Indoor Air Quality Investigation Sampling and Analysis Plan Bozeman Landfill

Bozeman, Montana

Prepared for:

Dustin Johnson, P.E.

City of Bozeman
P.O. Box 1230
Bozeman, MT 59715

Prepared by:

Tetra Tech

851 Bridger Drive, Suite 6 (59715)
PO Box 1413 (59771)
Bozeman, MT
(406) 582-8780
Fax (406) 582-8790

Tetra Tech Project No. 114-710303.740

June 27, 2013

Indoor Air Quality Investigation
Sampling and Analysis Plan
Bozeman Landfill

Bozeman, Montana

Tetra Tech

June 2013

Signatures and Distribution List:

_____
Mark F. Pearson, Tetra Tech
Project Manager, Hydrogeologist

_____
Kirk A. Miller, Tetra Tech
Senior Project Manager

_____
Dustin Johnson, P.E., City of Bozeman
City Engineer

APH	Air Phase Hydrocarbon
bgs	below ground surface
CMA	Corrective Measures Assessment
COC	Chain-of-Custody
DEQ	Montana Department of Environmental Quality
DQO	Data Quality Objective
inHg	Inches of Mercury
JSA	Job Safety Analysis
LEL	Lower Explosive Limit
LFG	Landfill Gas
MADEP	Massachusetts Department of Environmental Protection
QA/QC	Quality Assurance/Quality Control
RL	Reporting Limit
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SIM	Select-Ion Monitoring
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
VOC	Volatile Organic Compound

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

This document includes a Sampling and Analysis Plan (SAP) and a Job Safety Analysis (JSA) prepared for the City of Bozeman as part of the ongoing investigation of soil gas in the vicinity of the Bozeman Landfill. The project is funded by the City of Bozeman.

This SAP was prepared to guide the Indoor Air Quality Investigation which is being conducted in response to the recent discovery of elevated concentrations of volatile organic compounds (VOCs) in soil gas near the southern border of the Bozeman Landfill and the neighboring community (Tetra Tech, 2013c).

This SAP is organized as follows: *Section 1* presents the Introduction, *Section 2* presents a Site Summary, *Section 3* the Investigation Objectives, and *Section 4* the Methodology. **Appendix A** presents the project JSA; **Appendix B** presents Tetra Tech's Standard Operating Procedures (SOPs); **Appendix C** presents a copy of the Household Survey; **Appendix D** presents the Laboratory Chain-of-Custody Form.

1.1 Objectives

There are two primary objectives of the proposed investigation: (1) determine whether vapor intrusion has the potential to occur in residences along the southern border of the Bozeman Landfill, and (2) develop recommendations for additional sampling and vapor mitigation if necessary.

Vapor intrusion refers to the process by which volatile chemicals migrate from subsurface contaminant sources such as contaminated soil or groundwater into the indoor air of overlying structures. Soil vapor is the air found in the pore spaces between soil particles which can become contaminated when volatile chemicals migrate from contaminant sources. Volatile chemicals are chemical that generate vapors and mainly include VOCs and some semi-volatile organic compounds (SVOCs). Contaminated soil vapors may enter structures through cracks in slabs or basement walls, through the junction between the slab footing and the basement floor, through dirt floors, and through openings around sump pumps or where pipes and electrical wires go through the foundation (DEQ, 2011).

To achieve the first objective Tetra Tech proposes to conduct two indoor air sampling events from participating residents and have the samples analyzed for VOCs. Laboratory results will then be compared to soil gas results that were collected during the fall 2012 and spring 2013 soil gas monitoring events (Tetra Tech, 2013a, 2013b, 2013c). In the event that indoor air concentrations of VOCs correlate with subsurface soil gas results, then more invasive measures such as sub-slab soil gas monitoring may be recommended. Additionally, groundwater samples will be collected simultaneously during the first indoor air sampling event to further assess the impact that potentially contaminated aquifers may have on vapor intrusion.

2.0 SITE SUMMARY

The City of Bozeman purchased approximately 200 acres for use as a landfill in 1969. The location of the Bozeman Landfill is shown in **Figure 1**. Disposal of garbage at the site began soon afterwards. Class II, III, and IV wastes have been accepted. The majority of waste has been class II and includes decomposable wastes such as municipal and household solid waste including food, paper, cardboard, cloth, glass metal, and plastics. Class II designation prohibits the disposal of regulated hazardous wastes.

Garbage disposal was conducted in an unlined waste cell between 1969 and 1995. The unlined waste cell is in the southeastern corner of the landfill property. The cell is approximately 32 acres and contains waste up to approximately 100 feet in thickness.

Garbage disposal was conducted in a second waste cell between 1995 and 2008. The second cell has an impermeable liner with a leachate collection system connected to the municipal sewer. The second cell is approximately 12 acres and up to approximately 100 feet in thickness.

Groundwater contamination issues were identified in the late 1970s. Groundwater monitoring wells were installed and a groundwater monitoring program was implemented in 1981. Monitoring results have shown that groundwater quality has been impacted primarily by VOCs originating from the unlined waste cell. The network of groundwater monitoring wells is shown in **Figure 2**.

Bridger Creek Golf Course opened with adjacent residential development in 1994. The residential subdivisions surrounding the Bridger Creek Golf Course are within City of Bozeman limits and are connected to City water and sewer.

A Corrective Measures Assessment (CMA) was prepared in 1995 to address VOC impacts to groundwater at the Bozeman Landfill site. Various cleanup alternatives were evaluated in the CMA with the preferred alternative being an active landfill gas (LFG) extraction system installed in the unlined, closed cell. The LFG extraction system was installed and operating by 1997 and continuously operates, at present. The system collects approximately 1,100 pounds of VOCs per year from the extracted LFG. The VOCs are thermally destroyed using a candlestick flare. The network of LFG extraction wells is shown in **Figure 2**.

Groundwater monitoring is being conducted twice per year, in June and December. Monitoring results indicate a southwesterly groundwater flow. Three groundwater wells (wells LF-2, LF-3, and MW-10) and one spring (McIlhattan Seep) are monitored downgradient and outside of the landfill property. These off-site monitoring stations indicate that groundwater is impacted with low concentrations of VOCs including tetrachloroethene and trichloroethene. The concentration of these VOCs have not met or exceeded regulatory action levels in groundwater outside of the landfill property since June 2003. There are two monitoring wells in the western portion of the residential neighborhood south of the landfill property (wells LF-2 and LF-3 shown in **Figure 2**). These wells indicate that depth to groundwater in the neighborhood is approximately 14 feet.

Methane monitoring is being conducted on a monthly basis to confirm that no explosive concentrations of methane are leaving the landfill property. In addition, oxygen, carbon dioxide, and nitrogen are measured. The monitoring also determines the effectiveness of the operating LFG extraction system. Methane has intermittently exceeded regulatory limits (25 percent of the lower explosive limit (LEL)) in several of the perimeter gas probes during springtime when soil

has the greatest amount of moisture. Methane is now rarely detected in the perimeter gas monitoring probes following repairs to the LFG extraction well-heads and near continuous operation of the system. Location of the perimeter gas monitoring probes is shown in **Figure 2**.

Routine monitoring activities, attendant to LFG extraction system upgrades, detected additional VOCs in soil gas near the south boundary of the landfill in late 2012. In this initial investigation, gas samples were collected from four perimeter gas monitoring probes near the south boundary of the landfill property. Samples were analyzed for 62 VOC constituents by TO-15 analysis. Chloroform; benzene; trichloroethene; tetrachloroethene; ethylbenzene; and 1,2,4-trimethylbenzene were detected above U.S. Environmental Protection Agency (EPA) Resident Regional Screening Levels (RSL) for air. Concerned with potential health impacts to residents in the neighborhood south of the landfill, the City of Bozeman then conducted follow-up investigations in March through May 2013, in a residential neighborhood south of the landfill and again, along the south property boundary of the landfill. The analyte list included those parameters that had exceeded EPA RSLs in the first investigation and some additional petroleum hydrocarbon compounds and degradation compounds of tetrachloroethene. The subsequent investigations resulted in the detection of chloroform, benzene, trichloroethene, tetrachloroethene, and ethylbenzene exceeding EPA RSLs in a residential neighborhood south of the landfill. In addition, 1,2,4-trimethylbenzene and vinyl chloride were detected in excess of EPA RSLs in one soil gas location within the landfill property but near the south property boundary. The source of VOCs in soil gas is believed to be from the unlined closed cell and groundwater impacted with VOCs originating from the unlined closed cell.

3.0 INVESTIGATION OBJECTIVES

This section describes the objectives of the indoor air quality investigation. It identifies the study area boundaries, contaminants of potential concern, data quality objectives, and quality assurance and quality control (QA/QC) considerations for the project.

3.1 Project Objectives

The objectives of this indoor air quality investigation are to identify whether the vapor intrusion exposure pathway is being completed in residences in the project area. This will be completed by ascertaining whether VOCs are present in residential indoor air, and comparing indoor air concentrations to known soil gas concentrations in the vicinity of each residence (Tetra Tech, 2013c).

3.2 Contaminants of Potential Concern

Tetra Tech has identified the following contaminants of potential concern at or above laboratory analytical reporting limits in soil gas beneath residences along the southern border of the Bozeman Landfill.

- Tetrahydrofuran
- 1,2,4 trimethylbenzene
- Vinyl chloride
- cis 1,2-dichloroethene
- Benzene
- Trichloroethene
- Toluene
- Tetrachloroethene
- Ethylbenzene
- Xylenes
- Chloroform

3.3 Scope of Work

The scope of work for this investigation was developed based on analytical data from previous soil gas investigations conducted in October 2012, April 2013, and May 2013 (Tetra Tech, 2013a, 2013b, 2013c). Tetra Tech proposes to complete the following as part of the scope of work for this project.

- Conduct two indoor air sampling events at up to 26 homes near the southern border of the Bozeman Landfill located on Saint Andrews Drive, Turnberry Court, and Caddie Court in Bozeman, Montana. Air samples will be collected and submitted for VOC analysis.
- Collect groundwater samples from residential irrigation wells belonging to homes within the project area and submit samples for VOC analysis.
- Prepare one progress report after the initial sampling event and one Indoor Air Quality Investigation Report which presents the results of the investigation.

The investigation work will be performed in June and July 2013, and November and December 2013. It is anticipated that the first set of analytical data will be received by mid-August, and a progress report will be submitted to the City of Bozeman by August 31, 2013. The second set of

analytical results will likely be received by mid-January. A progress report will be prepared following receipt of each monitoring event's lab results and submitted to City of Bozeman. Lab results for each home investigated will be shared with each owner of that home.

A Draft Indoor Air Quality Investigation Report will be submitted by January 31, 2014. A Final Indoor Air Quality Investigation Report will subsequently be submitted once comments have been received by the City of Bozeman.

3.4 Quality Assurance/Quality Control

Where applicable, Tetra Tech will follow procedures outlined in the Montana Department of Environmental Quality (DEQ) Vapor Intrusion Guide (DEQ, 2011). Field staff will utilize Tetra Tech Standard Operating Procedures (SOPs) while collecting field samples and duplicates. This SAP provides details on the collection frequency requirements for each QA/QC sample, as well as other QA/QC requirements and procedures for this project.

3.4.1 Data Validation

Data validation consists of completing a review of raw analytical data. The laboratory will validate raw data using EPA Contract Laboratory program National Functional Guidelines and according to specific analytical method requirements. The analytical laboratory will perform data validation on raw analytical data prior to preparing a final analytical report.

Data evaluation consists of completing a review of laboratory analytical reports that have undergone internal laboratory validation. The objective of data validation and evaluation is to identify any unreliable or invalid laboratory measurements and qualify data for interpretive use. The data evaluation will include review of field QA/QC data and additional review of qualifiers assigned to the data by the analytical laboratory. Additional qualifiers will be assigned to the data as necessary based on, but not limited to, precision and accuracy of results, blank contamination, and holding time exceedances.

Project personnel will complete data evaluation checklists, as outlined in **Appendix C**. The checklists provide a guide for review of the laboratory and field procedures and data collected. The review will evaluate whether the following were completed according to SAP requirements, EPA guidelines and/or method specifications:

- Chain-of-custody procedures;
- Temperatures;
- Holding times;
- Laboratory QA/QC (i.e. review of results for method blanks, control samples, calibration results, duplicates, matrix spike/matrix spike duplicates; and review detection limits are met);
- Lab data evaluation will also consider instrument tuning and system performance, calibration results, and detection limits; and,
- Field QA/QC (sample handling, duplicates, and field and equipment blanks).

