and its agents and DEQ. This includes consent for implementation of the VCP and, if the VCP provides for institutional controls (ICs) that require filing on the property records, agreement to implement and comply with those ICs. When identifying property boundaries and owners, it is necessary to obtain this written consent from all property owners.

If a corporation owns property, a designated representative can sign. If it is owned individually, all owners must sign unless the owners have signed a legal document (i.e., power of attorney) giving one person the right to consent on behalf of the other property owners. The consent form should identify the specific VCP (i.e., title and date) for which consent is granted. An example of a consent form for both the Environmental Assessment and the Remediation Proposal is provided as Attachment B of this guide.

2.3 Physical Characteristics

Section 75-10-734(2)(b), MCA, requires that the VCP include the physical characteristics of the facility and areas contiguous to the facility, including the location of any surface water bodies and groundwater aquifers. This section of the VCP should also include a map drawn to scale showing areas contiguous to the facility with an accompanying narrative providing additional description. The following are examples of physical characteristics that could be discussed in this section of VCP and drawn on a map, as appropriate:

- Topography;
- Stratigraphy;
- Structural geology;
- Regional groundwater flow patterns;
- Groundwater aquifers;
- Hydraulic conductivity;
- Floodplain designation;
- Climatological data, including wind speed and direction;
- All surface water bodies and wastewater discharge points;
- Groundwater monitoring and supply wells;
- Surface water intakes;
- Aquatic and terrestrial habitats;
- Sensitive environments (e.g., wetlands);
- Physical features such as buildings or roads;
- Facility process units and loading docks;
- Chemical and/or fuel transfer, and pumping stations;
- Current and historic railroad tracks and railcar loading areas;
- Surface and storm water run-off retention ponds and discharge points;
- Building drainage or wastewater discharge points;
- Spill collection sumps and/or drainage collection areas;
- Wastewater treatment units;
- All underground and above ground storage tanks;
- Underground and above ground piping;
- Water cooling systems and/or refrigeration units;
- Sewer lines;
- Underground utility lines and buried cables;
- French-drain systems;
- Water recovery sumps and building foundations;
- Surface impoundments;
- Waste storage and/or disposal areas/pits, landfills etc.;
- Chemical and/or product storage areas;
- Septic leach fields (drain fields);
- Irrigation ditches and/or irrigation systems;
- Dry wells and/or waste disposal sumps; and
- A list of all the other impacted facilities (CECRA, federal Superfund, leaking underground tank, contaminated

groundwater, hazardous waste, etc.) within one-quarter mile of the facility. DEQ's digital atlas/online query service can be a valuable tool for locating neighboring facilities: http://deq.mt.gov/rem/interactivemaps.asp

2.4 Area Wells

Section 75-10-734(2)(c), MCA, requires that the VCP include the location of any wells located on the facility or on areas within a one-half mile radius of the facility and a description of the use of those wells. Because CECRA defines "facility" as wherever contamination has come to be located, the applicant should identify wells within a one-half mile radius of any contamination regardless of property boundaries. Well information is required regardless of whether groundwater at the facility is impacted. This section of the VCP should include the following information unless it is unavailable, in which case an explanation should be provided in the VCP:

- A list of all wells within the one-half mile radius of the facility, including monitoring wells, from the Montana Bureau of Mines and Geology Groundwater Information Center (406-496-4336; http://mbmggwic.mtech.edu), the Montana Department of Natural Resources and Conservation, and any other sources that identify the use, depth, geologic formation/aquifer and yield of those wells;
- To the extent practicable, a map drawn to scale with geographic references that shows the locations of these wells;
- Documentation of any efforts to verify the presence or absence of unregistered wells supplying groundwater for domestic use in older residential neighborhoods or in rural areas (i.e., door-to-door inspection). Note: This information is critical when there is a likelihood that groundwater contamination has or may affect drinking water wells that are not listed in readily available databases; and
- To the extent practicable the following should also be provided: owner, address, map location, driller, date drilled, static water level, well logs, and well construction designs or diagrams (and lithologic logs, if available) showing screened interval, casing type and construction details (available from the Montana Department of Natural Resources and Conservation) including: gravel pack interval, bentonite seal thickness and cemented interval. This information is particularly important for wells within the current or historical operational areas of the facility.

2.5 Groundwater and Surface Water Usage

Section 75-10-734(2)(d), MCA, requires that the VCP include the current and reasonably anticipated future use of groundwater and surface water at the facility. This section of the VCP should include sufficient detail about both current and anticipated future groundwater and surface water usage to evaluate human health and environmental exposure. The determination of future groundwater and surface water usage should be based on the following:

- Suitability of water for beneficial uses;
- Historical land and water uses;
- Anticipated future land and water uses;
- Community and nearby property owners' concerns regarding future water use;
- Regional and local development patterns;
- Regional and local population projections;

- Availability of alternate water sources including, but not limited to, public water supplies, groundwater sources, and surface water sources;
- Specific conductivity and class of the groundwater (discussed below); and
- Classification of any steams or rivers on or near the facility (discussed below).

This section should also include the specific conductivity of the groundwater and indicate the class of the groundwater as defined in ARM 17.30.1006. A general description of the suitable use of the class of groundwater should also be provided. The lowest specific conductivity for the groundwater at the facility corresponding to the highest quality is appropriate for classification of the groundwater. This may require determination of the specific conductivity of the groundwater upgradient from any contaminant sources.

Example

The following specific conductivities are available for monitoring wells at the facility:

800 µSiemens/cm	1050 µSiemens/cm
950 µSiemens/cm	1100 µSiemens/cm

The groundwater is Class I because the lowest specific conductivity is less than or equal to 1000 µSiemens/cm (ARM 17.30.1006(1)(a)).

In addition, this section should include the classification of any streams or rivers located on or near the facility and a general description of suitable use of the class of stream. ARM 17.30.606 through 17.30.629 provides information about stream classification. The Montana 303(d) list of impaired and threatened water bodies in need of water quality restoration should also be consulted to determine if any surface water bodies located on or near the facility are included. If any water bodies located on or near the facility are determined to be on the list, the VCP should include a description of any contribution the current condition of the facility or the proposed remediation of the facility will have on the total maximum daily load for the water body.

2.6 Operational History of the Entire Facility

Section 75-10-734(2)(e), MCA, requires that the VCP include the operational history of the facility, including ownership, and the current use of the facility, including any readily available aerial photographs from within the state of Montana.

Examples of the information appropriate for this section include:

- Records, dates, and descriptions of past and current operations, activities, conditions or incidents at the facility or nearby facilities that may have resulted in a release or threatened release of a hazardous or deleterious substance;
- Historic ownership records, including copies of deeds and any easements;
- Readily available aerial photographs;

- Building department records;
- A description of all activities or businesses that occupied the facility as far back as typical historical records and knowledge allows, including years of operation;
- A description of any historical records including county clerk and recorder and tax assessor records, Polk directories, and Sanborn fire insurance maps (copies of easily obtainable, relevant documents should be included in an appendix to the VCP);
- Diagrams of all facility operations (e.g., railroad facility maps, permitted activity diagrams);
- The dates that the activities occurred and the dates during which the hazardous or deleterious substances may have been released into the environment;
- The approximate volumes of the materials released;
- A description of past and present waste disposal practices and areas;
- A list of any known hazardous or deleterious substances used at the facility, with volume estimates and a list of all wastes generated at the facility, including manifests for disposal;
- References and information about the sources of the operational history, including a brief description of the efforts made to research various informational sources;
- Information about the current use of the facility;
- Current hazardous or deleterious substance usage;
- Current waste disposal practices;
- Registries or publicly available lists of engineering controls; and
- Registries or publicly available lists of institutional controls, including any use restrictions and current zoning information along with copies of zoning regulations as an appendix.

2.7 Current and Future Facility Usage

Section 75-10-734(2)(f), MCA, requires that the VCP include the current and reasonably anticipated future uses of the facility and immediately adjacent properties.

"Reasonably anticipated future uses" is defined in § 75-10-701(18), MCA, as likely future land or resource uses that take into consideration: (a) local land and resource use regulations, ordinances, restrictions, or covenants; (b) historical and anticipated uses of the facility; (c) patterns of development in the immediate area; and (d) relevant indications of anticipated land use from the owner of the facility and local planning officials. This section of the VCP should include the current use of the facility and immediately adjacent properties along with information about the anticipated future use of the facility and immediately adjacent properties and provide the source of information used to determine future use. Information that may be used to determine current and future use includes local zoning regulations, comprehensive plans, redevelopment plans, and consultation with local planners and property owners. The VCP must include enough information on current and future uses of the facility and immediately adjacent properties to determine whether the remediation proposal will be protective of those uses. In addition to identifying general uses (e.g. industrial, residential, commercial, recreational, etc.), this section should identify any relevant zoning, zoning restrictions, easements, restrictive covenants, equitable servitudes, and any other restrictions on the use of the facility and adjacent property.

2.8 Regulatory and Compliance History

Section 75-10-734(2)(j), MCA, requires that the VCP include readily available information on the environmental regulatory and compliance history of the facility, including all environmental permits. This section of the VCP should include the following and any other relevant regulatory history:

- A list of all local, state, and federal environmental permits obtained for the facility, including, for example:
  - Montana Pollutant Discharge Elimination System
  - Montana Ground Water Pollution Control System
  - underground storage tank removal
  - storage or disposal
  - asbestos abatement
  - pesticide applicator
  - storm water discharge
  - solid waste disposal
  - hazardous waste treatment
  - air quality
  - mining

- Information on permit violations, notices to take corrective action, or similar issues for each of these permits;

- A list of all facility-specific notifications made as a result of any management activities of hazardous substances conducted at the facility, including any and all EPA identification numbers obtained for management of hazardous substances at the facility from either the state or the EPA and any conditionally exempt small quantity generator determinations;

- A list of all notifications made to state and/or federal agencies reporting spills and/or accidental releases and any actions taken to address those spills/releases, including confirmation sample results;

- A description of any actions taken under any regulatory authority (including but not limited to CECRA, CERCLA, RCRA, WQA, CWA,) at the facility (e.g., notice letters, proper and expeditious letters, or orders);

- A description of any private or agency litigation associated with the facility; and

- A description of any Controlled Allocation of Liability Act actions related to the facility.

Please note that all non-reported spills should be referenced in Section 2.6.

2.9 Facility Characterization

Section 75-10-734(2)(g), MCA, requires that the VCP include information on the methods and results of investigations concerning the nature and extent of any releases or threatened releases of hazardous or deleterious substances that have occurred at the facility. It also requires a map showing general areas and concentrations of hazardous or deleterious substances. Investigations should characterize the entire facility including surface soils, subsurface soils, sediment, air, vapor intrusion, groundwater, and surface water, as applicable. The facility characterization will delineate the areas and the extent of contamination at the facility.

Section 75-10-734(2)(h), MCA, requires that the VCP include any sampling results or other data that characterizes the soil, air, sediment, groundwater, or surface water on the facility. Sample results

should be summarized in the text of the VCP and provided in summary tables. Lab and data validation reports should also be summarized in the text of the VCP and included as an appendix. An example of the extent of data validation required can be found by referencing DEQ's Data Validation Guidelines for Evaluating Analytical Data (http://deq.mt.gov/StateSuperfund/PDFs/DataValidationReport.pdf). Data previously submitted to DEQ and validated may be summarized and referenced in the VCP.

2.9.1 Characterization Information

Examples of the information appropriate for this section include:

- Identification of the nature and extent of hazardous or deleterious substances that have been released into surface soil, subsurface soil, soil gas, air, sediment, groundwater and surface water throughout the facility (which includes wherever the contamination has come to be located regardless of property boundaries);

- Include a table or list of contaminants indicating which media are contaminated and the estimated vertical and areal extent of contamination in each medium;

- A data summary discussion and table of the contamination present at the facility separated out by impacted media, including all of the samples collected in that media and the extent of contamination present in each media. The data tables should also include comparison to generic screening levels;

- A map indicating all potential source areas, areas and concentrations of hazardous or deleterious substances, previous, hazardous or deleterious substance treatment, and storage or discharge areas;

- A site conceptual model of sources showing potential migration pathways;

- A description of the chemical nature, mobility and toxicity of the hazardous or deleterious substances, estimated volumes and concentrations of substances discharged at each area, discharge point, drain, or leakage point (if information is not available, clarify steps taken to try and determine if the information was available);

- A map drawn to scale showing groundwater elevation across the facility and the inferred direction and estimated rate of groundwater movement across the facility using a minimum of three measuring points and depicting high and low water seasonal variations;

- A discussion of all hydraulic tests performed at the facility or nearby to characterize the hydrogeologic properties of any facility aquifers and in the area including vertical gradients if appropriate;

- A discussion of how all environmental samples/data were collected, including
  - the rationale involved in sampling locations, parameters, and methodology;
  - a description of sampling locations (including test pit and borehole logs);
  - facility well construction details (showing screened interval, casing type, gravel pack interval, bentonite seal thickness and cemented interval) and lithologic logs;
  - quality assurance/quality control measures associated with the sampling and analysis as well as data validation of sample results including a brief discussion of the quality of the data;

- sampling frequency and locations; and
- the rationale involved in choosing the analytical methods. These methods should be appropriate and sufficient to fully characterize the nature and extent of contamination. The applicant should use EPA-approved or DEQ-approved analytical methods with appropriate method detection limits. Detection limits must be low enough to allow comparison to appropriate screening levels or cleanup levels. The applicant should consult DEQ about the suitability of other analytical methods before using them; and

- A discussion of any remedial actions already performed at the facility (especially important for "no further action" VCPs), including:
  - a description and figure showing the location of contaminants of concern (COCs);
  - a description and figure showing the area of the remedial action and confirmation samples;
  - the method employed to carry out the remedial action;
  - assessment of methodology, analytical methods, and frequency of confirmation samples;
  - a description of the ultimate disposition of all contaminated media; and
  - comparison of confirmation samples to the screening/cleanup levels that were used to verify the effectiveness of the remedial action.

DEQ reserves the right to require additional confirmation sampling and /or investigations.

2.9.2 Screening Contaminants of Concern

Hazardous or deleterious substances at a facility may present an imminent and substantial endangerment to public health, welfare, and safety and of the environment if contaminant concentrations exceed certain screening levels. COCs are those contaminants whose concentrations exceed these screening levels and therefore require additional evaluation. Contaminants whose concentrations fall below these screening levels will not typically trigger CECRA action.

The various screening levels listed below are separated out by media (please note that these screening levels are updated periodically; therefore, the applicant must ensure that the most current version of these screening levels are used; see DEQ's website).

2.9.2.1 Groundwater/Drinking water/Surface water

Screen surface water and groundwater concentrations against the standards provided in the Montana Numeric Water Quality Standards Circular DEQ-7 (DEQ-7).

Screen drinking water against the Maximum Contaminant Levels (MCLs), published at 40 CFR 141.

Screen petroleum compounds that do not have DEQ-7 standards or MCLs against the groundwater risk-based screening levels (RBSLs) from the Montana Tier 1 Risk-Based Corrective Action Guidance for Petroleum Releases (RBCA) document.

Screen those compounds or chemicals with no DEQ-7 standard, MCL, or RBSL screening level against the tap water regional screening levels contained in the EPA Regional Screening Levels for Chemical Contaminants at Superfund Sites (RSLs).

2.9.2.2 Soils and Sediments

Screen dry-weight sediment concentrations against EPA Region 3 BTAG Freshwater Sediment Screening Benchmarks.

Screen dry-weight soil concentrations using DEQ's Soil Screening Process flowchart found in Attachment C. DEQ's Soil Screening Process flowchart examines both direct contact and leaching to groundwater risks and contains the following screening levels:

- DEQ's Remediation Division, Action Level for Arsenic in Surface Soil.
- Soil RBSLs for petroleum compounds provided in the RBCA Guidance.
- All other soils are screened using EPA RSLs, adjusted as follows:

  (i) Non-carcinogenic contaminant screening levels found in the RSL table are based upon a hazard index of 1. When screening contaminant concentrations to the RSLs, with the exception of lead, adjust all non-carcinogenic levels by dividing by ten. This ensures that when multiple contaminants are found at a facility that may have the same health effects, cumulative potential health effects are considered.

  (ii) Exposure to lead in soils is evaluated in a unique way by calculating potential blood lead levels resulting from exposure to lead in soil, in addition to other unavoidable lead exposure pathways like water and food. Therefore, DEQ does not include exposure to lead with the other cumulative non-carcinogenic effects. DEQ currently uses the EPA RSLs of 400 mg/kg for lead in residential soils and 800 mg/kg for lead in industrial soils; check DEQ's website to ensure that the most current version of these screening levels is used.

  (iii) The protection of groundwater soil screening levels (SSLs) found in the RSL table are based upon MCLs and a dilution attenuation factor of one (1). For compounds whose MCL and the DEQ-7 groundwater standard is the same, the SSL can be multiplied by a dilution attenuation factor of 10, the state-specific attenuation factor. If the DEQ-7 groundwater standard is more conservative than the MCL, recalculate the SSL so that it is based upon DEQ-7 groundwater standard and then multiply by the dilution attenuation factor of 10 (See Attachment C for an example equation).

2.9.2.3 Indoor Air/Soil Vapor

Indoor air and soil vapor concentrations are compared to the RSLs. Similar to soils, non-carcinogenic indoor air and soil vapor contaminant screening levels found in the RSL table are based upon a hazard index of 1. When screening contaminant concentrations to the RSLs, adjust all non-carcinogenic levels by dividing by ten.

DEQ has developed generic screening levels for the petroleum fractions detected using the Massachusetts Air-Phase Petroleum Hydrocarbons (APH) method not found in the RSL table. DEQ calculated these screening levels using the same assumptions as those EPA used to calculate the RSLs. As these petroleum fractions are non-carcinogens, DEQ adjusted the target hazard index by dividing by ten to ensure that cumulative potential health effects are considered (please see Section 2.9.1.2). The adjusted APH generic screening levels can be found at the following link:

http://deq.mt.gov/StateSuperfund/FrequentlyAskedQuestions.mcpx#4.

2.10 Human and Environmental Exposure

Section 75-10-734(2)(i), MCA, requires that the VCP include a description of the human and environmental exposure to releases or threatened releases of hazardous or deleterious substances at the facility based upon the current use of the facility and adjacent properties and any reasonably anticipated future uses of the facility. This section of the VCP should describe the types of people, plants, animals, and components of the environment (e.g., the groundwater) that may potentially be exposed to contamination from the facility and how they may be exposed. DEQ also considers the reasonably anticipated future uses of adjacent properties in determining potential exposure.

The applicant should start by providing a site conceptual exposure model (SCEM) for the current and reasonably anticipated future use of the facility that indicates the facility-specific contaminant sources (e.g., underground tanks, sewer lines, etc.), release mechanisms, transport routes and media, and potential receptors. An example of a SCEM is provided as Attachment D; note that Attachment D is more extensive than what may be necessary for most VCRA facilities and may not include all exposure pathways but is meant to provide a reasonably comprehensive example. For instance, the breast milk exposure media is not evaluated at all facilities and is typically included for facilities with bioconcentrating contaminants like dioxins/furans. A visual diagram SCEM (also found in Attachment D) can also be helpful in portraying and explaining sources of contamination to the public.

The applicant should also include a standard risk assessment table for the facility's COCs. This table should follow the Occurrence, Distribution, and Selection of Chemicals of Potential Concern (ODSCOPC) table (EPA 2001) and include at a minimum the following: COC, minimum concentration, maximum concentration, location of maximum concentration, detection frequency, range of detection limits, sample concentration used for screening, generic screening level and source, facility-specific screening level (if appropriate) and source, if the chemical is a COC, and the rationale for this decision. The ODSCOPC table can be found at the following link: http://www.epa.gov/oswer/riskassessment/ragsd/pdf/exampletable2_1.pdf.

When evaluating current and future exposure, DEQ considers the top 0 – 2 feet below ground surface as surface soil available for the long-term residential, commercial/industrial, construction worker, recreational, and trespasser type exposure. DEQ considers soils from 2 – 10 feet below ground surface as short-term excavation or construction worker exposures. DEQ has developed guidance related to soil sampling that can be found at the following link: http://deq.mt.gov/StateSuperfund/FrequentlyAskedQuestions.mcpx#2

This section of the VCP should also include a narrative discussion of the SCEM. More exposure information may be necessary if the remediation proposal involves cleanup to facility-specific cleanup levels rather than generic screening levels.

CECRA requires an analysis of both human exposure at the facility and the potential exposure of ecological receptors to any contaminated media at the facility. The amount of discussion and evaluation of ecological exposure required varies based on the type of facility. An operating commercial/industrial facility located in an urban area may only require a brief discussion indicating that the setting is not suitable habitat for long-term ecological exposure. In contrast, a more isolated facility, such as a closed mine located along a stream, may require a more extensive analysis.

Evaluation of the soil to groundwater pathway is also necessary as all soil cleanup levels must be protective of groundwater. Soils greater than 10 feet below ground surface are typically only required to meet leaching to groundwater cleanup levels. Contaminant concentrations in soil must not be significant enough to leach to groundwater and cause contamination above MCLs, DEQ-7 standards, and other appropriate risk-based concentrations for contaminants not included in DEQ-7 or MCLs. This section should include an analysis of the fate and transport scenario for this pathway at the facility and include an analysis of human exposure to groundwater that may potentially become contaminated in the future.

If volatile compounds are present at the Facility in soil or groundwater, DEQ requires an evaluation of vapor intrusion to indoor air. Please see DEQ's Vapor Intrusion Guide found at http://deq.mt.gov/StateSuperfund/viguide.mcpx for more information. Please also see section 2.9.2 for how to screen indoor air and soil vapor concentrations.

"No further action" VCPs must include a demonstration that the current condition of the facility meets all facility-specific cleanup levels and that no further remedial action is necessary to ensure protectiveness of public health, welfare, and safety and of the environment and meet applicable or relevant ERCLs.

2.11 Summary of Maps, Figures, and Photographs

Where appropriate, please include the following maps, figures, or photographs in the Environmental Assessment. These maps may be combined where appropriate:

—**Site/Facility Location Map**
- Portion of the USGS 7.5' Quadrangle depicting the site/facility location;
- Facility boundary;
- Surface water bodies; and
- Topography.

—**Aerial Photographs:** Current and all historical readily available aerial photographs.

—**Site/Facility Plan View Map(s)**
- Location and size of Facility;
- Property boundaries;
- Facility boundary;
- Surface topography;
- Surface & Subsurface structures;
- Utility lines;
- Above- or below- ground tanks;
- Surrounding, nearby, and/or impacted properties;
- Physical characteristics;
- All Facility wells within one-half mile radius (including a description of use);
- Potential source areas and concentrations of hazardous or deleterious substances; and
- Potentially impacted receptors.

- **Sample Location Map(s)**
  - Depict locations of all monitoring wells;
  - Soil borings and test pits;
  - Soil gas;
  - Groundwater survey probes;
  - Surface and subsurface samples;
  - Surface water and groundwater (including residential, commercial, and public water supply) samples; and
  - One map should include (as a base layer) the highest quality or most current color orthophoto with georeferenced Sanborn map information and/or any other site/facility historic blueprint/map information overlain with all labeled sample locations to assist in the identification of historic sources and operations (this map is typically a 24”x26” map to allow for greater site detail).
- **Potentiometric Surface Map(s)**
  - Includes depicting the potentiometric groundwater surface during high and low water table;
  - Data such as static water level elevations (expressed as feet above Mean Sea Level); and
  - Arrows depicting groundwater flow direction.
- **Geologic Cross Sections**
  - Show site stratigraphy through full depth of potentially impacted water-bearing units;
  - A minimum of three cross-sections per site (i.e. one parallel to groundwater flow direction and two perpendicular to flow direction and/or skewed to align with actual well/boring sample locations); and
  - Indicate contaminant location, monitoring wells depicting their screened intervals, and subsurface conduits/piping, etc., depicting the subsurface of the property.
- **Soil Contamination**
  - Isoconcentration map depicting soil analytical data. Include at least three labeled isoconcentrations for each contaminant (one identifying the area of sampling method detection limit exceedance, one identifying each applicable standard and/or screening level (i.e. RBSL, RSL, etc.) exceedance, and one identifying areas of increased concentrations.
- **Groundwater Contamination Isoconcentration Map(s)**
  - Isoconcentration map depicting the extent and degree of groundwater contamination; and
  - Include at least three labeled isoconcentrations for each contaminant (one identifying the required reporting value identified in DEQ-7, one identifying each applicable standard and/or screening level (i.e. MCL, DEQ-7, RBSL) exceedance, and then as many isoconcentrations as necessary to demonstrate the range of dissolved concentrations).
- **Separate Phase Product Isoconcentration Map(s)**
  - If separate phase product is encountered, a map depicting product extent and thickness should be provided. Include at least three labeled isoconcentration s for each separate phase product (one identifying the edge of measurable product thickness; then as many isoconcentrations as necessary to demonstrate the range of thickness encompassed by the plume).

- **Facility Contaminant Affected Area Map**
  - Map of all identified contaminant isoconcentration areas (for all media in both the surface and subsurface) color-coded to distinguish different contaminant areas/media. All sample locations should be labeled and included, contaminant source locations should be identified, as well as other pertinent features.

3.0 REMEDIATION PROPOSAL

Section 75-10-736(2), MCA states that once DEQ determines that the environmental assessment component of a VCP is complete, the applicant may submit the remediation proposal component. Section 75-10-734(3), MCA, includes the requirements for the remediation proposal component of the VCP. The information required in the remediation proposal is further described in sections 3.1 through 3.8 of this guide.

DEQ expects that the Remediation Proposal will be submitted in a timely manner after completion of the Environmental Assessment so as to ensure that there are no changes to the facility conditions as presented in the complete Environmental Assessment.

As in the Environmental Assessment, the Remediation Proposal must be prepared by a qualified environmental professional. The previously-provided access, via written consent of the current owners of the facility or property for the VCP, must also be in place so that access to the facility by the applicant and its agents and DEQ is still current. The written consent provided with the Environmental Assessment can be used in the Remediation Proposal provided that the consent is current and continues to allow for the implementation of the VCP as described in section 2.2.1.

3.1 Introduction

The introduction should include a statement that the Environmental Assessment was deemed complete by DEQ and reference the completeness determination date. In addition, a statement should also be included in the introduction to the Remediation Proposal component of the VCP identifying whether the VCP addresses the entire facility or a portion of the facility. Section 75-10-733(4), MCA states that DEQ may approve a VCP that provides for phases of remediation or that addresses only a portion of the facility. If only a portion of the facility is being addressed by the VCP, a statement must be included stating how the remainder of the facility will be addressed. If the VCP is to be considered as a “no further action” VCP, this should be stated in the introduction. A statement indicating the anticipated length of time needed to complete the cleanup should also be included.

3.1.1 Verification of Facility Conditions

DEQ’s determination that the Environmental Assessment is complete is based on the conditions of the facility at the time of the Environmental Assessment’s submittal. Please include a brief discussion verifying that facility conditions have not changed that may affect the Environmental Assessment. Examples of changes in conditions include but are not limited to: facility use, zoning, surface conditions, activities that may alter sampling results, adjacent property use, changes in groundwater or surface water use, new releases, or changes that affect eligibility. If any remedial actions have occurred since completion of the Environmental Assessment, include a detailed description those actions completed prior to the submittal of the Remediation Proposal.

3.1.2 Review of COCs

Provide a summary discussion of all the COCs for the various media that were discussed in the Environmental Assessment component of the VCP.

3.2 Cleanup Levels

Section 75-10-734(3)(i), MCA, requires that the Remediation Proposal portion of the VCP include the proposed cleanup levels for the facility. The proposed cleanup levels must be protective of public health, welfare, and safety and of the environment based on the current and reasonably anticipated future uses of the facility. Once the COCs for the facility have been determined, appropriate cleanup levels can be derived using the following methods or a combination of methods. Whichever methods are used, the rationale and description for selecting the proposed cleanup level must be detailed in the Remediation Proposal. Please note the phytotoxicity of metals must also be considered in determining appropriate cleanup levels.

1) **Background levels:** Attainment of DEQ-approved facility-specific background levels based on samples collected from unimpacted areas representative of conditions at the facility for compounds such as metals. DEQ has developed an action level for arsenic in surface soil (0-2' deep) of 40 ppm. Established literature values for background concentrations may also be proposed (including those found on DEQ's website http://deq.mt.gov/StateSuperfund/PDFs/BackgroundConcentrationsForInorganicInSoil.pdf). In some cases, background concentrations may exceed screening levels and may be used in place of screening levels. However, background concentrations that exceed ERCLs may necessitate that a facility remain on the CECRA Priority List regardless of the status of a VCP.

2) **Established generic screening levels:** The screening levels described in Section 2.9.2 above and found in ARM 17.55.109 at the following link: www.deq.mt.gov/dir/legal/Chapters/CH55-01.pdf may be appropriate as cleanup levels.

3) **Facility-specific adjusted screening levels:** The generic screening levels described above may be adjusted based on the number of compounds present at an individual facility. For carcinogens, the cumulative risk for all of the contaminants at the facility must not exceed the DEQ-accepted cumulative cancer risk of $1x10^{-5}$. For non-carcinogens, the cumulative potential health effects must not exceed a total hazard index equal to 1. For example, in the RSL table, RSLs for carcinogenic compounds are based on a $1x10^{-6}$ cumulative risk, while DEQ will accept a cumulative risk of 1x10-5. The RSLs for non-carcinogenic compounds can be adjusted in a similar manner to account for multiple compounds that have the same critical effect or target organ.

4) **Facility-specific risk-based cleanup levels:** The applicant can propose cleanup levels based on a facility-specific risk analysis conducted using standard EPA human health risk assessment guidance (RAGS) (EPA 2009, 2004, 2001, 1999, 1997b, 1992, 1991a-c, and 1989) and/or, as applicable, standard EPA ecological risk assessment guidance (EPA 2000a, 1998, and 1997a). For human health, DEQ allows cleanup levels calculated based on cumulative risk levels less than or equal to a total excess cancer risk of $1x10^{-5}$ for carcinogens or a total hazard index less than or equal to 1 for non-carcinogens. Ecological risks must also be evaluated and acceptable risk determinations are made on a facility-specific basis. All exposure assumptions must be acceptable to DEQ and are best determined in consultation with DEQ. Additional information can be found on DEQ's FAQ webpage.

5) **Facility-specific leaching to groundwater cleanup levels:** The applicant can propose facility-specific fate and transport modeling for the development of facility-specific cleanup levels. DEQ's Technical Guidance for Fate and Transport Modeling can be found at the following link: http://deq.mt.gov/StateSuperfund/PDFs/DeqRemFateTransportGuideSept2008.pdf.

This section does not address the development of facility-specific cleanup levels to address protectiveness of ecological receptors. If the facility at issue may pose a risk to ecological receptors, please discuss with DEQ before submitting the Remediation Proposal.

3.3 Remedial Alternatives Comparison

Section 75-10-734(3)(b), MCA, requires a brief comparison of reasonable remedial alternatives based on the remedy selection criteria specified in § 75-10-721, MCA. These seven criteria indicate that the proposed remedy must:

- assure protection of public health, welfare, and safety and of the environment;
- be consistent with applicable or relevant state and federal ERCLs (See Section 3.3.2 for a discussion of ERCLs);
- consider present and reasonably anticipated future uses, and giving due consideration to institutional controls, demonstrate acceptable mitigation of exposure to risks to the public health, welfare, and safety and of the environment;
- be effective and reliable in the short and long term;
- be technically practicable and implementable;
- use treatment technologies or resource recovery technologies if practicable giving due consideration to engineering controls; and
- be cost-effective.

This section is meant to provide a truncated feasibility study type analysis, which includes both text and a summary table. The text should provide a brief description of each alternative based on how it would or would not meet each of the seven criteria included in § 75-10-721, MCA.

Comparisons between the remedial alternatives should **not** be discussed or included in the table at this point. The table is meant to provide a concise summary of the each alternative to each of the criteria. Attachment E provides an example of a comparison of alternatives including a summary table. The following is a summary of the type of information that should be included in the table for each alternative.

Criteria	**Evaluation of Criteria Relative to Alternative**
Protectiveness	Whether the alternative is protective of public health, welfare, and safety and of the environment.
Compliance with ERCLs	Whether the alternative complies with all ERCLs.
Mitigation of exposure to risk	Whether the alternative mitigates exposure to risk to public health, welfare, and safety and of the environment; includes an analysis of the proposed cleanup levels from Section 3.2.
Effectiveness and reliability	Whether the alternative is effective and reliable in the short term. Whether the alternative is effective and reliable in the long term.
Practicability and implementability	Whether the alternative can be implemented and the ease or difficulty with which it may be implemented.
Use of treatment or resource recovery technologies	Whether the alternative employs these types of technologies; CECRA indicates a preference for treatment or recovery.
Cost-effectiveness	Compare incremental cost with incremental risk reduction.

The final remedial proposal is selected based on which alternative best meets the seven remedy selection criteria. If multiple remedial alternatives meet all seven criteria, a discussion must be included describing why the remedial proposal was proposed (e.g. while alternative A and B equally meet criteria 1 through 6, alternative A is the most cost-effective alternative).

If future use of the facility is proposed as anything other than unrestricted residential use, ICs must be included as part of the proposed remedy to ensure long-term protectiveness. One IC typically used at CECRA facilities is a restrictive covenant document; an example is included as Attachment F.

No-Further Action Proposals

"No further action" VCPs must follow the same remedial alternative comparison process as traditional "action" VCPs. However, this analysis is typically more brief than that necessary for VCPs requiring further remedial action. The "no further action" alternative must still be evaluated against all seven of the criteria. In addition, other remedial alternatives must also be individually evaluated against the same criteria. A discussion should then be included explaining why "no further action" was chosen as the remedial proposal. Typical remedial alternatives evaluated in "no further action" VCPs include capping, complete removal and off-site disposal, or an on-site repository.

Typically "no further action" VCPs are submitted for facilities with residual contaminant levels that are below acceptable cleanup levels. Therefore, all remedial alternatives may be equally protective, in compliance with ERCLs, mitigate risks, and as effective and reliable as the no action alternative. However, these alternatives are typically less practicable and implementable and cost-effective than the "no action" alternative and they may or may not use treatment, resource recovery technologies, or engineering controls. A brief discussion is required explaining how the "no action" alternative best meets the seven remedy selection criteria.

"No further action" VCPs for facilities meeting facility-specific cleanup levels must also include a brief alternatives analysis to balance the need for remediation with the risk analysis.

Please note that VCPs where ICs are proposed to restrict certain exposure scenarios are considered "action" VCPs. The remediation proposal in these instances is the implementation of the IC; therefore, this proposal is addressed as described earlier in Section 3.3.

3.3.1 Protectiveness

Section 75-10-721(1), MCA, requires that a voluntary cleanup under §§ 75-10-730 through 75-10-738, MCA, attain a degree of cleanup of the hazardous or deleterious substance and control of a threatened release or further release of that substance that assures protection of public health, welfare, and safety and of the environment. This section of the VCP should describe how the remediation proposal renders the facility protective for current and reasonably anticipated future uses. For instance, the remedy may include soil removal to cleanup levels, described in Section 3.2, which is protective of both the groundwater and future residential users based on a facility-specific risk analysis. Another remedy might include an on-site repository that provides both a liner as a barrier between soil and groundwater and a cap to prevent direct exposure to contaminated soil. Thus, the repository is protective of the groundwater and current and future on-site recreational users. "No further action" VCPs must include evidence that further action is not required to assure the facility is protective.

3.3.2 Environmental Requirements, Criteria, or Limitations

Sections 75-10-721(2)(a) and (b), MCA, provides that in approving or carrying out remedial actions performed under this part, DEQ must require cleanup consistent with applicable state or federal ERCLs and may consider substantive state or federal ERCLs that are relevant to the facility conditions. This section of the VCP should include a description of both applicable and relevant state and federal ERCLs. Applicable requirements apply at a facility regardless of whether the proposed remedy is being conducted under VCRA. Relevant requirements are those that are not applicable, but address situations or problems sufficiently similar to those at the facility and therefore, are relevant for use at the facility. Section 75-10-721(b), MCA, states that DEQ may consider relevant requirements in approving cleanups. DEQ considers relevant ERCLs on a case-by-case basis considering facility-specific information. Some ERCLs may change from relevant to applicable if the proposed remedy changes.

ERCLs are generally of three types: action-specific, contaminant-specific, and location-specific. Action-specific requirements are those that are triggered by the performance of a certain activity as part of a particular remedy. They do not in themselves determine the remedy but rather indicate the manner in which the remedy must be implemented. For example, hazardous waste disposal requirements include specifications for the manner in which land disposal units are constructed but these requirements are not triggered unless a land disposal unit is proposed. Contaminant-specific requirements are those that establish an allowable level or concentration of a hazardous or deleterious substance in the environment or that prescribe a level or method of treatment for a hazardous or deleterious substance. Examples include promulgated state standards establishing acceptable concentrations of constituents present at the facility in air, surface water, or groundwater. Location-specific requirements are those that serve as restrictions on the concentration of a hazardous or deleterious substance or the conduct of activities solely because the facility is in a specific location or the action affects specified types of areas. Location-specific requirements relate to facilities with potential historical, cultural, or ecological significance, or facilities located near wetlands, floodplains, surface water, endangered species habitat, and migratory bird habitat. DEQ has prepared these analyses for various facilities and the applicant is encouraged to obtain relevant examples from DEQ to assist in the applicant's analysis of applicable laws and regulations. The ERCLs analysis must include information about **how** the remediation proposal complies with each ERCL. A sample ERCLs analysis is included as Attachment G.

"No further action" VCPs must also include a complete ERCLs analysis. Action-specific ERCLs are included in "no further action" VCPs in order to evaluate alternatives involving remedial actions. This section of the "no further action" VCP must demonstrate **how** no further action complies with all of the ERCLs. When evaluating whether the "no further action" alternative meets action-specific ERCLs, the VCP should include a statement that the alternative complies with these ERCLs since no action is proposed or required.

3.3.3 Mitigation of Risk

Section 75-10-721(2)(c)(i), MCA, requires DEQ to select remedial actions, considering present and reasonably anticipated future uses, that demonstrate acceptable mitigation of exposure to risks to the public health, welfare, and safety and of the environment. In addition, § 75-10-734(3)(a)(iv), MCA, requires a demonstration that exposures to risk affecting the public health, welfare, and safety and of the environment at the facility will be substantially mitigated by the plan. This section of the VCP should include a description of how the proposed remedy mitigates the risks presented at the facility.

Mitigation of risks can be shown by describing how the remedy reduces the levels of contaminants to which humans and ecological receptors will be exposed. Risks to components of the environment, like the groundwater, must also be mitigated. This requirement can be addressed by describing how the proposed cleanup levels will be achieved and stating that these cleanup levels represent risks that are allowable by DEQ. Alternatively, risks may be mitigated with remedies that block the pathways by which exposure may occur via the installation of caps, liners, or on-site repositories. "No further action" VCPs must include a demonstration that risks at the facility are less than or equal to those allowed by DEQ and therefore no action is required to mitigate them.

3.3.4 Effective and Reliable

Section 75-10-721(2)(c)(ii), MCA, requires DEQ to select remedial actions, considering present and reasonably anticipated future uses, that are effective and reliable in the short-term and the long-term. This section of the VCP should include a demonstration that the proposed remedy is effective and reliable in the short term because it will not result in a further release of contamination or an increase in the risks posed by the facility to unacceptable levels during the cleanup. Short-term adverse effects may include air emissions or mobilization of contaminants into the groundwater or surface water via runoff. This section of the VCP should also demonstrate that the remedy is effective and reliable in the long-term because it includes measures to ensure that a release will not occur in the future and that acceptable risk levels will be maintained on a long-term basis. Assuring long-term effectiveness may require remedial actions such as the implementation of institutional controls (e.g., restrictive covenants) or repository maintenance. "No further action" VCPs must include a demonstration that taking no further remedial action is effective and reliable in the short and long term. This may require assurance that facility usage will not change and that controls are in place to guarantee this.

3.3.5 Practicable and Implementable

Section 75-10-721(2)(c)(iii), MCA, requires DEQ to select remedial actions, considering present and reasonably anticipated future uses, that are technically practicable and implementable. This section of the VCP should include a demonstration that the proposed remedy may be implemented. Remedies that include impracticable components may not be selected. For example, reprocessing of tailings material may not be practicable because there may be no methods currently available to extract reasonable quantities of metals from the material. A soil vapor extraction system may be a proven effective remedial technology for solvents in certain types of soil and installation of a system is achievable. "No further action" VCPs should include a statement that no further remedial action is practicable and implementable because there are no impediments to taking no further action.

3.3.6 Treatment or Resource Recovery Technologies

Section 75-10-721(2)(c)(iv), MCA, requires DEQ to select remedial actions, considering present and reasonably anticipated future uses, that use treatment technologies or resource recovery technologies if practicable, giving due consideration to engineering controls. This section of the VCP should include a discussion of whether the proposed remedy employs treatment technologies, resource recovery technologies, or engineering controls. An example of a remedy employing resource recovery technologies is the use of petroleum-contaminated soils in asphalt production. An example of treatment technologies would be stabilization of lead-contaminated soil to remove a toxicity characteristic or soil vapor extraction to remove volatile organic compounds from soil. These remedies may be preferable to excavation and land disposal. A proposed remedy may not meet this criteria, but still be chosen as the preferred alternative if it meets all the other selection criteria. DEQ

interprets the statute as referring to long-term engineering controls, not engineering controls employed only during remediation, such as dust control. An example of an engineering control that DEQ might consider an appropriate remedy would be an on-site repository. "No further action" VCPs should include a statement that treatment technologies, resource recovery technologies, or engineering controls are not necessary because no further remedial action is required to meet the other cleanup requirements.

3.3.7 Cost-Effectiveness

Section 75-10-721(2)(c)(v), MCA, requires DEQ to select remedial actions, considering present and reasonably anticipated future uses, that are cost-effective. Section 75-10-721(5), MCA, states that cost-effectiveness must be determined through an analysis of incremental costs and incremental risk reduction and other benefits of alternatives considered, taking into account the total anticipated short-term and long-term costs of remedial action alternatives considered, including the total anticipated cost of O&M activities. This section of the VCP should include a demonstration that the proposed remedy is cost-effective for the amount of risk reduction achieved. Actual estimated costs should be provided. "No further action" VCPs should include a statement that no further remedial action is cost-effective given that there is no cost and no risk reduction is necessary to meet the other cleanup requirements.

3.4 Proposed Cleanup Plan

Based on the comparison of alternatives in Section 3.3, the applicant identifies its preferred remedy. Section 75-10-734(3)(a), MCA, requires that the VCP include a detailed description of the components of the Remediation Proposal. The proposal must be described in sufficient detail to allow DEQ to evaluate whether or not the proposal satisfies all cleanup requirements of Section 75-10-721. The proposal must also provide enough detail for DEQ to determine whether all environmental requirements will be met by the proposal. Maps identifying areas to be remediated and diagrams of the remedial design, with specifications as appropriate, are examples of the type of information needed to fulfill this requirement. DEQ must also be able to determine if the proposal can be completed within the 60-month timeframe specified in § 75-10-736, MCA. "No further action" VCPs must include a statement that no further remedial action is required at the facility to meet the requirements specified in the following sections.

3.4.1 Waste Management

Many cleanup actions involve the treatment and/or disposal of wastes that are listed or characteristic wastes as defined in the Resource Conservation and Recovery Act (RCRA) and the Montana Hazardous Waste Act and the regulations adopted pursuant to it. The Remediation Proposal should include a discussion of whether or not a hazardous waste will be generated by its implementation (e.g., through the excavation of contaminated material, which may have been discharged prior to 1980, but which would become a hazardous waste upon being excavated or managed), and the volume of this material. This section of the VCP should also include a description of how such hazardous waste will be managed in accordance with current state and federal hazardous waste regulations. Specific information about the proposed disposal facility should be included in the VCP, if applicable. If applicable, the VCP should describe the sampling program that will be used to verify that the material is not a hazardous waste or that treatment of the contaminated media has resulted in a non-hazardous waste.

3.4.2 Implementation of the Approved Plan

Section 75-10-736(9), MCA, provides that if conditions are discovered during implementation of the VCP that were not identified in the Environmental Assessment, affect the risk to public health, welfare, and safety and of the environment, and change the scope of the approved VCP, the applicant must notify DEQ within ten days of discovery. DEQ may require the applicant to submit an amendment to the VCP to address the conditions or may determine that a VCP is no longer appropriate.

Most remediation proposals will include a description of all confirmation sampling, backfill, and revegetation activities.

3.4.2.1 Confirmation Sampling

A confirmation sampling plan needs to provide sufficient sampling coverage to ensure all contamination above cleanup levels has been removed and to verify attainment of cleanup levels. This section of the VCP should include a description of the confirmation sampling that will be conducted following the cleanup to verify that cleanup levels have been met. A confirmation sampling plan should include the following:

- A discussion of the number, location, and type of samples to be collected;
- Collection methods and analytical methods that will be used. Please note that it is critical that confirmation samples be analyzed using methods with detection limits adequate to determine if the data is valid and whether cleanup levels have been met;
- A brief reference to the approved cleanup levels ("No further action" VCPs should include a reference to the risk analysis which indicates that no further actions are necessary);
- Any RCRA contained-out determinations should be discussed in this section; and
- A discussion of what quality assurance/quality control (QA/QC) documentation will be followed including the following: a complete data validation checklist/report, copies of all laboratory results, and a completed chain of custody with the laboratory's sample receipt checklist. Please ensure that all QA/QC issues in the validation checklist/report will be clearly identified and discussed.

DEQ typically requires that a 5-point composite confirmation be collected from 25 feet by 25 feet sampling grids. Confirmation samples should be collected from the excavation floor as well as along all side-walls. If sampling along a narrow corridor, a 5-point composite sample should be collected over an area of 625 ft sq. Alternate sampling strategies are considered on a facility-specific basis. For example, it may be appropriate to collect samples along radial lines extending from a known source of airborne contamination. It may also be appropriate to collect samples from larger grids on very large facilities; however, factors like heterogeneity of contamination must be considered in determining grid size.

In some situations, EPA's ProUCL software can be used to calculate a reasonable maximum exposure point concentration (RMEPC) for direct contact. Additional information regarding RMEPCs, EPA's ProUCL software, and general assumptions for facility specific risk assessment/analysis can be found at the following link: http://deq.mt.gov/StateSuperfund/FrequentlyAskedQuestions.mcpx#5.

The confirmation sampling results are typically provided to DEQ for approval as soon as the validated analytical results are available.

3.4.2.2 Backfill

Backfill material to be used at a facility needs to be adequately characterized to demonstrate that the backfill material does not contain contaminants at concentrations greater than the appropriate cleanup or screening levels. A backfill approval request letter should be submitted for DEQ approval, for all proposed backfill and borrow source material, before backfilling takes place. A backfill approval request letter should include the following:

- A description and map of the backfill source material. This discussion must include the search results in DEQ's electronic databases for known contaminated facilities to determine if the proposed backfill source is in the database or is adjacent to a facility listed in the database. If the proposed backfill source is in the database or is adjacent to a facility listed in the database, additional analysis may be required for parameters known to be present at the listed facility. See the Montana DEQ Digital Atlas/Online Query Service to search for facilities in DEQ's database. In addition to contaminants present in known sources of contamination on or adjacent to the backfill source area, the samples must also be analyzed for the following metals: arsenic, barium, cadmium, chromium, lead, selenium, silver, and mercury.
- A discussion of the number and type of samples collected and the quantity of material that will be used as source material. Generally, at least one 5-point composite sample should be collected for every 400 cubic yards of backfill material. If large volumes of backfill material are needed, the applicant may propose an alternate sample frequency.
- A discussion of the sample results compared to DEQ cleanup or generic screening levels (for additional information please see DEQ's flow chart of the soil screening process at the following link: http://deq.mt.gov/StateSuperfund/VCRA_Guide/ss_flowchart.pdf). This discussion must include a summary table with both the analytical results and all appropriate cleanup or screening levels.
- Proper QA/QC documentation, including a complete data validation checklist/report, copies of all laboratory results, and a completed chain of custody with the laboratory's sample receipt checklist. All QA/QC issues in the validation checklist/report must be clearly identified and discussed.

3.4.2.3 Revegetation

Based on applicable or relevant reclamation ERCLs, the following information should be provided in this section of the VCP, as appropriate:

- Recontouring/grading, including final slope and aspect, drainageway reconstruction, and erosion control methods;
- Coversoil/topsoil, including soil source, soil texture, percent rock fragments, and percent organic matter;
- Seedbed preparation, including depth of tilling and equipment to be used;
- Amendment application, including fertilizer, mulch, or other amendment application rates;

- Seeding/planting, including seed mixes, seed sources, seeding rates, seeding techniques, seeding times, and transplants;
- Reference area delineation or description of vegetation typical of the surrounding area (see below); and
- Monitoring, including monitoring and reporting frequency, and sampling methods.

Success of revegetation must be determined by comparison with uncontaminated reference areas or by comparison with technical standards. Reference areas and standards must be representative of vegetation and related site characteristics and must occur on lands exhibiting good ecological integrity. DEQ will approve the reference areas, technical standards, and methods of comparison.

Reference areas are parcels of land chosen for comparison to revegetated areas. A reference area is not required for vegetation parameters with approved technical standards.

Production, cover, and density shall be considered equal to the approved success standard when they are equal to or greater than 90% of the standard. The noxious weed target will be 0% over the revegetated areas (§ 17-24-726, ARM). Compliance with the Noxious Weed Management Act (7-22-2101 through 7-22-2153 , MCA, as amended) may be required.

Descriptions of reference areas of vegetation typical of the surrounding area and vegetation monitoring reports should provide adequate information for DEQ to be able to assess vegetation success according to the following criteria:

- Percent vegetation cover by species (current year's growth, including noxious weeds);
- Percent total vegetative cover (current year's growth, not including noxious weeds);
- Percent litter (litter plus rock over 2 inches in diameter);
- Percent bare ground;
- Herbaceous production;
- Shrub density (if applicable); and
- List of species (observed anywhere within the seeded area).

By the end of the first season after remediation, DEQ may perform a revegetation inspection. Only after the DEQ has approved the revegetation and the applicant has submitted and receive approval of their revegetation plan from the County Weed Control Board should the applicant submit a construction completion report.

3.4.2.4 Cover Soils

The organic content of the topsoil should be within a range of values not less than 1% and not greater than 20%. The top 24 inches should have no more than 20% particles greater than 2.0 mm. The soil pH should be between 5.5 and 8.0.

The proposed topsoil source may not contain any "noxious weeds or noxious weed seeds." If noxious weeds are found on the topsoil source site, the topsoil will be rejected and not used for revegetation.

Clay textured soils with more than 40% clay may be unsuitable. The following is an example of topsoil specification used by the Abandoned Mine Reclamation Bureau (DEQ 1990).

TOPSOIL GRADATION SPECIFCIATIONS

Fraction	Particle Size (mm)	Max. % of Soil (-10 Mesh) Fraction
Sand	0.05 - 2.0	70
Silt	0.002 - 0.05	70
Clay	Less than 0.0023	40
Gravel	Larger than 2.0	Maximum 20%

3.4.3 Operation and Maintenance

For VCPs that include an O&M period, an O&M plan should be submitted with the Remediation Proposal component of the VCP. The O&M plan should describe the O&M activities that will be performed to ensure that cleanup action objectives will not be compromised. The O&M plan may also include a sampling program that may be used to monitor the effectiveness of the remedy. As stated previously, DEQ may require financial assurance for O&M. Closure letters for facilities requiring O&M will be limited and include language related to the O&M and continued payment of DEQ costs related to the O&M. For facilities where all remedial activities except O&M activities are complete, the facility will be placed in O&M status on the CECRA Priority List.

3.4.4 Treatability Studies

The applicant is required to address any treatability studies in the Remediation Proposal component of the VCP.

Section 75-10-734(3)(a)(iii), MCA, requires that the Remediation Proposal component of the VCP include identification of sampling or treatability studies. This section of the VCP should include a description of any sampling or treatability studies required before or during the implementation of the VCP. For example, if an appropriate stabilization mixture must be developed prior to implementation,a description of the treatability studies associated with its development should be included here. It is advisable that the applicant conduct the majority of the sampling and treatability studies necessary for the remedy prior to submittal of the VCP, to ensure that adequate information is available to indicate that the remedy is appropriate.

3.5 VCP Schedule

Section 75-10-734(3)(c), MCA, requires a timetable for implementing the proposal and for any necessary monitoring of the facility after the proposed measures are completed. Rather than specifying the dates, the timetable should provide relative timeframes. As stated in § 75-10-736(8), MCA, voluntary cleanups must be initiated within 12 months of approval of the VCP and completed in 60

months or less, excluding O&M, or DEQ's approval lapses. Under facility-specific circumstances, DEQ may grant an extension of the time limit for completion of the VCP.

3.6 Health and Safety

Section 75-10-734(3)(d), MCA, requires that the Remediation Proposal component of the VCP include a statement that applicable health and safety regulations will be met during implementation of the remediation proposal. DEQ requires only that this commitment be included without any further information. DEQ does not approve health and safety plans; however, DEQ may request copies of facility-specific health and safety plans prior to conducting oversight of field activities to ensure the health and safety of DEQ staff.

3.7 Minimization of Short-Term Disturbances

Section 75-10-734(3)(e), MCA, requires that the Remediation Proposal component of the VCP include a description of how short-term disturbances during implementation of the remediation proposal will be minimized. Examples include: how dust or storm water runoff will be controlled during construction activities, traffic plans for haul trucks, etc.

3.8 Required Permits

Section 75-10-734(3)(f), MCA, requires that the Remediation Proposal component of the VCP include identification of any permits necessary to conduct the proposed remedy. Any federal, state, and/or local permits that may be required must be obtained before the VCP can be implemented. Examples of permits that may be required include EPA Form 8700-12, Notification of Hazardous Waste Activity, State of Montana construction storm water discharge permit, State of Montana Floodplain Development Permit, U.S. Army Corps of Engineers 404 permit, State of Montana 312 Permit, and County Conservation District 310 Permit. The Montana Environmental Quality Council publishes the Montana Index of Environmental Permits available online at http://leg.mt.gov/css/publications/environmental/permit_index/permit_tofc.asp. In addition, for remedies impacting streams, the Montana Association of Conservation Districts publishes a Guide to Stream Permitting in Montana. These guides should be consulted to determine which permits may be required for the proposed remedy. The proposed remedy must comply with all federal, state, and local regulations regarding health and safety and remediation. The VCP should identify any applicable local regulations. Copies of all required permits must be provided to DEQ prior to initiation of the cleanup.

4.0 COMPLETION OF THE VCP

4.1 Construction Completion Report

As indicated in § 75-10-736(11), MCA, 60 days after completion of the approved Remediation Proposal (including established revegetation), the applicant shall provide to DEQ a certification from a qualified environmental professional that the VCP has been fully implemented. In this certification, the qualified environmental professional should include a signed letter to this effect and must include all documentation necessary to demonstrate the successful implementation of the VCP. This documentation should include (but is not limited to) the following:

- A list of all COCs along with the remaining concentrations;
- Any deviations from the approved Remediation Proposal. Significant deviations (e.g. discovery of new sources of COCs; discovery of significant new amounts of known COCs; inability to complete the approved Remediation Proposal; newly-discovered condition that affects the risk to public health, welfare, and safety and of the environment; or newly-discovered condition that changes the scope of the approved Remediation Proposal) will require DEQ's pre-approval. Discussions of these significant deviations and copies of DEQ's pre-approval should be included in this section;
- Any material changes or differences from either the Environmental Assessment or Remediation Proposal;
- Final construction diagrams and pertinent figures and drawings of all remedial systems;
- Disposal manifests;
- Confirmation sampling locations, sample results and laboratory data packages, data validation reports of the confirmation sampling, and comparison to approved VCP cleanup levels;
- A discussion of the DEQ approved backfill and a reference to the backfill approval request letter.
- Copies of all field logbooks and photographs taken during implementation of the Remediation Proposal;
- Documentation of revegetation with photos;
- Discussion and scheduling of any long-term O&M or engineering controls;
- A copy of all recorded ICs;
- Any VCP amendments; and
- Any other documentation necessary for DEQ to determine if the VCP has been fully implemented.

4.2 Closure and No Further Action

Sections 75-10-738(1) and (2), MCA, indicate that after completion of the VCP, an applicant may petition DEQ for closure of the facility. Within 60 days of receipt of a petition for closure, weather

permitting, DEQ shall conduct a review to determine that the releases or threatened releases addressed in the VCP do not pose a significant threat to public health, welfare, and safety and of the environment as determined in accordance with § 75-10-721, MCA, and that the applicant has:

1. implemented all appropriate remedial actions;
2. if necessary, provided for long-term funding for facility maintenance or monitoring; and
3. reimbursed DEQ for all remedial action costs of the voluntary cleanup.

Section 75-10-738(4), MCA, indicates that after completion of a portion of a facility addressed in the VCP, DEQ shall issue a letter of completion notice to the applicant if DEQ determines that the applicant has satisfied the requirements of § 75-10-738(2), MCA.

If the entire facility is not addressed in the VCP, DEQ's letter of completion notice is typically equivalent to a "no further action" letter for that portion of the facility addressed in the VCP.

4.3 Delisting

If a facility is included on the CECRA Priority List and the entire facility is addressed in the VCP, the applicant's petition for closure may also include a petition for delisting of the facility. If appropriate, DEQ will initiate the delisting process described in ARM 17.55.114 upon issuing a closure letter for the facility.

5.0 REFERENCES

This section of the VCP should include a list of the references cited in the VCP. The following are a list of references used to complete the VCRA Guide. It does not include legal citations such as those found in the Montana Code Annotated, Administrative Rules of Montana, United States Code, and Code of Federal Regulations.

DEQ 2011a. DEQ SRS Frequently Asked Questions: http://deq.mt.gov/StateSuperfund/FrequentlyAskedQuestions.mcpx

DEQ 2011b. Montana Vapor Intrusion Guide, April 2011.

DEQ 2010. Circular DEQ-7, Montana Numeric Water Quality Standards, August 2010.

DEQ 2009. Montana Tier 1 Risk-Based Corrective Action Guidance for Petroleum Releases, September 2009.

DEQ 2008. DEQ's Technical Guidance General Field Data Needs for Fate and Transport Modeling

DEQ 2005. Montana Department of Environmental Quality, Remediation Division, Action Level for Arsenic in Surface Soil, April 2005

DEQ 2004. Abandoned Mine Reclamation Bureau Risk-Based Cleanup Guidelines for Abandoned Mine Sites, July 2004.

DEQ 1990. Standard Specifications for Abandoned Mine Construction: Montana Abandoned Mine Reclamation Bureau 12/90.

EPA 2011. EPA Regional Screening Levels, November 2011.

EPA, 2009. Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). January 2009.

EPA 2006. EPA Region 3 Biological Technical Assistance Group Freshwater Sediment Screening Benchmarks, August 2006.

EPA 2004. Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Supplemental Guidance for Dermal Exposure Assessment (Part E) (EPA/540/R/99/005, July 2004)

EPA 2002. OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), November 2002.

EPA 2001. RAGS, Volume 1, Human Health Evaluation Manual Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments: EPA/540-R-97-033, December 2001.

EPA 2000a. Draft Ecological Soil Screening Level Guidance, July 2000.

EPA 1999. Supplemental Guidance to Risk Assessment Guidance for Superfund, Volume I,

Human Health Evaluation Manual: Dermal Risk Assessment Interim Guidance, March 1999.

EPA 1998. Guidelines for Ecological Risk Assessment: EPA/630/R-95/002F, April 1998.

EPA 1997a. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, June 1997.

EPA 1997b. Exposure Factors Handbook, Volumes I-III, EPA/600/P-95/002Fa-c, August 1997.

EPA 1996. Soil Screening Guidance, EPA/540/R-94/101, April 1996. Note: Accompanying documents include Soil Screening Guidance: Technical Background Document: EPA/540/R-95/128 and Soil Screening Guidance: User's Guide, EPA/540/R-96/018.

EPA 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term, Publication 9285.7-081, May 1992.

EPA 1991a. Supplemental Guidance to RAGS: Default Exposure Factors, March 1991, OSWER Directive 9285.6-03.

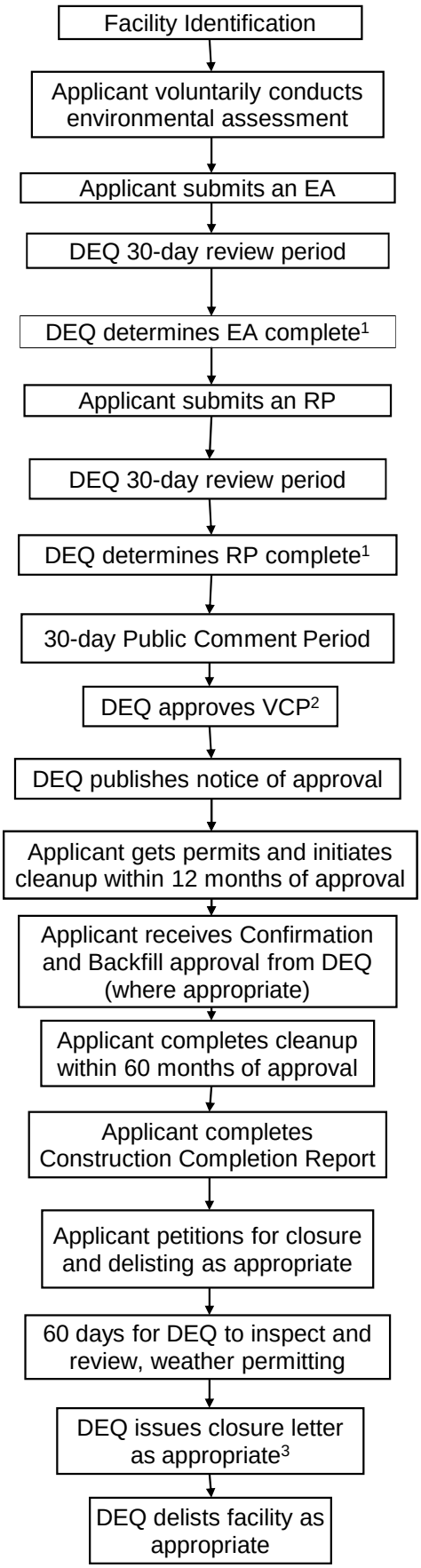
EPA 1991b. RAGS, Volume I, Human Health Evaluation Manual Part B, Development of Risk-based Preliminary Remediation Goals: EPA 540/R-92/003, December 1991.

EPA 1991c. RAGS, Volume I, Human Health Evaluation Manual Part C, Risk Evaluation of Remedial Alternatives: EPA/540/R-92/004, December 1991.

EPA 1989. RAGS, Volume I, Human Health Evaluation Manual Part A: EPA/540/1-89/002, December 1989.

NE&W 1999. Final Phase Remedial Investigation Report for the Bozeman Solvent Site. DEQ file No. 20-06-06. September 1999.

FIGURE 1
THE VOLUNTARY CLEANUP AND REDEVELOPMENT ACT (VCRA) PROCESS



VCP = Voluntary Cleanup Plan (a complete EA & RP)
DEQ = Montana Department of Environmental Quality
EA = Environmental Assessment
RP = Remediation Proposal

[1] A VCP may require more than one revision to be deemed complete.

[2] DEQ may require changes based on public comment prior to approval or may not approve the VCP.

[3] Applicants are required to pay the State's remedial action costs before DEQ will issue a closure letter.

VCRA Guide Checklist

This checklist includes all the elements to a complete VCP and is organized to coincide with the sections of the VCRA Guide. If an element is not included in the submitted VCP, its absence must be explained in the narrative.

Environmental Assessment (EA)

- ☐ **Applicant has reviewed both Section 1 and 2 of the VCRA Guide**

2.0 ENVIRONMENTAL ASSESSMENT

2.1 Introduction: (additional information may also be found in Section 1.0 of the VCRA Guide)

- ☐ Facility name and general location;
- ☐ Name and address of applicant submitting the VCP (and owner if different);
- ☐ Statement indicating whether the facility is on the CECRA Priority List;
- ☐ In general, type and source of contamination;
- ☐ Statement indicating if the VCP addresses the entire facility or only a portion (if so, what portion); and
- ☐ An agreement to reimburse DEQ costs.
- ☐ Statement acknowledging that cleanup will be completed within 60 months of approval of the Remediation Proposal (RP);
- ☐ Statement indicating that the facility is eligible for voluntary cleanup procedures per the criteria discussed in Section 2.0 of the VCRA guide;
- ☐ Information indicating the EA has been prepared by a qualified environmental professional;
    - ☐ Include all qualifications in an Appendix to the EA. The RP can reference back to that information.
    - ☐ If the RP is prepared by a different professional, include those qualifications in an Appendix to the RP.

2.2 Legal Description and Map:

- ☐ Include county, city, or distance to nearest city; street address; township, range and section; and latitude and longitude;
- ☐ Map to scale identifying the location and size of the facility and relevant features such as property boundaries, surface topography, surface and subsurface structures, and utility lines;
- ☐ Copies of property deeds should be included as an appendix.

2.2.1 Written Consent of Current Owners: The written consent of current owners of the facility or property for the EA, RP, implementation of the remedy and ICs, and access to the facility by the applicant and its agents and DEQ.

2.3 Physical Characteristics of the Facility: (includes all areas where contamination has come to be located) and areas contiguous to the Facility including:

- ☐ Topography;
- ☐ Stratigraphy;
- ☐ Structural geology;
- ☐ Regional groundwater flow patterns;
- ☐ Groundwater aquifers;
- ☐ Hydraulic conductivity;
- ☐ Floodplain designation;
- ☐ Climatological data, including wind speed and direction;
- ☐ All surface water bodies and wastewater discharge points;
- ☐ Groundwater monitoring and supply wells;
- ☐ Surface water intakes;
- ☐ Aquatic and terrestrial habitats;
- ☐ Sensitive environments (e.g., wetlands);
- ☐ Physical features such as buildings or roads;
- ☐ Facility process units and loading docks;

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- Chemical and/or fuel transfer and pumping stations;
- Current and historic railroad tracks and railcar loading areas;
- Surface and storm water run-off retention ponds and discharge points;
- Building drainage or wastewater discharge points;
- Spill collection sumps and/or drainage collection areas;
- Wastewater treatment units;
- All underground and above ground storage tanks;
- Underground and above ground piping;
- Water cooling systems and/or refrigeration units;
- Sewer lines;
- Underground utility lines and buried cables;
- French drain systems;
- Water recovery sumps and building foundations;
- Surface impoundments;
- Waste storage and/or disposal areas/pits, landfills etc.;
- Chemical and/or product storage areas;
- Septic leach fields (drain fields);
- Irrigation ditches and/or irrigation systems;
- Dry wells and/or waste disposal sumps; and
- A list of all the other impacted facilities (CECRA, federal superfund, leaking underground storage tank, contaminated groundwater, hazardous waste, etc.) within one-quarter mile of the facility.

2.4 Area Wells: Provide a description of all wells at the facility or within a one-half mile radius of the facility, including:

- A list of all wells identifying the use, depth, geologic formation/aquifer and yield of those wells;
- A map to scale using geographic references showing the locations of these wells;
- Documentation of any efforts to verify the presence or absence of unregistered wells; and
- A list providing all available well construction information, ownership, address, driller, date drilled, static water level, well construction design, well logs, and field notes.

2.5 Groundwater and Surface Water Usage: Provide a description of the current and reasonably anticipated future use of onsite ground and surface water, including:

- Suitability of water for beneficial uses;
- Historical land and water uses;
- Anticipated future land and water uses;
- Community and nearby property owners' concerns regarding future water use;
- Regional and local development patterns;
- Regional and local population projections;
- Availability of alternate water sources including, but not limited to, public water supplies, groundwater sources, and surface water sources;
- Specific conductivity and class of the groundwater.; and
- Classification of any steams or rivers on or near the facility.

2.6 Operational History of the Entire Facility: Provide a description of the following:

- Records, dates, and descriptions of past and current operations, activities, conditions or incidents at the facility or nearby facilities that may have resulted in a release or threatened release of a hazardous or deleterious substance;
- Complete ownership history of all property comprising the facility;
- Copies of deeds/easements;
- Readily available aerial photographs;
- Building department records;

- A description of all activities or businesses that occupied the facility as far back as typical historical records and knowledge allows, including years of operation;
- A description of any historical records including county clerk and recorder and tax assessor records, Polk directories, and Sanborn fire insurance maps (include copies of easily obtainable, relevant documents in an appendix);
- Diagrams of facility operations (e.g., railroad facility maps, permitted activity diagrams);
- The dates that the activities occurred and the dates during which the hazardous or deleterious substances may have been released into the environment;
- The approximate volumes of the materials released;
- A description of past and current waste disposal practices and areas;
- A list of any known hazardous or deleterious substances used at the facility, with volume estimates and a list of all wastes generated at the facility, including manifests for disposal;
- References and information about the sources of the operational history, including a brief description of the efforts made to research various informational sources;
- A description of the current use of the facility;
- Current hazardous or deleterious substance usage;
- Current waste disposal practices;
- Registries or publicly available lists of engineering controls; and
- Registries or publicly available lists of institutional controls, including environmental land use restrictions.

2.7 Current and Future Facility Use:
Describe the current and reasonably anticipated future uses of the facility and immediately adjacent properties by analyzing likely future land or resource uses that take into consideration the following:

- Local land and resource use regulations, ordinances, restrictions, or covenants;
- Historical and anticipated uses of the facility;
- Patterns of development in the immediate area; and
- Relevant indications of anticipated land use from the owner of the facility and local planning officials.

2.8 Regulatory and Compliance History:
Provide a description of the following

- List of all local, state, and federal environmental permits obtained for the facility;
- Information on permit violations, notices to take corrective action, or similar issues for each of these permits;
- List all facility-specific notifications made as a result of any management activities of hazardous substances conducted at the facility, including any and all EPA identification numbers obtained for management of hazardous substances at the facility from either the state or the EPA and any conditionally exempt small quantity generator determinations;
- List all notifications made to state and/or federal agencies reporting spills and/or accidental releases and any actions taken to address those spills/releases, including confirmation sample results;
- A description of any actions taken under any regulatory authority (CECRA, CERCLA, RCRA, WQA, CWA, etc.) at the facility (e.g., notice letters, proper and expeditious letters, or orders); and
- A description of any private or agency litigation associated with the facility; and

- A description of any controlled allocation of liability act actions related to the facility.

2.9 Facility Characterization:

2.9.1 Characterization Information:

- A narrative describing methods and results from all investigations characterizing nature and extent of any releases or threatened releases of hazardous or deleterious substances that have occurred at the facility. The investigations should characterize the entire facility including surface soils, subsurface soils, sediment, air, soil gas, vapor intrusion, groundwater, and surface water, as applicable;
- A table of contaminants indicating which media is contaminated and estimated extent of that contamination;
- A data summary discussion and table of the contamination present at the facility separated out by impacted media, including all of the samples collected in that media and the extent of contamination present in each media. These data tables should also include comparison to generic screening levels;
- A map indicating all potential source areas, areas and concentrations of hazardous or deleterious substances, previous, hazardous or deleterious substance treatment, and storage or discharge areas;
- Site conceptual model of sources showing potential migration pathways;
- Describe the chemical nature, mobility and toxicity of the hazardous or deleterious substances, estimated volumes and concentrations of substances discharged at each area, discharge point, drain, or leakage point (if available);
- Map drawn to scale showing groundwater elevation and groundwater flow direction;
- Discussion of all hydraulic tests performed at the facility or nearby to characterize the hydrogeologic properties of any aquifers in the area;
- Discussion of how all environmental samples/data were collected, including:
  - The rationale involved in sampling locations, parameters, and methodology;
  - A description of sampling locations;
  - Well construction details (showing screened interval, casing type, gravel pack interval, bentonite seal thickness and cemented interval) and lithologic logs;
  - Test-pit and borehole logs;
  - Quality assurance/quality control measures associated with the sampling and analysis;
  - Data validation of sample results including a brief discussion of the quality of the data;
  - Sampling frequency and locations;
  - The use of EPA-approved analytical methods with appropriate method detection limits. Detection limits must be low enough for comparison with appropriate screening levels or cleanup levels; and
  - Include the laboratory data and data validation reports as an appendix.
- Discussion of any remedial actions already performed at the facility (especially important for "no further action" VCPs), including:
  - A description and figure of the location of contaminants of concern (COCs);
  - A description and figure of the area of the remedial action and confirmation samples;
  - The method employed to carry out the remedial action;
  - Assessment of, methodology, analytical methods, and frequency of confirmation samples;

— Description of the disposition of all contaminated media; and
— Comparison of confirmation samples to screening/cleanup levels which were used to verify the effectiveness of the remedial action.

2.9.2 Screening Contaminants of Concern: All contaminants must be screened against generic screening levels to determine the COCs for the Facility. This section should include:

- Surface water and groundwater concentrations must be screened against the DEQ-7 standards, RBSLs, or tapwater RSLs;
- Drinking water must be compared to the MCLs;
- Dry weight sediment concentrations must be compared to U.S. Environmental Protection Agency EPA Region 3 Biological Technical Assistance Group Freshwater Sediment Screening Benchmarks;
- Dry weight soil concentrations must screened by using DEQ's Soil Screening Process found in Attachment C in the VCRA Guide; and
- Soil-gas, sub-slab, and indoor air concentrations must be screened against the Residential Air values found in the EPA's RSLs and the Massachusetts APH generic screening levels.

2.10 Human and Environmental Exposure: Description of the human and environmental exposure to releases or threatened releases of hazardous or deleterious substances at the facility based upon the current use of the facility and adjacent properties and any reasonably anticipated future uses of the facility;

- Provide a site conceptual exposure model (SCEM) and a visual diagram SCEM. Include a narrative for the current and reasonably anticipated future use of the facility that indicates the facility-specific contaminant sources (e.g., underground tanks, sewer lines, etc.), release mechanisms, transport routes and media, and potential receptors;
- Include a table or list of site contaminants indicating which media are contaminated and the estimated vertical and areal extent of contamination in each medium;
- Include an Occurrence, Distribution, and Selection of Chemicals of Potential Concern (ODSCOPC) table with the following information: COCs minimum concentration, maximum concentration, location of maximum concentration, detection frequency, range of detection limits, sample concentration used for screening, generic screening level and source, site-specific screening level (if appropriate) and source, if the chemical is a COC, and the rationale for this decision;
- Discuss and evaluate ecological receptors;
- Provide an evaluation of the soil leaching to groundwater pathway. All soil cleanup levels must be protective of groundwater;
- If volatile compounds are present at the facility, evaluate vapor intrusion to indoor air; and
- "No further action" VCPs must include a demonstration that the current condition of the facility meets all appropriate cleanup levels and that no further remedial action is necessary to achieve cleanup goals.

2.11 Facility Maps, Figures, and Photographs: The following is a list of maps, figures, and photographs that should be included where appropriate. These maps, figures, and photographs may be combined where appropriate.

- **Site/Facility Location Map**

- Portion of the USGS 7.5' Quadrangle depicting the site/facility location;
- Facility boundary;
- Surface water bodies; and
- Topography.

☐ **Aerial Photographs:** Current and all historical readily available aerial photographs.

☐ **Site/Facility Plan View Map(s)**
- Location and size of Facility;
- Property boundaries;
- Facility boundary;
- Surface topography;
- Surface & Subsurface structures;
- Utility lines;
- Above- or below- ground tanks;
- Surrounding, nearby, and/or impacted properties;
- Physical characteristics;
- All Facility wells within one-half mile radius (including a description of use);
- Potential source areas and concentrations of hazardous or deleterious substances; and
- Potentially impacted receptors.

☐ **Sample Location Map(s)**
- Depict locations of all monitoring wells;
- Soil borings and test pits;
- Soil gas;
- Groundwater survey probes;
- Surface and subsurface samples;
- Surface water and groundwater (including residential, commercial, and public water supply) samples; and
- One map should include (as a base layer) the highest quality or most current color orthophoto with georeferenced Sanborn map information and/or any other site/facility historic blueprint/map information overlain with all labeled sample locations to assist in the identification of historic sources and operations (This map is typically a 24"x26" map to allow for greater site detail).

☐ **Potentiometric Surface Map(s)**
- Includes depicting the potentiometric groundwater surface during high and low water table;
- Data such as static water level elevations (expressed as feet above Mean Sea Level); and
- Arrows depicting groundwater flow direction.

☐ **Geologic Cross Sections**
- Show site stratigraphy through full depth of potentially impacted water-bearing units;
- A minimum of three cross-sections per site (i.e. one parallel to groundwater flow direction and two perpendicular to flow direction and/or skewed to align with actual well/boring sample locations); and
- Indicate contaminant location, monitoring wells depicting their screened intervals, and subsurface conduits/piping, etc., depicting the subsurface of the property.

☐ **Soil Contamination**
- Isoline map depicting soil analytical data. Include at least three labeled isolines for each contaminant (one identifying the area of sampling method detection limit exceedance, one identifying each applicable standard and/or screening level (i.e. RBSL, RSL, etc.) exceedance, and one identifying areas of increased concentrations.

☐ **Groundwater Contamination Isoconcentration Map(s)**
- Isoline map depicting the extent and degree of groundwater contamination; and
- Include at least three labeled isolines for each contaminant (one identifying the required reporting value identified in DEQ-7, one identifying each applicable standard and/or screening level (i.e. MCL, DEQ-7, RBSL) exceedance, and as many isoconcentrations as necessary to demonstrate the range of dissolved concentrations).