Knowing the limitations of the data assists the data user when making interpretations. Data with limitations are usable for evaluation as long as the limitations are considered. Professional judgment is required and will be used to assess the impact of field QC on the overall quality and usability of the field data.

3.5 Project Organization

The overall project manager for the investigation is Mr. Dustin Johnson, P.E., City Engineer for the City of Bozeman. Mr. Mark Pearson is the Tetra Tech Project Manager. Mr. Nicholas Sovner is the Tetra Tech staff scientist assigned to work with Mr. Pearson to assist in executing field activities and project administration. Mr. Kirk Miller is the Tetra Tech Senior Project Manager and will provide technical oversight, assistance with public outreach, and will ensure field crews adhere to Tetra Tech health and safety protocols.

3.6 Data Quality Objectives

Data quality objectives (DQOs) for this investigation were developed to ensure data quality and to define procedures for data collection. The DQO process allows Tetra Tech to evaluate the level of data quality required for specific data collection activities.

3.6.1 Problem Statement

The City of Bozeman is interested in addressing the issue of vapor intrusion in residences along the southern border of the Bozeman Landfill which encompasses the neighborhood along Saint Andrews Drive, Turnberry Court, and Caddie Court. Media affected by contaminants of potential concern at the Site may include groundwater, subsurface soil, soil gas, and residential indoor air. This investigation is necessary to confirm or deny the presence of environmental contamination at the above-mentioned neighborhood and to determine the extent and magnitude of any impacts to indoor air.

3.6.2 Decision Statement

The indoor air quality investigation will involve collecting environmental data to confirm or deny the presence of VOCs in residential indoor air. Collected media will include indoor air and groundwater from residential irrigation wells. Tetra Tech will evaluate available data and make decisions based on the following decision statements:

- Do residences in the selected area contain VOC concentrations that are believed to have originated from the subsurface and meet or exceed federal indoor air quality regulatory standards?
- What actions will be necessary after the completion of the investigation to confirm the findings and what mitigation measures (if any) are necessary?

3.6.3 Site Conceptual Model

VOCs have been detected in soil gas at the south boundary of the landfill and along Saint Andrews Drive, Turnberry Court, and Caddie Court. The presence of these VOCs may be due to landfill gas escaping from closed waste cells, or from impacted groundwater that has leached from these waste cells. The Bozeman Landfill is known to contain household and commercial waste products that may contain sources of VOCs (see *Section 2.0*).

The primary exposure pathway of concern for potential Site contaminants includes inhalation of soil vapors within residences. The secondary exposure pathway of concern includes dermal contact or ingestion of groundwater impacted with VOCs through the use of private irrigation wells within the project area. Residences are known to utilize the municipal water supply for domestic use which is not believed to be impacted.

Sampling activities will investigate potential exposures at the Site. Indoor air exposure will be investigated through the direct sampling of indoor air throughout participating residences. Groundwater will also be sampled in irrigation wells at participating residences.

3.6.4 Temporal Boundaries

The horizontal study boundary for the Site includes the residences shown in **Figure 2** which are referenced in *Section 3.6.3.* The vertical study boundary includes first encountered groundwater which is believed to exist at its shallowest elevation: 14 feet below ground surface (bgs) in the western part of the Site, soil gas from a maximum depth of approximately 30 feet bgs to its shallowest depth of approximately at or less than 6 feet bgs, and indoor air within the selected residences.

3.6.5 Decision Rule

Federal regulatory standards will be used to evaluate residential indoor air quality and State water quality standards will be used to evaluate groundwater quality.

- EPA Region 9, May 2013 RSLs for Residential Air will be used to determine whether analytical results from air samples pose a health risk (EPA, 2013);
- Circular DEQ-7 October 2012 Montana Numeric Water Quality Standards for groundwater will be used to determine whether analytical results from water samples pose a health risk (DEQ, 2012b).

If the investigative work indicates that impacted media is present at concentrations above the applicable screening levels, standards, or guidelines for a particular reuse scenario, then further assessment or remediation may be required.

3.6.6 Tolerable Limits of Decision Errors

Decision errors are incorrect conclusions about a site caused by using data that are not representative of site conditions due to sampling or analytical error. Limits on decision error are typically established to control the effect of sampling and measurement errors on decisions regarding a site, thereby reducing the likelihood that an incorrect decision is made. The null hypothesis is that a site is contaminated. A false positive decision error is one that decides a site is clean when, in actuality, it is not clean. A false negative decision error is one that decides a site requires cleanup when, in actuality, it requires no cleanup. False positive and negative decision errors should be minimized as much as possible during this project.

This SAP identifies specific field and laboratory methods and sampling strategies that reduce sampling error. The total study error will be reduced by collecting an appropriate number of environmental samples deemed necessary by the assessment team that are intended to represent the range of concentrations present at the Site. The sampling program is designed to reduce sampling error by specifying an adequate number and distribution of samples to meet project objectives.

4.0 METHODOLOGY

4.1 Air Quality Investigation

Tetra Tech will conduct two indoor air sampling events within the project area at participating residential properties. The first event will occur in late June and early July, 2013 to assess current VOC concentrations. The second event will occur in either November or December 2013 to optimize winter conditions where concentrations are considered worst case. Where practicable, methodology will closely follow DEQ procedures outlined in the April 2011 Montana Vapor Intrusion Guide (DEQ, 2011).

4.1.1 Household Survey

Prior to sample collection a household survey will be conducted with the assistance of a primary resident. The purpose of the survey to document potential background sources of VOCs that could potentially bias the samples and to gather information regarding home construction and ventilation types that may affect the movement of vapors through the structure.

Indoor sources of VOCs may include consumer products such as cleaners, solvents, strippers, polish, adhesives, water repellants, lubricants, air fresheners, aerosols, mothballs, scented candles, insect repellents, plastics. Other sources of VOCs are from fuel storage and/or combustion processes such as smoking, cooking, home heating, attached garages, dry cleaning and other hobby related activities (DEQ, 2012a).

The survey will be provided to each resident prior to the sampling event, and will be thoroughly reviewed by Tetra Tech field personnel upon arrival at the residence. At this time field personnel will ensure that known sources of VOC's were removed from the residence at least 48 hours prior to sampling.

4.1.2 Sample Locations

Sample location selections will be based on a variety of factors including the number floors of the home, the square footage of each floor, typical breathing height, and in an area that is not intrusive for the occupant.

Samples will be collected from one to three locations within each residence to provide a representative survey area and to provide a vertical gradient for analyte concentrations. One sample will be collected from a basement and/or crawlspace if present. At least one sample will be collected from the first floor and the second floor of each home. Where applicable, a sample should represent up to 1,500 square feet in an area, and should be collected from typical breathing height at approximately 3 to 5 five feet above the floor (EPA, 2012).

One ambient outdoor air sample will be collected from a representative upwind location each day that indoor air sampling is conducted. If necessary, multiple ambient air samples may also be collected to account for spatial variability across the Site depending on daily indoor air sample locations (i.e. simultaneous ambient air collection on the east and west end of the project area).

4.1.3 Sample Containers

The number of canisters used at the project will be based on the number of residents requesting that samples be collected at their homes. 24 residences are present within the project area.

The number of canisters used will depend on the size of the home and the number of floors, excluding a second floor. A canister will be placed in a basement floor, if furnished. A maximum of three samples will be collected from each residence.

The project is expected to take approximately five days thus five ambient air samples could be collected. In total, up to 77 field samples may be collected during the course of each sampling event ([24 x 3] + 5 = 77).

Tetra Tech will request individually certified 6-Liter Summa Canisters from Eurofins Air Toxics Laboratory (Air Toxics) in Folsom, California. Included with each canister will be a flow controller and a pressure gage. Flow controllers will be preset by the laboratory to collect air samples over a 24 hour period. Prior to collecting samples the vacuum pressure will be checked with the laboratory supplied vacuum gage in each canister to ensure canisters were shipped with an acceptable pressure (greater than -25 inches mercury (inHg)). Samples will be collected when canister vacuum pressures are between -10 and -5 inHg.

4.1.4 Analytical Methods

Air samples will be analyzed for Air Phase Hydrocarbons (APH) according to the Massachusetts Department of Environmental Protection (MADEP) December 2009 method and EPA Method TO-15. The analyses will include 13 constituents. **Table 1** displays target detection limits in order to reach the May 2013 EPA RSLs.

4.1.5 Sample Shipment

Samples will be shipped overnight delivery back to Air Toxics within 24 hours after sample collection to ensure that 30 day holding time limits are met. Summa Canisters and assembly components will be returned in the shipping containers in which they were received.

4.1.6 Methane Monitoring

In addition to air sample analysis for APH and VOCs, field personnel will monitor methane gas while inside each residence. A Gas Data LMSx Multigas Analyzer will be used to screen for methane gas and will be measured in nitrogen percent by volume.

Residents will be notified if methane is detected. The regulatory limit of methane is 25 percent of LEL.

4.2 Groundwater Sampling

Field personnel will sample available on-Site irrigation water supply wells where encountered. Field personnel will collect the water sample from the closest tap to the well. If the open well head is accessible water level measurements will be collected using a Solinist Water Level Probe. The water level probe will be decontaminated according to SOP 11 between each use. A garden hose will be attached to the faucet and the well will be pumped in an attempt to clear approximately 3 well casing volumes from the well. Water from the irrigation well will be discharged to a nearby drainage or lawn.

Field personnel will record the approximate pumping rate for each well using a bucket and stopwatch, and will attempt to purge three well casing volumes using the equation below:

$$V=0.13(d^2)W$$

Where: *V = Volume (in gallons)*
d = Casing diameter (in inches)
W = Water column (in feet)

The garden hose will be removed following purging of the well and prior to sampling. Calculations, well purging, monitoring, and sampling activities will be documented in field notebooks and on field logs.

Samples will be analyzed by Pace Laboratories, Inc. in Billings, Montana by EPA method 8260B for VOCs. Sample results will be compared to October 2012 Circular DEQ-7 Montana Numeric Water Quality Standards (DEQ, 2012) to determine whether exposure to groundwater potentially causes a risk to human health. **Table 2** presents the laboratory detection limits for EPA method 8260B analytes.

4.3 Field Methods

Field crews will mobilize from Tetra Tech's Bozeman (851 Bridger Drive, Suite 6) and Helena (303 Irene Street), Montana offices. The Bozeman office will serve as the support facility during field activities and the center for supplies and equipment. The following sections describe Tetra Tech's methods for conducting field investigations.

4.3.1 Standard Operating Procedures

Filed personnel will use the Tetra Tech SOPs listed below during this investigation. **Appendix B** presents copies of the listed SOPs.

SOP-11 *Equipment Decontamination*
SOP-12 *Sample Documentation*
SOP-13 *QC Samples*
SOP-18 *Ground Water Sampling*
SOP-19 *Preparation and Preservation of Acid Soluble Samples*
SOP-20 *Field Measurement of Ground Water Level*

4.3.2 Field Notes

All field observations will be recorded in project-dedicated field notebooks in accordance with SOP-12, Sample Documentation. The standard project field books that will be used by all personnel will be the equivalent of the pocket-sized "Rite in the Rain"® All-weather Transit Notebook No. 301 (4-5/8 x 7" with numbered pages). Each field book will be labeled on the front cover with the project name, beginning entry date, final entry date, and general contents of notes (e.g. indoor air sampling).

The field team leader is responsible for recording information such as weather conditions, field crew members, visitors to the site, samples collected, the date and time of sample collection, procedures used, any field data collected, problems encountered in the field, and any deviations from this SAP. The field notebook will be the master log of all field activities. As such, in addition to standard field notations, information entered into the field notebook will also include: the number and type of measurements taken, the location and types of data recorded by another means (i.e. field forms), the number of samples collected each day, sample packaging and shipping summaries (i.e. number and type of shipping containers, shipping carrier, date and

time of shipment, etc.), and any other information relevant to the field event. Field personnel will also provide a sketch showing the position of sample locations relative to site features and structures, or record this information on a copy of the building plans. All field forms/field notes will be completed prior to leaving the Site.

4.3.3 Sample Shipping and Chain-of-Custody Procedures

After samples have been collected, they will be maintained under strict chain-of-custody protocols. The field sampling personnel will complete a chain-of-custody record (COC) form for each shipping container (i.e., laboratory supplied shipping boxes) of samples to be delivered to the laboratory for analysis. The sampler is responsible for initiating and filling out the COC form. The COC will be signed by the sampler when he or she relinquishes the samples to anyone else.