- **Separate Phase Product Isoline Map(s)**
  - If separate phase product is encountered, a map depicting product extent and thickness should be provided. Include at least three labeled isolines for each separate phase product (one identifying the edge of measurable product thickness; then as many isolines as necessary to demonstrate the range of thickness encompassed by the plume).

- **Facility Contaminant Affected Area Map**
  - Map of all identified contaminant isoline areas (for all media in both the surface and subsurface) color-coded to distinguish different contaminant areas/media. All sample locations should be labeled and included, contaminant source locations should be identified, as well as other pertinent features.

Please ensure that all relevant Figures, Tables, and Appendixes included in EA are also included in the Remediation Proposal.

Remedial Proposal (RP):

- ☐ **Applicant has reviewed both Section 3 and 4 of the VCRA Guide**

3.0 REMEDIATION PROPOSAL

- ☐ Once DEQ determines that the EA component of VCP is complete, the applicant may submit the RP component.
- ☐ Verify the RP was prepared by a qualified environmental professional (include qualifications in an Appendix).
- ☐ This section of the VCP should include the information described in Section 3 of the VCRA guide.

3.1 Introduction: Include the following information:

- ☐ Facility name and general location;
- ☐ Date that the EA was deemed complete by DEQ;
- ☐ Statement indicating if the VCP addresses the entire facility or only a portion (if so what portion);
- ☐ Anticipated length of time needed to complete the cleanup (e.g. "No Further Action", 6 months, 2 years, 5 years);
- ☐ Verification of Facility Conditions;
- ☐ Review of COCs; and
- ☐ A detailed description of all actions that have occurred between completion of the EA and the submittal of the RP.

3.2 Cleanup Levels: Identify the proposed cleanup levels for the facility and how they were derived:

- ☐ Background cleanup levels;
- ☐ Established generic screening levels;
- ☐ Facility-specific adjusted screening levels;
- ☐ Facility-specific risk-based cleanup levels; and
- ☐ Facility-specific leaching to groundwater cleanup levels.

3.3 Remedial Alternatives Comparison: This section requires a brief comparison of several remediation alternatives. This section of the VCP should include:

- ☐ Text providing a brief description of each alternative, and a discussion regarding how each alternative would or would not meet each of the seven criteria from section 75-10-721, MCA;
  - ☐ Protectiveness;
  - ☐ Compliance with ERCLs;
  - ☐ Mitigation of risk;
  - ☐ Effectiveness and reliability;
  - ☐ Practicability and implementability;
  - ☐ Use of treatment or resource recovery technologies; and
  - ☐ Cost-effectiveness.
- ☐ A summary table providing a comparison of the proposed remedy to other reasonable alternatives based on the seven criteria. This section is meant to provide a truncated feasibility study type analysis.

3.4 Proposed Cleanup Plan: The RP must provide a detailed description of all components of the cleanup plan.

- ☐ Remediation system design diagrams showing how the system will be constructed in the field;
- ☐ A map identifying areas to be remediated, the area where the remediation system will be located, the locations of confirmation samples, the locations of monitoring wells, areas where contaminated media will temporarily be stored/staged and areas not requiring cleanup;
- ☐ Sufficient information to determine if the applicant will be capable of

completing the VCP within the 60-month time requirement; and

- "No further action" VCPs must include a statement that no further remedial action is required at the facility to meet the requirements specified in § 75-10-721, MCA.

- **3.4.1 Waste Management**: Include a discussion of whether or not a hazardous waste will be generated and the volume of this material. If applicable, the RP should describe the sampling program that will be used to verify that the material is not a hazardous waste or that treatment of the contaminated media has resulted in a non-hazardous waste.

- **3.4.2 Implementation of the VCP:** the RP should include a discussion of:

  - **Confirmation Sampling Plan:** The confirmation sampling plan should describe the sampling program that will be used to verify clean-up levels and includes:

    - A discussion of the number, location, and type of samples to be collected;

    - Collection methods and analytical methods that will be used;

    - A brief reference to the approved cleanup levels;

    - Any RCRA contained-out determinations; and

    - A discussion of what quality assurance/quality control (QA/QC) documentation will be followed.

  - **Backfill:** A backfill approval request letter should be submitted for DEQ approval, for all proposed backfill and borrow source material, **before** backfilling takes place. A backfill approval request letter should include the following:

    - A description and map of the backfill source material;

    - A discussion of the number and type of samples collected and the quantity of material that will be used as source material;

    - A discussion of the sample results verses DEQ cleanup or generic screening levels; and

    - Proper QA/QC documentation, including a complete data validation checklist/report, copies of all laboratory results, and a completed chain of custody with the laboratory's sample receipt checklist.

  - **Revegetation**:

    - Recontouring/grading, including final slope and aspect, drainageway reconstruction, and erosion control methods;
    - Coversoil/topsoil, including soil source, soil texture, percent rock fragments, and percent organic matter;
    - Seedbed preparation, including depth of tilling and equipment to be used;
    - Amendment application, including fertilizer, mulch, or other amendment application rates;
    - Seeding/planting, including seed mixes and sources; and seeding rates, techniques, times, and transplants;
    - Submit revegetation plan to, and receive approval from, the county weed control board.
    - Reference area delineation or description of vegetation typical of the surrounding area;
    - Monitoring, including monitoring and reporting frequency, and sampling methods; and
    - Description of reference areas or vegetation typical of the surrounding area needs to provide adequate information for DEQ to be able to

assess vegetation success according to the following criteria:

- Percent vegetation cover by species (current year's growth, including noxious weeds);
  - Percent total vegetative cover (current year's growth, not including noxious weeds);
  - Percent litter (litter plus rock over 2 inches in diameter);
  - Percent bare ground;
  - Herbaceous production;
  - Shrub density (if applicable);
  - List of species (observed anywhere within the seeded area); and
  - Discussion of the gradation and organic content of topsoil.

3.4.3 Operation and Maintenance: The RP O&M plan should include, at a minimum:

- How the system will be optimized and operated to ensure that it functions as designed without interruptions; and
- A sampling program that will be used to monitor its effectiveness in achieving the desired goal.

3.4.4 Sampling or Treatability Studies:

- The RP should include a description of any sampling or treatability studies required before or during the implementation of the VCP.

3.5 Project Schedule:

- A timetable for implementing the RP and for any necessary monitoring of the facility after the proposed measures are completed
- Voluntary cleanups must be initiated within 12 months of approval of the VCP and completed in 60 months or less, excluding O&M.

3.6 Health and Safety Regulations:

- A statement that applicable health and safety regulations will be met during implementation of the RP.

3.7 Minimization of Short-Term Disturbances:

- A description of how short-term disturbances during implementation of the RP will be minimized

3.8 Permits

- Identification of any permits necessary to conduct the work.
- Provide copies of the permits to DEQ before initiation of remediation

4.0 CONSTRUCTION COMPLETION REPORT: Within 60 days after completion of the VCP (including established revegetation), the applicant shall provide to DEQ the following:

A certification in letter form from a qualified environmental professional that the VCP has been fully implemented (including initiation of any required O&M or ICs);

A construction completion report including:

- A list of all COCs along with the remaining concentrations;
- Any deviations from the approved RP and copies of DEQ's approval of those deviations;
- Any material changes or difference from either the EA or the RP VCP;
- Final construction diagrams and pertinent figures and drawings of all remedial systems;
- Disposal manifests;
- Confirmation sampling locations, sample results and laboratory data packages, data validation reports of the confirmation sampling, and comparison to approved VCP cleanup levels;
- Copies of all field logbooks and photographs taken during implementation of the RP;
- Documentation of revegetation with photos;
- Discussion and scheduling of any long-term O&M or engineering controls;
- A copy of all recorded ICs;
- Any VCP Amendments; and
- Any other documentation necessary for DEQ to determine if the VCP has been fully implemented.

ATTACHMENT B

WRITTEN CONSENT OF PROPERTY OWNERS FOR VOLUNTARY CLEANUP AND ACCESS [insert facility name and location]

Sections 75-10-730 through 738, Montana Code Annotated (MCA) authorizes any person to submit a voluntary cleanup plan to the Montana Department of Environmental Quality (DEQ) for remedial actions at a facility. [insert applicant name] is submitting this voluntary cleanup plan for the [insert facility name] located in [insert city], Montana.

Section 75-10-733(2)(c), MCA requires that voluntary cleanup plans must include, "The written consent of current owners of the facility or property to both the implementation of the voluntary cleanup plan and access to the facility by the applicant and its agents and the department." The following agreement has been developed to satisfy this requirement.

As a property owner of [insert facility name (or a portion of the facility name)] as described below, I, [insert owner name], provide consent for the implementation of this voluntary cleanup plan proposed for the facility as approved by DEQ. I further grant access to the facility to [insert applicant name], its agents, and DEQ.

[insert property description]

[insert name and address of owner]

_____

Signature(s)

_____

Name/Title (please print)

_____

Date

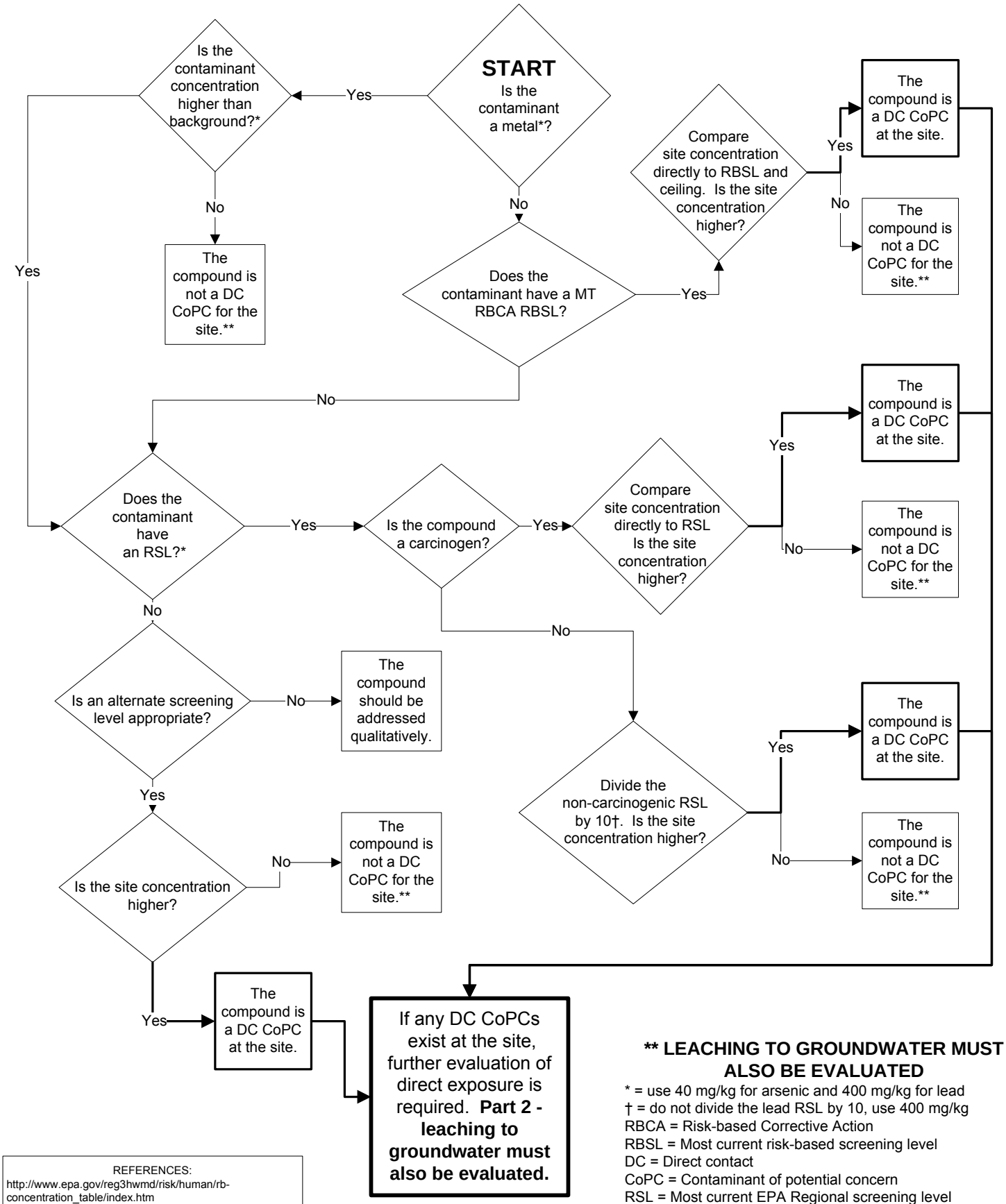
Attachment C - Soil Screening Process – **Must Complete Part 1 and Part 2**

April 2012

Please check http://www.deq.mt.gov/StateSuperfund/FrequentlyAskedQuestions.mcpx#2 for the most current version

Part 1 - Direct Exposure

Note: For volatile contaminants in soil or groundwater, vapor intrusion must be evaluated separately.



**** LEACHING TO GROUNDWATER MUST ALSO BE EVALUATED**

* = use 40 mg/kg for arsenic and 400 mg/kg for lead
† = do not divide the lead RSL by 10, use 400 mg/kg
RBCA = Risk-based Corrective Action
RBSL = Most current risk-based screening level
DC = Direct contact
CoPC = Contaminant of potential concern
RSL = Most current EPA Regional screening level
EPA = Environmental Protection Agency

REFERENCES:
http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
http://www.deq.mt.gov/statesuperfund/rbca_guide.mcpx
http://www.deq.mt.gov/wqinfo/Standards/default.mcpx

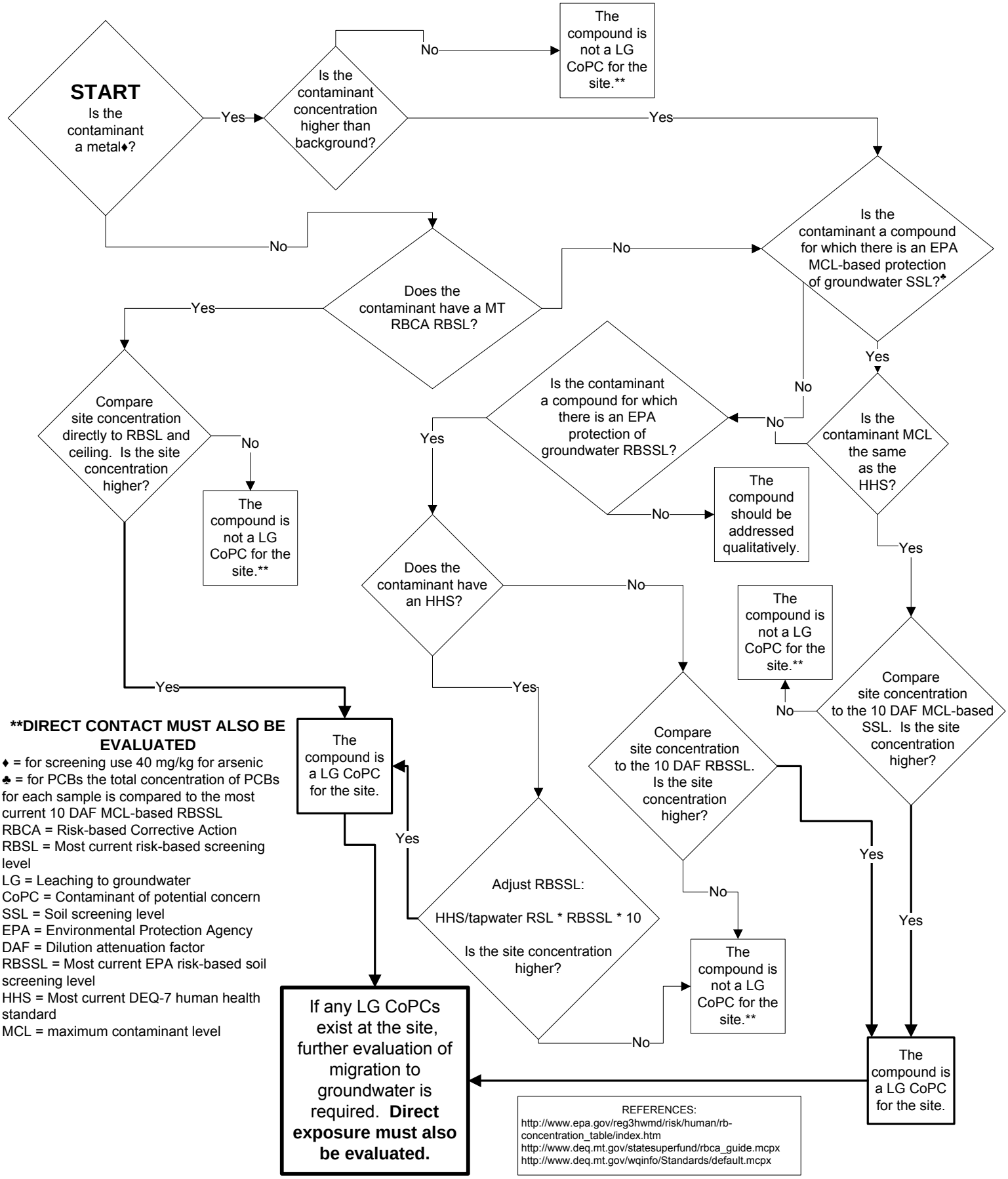
Attachment C - Soil Screening Process – **Must Complete Part 1 and Part 2**

April 2012

Please check http://www.deq.mt.gov/StateSuperfund/FrequentlyAskedQuestions.mcpx#2 for the most current version

Part 2 - Leaching to Groundwater

Note: For volatile contaminants in soil or groundwater, vapor intrusion must be evaluated separately.



****DIRECT CONTACT MUST ALSO BE EVALUATED**

♦ = for screening use 40 mg/kg for arsenic

♣ = for PCBs the total concentration of PCBs for each sample is compared to the most current 10 DAF MCL-based RBSSL

RBCA = Risk-based Corrective Action

RBSL = Most current risk-based screening level

LG = Leaching to groundwater

CoPC = Contaminant of potential concern

SSL = Soil screening level

EPA = Environmental Protection Agency

DAF = Dilution attenuation factor

RBSSL = Most current EPA risk-based soil screening level

HHS = Most current DEQ-7 human health standard

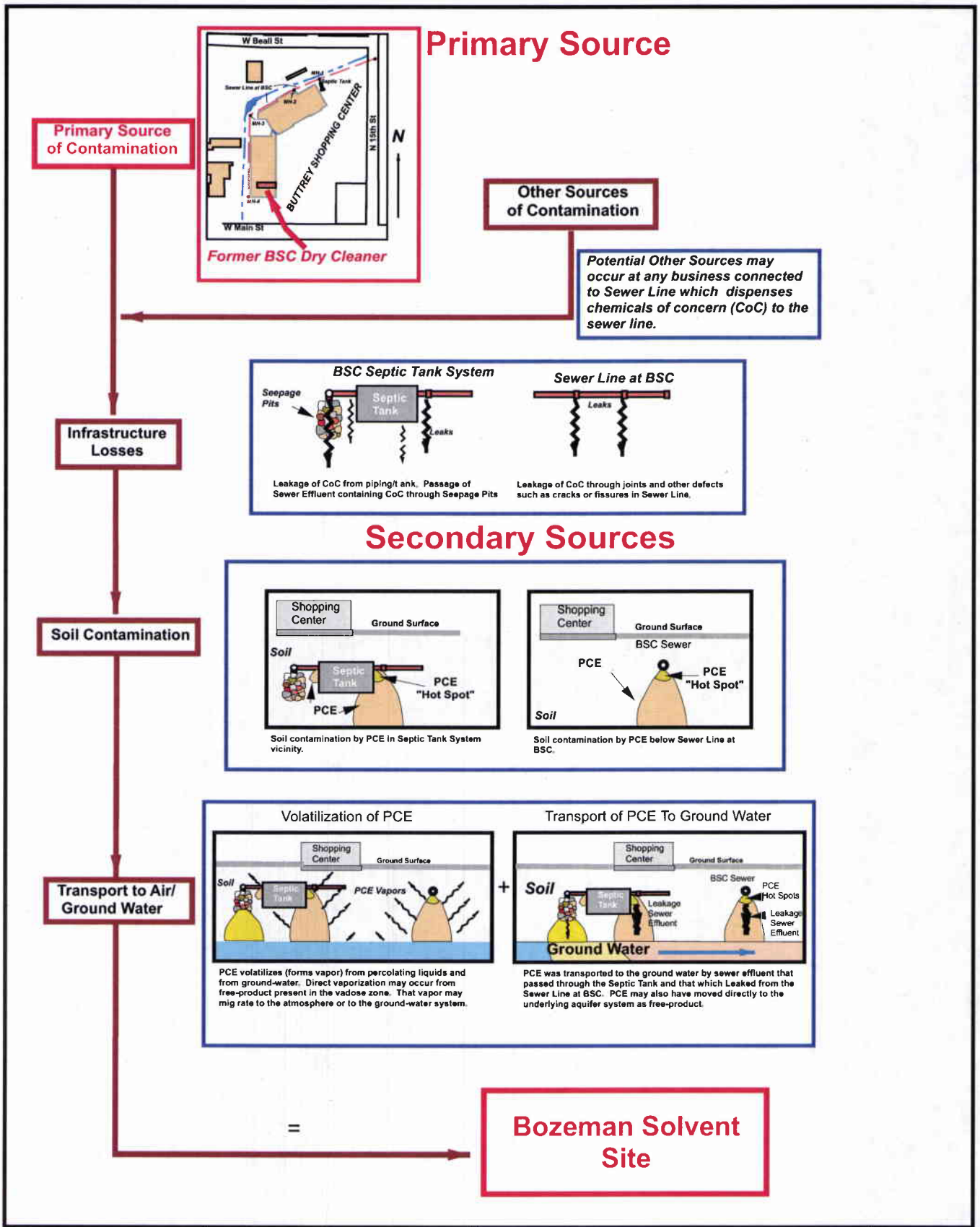
MCL = maximum contaminant level

REFERENCES:

http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

http://www.deq.mt.gov/statesuperfund/rbca_guide.mcpx

http://www.deq.mt.gov/wqinfo/Standards/default.mcpx



From: NE&W, 1999

NICKLIN EARTH & WATER, INC.

Primary and Secondary Sources of Contamination at Buttrey Shopping Center

Figure 5

ATTACHMENT E

TABLES 5-1 AND 5-2

Table 5-1	Evaluation Criteria						
Alternative	**Protective**	**Complies with ERCLs**	**Mitigates Risk**	**Effective & Reliable**	**Practicable & Implementable**	**Use of Technologies**	**Cost-Effective**
No Action	No	No	No	No	Yes	No	Yes, $0
Removal & Disposal at Offsite Permitted Waste Rock Repository	Yes	Yes	Yes	Short-term: Yes Long-term: Yes	Yes	Engineering controls	Yes, $600,000
Consolidation of Wastes in Existing Capped Onsite Repository	Yes	Yes	Yes	Short-term: Yes Long-term: Yes	Yes	Engineering controls	No, $645,000
Construction of New Onsite Repository	Potentially	Yes	Yes	Short-term: Yes Long-term: No	Potentially	Engineering controls	No, $536,000

Table 5-2	Evaluation Criteria						
Alternative	**Protective**	**Complies with ERCLs**	**Mitigates Risk**	**Effective & Reliable**	**Practicable & Implementable**	**Use of Technologies**	**Cost-Effective**
No Further Action	Yes	Yes	Yes, risk already allowable	Yes	Yes	No, none necessary	Yes, $0
Removal & Disposal at Offsite Permitted Land Disposal Facility	Yes	Yes	Yes, risk already allowable	Short-term: Yes Long-term: Yes	Yes	Engineering controls	No, $100,000
Consolidation and Capping of Material Onsite	Yes	Yes	Yes, risk already allowable	Short-term: Yes Long-term: Yes	Yes	Engineering controls	No, $50,000

ATTACHMENT E

EXAMPLE
(Further Remediation Required)

5.5 COMPARISON OF REMEDIATION PROPOSAL TO ALTERNATIVES

Section 75-10-734(3)(b), MCA, requires a brief comparison of the remediation proposal to reasonable alternatives based on the remedy selection criteria in § 75-10-721, MCA. Based on the information available about the facility and knowledge and experience with remedies for other similar facilities, four remedial alternatives have been identified as the most reasonable alternatives for the facility.

Alternative 1: No action (this alternative is retained as a basis for comparison to other alternatives)

Alternative 2: Remove all mine/mill waste and dispose in active offsite mine waste repository with associated institutional controls

Alternative 3: Consolidation of wastes in an existing capped onsite repository with its associated institutional controls

Alternative 4: Construction of a new onsite repository with additional institutional controls

These four alternatives are evaluated based on the following seven criteria (giving due consideration to institutional controls) included in § 75-10-721, MCA.

Protectiveness – The proposed remedy must be demonstrated protective of public health, safety and welfare and the environment.

Compliance – The proposed remedy must comply with applicable and relevant state or federal environmental requirements, criteria, or limitations.

Mitigation – The proposed remedy must be demonstrated to mitigate exposure to risks to public health, safety, and welfare and the environment to allowable levels.

Effectiveness and Reliability – The proposed remedy must be effective and reliable in the short and long term.

Practicability and Implementability – The proposed remedy must be practicable and implementable.

Applicable Technology – The proposed remedy must be chosen in consideration of treatment and resource recovery technologies, giving due consideration to engineering controls.

Cost-Effectiveness – The proposed remedy must be cost-effective relative to the risk reduction it would achieve.

5.5.1 Alternative 1: No Action

The no action alternative would leave the facility in its present condition without further remediation, monitoring, or institutional controls. The no action alternative is used as a baseline against which other remedial options may be compared.

Protectiveness – This alternative would not be protective of public health, safety and welfare and the environment as it would not prevent contact with impacted soil, surface water, or sediment, runoff to surface water, or contaminants leaching to groundwater.

Compliance – The no action alternative does not comply with ERCLs as it does not prevent leaching to groundwater or runoff to surface water that may result in exceedance of DEQ-7 standards. In addition, the no action alternative includes leaving contaminated material in a floodplain.

Mitigation – This alternative would not mitigate exposure to risks to public health, safety, and welfare and the environment.

Effectiveness and Reliability – This alternative is not effective and reliable in the short or long term.

Practicability and Implementability – This alternative is practicable and implementable.

Applicable Technology – This alternative does not use treatment technologies, resource recovery technologies, or engineering controls.

Cost-Effectiveness – The no further action alternative has no cost but does not reduce risks.

5.5.2 Alternative 2: Mine/Mill Waste Removal and Disposal in an Active Offsite Mine Waste Repository

This is the proposed remedy described in detail in Section 5.1. The remedy involves excavating, hauling, and placing all mine/mill waste materials, including soil contaminated above cleanup levels, in an active offsite mine waste repository and reconstructing the stream channel and floodplain. Institutional controls will only be required to prevent disturbance of the offsite repository. Long-term operation and maintenance of the offsite repository would be required.

Protectiveness – This alternative is protective of public health, safety and welfare and the environment because all contaminated materials would be placed in a permitted, maintained facility isolated from human contact and the environment (i.e., non-leaching).

Compliance – This alternative complies with all applicable and relevant ERCLs as described in Section 5.3.

Mitigation – This alternative mitigates exposure to risks by reducing contaminant concentrations remaining onsite to allowable levels as described in Section 5.2.

Effectiveness and Reliability – This alternative is effective and reliable in the short and long term because it will be conducted with adequate controls to prevent the spread of contamination during the remediation and the waste repository will be maintained in perpetuity.

Practicability and Implementability – This alternative is practicable and implementable because the technology exists to remove the contaminated materials and place them in an appropriate repository.

Applicable Technology – Although this alternative does not involve treatment or resource recovery technologies, it does make good use of available engineering controls.

Cost-Effectiveness – This alternative would cost approximately $600,000 to implement, which is cost-effective relative to the level of long-term risk reduction achieved.

5.5.3 Alternative 3: Consolidation of Wastes in Existing Capped Onsite Repository

This alternative involves excavating, hauling, and placing all mine/mill waste materials, including soil contaminated above cleanup levels, in the existing, capped, onsite repository. To accomplish this, approximately seven acres of the existing cap, which consists of soil cover, geotextile filter fabric layer, and capillary barrier rock layer, must be removed to expose the tailings previously placed in the repository. Based on the anticipated waste volume, the wastes could most likely be placed in the repository without expanding the repository footprint. However, the existing runon control ditch would require relocation. Removal and replacement of the cap materials would be costly for the small amount of additional waste placement and would destroy the existing vegetative cover, which would require replacement. Segregation of the cap materials would be difficult. The geotextile layer would likely be destroyed during the removal and would require replacement. Excavation and removal of the capillary barrier rock could not be accomplished without cross-contamination from tailings in the repository. Therefore, the existing capillary barrier would be left in place and the additional mine/mill wastes would be placed on top of it. This would require the placement of a new capillary barrier layer, which results in additional repository volume. If the waste volume were to exceed the capacity of the existing repository footprint, expansion of the repository would require removal and relocation of the existing repository terrace and subsurface riprap protections, which is cost prohibitive. Existing institutional controls would be maintained to prevent disturbance of the repository. Long-term operation and maintenance of the repository would be required.

Protectiveness – This alternative would be protective of public health, safety and welfare and the environment because all contaminated materials would be placed in a maintained facility isolated from human contact and the environment (i.e., non-leaching).

Compliance – This alternative would comply with all applicable and relevant ERCLs.

Mitigation – This alternative mitigates exposure to risks by reducing contaminant concentrations remaining onsite to allowable levels as described in Section 5.2.

Effectiveness and Reliability – This alternative is effective and reliable in the short and long term because it will be conducted with adequate controls to prevent the spread of contamination during the remediation and the waste repository would be maintained in perpetuity.

Practicability and Implementability – This alternative is practicable and implementable because the technology exists to remove the contaminated materials and place them in the existing repository.

Applicable Technology – Although this alternative does not involve treatment or resource recovery technologies, it does make use of available engineering controls.

Cost-Effectiveness – This alternative would cost approximately $645,000 to implement, which is not as cost-effective relative to the level of long-term risk reduction achieved as Alternative 2.

5.5.4 Alternative 4: Construction of New Onsite Repository

This alternative involves excavating and placing all mine/mill wastes, including soils above cleanup levels, in a new onsite repository. The repository would be constructed in the northwest area of the facility. The repository would be designed to contain the estimated waste volume of 41,000 cubic yards plus a 20 percent contingency for additional waste volume, which is a total volume of approximately 49,000 cubic yards. Figure 5-5-1 (fictitious) shows the conceptual design of an onsite repository with top dimensions of 92 feet by 250 feet and 4H:1V site slopes, which results in a waste storage volume of 49,940 cubic yards. The repository would be keyed into the elevation of the main level of the area (4,800 feet above mean sea level). As shown on Figure 5-5-1, a repository of this size would cross the gravel road on the east side of the area onto adjacent private property proposed for residential cleanup and would encroach on the paved county road. Because of the presence of relatively shallow groundwater (15 feet), the coalluvial nature of the underlying soil and the potential for acid generation, the repository would be constructed with top and bottom geosynthetic clay liners and a geocomposite drainage layer to prevent leaching of the mine/mill waste into the soil and groundwater.

Several problems exist with this alternative. 1) Although the applicant has been designated a potentially liable person for the facility, it does not currently own any portion of the facility. Implementation of this alternative would require the applicant to construct, operate and maintain a repository on property it does not own. This is not desirable from the standpoint of long-term access for operation and maintenance, and it may be difficult for the applicant to prevent the current or future property owners from disturbing the repository or changing its intended use. Purchasing the property from the current owners would add considerable cost to the overall project costs. 2) The repository would be located directly adjacent to the nearby town with virtually no separation from the paved county road. This coupled with the repository ownership issues, make it difficult to keep the repository secure and prevent long-term exposure to the mine/mill wastes. 3) This alternative would require rerouting or closing the gravel road on the east side of the facility and would deposit mine/mill waste on property owned by private individuals in the nearby town. Institutional controls would be required to prevent disturbance of the repository. Long-term operation and maintenance of the repository would be required.

Protectiveness – This alternative may be protective of public health, safety and welfare and the environment because all contaminated materials would be placed in a maintained facility isolated from human contact and the environment (i.e., non-leaching). However, significant long-term risk may exist because of the proximity of the repository to residential areas.

Compliance – This alternative would comply with all applicable and relevant ERCLs.

Mitigation – This alternative mitigates exposure to risks by reducing contaminant concentrations remaining onsite to allowable levels as described in Section 5.2. However, significant long-term risk may exist because of the proximity of the repository to residential areas.

Effectiveness and Reliability – This alternative is effective and reliable in the short-term because it will be conducted with adequate controls to prevent the spread of contamination during the remediation. However, the close proximity of the repository to the residential areas in the nearby town reduces the long-term effectiveness and reliability of the remedy for preventing exposures.

Practicability and Implementability – This alternative is practicable and implementable because the technology exists to remove the contaminated materials and place them in the existing repository. However, landowner and road issues may provide limitations to the remedy's implementation.

Applicable Technology – Although this alternative does not involve treatment or resource recovery technologies, it does make use of available engineering controls.

Cost-Effectiveness – This alternative would cost approximately $536,000 to implement, without the cost of purchasing property, which is not cost-effective relative to the level of long-term risk reduction achieved.

5.5.5 Summary of Alternatives Comparison

Alternative 1 was retained for comparative reasons but does not meet the seven criteria included in § 75-10-721, MCA. Alternative 3 meets the evaluation criteria; however, it does not provide a greater level of incremental risk reduction for the additional cost above that of Alternatives 2 and 4 and has greater cost uncertainty because of the potential to exceed the capacity of the existing repository footprint. Alternative 4 does not reduce long-term risks to an acceptable level and is not cost-effective relative to the level of long-term risk reduction achieved. There are also land ownership issues that may affect the implementability of this alternative. Alternative 2 meets all of the evaluation criteria, provides greater long-term protection of public health, safety and welfare and the environment than Alternative 4 and is more cost-effective relative to risk reduction that Alternative 3. Based on this analysis, Alternative 2, mine/mill waste removal and disposal in an active offsite mine waste repository, is the proposed remedy for the facility. Table 5-1 summarizes this evaluation.

EXAMPLE
(No Further Remedial Action Required)

5.5 COMPARISON OF REMEDIATION PROPOSAL TO ALTERNATIVES

Section 75-10-734(3)(b), MCA, requires a brief comparison of the remediation proposal to reasonable alternatives based on the remedy selection criteria in § 75-10-721, MCA. Based on the information available about the facility and knowledge and experience with remedies for other similar facilities, four remedial alternatives have been identified as the most reasonable alternatives for the facility.

Alternative 1: No further action

Alternative 2: Remove and dispose of all wastes at an appropriate offsite land disposal facility

Alternative 3: Consolidation and capping of materials onsite

These three alternatives are evaluated based on the following seven criteria (giving due consideration to institutional controls) included in § 75-10-721, MCA.

Protectiveness – The proposed remedy must be demonstrated protective of public health, safety and welfare and the environment.

Compliance – The proposed remedy must comply with applicable and relevant state or federal environmental requirements, criteria, or limitations.

Mitigation – The proposed remedy must be demonstrated to mitigate exposure to risks to public health, safety, and welfare and the environment to allowable levels.

Effectiveness and Reliability – The proposed remedy must be effective and reliable in the short and long term.

Practicability and Implementability – The proposed remedy must be practicable and implementable.

Applicable Technology – The proposed remedy must be chosen in consideration of treatment and resource recovery technologies, giving due consideration to engineering controls.

Cost-Effectiveness – The proposed remedy must be cost-effective relative to the risk reduction it would achieve.

5.5.1 Alternative 1: No Further Action

The no action alternative would leave the facility in its present condition without further remediation, monitoring, or institutional controls.

Protectiveness – This alternative is protective of public health, safety and welfare and the environment because contaminant levels remaining at the facility are appropriate for current and reasonable anticipated future usage of the facility.

Compliance – The no further action alternative complies with the ERCLs identified in Section 5.3 because no contaminant levels remaining at the facility are above levels that may result in leaching to groundwater or runoff to surface water that may result in exceedance of DEQ-7 standards. In addition, the no action alternative does not involve leaving contaminated material in a floodplain. All other ERCLs are similarly met by the no further action alternative as explained in Section 5.3.

Mitigation – The no further action alternative does not include mitigation of risks as the risks posed by the contaminant levels remaining are the facility are at allowable levels (see Section 5.2).

Effectiveness and Reliability – The no further action alternative is effective and reliable in the short and long term because, as it is, the facility is protective of current and reasonably anticipated future use.

Practicability and Implementability – The no further action alternative is practicable and implementable as it does not require any further action.

Applicable Technology – Although the no further action alternative does not employ treatment or resource recovery technologies or engineering controls, these technologies are not necessary to meet the other evaluation criteria.

Cost-Effectiveness – The no further action alternative has no cost and no risk reduction is required.

5.5.2 Alternative 2: Waste Removal and Disposal in an Offsite Land Disposal Facility

This alternative involves excavation, hauling, and disposal of residually contaminated soil at an offsite land disposal facility. To accomplish this, approximately 100 yards of material with residual contaminant concentrations below the cleanup levels included in Section 5.2 would require excavation, hauling, and disposal.

Protectiveness – This alternative would be protective of public health, safety and welfare and the environment because all contaminated materials would be placed in a permitted maintained facility isolated from human contact and the environment (i.e., non-leaching).

Compliance – This alternative would comply with all applicable and relevant ERCLs.

Mitigation – This alternative mitigates exposure to risks by reducing contaminant concentrations remaining onsite. However, this mitigation is not required because contaminant concentrations remaining onsite are below allowable levels as explained in Section 5.2.

Effectiveness and Reliability – This alternative is effective and reliable in the short- and long-term because it would be conducted with adequate controls to prevent the spread of contamination during the remediation and the permitted waste disposal facility would be maintained in perpetuity. However, excavation and hauling involve unnecessary short-term risks (risk of accidents during remediation and hauling) as the material may be appropriately left in place.

Practicability and Implementability – This alternative is practicable and implementable because the technology exists to remove and dispose of the contaminated materials. However, the no further action alternative is more practicable and implementable.

Applicable Technology – This alternative does not involve treatment or resource recovery technologies, it does make use of available engineering controls.

Cost-Effectiveness – This alternative would cost approximately $100,000 to implement, which is not as cost-effective relative to the level of long-term risk reduction achieved as Alternative 1.

5.5.3 Alternative 3: Consolidation and Capping Onsite

This alternative involves consolidating and capping all residually contaminated soil onsite. To accomplish this, approximately 50 yards of material with residual contaminant concentrations below the cleanup levels included in Section 5.2 would require excavation and consolidation. This remedy would also include construction and long-term maintenance of a 100 foot by 100 foot asphalt cap. Institutional controls would be required to prevent disturbance of the cap. Long-term operation and maintenance of the cap would be required.