The sampling personnel whose signature appears on the COC is responsible for the custody of the samples from the time of sample collection until custody of the samples is transferred to a designated laboratory, a courier, or to another project employee for the purpose of transporting the sample to the designated laboratory. The sample is considered to be in custody when the sample is: (1) in the direct possession of the sample custodian; (2) in plain view of the sample custodian; or (3) is securely locked in a restricted-access area by the sample custodian.

Custody is transferred when both parties to the transfer complete the portion of the COC under "Relinquished by" and "Received by." Signatures, printed names, company names, dates and times are required. Upon transfer of custody, the sampling personnel who relinquished the samples will retain the third sheet (pink copy) of the COC. It is not necessary for courier personnel to sign the COC.

Samples will be shipped at the end of the sampling event, or sooner if required to meet holding time requirements. Upon receipt by the laboratory, the samples will be inspected for sample integrity. The COC will be reviewed to verify completeness. Any discrepancies between the COC and sample labels and any problems noted upon sample receipt will be communicated immediately to Tetra Tech. The laboratory will be responsible for following their internal custody procedures from the time of sample receipt until sample disposal.

4.3.4 Quality Assurance/Quality Control Sample Requirements

The project manager and field staff will coordinate the field effort and be responsible for QA/QC for the project. The project manager will manage all data for the project once it has been collected. The data will be maintained in the project file in Bozeman, Montana. The project manager and field staff will be responsible for coordinating the project and ensure equipment is ready for use and sample containers have been ordered from the laboratory. The field team leader will be responsible for inspection of field equipment prior to use and periodically over the course of the project. Field personnel will be working near Tetra Tech's Bozeman office. Additional field equipment and tools will be stored at the Bozeman office should field equipment become compromised or damaged. Field personnel will collect QA/QC samples to evaluate precision, accuracy, representativeness, completeness, and comparability. Field personnel will use SOP 13 for guidance.

For every ten indoor air samples, one blind duplicate will be collected (10 percent ratio). Blind duplicates will be collected using a laboratory supplied T assembly component that allows for the simultaneous collection of indoor air samples. Samples will be labeled as if there is an additional floor in the residence and noted in the field book. Duplicates will be submitted to the

laboratory for the same analytical methods as the field samples. Duplicates of ambient air samples will not be collected, the frequency at which ambient air samples are collected will serve as a QC measure of precision and accuracy.

A 10 percent ratio will also be applied to the number of blind duplicate groundwater samples. If less than ten samples are collected during each sampling event then only one blind duplicate groundwater sample will be collected. A trip blank and a temperature blank will also be included in each water sample shipment to the laboratory.

4.3.5 Reporting

A progress report will submitted to the City of Bozeman within 15 days of receiving analytical results from the first indoor air monitoring event. The progress report will include a summary of any special considerations that were made during the sampling event, brief description of the analytical results, and recommendations for any changes that should be made for the second winter monitoring event.

A Draft Indoor Air Quality Investigation Report will be submitted to the City of Bozeman within 15 days of receiving analytical data from the second air monitoring event. The Report will summarize the results of the field investigation. Within 15 days of receipt of comments on the draft, final versions of the Report will be issued. The project reports will be submitted both in hardcopy and electronic format.

The reports will include a description of background conditions, field activities, investigative findings, conclusions and recommendations for corrective action. They will include tables depicting field results, laboratory results with relevant action levels, and will include maps and diagrams for documentation of sample locations. The project report will reconcile the information from the investigation that is critical and what is for information purposes only.

A section of the report will be devoted to QA/QC issues and will include: sample holding times, temperatures; results of field and laboratory blanks; consistency between recent data and any previous data; data validation results; and the impact of any QA/QC issues on the data. Report appendices will include laboratory data sheets, laboratory data validation package, and data validation forms; field logs; a photographic log of sampling locations; and all borehole logs. All information collected in the field and analytical data is considered critical.

5.0 REFERENCES

Montana Department of Environmental Quality (DEQ), 2011. Montana Vapor Intrusion Guide. MDEQ Remediation Division. April 22, 2011.

Montana Department of Environmental Quality (DEQ), 2012a. Typical Indoor Air Concentrations of Volatile Organic Compounds in Non-Smoking Montana Residences Not Impacted by Vapor Intrusion; A Montana Indoor Air Quality Investigation. MDEQ Remediation Division. August 2012.

Montana Department of Environmental Quality (DEQ), 2012b. Circular DEQ-7 Montana Numeric Water Quality Standards. October 2012.

Tetra Tech, 2013a. Progress Report on Sampling and Analysis of Soil Gas From Perimeter Methane Monitoring Wells BLG-3,4,5, and 10. January 3, 2013.

Tetra Tech, 2013b. Progress Report on Soil Gas Probe Installation, Sampling and Analysis of Soil Gas Samples; Soil Gas Probes BSV-1 through BSV-8. May 14, 2013.

Tetra Tech, 2013c. Progress Report on Soil Gas Probe BSV-9 through BSV-12 Installations; Second Sampling Event and Analysis of Soil Gas Samples from Soil Gas Probes BSV-1 through BSV-12. June 4, 2013.

U.S. Environmental Protection Agency (EPA), 2012a. Superfund Vapor Intrusion FAQs. February 2012.

U.S. Environmental Protection Agency (EPA), 2012b. Regional Screening Levels for Chemical Contaminants. May 2013.

TABLES

Table 1
Summary of Air Sample Reporting Limits vs. EPA Residential RSLs
April and May 2013 Monitoring Events
Bozeman Landfill
Bozeman, Montana

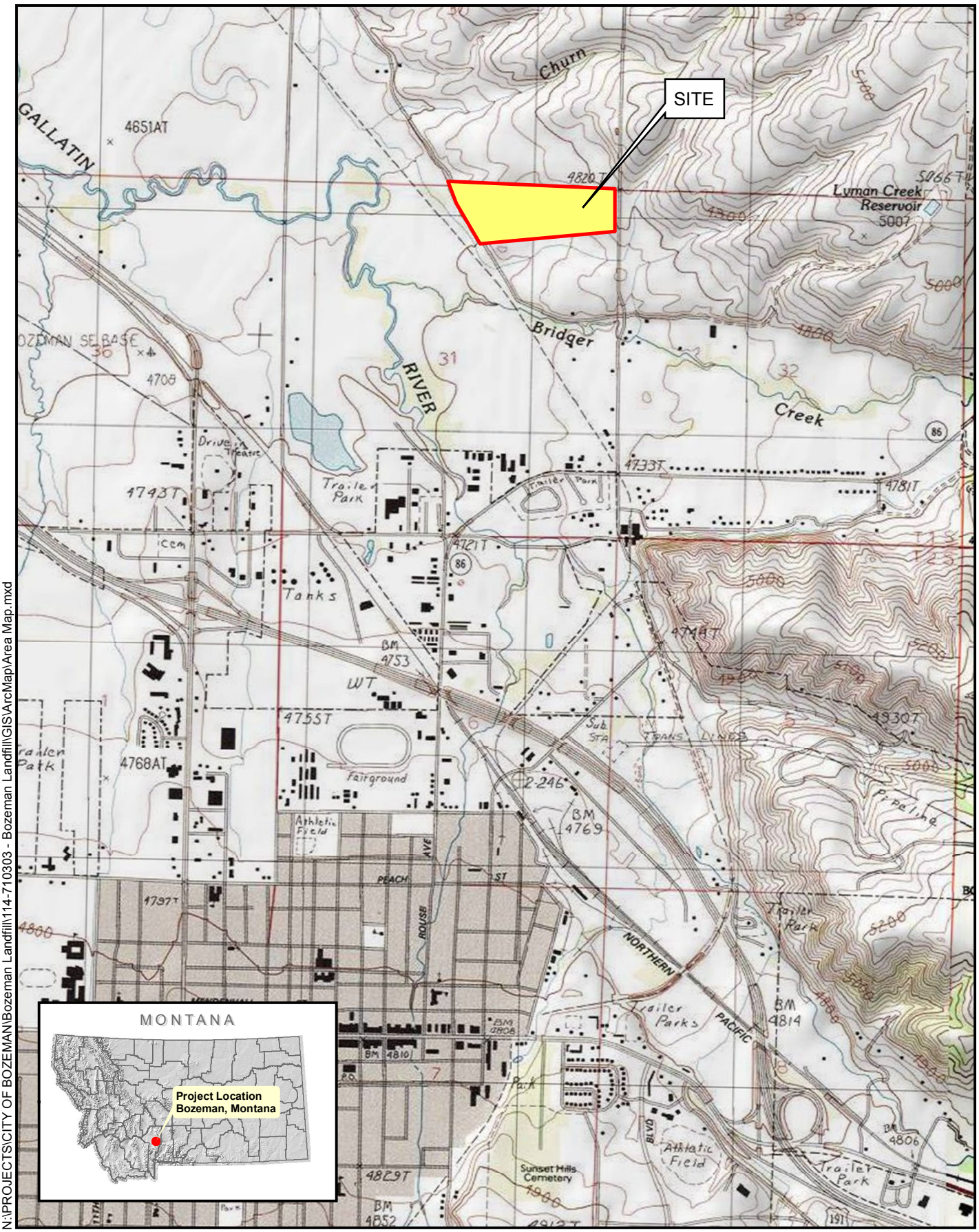
Compound	RL* (µg/m³)	EPA RSL (µg/m³)
Benzene	0.16	0.312
Chloroform	0.098	0.106
1,2-cis-Dichloroethylene	0.079	-
1,2-trans-Dichloroethylene	0.40	62.6
Ethylbenzene	0.087	0.973
Tetrahydrofuran	1.5	2,090
Tetrachloroethylene	0.14	9.39
Toluene	0.075	5,210
Trichloroethylene	0.11	0.234
1,2,4-Trimethylbenzene	0.49	7.30
Vinyl Chloride	0.026	0.161
p-Xylene	0.17	104
m-Xylene	0.17	104
0-Xylene	0.087	104

*Reporting Limit is from the modified TO-15 Hi/Lo method which combines TO-15 and TO-15 SIM

Table 2
Summary of Laboratory Reporting Limits for Groundwater VOC Analysis
June/July 2013 Monitoring Event
Bozeman Landfill
Bozeman, Montana

Compound	RL (µg/L)
1,1,1,2-Tetrachloroethane	0.5
1,1,1-Trichloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
1,1,2-Trichloroethane	0.5
1,1-Dichloroethane	0.5
1,1-Dichloroethene	0.5
1,1-Dichloropropene	0.5
1,2,3-Trichloropropane	0.5
1,2-Dibromoethane	0.5
1,2-Dichlorobenzene	0.5
1,2-Dichloroethane	0.5
1,2-Dichloropropane	0.5
1,3-Dichlorobenzene	0.5
1,3-Dichloropropane	0.5
1,4-Dichlorobenzene	0.5
1,4-Dichlorobenzene-d4	0
2,2-Dichloropropane	0.5
2-Chloroethyl vinyl ether	0.5
2-Chlorotoluene	0.5
4-Chlorotoluene	0.5
Benzene	0.5
Bromobenzene	0.5
Bromochloromethane	0.5
Bromodichloromethane	0.5
Bromoform	0.5
Bromomethane	0.5
Carbon tetrachloride	0.5
Chlorobenzene	0.5
Chlorobenzene-d5	0
Chlorodibromomethane	0.5
Chloroethane	0.5
Chloroform	0.5
Chloromethane	0.5
cis-1,2-Dichloroethene	0.5
cis-1,3-Dichloropropene	0.5
Dibromomethane	0.5
Dichlorodifluoromethane	0.5
Ethylbenzene	0.5
Fluorobenzene	0
m+p-Xylenes	0.5
Methyl ethyl ketone	10
Methyl tert-butyl ether (MTBE)	0.5
Methylene chloride	0.5
o-Xylene	0.5
Styrene	0.5
Tetrachloroethene	0.5
Toluene	0.5
trans-1,2-Dichloroethene	0.5
trans-1,3-Dichloropropene	0.5
Trichloroethene	0.5
Trichlorofluoromethane	0.5
Vinyl chloride	0.5
Xylenes, Total	1

FIGURES



N:\PROJECTS\CITY OF BOZEMAN\Bozeman Landfill\114-710303 - Bozeman Landfill\GIS\ArcMap\Area Map.mxd

N
W E
S

0 1,000 2,000
Feet

Datum: NAD83 StatePlane Montana

Area Map
Bozeman Landfill
Bozeman, Montana
June 2013
FIGURE 1

Notes: Soil gas probes were installed in March and May, 2013; all probe locations are between the sidewalk and street curb in the public right-of-way or on Bozeman Landfill property.