Protectiveness – This alternative would be protective of public health, safety and welfare and the environment because all contaminated materials would be placed under a maintained cap isolated from human contact and the environment (i.e., leaching prevented).

Compliance – This alternative would comply with all applicable and relevant ERCLs.

Mitigation – This alternative mitigates exposure to risks by reducing contaminant concentrations remaining onsite. However, this mitigation is not required because contaminant concentrations remaining onsite are below allowable levels as explained in Section 5.2.

Effectiveness and Reliability – This alternative is effective and reliable in the short- and long-term because it would be conducted with adequate controls to prevent the spread of contamination during the remediation and the cap would be maintained in perpetuity. However, excavation and consolidation involve unnecessary short-term risks (risk of accidents during remediation) as the material may be appropriately left in place.

Practicability and Implementability – This alternative is practicable and implementable because the technology exists to consolidate and cap the contaminated materials. However, the no further action alternative is more practicable and implementable.

Applicable Technology – This alternative does not involve treatment or resource recovery technologies, but it does make use of available engineering controls.

Cost-Effectiveness – This alternative would cost approximately $50,000 to implement, which is not as cost-effective relative to the level of long-term risk reduction achieved as Alternative 1.

5.5.5 Summary of Alternatives Comparison

Alternative 2 meets some of the evaluation criteria; however, it does not provide a greater level of incremental risk reduction for the additional cost above that of Alternative 1 and includes additional unnecessary risks during excavation and hauling. Alternative 3 meets some of the evaluation criteria; however, it does not provide a greater level of incremental risk reduction for the additional cost above that of Alternative 1 and includes additional unnecessary risks during excavation and capping. Based on this analysis, Alternative 1, no further action, is the proposed remedy for the facility. Table 5-2 summarizes this evaluation.

ATTACHMENT F
DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY

THIS DECLARATION OF RESTRICTIVE COVENANTS ON REAL PROPERTY (Restrictive Covenants) is made by [insert owner's name] as of [insert date].

RECITALS

WHEREAS, [insert owner's name] is the owner of certain real property (the Subject Property) located in [insert county name] County, Montana, is shown on Attachment 1 and is more particularly described as:

[insert property description]

WHEREAS, the Subject Property is or was previously located within the [insert facility name] (Facility) upon which hazardous or deleterious substances have come to be located; and

WHEREAS, [insert voluntary cleanup applicant's name] is seeking approval from the Montana Department of Environmental Quality (DEQ) for a Voluntary Cleanup Plan (VCP) for the Facility]. As part of the VCP, [insert voluntary cleanup applicant's name] and its officers, employees, agents, representatives, predecessors, successors in interest, and assignees desires to restrict development on the Subject Property and [insert owner's name] is willing to record and comply with such restrictions:

NOW, THEREFORE, [insert owner's name] hereby agrees and declares:

1. No wells may be drilled within the boundaries of the Subject Property without the express prior written approval of DEQ. Groundwater within the Subject Property may not be used for any purpose other than sampling without the express prior written approval of DEQ. The integrity of any monitoring wells must be maintained and no seals may be removed on any closed wells.

2. No soil or soil caps shall be disturbed in any manner, including without limitation drilling or excavation, without the express prior written approval of DEQ. It is the [insert owner's name] intent that this limitation be construed as broadly as possible to prohibit any type of excavation whatsoever.

3. No residential development or use, including but not limited to permanent residential use; temporary residential use; limited residential use; short-term residential use; children's day care; mobile homes with or without footings; mobile home with or without a pad; or camping shall occur upon the Subject Property. It is the [insert owner's name] intent that this limitation be construed as broadly as possible to prohibit any type of residential use whatsoever.

4. No structures, containments, footings for any purpose, or similar below ground appurtenances may be constructed upon the Subject Property.

5. No irrigation of any kind may occur on the Subject Property.

6. No action shall be taken, allowed, suffered, or omitted on the Subject Property if such action or omission is reasonably likely to create a risk of migration of hazardous or deleterious substances or a potential hazard to public health, safety, or welfare or the environment or result in a disturbance of the structural integrity of any engineering controls designed or utilized at the Facility to contain hazardous or deleterious substances or limit human or environmental exposure to the hazardous or deleterious substances.

7. [Insert owner's name] agrees to provide DEQ and its representatives and contractors, [insert voluntary cleanup applicant's name], and all representatives and contractors of any person conducting DEQ-approved remedial actions on the Subject Property access at all reasonable times to the Subject Property.

8. At all times after [insert owner's name] conveys its interest in the Subject Property and no matter what person or entity is in title to or in possession of the Subject Property, [insert owner's name] agrees that [insert voluntary cleanup applicant's name] and its agents shall retain the right to enter the Subject Property at reasonable intervals and at reasonable times of the day in order to inspect for violations of the Restrictive Covenants contained herein.

9. As part of its VCP, [insert voluntary cleanup applicant's name] has agreed to enforce the requirements of these Restrictive Covenants and take prompt action to correct any violations of these Restrictive Covenants. [Insert voluntary cleanup applicant's name] has also agreed to notify DEQ within 30 calendar days of receiving actual or constructive notice of any violation or potential violation of these Restrictive Covenants. [Insert owner's name] specifically agrees that the remedy of "specific performance" of these Restrictive Covenants shall be available to [insert voluntary cleanup applicant's name] in such proceedings. .

10. DEQ shall also be entitled to enforce these Restrictive Covenants as an intended beneficiary thereof. [Insert owner's name] specifically agrees that the remedy of "specific performance" of these Restrictive Covenants shall be available to DEQ in such proceedings. Venue for enforcement of these Restrictive Covenants by DEQ shall be in the state First Judicial District Court, Montana.

11. The provisions of these Restrictive Covenants of the Subject Property shall run with the land and bind all holders, owners, lessees, occupiers, and purchasers of the Subject Property. These restrictive covenants apply in perpetuity and every subsequent instrument conveying an interest in all or any portion of the Subject Property shall include these Restrictive Covenants. [Insert owner's name] will notify DEQ of any proposed conveyance of all or a portion of the Subject

Property at least 30 days prior to any such conveyance. [Insert owner's name] and all future owners will provide notice to all potential purchasers by providing a copy of these Restrictive Covenants prior to the conveyance of all or a portion of the Subject Property and shall provide a copy of this notice to DEQ.

12. [Insert owner's name] and all future owners shall cause the requirements of these Restrictive Covenants to be placed in all instruments that convey an interest in the Subject Property and shall file this document with the county clerk and recorder in [__] County, [___], Montana.

13. The rights provided to DEQ in this declaration include any successor agencies of DEQ.

IN WITNESS WHEREOF, [insert owner's name] has executed this Declaration of Restrictive Covenants on Real Property as of the first date written above.

[INSERT OWNER'S NAME]

_____

By:

State of Montana)
:ss.
County of [insert county name])

On this __ day of _____, 20__, personally appeared _____, before me, a Notary Public for the State of Montana, known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year hereinabove first written.

_____

NOTARY PUBLIC FOR THE STATE OF MONTANA

(SEAL) Residing at _____

My Commission Expires: _____

ATTACHMENT G
EXAMPLE

This document has been prepared to provide an example of an environmental requirements, criteria or limitations (ERCLs) analysis prepared to meet the requirements of the Voluntary Cleanup and Redevelopment Act (VCRA), which requires that the proposed remedy meet the requirements of §§ 75-10-721(2)(a) and (b), MCA. DEQ has included the ERCLs that have been identified in previous voluntary cleanup plans (VCPs) or other remedial actions. Therefore, the conditions described as being in the fictitious VCP under the VCP Compliance sections of this example may not be consistent with one remedy but are meant as examples of how various remedies might comply with the ERCLs identified. In addition, it is possible that some of these ERCLs might not apply to a remedy or that additional ERCLs may apply. It is the responsibility of the VCP applicant to identify laws that apply to the remedial actions and comply with those laws.

The introductory text that follows should be included at the beginning of the ERCLs section of the VCP with the VCP-specific bracketed information completed.

ENVIRONMENTAL REQUIREMENTS, CRITERIA OR LIMITATIONS ANALYSIS

Remedial action undertaken pursuant to the Comprehensive Environmental Cleanup and Responsibility Act (CECRA), § 75-10-701, *et seq.*, MCA, must "attain a degree of cleanup of the hazardous or deleterious substance and control of a threatened release or further release of that substance that assures protection of public health, safety and welfare and of the environment." Section 75-10-721(1), MCA. Additionally, DEQ "shall require cleanup consistent with applicable state or federal environmental requirements, criteria, or limitations" and "may consider substantive state or federal environmental requirements, criteria or limitation that are relevant to the facility conditions." Sections 75-10-721(2)(a) and (b), MCA.

There is a distinction between "applicable" requirements and those that are "relevant." "Applicable" requirements are those requirements that would legally apply at the facility regardless of the CECRA action. "Relevant" requirements are those requirements that are not applicable, but address situations or problems sufficiently similar to those at the facility and, therefore, are relevant for use at the facility. Attainment of "applicable" requirements is mandatory under CECRA. "Relevant" requirements may be considered by DEQ in approving remedial actions under CECRA. All relevant requirements identified in the approved VCP must be attained.

Environmental requirements, criteria or limitation (ERCLs) are generally of three types: action-specific, contaminant-specific, and location-specific. Action-specific requirements are those that are triggered by the performance of a certain activity as part of a particular remedy. They do not in themselves determine the remedy but rather indicate the manner in which the remedy must be implemented. Contaminant-specific requirements are those that establish an allowable level or concentration of a hazardous or deleterious substance in the environment or which prescribe a level or method of treatment for a hazardous or deleterious substance. Location-specific

requirements are those that serve as restrictions on the concentration of a hazardous or deleterious substance or the conduct of activities solely because the facility is in a specific location or the action affects specified types of areas. Some ERCLs could be categorized in more than one way; in this case, they are generally not duplicated within the document.

CECRA defines as cleanup requirements only state and federal ERCLs. Remedial designs, implementation, operation, and maintenance must, nevertheless, comply with all other applicable laws, both state and federal. Many such laws, while not strictly environmental, have environmental impacts. Identification of all applicable laws, including health and safety laws and local regulations that must be complied with during implementation of the voluntary cleanup plan, remains the VCRA applicant's responsibility.

Many requirements listed here are promulgated as identical or nearly identical requirements in both federal and state law, usually pursuant to delegated environmental programs administered by the Environmental Protection Agency and the states, such as the requirements of the federal Clean Water Act and the Montana Water Quality Act. The preamble to the National Contingency Plan states that such a situation results in citation to the state provision as the appropriate standard, but treatment of the provision as a federal requirement. ERCLs and other laws that are unique to state law are also identified.

Within this document, are identified applicable or relevant state and federal ERCLs for the proposed [Facility] voluntary cleanup plan (VCP). The ERCLs contained in this document are tailored to the proposed voluntary cleanup plan submitted and are intended to apply exclusively to this voluntary cleanup plan dated [VCP Date]. If a different plan or remedial action were proposed, preferred, chosen, or implemented for this facility, the ERCLs contained herein might be substantially different.

1.0 ACTION-SPECIFIC ERCLs

1.1 Water Quality Requirements

1.1.1 Clean Water Act, Point Source Discharges Requirements, 33 USC §•1342 (applicable, substantive provisions only): Section 402 of the Clean Water Act, 33 USC §• 1342, *et seq.*, authorizes the issuance of permits for the discharge of any pollutant. This includes storm water discharges associated with industrial activity. *See*, 40 CFR 122.1(b)(2)(iv). Industrial activity includes inactive mining operations that discharge storm water contaminated by contact with or that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations, *see*, 40 CFR 122.26(b)(14)(iii); landfills, land application sites, and open dumps that receive or have received any industrial wastes including those subject to regulation under RCRA subtitle D, *see*, 40 CFR 122.26(b)(14)(v); and construction activity including clearing, grading, and excavation activities, *see*, 40 CFR 122.26(b)(14)(x). Because the State of Montana has been delegated the authority to implement the Clean Water Act, these requirements are enforced in Montana through the Montana Pollutant Discharge Elimination System (MPDES). The MPDES requirements are set forth below.

ARM 17.30.1201 *et seq.*, (standards) and ARM 17.30.1301 *et seq.* (permits) (applicable): If point sources of water contamination are retained or created by any remediation activity, applicable Clean Water Act standards would apply to those discharges. The State of Montana established state standards and permit requirements in conformity with the Clean Water Act, and these standards and requirements apply to point source discharges. *See* ARM 17.30.1201.

ARM 17.30.1342-1344 (applicable): The State of Montana has been delegated the authority to implement the Clean Water Act and these requirements are enforced in Montana through the MPDES. These regulations set forth the substantive requirements applicable to all MPDES and National Pollutant Discharge Elimination System permits. The substantive requirements, including the requirement to properly operate and maintain all facilities and systems of treatment and control, are applicable requirements.

Model VCP Compliance: A permit will be obtained prior to initiation of cleanup activities and the conditions of the permit will be met throughout the remediation. Therefore, the proposed remedy meets the requirements of this ERCL.

1.1.2 Montana Water Quality Act, §§ 75-5-101, *et.seq.*, MCA:

Section 75-5-605, MCA (applicable), prohibits causing pollution of any state waters. Pollution is defined as contamination or other alteration of physical, chemical, or biological properties of state waters which exceeds that permitted by the water quality standards or the discharge, seepage, or drainage of any substances into state water that will likely create a nuisance or render the water harmful, detrimental or injurious to public health, recreation, safety, or welfare, or to livestock or wild animals. Also, it is unlawful to place or cause to be placed any wastes where they will cause pollution of any state waters.

Section 75-5-303, MCA (applicable), states that existing uses of state waters and the level of water quality necessary to protect the uses must be maintained and protected. Section 75-5-317, MCA, provides an exemption from nondegradation requirements which allows changes of existing water quality resulting from an emergency action or reclamation that is designed to protect the public health or the environment and that is approved, authorized, or required by the department. Degradation meeting these requirements may be considered nonsignificant.

ARM 17.30.637 (applicable), prohibits discharges containing substances that will: (a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; (b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials; (c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish flesh or make fish inedible; (d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; or (e) create conditions which produce undesirable aquatic life.

ARM 17.30.705 (applicable), provides that for all state waters, existing and anticipated uses and the water quality necessary to protect these uses must be maintained and protected unless degradation is allowed under the nondegradation rules at ARM 17.30.708.

ARM 17.30.1011 (applicable), provides that any groundwater whose existing quality is higher than the standard for its classification must be maintained at that high quality unless degradation may be allowed under the principles established in Section 75-5-303, MCA and the nondegradation rules at ARM 17.30.701, *et seq.*

1.1.3 Stormwater Runoff Control Requirements

ARM 17.24.633 (applicable), provides all surface drainage from a disturbed area must be treated by the best technology currently available (BTCA). Sediment control through BTCA must be maintained until the disturbed area has been reclaimed, the revegetation requirements have been met, and the area meets state and federal requirements for the receiving stream.

ARM 17.30.1341 (applicable), DEQ issues storm water permits for certain activities. Generally, the permits require the permittee to implement best management practices (BMPs) and to take all reasonable steps to minimize or prevent any discharge which has a reasonable likelihood of adversely affecting human health or the environment. However, if there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with the activity, an individual MPDES permit or alternative general permit may be required.

Model VCP Compliance: As described in Section 5.1 of this VCP, remedial actions at the facility are not expected to result in runoff to surface water at the facility. Remedial actions will be halted if significant runoff is generated and will not resume until adequate runoff control measures are in place. Therefore, the VCP meets the requirements of this ERCL.

1.2 Air Standards

These standards, promulgated pursuant to section 109 of the Clean Air Act, 42 U.S.C. §§ 7401, *et seq.*, (applicable) are applicable to releases into the air from any cleanup activities.

Sections 75-2-101, *et seq.*, MCA, (applicable) provide that state emission standards are enforceable under the Montana Clean Air Act.

ARM 17.8.802 (applicable) incorporates by reference the air regulations in certain parts of CFR Title 40 regarding quality assurance requirements for prevention of significant deterioration air monitoring; standards of performance for new stationary sources; emission standards for hazardous air pollutants, and other standards and requirements.

ARM 17.8.805 (applicable) provides ambient air ceilings, and states that no concentrations of a pollutant shall exceed concentrations permitted under with the applicable secondary or the primary national ambient air quality standard, whichever concentration is lowest for the pollutant for a period of exposure.

ARM 17.8.204 and ARM 17.8.206 (applicable) provides for ambient air monitoring and provides that, generally, all ambient air monitoring, sampling and data collection, recording, analysis and transmittal must be in compliance with the Montana Quality Assurance Manual except when DEQ determines that more stringent requirements are necessary.

ARM 17.8.220 (applicable) prohibits causing or contributing to concentrations of particulate matter in the ambient air such that the mass of settle particulate matter exceeds a 30 day average: 10 gm/m^2, 30 day average, not to be exceeded. A measurement method is also provided.

Dust control regulations are promulgated at ARM 17.8.223 as part of a federally approved State Implementation Plan (SIP), pursuant to the Clean Air Act of Montana, §§ 75-2-101 *et seq.*, MCA (applicable). Corresponding federal regulations are found at 40 CFR 50.6 (applicable).

ARM 17.8.308 (applicable) provides that no person shall cause or authorize the production, handling, transportation or storage of any material; or cause or authorize the use of any street, road, or parking lot; or operate a construction facility or demolition project, unless reasonable precautions to control emissions of airborne particulate matter are taken.

ARM 17.8.308 and ARM 17.8.304 (applicable) state that emissions of airborne particulate matter must be controlled so that they do not "exhibit an opacity of twenty percent (20%) or greater average over six consecutive minutes."

ARM 17.8.324 (applicable) contains certain standards regarding hydrocarbon emissions and the treatment, storage, and handling of petroleum products.

ARM 17.8.604 (applicable) lists certain wastes that may not be disposed of by open burning, including oil or petroleum products, RCRA hazardous wastes, chemicals and wood and wood byproducts that have been coated, painted, stained, treated or contaminated by foreign material. Any waste which is moved from the premises where it was generated and any trade waste (material resulting from construction or operation of any business, trade, industry or demolition project) may be open burned only in accordance with the substantive requirements of ARM 17.8.611 or 612.

ARM 17.24.761 (relevant) specifies a range of measures for controlling fugitive dust emissions during mining and reclamation activities. Some of the measures could be considered relevant to control fugitive dust emissions in connection with excavation, earth moving and transportation activities conducted as part of the remedy at the facility. Such measures include, for example, paving, watering, chemically stabilizing, or frequently compacting and scraping roads, promptly removing rock, soil or other dust-forming debris from roads, restricting vehicle speeds, revegetating, mulching, or otherwise stabilizing the surface of areas adjoining roads, restricting unauthorized vehicle travel, minimizing the area of disturbed land, and promptly revegetating regraded lands.

Model VCP Compliance: The proposed remedy does involve handling impacted soil. However, as described in Section 5.1 of this VCP, remedial actions at the facility will include wetting and other best management practices related to fugitive dust control. Remedial actions

will be halted if significant dust is generated and will not resume until adequate dust control measures are in place. Dust control measures will ensure that air standards will not be exceeded during the proposed remedial action. Air monitoring is not a necessary component of the proposed remedial action. The proposed remedy will not result in emissions of the specific compounds included in these regulations. The proposed remedy does not involve the treatment, storage or handling of petroleum products other than basic refueling of construction equipment. Therefore, the proposed remedy meets the requirements of these ERCLs.

1.3 Water Well Requirements

Sections 37-43-101 to 402, MCA (applicable) provides regulations and licensing for drillers or makers of water wells and monitoring wells.

Section 85-2-505, MCA (applicable) precludes the wasting of groundwater. Any well producing waters that contaminate other waters must be plugged or capped, and wells must be constructed and maintained so as to prevent waste, contamination, or pollution of groundwater.

Section 85-2-516, MCA (applicable) states that within 60 days after any well is completed a well log report must be filed by the driller with the Montana Bureau of Mines and Geology.

ARM 17.30.641 (applicable) provides standards for sampling and analysis of water to determine quality.

ARM 17.30.646 (applicable) requires that bioassay tolerance concentrations be determined in a specified manner.

ARM 36.21.670-678 and 810 (applicable) specifies certain requirements that must be fulfilled when abandoning monitoring wells.

Model VCP Compliance: A licensed monitoring well constructor will abandon a monitoring well and install a monitoring well as part of the proposed remedy. The licensed monitoring well constructor will complete a well log report and file it with the Montana Bureau of Mines and Geology. Monitoring wells will also be sampled as part of the proposed remedy. These activities will be conducted in accordance with the requirements of these ERCLs.

1.4 Solid Waste Management Requirements

Montana Solid Waste Management Act and regulations, §§ 75-10-201, *et seq.*, MCA, ARM 17.50.101 *et seq.* (applicable) - Regulations promulgated under the Solid Waste Management Act, § 75-10-201, *et seq.*, MCA, and pursuant to the federal Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901 *et seq.* (RCRA Subtitle D) specify requirements that apply to the to the transportation of solid wastes and the operation, closure and post-closure care of solid waste facilities:

ARM 17.50.523 (applicable) **s**pecifies that solid waste must be transported in such a manner as to prevent its discharge, dumping, spilling or leaking from the transport vehicle.

ARM 17.50.525 (applicable) specifies DEQ may inspect solid waste facilities at reasonable hours.

ARM 17.50.1009(1)(c) (applicable) requires that solid waste facilities not discharge pollutants in excess of state standards. A solid waste facility must contain a leachate collection system unless there is no potential for migration of a constituent in Appendix I or II to 40 CFR 258.

ARM 17.50.1106 (applicable) specifies the concentration of methane gas generated by a solid waste facility cannot exceed 25 percent of the lower explosive limit for methane in facility structures, excluding gas control or recovery system components, and cannot exceed the lower explosive limit for methane at the facility property boundary.

ARM 17.50.1204 (applicable) provides solid waste facilities must either be designed to ensure that MCLs are not exceeded or the solid waste facility must contain a composite liner and leachate collection system that complies with specified criteria.

ARM 17.50.1108 (applicable) requires that the owner or operator of a solid waste facility use barriers to control public access.

ARM 17.50.1109 (applicable) requires that owners or operators of solid waste facilities design, construct and maintain a run-on control system to prevent flow onto the active portion of the solid waste facility during the peak discharge from a 25-year storm and a run-off control system from the active portion of the solid waste facility to collect and control at least the water volume result from a 24-hour, 25-year storm.

ARM 17.50.1110 (applicable) prohibits any discharge of a pollutant from a solid waste facility to state waters, including wetlands, that violates any requirement of the Montana Water Quality Act. Prohibits any discharge from a solid waste facility of a nonpoint source of pollution to waters of the United States, including wetlands, that violates any requirement of an area-wide or statewide water quality management plan approved under the Federal Clean Water Act.

ARM 17.50.1111 (applicable) prohibits placement of bulk or noncharacterized waste into a solid waste facility, unless the waste is household waste other than septic liquid waste or leachate derived from and placed back into a facility with a composite liner and leachate collection and removal system.

ARM 17.50.1116 (applicable) sets forth requirements for operation of a solid waste facility, including: that solid waste facilities be created and maintained with supervision, fencing and signage; that owners or operators of solid waste facilities take effective measures to control litter and prevent the public from salvaging materials at the facility; and that the facility be designed to control litter, insects, rodents, odor, residues, waste water and air pollutants.

ARM 17.50.1403 (applicable) sets forth closure requirements for solid waste facilities. Solid waste facilities must meet the following criteria: (1) install a final cover that is designed to minimize infiltration and erosion; (2) design and construct the final cover system to minimize infiltration through the closed unit by the use of an infiltration layer that contains a minimum 18

inches of earthen material and has a permeability less than or equal to the permeability of any bottom liner, barrier layer, or natural subsoils or a permeability no greater than 1 X 10^{-5} cm/sec, whichever is less; and (3) minimize erosion of the final cover by the use of a seed bed layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

ARM 17.50.1404 (applicable) sets forth post-closure care requirements for solid waste facilities. Post-closure care must be conducted for a period sufficient to protect human health and the environment. Post-closure care requires maintenance of the integrity and effectiveness of any final cover, including making repairs to the cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the cover and comply with the groundwater monitoring requirements found at ARM Title 17, chapter 50, subchapter 7.

Section 75-10-206, MCA,(applicable) allows variances to be granted from solid waste regulations if failure to comply with the rules does not result in a danger to public health or safety or compliance with specific rules would produce hardship without producing benefits to the health and safety of the public that outweigh the hardship.

40 CFR Part 257 (applicable) establishes standards with which solid waste disposal must comply to avoid possible adverse effects on health or the environment. These criteria apply to any remedial alternatives that require any type of onsite solid waste disposal. The criteria do not apply to hazardous waste disposal that is subject to regulation under subtitle C of the Resource Conservation and Recovery Act (RCRA). Part 257.3-2 provides for the protection of threatened or endangered species. Part 257.3-3 provides that a facility shall not cause the discharge of pollutants into waters of the United Sates. Part 257.3-4 states that a facility or practice shall not contaminate underground drinking water. Part 257.3- states that a facility or practice shall not engage in open burning of solid waste. Part 257.3-8 states the explosive limits or other specifics regarding safety.

ARM 17.36.911 *et seq.* (applicable) governs onsite subsurface wastewater treatment systems. If such a system is constructed, altered or extended, these regulations apply.

Model VCP Compliance: Non-hazardous waste from this facility will be transported and disposed of at [insert the name of the disposal facility], a licensed solid waste management facility, in accordance with these ERCLs. Transport vehicles will be tarped and tied down to avoid any leaking of waste during transport. The impacted soil remaining onsite will not adversely affect human health or the environment as it will be located below the ground surface and as indicated in Section 3.8.3 it is not leaching contaminants to groundwater. Dumping is not part of the proposed action and the owner of the facility has consented to leaving impacted soil below five feet at the facility. An onsite subsurface wastewater treatment system is not proposed for the facility. Therefore, the proposed remedy meets the requirements of these ERCLs.

1.5 Hazardous Waste Management Requirements

1.5.1 RCRA, 42 U.S.C. §§ 6901 *et seq.*, (applicable, as incorporated by the Montana Hazardous Waste Act) and the Montana Hazardous Waste Act, §§ 75-10-401 *et seq.*, MCA, (applicable) and regulations.

These Acts establish a regulatory structure for the generation, transportation, treatment, storage and disposal of hazardous wastes. These requirements are applicable to substances and actions at the facility which involve the active management of hazardous wastes.

Wastes may be designated as hazardous by either of two methods: listing or demonstration of a hazardous characteristic. Listed wastes are the specific types of wastes determined by EPA to be hazardous as identified in 40 CFR Part 261, Subpart D (40 CFR 261.30 - 261.33) (applicable, as incorporated by the Montana Hazardous Waste Act). Listed wastes are designated hazardous by virtue of their origin or source, and must be managed as hazardous wastes regardless of the concentration of hazardous constituents. Characteristic wastes are those that by virtue of concentrations of hazardous constituents demonstrate the characteristic of ignitability, corrosivity, reactivity or toxicity, as described at 40 CFR Part 261, Subpart C (applicable, as incorporated by the Montana Hazardous Waste Act).

See 40 CFR 261.31 (Hazardous Waste Numbers F001 and F002) (applicable, as incorporated by the Montana Hazardous Waste Act) and ARM 17.53.501(applicable). Certain of the wastes at the facility demonstrate the characteristic of toxicity, and are therefore characteristic hazardous wastes upon excavation. The facility also contains F001 and F002 listed hazardous wastes for chlorinated solvents. The various media and wastes at the facility contaminated by the F001 and F002 wastes are also hazardous wastes pursuant to 40 CFR Part 261 upon excavation. The RCRA requirements specified below are applicable requirements for the treatment, storage and disposal of these wastes. These ERCLs apply to remedial actions; on-going operations must comply with state and federal requirements and permits.

ARM 17.53.112 (applicable, as incorporated by the Montana Hazardous Waste Act) specifies that the presence of listed and characteristic hazardous waste require the permit requirements specified below that are applicable for the types of waste management units or the waste management practices anticipated in the remedial actions at the facility.

The RCRA regulations at 40 CFR Part 262 (applicable, as incorporated by the Montana Hazardous Waste Act) establish standards that apply to generators of hazardous waste. These standards include requirements for obtaining an EPA identification number and maintaining certain records and filing certain reports. These standards are applicable for any waste which will transported offsite.

The RCRA regulations at 40 CFR Part 263 (applicable, as incorporated by the Montana Hazardous Waste Act) establish standards that apply to transporters of hazardous waste. These standards include requirements for immediate action for hazardous waste discharges. These standards are applicable for any onsite transportation. These standards are independently applicable for any offsite transportation.

The regulations at 40 CFR 264, Subpart B (applicable, as incorporated by the Montana Hazardous Waste Act) establish general facility requirements. These standards include requirements for general waste analysis, security and location standards.

The regulations at 40 CFR 264, Subpart F (applicable, as incorporated by the Montana Hazardous Waste Act) establish requirements for groundwater protection for RCRA-regulated solid waste management units (i.e., waste piles, surface impoundments, land treatment units, and landfills). The regulations at Subpart F establish monitoring requirements for RCRA-regulated solid waste management units (i.e., waste piles, surface impoundments, land treatment units, and landfills). Subpart F provides for three general types of groundwater monitoring: detection monitoring (40 CFR 264.98); compliance monitoring (40 CFR 264.99); and corrective action monitoring (40 CFR 264.100). Monitoring wells must be cased according to 264.97(c).

Monitoring is required during the active life of a hazardous waste management unit. If hazardous waste remains, monitoring is required for a period necessary to protect human health and the environment.

40 CFR Part 264, Subpart G (applicable, as incorporated by the Montana Hazardous Waste Act) establishes that hazardous waste management facilities must be closed in such a manner as to (a) minimize the need for further maintenance and (b) control, minimize or eliminate, to the extent necessary to protect public health and the environment, post-closure escape of hazardous wastes, hazardous constituents, leachate, contaminated runoff or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.

Requirements for facilities requiring post-closure care include the following: the facilities must undertake appropriate monitoring and maintenance actions, control public access, and control post-closure use of the property to ensure that the integrity of the final cover, liner, or containment system is not disturbed. In addition, all contaminated equipment, structures and soil must be properly disposed of or decontaminated unless exempt and free liquids are removed or solidified, the wastes stabilized, and the waste management unit covered.

40 CFR Part 264, Subparts I and J (Applicable, as incorporated by the Montana Hazardous Waste Act) apply to owners and operators of facilities that store hazardous waste in containers, and store or treat hazardous waste in tanks, respectively. These regulations are applicable to any storage or treatment in these units at the facility. The related provisions of 40 CFR 261.7 regarding residues of hazardous waste in empty containers are also applicable.

40 CFR Part 264, Subpart S (Applicable, as incorporated by the Montana Hazardous Waste Act) provides special provisions for cleanup; 40 CFR 264.552 allows the designation of a corrective action management unit (CAMU) located within the contiguous property under the control of the owner or operator where the wastes to be managed in the CAMU originated and provides requirements for siting, managing, and closing the CAMU. An example of CAMU-eligible waste includes F001-contaminated soil that must be managed to implement the cleanup. Placement of this CAMU-eligible waste does not constitute land disposal of hazardous waste. If staging piles are needed during remediation, compliance with 40 CFR 264.554 will be required.

40 CFR 264.554 sets forth the requirements for a staging pile. A staging pile must be located within the contiguous property under the control of the owner/operator where the wastes to be managed in the staging pile originated. The staging pile must be designed so as to prevent or minimize releases of hazardous wastes and hazardous constituents into the environment, and minimize or adequately control cross-media transfer, as necessary to protect human health and the environment (for example, through the use of liners, covers, run-off/run-on controls, as appropriate). The staging pile must not operate for more than two years and cannot be used for treatment.

Since the wastes to be treated are listed and characteristic wastes, the RCRA Land Disposal Restrictions (LDRs) treatment levels set forth in 40 CFR Part 268 are applicable requirements including the treatment levels for F001 and F002 listed wastes for the disposal of hazardous wastes generated at the facility. With the exception of treated soils, hazardous wastes are prohibited from disposal onsite.

The Hazardous Waste Identification Rule (HWIR) Media Rule promulgated at 63 Fed. Reg. 65874 (November 30, 1998) (applicable, as incorporated by the Montana Hazardous Waste Act) allows listed waste treated to levels protective of human health and the environment to be disposed onsite without triggering land ban or minimum technology requirements for these disposal requirements. Treated soils containing hazardous waste will need to meet cleanup levels to avoid triggering land ban or minimum technology requirements for these disposal requirements.

40 CFR Part 270 (applicable, as incorporated by the Montana Hazardous Waste Act) sets forth the hazardous waste permit program. The requirements set forth in 40 CFR Part 270, Subpart C (permit conditions), including the requirement to properly operate and maintain all facilities and systems of treatment and control are applicable requirements.

1.5.2 The Montana Hazardous Waste Act, §§ 75-10-401 *et seq.*, MCA (applicable) and regulations.

This Act establishes a regulatory structure for the generation, transportation, treatment, storage and disposal of hazardous wastes. These requirements are applicable to substances and actions at the facility which involve listed and characteristic hazardous wastes.

ARM 17.53.501-502 (applicable) adopts the equivalent of RCRA regulations at 40 CFR Part 261, establishing standards for the identification and listing of hazardous wastes, including standards for recyclable materials and standards for empty containers, with certain State exceptions and additions.

ARM 17.53.601-604 (applicable) adopts the equivalent to RCRA regulations at 40 CFR Part 262, establishing standards that apply to generators of hazardous waste, including standards pertaining to the accumulation of hazardous wastes, with certain State exceptions and additions.

ARM 17.53.701-708 (applicable) adopts the equivalent to RCRA regulations at 40 CFR Part 263, establishing standards that apply to transporters of hazardous waste, with certain State exceptions and additions.

ARM 17.53.801-803 (applicable) adopts the equivalent to RCRA regulations at 40 CFR Part 264, establishing standards that apply to hazardous waste treatment, storage and disposal facilities, with certain State exceptions and additions.

ARM 17.53.1101-1102 (applicable) adopts the equivalent to RCRA regulations at 40 CFR Part 268, establishing land disposal restrictions, with certain State exceptions and additions.

Section 75-10-422 MCA (applicable) prohibits the unlawful disposal of hazardous wastes.

ARM 17.53.1201-1202 (applicable) adopts the equivalent to RCRA regulations at 40 CFR Part 270 and 124, which establish standards for permitted facilities, with certain State exceptions and additions.

ARM 17.53.1401 (applicable) adopts the equivalent of RCRA regulations at 40 CFR Part 279 that set forth the standards for the management of used oil.

Model VCP Compliance: As described in Section 5.1, the proposed remedy involves properly treating, transporting, and disposing of all hazardous waste at [insert the name of the facility] in accordance with the requirements of these ERCLs. The excavated soil will be placed into appropriately-sized containers that meet RCRA requirements and disposed of at an offsite RCRA-permitted hazardous waste facility. Investigation derived waste (IDW) will be generated in the form of water used for decontamination of sampling equipment (backhoe). IDW from decontamination of equipment will likely contain FO01 listed hazardous waste and therefore will be contained in a drum with a lid that can be tightened to prevent leaking that will be placed into an overpack drum or other secondary containment and stored within an access-controlled (fenced) outdoor temporary storage area pending disposal at an offsite RCRA-permitted hazardous waste disposal facility capable of accepting FO01 waste. The IDW will be transported outside the Facility within 90 days, a hazardous waste transporter will be used, and the hazardous waste will be manifested.

1.6 Technology-Based Treatment

ARM 17.30.1203 (Applicable): Provisions of 40 CFR Part 125 for criteria and standards for the imposition of technology-based treatment requirements are adopted and incorporated in DEQ permits. For toxic and nonconventional pollutants treatment must apply the best available technology economically achievable (BAT); for conventional pollutants, application of the best conventional pollutant control technology (BCT) is required. Where effluent limitations are not specified for the particular industry or industrial category at issue, BCT/BAT technology-based treatment requirements are determined on a case by case basis using best professional judgment (BPJ).

Model VCP Compliance: The VCP applicant will obtain the required permit which may impose a technology-based treatment requirement. The applicant will comply with all permit requirements. Therefore, the proposed remedy meets the requirements of these ERCLs.

1.7 Underground Injection Control Program

The Underground Injection Control Program provided in 40 CFR Parts 144 and 146 (Applicable) sets forth the standards and criteria for the injection of substances into aquifers. Wells are classified as Class I through V, depending on the location and the type of substance injected. For all classes, no owner may construct, operate or maintain an injection well in a manner that results in the contamination of an underground source of drinking water at levels that violate maximum contaminant levels (MCLs) or otherwise adversely affect the health of persons. Each classification may also contain further specific standards, depending on the classification.

Model VCP Compliance: No injection of substances will occur as part of the proposed remedy. Therefore, the proposed remedy meets the requirements of these ERCLs.

1.8 Underground Storage Tank Requirements

40 CFR Part 280, Subpart F (applicable**)** sets forth requirements for Release Response and Corrective Action for underground storage tank (UST) Systems Containing Petroleum or Hazardous Substances. These include initial response, initial abatement measures, facility characterization, free product removal, and investigations for soil and groundwater cleanup.

40 CFR 280.64 (applicable) provides that where investigations in connection with leaking underground storage tanks reveal the presence of free product, owners and operators must remove free product to the maximum extent practicable as determined by the implementing agency. This regulation also requires that the free product removal be conducted in a manner that minimizes the spread of contamination into previously uncontaminated zones by using recovery and disposal techniques appropriate to the hydrogeologic conditions at the facility, and that properly treats, discharges or disposes of recovery byproducts in compliance with applicable local, state and federal regulations.

40 CFR 280.64 (applicable) provides that abatement of free product migration is a minimum objective for the design of the free product removal system provides that any flammable products must be handled in a safe and competent manner to prevent fires or explosions.

40 CFR Part 280, Subpart D (applicable) sets forth requirements for release detection.

40 CFR 280.43 (relevant) specifies groundwater monitoring requirements for underground storage tanks and requires continuous monitoring devices or manual methods used to detect the presence of at least 1/8 of an inch of free product on top of the groundwater in the monitoring wells.

The Montana regulations regarding underground storage tanks include similar requirements.

ARM Title 17, Chapter 56, Sub-Chapter 4 (applicable) specifies release detection.

ARM 17.56.407 (applicable) specifies groundwater monitoring requirements for underground storage tanks and requires continuous monitoring devices or manual methods used to detect the presence of at least 1/8 of an inch of free product on top of the groundwater in the monitoring wells.

ARM Title 17, Chapter 56, Sub-Chapter 6 (applicable) specifies release response and corrective action for tanks containing petroleum or hazardous substances.