Site Map
Bozeman Landfill
Bozeman, Montana
June 2013
FIGURE 2

APPENDIX A
JOB SAFETY ANALYSIS

TETRA TECH

Safety Excellence

HEALTH AND SAFETY PLAN (HASP)

PREPARED BY TETRA TECH
FOR SERVICES PROVIDED TO
City of Bozeman

SITE NAME:	**Bozeman Landfill**
SITE LOCATION:	**2143 Story Mill Rd, Bozeman, MT**
DATE PREPARED:	**June 28, 2013**

EMERGENCY CONTACT INFORMATION

NOTE: Information entered into the emergency section of this HASP will automatically be entered onto this cover page.

24 Hour Ambulance:	**911**
Police Department:	**911**
Fire Department:	**911**
US Poison Control Centers:	**1-800-222-1222**
Tt Project Emergency Contact:	**Kirk Miller 406.461.0234**
Tt Corporate Emergency Contact:	**Yvonne Freix** Office: 715-845-4100 Mobile: 888-297-8552 Home: 715-355-4193
Name of Closest Hospital:	**Bozeman Deaconess Hospital**
Route:	Follow Story Mill Road south until intersection with Bridger Drive. Turn right on Bridger Drive and continue approximately 1.1 miles. Turn left onto E Main Street and follow approximately 2 miles. Bear right then immediately turn right onto Highland Blvd, Hospital is at 915 Highland Blvd.

TETRA TECH
Safety Excellence

City of Bozeman - Bozeman Landfill
HEALTH AND SAFETY PLAN (HASP)

TABLE OF CONTENTS

Note: The sections highlighted in yellow are required for all health and safety plans with the other sections optional depending on the project, tasks and associated hazards. If this template is used for sites without chemical hazards, the following sections may be eliminated as well; H&S Evaluation Chemicals of Concern, Hazard Evalution of Chemicals of Concern and Precautions for Chemicals of Concern; and Decontamination Plan.

Forms Attached

Worker / Visitor Sign-In Form	√
Daily Tailgate Meeting Form	√
Field Audit Form	√
Air Monitoring Results - Total Organic Vapors and Toxic Gases	√
Air Monitoring Results - Detector Tubes	√
Equipment Calibration Form	√
Chemical/MSDS Inventory	√
Drill Rig Pre-Shift Inspection Form	√
Subcontractor Project Specifc Requirements Verification Form	√
Other _____	√
Other _____	√
Other _____	√

TETRA TECH
Safety Excellence

HEALTH AND SAFETY PLAN (HASP)

Bozeman Landfill AT 2143 Story Mill Rd, Bozeman, MT

Prepared By:	Nicholas Sovner Helena, MT	**Date:** June 28, 2013 **Tt Project No:**	114-710303

Project Identification:

Service Type:	Environmental Sciences	**Site Name:**	Bozeman Landfill
Client Name:	City of Bozeman	**Site Location:**	2143 Story Mill Rd, Bozeman, MT
Client Contact:	Dustin Johnson	**Client Phone No:**	406.582.2288

Site History:	Landfill operated from 1969 to 2008 in lined and unlined waste cells. Grounwater contamination issues identified in the 1970s, gw monitoring began in 1981. Bridger Creek Golf Course and residential community opening in 1994. VOCs are known to be present in groundwater, and in late 2012 were discovered in soil gas in the vicinity of the golf course and residences.
Scope of Work:	Groundwater and methane monitoring, leachate monitoring, vapor intrusion investigation and mitigation.

Site Regulatory Status:

CERCLA/SARA		RCRA		OSHA		OTHER FEDERAL	
US EPA:	n	**US EPA:**	n	**1910:**	n	**Dept of Energy (DOE):**	n
State:	n	**state:**	y	**1926:**	n	**Dept of Trans (DOT):**	n
NPL site:	n	**NRC**		**state:**	n	**USATHAMA:**	n
		10CFR20:	n			**Air Force:**	n

NPL - US EPA National Priorities List
NRC - Nuclear Regulatory Commission
USATHAMA - US Army Toxic and HazMat Agency
OSHA 1910 - General Industry Standards and Regulations
OSHA 1926 - Construction Standard and Regulations
OSHA state - site located in a state that has its own OSHA regulations

Review and Approval Documentation

Reviewed By:

Name: Marc Pearson Signature _____
Title: Project Manager Date: _____

Name: Kirk Miller Signature _____
Title: Senior Project Manager Date: _____

Reviewer signature also certifies that the PPE selected for this project was based on a hazard assessment of the tasks to be performed and selected according to the requirements established by OSHA in 29 CFR 1910.132 (d).

Project Dates		HASP Amendment Dates:	
Project Start Date:	May 8, 1996	1	March 22, 2004
Project End Date:	Ongoing	2	Enter date
This site HASP must be reissued/reapproved for		3	Enter date
activities conducted after:	Enter date	4	Enter date

HEALTH AND SAFETY PLAN (HASP)

Bozeman Landfill AT 2143 Story Mill Rd, Bozeman, MT

Tetra Tech Representatives			
Branch Address and Phone		**Name/Title**	**Role and Responsibilities**
Tetra Tech 851 Bridger Canyon Dr Bozeman, MT 59715	406.582.8780	Marc Pearson Shane Matolyak Brooks Quaintance	Project Manager Staff Scientist Field Technician, CAD
Tetra Tech 303 Irene St Helena, MT 59601	406.443.5210	Nicholas Sovner Kirk Miller Randy English	Staff Scientist Senior Project Manager SHSC

Tetra Tech Subcontractors			
Organization/Address and Phone		**Name/Title**	**Role and Responsibilities**
Enviro Probe 480 E Park St Butte, MT 59701	406.782.5508	Pat Thompson	Office Manager
	Scope of Work	Describe in detail the subcontractor's scope of work for this project.	
Organization/Address and Phone		**Name/Title**	**Role and Responsibilities**
Name of Subcontractor 2 address city, ST zipcode	phone no		
	Scope of Work	Describe in detail the subcontractor's scope of work for this project.	
Organization/Address and Phone		**Name/Title**	**Role and Responsibilities**
Name of Subcontractor 3 address city, ST zipcode	phone no		
	Scope of Work	Describe in detail the subcontractor's scope of work for this project.	

HEALTH AND SAFETY PLAN (HASP)

Bozeman Landfill AT 2143 Story Mill Rd, Bozeman, MT

Client / Tetra Tech / Subcontractor H&S Program & Policy Bridging Section

Identify which specific H&S programs will be followed for the designated scope of work.

H&S Program	Specify Program To Be Used	Comments
Emergency Evacuation Procedures	X Client ☐ Tetra Tech ☐ Sub ☐ Other	All site personnel will follow the evacuation procedures detailed by the client for this products terminal
Drilling and subsurface structure locates	☐ Client X Tetra Tech ☐ Sub ☐ Other	The ERD Safety Guidance Document will be utilized for identifying potential subsurface structures prior to drilling
Permit Required Confined Space Entry	☐ Client ☐ Tetra Tech X Sub ☐ Other	Sub ABC confined space program for task 1
Lockout / Tagout	X Client ☐ Tetra Tech ☐ Sub ☐ Other	All site personnel will comply with client LOTO program for all tasks
Other	☐ Client ☐ Tetra Tech ☐ Sub ☐ Other	
Other	☐ Client ☐ Tetra Tech ☐ Sub ☐ Other	
Other	☐ Client ☐ Tetra Tech ☐ Sub ☐ Other	
Other	☐ Client ☐ Tetra Tech ☐ Sub ☐ Other	

Tetra Tech's policy is to provide a safe working environment for all employees and contractors so that work may be conducted in a safe and efficient manner.

Tetra Tech employees and subcontractor employees working at the specific project covered by this HASP shall adopt and adhere to this HASP and the above referenced programs/policies by following all requirements stated in the safe work practices applicable to their work. No work is so urgent or important that we cannot take the time to do it safely. **ALL** personnel on site including subcontractor's have the right and responsibility to stop the work if they feel a safety protocol is not being followed or if they feel an unsafe condition exists.

Site Specific Health and Safety Personnel

Randy English has been designated **Site Health and Safety Coordinator (SHSC)** for activities to be conducted at this site. The SHSC has total responsibility for ensuring that the provisions of this HASP are adequate and implemented in the field. Changing field conditions may require decisions to be made concerning adequate protection programs. Therefore, the personnel assigned as SHSCs are experienced and meet the additional training requirements specified by OSHA in 29 CFR 1910.120.

Marc Pearson has (have) been designated as the **alternate SHSC(s)**.

TETRA TECH
Safety Excellence

HEALTH AND SAFETY PLAN (HASP)

Bozeman Landfill AT 2143 Story Mill Rd, Bozeman, MT

Activities Covered Under This Plan

Task	**1**	**Schedule:** Quarterly
Groundwater Monitoring		Measurement of groundwater elevations and collection of groundwater samples. Quarterly events are scheduled for March, June, September, and December
Task	**2**	**Schedule:** Quarterly to semi-annually
Methane Monitoring/Sampling		Measurement of methane concentrations in monitoring probes and buildings. Also, collect landfill gas samples from flare stations. Quarterly monitoring events are scheduled for March, June, September and December. Flare station sampling is semi-annually in March and September
Task	**3**	**Schedule:** Semi-annual
Leachate Sampling		Collection of landfill leachate at pipe discharge into leachate collection pond. Semi-annual events are scheduled for March and September.
Task	**4**	**Schedule:** Monthly to semi-annual
Soil Gas/VI Sampling		Collection of indoor air, sub-slab soil gas, and outdoor soil gas samples on a monthly to semi-annual basis depending on level of priority. Installation of soil gas probes, sub-slab soil gas collection points, and vapor mitigation systems as necessary to investigate vapor intrusion (VI).

Types and Sources of Hazards

Physiochemical		Radiation		Chemically Toxic	
Flammable:	y	**Ionizing:**	n	**Inhalation:**	y
Explosive:	y	**Non-Ionizing:**	n	**Ingestion:**	y
Corrosive:	n	**Other**		**Absorption:**	y
Reactive:	n	**Physical Hazards:**	y	**Carcinogen:**	y
O2 Rich:	n	**Construction Activities:**	y	**Mutagen:**	n
O2 Deficient:	y			**Teratogen:**	n
Biological				**OSHA listed:**	n
Etiological Agent:	n	**Specific OSHA Standards:**	none		
Other:	y				
(plant, insect, animal)					

Etiological - disease causing agent

Chemical toxicity information (such as routes of enry and whether or not a chemical is carcinogenic, mutagenic, etc) can be found in the Chem worksheet of this template, on the chemicals of concern page under target organs, or in the NIOSH pocket guide.

Direct Sources of Hazards				Indirect Sources (Describe)
Air:	y	**Other:**	y	none
Groundwater:	y		Leachate	
Soil:	y			
Surface Water:	n			

Health and Safety Evaluation - Chemicals of Concern				
Chemical Name	**Entry Route**	**Carc***	**Symptoms**	**Target Organs**
Methane (Aliphatic Hydrocarbons including methane, ethane, propane and butane)	Inh, Con (liquid)	n	Simple asphyxiant causing oxygen-deficient atmospheres. Symptoms include respiratory difficulty, headache, dizziness, and nausea. At high concentrations, unconsciousness or death may occur. Contact with cryogenic liquid or rapidly expanding gases may cause frostbite.	Respiratory system, skin and eyes
Hydrogen Sulfide	Inh, Con	n	Eye irritation, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), conjunctivitis, corneal vesiculation, respiratory system irritation, apnea, dizziness, headace, fatigue, irritability, insominia, convulsions and coma, gastrointesintal disturbance.	Eyes, respiratory system and central nervous system
Carbon Monoxide	Inh	n	Headache, tachypnea, nausea, weakness and exhaustion, dizziness, confusion, hallucinations; cyanosis; depression of S-T segment of electrocardiogram, angina and suncope	Vardiovascular System, lungs, blood and Central Nervous System
Benzene	Inh, Abs, Ing, Con	y	Irritant (eyes, nose, skin, respiratory system), giddiness, headache, nausea, staggering, fatigue, anorexia, weakness, dermatitis, bone marrow depression.	Eyes, skin, respiratory system, blood, central nervous system, bone marrow (leukemia)
1,2-Dichloroethane (Ethylene Dichloride)	Inh, Abs, Ing, Con	y	Eye irritation, corneal opacity, central nervous system depression, nausea, vomiting, dermatitis, liver and kidney damage, cardiovascular system damage, cancer.	Eyes, skin, kidneys, liver, central nervous system, cardiovascular system (In animals: forestomach, mammary gland, and circulatory system cancer).
Methylene Chloride (Dichloromethane)	Inh, Abs, Ing, Con	y	Irritant (eyes, skin), fatigue, weakness, sleeplessness, light headed, numb and tingling limbs, nausea, cancer.	Eyes, skin, cardiovascular system, central nervous system (In animals: lung, liver, salivary and mammary gland tumors).
Tetrachloroethylene (PCE)	Inh, Abs, Ing, Con	y	Irritant (eyes, nose, throat), nausea, flush face and neck, vertigo, dizziness, incoordination, headache, sleeplessness, skin redness, liver damage, cancer.	Eyes, skin, respiratory system, liver, kidneys, central nervous system (In animals: liver tumors).
Trichloroethylene	Inh, Abs, Ing, Con	y	Irritant (eyes, skin), headache, vertigo, visual disturbance, fatigue, giddiness, tremor, sleeplessness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury, cancer.	Eyes, skin, respiratory system, heart, liver, central nervous system, (In animals: liver and kidney cancer).
Vinyl Chloride	Inh, Con (liquid)	y	Weakness, abdominal pain, GI bleeding, enlarged liver, pallor or cyanosis of extremities, frostbite (liquid), cancer.	Liver, central nervous system, blood, respiratory system, lymphatic system (liver cancer).
Acetone	Inh, Ing, Con	n	Irritant (eyes, nose, throat), headache, dizziness, central nervous system depression, dermatitis.	Eyes, skin, respiratory system, central nervous system.

Health and Safety Evaluation - Hazard Evaluation of Chemicals of Concern

Chemical Name	LEL/UEL (%)	Flam	OT (ppm)	IDLH	Exposure Limits
Methane(Aliphatic Hydrocarbons	C1 - 5 / 15 C2 - 3 / 12.4 C3 - 2.1 / 9.5 C4 - 1.8 / 8.4	y	-	10% of the LEL	**ACGIH-TLV-TWA** = 2000 ppm There are no other specific limits - these gases are highly flammable and are simple asphyxiants and displace oxygen
Hydrogen Sulfide	4.0 / 44.0	y	<0.1 (d) <0.1 (r)	100 ppm	**OSHA-PEL-Ceiling** = 20 pppm*; **ACGIH-TLV-TWA** = 10 ppm; STEL = 15 ppm** **NIOSH-REL-Ceiling** = 10 ppm *The OSHA limit of TWA = 10 ppm and STEL = 15 ppm was vacated by the court ruling of 1993. **The ACGIH has issued a notice of intended change to TWA = 1 ppm and STEL = 5 ppm Note: Hydrogen sulfide is a colorless gas with a strong odor of rotten eggs. However, the sense of smell becomes rapidly fatigued and can NOT be relied upon to worn of continuous presence.
Carbon Monoxide	12.5 / 74	y	odorless gas	1200 ppm	**OSHA-PEL-TWA** = 50 ppm*; **ACGIH-TLV-TWA** = 25 ppm; **NIOSH-REL-TWA** = 35 ppm; **NIOSH-REL-Ceiling** = 200 ppm *The OSHA limit of TWA= 35 ppm and a Ceiling = 200 ppm was vacated by the court ruling of 1993.
Benzene	1.2 / 7.8	y	61 (d) 97 (r)	500 ppm	**OSHA-PEL-TWA** = 1 ppm; **OSHA-PEL-STEL** = 5 ppm; **ACGIH-TLV-TWA** = 0.5 ppm (skin); **ACGIH-TLV-STEL** = 2.5 ppm (skin); **NIOSH-REL-TWA** = 0.1 ppm; **NIOSH-REL-STEL** = 1 ppm
1,2-Dichloroethane(Ethylene Dic	6.2 / 16	y	26 (d) 87 (r)	50 ppm	**OSHA-PEL-TWA** = 100 ppm; **OSHA-PEL-Ceiling** = 200 ppm; **ACGIH-TLV-TWA** = 10 ppm; **NIOSH-REL-TWA** = 1 ppm; **NIOSH-REL-STEL** = 2 ppm
Methylene Chloride(Dichloromet	13 / 23	n	160 (d) 230 (r)	2300 ppm	**OSHA-PEL-TWA** = 25 ppm; **OSHA-PEL-STEL(C)** = 125 ppm; **ACGIH-TLV-TWA** = 50 ppm; **NIOSH - REL-TWA** = 100 ppm
Tetrachloroethylene (PCE)	NA	n	47 (d) 71 (r)	150 ppm	**OSHA-PEL-TWA** = 100 ppm* ; **Ceiling** = 200 ppm*; **ACGIH-TLV-TWA** = 25 ppm; **ACGIH-TLV-STEL** = 100 ppm **NIOSH-REL** - Limit workplace exposure concentrations *The OSHA limit of TWA = 25 ppm was vacated by the court ruling of 1993.
Trichloroethylene	8 / 10.5	n	82 (d) 110 (r)	1000 ppm	**OSHA-PEL-TWA** = 100 ppm*; **Ceiling** = 200 ppm*; **ACGIH-TLV-TWA** = 10 ppm; **ACGIH-TLV-STEL** =25 ppm; **NIOSH-REL-TWA (10 hour)** = 25 ppm *The OSHA limit of TWA = 50 ppm and STEL = 200 ppm was vacated by the court ruling of 1993.
Vinyl Chloride	3.6 / 33	y	-	Not Determined	**OSHA-PEL-TWA** = 1 ppm; **OSHA-PEL-Ceiling** = 5 ppm; **ACGIH-TLV-TWA** = 1 ppm;
Acetone	2.5 / 12.8	y	62 (d) 130 (r)	2500 ppm	**OSHA-PEL-TWA** = 1000 ppm*; **ACGIH-TLV-TWA** = 500 ppm; **ACGIH-TLV-STEL** = 750 ppm; **NIOSH-REL-TWA** = 250 ppm *The OSHA limit of TWA=1 ppm was vacated by the court ruling of 1993.

Health and Safety Evaluation - Chemicals of Concern / Precautions

PRECAUTIONS

INGESTION: All listed chemicals have the potential for accidental ingestion, however in work place settings it is not considered a primary route of entry. All accidental ingestions should be addressed by referring to the MSDS and seeking immediate medical attention.

INHALATION: Listed chemicals capable of inhalation routes of entry should be maintained below the established exposure limits. If there is indication that the exposure limits are being exceeded, appropriate respiratory protection should be used. If appropriate PPE has not been planned for, work should cease and the SHSC should be contacted.

ABSORBANCE/CONTACT: Listed chemicals presenting an absorbance or contact hazards should be handled only with the use of appropriate PPE.

NOTE: Overexposure to any chemical via any route of entry should be addressed by referring to the MSDS and seeking immediate medical attention. Avoid contact with all chemical hazards when possible and consult MSDS before any exposure may occur.

OTHER PRECAUTIONS

*The OSHA limit of TWA=750 ppm and STEL =

none

ABBREVIATIONS

LEL= Lower Explosive Limit

UEL = Upper Explosive Limit

ppm = parts per million

mg/m3 = milligram per cubic meter

TWA = Time Weighted Average

STEL = Short Term Exposure Limit

Flam = Flammable

IDLH = Immediately Dangerous to Life and Health

OT = Odor Threshold

NOTE: Odor Thresholds were obtained from the American Industrial Hygiene Association's (AIHA) publication on Odor Thresholds. The listed thresholds are best estimates based on existing experimental data. (d) indicates the threshold for detection and (r) indicates the threshold for recognition.

NOTE: * In 1989, OSHA published new exposure limits (in most cases lower) for some chemical compounds. However, in 1993, under a court decision, these newly established limits were vacated and reverted back to the previous limit or to none if a limit was not previously established for the chemical compound. The limits listed in the table are the older, enforceable OSHA limits. It is recommended that the most conservative exposure limit listed be used in assessing exposures and determining controls and safety measures.

Health and Safety Evaluation - Physical / Construction Hazards of Concern

For the hazards that apply to this site, indicate the task(s) to which each particular hazard applies. For the hazards that do not apply to this site, delete the "1" in the Task No(s) column.

HAZARD	Task No(s)	Protection Procedure
Noise	1-4	Wear hearing protection during high noise activities
Heat - Ambient Air	1-4	Frequent intake of fluids and adequate work-rest schedule
Cold	1-4	Warm clothing; if symptoms develop - go to warm area
Rain	1-4	Wear rain gear; watch footing on wet surfaces
Snow	1-4	Warm clothing - watch footing on slippery surfaces
Electrical Storms	1-4	Discontinue operations
Heavy Lifting / Moving	1-4	Utilize proper lifting techniques
Rough Terrain	1-4	Watch footing
Housekeeping	1-4	Maintain order
Neighborhood	4	Awareness of area; comply with contingency / ER plans
Diving	1-4	Only by certified divers; inspect equipment
Traffic	1-3	Obey traffic regulations; implement traffic control
Materials Handling	1-3	Determine safest physical means of handling material
Flammable Liquids / Gases	1-4	Consult MSDS and Tt Safe Work Practices
Electrical - General	1-4	See Tt Safe Work Practice; Comply with OSHA regulations
Hand Tools	1-4	Use appropriate tools for the task-inspect prior to use
Powered Hand Tools	1-4	Follow operating instructions - use PPE
High Pressure Water	1-4	Follow operating instructions - use PPE
Other: Fire extinguisher	4-Jan	See handbook and comply with OSHA regs
Other:		

Task Based Risk Analysis and Protection Plan

The preceding tables have identified the known and suspected hazards to be present in performing the tasks required to complete this project. Below is a breakdown by task of the hazards, likelihood of exposures, and protective protocols to be used to minimize risk.

Task: 1	Groundwater Monitoring	
Associated Hazards:	**CHEMICAL**	Well screens are submerged in water, therefore no chmical exposure to gas is associated with gw sampling. However, some exposure may be present in indoor air sampling and soil gas probe installation and sampling. Exposure to dissolved chemicals that may be present in groundwater.
	PHYSICAL	Physical hazards associated with this task include strains & sprains from material handling, slip / trip / fall hazards, Vehicle driving / parking hazards, pinch points related to the equipment, noise, cold/heat stress depending on the season.
	BIOLOGICAL	No specific biological hazards have been identified for this site. However, unidentified biological hazards may exist, such as insects, snakes, animals, etc.
	OTHER	No other specific hazards have been identified for this site. However, personnel should be continually aware that other possible hazards may be present or may develop during activities.
Exposure Potential:	**CHEMICAL**	low
	PHYSICAL	low
	BIOLOGICAL	low
	OTHER	low
PPE:	Level D	Safety glasses, safety-toed work boots, ear protection as necessary and latex or nitrile gloves.
Air Monitoring Plan	None	
Air Monitoring Equipment	None	

Precautions:	**CHEMICAL**	Wear appropriate PPE. Wash hands and face with clean water prior to handling food.
	PHYSICAL	Wear clothing appropriate for weather. Train site personnel in cold/heat stress. Determine safe routes of travel. Practice good housekeeping to prevent trips and falls. Use proper lifting techniques such as bending at knees and centering the load and use buddy system when needed (above 75 lbs). Wear proper PPE such as type 2 or 3 cut resistant gloves when appropriate. Be aware of surroundings and place potential spark producing equipment as far away as possible from potential vapor sources.
	BIOLOGICAL	The prescribed PPE requirements will provide some protection from insects. Be aware of possible insect activity and attractive environments for snakes and insects such as well casings and idle equipment/materials.
	OTHER	None

Task Based Risk Analysis and Protection Plan

The preceding tables have identified the known and suspected hazards to be present in performing the tasks required to complete this project. Below is a breakdown by task of the hazards, likelihood of exposures, and protective protocols to be used to minimize risk.

Task: 2 Methane Monitoring/Sampling

Associated Hazards:	**CHEMICAL**	Chemical exposure to Methane Gas, Hydrogen Sulfide Gas, and Carbon Monoxide can be associated with methane monitoring. Exposure may result from contaminants in air. The potential for fire and explosion exist during monitoring.
	PHYSICAL	Physical hazards associated with this task include strains and sprains from material handling, slips/trips/falls, pinch points related to the equipment, Hazards associated with heavy equipment operating in the area, and cold/hear stress depending on the season.
	BIOLOGICAL	No specific biological hazards have been identified for this site. However, unidentified biological hazards may exist, such as insects, snakes, animals, etc.
	OTHER	Oxygen deficient confined space has been identified on the site, consisting of four leachate collection manholes. The manholes are locked, and may be monitored for landfill gas without entry. No other specific hazards have been identified for this site. However, personnel should be continually aware that other possible hazards may be present or may develop during activities.