ARM 17.56.602 through 605 (applicable) requires certain mitigation measures including removal of as much of the regulated substance from the system as is necessary to prevent further release into the environment and prevention of further migration of the released substance into surrounding soil and groundwater. In particular, ARM 17.56.602(1)(c) (applicable requires that after a release from an underground storage tank system is identified in any manner, owners and operators must investigate to determine the possible presence of free product, begin free product removal as soon as practicable, conduct free product removal in a manner that minimizes the spread of contamination into previously uncontaminated zones by using recovery and disposal techniques appropriate to the hydrogeologic conditions at the site, and that properly treats, discharges or disposes of recovery byproducts in compliance with applicable local, state and federal regulations. This regulation also provides that abatement of free product migration is a minimum objective for the design of the free product removal system and provides that any flammable products must be handled in a safe and competent manner to prevent fires or explosions.

ARM 17.56.607 (relevant) specifies that all free product must be removed to the maximum extent practicable before a release may be considered resolved.

ARM 17.56.702 (applicable) requires that all tanks and connecting piping which are taken out of service permanently must be removed from the ground. This applies if any remaining underground piping is encountered during remedial activities.

Model VCP Compliance: All underground storage tanks have been removed from the facility previously in compliance with these ERCLs. Also, there is no detectable free product in any groundwater well. Therefore, the proposed remedy meets the requirements of these ERCLs.

1.9 Reclamation and Revegetation Requirements

Certain portions of the Montana Strip and Underground Mining Reclamation Act and Montana Metal Mining Act as outlined below are relevant requirements for activities at the facility. While no mining activities are occurring at the facility, these requirements are relevant for the management and reclamation of areas disturbed by excavation, grading, or similar actions.

ARM 17.24.501 (relevant) gives general backfilling and final grading requirements.

ARM 17.24.631 (relevant) provides that long-term adverse changes in the hydrologic balance from mining and reclamation activities, such as changes in water quality and quantity, and location of surface water drainage channels shall be minimized. Water pollution must be

minimized and, where necessary, treatment methods utilized. Diversions of drainages to avoid contamination must be used in preference to the use of water treatment facilities. Other pollution minimization devices must be used if appropriate, including stabilizing disturbed areas through land shaping, diverting runoff, planting quickly germinating and growing stands of temporary vegetation, regulating channel velocity of water, lining drainage channels with rock or vegetation, mulching, and control of acid-forming, and toxic-forming waste materials.

ARM 17.24.633 (relevant) states that all surface drainage from a disturbed area must be treated by the best technology currently available (BTCA). Treatment must continue until the area is stabilized.

ARM 17.24.635 through 17.24.637 (relevant) set forth requirements for temporary and permanent diversions.

ARM 17.24.638 (relevant) specifies sediment control measures to be implemented during operations.

ARM 17.24.640 (relevant) provides that discharge from sedimentation ponds, permanent and temporary impoundments, and diversions shall be controlled by energy dissipaters, riprap channels, and other devices, where necessary, to reduce erosion, prevent deepening or enlargement of stream channels, and to minimize disturbance of the hydrologic balance.

ARM 17.24.641(relevant) indicates that practices to prevent drainage from acid or toxic forming spoil material into groundwater and surface water will be employed.

ARM 17.24.703 (relevant) require that when using materials other than, or along with, soil for final surfacing in reclamation, the operator must demonstrate that the material (1) is at least as capable as the soil of supporting the approved vegetation and subsequent land use, and (2) the medium must be the best available in the area to support vegetation. Such substitutes must be used in a manner consistent with the requirements for redistribution of soil in ARM 17.24.701 and 702.

ARM 17.24.713 (relevant) provides that seeding and planting of disturbed areas must be conducted during the first appropriate period for favorable planting after final seedbed preparation, but may not be more than ninety days after soil has been replaced.

ARM 17.24.714 (relevant) requires use of a mulch or cover crop or both until an adequate permanent cover can be established. Use of mulching and temporary cover may be suspended under certain conditions.

ARM 17.24.716 (relevant) establishes the required method of revegetation, and provides that introduced species may be substituted for native species as part of an approved plan for alternate vegetation.

ARM 17.24.721 (relevant) specifies that rills and gullies must be stabilized and the area reseeded and replanted if the rills and gullies are disrupting the reestablishment of the vegetative cover.

ARM 17.24.751(relevant) measures to prevent degradation of fish and wildlife habitat will be employed.

ARM 17.24.761 (relevant) requires that fugitive dust control measures will be employed during excavation and construction activities to minimize the emission of fugitive dust.

Model VCP Compliance: The excavation will be backfilled with clean fill and regraded to slopes appropriate for its usage. Surface water controls will be implemented during construction to prevent runoff from contaminated soil. Final surfacing will use appropriate soil material. Seeding and planting of disturbed areas will be conducted within ninety days after the soil has been replaced. A mulch cover will be used until an adequate cover is established. The disturbed areas will be revegetated consistent with these requirements. Surface water run-on and runoff measures will be implemented to prevent the spread of contamination into areas where it could degrade fish and wildlife habitat. Dust control measures will be used during excavation and backfilling areas. Thus the proposed remedy meets the requirements of these ERCLs.

1.10 Noxious Weed Requirements

Section 7-22-2101(7)(a), MCA (applicable) defines "noxious weeds" as any exotic plant species established or that may be introduced in the state which may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses or that may harm native plant communities and that is designated: (i) as a statewide noxious weed by rule of the department; or (ii) as a district noxious weed by a board, following public notice of intent and a public hearing.

Designated noxious weeds are listed in ARM 4.5.206 through 4.5.210 (applicable) and must be managed consistent with weed management criteria developed under § 7-22-2109(2)(b), MCA (applicable).

Section 7-22-2152, MCA (applicable) requires that any person proposing certain actions including but not limited to a solid waste facility, a highway or road, a commercial, industrial, or government development, or any other development that needs state or local approval and that results in the potential for noxious weed infestation within a district shall notify the district weed board at least 15 days prior to the activity. The board will require that the areas be seeded, planted, or otherwise managed to reestablish a cover of beneficial plants. The person committing the action shall submit to the board a written plan specifying the methods to be used to accomplish revegetation at least 15 days prior to the activity. The plan must describe the time and method of seeding, fertilization practices, recommended plant species, use of weed-free seed, and the weed management procedures to be used. The plan is subject to approval by the board, which may require revisions to bring the revegetation plan into compliance with the district weed management plan. The activity for which notice is given may not occur until the plan is approved by the board and signed by the presiding officer of the board and by the person or a representative of the agency responsible for the action. The signed plan constitutes a binding agreement between the board and the person or agency. The plan must be approved, with revisions if necessary, within 10 days of receipt by the board.

Model VCP Compliance: As specified in Section 5.1, the county weed board will be notified of the impending cleanup activity and provided with a copy of the VCP if requested. A revegetation plan meeting the requirements specified in Section 5.1 and any other specific requirements of the board will be submitted to the board at least 15 days prior to initiation of the cleanup. A copy of the revegetation and approval letter will be provided to DEQ when available. Therefore, the proposed remedy meets the requirements of these ERCLs.

2.0 CONTAMINANT-SPECIFIC ERCLs

2.1 Groundwater Standards

2.1.1 Safe Drinking Water Act – 42 U.S.C. § 300f *et seq*. and the National Primary Drinking Water Regulations (40 CFR Part 141) (relevant – this ERCL may be applicable if a public drinking water supply is involved at the facility) establish MCLs and maximum contaminant level goals (MCLGs) for contaminants in drinking water distributed in public water systems. The requirements were evaluated in this ERCLs analysis in conjunction with the ground water classification standards promulgated by the State of Montana.

Use of these standards for this action is fully supported by EPA regulations and guidance. The Preamble to the National Contingency Plan (NCP) clearly states that MCLs are relevant for groundwater that is a current or potential source of drinking water (55 Fed.Reg. 8750, March 8, 1990), and this determination is further supported by requirements in the regulations governing conduct of the RI/FS studies found at 40 CFR 300.430(e)(2)(i)(B). EPA's guidance on Remedial Action for Contaminated Groundwater at Superfund Sites states that "MCLs developed under the Safe Drinking Water Act generally are ARARs [the federal equivalent of ERCLs] for current or potential drinking water sources." MCLGs which are above zero are relevant under the same conditions (55 Fed.Reg. 8750-8752, March 8, 1990). *See also*, *State of Ohio v. EPA*, 997 F.2d 1520 (D.C. Cir. 1993), which upholds EPA's application of MCLs and non-zero MCLGs as ARARs for groundwater which is a potential drinking water source.

Chemical	MCLG	MCL
Arsenic	0[1]	10 ug/L
Benzene	0[1]	5 ug/L
Dioxins/furans	0[1]	.00003 ug/L (30 ppq)
Ethylbenzene	700	700 ug/L
Pentachlorophenol	0[1]	1 ug/L
Toluene	1,000 ug/L	1,000 ug/L

[1] An MCLG of zero is not an appropriate standard for Superfund site cleanups.

In addition, the Secondary Maximum Contaminant Levels (SMCLS) specified in 40 CFR Part 143.3 are relevant requirements which are ultimately to be attained by the remedy for [insert name of facility]. This regulation contains standards for iron, manganese, color, odor, and corrosivity that are relevant to the remedial actions.

2.1.2 The Montana Water Quality Act, §§ 75-5-101, *et seq.*, MCA (applicable) and regulations.

ARM 17.30.1005 and –1006 (applicable) provides that groundwater is classified I through IV based on its beneficial uses. Class I is the highest quality class; class IV the lowest.

ARM 17.30.1006 (applicable) sets the standards for the different classes of groundwater. Concentrations of dissolved substances in groundwater may not exceed the human health standards listed in Department Circular DEQ-7[1], (applicable) including narrative standards, which are promulgated pursuant to the state Water Quality Act, §§ 75-5-101, *et seq.*, MCA. Concentrations of other dissolved or suspended substances must not exceed levels that render the waters harmful, detrimental or injurious to beneficial uses. For the primary contaminants of concern, the DEQ-7 standards are listed below. However, compliance with all DEQ-7 standards is required and remedial actions must meet the DEQ-7 standards for all contaminants at the facility, including any breakdown products generated during remedial actions.

Chemical	DEQ-7 Standard for Groundwater
tetrachloroethene (PCE)	5 μg/l
trichloroethene (TCE)	5 μg/l
trans-1,2 dichloroethene	100 μg/l
cis-1,2 dichloroethene	70 μg/l
vinyl chloride	0.2 μg/l

ARM 17.30.1011 (applicable) provides that any ground water whose existing quality is higher than the standard for its classification must be maintained at that high quality unless degradation may be allowed under the principles established in § 75-5-303, MCA, and the nondegradation rules at ARM 17.30.701 *et seq.*

Model VCP Compliance: No public drinking water supply sources are located near the facility. As described in Section 3.8.3 of this VCP, the impacted soil is not leaching COPCs to the groundwater at concentrations above human health standards or risk based screening levels. Groundwater at the facility would be classified as Class II based on specific conductivity greater than 1,000 microSiemens/cm but less than 2,500 microSiemens/cm. Groundwater at the facility does not exceed the standards listed in DEQ-7 or the MCLs. The proposed remedy will not create additional groundwater degradation, which will be verified through groundwater monitoring. Therefore, the proposed remedy meets the requirements of these ERCLs.

2.2 Surface Water Quality Standards

The Montana Water Quality Act, §§ 75-5-101 *et seq.*, MCA, (applicable) establishes requirements for restoring and maintaining the quality of surface and ground waters and the federal Clean Water Act, 33 U.S.C. §§ 1251 *et seq.*, establishes requirements for restoring and maintaining the quality of surface waters. Under these Acts the state has authority to adopt water quality standards designed to protect beneficial uses of each water body and to designate uses for each water body. Montana's regulations classify state waters according to quality, place

[1] Montana Department of Environmental Quality, Water Quality Division, *Circular DEQ-7, Montana Numeric Water Quality Standards* (August 2010) ("DEQ-7").

restrictions on the discharge of pollutants to state waters and prohibit the degradation of state waters.

ARM 17.30.611(1) (applicable) provides that the waters of the [insert river name] River drainage from [insert stretch description] are classified "B-3" for water use.

The "B-3" classification standards are contained in ARM 17.30.625 (applicable) of the Montana water quality regulations. This section provides the beneficial uses for the B-3 classification, and provides that concentrations of toxic, carcinogenic, or harmful parameters in the waters may not exceed DEQ-7 standards. The section also provides the specific water quality standards for water classified as B-3.

For the primary contaminants of concern, the DEQ-7 levels are listed below. DEQ-7 provides that "whenever both Aquatic Life Standards and Human Health Standards exist for the same analyte, the more restrictive of these values will be used as the numeric Surface Water Quality Standard."

Chemical	DEQ-7 Standard for Surface Water
tetrachloroethene (PCE)	5 μg/l
trichloroethene (TCE)	5 μg/l
trans-1,2 dichloroethene	100 μg/l
cis-1,2 dichloroethene	70 μg/l
vinyl chloride	0.25 μg/l

ARM 17.30.625 provides that concentrations of carcinogenic, bioconcentrating, toxic or harmful parameters which would remain in the water after conventional water treatment may not exceed the applicable standards set forth in DEQ-7.

The B-3 classification standards at ARM 17.30.625 also include the following criteria: 1) dissolved oxygen concentration must not be reduced below the levels given in department circular DEQ-7; 2) hydrogen ion concentration (pH) must be maintained within the range of 6.5 to 9.0; 3) the maximum allowable increase above naturally occurring turbidity is 5 nephelometric turbidity units; 4) temperature increases must be kept within prescribed limits; 5) no increase are allowed above naturally occurring concentrations of sediment, settleable solids, oils, floating solids, which will or is likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish or other wildlife; and 6) true color must be kept within specified limits.

ARM 17.30.637 (applicable) prohibits discharges containing substances that will: (a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; (b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials; (c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish flesh or make fish inedible; (d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; (e) create conditions which produce undesirable aquatic life.

ARM 17.30.637 (Applicable) also provides that leaching pads, tailing ponds, or water, waste or product holding facilities must be located, constructed, operated and maintained to prevent any discharge, seepage, drainage, infiltration, or flow which may result in pollution of state waters, and a monitoring system may be required to ensure such compliance. No pollutants may be discharged and no activities may be conducted which, either alone or in combination with other wastes or activities, result in the total dissolved gas pressure relative to the water surface exceeding 110 percent of saturation.

ARM 17.30.705 (Applicable) provides that for any surface water, existing and anticipated uses and the water quality necessary to protect these uses must be maintained and protected unless degradation is allowed under the nondegradation rules at ARM 17.30.708.

Model VCP Compliance: As described in Section 5.1 of this VCP, remedial actions at the facility include relocation of the stream and will result in remediation of the surface water and sediment in the stream. The remedial actions will be conducted in accordance with applicable permits to minimize the discharge of any material to surface water at the facility. Following the remediation, surface water at the facility will not exceed the standards listed in DEQ-7. Therefore, the VCP meets the requirements of these ERCLs.

2.3 Air Standards

The Clean Air Act (42 U.S.C. §§ 7401 *et seq.*) (applicable) provides limitations on air emissions resulting from cleanup activities or emissions resulting from wind erosion of exposed hazardous substances. Some of these ERCLs, identified as action-specific requirements could also be identified here as contaminant specific requirements but will not be repeated.

The National Emission Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR Part 61 (applicable) establishes emission standards for specific air pollutants.

Sections 75-2-101, *et seq.*, MCA, (applicable) provides that state emission standards are enforceable under the Montana Clean Air Act.

ARM 17.74 Subchapter 3 (applicable) addresses requirements related to persons or entities engaged in asbestos related occupations, in charge of asbestos projects, or engaged in facility demolition or renovation activities. Training requirements for persons engaged in asbestos-type occupations are specified.

The Asbestos Control Act (§§ 75-2-501 *et seq.*, MCA) (applicable) establishes requirements for asbestos projects including permitting and inspection requirements.

ARM 17.8.220 (applicable) provides that no person shall cause or contribute to concentrations of particulate matter in the ambient air such that the mass of settled particulate matter exceeds a 30-day average of 10 $gm/m^{2.}$ A measurement method is also provided.

ARM 17.8.221 (applicable) provides concentrations of particulate matter in ambient air shall not exceed annual average scattering coeffient of 3×10^{-5} per meter.

40 CFR 50.12 and ARM 17.8.222 (applicable) provides ambient air quality standards for lead. Lead concentrations in air shall not exceed the following 90-day average: 1.5 micrograms per cubic meter of air.

ARM 17.8.223 (applicable) provides PM-10 concentrations in ambient air shall not exceed a 90 day average of 1.5 micrograms per cubic meter of air and an annual average of 50 micrograms per cubic meter of air.

Ambient air standards under section 109 of the Clean Air Act are also promulgated for carbon monoxide, hydrogen sulfide, nitrogen dioxide, sulfur dioxide, and ozone. If emissions of these compounds were to occur at the facility in connection with any cleanup action, these standards would also be applicable. *See* ARM 17.8.210, 17.8.211, 17.8.212, 17.8.213, and 17.8.214.

Model VCP Compliance: The proposed remedy involves handling impacted soil and prevent the release of dust, including asbestos fibers. All persons conducting remedial actions will be accredited by DEQ as provided for in ARM 17.74.362, the applicant will obtain an asbestos project permit as required by ARM 17.74.355, and all the sampling required by ARM 17.74.357 will be conducted. As described in Section 5.1 of this VCP, remedial actions at the facility will include wetting and other dust control measures. The air monitoring program plan, presented in Section 5.1.3 of this VCP, details the air monitoring program and procedures. Asbestos will be used as an indicator of fugitive dust control. Remedial actions will be halted if significant dust is generated and will not resume until adequate dust control measures are in place. Any unpaved roads used for waste hauling will be treated with a binder to reduce dust emissions. Therefore, the VCP meets the requirements of these ERCLs.

2.4 Natural Streambed and Land Preservation Act

Section 75-7-111, MCA, (applicable) provides that a person planning to engage in any activity that will physically alter or modify the bed or banks of a stream must give written notice to the Board of Supervisors of a Conservation District, the Directors of a Grass Conservation District, or the Board of County Commissioners if the proposed project is not within a district, and must submit a "310 Permit" application to one of those entities.

ARM 36.2.404 (applicable) establishes minimum standards which would be applicable if a remedial action alters or affects a streambed, including any channel change, new diversion, riprap or other streambank protection project, jetty, new dam or reservoir or other commercial, industrial or residential development. No such project may be approved unless reasonable efforts will be made consistent with the purpose of the project to minimize the amount of stream channel alteration, insure that the project will be as permanent a solution as possible and will create a reasonably permanent and stable situation, insure that the project will pass anticipated water flows without creating harmful erosion upstream or downstream, minimize turbidity, effects on fish and aquatic habitat, and adverse effects on the natural beauty of the area and insure that streambed gravels will not be used in the project unless there is no reasonable alternative. Soils erosion and sedimentation must be kept to a minimum. Such projects must also protect the use of water for any useful or beneficial purpose. See § 75-7-102, MCA.

Model VCP Compliance: As described in Section 5.1 of this VCP, these permits will be obtained before streambank relocation is conducted at the facility. All conditions of the permits will be met during the remedial activity. Therefore, the VCP meets the requirements of these ERCLs.

3.0 LOCATION-SPECIFIC ERCLS

3.1 Endangered Species.

3.1.1. The Endangered Species Act (relevant). This statute and implementing regulations (16 U.S.C. § 1531 *et seq.*, 50 CFR Part 402, 40 CFR 6.302(h), and 40 CFR 257.3-2) require that any federal activity or federally authorized activity may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat. Compliance with this requirement involves consultation with the U.S. Fish and Wildlife Service (USFWS) and a determination of whether there are listed or proposed species or critical habitats present at the facility, and, if so, whether any proposed activities will impact such wildlife or habitat.

3.1.2 Montana Nongame and Endangered Species Act, §§ 87-5-101 *et seq.* (applicable): Endangered species should be protected in order to maintain and to the extent possible enhance their numbers. These sections list endangered species, prohibited acts and penalties. *See also*, § 87-5-201, MCA, (applicable) concerning protection of wild birds, nests and eggs; and ARM 12.5.201 (applicable) prohibiting certain activities with respect to specified endangered species.

Model VCP Compliance: Based on information obtained from the Montana Natural Heritage Program (Appendix G of the VCP), endangered species have not been identified at the facility. Thus, the proposed remedy meets the requirements of this ERCL.

3.2 Migratory Bird Treaty Act

This requirement (16 USC §§ 703 *et seq.*) (relevant) establishes a federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the appropriate program within the USFWS during remedial design and remedial construction to ensure that the cleanup of the facility does not unnecessarily impact migratory birds.

Model VCP Compliance: Migratory birds are present near the facility. However, the facility does not provide the majority of habitat for these species relative to the surrounding area. There are no features of the facility that are particularly attractive to these species. Therefore, remedial actions at the facility are not expected to impact migratory birds. Thus, the proposed remedy meets the requirements of this ERCL.

3.3 Bald Eagle Protection Act

This requirement (16 USC §§ 668 *et seq.*) (relevant) establishes a federal responsibility for protection of bald and golden eagles, and requires continued consultation with the appropriate program within the USFWS during remedial design and remedial construction to ensure that any cleanup of the facility does not unnecessarily adversely affect the bald and golden eagle.

Model VCP Compliance: Bald and golden eagles have not been observed at the facility. In addition, the facility does not provide the majority of habitat for these species relative to the surrounding area. There are no features of the facility that are particularly attractive to these species. Therefore, remedial actions at the facility are not expected to impact these species. Thus, the proposed remedy meets the requirements of this ERCL.

3.4 Historic Sites, Buildings, Objects and Antiquities Act

These requirements, found at 16 USC 461 *et seq.*, (relevant) provide that, in conducting an environmental review of a proposed action, the responsible official shall consider the existence and location of natural landmarks using information provided by the National Park Service pursuant to 36 CFR § 62.6(d) to avoid undesirable impacts upon such landmarks.

Model VCP Compliance: Current data indicate that no landmarks are present on the facility. Thus, the proposed remedy meets the requirements of this ERCL.

3.5 Resource Conservation and Recovery Act:

40 CFR 264.18 (relevant) provides location requirements for owners and operators of hazardous waste management units. Portions of new management units must not be located within 200 feet of a fault which has had displacement in Holocene time and management units in or near a 100 year floodplain must be designed, constructed, operated, and maintained to avoid washout.

Model VCP Compliance: All hazardous waste will be removed from the facility and no management units will be created. Thus, the proposed remedy meets the requirements of this ERCL.

3.6 Fish and Wildlife Coordination Act

These standards are found at 16 USC § 661 *et seq.* and 40 CFR 6.302(g) (relevant) and require that federally funded or authorized projects ensure that any modification of any stream or other water body affected by a funded or authorized action provide for adequate protection of fish and wildlife resources.

Model VCP Compliance: As stated in section 5.1 of the VCP, the proposed remedy includes rerouting of the stream channel. Any fish caught in pools after the stream diversion will be collected and relocated into the active stream channel. No other wildlife species reside primarily at the facility and the proposed remedy is not expected to impact any other species. Therefore, the proposed remedy meets the requirements of these ERCLs.

3.7 Floodplain Management Order

Executive Order 11988 (relevant) requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Implementing regulations for this executive order are found at 40 CFR

6. The executive order and regulations are relevant because a portion of the facility is in a floodplain; however, no federal action is anticipated at the facility. In addition, application of the Montana floodplain requirements (see below) addresses protection of the floodplain.

Model VCP Compliance: No federal action is anticipated at the facility. Also, as stated in section 5.1 of the VCP, the proposed remedy includes reconstruction of a 100-year floodplain along the new stream channel which will comply with Montana's floodplain requirements. Therefore, the proposed remedy will not result in adverse impacts to the floodplain and will meet the requirements of this ERCL.

3.8 Protection of Wetlands Order

This requirement (40 CFR Part 6, Appendix A, Executive Order No. 11,990) (relevant) mandates that federal agencies and potentially responsible parties avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.

Section 404(b)(1), 33 U.S.C. § 1344(b)(1) (relevant) also prohibits the discharge of dredged or fill material into waters of the United States. Together, these requirements create a "no net loss" of wetlands standard.

Model VCP Compliance: There is one small designated wetland present at the facility. The VCP provides a detailed pre-construction drawing that reflects the location of this wetland. It is not anticipated that the excavation conducted under the VCP will impact the wetland. However, if the wetland is disturbed by the proposed remedy, this habitat will be re-established by reseeding with appropriate vegetation and ensuring the reconstructed stream channel will continue to support a wetland. Therefore, the proposed remedy will meet the requirements of this ERCL.

3.9 Solid Waste Management Requirements

Regulations promulgated under the Solid Waste Management Act, §§ 75-10-201 *et seq.*, MCA, (applicable) specify requirements that apply to the location of any solid waste management facility.

ARM 17.50.1004 (applicable) specifies a solid waste facility located within the 100-year floodplain may not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste that poses a hazard to human health or the environment. *See also* ARM 17.50.1009(1)(h) (applicable).

ARM 17.50.1005 (applicable) specifies a solid waste facility may not be located in a wetland, unless there is no demonstrable practicable alternative.

ARM 17.50.1006 (applicable) specifies a solid waste facility cannot be located within 200 feet (60 meters) of a fault that has had displacement in Holocene time without demonstration that an

alternative setback will prevent damage to the structural integrity of the solid waste facility and will be protective of human health and the environment.

ARM 17.50.1007 (applicable) specifies a solid waste facility may not be located in a seismic impact zone without demonstration, by a Montana licensed engineer, that the solid waste structure is designed to resist the maximum horizontal acceleration in lithified earth material for the site.

ARM 17.50.1008 (applicable) specifies a solid waste facility may not be located in an unstable area (determined by consideration of local soil conditions, local geographic or geomorphologic features, and local artificial features or events, both surface and subsurface) without demonstration, by a Montana licensed engineer, that the solid waste facility is designed to ensure that the integrity of the structural components will not be disrupted.

ARM 17.50.1009 (applicable) sets forth general requirements applying to the location of any solid waste facility. Among other things, the location must have sufficient acreage, including adequate separation of wastes from underlying groundwater or adjacent surface water, must be located so as to prevent pollution of ground, surface, and private and public water supply systems, and must allow for reclamation of the land.

Under ARM 17.50.1009, a facility for the treatment, storage or disposal of solid wastes:

1. must be located where a sufficient acreage of land is suitable for solid waste management, including adequate separation of wastes from underlying ground water or adjacent surface water[2];

2. must be located where local roads are capable of providing access in all weather conditions and local bridges are capable of supporting vehicles with maximum rated loads;

3. must be located in a manner that does not allow the discharge of pollutants in excess of state standards for the protection of state waters, public water supply systems, or private water supply systems;

4. drainage structures must be installed where necessary to prevent surface runoff from entering waste management areas; and

5. must be located to allow for closure, post-closure, and planned uses of the land.

Section 75-10-212, MCA (applicable) prohibits dumping or leaving any debris or refuse upon or within 200 yards of any highway, road, street, or alley of the State or other public property, or on privately owned property where hunting, fishing, or other recreation is permitted. However, the

[2] The extent of separation shall be established on a case-by-case basis, considering terrain and the type of underlying soil formations, and facility design.

restriction relating to privately owned property does not apply to the owner, his agents, or those disposing of debris or refuse with the owner's consent.

Model VCP Compliance: All solid waste at the facility will be removed, transported, and properly disposed of at [insert the name of the facility], an appropriate permitted disposal facility. Therefore, the proposed remedy meets the requirements of these ERCLs.

3.10 Floodplain and Floodway Management Act and Requirements

The following standards are included here to indicate the restrictions on any related activities that might occur in or affect the floodway or floodplain.

Section 76-5-401, MCA and ARM 36.15.601 (applicable) provide that residential, certain agricultural, industrial-commercial, recreational and other uses are permissible within the designated floodway, provided they do not require structures other than portable structures, fill or permanent storage of materials or equipment.

Section 76-5-402, MCA and ARM 36.15.701 (applicable) provide that in the flood fringe (i.e., within the floodplain but outside the floodway), residential, commercial, industrial, and other structures may be permitted subject to certain conditions relating to placement of fill, roads, and floodproofing.

ARM 36.15.602(6) (applicable) provides that domestic water supply wells may be permitted, even within the floodway, provided the well casing and well meets certain conditions.

ARM 36.15.602(5), 36.15.605, and 36.15.703 (applicable) provide that solid and hazardous waste disposal and storage of toxic, flammable, hazardous, or explosive materials are prohibited anywhere in floodways or floodplains.

Section 76-5-402, MCA (applicable) states that the following are prohibited in a floodway: buildings for living purposes or place of assembly or permanent use by human beings; any structure or excavation that will cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway; and the construction or permanent storage of an object subject to flotation or movement during flood level periods.

Section 76-5-406, MCA and ARM 36.15.216 (applicable) contain substantive factors that address obstruction or use within the floodway or floodplain.

ARM 36.15.604 (increase in upstream elevation or significantly increase flood velocities), ARM 36.15.602(1) (excavation of material from pits or pools), and ARM 36.15.603 (water diversions or changes in place of diversion) (applicable) provide further conditions or restrictions that generally apply to specific activities within the floodway or floodplain.

ARM 36.15.701(3)(c) (applicable) requires that roads, streets, highways and rail lines must be designed to minimize increases in flood heights.

ARM 36.15.701(3)(d) (applicable) provides that structures and facilities for liquid or solid waste treatment and disposal must be floodproofed to ensure that no pollutants enter flood waters and may be allowed and approved only in accordance with DEQ regulations, which include certain additional prohibitions on such disposal.

ARM 36.15.702(2) (applicable) provides the standards applied to residential, commercial or industrial structures.

ARM 36.15.606 (applicable) provides that flood control works comply with safety standards for levees, floodwalls, and riprap.

ARM 36.15.901 (applicable) requires electrical systems to be flood-proofed.

Model VCP Compliance: As stated in section 5.1 of the VCP, the proposed remedy includes reconstruction of a 100-year floodplain along the new stream channel. No development, structures or other features will be constructed in the floodplain. Therefore, the proposed remedy meets the requirements of these ERCLs.

APPENDIX D

Sample Field Forms and Chain-of-Custody Forms

DAILY FIELD RECORD

Page_____ of _____

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Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

Personnel: Name	Company	Time in	Time Out

PERSONAL SAFETY CHECKLIST

	Steel-toed boots		Hard Hat		Traffic Vest
	Gloves		Safety Goggles		Ear Protection

TIME	DESCRIPTION OF WORK PERFORMED

DAILY FIELD RECORD

Page______ of ______

NewFields
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Date:________________________

TIME	DESCRIPTION OF WORK PERFORMED

Air Sampling Record

Site Name:

Project Number:

Location ID:

Field Personnel:

Date:

Canister/Tube #

Weather:

Height of Sampling:

Flow Controller #

Air Temp:

Sampling Method:

Sampling Summary: Initial Time / Vac.

Atmospheric Pressure:

Sampling Rate (mL/min):

Final Time / Vac.

Wind speed:

Total Sampled Volume (mL):

PID reading (ppm):

Wind direction:

Time	Rate (mL/min)	Cumul. Vol. (mL)	Can Pressure (in. Hg)	Remarks

NewFields

PROJECT:	**PROJECT NO:**	**BORING NO:**
LOCATION OF BORING	DRILLING METHOD:	DRILLING CONTRACTOR:
	SAMPLE METHOD:	DRILLER:
	SAMPLER(S)/LOGGER(S):	
	START DATE/TIME:	RIG/EQUIPMENT:
	TOTAL BOREHOLE DEPTH:	FINISH DATE/TIME:
	WATER LEVEL/TIME/DATE:	CASING DEPTH:

SAMPLE								SOIL DESCRIPTION	COMMENTS
SAMPLE TYPE	INCHES DRIVEN	INCHES RECOVERED	SAMPLE NO.	SAMPLE DEPTH	PID READING	DEPTH IN FEET	LITHOLOGY	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	OBSERVATIONS (ODOR, STAINING, DRILLING RATE, DRILLING ISSUES, ETC.)
						1			
						2			
						3			
						4			
						5			
						6			
						7			
						8			
						9			
						0			
						1			
						2			
						3			
						4			
						5			
						6			
						7			
						8			
						9			
						0			

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WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: _____ **WELL NO:** _____

PROJECT: _____ *STATE:* _____ COUNTY: _____ LOGGED BY: _____

LEGAL LOCATION:
T R S TRACT _____

DESCRIPTIVE LOCATION: _____

DATE STARTED: _____ DATE COMPLETED: _____ DRILLING CO/ DRILLER: _____

DRILLING METHOD _____ BOREHOLE DIAM (IN): _____ DRILL FLUIDS USED: _____

TOTAL DEPTH DRILLED: _____ TOTAL DEPTH CASED: _____ INTERVAL PERFORATED FROM _____ OR SCREENED (FT:) _____ DIAMETER: _____ CASING TYPE: _____

METHOD OF PERFORATION:
- _____ Open Hole
- _____ Open Bottom
- _____ Saw Slotted
- _____ Factory ___ (size)
- _____ Other: Roller Perf tool 1/2" x 1"; 4 rows

DURING WELL CONSTRUCTION WAS/WERE:

	YES	NO
Well Developed		
Well Pumped		
Water Samples Collected		
Material Samples Collected		

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR: LENGTH: _____
DIAM: _____
LOCK NO: _____

SURFACE SEAL TYPE:	FROM:	TO:	
BACKFILL MATERIAL:	FROM:	TO:	
HOLE PLUG:	FROM:	TO:	
FILTER PACK TYPE:	FROM:	TO:	

STATIC WATER LEVEL: _____ DATE: _____ MEASURING POINT DESCRIPTION/ ELEVATION: _____ MEASURING POINT RELATIVE TO GROUND SURFACE (+/-) _____

REMARKS: _____

INTERVAL(FT) below ground surface	**LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology**	**REMARKS**

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WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: _____

PROJECT: _____ WELL NO: _____

INTERVAL(FT) below ground surface	**LITHOLOGIC DESCRIPTION USCS NAME (USCS symbol): color, moist, % by weight, plasticity, consistency, structure, cementation, geology**	**REMARKS**

NewFields

Pit ID: _____

Project: _____ Project #: _____

Project Location: _____ Date: _____

Equipment: _____ Contractor: _____ Logged by: _____

Lat/Long (N/E): _____ Elevation: _____ Total Pit Depth: _____

Shoring (if used): _____ Surface Condtions: _____ Backfilled: _____

Depth	Sample (depth & type)	Pit Wall Profile Profile of face (refer to plan view of pit below): _____ Profile Width = _____	Description	Additional Notes

Legend:

SD	Small disturbed sample
LD	Large disturbed sample
ST	Thin-walled tube sample (vert / horz.)
BL	Block sample
ρ	In-situ density test
ω	Water content
▼	Water table encountered

Plan View of Pit: (include width, length, and North direction)

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Englewood, CO 80112

TEST PIT LOG

Project: _____ Project No.: _____
Test Pit No.: _____ Date: _____
Total Pit Depth: _____ Logged By: _____
Contractor: _____ Equipment: _____

Depth	Sample (depth & type)	Description	USCS	Remarks

Sample Type:
LD = Large Disturbed SD = Small Disturbed
HD = Hand Drive Cal = California Spoon

Soil Gas Sampling Record

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	Site Name:		
	Project Number:		
Probe ID:	Field Personnel:		
Date:	Canister #		Weather:
Depth of Sampling:	Flow Controller #		Air Temp:
Purge Method:	Sampling Summary:	Initial Time / Vac.	Atmospheric Pressure:
Purge Rate (mL/min):		Final Time / Vac.	He detector model:
Total Purge Volume (mL):	Paving (Type/Thickness):		

Time	Process (purge or sampling)	Rate (mL/min)	Cumul. Vol. (mL)	Line Pressure (in. Hg)	Can Pressure (in. Hg)	He conc. beneath shroud (%)	He conc. in probe (%)	PID in probe (ppm)	Remarks

NewFields

PROJECT NUMBER	BORING NUMBER SHEET OF

SOIL BORING LOG

PROJECT _____ LOCATION _____

DRILLER NAME _____ DRILLING CONTRACTOR _____

DRILLING METHOD AND EQUIPMENT Direct-Push Continuous Core

WATER LEVEL _____ DATE START _____ DATE FINISH _____ LOGGER _____

DEPETH BE(LOW SURFACE (FT)	SAMPLE			PID Reading (ppm)	SOIL DESCRIPTION	COMMENTS
	INTERVAL RECOVERY (%)	SAMPLE DEPTH INTERVAL (ft bgs)	INTERVAL ID #		SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	OBSERVATIONS (ODOR, STAINING, DRILLING RATE, DRILLING ISSUES, ETC.)

MONITORING WELL INSTALLATION RECORD

MONITORING WELL

MONITORING WELL NO.: _____
PROJECT: _____
SITE: _____
BOREHOLE NO.: _____
WELL PERMIT NO.: _____
TOC TO BOTTOM OF WELL: _____

DRILLING INFORMATION

DRILLING BEGAN:
DATE: _____ TIME: _____
WELL INSTALLATION BEGAN:
DATE: _____ TIME: _____
WELL INSTALLATION FINISHED:
DATE: _____ TIME: _____
DRILLING CO.: _____
DRILLER: _____
LICENSE: _____
DRILL RIG: _____
DRILLING METHOD:
☐ HOLLOW STEM AUGER
☐ AIR ROTARY
☐ OTHER: _____
DIAMETER OF AUGERS:
ID: _____ OD: _____

WELL CASING

☐ SCHEDULE 40 PVC
☐ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: _____ OD: _____
LENGTH OF CASING (TOTAL): _____

**NOTE: IF CASING SEGMENTS OF VARYING LENGTH ARE USED, RECORD ALL SEGMENT LEGTHS ON BACK*

WELL SCREEN

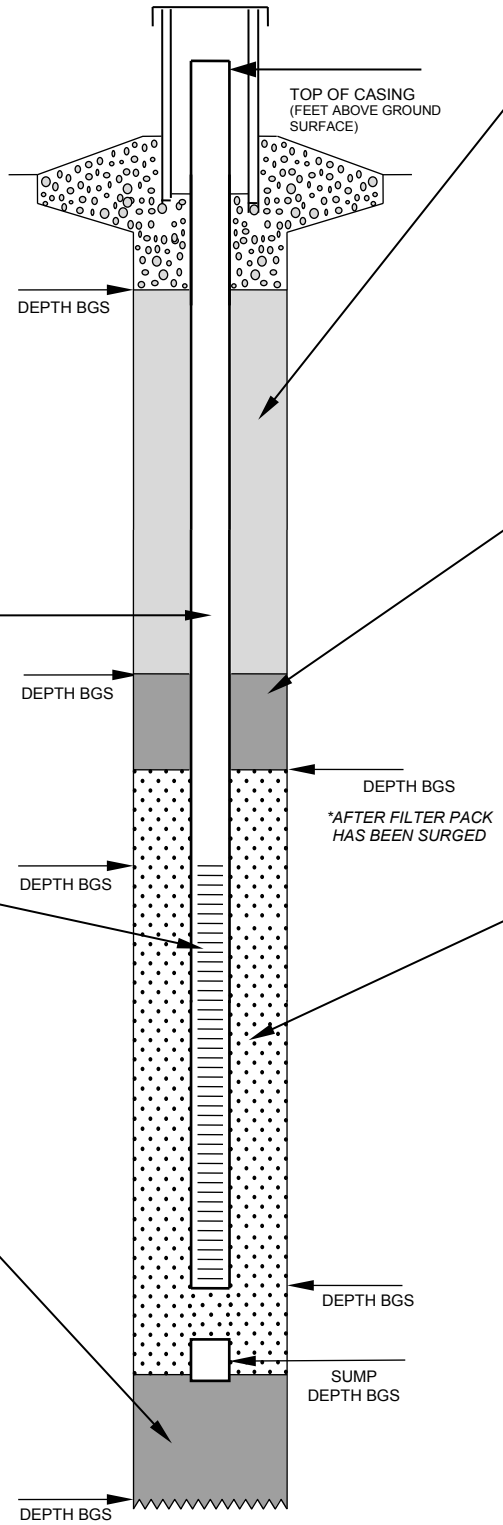
☐ SCHEDULE 40 PVC
☐ OTHER: _____
PRODUCT: _____
MFG. BY: _____
CASING DIAMETER:
ID: _____ OD: _____
SLOT SIZE: _____
LENGTH OF SCREEN: _____

BOREHOLE BACKFILL

AMOUNT CALCULATED: _____
AMOUNT USED: _____
❑ BENTONITE CHIPS, SIZE: _____
❑ BENTONITE PELLETS, SIZE: _____
❑ SLURRY: _____
❑ FORMATION COLLAPSE: _____
❑ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

SURFACE COMPLETION

❑ FLUSH MOUNT
❑ ABOVE GROUND WITH BUMPER POST
❑ CONCRETE ❑ ASPHALT



SURVEY INFORMATION

TOC ELEVATION: _____
GROUND SURFACE ELEVATION: _____
NORTHING: _____
EASTING: _____
DATE SURVEYED: _____
SURVEY CO.: _____

ANNULAR SEAL

VOLUME CALCULATED: _____
AMOUNT USED: _____
❑ GROUT FORMULA (PERCENTAGES)
PORTLAND CEMENT: _____
BENTONITE: _____
WATER: _____
❑ PREPARED MIX
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____

BENTONITE SEAL

VOLUME CALCULATED: _____
AMOUNT USED: _____
☐ PELLETS, SIZE: _____
☐ CHIPS, SIZE: _____
☐ OTHER: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
☐ POURED ☐ TREMIE
☐ OTHER: _____
AMOUNT OF WATER USED: _____

FILTER PACK

❑ PREPACKED FILTER
VOLUME CALCULATED: _____
AMOUNT USED: _____
❑ SAND, SIZE: _____
PRODUCT: _____
MFG. BY: _____
METHOD INSTALLED:
❑ POURED ❑ TREMIE
❑ OTHER: _____
WATER LEVEL: _____
(BTOC AFTER WELL INSTALLATION)

CENTRALIZERS USED?

❑ YES ❑ NO;
CENTRALIZER DEPTHS: _____ _____ _____
_____ _____ _____ _____ _____
_____ _____ _____ _____ _____

BGS – BELOW GROUND SURFACE
BTOC – BELOW TOP OF CASING
N/A – NOT APPLIC ABLE
NR – NOT RECORDED
TOC – TOP OF CASING

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NewFields Perspective. Vision. Solutions.	Project:	Personnel:
	Project #	
	Date/Time:	

Groundwater Sampling and/or Development Field Form

Well ID/Sample Location:		Measuring Point (mp)	(+GS)
Well Type:	Total Depth: (bgs / bmp)	Casing Type:	
SWL before purging: (bgs / bmp)	SWL post purge: (bgs / bmp)	Well Diameter: ( )	
Well Locked: Y / N	Cap/lid: Y / N	Photos taken: Y / N	Monument Type:

Purge & Sampling Equipment

Pump Type:	Pump Depth: ( ) bgs / bmp	
Purging Method:	Sampling Method:	$1ft^3 = 7.48$ gal
1 Casing Vol:	3 Casing Vol:	Total Vol. Removed:

Instrument Calibration

	Model/Unit #	Buffer Soln 1	Buffer Soln 2	Field Temp. (°C)	Instrument Rdg.	Comments
pH						
Specific Cond.						
Redox						
ORP						
DO		Salinity %:	Pressure (mmHg):			

Well Evacuation & Monitoring Data

Time	DTW (bmp)	Purge Rate (L/min)	Purge Vol. (L)	Temp (°C)	pH	SC (µS/cm)	DO (mg/L)	ORP (mV)	Turb (NTU)	Comments

Sampling Data

Bottle Label	Sample Time	Sampling Parameter(s)	Preservative	Method	Other
Samples Analyzed by:	Lab Name:				

Monitoring Well Sampling Log (Low Flow)

MWO#: _____ **Project/Site Name:** _____ **Date:** _____ **Well ID:** _____

Well Data:

Casing Diameter: _____
Borehole Diameter: _____
Depth of Casing (ft bTOC): _____
Screen Interval (ft bTOC): _____
Pump Intake (ft bTOC): _____
Well Condition (Comments): _____
_____
Weather (temp/pressure/wind): _____
_____

Initial Measurements & Calculations:

Initial PID Reading at TOC (ppm): _____
Depth to Product (ft bTOC; NA if none): _____
Product Thickness (ft bTOC): _____
Static Depth to Water (ft bTOC): _____
Standing Water Column (ft): _____
a) One Pump Volume (mL): 300 mL
b) One Tube Volume (mL): ft x (9.7 ml/ft)= mL
c) One Purge Volume (=a+b): _____ mL
Minimum Volume to be Purged (=2xc): _____ mL

Equipment Documentation:

Water Level Meter: _____
Product Probe/Sampler (NA if none): _____
Multi-Parameter Meter: _____
PID: _____
Purge/Sample Pumps: _____
Control Box Settings:
Pressure (psi): _____
Fill Cycle (sec): _____
Pump Cycle (sec): _____

All measurements taken from the surveyor mark at top of casing, or north side if no mark exists.

Time	Amount Purged (mL)	Field Parameters Measured										Comments (field observations, odor, color, problems, well performance, etc.)	Field Tech.
		Temp. (ºC)	Salinity (%)	pH	S.C. (mS/cm)	Turbidity (NTU)	D.O. (mg/L)	ORP (mV)	PID Breathing Zone / TOC	Depth to Water (ft bTOC)	Flow Rate (mL/min)		
												(flow reduced to ____ ml/min prior to VOC collection)	
Sample													

Purge Information:

Purge Method (circle one): Marshalk System / Aquarious / Bladder Pump
Time Purging Began: _____
Total Milliliters Purged: _____
Total Pump/Tubing Volumes Purged: _____
Time Purging Completed: _____

Sampling Information:

Sampling QA/QC Requirements (circle one): NA Dup/Split MS/MSD
Sampling Method: _____
Time Sampling Began: _____
Filter Type (size/brand): NA / QEC (0.45 micron) / Other: _____
Amount Flushed Through Filter (well water in mL): _____
Time Sampling Completed: _____

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Water Level Record

Site Name: ______________________

Project Number: ______________________

Field Personnel: ______________________

Date: ______________________

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Well ID	Date	Time	Depth to Water	Comments

Well Sampling or Development Record

Site Name:
Project Number:
Field Personnel:

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Well ID _____ Depth to Water (DTW) prior to sampling, ft. _____ Intake Depth _____
Date _____ DTW after sampling, ft. _____

Time	Purge Rate (Lpm)	Purge Vol. (L)	DTW	EC, µS/cm	DO, mg/L	ORP, mV	pH	Temp., ^{0}C	Comments

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www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: of

1628866

Section A **Required** Client Information:	Section B **Required** Project Information:	Section C Invoice Information:
Company:	Report To:	Attention:
Address:	Copy To:	Company Name:
		Address:
Email To:	Purchase Order No.:	Pace Quote Reference:
Phone: Fax:	Project Name:	Pace Project Manager:
Requested Due Date/TAT:	Project Number:	Pace Profile #:

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER _____

Site Location
STATE: _____

Section D
Required Client Information

SAMPLE ID
(A-Z, 0-9 / ,-)
Sample IDs MUST BE UNIQUE

Matrix Codes
MATRIX / CODE

Drinking Water	DW
Water	WT
Waste Water	WW
Product	P
Soil/Solid	SL
Oil	OL
Wipe	WP
Air	AR
Tissue	TS
Other	OT

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED: COMPOSITE START DATE	COLLECTED: COMPOSITE START TIME	COLLECTED: COMPOSITE END/GRAB DATE	COLLECTED: COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test (Y/N)	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			

ORIGINAL

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: **DATE Signed (MM/DD/YY):**

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

CHAIN OF CUSTODY

107 New Edition Court, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:
CEI Lab Code:
CEI Lab I.D. Range:

COMPANY CONTACT INFORMATION	
Company:	Client #:
Address:	Job Contact:
	Email:
	Tel:
Project Name:	Fax:
Project ID #:	P.O. #:

		TURN AROUND TIME					
ASBESTOS	**METHOD**	**4 HR***	**8 HR***	**24 HR**	**2 DAY**	**3 DAY**	**5 DAY**
PLM BULK	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (400)	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (1000)	EPA 600	☐	☐	☐	☐	☐	☐
PLM GRAVIMETRIC	EPA 600		☐	☐	☐	☐	☐
PLM GRAV w POINT COUNT	EPA 600		☐	☐	☐	☐	☐
PCM AIR	NIOSH 7400	☐	☐	☐	☐	☐	☐
TEM AIR	AHERA	☐	☐	☐	☐	☐	☐
TEM AIR	NIOSH 7402	☐	☐	☐	☐	☐	☐
TEM BULK	CHATFIELD		☐	☐	☐	☐	☐
TEM DUST WIPE	ASTM D6480-05	☐	☐	☐	☐	☐	☐
TEM DUST MICROVAC	ASTM D5755-09	☐	☐	☐	☐	☐	☐
TEM QUALITATIVE	CEI LABS	☐	☐	☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐
LEAD PAINT	**METHOD**	**4 HR****	**8 HR****	**24 HR****	**2 DAY**	**3 DAY**	**5 DAY**
LEAD PAINT	EPA SW846 7000B				☐	☐	☐
LEAD WIPE	EPA SW846 7000B				☐	☐	☐
LEAD SOIL	EPA SW846 7000B				☐	☐	☐
LEAD AIR	NIOSH 7082				☐	☐	☐
OTHER:					☐	☐	☐

REMARKS:	☐ Accept Samples ☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time

***Call to confirm RUSH analysis.** **Samples will be disposed of 30 days after analysis**

****TAT's are not available. Lead samples are subcontracted for analysis to an ELLAP accredited lab.**

SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company:	Job Contact:
Project Name:	
Project ID #:	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	COMMENTS

APPENDIX E

Montana DEQ Data Validation Guidelines

Montana Department of Environmental Quality
Data Validation Guidelines for Evaluating Analytical Data
(updated August 5, 2010)

This document was assembled by the Montana Department of Environmental Quality Site Response Section (DEQ) to formalize technical direction for conducting data validation. Data validation is a standardized review process for judging the analytical quality and usefulness of a discrete set of chemical data and is necessary to ensure that data of known and documented quality are used in making environmental decisions.

While these guidelines are generally used by DEQ, there may be circumstances that warrant a higher level of data validation review and DEQ reserves the right to require additional validation. For investigations where XRF or other field screening equipment is used, an evaluation including the comparison and correlation of field screening data to laboratory confirmation data must be also be included in the data validation discussion (please see DEQ's frequently asked questions at http://deq.mt.gov/StateSuperfund/FrequentlyAskedQuestions.mcpx for specifics associated with the use of XRF equipment and data collection/evaluation).

A separate data validation report must be completed for each sample batch/group. A brief summary of this validation report and the usability of the data should be included in the text of the project report with the validation report included as an appendix. The data validation should include an assessment of data using the precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters:

Precision: The degree of mutual agreement between individual measurements of the same property under similar conditions.

- Combined field and laboratory precision is evaluated by collecting and analyzing field duplicates and then calculating the variance between the samples, typically as a relative percent difference (RPD). Laboratory analytical precision is evaluated by analyzing matrix spike/matrix spike duplicate (MS/MSD) samples and using the results to calculate an RPD.

Accuracy: The degree of agreement between an analytical measurement and a reference accepted as a true value.

- The accuracy of a measurement system can be affected by errors introduced by field contamination, sample preservation, sample handling, sample preparation, and analytical techniques. Analysis of MS/MSD samples, laboratory control spikes (LCS) or blank spikes, surrogate standards, and method blanks are typically used to calculate the percent recovery (%R) for evaluating accuracy.

Representativeness: The degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition that they are intended to represent.

- Typically, representative data will be obtained through careful selection of sampling locations and analytical parameters; proper collection and handling of samples; and through use and consistent application of established field and laboratory procedures. Evaluation of field and laboratory blank samples for presence of contaminants can be useful in evaluating representativeness of sample results.

Completeness: A measure of the percentage of project-specific data that is valid.

- Valid data are obtained when samples are collected and analyzed in accordance with quality control (QC) procedures outlined in the SAP, and when none of the QC criteria that affect data usability are exceeded. Once data validation is complete, the number of useable sample results is divided by the total number of sample results planned for the investigation to determine the percent completeness. A completeness goal should be developed for each project (i.e., 100% completeness for residential samples to ensure that all properties requiring sampling are sampled).

Comparability: Expression of the confidence with which one data set can be compared with another.

- Comparability of data is achieved by consistently following standard field and laboratory procedures and by using standard measurement units in reporting analytical data.

DATA VALIDATION REPORT

1. Please provide the following information at the beginning of the data validation report:
   - Project name
   - Name and Date of approved Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP), or other applicable document
   - Laboratory Name
   - Laboratory Project ID
   - Sample Matrix
   - Sample Start and End Dates
   - Parameters Included (e.g., volatile organic compounds using EPA Method 8260)
   - Date Validated
   - Name of Validator

2. Please include a description of the data validation criteria used. These data validation criteria should be outlined in the appropriate QAPP, SAP, or other applicable document. ***For example:***

   - *USEPA Contract Laboratory Program (CLP) National Functional Guidelines (NFG) for Superfund Organic Methods Data Review, USEPA-540-R-08-01, June 2008; with additional reference to USEPA CLP NFGs for Organic Data Review, EPA 540/R-99-008, October 1999*
   - *USEPA CLP NFGs for Inorganic Superfund Data Review, EPA 540R-10-011, January 2010.*
   - *USEPA Region 1 Laboratory Data Validation Function Guidelines for Evaluation of Organic Analysis, December 1996.*

3. Please include a table or list identifying all samples evaluated in this validation report. Please provide the associated laboratory sample identification numbers if different than the project sample ID/name.

4. Please include a description of the acceptability and usability of the data, including any qualified data Please explain data qualification flags or any other notes used by the laboratory. Please identify and explain any exceptions (i.e., rejected data) to the acceptability and usability of the data. Also include a cross reference where data qualified by the laboratory is discussed. ***For example:*** *Based on a data validation review, the data are acceptable as delivered with the exceptions noted below as rejected data. Data qualified by the laboratory are discussed in Section #2 [of the project report].*

5. Please include a description of the data qualifiers used during this validation. ***For example***: *J - estimated concentration; UJ – estimated reporting limit (for non-detect results); or R - rejected, data not usable.*

6. Does the laboratory case narrative note any nonconformance issues with the analytical data? Please identify the nonconformance issues.

7. Were sample chain-of-custody (CoC) forms complete? Please describe. ***For example:*** *The CoC records from field to laboratory were complete, and custody was maintained as evidenced by field and laboratory personnel signatures, dates, and times of receipt.*

8. Were detection limits in accordance with the project requirements? If applicable, discuss how this relates to method selection, screening levels, and matrix interference. Please explain, and include discussion of how this affects the data.

9. Were the requested analytical methods in compliance with project requirements (i.e., QAPP, SAP)? If not, please explain, and include discussion of how this affects the data.

10. Were samples received in good condition within method specified requirements? Please explain any exceptions, and how sample condition may affect the results. ***For example:*** *Sample collected and listed on CoC; however, lab noted sample not received in shipment. No qualification necessary.*

11. Were samples analyzed within method specified or technical holding times? Please explain any exceptions, and how this may affect the results.

12. Were reported units appropriate for the associated sample matrix/matrices and method(s) of analyses? Please explain.

13. Do the laboratory reports include all constituents requested to be analyzed on the CoC or under the QAPP, SAP, or other applicable document? Please explain.

14. Was there indication from the laboratory that the initial or continuing calibration verification results were within acceptable limits? Please explain. ***For example:*** *Initial and continuing calibration data were not included as part of this data set; however, these data are assumed to be acceptable as the laboratory did not note any calibration results that were outside of QC limits.*

15. Was the total number of method blank samples prepared equal to at least 5% (1 in 20) of the total number of samples, or analyzed as required by the method? Please explain.

16. Were laboratory blank samples free of analyte contamination? Please explain, and include discussion of how this affects the data. ***For example:*** *The method blank samples were reported to be free of analyte contamination with the following exceptions: MADEP VPH - the analyte naphthalene was detected at 0.0256 mg/Kg in the method blank prepared for batch X. As naphthalene was not detected in the associated samples, no qualification of data was required.*

17. Was the total number of matrix spike samples prepared equal to at least 5% of the total number of samples, or analyzed as required by the method? Please include a discussion of the project samples used to prepare the MS and MSD samples, if applicable. Please explain, and include discussion of how this affects the data. ***For example:*** *The total number of MS/MSD samples was equal to at least 5% of the total number of samples for each analysis and batch, with the exception of pesticides by Method 8081A batch X, where the laboratory indicated with a MNR1 qualifier that sufficient sample volume was not available to perform matrix spikes. These data were evaluated using other laboratory QC data. Additionally, no matrix spike samples were analyzed for percent dry solids as it is not required by the method.*

18. Please include a discussion of the project samples used to prepare the MS and MSD samples, if applicable.

19. Were MS/MSD percent recoveries and MS/MSD relative percent difference (RPDs) within data validation or laboratory QC limits? Please explain, and include discussion of how this affects the data.

20. Was the reference material used for the laboratory control standard (LCSs) the correct matrix and concentration? Please explain, and include discussion of how this affects the data.

21. Was the total number of LCSs samples analyzed equal to at least 5% (1 in 20) of the total number of samples, or analyzed as required by the method? ***For example:*** *The frequency requirements for laboratory quality control samples (1/20) were met.*

22. Were LCSs prepared in the same way as the associated samples? Please explain, and include discussion of how this affects the data.

23. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within laboratory QC limits? Please explain, and include discussion of how this affects the data.

24. Were surrogate recoveries within laboratory QC limits? Please explain and include a discussion of how this affects the data. ***For example:*** *In sample A, the surrogates 2-fluorobiphenyl and 2-bromonaphthalene were recovered outside the laboratory QC limits of 40-140% at 143% and 151%, respectively. As a result, the detection for the analyte C19-C36 aliphatic hydrocarbons was qualified as J in this sample due to possible high bias.*

25. Were the number of equipment, trip, or field blanks collected equal to at least 10% of the total number of samples, or as required by the project requirements, QAPP, or SAP? Please explain, and include discussion of how this affects the data.

26. Were the trip blank, field blank, and/or equipment blank samples free of analyte contamination? Please explain, and include discussion of how this affects the data.

27. Were the field duplicates collected as required by the project requirements, QAPP or SAP? Please explain, and include discussion of how this affects the data. Also, please provide a summary or a table identifying primary and duplicate sample pairs.

28. Were field duplicate RPD values within data validation QC limits (generally soil 0-50%, water 0-30%, or air 0-25%, or otherwise specified in the QAPP/SAP)? Please explain, and include discussion of how this affects the data.

29. Were laboratory duplicate RPD values within laboratory-specified limits? Please explain, and include discussion of how this affects the data.

30. If any data was qualified, please provide a data qualification summary or table that includes the analyte, sample ID, laboratory ID, laboratory result, validator qualifier, and reason for qualification (and include how data is affected/biased). ***For example:***

Analyte	***Sample ID***	***Laboratory ID***	***Laboratory Result***	***Validator Qualifier***	***Reason for Qualification***
C5-C8 Aliphatic Hydrocarbons	*All Samples*	*Lab-01 through Lab-14*	*Detects and Non-Detects*	*J for detections or UJ for non-detections*	*The RPD for the MS/MSD or LCS/LCSD was greater than the acceptable difference indicating poor repeatability. The MS and/or MSD recovery(ies) were below the acceptable limits indicating possible matrix interference.*
Benzene	*All Samples*	*Lab-01 through Lab-14*	*Detects and Non-Detects*	*J for detections or UJ for non-detections*	*The RPD for the MS/MSD or LCS/LCSD was greater than the acceptable difference indicating poor repeatability. The MS and/or MSD recovery(ies) were below the acceptable limits indicating possible matrix interference.*

31. If DEQ collected split samples, explain how those results compare to the natural sample.

32. Please provide any other general comments or other observations.

APPENDIX E

Standard Operating Procedures (SOPs)

SOP	TITLE
1	Field Log Book & Field Sampling Forms
2	Equipment Decontamination
3	Sample Nomenclature, Documentation, & Chain-of-Custody Procedures
4	Sample Packaging & Shipping
13	Surface Soil Sampling
27	Asbestos Sample Collection
28	Lead-Based Paint (LBP) Sample Collection
28C	XRF Lead-Based Paint Inspection
28D	Pre-Renovation Paint Chip Sample Collection
28E	Pre-Demolition TCLP Lead-Based Paint Sample Collection

SOP-1

FIELD LOG BOOK AND FIELD SAMPLING FORMS

Pertinent field investigation and sampling information should be recorded on a daily field log book and appropriate sampling forms to provide a continual record of actions taken each day on the site. Each employee is responsible for completing a record of the day's activities in a log book and field forms of sufficient detail such that someone can reconstruct the field activities without relying on the memory of the field crew. At a minimum, entries on the field log book shall include:

- Project and client name
- Purpose of the field effort
- Names of field crew leader and team members present on the site, and other site visitors
- Description of site conditions and any unusual circumstances, including weather conditions
- Details of actual work effort, particularly any deviations from the field work plan or standard operating procedures
- Location of sample site, including map reference, if relevant
- Field observations
- Field measurements made (e.g., PID readings, pH, temperature) on appropriate forms.
- Date and time of initiation and cessation of work.

Purpose

To provide guidance on how to document activities completed in the field by NewFields employees

Goal and Objective

To provide a record of our project work and the decisions made in the field

Equipment Needs

Field Note Book
Field Sampling Forms

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

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

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

SOP-2

EQUIPMENT DECONTAMINATION

Decontamination of field equipment is necessary to prevent cross contamination between sites and sampling locations. Decontamination should be performed on all non-dedicated and non-disposable sampling equipment that may contact potentially contaminated media. Field personnel must wear disposable gloves while decontaminating equipment to prevent cross contamination.

The following should be done to decontaminate field equipment:

- Set up a decontamination area, preferably upwind from your sampling area to reduce the potential for windborne contamination.
- Prior to initiating decontamination, visually inspect sampling equipment for evidence of contamination; use stiff brush to remove visible material.
- Once rough brushing is complete, decontaminate each piece of equipment following a sequential process of washing with Liquinox or an equivalent degreasing detergent; rinsing with distilled water; rinsing with 10% dilute nitric acid; and finally rinsing with distilled water three times. Best procedure is to set up wash tubs for each of the above processes.
- Rinse equipment with methanol instead of nitric acid if sampling for organic contamination.
- Decontaminated equipment that is used for sampling organics should be wrapped in aluminum foil or another inert material if not used immediately.

Field equipment can be decontaminated by steam cleaning as an alternative. If equipment is steam cleaned, it should still be rinsed with 10% dilute nitric acid and distilled water.

All disposable items (e.g., paper towels, latex gloves) should be deposited into a garbage bag and disposed of in a proper manner. Handling and disposal procedures for the rinse and wash water will depend on the likely presence and type of contaminant in the wash water. The project Sampling & Analysis Plan should be reviewed to determine the process for handling wash water.

Purpose

The purpose of this SOP is to describe general decontamination procedures for field equipment

Goal and Objective

To sufficiently clean field equipment to prevent cross contamination between sites and sample locations

Equipment Needs

5-gallon plastic tubs

Distilled water

1-gallon cube of 10% Nitric Acid

Spray Bottle of 10% Methanol

Liquinox Soap

Hard Bristle Brush

Garbage Bags

Disposable Gloves

Paper Towels

55-gallon drums (optional depending on need to containerize wash water)

A list of equipment for decontamination is provided below. The amount of dissolved water needed on site will depend on the number of samples to be collected and the sampling methods. For this reason, the you should evaluate the need prior to going in the field.

SOP-3

SAMPLE NOMENCLATURE, DOCUMENTATION, AND CHAIN-OF CUSTODY PROCEDURES

When completing sampling it is critical that the process used to label and transport samples to the laboratory for analysis is sufficient to demonstrate with confidence that the samples were collected from the location indicated, and that during transport to the lab no actions were taken to potentially alter the integrity of the samples. Without following strict sample labeling and chain-of-custody procedures, analytical data collected at a site has little to no value.

SAMPLE NOMENCLATURE

Samples should be labeled in such a way to allow a person unfamiliar with the site to understand where the samples were collected. Samples should be labeled sequentially as follows:

> Project site initials- sample type- sampling method- sample number-sample depth.

For example, the sample KR-SBSS-TP1-12', indicates the sample was collected at Knife River (KR), the sample was a sub-surface soil sample (SBSS), was from test pit 1 (TP-1), and was collected at 12 feet below ground. Samples numbers should be numerically sequential (TP1, TP2, etc.). Prior to initiating sampling, field personnel should familiarize themselves with the Sampling & Analysis Plan and the nomenclature to be used for the site. The character prefixes in the table below are recommended for sample types.

Purpose

To identify the specific requirements for labeling and documenting sample collection

Goal and Objective

To increase the confidence in sample locations and to submit samples to the laboratory without risk of integrity loss

Equipment Needs

Indelible ink pen

Chain-of-custody forms

Field Log Book

Field Sampling Form

SAMPLE DOCUMENTATION

In addition to the chain-of-custody forms discussed below, field person must keep a list of samples collected at the field in the field log book and on appropriate field sampling forms. This allows you to go back and verify sample locations and numbers should there be any confusion at a later time. Upon returning to the office, the field log book and forms should be kept in the project file and subsequent copies sent to the laboratory, or other designated parties, as needed.

Each person in the field is responsible for putting entries into the field log and sampling forms. Designating an individual from the sampling team for record keeping is fine, provided all field personnel come to an agreement as to who this will be, and the field crew leader is certain field personnel are familiar with the record keeping requirements. All entries on the log book and field sampling forms must be made in indelible ink.

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

CHAIN OF CUSTODY PROCEDURES

A chain-of-custody form must be generated for all samples collected in the field for laboratory analysis. Samples from more than one project should not be included on the same chain of custody; however, multiple samples from a specific project can be included on the same custody form.

Copies of the chain-of-custody form should be maintained in the project file. The sampler may use a NewFields' chain-of-custody form or a chain- of-custody form provided by the laboratory. Sample custody records must be maintained from the time of sample collection until the time of sample delivery to the analytical laboratory and should accompany the sample through analysis and final disposition. The information to be included on the chain-of-custody form will include, but is not limited to:

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

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

A sample is considered under a person's control when it is in their possession. When custody of a sample is relinquished by the sampler, the sampler will sign and date the chain-of-custody form and note the time that custody was relinquished. The person receiving custody of the sample will also sign and date the form and note the time that the sample was accepted into custody. The goal is to provide a complete record of control of the samples. Should the chain be broken (signed by the relinquisher but not receiver or vice versa), the integrity of the sample is lost and the resulting analytical data suspect. Samples must be shipped to the analytical laboratory following the procedures described in in SOP-4. If an overnight shipping service is used to transport the samples to the laboratory, custody of the samples must be relinquished to the shipping service. If possible, have the shipping service sign the chain-of-custody form prior to placing the chain of custody in the sample cooler. If this is not possible (i.e. form placed in the sealed cooler), a note should be included on the chain of custody that the shipping company has received the samples with the chain of custody inside the cooler.

SOP-4

SAMPLE PACKAGING AND SHIPPING

SAMPLE PACKAGING

Samples must be packaged to preclude breakage or damage to sample containers, and shipped to comply with shipper, U.S. EPA, and U.S. DOT regulations. When packaging samples:

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

Purpose

To ensure samples are properly packaged for shipment to the analytical laboratory

Goal and Objective

To have samples received by the analytical laboratory in good condition and within EPA temperature thresholds

Equipment Needs

Indelible ink pen

Chain-of-custody forms

Custody Seals

Sample Labels from Lab

Coolers and Ice

Field Sampling Form

SHIPPING HAZARDOUS MATERIALS/WASTE

Transportation regulations for shipping of hazardous substances and dangerous goods are defined by the U.S. DOT in 49 CFR, Subchapter C, Part 171 (October 1, 1988); IATA and ICAO. These regulations are accepted by Federal Express and other ground and air carriers.

According to DOT regulations, environmental samples are classified as Other Regulated Substances (ORS). ORS are articles, samples, or materials that are suspected or known to contain contaminants and/or are capable of posing a risk to health, safety, or property when transported by ground or air. Samples, substances, or materials from sources other than material drums, leachate streams, and sludges should be considered as ORS or environmental samples. Materials shipped under the classification of ORS must not meet any of the following definitions:

Class 1: Explosives; Class 2: Gases- compressed, liquefied, dissolved under pressure, or deeply refrigerated; Class 3 Flammable Liquids; Class 4: Substances susceptible to spontaneous combustion; Class 5: Oxidizing substances; Class 6: Poisonous (toxic and infectious); Class 7: Radioactive materials; Class 8: Corrosives.

If your samples might meet any of the above definitions, contact the project manager to obtain instructions on sample shipment.

SOP-13

SURFACE SOIL SAMPLING

This SOP describes the field equipment and sampling methods for surface sampling of soil. Be sure to review the project specific Sampling and Analysis Plan (SAP) for additions or deletions to the methods noted below. These procedures may be modified in the field based on field and site conditions after appropriate annotations have been made in the field logbook and the project manager is consulted to discuss.

All sampling equipment shall be decontaminated before arriving on site.

Purpose

Provide guidelines for sampling of surface soil.

Goal and Objective

To employ a method of collecting surface soil samples representative of field conditions.

Equipment Needs

Stainless steel mixing bowl and sampling trowel

Hand lens (10) power

pH and electrical conductivity meters (if required)

Munsel color book (if required)

Latex or Nitrile gloves

Locating Flags

Coolers and Ice

GPS Unit

Field forms and field book

SURFACE SOIL SAMPLING

Commonly, there are two different methods of surface soil sampling completed on a site: Discreet or Grab Samples, and Composite Samples. The methods for each of these are described below.

For both methods, surface soil samples should be collected from the surface to a depth of six inches unless otherwise specified in the project specific SAP.

Soils should be described according to the procedures outlined in the United Soil Classification System (USCS; method ASTM D2487) or the Soil Conservation Service (SCS) classification system. Soil texture should be classified by either the USCS or the U.S. Department of Agriculture (USDA) classification. Descriptions shall be recorded in the field books or on standard morphological description logs as provided in the SAP.

Discrete or Grab Soil Samples

- Locate the site as directed in the appropriate sampling and analysis plan.
- Wearing disposable latex or nitrile gloves collect a sample by scraping the 0-6 inch interval of soil with a stainless steel spoon.
- Place the soil in a stainless steel bowl.
- Remove all coarse fragments greater than 0.5 inches from the bowl. If volatile organics analysis is not required, mix the remaining sample in the bowl with the stainless steel spoon.
- Transfer the soil sample directly into a glass sample jar with Teflon cap (4 or 8 ounce, depending on number of analyses required) and store in a cooler at 4 degrees Celsius or less. Retain approximately 30 grams of the sample in a plastic bag for field measurement of pH or PID screening, if required.

- Push flag into the ground at the sample location, which will allow for obtaining the coordinates of the sample location later with a GPS Unit, or take a coordinate reading of the location prior to moving to another sample location.
- Record information about the sample collection on the appropriate forms.

Composite Samples

Review the work plan or SAP to determine the location and spacing of sampling area grids for the collection of composite samples. When reviewing, determine the grids to be cordoned off in the field and the number of composite samples to be collected within the each grid. Follow the process below to collect the composite samples. **Composite soil samples should not be collected for analysis of volatile organic compounds.**

- Prior to collecting the composite samples, mark off the sampling grid as described in the SAP.
- Collect five to eight (as indicated in the SAP) surface soil samples of equal volume using a sampling trowel from discrete locations within a sampling area and place them in the mixing bowl. If a sod or duff layer is present, this layer should be peeled back to the top of the mineral soil.
- Remove all coarse fragments greater than 0.5 inches from the bowl.
- Mix the samples in the mixing bowl well and then a fill a laboratory supplied sample container with the mixed soil.
- Complete appropriate field sampling forms and the chain of custody. Store all samples in a cooler with ice.

SOP-27

ASBESTOS SAMPLE COLLECTION

PLANNING PHASE

Prior to commencing building inspection activities the following tasks should be performed:

- Contact management of the facility to inform them as to what will take place during the inspection.
- Develop a project schedule agreeable to the building owner including arrival time at the site and time of initial meeting with building personnel.
- Review existing as-built drawings, if available, to become familiar with the facility as to the mechanical system layout, and materials used in construction. Develop scaled drawings from as-built drawings, if provided by the building owner, for use in the inspection.
- Review any previous asbestos inspections that may have been conducted in the past.

INSPECTION PHASE

Inspections should be performed using the currently recognized standard protocol developed for schools under AHERA. General guidelines for conducting the inspection are as follows:

- Conduct on-site informational meetings with facility personnel to inform them of what will transpire during the inspection. Discuss bulk sampling protocol with maintenance personnel and determine sampling locations that will be acceptable to the owner.
- Perform an initial walk through of the building accompanied by a maintenance person if possible.
- Observe the building layout and whether the building was built in phases or all at once.
- Observe where the divisions are between construction phases.
- Locate all mechanical areas.
- Document location of and access to all pipe chases, pipe tunnels, crawl spaces, attics, and roof(s).

Purpose

To identify the specific requirements for asbestos sample collection in the field

Goal and Objective

To employ a method of asbestos sample collection to ensure staff safety and to prevent cross contamination between sites and sample locations

Equipment Needs

Ladder to access areas

Flashlight to aid in visibility

Air tight sampling containers (film canisters, centrifuge tubes, zip lock baggies)

Spray mister bottle with water to spray the area to be sampled

Plastic drop cloth to spread beneath the area to be sampled

Knife, linoleum cutter, cork borer, or other tool appropriate for extracting samples

Caulking gun and compound for filling holes once a sample has been extracted

Spray acrylic or adhesive to encapsulate sample extractions.

- Walk completely around the outside of the building.
- Fill out asbestos inspection checklist sheet.
- Fill out building information sheet.
- Fill out homogeneous area summary sheet.
- Fill out room by room sheets.
- Prepare a building diagram.

NUMBER OF SAMPLES

Nine samples per homogeneous sampling area are generally recommended. Cost or other constraints, may limit the number of samples that can be collected. If nine samples cannot be collected, use the following table to determine the minimum number as required by AHERA Rules.

Friable Surfacing Material

The number of samples collected from friable surfacing material was determined based on the following protocol developed under AHERA.

- 1,000 square feet or less: Three bulk samples
- 1,000 to 5,000 square feet: Five bulk samples
- Over 5,000 square feet: Seven bulk samples

Thermal System Insulation

Thermal system insulation should be sampled in a randomly distributed manner, with at least three bulk samples collected from each homogeneous material. At least one bulk sample should be collected from each homogeneous material of patched thermal system insulation that is not assumed to be ACBM.

Bulk samples should also be collected from each insulated mechanical system where cement or plaster was used on fittings, such as tees, elbows, or valves. The number of samples should be sufficient to determine whether the material is asbestos containing. Generally, a minimum of three samples should be collected from each homogenous area.

Bulk samples should not be collected from any homogeneous material where the inspector determined that the thermal system insulation is fiberglass, foam glass, rubber, or other non- asbestos containing building material.

Miscellaneous Material

Bulk samples should also be collected from each miscellaneous material. The number of samples should be sufficient to determine whether the material is asbestos containing. Generally, a minimum of three samples were collected from each homogenous area.

Equipment Needs
(Continued)

Duct tape for repairing thermal system insulation jackets

Cloth (pre-moistened) for cleaning up debris and tools

Vacuum cleaner equipped with high efficiency particulate air (HEPA) filters

Indelible ink pen for labeling sample containers

Camera for photographic documentation

Disposable protective clothing, gloves and bootees

Personal respirator, either a negative pressure full or half mask with HEPA cartridge.

Safety glasses for eye protection

Non-friable suspected ACBM.

The number of samples collected from non-friable suspect ACBM should be sufficient to determine whether the material is asbestos containing. Generally, a minimum of three samples should be collected from each homogenous area.

SELECTION OF SAMPLES

Sample locations should be selected so that they are representative of the sample area. Sample locations should be distributed evenly throughout the sampling area. If fewer than nine samples are collected, a random sampling scheme should be used to determine their location. Choosing sample locations according to personal judgment produces samples which may not be representative and can lead to a wrong decision about the presence or absence of asbestos. The sampling scheme described below should be used to avoid this problem.

> *Divide the sampling area into nine equally sized sub areas and label them 1 through 9. This can be done carefully by eye. Exact measurements are not needed. If three samples are going to be collected, randomly select three numbers from 1 to 9 and collect a sample from the corresponding subarea shown on map.*

For each sampling area, use a new diagram. If you have more than 18 sampling areas, start again at the top of the random number diagram (sample area #1) to determine sampling locations for sampling area 19.

IDENTIFICATION OF SAMPLES

Assign a unique sample ID number to each sample location. This ID number should be placed on the sampling container when shipped to the certified laboratory for analysis. Record the ID number and the sample location on the sample area diagrams and also on room by room summary sheets.

This must be done carefully so that there is no uncertainty about the location and identity of each sample collected. Make sure that no two samples have the same ID number. Non- sequential numbers are used to prevent the laboratories from knowing which samples come from the same sample areas or the same buildings. On the other hand, non-sequential ID numbers make organizing the analytical results by homogeneous area much more difficult.