HEALTH AND SAFETY PLAN (HASP)

Bozeman Landfill AT 2143 Story Mill Rd, Bozeman, MT

Exposure Potential:	**CHEMICAL**	low
	PHYSICAL	low
	BIOLOGICAL	low
	OTHER	low
PPE:	Level D	Safety glasses, steel toe boots, long pants, ear protection as necessary, and leather/nitrile/latex gloves. Occasionally, high visible clothing depending on location.
Air Monitoring Plan	Methane monitoring will be conducted unless action levels for explosive atmosphere or organic gases and vapors are found. Discontinue operation if atmospheric levels are >20% LEL. Proceed with caution if atmopsheric levels are 10% LEL.	
Air Monitoring Equipment		
Precautions:	**CHEMICAL**	Wear proper PPE.
	PHYSICAL	Practice good housekeeping, watch your step, and use proper lifting techniques. Take frequent rest breaks if repetitive motion is noticeable. Wear safety vest for visibility.
	BIOLOGICAL	Use insect repellent and watch for snakes.
	OTHER	none

Task Based Risk Analysis and Protection Plan

The preceding tables have identified the known and suspected hazards to be present in performing the tasks required to complete this project. Below is a breakdown by task of the hazards, likelihood of exposures, and protective protocols to be used to minimize risk.

Task: 3	Leachate Sampling	
Associated Hazards:	**CHEMICAL**	The leachate pond and discharge are not located in enclosures, therefor no chemical exposure to gases is associated with sampling. Exposure to chemicals dissolved in leachate (acetone, benzene, 1,1-dichloroethane, tetrachloroethene, trichloroethylene, methylene chloride, and vinyl chloride) can be associated with sampling.
	PHYSICAL	Physical hazards associated with this task include strains and sprains from material handling, slips/trips/falls, pinch points related to the equipment, Hazards associated with heavy equipment operating in the area, and cold/hear stress depending on the season.
	BIOLOGICAL	No specific biological hazards have been identified for this site. However, unidentified biological hazards may exist, such as insects, snakes, animals, etc.
	OTHER	No other specific hazards have been identified for this site. However, personnel should be continually aware that other possible hazards may be present or may develop during activities.
Exposure Potential:	**CHEMICAL**	low
	PHYSICAL	low
	BIOLOGICAL	low
	OTHER	low
PPE:	Level D	Safety glasses, steel toe boots, long pants, ear protection as necessary, and leather/nitrile/latex gloves. Occasionally, high visible clothing depending on location.
Air Monitoring Plan	none	
Air Monitoring Equipment	none	
Precautions:	**CHEMICAL**	All equipment will be inspected prior to use on a daily basis. Safe operating procedures will be followed and a buddy system implemented.
	PHYSICAL	Safe operating procedures will be followed and the buddy system implemented. Personnel shall avoid stepping on the HDPE leachate pond liner during access and sampling activities. Visually inspect the pond escape rope ladder in the southwest corner of the pond prior to entry inside the fenced enclosure.
	BIOLOGICAL	Use insect repellent and watch for snakes. Safe operating procedures will be followed and a buddy system implemented.
	OTHER	Safe operating procedures will be followed and a buddy system implemented.

Task Based Risk Analysis and Protection Plan

The preceding tables have identified the known and suspected hazards to be present in performing the tasks required to complete this project. Below is a breakdown by task of the hazards, likelihood of exposures, and protective protocols to be used to minimize risk.

Task: 4	Soil Gas/VI Sampling	
Associated Hazards:	**CHEMICAL**	Chemical exposure to VOCs can be associated with indoor air sampling monitoring. Exposure may result from contaminants in air.
	PHYSICAL	Physical hazards associated with this task include strains and sprains from material handling, slips/trips/falls, pinch points related to the equipment, Hazards associated with heavy equipment operating in the area, and cold/hear stress depending on the season.
	BIOLOGICAL	No specific biological hazards have been identified for this site. However, unidentified biological hazards may exist, such as insects, snakes, animals, etc.
	OTHER	No other specific hazards have been identified for this site. However, personnel should be continually aware that other possible hazards may be present or may develop during activities.
Exposure Potential:	**CHEMICAL**	low
	PHYSICAL	low
	BIOLOGICAL	low
	OTHER	low
PPE:	Level D	Safety glasses, steel toe boots, long pants, ear protection as necessary, and leather/nitrile/latex gloves. Occasionally, high visible clothing depending on location.
Air Monitoring Plan	Describe the monitoring that will be required during this task and action levels along with actions that will be taken if the levels are reached. Example: Analysis for organic vapors will be performed before beginning this task and hourly thereafter using an FID. If levels reach any individual OSHA-PELs for the chemicals listed above, PPE will be upgraded to level C (Level D as listed above plus an Air Purifying respirator. Use of a respirator can be eliminated by screening for the individual chemical of concern. i.e. Draeger tube for Benzene indicates that the PEL for Benzene has not been exceeded.	
Air Monitoring Equipment	In this section describe the air monitoring equipment that will be used, when and how the equipment is to be calibrated and proper maintenance and storage of the equipment.	
Precautions:	**CHEMICAL**	Wear proper PPE.
	PHYSICAL	Practice good housekeeping, watch your step, and use proper lifting techniques. Take frequent rest breaks if repetitive motion is noticeable. Wear safety vest for visibility.
	BIOLOGICAL	Use insect repellent and watch for snakes.
	OTHER	none

Personal Protective Equipment Level Definitions

Level D

Level D protection is assigned when minimal protection is warranted. Level D offers protection from nuisance contamination only and is made up of a typical work uniform for the work to be performed. Level D protection includes the following:

Hard hat, safety glasses, hearing protection (as required), gloves, and steel toe boots.

Level C

Level C protection is assigned when the type(s) and concentration(s) of contaminants is known and the criteria for using an air-purifying respirator are met. Level C is an upgrade from level D and in addition to the requirements of level D, the following requirements must be met:

Level D plus Full-face or half-mask air purifying canister/cartridge equipped respirator, hooded chemical resistant clothing, and inner and outer chemical resistant gloves.

Level B

Level B protection is assigned when the type(s) and concentration(s) of contaminants is unknown or is known and warrants the highest level of respiratory protection with a lesser level of skin protection. Level B is an upgrade from level C and in addition to level C requirements, the following requirements must be met:

Level C plus pressure-demand full-face SCBA or pressure demand supplied air respirator with escape SCBA.

Level A

Level A protection is assigned when the atmosphere is IDLH (Immediately Dangerous to Life and Health) and warrants the highest degree of respiratory protection and skin protection. Level A is and upgrade from level B and in addition to level B requirements, the following requirements must be met.

Level B plus totally encapsulating chemical-protective suit.

CARTRIDGE CHANGEOUT SCHEDULE

Cartridge Changeout Schedule:	NA
Method Used to Determine Schedule:	NA

Decontamination Plan

Personal Decontamination

The section outlining task by task risk assessment and protection plan specifies the level of protection required for each task. Consistent with the level of protection required, step by step procedures for decontamination for each level of protection are given below.

No hazardous wastes are expected at the site. Purge water will be land applied.

Levels of Protection Required for Decontamination Personnel

The level of protection required for a person assisting with decontamination is:

LEVEL: D

Modification: (upgrade or downgrade) will be made under the following conditions:

Indicate the conditions that will trigger the upgrade or downgrading of PPE worn by personnel assisting in decontamination. Example: Upgrading and downgrading of personal protective equipment for personnel designated as decon personell will follow the requirements for that of the workers involved.

Disposition of Contaminated Wastes

The following outlines the protocol to be followed for contaminated wastes that are encountered:

No hazardous wastes are expected at the site. Purge water will be land applied.

Sampling Equipment Decontamination

The following outlines the protocol to be followed for decontamination of sampling equipment:

Between wells, wash with 10% liquinox solution; rinse with methanol followed by a distilled water rinse. Tetra Tech Field Work SOP 11 describes general decontamination procedures.

Non-Sampling Equipment Decontamination

The following outlines the protocol to be followed for decontamination of non-sampling equipment:

Should any non-sampling equipment become contaminated, it will be decontaminated either with high pressure hot water to prevent cross contamination according toTetra Tech's Field Work SOP 11 procedures or described above sampling equipment.

HEALTH AND SAFETY PLAN (HASP)

Bozeman Landfill AT 2143 Story Mill Rd, Bozeman, MT

Contingencies

Emergency Contacts and Phone Numbers

Agency	Contact	Phone Number
Tt Project Emergency Contact	Marc Pearson, Project Manager	(406) 459-4169 cell
24 Ambulance Service	911	911
Fire Department	911	911
Police Department	911	911
US Poison Control Center	NA	1-800-222-1222
Onsite Coordinator	Marc Pearson, Project Manager	(406) 459-4169 cell
Site Telephone	cell	
Nearest Telephone	cell	

In the event of an incident, the TT-MM reporting protocol requires that a corporate contact be notified as soon as possible.	**Yvonne Freix**	**Office:** 715-845-4100	**Mobile:** 888-297-8552	**Home:** 715-355-4193
	Nancy Garreaud	**Office:** 801-364-2027	**Mobile:** 801-550-0894	
	Tory Fravel	**Office:** 970-223-9600	**Mobile:** 970-481-0883	**Home:** 970-266-9409

Local Medical Emergency Facility(s)

Name of Hospital:	Bozeman Deaconness	**Distance:**	4.4 miles
Address:	915 Highland Dr, Bozeman, MT	**Time:**	11 minutes
Type of Service:	ER, 24 hr		
Route:	Follow Story Mill Road south until intersection with Bridger Drive. Turn right on Bridger Drive and continue approximately 1.1 miles. Turn left onto E Main Street and follow approximately 2 miles. Bear right then immediately turn right onto Highland Blvd, Hospital is at 915 Highland Blvd.		

In the case of a **SERIOUS OR LIFE-THREATENING EVENT** (any injury, accident or near-miss event):
1. Seek emergency medical treatment immediately
2. Once the injured person(s) is appropriately cared for, call a corporate contact listed on the emergency wallet card and update the employee's supervisor and project manager as soon as possible.

Secondary Provider (Occupational Health Clinic)

Name of Occ Clinic:	NA	**Distance:**	X miles
Address:	NA	**Time:**	X minutes
Type of Service:	NA		
Route:	NA		

In the case of a **NON-EMERGENCY/NON-LIFE THREATENING INCIDENT** (any injury, accident or near-miss event) call one of the corporate contacts listed on the wallet card (and above) prior to an Employee visiting a physician and implementing the following procedure:
1. Administer first aid immediately.
2. Tetra Tech employees call WorkCare (Tetra Tech contracted physicians) at 1-800-455-6155 for a triage call/discussion with an Occupational Health Nurse (OHN).
3. Mention that this is regarding an injury. At this point the nurse/physician will assist the employee/supervisor/H&S Coordinator to determine the best treatment plan. For example, he/she will recommend first aid or urgent care.
4. WorkCare will require the following information when a call is placed: Name of person calling, phone number, location, name of person injured, Social Security number, date and type of injury.

Response Plans

Medical - General

First Aid Kit:
- Type: Portable
- Location: Vehicle, Bozeman office

Eye Wash:
- Required?: Yes
- Location: Vehicle

Safety Shower:
- Required?: n
- Location: NA

Special First Aid Precautions:
- Hydrofluoride on Site: n
- Cyanides on Site: n
- Other: NA

Special Procedures:

Consult MSDS for appropriate first aid measures related to chemical exposures. Seek immediate medical attention when incidents warrant anything beyond minor first aid response.

Current CPR/First Aid Training for at least one person onsite while performing work. Consult MSDS for appropriate first aid measures related to chemical exposures. Seek immediate medical attention when incidents warrant anything beyond minor first aid response.

Fire/Explosion

Special Procedures:

Use available fire extinguisher to extinguish small fires. For any fire beyond the control of a portable fire extinguisher contact the local firefighting authorities (911) as listed in the emergency contact section of this plan. Have 20lb fire extinguisher for drilling operations and place near drill operations.