SAMPLE COLLECTION

- Since inhalation of asbestos fibers during asbestos inspections and sampling projects may pose a health hazard, the use of personal protective equipment by building inspectors is required during the sampling process. As a minimum level of protection, inspectors should wear a respirator, either a negative pressure full or half mask with HEPA cartridges. Disposable clothing should be worn during sampling if the sampling operation is likely to dislodge pieces of suspect material or if the environment is extremely dusty. Inspectors should have plastic bags, twisters, and labels with them to handle the disposal of cartridges, protective clothing, wet cloths, and debris. These waste materials should be stored pending survey results. If laboratory results establish the presence of asbestos containing materials, these waste materials should be disposed of as asbestos containing waste.

- If possible, collect samples after hours or when the building is not in use.
- Spread the plastic drop cloth and set up other equipment.
- Put on protective equipment.
- Label containers with its ID, sample location, and type of material to be sampled on a sample data form. Always place the label on the container itself. If using ridged containers always place the ID on the container, not on the lid, as lids can be inadvertently switched by a laboratory when handling numerous sample containers.
- Mark the location of the sample on the sampling diagram and record the sample identification number on the plan diagram as well.
- Moisten the area to be sampled (spray the immediate area with water).
- Extract sample using a clean knife to cut or scrape off a small piece of the material. Be sure to penetrate all layers of material. Be careful not to disturb adjacent material.
- Place sample in a container and tightly seal it.
- Wipe the exterior of the container with a wet wipe to remove any material which may have adhered to it during sampling.
- Clean your tools with wet wipes and wet mop or vacuum sampling area with a HEPA vacuum to clean all debris.
- Fill hole with calking compound on highly friable material and/or spray with an encapsulant (to minimize subsequent fiber release).
- Repeat the above steps at each sample location. Place sample containers in plastic bags.
- Discard protective clothing, wet wipes and rags, filter cartridges, and drop cloth in a labeled plastic bag.

SAMPLE HANDLING

- After placing a sample in a container according to the procedures outlined earlier, enter the ID number on the Chain-of-Custody Sheet.
- Upon receipt of samples from the inspector, the laboratory should check and sign the Chain-of-Custody Sheet(s), copy same and return original(s) to the inspector. It is important that this, or a similar arrangement for sample accountability be agreed upon by the laboratory prior to sending samples for analysis.
- Each individual or laboratory engaged in asbestos identification shall participate in the American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) Program of quarterly external audits, the Asbestos Analyst Registry, or equivalent.
- Polarized light microscopy (PLM) according to EPA Method 600/R4-93-116 is the approved method for analyzing bulk materials for asbestos. PLM utilizes a light microscope equipped with polarizing filters. The identification of asbestos fiber bundles is determined by the visual properties displayed when the sample is treated with various dispersion staining liquids. Identification is substantiated by the actual structure of the fiber and the effect of polarized light on the filter, all of which is viewed by the trained technician. The limit of detection of asbestos by PLM is about 1% by area. Samples containing lower levels of asbestos are not reliable detected by this technique.

QUALITY ASSURANCE

After inspection is completed perform a field quality assurance program including the following tasks.

- Review all inspection forms for completeness. (Remember a physical street address is required by AHERA).
- Walk through building one last time to verify that you have identified all the suspect homogeneous areas.
- Review Chain-of-Custody document for completeness and verify the number of samples and sample numbers for the suspect materials collected during the inspection.

SOP-28

LEAD-BASED PAINT SAMPLE COLLECTION

PLANNING & PREPARATION

Prior to commencing building inspection activities the following tasks should be performed:

- Schedule the inspection with the site contact so adequate notice can be given to building occupants and/or tenants and review historical information regarding any previous lead-based paint activities at the site.
- Determine the hours of operation for the facility.
- Develop a project schedule agreeable with the building owner, including arrival time at the site and time of initial meeting with site personnel.
- Review any previous lead-based paint inspection reports, lead risk assessments, or lead-hazard screens.
- Collect all materials necessary for the inspection.
- Insure that all the XRF components are in its case. Equipment in the case should include; XRF with battery, spare battery, battery charger, charger cords, bar-code reader wand, XRF Computer interface cable, building component barcode pages, lead calibration pages, leak test documentation, and XRF source documentation.
- Insure that both batteries are fully charged and ready to go. Note that batteries will slowly lose a charge from sitting in the case and should be recharged before going into the field.
- Obtain the XRF Performance Characteristic Sheet for the instrument to be used for the inspection. Review it to determine the inconclusive range for the XRF.
- Follow radiation safety procedures when handling or using the XRF, as it is a potential source of radiation. Radiation dosimeter badges are assigned to personnel who routinely use the XRF instruments.
- For multi-family buildings, determine how many units can be considered homogeneous, based on the HUD Guidelines and determine the number of units required to be sampled.

Purpose

To identify the specific requirements for lead-based paint sample collection in the field

Goal and Objective

To employ a method of lead-based paint sample collection to ensure staff safety and to prevent cross contamination between sites and sample locations

Equipment Needs

X-Ray Fluorescence Spectrum Analyzer (XRF)

Ladder to access areas

Flashlight to aid in visibility

Air tight sampling containers (film canisters or centrifuge tubes)

Plastic drop cloth to spread beneath the area to be sampled

Heat gun, scraper or other tool appropriate for extracting samples

Required forms

Cloth (pre-moistened) for cleaning up debris and tools

Vacuum cleaner equipped with high efficiency particulate air (HEPA) filters

XRF INSPECTION PROCEDURE

Inspections should be performed using the currently recognized standard protocol developed by HUD. General guidelines for conducting the inspection for lead-based paint are described below:

Calibration of XRF

- Take at least three calibration check readings prior to the commencement of the lead-based paint inspection. These calibration check readings should be repeated every four hours, every time the XRF is turned on, or at the conclusion of the sampling job, which ever is more frequent.
- The XRF calibration check readings are taken on the red 1.02 mg/cm2 Standard Reference Material (SRM) paint film, developed by the National Institute of Standards and Technology (NIST). These films can be obtained by calling (301) 975-6776 and referencing SRM #2579.
- Calibration check readings should be taken through the red 1.02 mg/cm2 SRM paint film when the film itself is at least 12 inches away from any source of lead. For example, the red NIST SRM film should not be placed on a tool box or suitcase or on a surface coated with lead-based paint to take calibration check readings.
- The red NIST SRM film should be attached to a wooden board measuring about 6 inches long by 4 inches wide by 1 inch thick or attached directly to the XRF probe. Readings can then be taken while standing further than a foot from the wall. Alternatively, the red NIST SRM film can be placed on top of a 12 inch piece of Styrofoam or some other lead-free material as recommended by the manufacturer before taking readings.
- Each time calibration check readings are made, three nominal-time readings should be taken on the red NIST (1.02 mg/cm2) SRM film and the results recorded. The average of the three calibration check readings should be computed and also recorded.
- Large differences of calibration check reading averages from 1.02 mg/cm2 may alert the lead-based paint inspector to problems in the instrument's performance. The calibration check reading averages should not differ from 1.02 mg/cm2 by more than the calibration check tolerance specified in the XRF Performance Characteristics Sheet for the specific instrument used.
- If the observed calibration check average minus 1.02 is greater than the calibration check tolerance, the instructions provided by the manufacturer should be followed in order to bring the instrument back into control before any more XRF testing is done. All readings taken by the suspended instrument since the last successful calibration check test should be repeated. If a backup XRF instrument is used as a replacement, the backup instrument must successfully pass the initial calibration check test before retesting the affected test locations.

Equipment Needs

(Continued)

Pen and indelible ink pen for labeling sample containers and completing field forms

Camera for photographic documentation

Disposable protective clothing, gloves and bootees

Personal respirator, either a negative pressure full or half mask with HEPA cartridges

Safety equipment required for the particular site (safety glasses, hearing protection, hard hat, steel-toed boots, etc.)

Radiation Dosimeter Badre

Laptop for downloading XRF readings

Single-Family Housing

- Obtain a drawing of the building and exterior areas.
- Perform a walk-through of the building with building personnel to familiarize yourself with the layout of the building. An inventory of suspect paint in the house should be completed prior to any XRF testing. It may be also done on a room-by- room basis during testing.
- Determine the testing combinations in each room equivalent or on each exterior building component. An inventory of the painted surfaces in interior rooms, on exterior walls, and on surfaces in other exterior areas, such as fences, playground equipment, and garages, should be conducted.
- A testing combination is characterized by the room equivalent, component, substrate, and visible color of the paint. A completed inventory of the painted components in a room equivalent is a list of the testing combinations in that room equivalent.
- A room equivalent is an identifiable part of a residence, such as a room, a house exterior side, or an exterior area. Hallways, stairways, and exterior areas, such as porches, back yards, and each side of the house, are all examples of room equivalents. Closets or other adjoining areas to room equivalents should be designated room equivalents if large (for example, a walk-in closet) or if obviously dissimilar (for example, a different color) from the adjoining room equivalent. In most closets are not considered room equivalents.
- Each room equivalent is made up of components. Components can be located inside or outside the dwelling. For example, components in a bedroom could be the
- ceiling, floor, walls, a door and its casing, the window sash, and window casings. All components that are coated with paint, varnish, shellac, stain, or other coating should also be tested. Some components may be grouped if painting histories are identical as described below.
- Take at least one XRF Reading on each testing combination.
- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that testing combination. If necessary, determine the substrate correction value using the method specified in the HUD Guideline.
- XRF results are corrected for substrate bias by subtracting a correction value determined separately in each house for each type of substrate. The substrate is the material underneath the paint. Substrates are generally classified into one of six substrate types: brick, concrete, drywall, metal, plaster, and wood. These substrate types are intended to include a broad range of materials. For example, the concrete substrate type includes poured concrete, precast concrete, and concrete block. If the true substrate is not one of the six types, the substrate type that most closely matches the true substrate should be selected. For substrates on top of substrates, such as plaster over concrete, the substrate directly beneath the painted surface should be used.

  The correction value is an average of XRF readings taken from test locations that have been scraped clean of their paint covering to expose the substrate. A criterion for selecting these test locations is that their initial XRF results should be less than 2.5 mg/cm2. If test locations with XRF results equal to or greater than 2.5 mg/cm2 are selected, the outcome might "overcorrect" XRF results. Therefore, only test locations with initial XRF results less than 2.5 mg/cm2 should be chosen. If all initial readings on a substrate type are above 2.5 mg/cm2, the locations with the lowest initial reading should be chosen. This will help ensure that XRF readings taken from non-

representative portions of substrates and other underlying materials, such as hidden nails and pipes, are not used to compute the substrate correction. It is important to note that some XRF results may not need to be corrected for substrate bias depending on the specific instruments used and the specifications in the XRF Performance Characteristics Sheet.

Using the same XRF instrument, take a reading on the first bare substrate area. Record the substrate and XRF readings. Repeat this procedure for each bare substrate area and record the readings on the same form. A variant to this step is to first cover the bare area with an NIST SRM film prior to taking the readings. The need for this variation will be specified in the XRF Performance Characteristics

- Sheet for affected XRF instruments and instructions will be provided explaining how to compute the correction value when this variation is used. Compute the correction value for each necessary substrate type in the house by computing the average of all readings.
- Take at least one XRF Reading on each testing combination.
- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that testing combination. If necessary, determine the substrate correction value using the method specified in the HUD Guidelines.
- Classify the XRF results as negative, positive, or inconclusive. For inconclusive readings, collect a bulk sample of the inconclusive paint for laboratory analysis. If sampling is not desired, inconclusive readings must be assumed positive.
- Record the locations, component, substrate, and color of paint found to be positive for lead or assumed to be positive for lead. The recorded location of the material should include room and side of the room. Component should be the component being tested. Substrate should be one of the six substrate types described above. For practical purposes, paint is almost always differentiated by color. Since more than one color may be observed when paint is peeling or the substrate is damaged, both "white" and "blue over green" would be acceptable color entries.

Multi-Family Housing

- Obtain a list of all units, common areas, and exterior site areas.
- Obtain a drawing of the building and exterior areas.
- Perform a walk-through of the building with building personnel to familiarize yourself with the layout of the building.
- Determine, using the HUD Guidelines, the areas that can be grouped together and the minimum number of units to be inspected. The minimum number of units to be sampled can be determined by using Table 7.3 located in Chapter 7 of the HUD Guidelines.
- Select units to be inspected using the random technique explained in the HUD Guidelines.
- For each unit, common area, or exterior site to be tested, determine the testing combinations in each room equivalent.
- Take at least one XRF Reading on each testing combination.
- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that testing combination. If necessary, determine the substrate correction value using the method specified in the HUD Guidelines.

- Classify the XRF results as negative, positive, or inconclusive.
- Record location of materials found positive for lead or assumed to be positive for lead.

FIELD FORMS

Since the information required for a lead-based paint inspection report is gathered in the field, accurate and complete forms are required.

LABORATORY ANALYSIS OF PAINT CHIP SAMPLES

For XRF results that fall into the inconclusive range and for areas that cannot be tested using XRF instruments due to project budget constraints or other reasons, a paint-chip sample should be collected from suspect painted surfaces and sent to a laboratory for lead determination.

If the sampled portions of the building are to remain in-place, lead analysis should be conducted by EPA Method 6010, and results should be reported in mg/cm2, the primary unit of measure. Results may be reported as percent by weight if the dimensions of the surface area cannot be accurately measured or if all paint within the sampled area cannot be appropriately removed. In these cases, results should not be reported in mg/cm2, but in mg/kg or weight percent.

If the sampled portions of the building are to be demolished and disposed of, lead analysis should be conducted according to TCLP procedure (EPA Method 1311) for waste characterization purposes.

If it is necessary to remove a paint-chip sample for laboratory analysis, only one paint-chip sample is needed for each testing combination. The paint-chip sample location should be representative of the paint on the entire testing combination. If the testing combination is replicated, one representative paint-chip sample should be taken from one randomly selected replicate.

Collect at least four square inches of material to ensure that the laboratory has a sufficient sample to conduct the analysis and that it is representative of the testing material sampled. Samples collected should be placed in sealable rigid container such as screw top, plastic centrifuge tubes rather than plastic bags which generate static electricity. Paint-chip collection should include, as a priority, collection of all the paint layers, while minimizing any collection of actual substrate. If substantial substrate material is included, results should be reported in mg/cm2 to avoid a downward bias in results.

Assign a unique sample ID number to each bulk paint sample. This ID number should be placed on the sampling container when it goes to the certified laboratory for analysis. Record the ID number and the sample location on the sample area diagrams, the room by room summary sheets, and the chain-of-custody form. This must be done carefully so that there is no uncertainty about the location and identity of each sample collected. Make sure that no two samples have the same ID number.

QUALITY ASSURANCE

After inspection is completed perform a field quality assurance including the following tasks.

- Review all inspection forms for completeness.
- Walk through building one last time to verify that you have identified all the homogeneous areas of paint suspected to be lead-based.

- Review Chain-of-Custody documents for completeness and verify that the number of samples, the sample numbers for the bulk samples collected.

SOP-28C

XRF LEAD-BASED PAINT INSPECTION

PLANNING & PREPARATION

Prior to commencing building inspection activities, the following tasks should be performed:

- Schedule the inspection with the site contact so adequate notice can be given to building occupants and/or tenants and review historical information regarding any previous lead-based paint activities at the site.
- Determine the hours of operation for the facility.
- Develop a project schedule agreeable with the building owner, including arrival time at the site and time of initial meeting with site personnel.
- Review any previous lead-based paint inspection reports, lead risk assessments, or lead-hazard screens.
- Collect all materials necessary for the inspection.
- Ensure that all the XRF components are in its case. Equipment in the case should include; XRF with battery, spare battery, battery charger, charger cords, bar-code reader wand, XRF Computer interface cable, building component barcode pages, lead calibration pages, leak test documentation, and XRF source documentation.
- Ensure that both batteries are fully charged and ready to for use. Note that batteries will slowly lose a charge from sitting in the case and should be recharged before going into the field.
- Obtain the XRF Performance Characteristic Sheet for the instrument to be used for the inspection. Review it to determine the inconclusive range for the XRF.
- Follow radiation safety procedures when handling or using the XRF, as it is a potential source of radiation. Radiation dosimeter badges are assigned to personnel who routinely use the XRF instruments.
- For multi-family buildings, determine how many units can be considered homogeneous, based on the HUD

Purpose

To identify the specific requirements for lead-based paint sample collection in the field

Goal and Objective

To employ a method of lead-based paint sample collection to ensure staff safety and to prevent cross contamination between sites and sample locations

Equipment Needs

X-Ray Fluorescence Spectrum Analyzer (XRF)

Ladder to access areas

Flashlight to aid in visibility

Air tight sampling containers (film canisters or centrifuge tubes)

Plastic drop cloth to spread beneath the area to be sampled

Heat gun, scraper or other tool appropriate for extracting samples

Required forms

Cloth (pre-moistened) for cleaning up debris and tools

Vacuum cleaner equipped with high efficiency particulate air (HEPA) filters

Guidelines and determine the number of units required to be sampled.

XRF INSPECTION PROCEDURE

Inspections should be performed using the currently recognized standard protocol developed by HUD. General guidelines for conducting the inspection for lead-based paint are described below:

Calibration of XRF

- Take at least three calibration check readings prior to the commencement of the lead-based paint inspection. These calibration check readings should be repeated every four hours, every time the XRF is turned on, or at the conclusion of the sampling job, whichever is more frequent.
- The XRF calibration check readings are taken on the red 1.02 mg/cm2 Standard Reference Material (SRM) paint film, developed by the National Institute of Standards and Technology (NIST). These films can be obtained by calling (301) 975-6776 and referencing SRM #2579.
- Calibration check readings should be taken through the red 1.02 mg/cm2 SRM paint film when the film itself is at least 12 inches away from any source of lead. For example, the red NIST SRM film should not be placed on a tool box or suitcase or on a surface coated with lead-based paint to take calibration check readings.
- The red NIST SRM film should be attached to a wooden board measuring about 6 inches long by 4 inches wide by 1 inch thick or attached directly to the XRF probe. Readings can then be taken while standing further than a foot from the wall. Alternatively, the red NIST SRM film can be placed on top of a 12 inch piece of Styrofoam or some other lead-free material as recommended by the manufacturer before taking readings.
- Each time calibration check readings are made, three nominal-time readings should be taken on the red NIST (1.02 mg/cm2) SRM film and the results recorded. The average of the three calibration check readings should be computed and also recorded.
- Large differences of calibration check reading averages from 1.02 mg/cm2 may alert the lead-based paint inspector to problems in the instrument's performance. The calibration check reading averages should not differ from 1.02 mg/cm2 by more than the calibration check tolerance specified in the XRF Performance Characteristics Sheet for the specific instrument used.
- If the observed calibration check average minus 1.02 is greater than the calibration check tolerance, the instructions provided by the manufacturer should be followed in order to bring

Equipment Needs

(Continued)

Pen and indelible ink pen for labeling sample containers and completing field forms

Camera for photographic documentation

Disposable protective clothing, gloves and bootees

Personal respirator, either a negative pressure full or half mask with HEPA cartridges

Safety equipment required for the particular site (safety glasses, hearing protection, hard hat, steel-toed boots, etc.)

Radiation Dosimeter Badge

Laptop for downloading XRF readings

the instrument back into control before any more XRF testing is done. All readings taken by the suspended instrument since the last successful calibration check test should be repeated. If a backup XRF instrument is used as a replacement, the backup instrument must successfully pass the initial calibration check test before retesting the affected test locations.

Single-Family Housing

- Obtain a drawing of the building and exterior areas.
- Perform a walk-through of the building with building personnel to familiarize yourself with the layout of the building. An inventory of suspect paint in the house should be completed prior to any XRF testing. It may be also done on a room-by- room basis during testing.
- Determine the testing combinations in each room equivalent or on each exterior building component. An inventory of the painted surfaces in interior rooms, on exterior walls, and on surfaces in other exterior areas, such as fences, playground equipment, and garages, should be conducted.
- A testing combination is characterized by the room equivalent, component, substrate, and visible color of the paint. A completed inventory of the painted components in a room equivalent is a list of the testing combinations in that room equivalent.
- A room equivalent is an identifiable part of a residence, such as a room, a house exterior side, or an exterior area. Hallways, stairways, and exterior areas, such as porches, back yards, and each side of the house, are all examples of room equivalents. Closets or other adjoining areas to room equivalents should be designated room equivalents if large (for example, a walk-in closet) or if obviously dissimilar (for example, a different color) from the adjoining room equivalent. In most closets are not considered room equivalents.
- Each room equivalent is made up of components. Components can be located inside or outside the dwelling. For example, components in a bedroom could be the ceiling, floor, walls, a door and its casing, the window sash, and window casings. All components that are coated with paint, varnish, shellac, stain, or other coating should also be tested. Some components may be grouped if painting histories are identical as described below.
- Take at least one XRF Reading on each component.
- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that component. If necessary, determine the substrate correction value using the method specified in the HUD Guideline.
- XRF results are corrected for substrate bias by subtracting a correction value determined separately in each house for each type of substrate. The substrate is the material underneath the paint. Substrates are generally classified into one of six substrate types: brick, concrete, drywall, metal, plaster, and wood. These substrate types are intended to include a broad range of materials. For example, the concrete substrate type includes poured concrete, precast concrete, and concrete block. If the true substrate is not one of the six types, the substrate type that most closely matches the true substrate should be selected. For substrates on top of substrates, such as plaster over concrete, the substrate directly beneath the painted surface should be used.

The correction value is an average of XRF readings taken from test locations that have been scraped clean of their paint covering to expose the substrate. A criterion for selecting these test locations is that their initial XRF results should be less than 2.5 mg/cm2. If test locations with XRF results equal to or greater than 2.5 mg/cm2 are selected, the outcome might "overcorrect" XRF results. Therefore, only test locations with initial XRF results less than 2.5 mg/cm2 should be chosen. If all initial readings on a substrate type are above 2.5 mg/cm2, the locations with the lowest initial reading should be chosen. This will help ensure that XRF readings taken from non-representative portions of substrates and other underlying materials, such as hidden nails and pipes, are not used to compute the substrate correction. It is important to note that some XRF results may not need to be corrected for substrate bias depending on the specific instruments used and the specifications in the XRF Performance Characteristics Sheet.

Using the same XRF instrument, take a reading on the first bare substrate area. Record the substrate and XRF readings. Repeat this procedure for each bare substrate area and record the readings on the same form. A variant to this step is to first cover the bare area with an NIST SRM film prior to taking the readings. The need for this variation will be specified in the XRF Performance Characteristics Sheet for affected XRF instruments and instructions will be provided explaining how to compute the correction value when this variation is used. Compute the correction value for each necessary substrate type in the house by computing the average of all readings.

- Classify the XRF results as negative, positive, or inconclusive. For inconclusive readings, collect a bulk sample of the inconclusive paint for laboratory analysis. If sampling is not desired, inconclusive readings must be assumed positive.
- Record the locations, component, substrate, and color of paint found to be positive for lead or assumed to be positive for lead. The recorded location of the material should include room and side of the room. Component should be the component being tested. Substrate should be one of the six substrate types described above. For practical purposes, paint is almost always differentiated by color. Since more than one color may be observed when paint is peeling or the substrate is damaged, both "white" and "blue over green" would be acceptable color entries.

Multi-Family Housing

- Obtain a list of all units, common areas, and exterior site areas.
- Obtain a drawing of the building and exterior areas.
- Perform a walk-through of the building with building personnel to familiarize yourself with the layout of the building.
- Determine, using the HUD Guidelines, the areas that can be grouped together and the minimum number of units to be inspected. The minimum number of units to be sampled can be determined by using Table 7.3 located in Chapter 7 of the HUD Guidelines.
- Select units to be inspected using the random technique explained in the HUD Guidelines.
- For each unit, common area, or exterior site to be tested, determine the testing combinations in each room equivalent.
- Take at least one XRF Reading on each testing combination.

- Using the XRF Performance Characteristic Sheet, determine whether or not a substrate correction is necessary for that testing combination. If necessary, determine the substrate correction value using the method specified in the HUD Guidelines.
- Classify the XRF results as negative, positive, or inconclusive.
- Record location of materials found positive for lead or assumed to be positive for lead.

FIELD FORMS

Since the information required for a lead-based paint inspection report is gathered in the field, accurate and complete forms are required.

LABORATORY ANALYSIS OF PAINT CHIP SAMPLES

For XRF results that fall into the inconclusive range and for areas that cannot be tested using XRF instruments due to project budget constraints or other reasons, a paint-chip sample should be collected from suspect painted surfaces and sent to a laboratory for lead determination. Refer to **SOP-28D** for information on paint chip sample collection.

SOP-28D
PRE-RENOVATION PAINT CHIP SAMPLE COLLECTION

PLANNING & PREPARATION

Prior to commencing building inspection activities, the following tasks should be performed:

- Schedule the inspection with the site contact so adequate notice can be given to building occupants and/or tenants;
- Develop a project schedule agreeable with the building owner, including arrival time at the site and time of initial meeting with site personnel;
- Review any previous lead-based paint inspection reports, lead risk assessments, or lead-hazard screens;
- Collect all materials necessary for a complete inspection; and,
- Ensure all field personnel have all applicable equipment to perform the task including field forms, tools, personal protective equipment.

PAINT CHIP INSPECTION PROCEDURE

Inspections should be performed using the currently recognized standard protocol developed by HUD. General guidelines for conducting the inspection for lead-based paint are described below:

- Review the floor plan with site contact and determine which building surfaces will be impacted by renovation.
- Collect 1 square inch of paint material for analysis from each location by:
    - Outlining sample area with a marking pen;
    - Score the outlined area with a razor; and
    - Decontaminate razor with alcohol wipes.
- Hold an open Ziploc® bag under target sample location to collect paint chips during the scraping process. If necessary tape one side of the Ziploc® bag to the surface below sample location, close to the scored location, to ensure all paint chips are captured inside the Ziploc® bag.

Purpose

To identify the specific requirements for lead-based paint sample collection in the field

Goal and Objective

To employ a method of lead-based paint sample collection to ensure staff safety and to prevent cross contamination between sites and sample locations

Equipment Needs

Ladder

Flashlight

Air tight sampling containers (quart size Ziploc® bags)

Plastic drop cloth to spread beneath the area to be sampled

Utility knife, safety razor blades, paint scraper, flexible putty knife, chisels, hammer, or other tool appropriate for extracting samples

Required field forms

Cloth (pre-moistened) for cleaning up debris and tools & cleaning cloths

Vacuum cleaner equipped with high efficiency particulate air (HEPA) filters

- To remove the paint chip sample, use a cutting tool to remove the paint chip sample from the substrate.
    - Slide the blade along the score and underneath the paint chip to gently pry and remove paint chip without disturbing the substrate.
    - Be sure to obtain an adequate sample of one square inch for laboratory analysis.
    - Decontaminate cutting tool with an alcohol wipe to prevent cross contamination.
- Label Ziploc® bag with Project or Client Name, Sample location (i.e. room number and location), Date of collection, and name of personnel collecting the sample.
- Record notes on applicable field forms, fill out chain-of-custody forms, and submit samples to the laboratory.

Paint-chip collection should include collection of all the paint layers, while minimizing any collection of actual substrate. If substantial substrate material is included in the paint-chip sample, results may be skewed showing a lower overall percent of total lead.

Lead analysis of paint chip samples should be conducted by NIOSH Method 7420 – Flame Atomic Absorption (Flame AA) and results should be reported in percent by weight. A minimum of 100 grams is required for each paint-chip sample obtained during the inspection.

Equipment Needs
(Continued)

Pen and indelible ink pen for labeling sample containers and completing field forms

Camera for photographic documentation

Disposable protective clothing, gloves and bootees

Personal respirator, either a negative pressure full or half mask with HEPA cartridges

Safety equipment required for the particular site (safety glasses, hearing protection, hard hat, steel-toed boots, etc.)

SOP-28E
PRE-DEMOLITION TCLP LBP SAMPLE COLLECTION

PLANNING & PREPARATION

Prior to commencing with building inspection activities, the following tasks should be performed:

- Schedule the inspection with the site contact so adequate notice can be given to building occupants and/or tenants;
- Determine the hours of operation for the facility;
- Develop a project schedule agreeable with the building owner, including arrival time at the site and time of initial meeting with site personnel;
- Review any previous lead-based paint inspection reports, lead risk assessments, or lead-hazard screens; and,
- Collect all materials necessary for the inspection.

TCLP Inspection/Sampling Procedure

The Toxicity Characteristic Leaching Procedure (TCLP) inspection/sampling method will be completed in accordance with Plan Three - Composite Sample and Demolish of the ASTM Standard E 1908-97, which uses a composite sample to access the lead content of all of the debris comprised within the waste stream.

- Identify the different components to be removed (e.g. foundation, framing, siding, roof, drywall, trim, windows, doors, insulation etc.).
- Take aliquots or sub-samples of each component using a power drill, or by removing portions of the component. Select the sub-samples carefully to ensure that the resulting composite sample will be truly representative of the component.
- Mix the sub-samples together in proportion to their percent by weight in the total quantity of debris being removed. The resulting weight of the composite sample is not important, except that it must equal or exceed the 100-gram minimum sample weight specified for the TCLP test.

Purpose

To identify the specific requirements for lead-based paint sample collection in the field

Goal and Objective

To employ a method of lead-based paint sample collection to ensure staff safety and to prevent cross contamination between sites and sample locations

Equipment Needs

Ladder

Flashlight

Air tight sampling containers (quart size Ziploc® baggies)

Plastic drop cloth to spread beneath the area to be sampled

Utility knife, safety razor blades paint scraper, flexible putty knife, chisel, hammer or other tool appropriate for extracting samples

Required sample and field forms

Cloth (pre-moistened) for cleaning up debris and tools

Vacuum cleaner equipped with high efficiency particulate air (HEPA) filters

- Take one composite sample per structure, or one per 2500 square feet of floor space, whichever results in the greater number of samples.
- Send the composite for TCLP laboratory analysis with EPA Method 1311.
- If the samples all come back with lead concentrations below 5.0 mg/l dispose of the debris as solid waste.
- If any of the samples come back with lead concentrations of 5.0 mg/l or more, then dispose of the structure represented by the sample as dangerous waste, or
- Retest the structure to determine the individual hazardous components and dispose of them as dangerous waste.

Quality Assurance

After inspection is completed perform a field quality assurance including the following tasks.

- Review all inspection forms for completeness.
- Walk through building one last time to verify that you have identified and obtained representative sub-samples of each component.
- Review Chain-of-Custody documents for completeness.

Equipment Needs

(Continued)

Pen and indelible ink pen for labeling sample containers and completing field forms

Camera for photographic documentation

Disposable protective clothing, gloves and bootees

Personal respirator, either a negative pressure full or half mask with HEPA cartridges

Safety equipment required for the particular site (safety glasses, hearing protection, hard hat, steel-toed boots, etc.)

APPENDIX F

Summary of Reporting Limits & Regulatory Action Limits

Appendix F: Summary of Reporting Limits and Regulatory Action Limits
Programmatic Sampling and Analysis Plan (SAP)
for Building Materials Inspection
Big Sky Economic Development

Target Analyte	Analytical Method	Reporting Limit	Regulatory Action Limit	Is the Reporting Limit low enough for decision-making purposes?
Asbestos	Building Materials: EPA 600/R-93/116	0.1 % (trace amount)	1% by weight or area	Yes. Building materials will be considered Asbestos Containing Materials (ACM) if they contain greater than 1 percent (1%) asbestos by area or weight based on the sampling results (40 CFR 763 and the Administrative Rules of Montana (ARM) 17.74.354).
	Air: Phase Contrast Microscopy (PCM)	0.0009	0.01 fiber/cc (Final Clearance Standard) 0.1 fiber/cc (OSHA 8-hour PEL) 1 fiber/cc (OSHA 1/2-hour Excursion Limit)	Yes.
Lead-Based Paint	XRF Spectrometer by HUD Protocol	0.1 mg/cm^2	1.0 mg/cm^2	Yes. Lead based paint will be considered potentially hazardous if the XRF results are above regulatory action limit.
	Paint Chip Testing by EPA Method 7420	0.02% (200 mg/kg)	0.5% (5,000 mg/kg)	
Lead in Soil	EPA Method 6010	1.0 mg/kg	400 mg/kg	Yes.
Leachable Lead in Demolition Waste Stream	EPA Method 1311	0.05 mg/L	5.0 mg/L	Yes.
PCBs (fluorescent lighting fixture ballasts)	None (visual identification)	none	If the light ballasts are labeled as containing PCBs, or if the ballast cannot be verified as PCB-free, then the ballasts must be managed as a hazardous waste.[1]	N/A

Notes:

[1] EPA recommends that any fluorescent lighting fixture ballasts dated 1979 or older be removed and properly disposed according to Toxic Substance Control Act (TSCA) requirements.

mg/cm^2 = milligrams per square centimeter

mg/kg = milligrams per kilogram

mg/L = milligrams per liter

cc = cubic centimeter

Final Clearance Standard is the concentration in air that must be met to allow unrestricted reoccupation of a space following asbestos abatement. This threshold is defined in both federal law (40 CFR 763, AHERA) and the Administrative Rules of Montana (ARM) 17.74.357.

OSHA 8-hour PEL is the Permissable Exposure Limit established by the U.S. Occupational Safety & Health Administration (OSHA) as a time-weighted average, assuming abatement workers are using a 1/2-face respirator.

OSHA 1/2-hour Excursion Limit is the threshold that must not be exceeded in the first 1/2-hour of abatement, when disturbance is typically greatest.

APPENDIX G

Montana Law Defining Asbestos Inspection Requirements

Linda McCulloch
MONTANA SECRETARY OF STATE

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Rule: 17.74.354

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Rule Title: INSPECTION REQUIREMENTS FOR DEMOLITION AND RENOVATION ACTIVITIES

Department: ENVIRONMENTAL QUALITY
Chapter: NOISE, ASBESTOS CONTROL, METHAMPHETAMINE CLEANUP
Subchapter: Asbestos Control

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Latest version of the adopted rule presented in Administrative Rules of Montana (ARM):

Printer Friendly Version

17.74.354 INSPECTION REQUIREMENTS FOR DEMOLITION AND RENOVATION ACTIVITIES

(1) Prior to any demolition or renovation of a facility, the owner or operator shall ensure the facility or part of the facility where demolition or renovation actions will occur is thoroughly inspected by a department-accredited asbestos inspector in accordance with this subchapter.

(2) The owner or operator shall ensure that a copy of the inspection report is kept on site during the asbestos project. The owner shall ensure that the report is kept on site during subsequent renovations or demolition. The inspection report must be made available to the department upon request.

(3) A department-accredited asbestos inspector conducting an inspection in accordance with this subchapter shall:

(a) visually inspect the areas that may be affected to identify the locations of all suspect ACM;

(b) touch all suspect ACM to determine whether it is friable;

(c) collect bulk samples from each surfacing material that is not assumed to be ACM in a statistically random manner that is representative of the surfacing material. Samples must be collected as follows:

(i) at least three bulk samples must be collected from each surfacing material area that is 1,000 ft^2 or less;

(ii) at least five bulk samples must be collected from each surfacing material area that is greater than 1,000 ft^2, but less than or equal to 5,000 ft^2; and

(iii) at least seven bulk samples must be collected from each surfacing material area that is greater than 5,000 ft^2;

(d) collect samples from thermal system insulation as follows:

(i) at least one bulk sample from each area of patched thermal system insulation that is not assumed to be ACM;

(ii) at least three random bulk samples from each type of thermal system insulation that is not assumed to be ACM;

(iii) no bulk samples where the accredited inspector has determined that the thermal system insulation is fiberglass, foam, glass, rubber, or other non-ACM;

(e) randomly collect at least three bulk samples from all mechanical system insulation and fittings, such as tees, elbows, and valves, that are not assumed to be ACM;

(f) randomly collect at least three bulk samples from each type of miscellaneous material that is not assumed to be ACM; and

(g) collect at least three bulk samples from any type of non-friable suspected ACM that is not assumed to be ACM.

(4) For inspections conducted under (3), the inspector shall ensure that:

(a) bulk samples are analyzed by persons or laboratories with proficiency demonstrated by current successful participation in a nationally recognized testing program such as the National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the round robin for bulk samples administered by the American Industrial Hygiene Association (AIHA), or an equivalent testing program accepted in writing by the department prior to analysis;

(b) except for wallboard system samples, bulk samples are not composited for analysis,

but are analyzed for asbestos content by polarized light microscopy (PLM) using the "Method for the Determination of Asbestos in Bulk Building Materials" (EPA/600/R-93/116) or another method acceptable to the department; and

(c) the sample analytical report includes:

(i) results of the analysis;

(ii) method of analysis;

(iii) name and address of each laboratory performing an analysis;

(iv) the laboratory's accreditation number;

(v) the date of analysis; and

(vi) the name and signature of the person performing the analysis.

(5) For the purposes of an inspection conducted under (3):

(a) a material is considered to be ACM if the analytical results of at least one sample collected from that material show that asbestos is present in an amount greater than one percent; and

(b) a material is considered not to be ACM only if the analytical results for all samples collected from the material show that asbestos is not present in an amount greater than one percent.

(6) For inspections conducted under (3), the asbestos inspector shall report the findings in a written inspection report to the owner of the building or the operator conducting the planned demolition or renovation activity. The asbestos inspection report must include:

(a) the site of the asbestos inspection;

(b) the scope and purpose of the inspection and how it corresponds to the extent of the planned renovation or demolition activity;

(c) the date of the asbestos inspection;

(d) the signature of the accredited inspector conducting the asbestos inspection;

(e) the inspector's accreditation number and expiration date;

(f) an inventory of all assumed asbestos-containing and sampled materials;

(g) all sample locations;

(h) where ACM is located by type;

(i) the areas where friable material is assumed to be ACM, and areas where non-friable material is assumed to be ACM;

(j) a copy of the sample analytical report, specified in (4)(c), with the name and address of each laboratory performing an analysis, the date of analysis, and the name and signature of the person performing the analysis; and

(k) information on whether it will be necessary to remove any ACM before any activity begins that would break up, dislodge, or similarly disturb the material.

(7) If the inspection required in (1) was not conducted or was improperly conducted prior to commencement of renovation or demolition activities, an inspection must be conducted in accordance with (3) as soon as possible upon discovery of the missing or improper inspection, and before any additional renovation or demolition activities occur, with the addition of the following:

(a) industry-recognized procedures must be employed for sampling and analyzing settled dust to determine the extent of any asbestos contamination. The department will provide a list of acceptable procedures upon request;

(b) air sampling may not be used by the department-accredited asbestos inspector as the sole means of evaluating whether asbestos is present; and

(c) the department-accredited asbestos inspector shall summarize sampling and analytical procedures and evaluation findings in a written report. A recommendation on whether a new or continued asbestos project is necessary based on the evaluation must be included in the written report. The report must be submitted to the department before any further renovation or demolition work occurs.

(8) The department may conduct its own asbestos inspection if it deems an inspection conducted under (7) deficient.

(9) An inspection conducted under (7) does not excuse any failure to complete the inspection required in (1).

History: 75-2-503, MCA; IMP, 75-2-503, MCA; NEW, 2006 MAR p. 1574, Eff. 6/23/06; AMD, 2011 MAR p. 2264, Eff. 10/28/11.

MAR Notices	Effective From	Effective To	History Notes
17-317	10/28/2011	Current	History: 75-2-503, MCA; IMP, 75-2-503, MCA; NEW, 2006 MAR p. 1574, Eff. 6/23/06; AMD, 2011 MAR p. 2264, Eff. 10/28/11.
	6/23/2006	10/28/2011	History: 75-2-503, MCA; IMP, 75-2-503, MCA; NEW, 2006 MAR p. 1574, Eff. 6/23/06.

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For questions regarding the content, interpretation, or application of a specific rule, please contact the agency that issued the rule.
A directory of state agencies is available online at http://www.mt.gov/govt/agencylisting.asp.

For questions about the organization of the ARM or this web site, contact sosarm@mt.gov.

APPENDIX H

Inspector Certificates

CERTIFICATE OF TRAINING

Northern Industrial Hygiene, Inc.
certifies that

Heather Grotbo

1120 Cedar Street
Missoula, MT 59801

has received

Inspector Refresher Training

For the purpose of accreditation as required under Section 17.74.315 of the Administrative Rules of Montana and Section 206 of Title II of the Toxic Substance Control Act (TSCA)

Date: September 17, 2015 Expiration Date: September 18, 2016
Location: Missoula, Montana

Certification #IR15I17-07

Douglas G. Tisdell — *September 17, 2015*
Douglas G. Tisdell — *Date*

Northern Industrial Hygiene, Inc. 1325 Euclid Avenue, Suite #1 Helena, Montana 59601 (406) 443-3369

HEATHER C GROTBO

has met the requirements of Montana Administrative Rule 17.74.362 and/or 17.74.363 for accreditation in the following asbestos occupation(s) through the specified expiration date(s).

MTA-4080

Asbestos Inspector 09/17/2016

Kevin Blanton

MT DEQ Asbestos Control Program

U.S. EPA – University of Nevada, Las Vegas
Lead-based Paint Accredited Training Program
Harry Reid Center for Environmental Studies
4505 S. Maryland Parkway, Las Vegas, Nevada 89154-4009
(702) 895-1423 - fax: (702) 895-3094 – Kd.lauckner@unlv.edu

Course Completion Form

Instructions: Participants must submit the **original form** to the U.S. EPA to apply for certification. Please keep a copy for your records and please fax a signed copy to UNLV.

Participant Information:

1. Name: Oliver (Last) Mark (First) A. (Middle)

2. Address: 2735 Terry Avenue (Street) Billings (City) MT (State) 59102 (Zip)

3. Social Security Number: 6272

4. Date of Birth: 08/09/1952 Phone: (406) 245-7766 (code) – number

5. I authorize the University of Nevada, Las Vegas – Harry Reid Center for Environmental Studies to release information regarding my completion of this instruction for the purpose of certification. I understand that his completion form does not constitute certification from the U.S. EPA.

_____ _____
Participant Signature Date

****

Training Information:

Accredited Training Provider: Kathy Lauckner Accreditation #: MT-II-999-3 &MT-I-R999-3

6. Type of Instruction: Initial Lead Inspector and Initial Lead Risk Assessor
7. Number of hours of instruction completed: 40 hours
8. Date of course: (beginning) 05/06/2013 (ending) 05/10/2013
9. Location of course: UNLV Harry Reid Center.
10: Date student passed the appropriate exam: 05/08/2013 (Inspector) / 05/10/2013 (Assessor)
11. UNLV Course Completion Number: II-0513-MAO-6272 and IR-0513-MAO-6272
12. EPA Certification Number: N/A
13. As Training Director, I hereby certify that the information provided herein is true and correct.

Kathleen Lauckner, Ph.D. Kathleen Lauckner 05/10/2013
Training Director Signature Date
Date Interim Certification *Expires*: 11/10/2013

United States Environmental Protection Agency

This is to certify that

Mark Allen Oliver

has fulfilled the requirements of the Toxic Substance Control Act (TSCA) Section 402(a)(1) and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226 as a:

Risk Assessor

in the States of Montana and Wyoming,
and areas under Indian Tribal jurisdiction in Region 8,
excluding areas under Navajo Nation Tribal jurisdiction in Region 8

These certifications are valid from date of issuance and expire on November 18, 2016.

Certification #MT-R-128655-1
Certification #WY-R-128655-1
Certification #T8-R-128655-1
Issued: November 5, 2013

Barbara Dehnerting for:
Melanie L. Wood, Director
Pollution Prevention,
Pesticides & Toxics Program

CERTIFICATE OF TRAINING

Northern Industrial Hygiene, Inc.
certifies that

Brian Nickel

201 South 30th Street
Billings, MT 59101

has received

AHERA Contractor Supervisor Initial Training

For the purpose of accreditation as required under Section 17.74.315 of the Administrative Rules of Montana and Section 206 of Title II of the Toxic Substance Control Act (TSCA)

Dates: May 11, 2015 through May 15, 2016
Expiration Date: May 16, 2016 *Location: Helena, Montana*

Certification #CSI15E15-04

Douglas G. Tisdell — *May 15, 2015*
Douglas G. Tisdell — *Date*

Northern Industrial Hygiene, Inc. 1325 Euclid Avenue, Suite #1 Helena, Montana 59601 (406) 443-3369

Summary of Analytical Methods, Reporting Limits & Regulatory Action Limits

Billings, Montana

APPENDIX G

Table G-1
Reporting Limits Compared to Screening Levels: Soil
Frank Properties
Billings, Montana

Analytical Method	Target Analyte	CAS Number	PACE Reporting Limits		Montana Tier 1 RBSLs Subsurface Soil (>20 ft GW)	EPA Industrial RSLs	[Screening Level] > [Reporting	Comment
			MDL (mg/kg)	PRL (mg/kg)			Subsurface Soil	
Extractable Petroleum Hydrocarbons (EPH)								
MDEP EPH	Total Extractable Hydrocarbons	TEH	2.61	10	200	--	TRUE	
	Aliphatic (C09-C18)	C09-C18	2.61	10	2000	--	TRUE	
	Aliphatic (C19-C36)	C19-C36	2.61	10	100000	--	TRUE	
	Aromatic (C11-22)	C11-22	2.61	10	2000	--	TRUE	
Volatile Petroleum Hydrocarbons (VPH)								
MDEP VPH	Total Purgeable Hydrocarbons	TPH	0.16	10	---	--	TRUE	
	Aliphatic (C5-C8)	C5-C8	0.096	5	500	--	TRUE	
	Aliphatic (C9-C12)	C9-C12	0.281	5	1000	--	TRUE	
	Aromatic (C9-C10)	C9-C10	0.221	1	700	--	TRUE	
	MTBE	1634-04-4	0.018	0.05	0.3	0.3	TRUE	
	Benzene	71-43-2	0.01266	0.025	0.2	0.2	TRUE	
	Toluene	108-88-3	0.01414	0.05	60	60	TRUE	
	Ethylbenzene	100-41-4	0.01472	0.05	60	30	TRUE	
	Xylenes	1330-20-7	0.04397	0.2	600	300	TRUE	
	Naphthalene	91-20-3	0.099	0.6	50	20	TRUE	
Metals								
EPA 6010	Arsenic	7440-38-2	0.29064	1	40	40	TRUE	
	Barium	7440-39-3	0.05485	0.5	820	820	TRUE	
	Cadmium	7440-43-9	0.0166	0.15	3.8	3.8	TRUE	
	Chromium	7440-47-3	0.06472	0.5	280	--	TRUE	
	Lead	7439-92-1	0.07397	1	400	400	TRUE	
	Selenium	7782-49-2	0.3401	0.75	2.6	2.6	TRUE	
	Silver	7440-22-4	0.05032	0.5	8.9	8.9	TRUE	
EPA 7471	Mercury	7439-97-6	0.006	0.02	1	1	TRUE	
Volatile Organic Compounds (VOCs)								
EPA 8260	1,1,1,2-Tetrachloroethane	630-20-6	0.025	0.05	--	8.8	TRUE	
	1,1,1-Trichloroethane	71-55-6	0.025	0.05	--	3600	TRUE	
	1,1,2,2-Tetrachloroethane	79-34-5	0.00686	0.05	--	2.7	TRUE	
	1,1,2-Trichloroethane	79-00-5	0.00846	0.05	--	5	TRUE	
	1,1,2-Trichlorotrifluoroethane	76-13-1	0.0209	0.2	--	17000	TRUE	
	1,1-Dichloroethane	75-34-3	0.00699	0.05	--	16	TRUE	
	1,1-Dichloroethene	75-35-4	0.00999	0.05	--	100	TRUE	
	1,1-Dichloropropene	563-58-6	0.00817	0.05	--	--	TRUE	
	1,2,3-Trichlorobenzene	87-61-6	0.0119	0.05	--	93	TRUE	
	1,2,3-Trichloropropane	96-18-4	0.00664	0.2	--	0.11	TRUE	
	1,2,4-Trichlorobenzene	120-82-1	0.00909	0.05	--	110	TRUE	
	1,2,4-Trimethylbenzene	95-63-6	0.025	0.05	--	24	TRUE	
	1,2-Dibromo-3-chloropropane	96-12-8	0.0265	0.5	--	0.064	TRUE	
	1,2-Dibromoethane (EDB)	106-93-4	0.00616	0.05	--	0.16	TRUE	
	1,2-Dichlorobenzene	95-50-1	0.025	0.05	--	930	TRUE	
	1,2-Dichloroethane	107-06-2	0.0118	0.05	--	2	TRUE	
	1,2-Dichloropropane	78-87-5	0.00803	0.05	--	4.4	TRUE	
	1,3,5-Trimethylbenzene	108-67-8	0.025	0.05	--	1200	TRUE	
	1,3-Dichlorobenzene	541-73-1	0.025	0.05	--	--	TRUE	
	1,3-Dichloropropane	142-28-9	0.025	0.05	--	2300	TRUE	
	1,4-Dichlorobenzene	106-46-7	0.025	0.05	--	11	TRUE	
	2,2-Dichloropropane	594-20-7	0.00668	0.2	--	--	TRUE	
	2-Butanone (MEK)	78-93-3	0.125	0.25	--	19000	TRUE	
	4-Chlorotoluene	106-43-4	0.025	0.05	--	2300	TRUE	
	4-Methyl-2-pentanone (MIBK)	108-10-1	0.125	0.25	--	5600	TRUE	
	Acetone	67-64-1	0.5	1	--	67000	TRUE	
	Allyl chloride	107-05-1	0.00656	0.2	--	3.2	TRUE	
	Benzene	71-43-2	0.01	0.02	0.2	0.2	TRUE	
	Bromobenzene	108-86-1	0.00867	0.05	--	180	TRUE	
	Bromochloromethane	74-97-5	0.00681	0.05	--	63	TRUE	
	Bromodichloromethane	75-27-4	0.0089	0.05	--	1.3	TRUE	
	Bromoform	75-25-2	0.1	0.2	--	86	TRUE	
	Bromomethane	74-83-9	0.25	0.5	--	3	TRUE	
	Carbon tetrachloride	56-23-5	0.00808	0.05	--	2.9	TRUE	
	Chlorobenzene	108-90-7	0.00769	0.05	--	130	TRUE	
	Chloroethane	75-00-3	0.01255	0.5	--	5700	TRUE	
	Chloroform	67-66-3	0.00762	0.05	--	1.4	TRUE	
	Chloromethane	74-87-3	0.00912	0.2	--	46	TRUE	
	cis-1,3-Dichloropropene	10061-01-5	0.00628	0.05	--	--	TRUE	
	Dibromochloromethane	124-48-1	0.01076	0.05	--	3.3	TRUE	
	Dibromomethane	74-95-3	0.01401	0.05	--	9.8	TRUE	
	Dichlorodifluoromethane	75-71-8	0.0231	0.2	--	37	TRUE	
	Dichlorofluoromethane	75-43-4	0.25	0.5	--	--	TRUE	

Table G-1
Reporting Limits Compared to Screening Levels: Soil
Frank Properties
Billings, Montana

Analytical Method	Target Analyte	CAS Number	PACE Reporting Limits		Montana Tier 1 RBSLs Subsurface Soil (>20 ft GW)	EPA Industrial RSLs	[Screening Level] > [Reporting	Comment
			MDL (mg/kg)	PRL (mg/kg)			Subsurface Soil	
Volatile Organic Compounds (VOCs) - Continued								
EPA 8260	Diethyl ether (Ethyl ether)	60-29-7	0.0106	0.2	--	23000	TRUE	
	Ethylbenzene	100-41-4	0.00628	0.05	60	30	TRUE	
	Hexachloro-1,3-butadiene	87-68-3	0.125	0.25	--	5.3	TRUE	
	Isopropylbenzene (Cumene)	98-82-8	0.025	0.05	--	990	TRUE	
	Methyl-tert-butyl ether	1634-04-4	0.025	0.05	0.3	0.3	TRUE	
	Methylene Chloride	75-09-2	0.1	0.2	--	1000	TRUE	
	Naphthalene	91-20-3	0.1	0.2	50	20	TRUE	
	Styrene	100-42-5	0.00747	0.05	--	3500	TRUE	
	Tetrachloroethene	127-18-4	0.01805	0.05	--	100	TRUE	
	Tetrahydrofuran	109-99-9	0.0639	2	--	9600	TRUE	
	Toluene	108-88-3	0.0068	0.05	60	60	TRUE	
	Trichloroethene	79-01-6	0.00622	0.05	--	6	TRUE	
	Trichlorofluoromethane	75-69-4	0.0089	0.2	--	310	TRUE	
	Vinyl chloride	75-01-4	0.00742	0.02	--	1.7	TRUE	
	Xylene (Total)	1330-20-7	0.01964	0.15	600	300	TRUE	
	cis-1,2-Dichloroethene	156-59-2	0.0102	0.05	--	230	TRUE	
	m-Xylene (coelute)	108-38-3	13.7	100	--	240	TRUE	
	p-Xylene	106-42-3	13.7	100	--	240	TRUE	
	n-Butylbenzene	104-51-8	0.00607	0.05	--	5800	TRUE	
	n-Propylbenzene	103-65-1	0.00606	0.05	--	2400	TRUE	
	o-Xylene	95-47-6	0.00594	0.05	--	280	TRUE	
	p-Isopropyltoluene	99-87-6	0.00725	0.05	--	--	TRUE	
	sec-Butylbenzene	135-98-8	0.00589	0.05	--	12000	TRUE	
	tert-Butylbenzene	98-06-6	0.025	0.05	--	12000	TRUE	
	trans-1,3-Dichloropropene	10061-02-6	0.00704	0.05	--	--	TRUE	
	trans-1,2-Dichloroethene	156-60-5	0.00992	0.05	--	2300	TRUE	
Semi-Volatile Organic Compounds (SVOCs)								
EPA 8270	1,2,4-Trichlorobenzene	120-82-1	0.03605	0.33	--	110	TRUE	
	1,2-Dichlorobenzene	95-50-1	0.165	0.33	--	9,300	TRUE	
	1,2-Diphenylhydrazine	122-66-7	0.165	0.33	--	2.9	TRUE	
	1,3-Dichlorobenzene	541-73-1	0.165	0.33	--	--	TRUE	
	1,4-Dichlorobenzene	106-46-7	0.03854	0.33	--	11	TRUE	
	1-Methylnaphthalene	90-12-0	0.03877	0.33	--	73	TRUE	
	2,4,5-Trichlorophenol	95-95-4	0.03659	0.33	--	82,000	TRUE	
	2,4,6-Trichlorophenol	88-06-2	0.165	0.33	--	210	TRUE	
	2,4-Dichlorophenol	120-83-2	0.165	0.33	--	2,500	TRUE	
	2,4-Dimethylphenol	105-67-9	0.058	0.33	--	16000	TRUE	
	2.4-Dinitrophenol	51-28-5	0.165	0.33	--	1600	TRUE	
	2,4-Dinitrotoluene	121-14-2	0.165	0.33	--	7.4	TRUE	
	2.6-Dinitrotoluene	606-20-2	0.06381	0.33	--	1.5	TRUE	
	2-Chloronaphthalene	91-58-7	0.165	0.33	--	--	TRUE	
	2-Chlorophenol	95-57-8	0.04123	0.33	--	--	TRUE	
	2-Methylnaphthalene	91-57-6	0.165	0.33	--	3000	TRUE	
	2-Methylphenol(o-Cresol)	95-48-7	0.165	0.33	--	--	TRUE	
	2-Nitroaniline	88-74-4	0.165	0.33	--	--	TRUE	
	2-Nitrophenol	88-75-5	0.165	0.33	--	--	TRUE	
	3&4-Methylphenol	108-39-4 106-44-5	0.165	0.66	--	--	TRUE	
	3,3'-Dichlorobenzidine	91-94-1	0.09352	0.33	--	--	TRUE	
	3-Nitroaniline	99-09-2	0.07329	0.33	--	--	TRUE	
	4,6-Dinitro-2-methylphenol	534-52-1	0.85	1.7	--	--	TRUE	
	4-Bromophenylphenyl ether	101-55-3	0.165	0.33	--	--	TRUE	
	4-Chloro-3-methylphenol	59-50-7	0.165	0.33	--	--	TRUE	
	4-Chloroaniline	106-47-8	0.08447	0.33	--	--	TRUE	
	4-Chlorophenylphenyl ether	7005-72-3	0.165	0.33	--	--	TRUE	
	4-Nitroaniline	100-01-6	0.165	0.33	--	--	TRUE	
	4-Nitrophenol	100-02-7	0.165	0.33	--	--	TRUE	
	Acenaphthene	83-32-9	0.165	0.33	800	45000	TRUE	
	Acenaphthylene	208-96-8	0.06452	0.33	--	--	TRUE	
	Anthracene	120-12-7	0.165	0.33	10,000	230000	TRUE	
	Benzo(a)anthracene	56-55-3	0.165	0.33	50	2.9	TRUE	
	Benzo(a)pyrene	50-32-8	0.165	0.33	5	0.29	TRUE	
	Benzo(b)fluoranthene	205-99-2	0.04183	0.33	50	2.9	TRUE	
	Benzo(g,h,i)perylene	191-24-2	0.04013	0.33	--	--	TRUE	
	Benzo(k)fluoranthene	207-08-9	0.165	0.33	500	29	TRUE	
	Butylbenzylphthalate	85-68-7	0.165	0.33	--	1200	TRUE	
	Carbazole	86-74-8	0.165	0.33	--	--	TRUE	

Table G-1
Reporting Limits Compared to Screening Levels: Soil
Frank Properties
Billings, Montana

Analytical Method	Target Analyte	CAS Number	PACE Reporting Limits		Montana Tier 1 RBSLs Subsurface Soil (>20 ft GW)	EPA Industrial RSLs	[Screening Level] > [Reporting	Comment
			MDL (mg/kg)	PRL (mg/kg)			Subsurface Soil	
Semi-Volatile Organic Compounds (SVOCs) - Continued								
EPA 8270	Chrysene	218-01-9	0.04434	0.33	5,000	290	TRUE	
	Di-n-butylphthalate	84-74-2	0.04576	0.33	--	82000	TRUE	
	Di-n-octylphthalate	117-84-0	0.165	0.33	--	--	TRUE	
	Dibenz(a,h)anthracene	53-70-3	0.165	0.33	5	2.9	TRUE	
	Dibenzofuran	132-64-9	0.165	0.33	--	1000	TRUE	
	Diethylphthalate	84-66-2	0.165	0.33	--	660000	TRUE	
	Dimethylphthalate	131-11-3	0.165	0.3	--	--	TRUE	
	Fluoranthene	206-44-0	0.165	0.33	2,000	30000	TRUE	
	Fluorene	86-73-7	0.165	0.33	2,000	30000	TRUE	
	Hexachloro-1,3-butadiene	87-68-3	0.03346	0.33	--	5.3	TRUE	
	Hexachlorobenzene	118-74-1	0.04337	0.33	--	0.96	TRUE	
	Hexachloroethane	67-72-1	0.165	0.33	--	8	TRUE	
	Indeno(1,2,3-cd)pyrene	193-39-5	0.165	0.33	50	2.9	TRUE	
	Isophorone	78-59-1	0.165	0.33	--	2400	TRUE	
	N-Nitroso-di-n-propylamine	621-64-7	0.165	0.33	--	0.33	TRUE	
	N-Nitrosodimethylamine	62-75-9	0.165	0.33	--	0.034	FALSE	Laboratory will be asked to report to MDL
	N-Nitrosodiphenylamine	86-30-6	0.165	0.33	--	470	TRUE	
	Naphthalene	91-20-3	0.02354	0.33	30	17	TRUE	
	Nitrobenzene	98-95-3	0.0372	0.33	--	22	TRUE	
	Pentachlorophenol	87-86-5	0.165	0.67	--	4	TRUE	
	Phenanthrene	85-01-8	0.04719	0.33	---		FALSE	Laboratory will be asked to report to MDL
	Phenol	108-95-2	0.165	0.33	--	250000	TRUE	
	Pyrene	129-00-0	0.04163	0.33	2,000	23000	TRUE	
	bis(2-Chloroethoxy)methane	111-91-1	0.165	0.33	--	2500	TRUE	
	bis(2-Chloroethyl) ether	111-44-4	0.165	0.33	--	1	TRUE	
	bis(2-Chloroisopropyl)ether	108-60-1	0.165	0.33	--	22	TRUE	
	bis(2-Ethylhexyl)phthalate	117-81-7	0.05642	0.33	--	160	TRUE	

Notes:
mg/kg - milligrams per kilogram
CAS - Chemical abstracts service registry number
MDL - Method Detection limit
PRL - Preliminary reporting limit
RBSLs - Risk based Screening Levels
GW - Groundwater
EPA - Enviornmental Protection Agency
RSLs - Regional screening levels

Appendix G-2
Reporting Limits Compared to Screening Levels: Groundwater
Frank Properties
Billings, Montana

Analytical Method	Target Analyte	CAS Number	PACE Reporting Limits		Montana Tier 1 Groundwater RBSLs (ug/L)	DEQ 7 Numeric Water Quality Standards	[Screening Level] > [Reporting Limit]	Comment
			MDL (ug/L)	PRL (ug/L)			Groundwater	
Extractable Petroleum Hydrocarbons (EPH)								
EPH	Total Extractable Hydrocarbons	TEH	69.1	200	1000	--	TRUE	
	Aliphatic (C09-C18)	C09-C18	100	200	1000	--	TRUE	
	Aliphatic (C19-C36)	C19-C36	5	200	1000	--	TRUE	
	Aromatic (C11-22)	C11-22	19	200	1000	--	TRUE	
Volatile Petroleum Hydrocarbons (VPH)								
VPH	Total Purgeable Hydrocarbons	TPH	2.578	20	1000	--	TRUE	
	Aliphatic (C5-C8)	C5-C8	2.71462	20	700	--	TRUE	
	Aliphatic (C9-C12)	C9-C12	1.666	20	1000	--	TRUE	
	Aromatic (C9-C10)	C9-C10	10	20	1000	--	TRUE	
	Aliphatic (C5-C8), adjusted	--	2.71462	20	--	--	TRUE	
	Aliphatic (C9-C12), adjusted	--	1.666	20	--	--	TRUE	
	Benzene	71-43-2	0.19185	0.5	5.0	5	TRUE	
	Ethylbenzene	100-41-4	0.15411	0.5	700	700	TRUE	
	Methyl-tert-butyl ether	1634-04-4	0.49053	1	30	30	TRUE	
	Naphthalene	91-20-3	0.25003	5	100	100	TRUE	
	Toluene	108-88-3	0.084	0.5	1000	1000	TRUE	
	Xylene (Total)	1330-20-7	0.52989	2	10000	--	TRUE	
	m&p-Xylene (co-elute)	108-38-3	0.141	1	--	10000	TRUE	
		106-42-3	0.141	1	--	10000	TRUE	
	o-Xylene	95-47-6	0.24789	1	--	10000	TRUE	
Volatile Organic Compounds (VOCs)								
EPA Method 8260	1,1,1,2-Tetrachloroethane	630-20-6	0.5	1	--	--	TRUE	
	1,1,1-Trichloroethane	71-55-6	0.264	1	--	200	TRUE	
	1,1,2,2-Tetrachloroethane	79-34-5	0.5	1	--	2	TRUE	
	1,1,2-Trichloroethane	79-00-5	0.127	1	--	3	TRUE	
	1,1,2-Trichlorotrifluoroethane	76-13-1	0.5	1	--	--	TRUE	
	1,1-Dichloroethane	75-34-3	0.159	1	--	--	TRUE	
	1,1-Dichloroethene	75-35-4	0.199	1	--	7	TRUE	
	1,1-Dichloropropene	563-58-6	0.5	1	--	--	TRUE	
	1,2,3-Trichlorobenzene	87-61-6	0.5	1	--	--	TRUE	
	1,2,3-Trichloropropane	96-18-4	1.22	4	--	--	TRUE	
	1,2,4-Trichlorobenzene	120-82-1	0.5	1	--	70	TRUE	
	1,2,4-Trimethylbenzene	95-63-6	0.5	1	--	--	TRUE	
	1,2-Dibromo-3-chloropropane	96-12-8	2	4	--	0.2	FALSE	Laboratory will be asked to report to MDL
	1,2-Dibromoethane (EDB)	106-93-4	0.148	1	--	0.004	FALSE	Laboratory will be asked to report to MDL
	1,2-Dichlorobenzene	95-50-1	0.16	1	--	600	TRUE	
	1,2-Dichloroethane	107-06-2	0.131	1	--	4	TRUE	
	1,2-Dichloropropane	78-87-5	0.142	4	--	5	TRUE	
	1,3,5-Trimethylbenzene	108-67-8	0.5	1	--	--	TRUE	
	1,3-Dichlorobenzene	541-73-1	0.5	1	--	600	TRUE	
	1,3-Dichloropropane	142-28-9	0.5	1	--	--	TRUE	
	1,4-Dichlorobenzene	106-46-7	0.5	1	--	75	TRUE	
	2,2-Dichloropropane	594-20-7	0.174	4	--	--	TRUE	
	2-Butanone (MEK)	78-93-3	2.5	5	--	--	TRUE	
	2-Chlorotoluene	95-49-8	0.138	1	--	--	TRUE	
	4-Chlorotoluene	106-43-4	0.0825	1	--	--	TRUE	
	4-Methyl-2-pentanone (MIBK)	108-10-1	2.5	5	--	--	TRUE	
	Acetone	67-64-1	10	20	--	--	TRUE	
	Allyl chloride	107-05-1	0.446	4	--	--	TRUE	
	Benzene	71-43-2	0.15	1	--	5	TRUE	
	Bromobenzene	108-86-1	0.132	1	--	--	TRUE	
	Bromochloromethane	74-97-5	0.115	1	--	--	TRUE	
	Bromodichloromethane	75-27-4	0.202	1	--	10	TRUE	
	Bromoform	75-25-2	2	4	--	80	TRUE	
	Bromomethane	74-83-9	2	4	--	10	TRUE	
	Carbon tetrachloride	56-23-5	0.159	1	--	3	TRUE	
	Chlorobenzene	108-90-7	0.0661	1	--	100	TRUE	
	Chloroethane	75-00-3	0.241	1	--	--	TRUE	
	Chloroform	67-66-3	0.161	1	--	70	TRUE	
	Chloromethane	74-87-3	0.341	4	--	30	TRUE	
	cis-1,3-Dichloropropene	10061-01-5	0.127	4	--	4	TRUE	
	Dibromochloromethane	124-48-1	0.5	1	--	4	TRUE	
	Dibromomethane	74-95-3	0.185	4	--	--	TRUE	
	Dichlorodifluoromethane	75-71-8	0.5	1	--	1000	TRUE	
	Dichlorofluoromethane	75-43-4	0.202	1	--	--	TRUE	
	Diethyl ether (Ethyl ether)	60-29-7	0.141	4	--	--	TRUE	
	Ethylbenzene	100-41-4	0.165	1	--	700	TRUE	
	Hexachloro-1,3-butadiene	87-68-3	0.5	1	--	5	TRUE	
	Isopropylbenzene (Cumene)	98-82-8	0.5	1	--	--	TRUE	
	Methyl-tert-butyl ether	1634-04-4	0.169	1	--	30	TRUE	
	Methylene Chloride	75-09-2	2	4	--	5	TRUE	
	Naphthalene	91-20-3	2	4	--	100	TRUE	
	Styrene	100-42-5	0.0627	1	--	100	TRUE	
	Tetrachloroethene	127-18-4	0.157	1	--	5	TRUE	
	Tetrahydrofuran	109-99-9	1.99	10	--	--	TRUE	
	Toluene	108-88-3	0.11	1	--	1000	TRUE	
	Trichloroethene	79-01-6	0.0906	0.4	--	5	TRUE	
	Trichlorofluoromethane	75-69-4	0.216	1	--	10000	TRUE	
	Vinyl chloride	75-01-4	0.082	0.4	--	--	TRUE	

Appendix G-2
Reporting Limits Compared to Screening Levels: Groundwater
Frank Properties
Billings, Montana

Analytical Method	Target Analyte	CAS Number	PACE Reporting Limits		Montana Tier 1 Groundwater RBSLs (ug/L)	DEQ 7 Numeric Water Quality Standards	[Screening Level] > [Reporting Limit]	Comment
			MDL (ug/L)	PRL (ug/L)			Groundwater	
Volatile Organic Compounds (VOCs) - Continued								
EPA Method 8260	Xylene (Total)	1330-20-7	0.404	3	--	--	TRUE	
	cis-1,2-Dichloroethene	156-59-2	0.133	1	--	70	TRUE	
	m-Xylene (coelute)	108-38-3	0.31	2	--	10000	TRUE	
	p-Xylene	106-42-3	0.31	2	--	10000	TRUE	
	n-Butylbenzene	104-51-8	0.5	1	--	--	TRUE	
	n-Propylbenzene	103-65-1	0.5	1	--	--	TRUE	
	o-Xylene	95-47-6	0.094	1	--	10000	TRUE	
	p-Isopropyltoluene	99-87-6	0.00725	0.05	--	300	TRUE	
	sec-Butylbenzene	135-98-8	0.00589	0.05	--	16	TRUE	
	p-Isopropyltoluene	99-87-6	0.5	1	--	--	TRUE	
	sec-Butylbenzene	135-98-8	0.5	1	--	--	TRUE	
	tert-Butylbenzene	98-06-6	0.5	1	--	--	TRUE	
	trans-1,3-Dichloropropene	10061-02-6	0.185	4	--	2	TRUE	
	trans-1,2-Dichloroethene	156-60-5	0.231	1	--	100	TRUE	
Metals								
EPA 6010	Arsenic	7440-38-2	3.14847	20	--	10	TRUE	
	Barium	7440-39-3	5	10	--	1000	TRUE	
	Cadmium	7440-43-9	0.25118	3	--	5	TRUE	
	Chromium	7440-47-3	5	10	--	100	TRUE	
	Lead	7439-92-1	1.77956	10	--	15	TRUE	
	Selenium	7782-49-2	6.64761	20	--	50	TRUE	
	Silver	7440-22-4	0.62787	10	--	100	TRUE	
EPA 7470	Mercury	7439-97-6	0.026	0.2	--	2	TRUE	
Semi-Volatile Organic Compounds (SVOCs)								
EPA 8270	tert-Butylbenzene	98-06-6	0.025	0.05	--	51	TRUE	
	trans-1,3-Dichloropropene	10061-02-6	0.00704	0.05	--	190	TRUE	
	trans-1,2-Dichloroethene	156-60-5	0.00992	0.05	--	190	TRUE	
	1,2,4-Trichlorobenzene	120-82-1	0.97	10	--	70	TRUE	
	1,2-Dichlorobenzene	95-50-1	1.00	10	--	600	TRUE	
	1,2-Diphenylhydrazine	122-66-7	0.76	10	--	0.4	FALSE	Laboratory will be asked to report to MDL
	1,3-Dichlorobenzene	541-73-1	1.16	10	--	400	TRUE	
	1,4-Dichlorobenzene	106-46-7	1.18	10	--	75	TRUE	
	1-Methylnaphthalene	90-12-0	0.73	10	--	--	TRUE	
	2,4,5-Trichlorophenol	95-95-4	0.95	10	--	7	FALSE	Laboratory will be asked to report to MDL
	2,4,6-Trichlorophenol	88-06-2	1.01	10	--	30	TRUE	
	2,4-Dichlorophenol	120-83-2	1.05	10	--	93	TRUE	
	2,4-Dimethylphenol	105-67-9	5.00	10	--	540	TRUE	
	2,4-Dinitrotoluene	121-14-2	1.04	10	--	0.5	FALSE	Laboratory will be asked to report to MDL
	2,4-Dinitrophenol	51-28-5	5.00	10	--	70	TRUE	
	2,6-Dinitrotoluene	606-20-2	1.01	10	--	0.5	FALSE	Laboratory will be asked to report to MDL
	2-Chloronaphthalene	91-58-7	1.16	10	--	1700	TRUE	
	2-Chlorophenol	95-57-8	1.16	10	--	120	TRUE	
	2-Methylnaphthalene	91-57-6	0.73	10	--	--	TRUE	
	2-Methylphenol(o-Cresol)	95-48-7	1.49	10	--	--	TRUE	
	2-Nitroaniline	88-74-4	1.10	10	--	--	TRUE	
	2-Nitrophenol	88-75-5	25.00	50	--	--	TRUE	
	3&4-Methylphenol	108-39-4 106-44-5	5.00	10	--	--	TRUE	
	3,3'-Dichlorobenzidine	91-94-1	25.00	50	--	0.4	FALSE	Laboratory will be asked to report to MDL
	3-Nitroaniline	99-09-2	5.00	10	--	--	TRUE	
	4,6-Dinitro-2-methylphenol	534-52-1	1.41	10	--	13.4	TRUE	
	4-Bromophenylphenyl ether	101-55-3	1.07	10	--	--	TRUE	
	4-Chloro-3-methylphenol	59-50-7	0.97	10	--	3000	TRUE	
	4-Chloroaniline	106-47-8	1.36	10	--	--	TRUE	
	4-Chlorophenylphenyl ether	7005-72-3	0.92	10	--	--	TRUE	
	4-Nitroaniline	100-01-6	1.09	10	--	--	TRUE	
	4-Nitrophenol	100-02-7	5.00	10	--	60	TRUE	
	Acenaphthene	83-32-9	0.82	10	670	420	TRUE	
	Acenaphthylene	208-96-8	1.12	10	--	--	TRUE	
	Anthracene	120-12-7	0.83	10	2,100	2100	TRUE	
	Benzo(a)anthracene	56-55-3	0.90	10	0.5	0.48	FALSE	Laboratory will be asked to report to MDL
	Benzo(a)pyrene	50-32-8	0.90	10	0.05	0.048	FALSE	Laboratory will be asked to report to MDL
	Benzo(b)fluoranthene	205-99-2	0.89	10	0.5	0.48	FALSE	Laboratory will be asked to report to MDL
	Benzo(g,h,i)perylene	191-24-2	0.87	10	--	--	TRUE	
	Benzo(k)fluoranthene	207-08-9	1.05	10	5	4.79	FALSE	Laboratory will be asked to report to MDL
	bis(2-Chloroethoxy)methane	111-91-1	1.08	10	--	--	TRUE	
	bis(2-Chloroisopropyl)ether	108-60-1	1.11	10	--	1400	TRUE	
	bis(2-Ethylhexyl)phthalate	117-81-7	1.08	10	--	6	FALSE	Laboratory will be asked to report to MDL
	bis(2-Chloroethyl) ether	111-44-4	5.00	10	--	0.31	FALSE	Laboratory will be asked to report to MDL
	Butylbenzylphthalate	85-68-7	1.04	10	--	3000	TRUE	
	Carbazole	86-74-8	0.92	10	--	--	TRUE	
	Chrysene	218-01-9	0.87	10	50	48	TRUE	
	Dibenz(a,h)anthracene	53-70-3	0.89	10	0.05	0.048	FALSE	Laboratory will be asked to report to MDL
	Dibenzofuran	132-64-9	0.74	10	--	--	TRUE	
	Diethylphthalate	84-66-2	0.78	10	--	23000	TRUE	
	Dimethylphthalate	131-11-3	0.80	10	--	313000	TRUE	
	Di-n-butylphthalate	84-74-2	0.89	10	--	2700	TRUE	
	Di-n-octylphthalate	117-84-0	4.18	10	--	--	TRUE	
	Fluoranthene	206-44-0	0.86	10	130	280	TRUE	
	Fluroene	86-73-7	0.89	10	1100	280	TRUE	

Appendix G-2
Reporting Limits Compared to Screening Levels: Groundwater
Frank Properties
Billings, Montana

Analytical Method	Target Analyte	CAS Number	PACE Reporting Limits		Montana Tier 1 Groundwater RBSLs (ug/L)	DEQ 7 Numeric Water Quality Standards	[Screening Level] > [Reporting Limit]	Comment
			MDL (ug/L)	PRL (ug/L)			Groundwater	
Semi-Volatile Organic Compounds (SVOCs)								
EPA 8270	Hexachloro-1,3-butadiene	87-68-3	0.98	10	--	--	TRUE	
	Hexachlorobenzene	118-74-1	1.05	10	--	0.2	FALSE	Laboratory will be asked to report to MDL
	Hexachloroethane	67-72-1	1.37	10	--	19	TRUE	
	Indeno(1,2,3-cd)pyrene	193-39-5	0.93	10	0.5	0.044	FALSE	Laboratory will be asked to report to MDL
	Isophorone	78-59-1	1.09	10	--	360	TRUE	
	Naphthalene	91-20-3	0.86	10	100	100	TRUE	
	Nitrobenzene	98-95-3	1.47	10	--	--	TRUE	
	N-Nitrosodimethylamine	62-75-9	5.00	10	--	0.0069	FALSE	Laboratory will be asked to report to MDL
	N-Nitroso-di-n-propylamine	621-64-7	0.78	10	--	0.05	FALSE	Laboratory will be asked to report to MDL
	N-Nitrosodiphenylamine	86-30-6	0.84	10	--	50	TRUE	
	Pentachlorophenol	87-86-5	1.32	20	--	1	FALSE	Laboratory will be asked to report to MDL
	Phenanthrene	85-01-8	0.90	10	--	--	TRUE	
	Phenol	108-95-2	5.00	10	--	300	TRUE	
	Pyrene	129-00-0	0.93	10	830	960	TRUE	

Notes:
mg/L - micrograms per liter
CAS - Chemical abstracts service registry number
MDL - Method Detection limit
MRL - Method reporting limit
RBSLs - Risk based Screening Levels
GW - Groundwater
DEQ - Montana Department of Enviornmental Quality
EPA - Enviornmental Protection Agency