Fire Extinguisher:
- Type: ABC
- Location: Vehicle

Spill Response

Special Procedures:

NA

Special Gear:
- Type: NA
- Location: NA

Weather/Natural Disaster Emergency

Special Procedures:

Cease work immediately . Tetra Tech personal shall head for home base (Bozeman Montana) immediately if possible. If travel is not possible seek immediate shelter as available.

Site Control Measures

Work Zones

Exclusion Zone:	Barricade areas immediately surrounding work zones if open to public. Work landfill property is not considered open to public.
Decon Zone:	NA
Support Zone:	NA
Other Zones:	NA

Methods for Delineating Zones

Work Zone Delineation Plan	Most work will take place in areas with little to no public access. For areas where public access is allowed, traffic candles and work vehicles will be used to establish a work zone.
Delineation Equipment	Traffic Cones, Work Vehicle

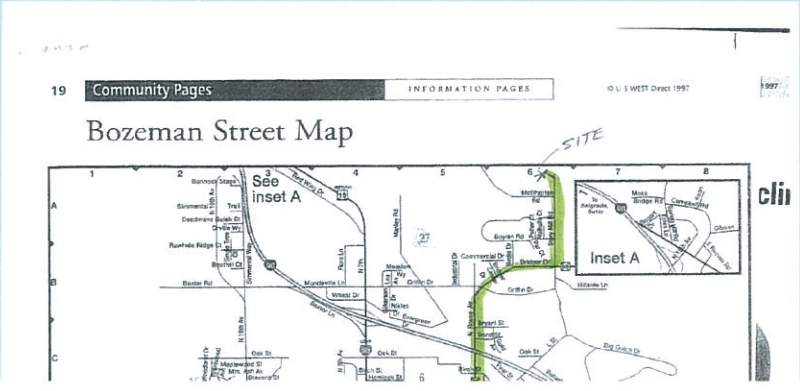
Security Measures

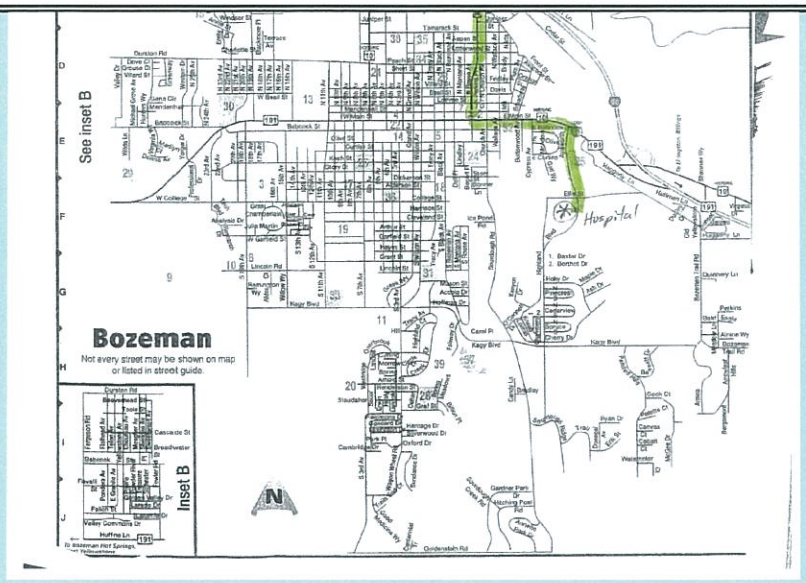
NA

Security Related Contacts

Agency	Contact Name	Phone Number
Gallatin Co Sherriff		582-2125

Site Map




See inset B
Bozeman
Not every street may be shown on map or listed in street guide.
Inset B
Hospital
N

HEALTH AND SAFETY PLAN (HASP)

Bozeman Landfill AT 2143 Story Mill Rd, Bozeman, MT

Site Personnel and Certification Status

Name:	Marc Pearson	**Medical Current:**	y
Title:	Project Manager	**HAZWOPER Current:**	y
Task(s):	1-4	**Fit Test Current:**	qual
CPR/First Aid:	current		
Other:			
Name:	Nick Sovner	**Medical Current:**	y
Title:	Staff Scientist	**HAZWOPER Current:**	y
Task(s):	1-4	**Fit Test Current:**	qual
CPR/First Aid:	current		
Other:			
Name:	Kirk Miller	**Medical Current:**	y
Title:	Sr Project Manager	**HAZWOPER Current:**	y
Task(s):	1-4	**Fit Test Current:**	qual
CPR/First Aid:	current		
Other:			
Name:		**Medical Current:**	
Title:		**HAZWOPER Current:**	
Task(s):		**Fit Test Current:**	
CPR/First Aid:			
Other:			
Name:		**Medical Current:**	
Title:		**HAZWOPER Current:**	
Task(s):		**Fit Test Current:**	
CPR/First Aid:			
Other:			

Medical Current:	All personnel, including visitors entering the exclusion or contamination reduction zones must be certified as medically fit to work and to wear a respirator if appropriate.
Training Current:	All personnel, including visitors entering the exclusion or contamination reduction zones must have certifications of completion of training in accordance with OSHA 29 CFR 1910.120.
Fit Test Current:	All personnel, including visitors entering any area requiring the use or potential use of any negative pressure respirator must have at a minimum, a qualitative fit test administered in accordance with OSHA 29 CFR 1910.134 or ANSI within the last 12 months. If site conditions require the use of a full face negative pressure air purifying respirator for protection against asbestos or lead, employees must have a qualitative fit test in accordance with OSHA 20 CFR 1910.1002 or 1025 within the last 6 months. * Bearded workers, who can not be fit-tested for a tight face fitting respirator, are required to wear a powered air purifying respirator (PAPR).
Note:	These requirements should be verified for any subcontractor personnel assigned to the site.

Training and Briefing Topics		
Note: The following topics will be covered as indicated (i.e., the initial site training, daily, monthly or periodically). Delete the X's corresponding to the topics that do not apply to this site. Indicate the frequency for the topics that do apply.		
Site characterization and analysis (29 CFR 1910.120 i)	X	Initial, daily
Physical Hazards	X	Initial, daily
Chemical Hazards	X	Initial, daily
Site Control (29 CFR 1910.120 d)	X	Initial, daily
Engineering Controls and Work Practices (29 CFR 1910.120 g)	X	Initial, daily
Heavy Machinery	X	Initial, daily
Equipment	X	Initial, daily
Tools	X	Initial, daily
PPE (29 CFR 1910.120 g; and 1910.134)	X	Initial, daily
Respiratory Protection (29 CFR 1910.120 g; and 1910.134)	X	periodically
Level D - Personal Protective Equipment	X	Initial, daily
Decontamination (29 CFR 1910.120 k)	X	Initial, daily
Emergency Response (29 CFR 1910.120 l)	X	Initial
Shipping and Transportation (49 CFR 172.101)	X	Initial
Illumination (29 CFR 1910.120 m)	X	Initial, daily
Sanitation (29 CFR 1910.120 n)	X	Initial, daily
Other:		

Drilling Considerations

Unfilled Bore-holes

Will bore-holes be drilled and need to be left unfilled for a period of time?	n
If yes, length of time before filled or well installed.	
Safe guarding requirements:	NA

Filling Bore-holes

Will bore-holes be drilled which require filling?	n
Procedure for backfilling of bore-holes	NA

Other Site Specific Drilling Concerns:

NA

Intrusive Activities Checklist

Will intrusive activities be performed for work under this HASP? Y or N

If yes, describe the type(s) of intrusive activity.

Subsurface Structures Present

Type	Present?	Located ?	Method Used/To Be Used for Locating
Electrical			
Gas			
Water			
Product Line			
Product Tank			
Other			

Shut-Offs Located

Type	Location of Shut-Off
Electrical	NA
Gas	
Water	
Product	
Other	

Emergency Contacts for Subsurface Structure Repair

Type	Appropriate Contact for Emergency Repair of Specific Subsurface Structure Type/Material
Electrical	NA
Gas	
Water	
Product	
Other	

Procedure for Ensuring Unknown Substructures Identified	
Although potential known and unknown subsurface structures are identified per the above sections, there is always the potential for unkown subsurface structures to be encountered during intrusive activities. Therefore, a protocol needs to be established for each particular site. For this site, the following procedures will be followed for the intrusive activities identified above: (Delete the X's in front of the procedure(s) that do not apply to this site.)	
X	"One Call" or equivalent utility locate per the local system for the site will be made (this is mandatory on all sites)
X	Follow up with one-calls (i.e. document who will be contacted with respect to the one call service along with their phone numbers and place and document calls to those orginizations that did not repsond). Form for one call follow up is attached.
Other Specific Subsurface Identification Requirements for this Site	
	NA

Required PPE and Equipment Checklist			
Delete the X's corresponding to the PPE/Equipment that does not apply to this site.			
HEALTH AND SAFETY BINDER / HASP, SITE CHECK IN/OUT PROCEDURES, ETC.		X	
RELATED MSDS's		X	
SAFETY GLASSES WITH SIDE SHIELDS		X	
HARD HAT		X	
STEEL-TOED BOOTS		X	
GLOVES	TYPE:	X	
RESPIRATOR	TYPE:	X	
RESPIRATOR CARTRIDGES	TYPE:	X	
HEARING PROTECTION	TYPE:	X	
HIGH VISIBILITY WEAR	TYPE:	X	
WASTE DISPOSAL BAGS / LABELS		X	
FIRE EXTINGUISHER		X	
EYE WASH BOTTLE		X	
FIRST AID KIT		X	
FLASHLIGHT		X	
WASH WATER		X	
SOAP		X	
INSECT REPELLENT		X	
UV PROTECTION		X	
TOOL KIT	ITEMS:	X	

FIELD AUDITS

A field auditing program should be determined for the project based on the scope of work, duration of the project and degree of hazards associated with the tasks involved.

During the course of this project a minimum number of field audits will be conducted as follows:	1
The following person is responsible for ensuring the audits and associated corrective actions are completed:	Marc Pearson

HAZARDOUS MATERIALS / DANGEROUS GOODS PACKAGING AND SHIPPING

Will known or suspect hazardous materials / dangerous goods be packaged and shipped?	N

If shipping materials classified or suspected as hazardous materials or dangerous goods attach and follow SWP 5.38 entitled "SHIPPING HAZARDOUS MATERIALS". NOTE: DOT HAZMAT training is required to package, label, prepare paper work and ship hazardous materials. TtMM personnel typically do not maintain this training and therefore these tasks typcially need to be subcontracted to trained personnel.

CONFINED SPACES

Are there any identified or potential confined spaces associated with the project?	N
Will the project involve any confined space entry?	N

If confined space entry is involved in the project, a confined space entry and permitting procedure needs to be identified here and attached to this HASP. If there are confined spaces present but they will not be entered, the spaces should be identified here and an indication provided as to how they will be labeled/marked to prevent entry. If neither apply, both answers can be indicated as no and an NA entered in this field.

TRAFFIC CONTROL

Is there exposure to traffic at this site during any of the designated work activities?	Yes
For which task(s) will traffic be an issue of concern ?	1-4
Will the project require an extensive or formal traffic control plan?	No

NA

Traffic Control Sketch

NA

FATIGUE MANAGEMENT

Is the work extensive or out of the ordinary typical work schedule with the potential to result in worker fatgiue that could increase the potential for incidents to occur during work tasks or travel to/from the site?	Yes

Describe situations or circumstances that have to potential to significantly impact worker fatigue.

Workers must travel to site and navigate construction activities. Also, area is known for windy conditions and extreme cold which can cause serious fatigue symptoms.

Define precautions that will be taken to minimize worker fatigue and eliminate/minimize its impact on safety.

Only travel when well rested and road conditions are good. Eat proper meals throughout the day and drink appropriate amounts of water.

PROVISIONS FOR LONE WORKERS

Will Tetra Tech employees or subcontractor employees be required to or have the potential to work alone?	Yes
For which task(s) will a site worker be or have the potential to be working alone?	1, 2, 3, 4
List the type of employees that will be permited to work alone and under what conditions:	Tetra Tech

All tasks may require a worker to be alone at times or for the duration.

Note: Personnel should not be allowed to work alone if there is high hazard potential associated with the site and/or task they will be performing, including but not limited to high physical hazard potential (such as heavy equipment operation, high voltage, intrusive activities, etc.), potential for extreme acute chemical exposure, high crime areas, remote sites, etc.

Lone Worker Check-In Procedure

Detail a daily check-in procedure for all site personnel who will be working alone. Note: There may be a need to detail different check-in procedures for different tasks, personnel etc.

Form of communication to be used for check-in:	Phone Bzoeman office
Primary check-in person:	Marc Pearson
Alternate check-in person:	Kirk Miller

Check-In Schedule

X	Initial Check-In:	Upon leaving office
X	Periodic Check-In:	Lunch time each day
X	Final Check-Out:	Upon arrival back at Bozeman office

Tetra Tech Compliance Agreement Form

PROJECT SCOPE: Groundwater and methane monitoring, leachate monitoring, vapor intrusion investigation and mitigation.

PROJECT NUMBER: 114-710303

I have read, understood, and agree with the information set forth in this Health and Safety Plan along with any related attachments and discussed in the Personnel Health and Safety briefing.

NAME	SIGNATURE	DATE

Subcontractor Notification of Hazards Acknowledgement Form

PROJECT SCOPE: Groundwater and methane monitoring, leachate monitoring, vapor intrusion investigation and mitigation.

PROJECT NUMBER: 114-710303

I am aware that Tetra Tech has provided this Health and Safety Plan for my review to inform me of the hazards identified with the project site and tasks that Tetra Tech will perform. I understand that this Health and Safety Plan does not fulfill requirements for subcontractor health and safety plans related to the tasks which they will perform.

NAME	SIGNATURE	DATE

TETRA TECH
Safety Excellence

Bozeman Landfill AT 2143 Story Mill Rd, Bozeman, MT

Worker / Visitor Log

PROJECT SCOPE: Groundwater and methane monitoring, leachate monitoring, vapor intrusion investigation and mitigation.

PROJECT NUMBER: 114-710303

Name	Company / Organization	Date	Time In	Time Out

TETRA TECH

Safety Excellence

Bozeman Landfill AT 2143 Story Mill Rd, Bozeman, MT

Daily Tailgate Meeting Form

PROJECT SCOPE: Groundwater and methane monitoring, leachate monitoring, vapor intrusion investigation and mitigation.

PROJECT NUMBER: 114-710303

Topics Discussed	Meeting Facilitator
	Meeting Date / Time

MEETING ATTENDEES

Name	Signature	Company / Organization

Project Name: _____ Number: _____ Location: _____

Project Manager: _____ Site Safety Coordinator: _____

Completed by: _____ Date: _____

Subcontractors on Site: ☐ yes ☐ no Subcontractor Company _____

Subcontractor Company _____

Note: Tetra Tech includes subcontracted personnel in all field audits.

General Items		In Compliance?		
Hazard Assessment and General Site Conditions		**Yes**	**No**	**NA**
1	Approved health and safety plan (HASP) on site or available	☐	☐	☐
2	If non-HAZWOPER site, is there an accident prevention plan or job safety analysis (JSA)	☐	☐	☐
3	Names of on-site personnel recorded in field logbook or daily log	☐	☐	☐
4	HASP compliance agreement form signed by all on-site personnel	☐	☐	☐
5	Material Safety Data Sheets on site or available	☐	☐	☐
6	Designated site safety coordinator present	☐	☐	☐
7	Daily tailgate safety meetings conducted and documented	☐	☐	☐
8	Site personnel meet medical exams, fit test, training requirements (including subs)	☐	☐	☐
9	Documentation of training, medical exams, and fit tests available from employer	☐	☐	☐
10	Compliance with specified safe work practices	☐	☐	☐
11	Exclusion, decontamination, and support zones delineated and enforced	☐	☐	☐
12	Windsock or ribbons in place to indicate wind direction	☐	☐	☐
13	Barricades used in areas where appropriate	☐	☐	☐
14	Proper signage and postings in place	☐	☐	☐
Emergency Planning		**Yes**	**No**	**NA**
15	Emergency telephone numbers posted or available	☐	☐	☐
16	Emergency route to hospital posted or available	☐	☐	☐
17	Local emergency providers notified of site activities	☐	☐	☐
18	Adequate safety equipment inventory available	☐	☐	☐
19	First aid provider and supplies available	☐	☐	☐
20	Eyewash stations in place	☐	☐	☐
Air Monitoring		**Yes**	**No**	**NA**
21	Monitoring equipment specified in HASP available and in working order	☐	☐	☐
22	Monitoring equipment calibrated and calibration records available	☐	☐	☐
23	Personnel know how to operate monitoring equipment / equipment manuals available on site	☐	☐	☐
24	Environmental and personnel monitoring performed as specified in HASP and documented	☐	☐	☐

Project Name_____ Project #_____

Safety Items		In Compliance?		
Personal Protection (Specify)		**Yes**	**No**	**NA**
25	Splash suit	☐	☐	☐
26	Chemical protective clothing	☐	☐	☐
27	Safety glasses, goggles or face shield	☐	☐	☐
28	Gloves	☐	☐	☐
29	Steel-Toed Boots	☐	☐	☐
30	Chemical Resistant Overboots	☐	☐	☐
31	Hard hat	☐	☐	☐
32	Dust mask	☐	☐	☐
33	Hearing protection	☐	☐	☐
34	Respirator	☐	☐	☐
35	Other: (describe)	☐	☐	☐
Instrumentation		**Yes**	**No**	**NA**
36	Combustible gas meter	☐	☐	☐
37	Oxygen meter	☐	☐	☐
38	Organic vapor analyzer	☐	☐	☐
39	Other: (describe)	☐	☐	☐
Supplies		**Yes**	**No**	**NA**
40	Decontamination equipment and supplies	☐	☐	☐
41	Fire extinguishers	☐	☐	☐
42	Spill cleanup supplies	☐	☐	☐
43	First Aid Kit	☐	☐	☐
44	Other: (describe)	☐	☐	☐
Comments:				
Corrective Action Taken During Audit:				
Corrective Action Still Needed:				

NA = Not applicable

_____ _____

Auditor's Signature Date

NOTE: This checklist provides a list of general items to look for during the field audit. It should not be considered all encompassing as each site and project is unique. The auditor should look for and address all safety and health issues associated with the site and tasks being performed. Additional items can be addressed in the comments and corrective actions sections or on an additional sheet.

APPENDIX B
STANDARD OPERATING PROCEDURES

SOP-11

STANDARD OPERATING PROCEDURE

EQUIPMENT DECONTAMINATION

The purpose of this section is to describe general decontamination procedures for field equipment in contact with mine/mill tailings, soil, or water. During field sampling activities, sampling equipment will become contaminated after it is used. Sampling equipment must be decontaminated between sample collection points if it is not disposable. Field personnel must wear disposable latex or vinyl gloves while decontaminating equipment at the project site. Change gloves between every sample. Every precaution must be taken by personnel to prevent contaminating themselves with the wash water and rinse water used in the decontamination process.

Table A-1 lists equipment and liquids necessary to decontaminate field equipment.

The following should be done in order to complete thorough decontamination:

1. Set up the decontamination zone upwind from the sampling area to reduce the chances of windborne contamination.

2. Visually inspect sampling equipment for contamination; use stiff brush to remove visible material.

3. The general decontamination sequence for field equipment includes: wash with Liquinox or an equivalent degreasing detergent; deionized water rinse; 10% dilute nitric acid rinse (if sampling for metals); deionized water rinse; rinse with sample water three times.

4. Rinse equipment with methanol in place of the nitric rinse if sampling for organic contamination. Follow with a deionized water rinse.

5. Decontaminated equipment that is to be used for sampling organics should be wrapped in aluminum foil if not used immediately.

6. Clean the outside of sample container after filling sample container.

Alternatively, field equipment can be decontaminated by steam cleaning, rinsing with 10% dilute nitric acid, and rinsing with deionized water.

All disposable items (e.g., paper towels, latex gloves) should be deposited into a garbage bag and disposed of in a proper manner. Contaminated wash water does not have to be collected, under most circumstances.

If vehicles used during sampling become contaminated, wash both inside and outside as necessary.

TABLE A-1. EQUIPMENT LIST FOR DECONTAMINATION

- 5-gallon plastic tubs
- 5-gallon plastic water-container
- 5-gallon carboy DI water
- 1-gallon cube of 10% HNO_3
- 1-gallon container or spray bottle of 10% Methanol or pesticide grade acetone for organics
- Liquinox (soap)
- Hard bristle brushes
- Garbage bags
- Latex gloves
- Squeeze bottles
- Paper Towels

SOP-12

STANDARD OPERATING PROCEDURE

SAMPLE DOCUMENTATION

Sample documentation is an important step to ensure the laboratory, project manager, and field personnel are informed on the status of field samples. Depending on the specifics required for each project, a number of forms will need to be filled out. Most sample documentation forms are preprinted carbonless triplicates, enabling copies to be filed or mailed from labs or offices. The forms will be completed by field personnel, who have custody of the samples. The office copy will be kept in the project file and subsequent copies sent to the laboratory, or other designated parties. The responsibility for the completion of these forms will be with each field crew leader. It is important the field crew leader is certain field personnel are familiar with the completion process for filling out forms, and the expected information is included.

Potential documents to be completed clearly in ink for each sample generated include:

- Field Form
- Chain-of-Custody
- Custody Seal

If working on Superfund activities, the following additional forms will also be prepared:

- EPA Sample Tags
- SAS Packing Lists
- Sample Identification Matrix Forms
- Organic Traffic Report (if applicable)
- Inorganic Traffic Report (if applicable)

SOP-13

STANDARD OPERATING PROCEDURE

QUALITY CONTROL (QC) SAMPLES

Quality Control (QC) samples are submitted along with natural samples to provide supporting laboratory data to validate laboratory results. QC samples typically are submitted blind, and do not have any unique identifying codes that would enable the lab or others to bias these samples in any way. Usually, the time or sampling location is modified in a way which will separate blank and standard samples from the rest of the sample train. QC samples are identified only on field forms and in field notebooks. The following codes are typically used:

N - Natural Sample	Soil, water, air, or other material from a field site
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 laboratory precision
BB - Bottle Blank	Deionized water collected in sample bottle; used to detect contamination in sample containers
CCB - Cross Contamination Blank	Deionized water run through decontaminated equipment and analyzed for residual contamination
BFS - Blind Field Standard	Certified chemical constituent(s) of known concentration; used to determine laboratory accuracy
TB - Travel or Trip Blank	Inert material (deionized water or diatomaceous earth) included in sample cooler; sent by the lab, the sample is used to determine if contamination by volatiles is present during collection or shipping

In general, selected QC samples will be inserted into the sample train within a group of 10 to 20 samples. Unless otherwise specified, QC samples will be prepared in the field. Deionized water for bottle blanks and cross-contamination blanks will be collected from carboys and cubitainers used in the field. An exception to field preparation of QC samples is some blind field standards. Since the analytes in some blind field standards are to be mixed according to specific manufacturer's instructions, field conditions may not provide the needed laboratory atmosphere. This is especially true for volatile organic compounds, which need to be prepared just before analyzing. Under these circumstances, such blind field standards will be shipped to the laboratory for preparation, keeping the concentration or manufacturer's QC Lot Number as blind as possible.

The number and types of samples submitted for each group of natural samples will be determined by the project manager and others, including state or Federal agencies, and will be defined in the project work plan. Each field crew leader will be responsible for all QC samples prepared in the field.

Methods for computing data validation statements can be found in EPA documents or obtained from the laboratory.

SOP-18

STANDARD OPERATING PROCEDURE

GROUNDWATER SAMPLING

EQUIPMENT:

five gallon bucket graduated in gallons	pH meter/thermometer (optional)
coolers and ice	specific conductance meter (optional)
sample bottles	bailer(s)
preservatives	bailer rope or teflon reel
filter apparatus	field sampling forms
decontamination equipment & fluids	indelible marker
water level probe	stop watch
purge pump(s)	generator
discharge hose	fuel

All sampling equipment shall be inspected for damage, and repaired if necessary, prior to arriving on-site.

GENERAL PROCEDURE - PURGING

Purging must be performed on all wells prior to sample collection. If required by the project workplan, the stability of pH, specific conductivity, and temperature will be evaluated. A minimum of three volumes of groundwater in the well casing shall be withdrawn prior to sample collection. The volume of water present in each well shall be computed using the length of water column, monitoring well inside diameter, and casing diameter. The total volume of water in the well (gallons) can be approximated using the following formula (depth and water level measurements in feet; borehole diameter in inches):

$$\textbf{(1/25)(Total Depth - Measured Water Level)(Casing Diameter)}^2 \textbf{ = gallons}$$

Several general methods are 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. Specific conductance, pH, temperature, and purge volume values will be entered on the Field Sampling Forms. If sampling for hydrocarbon compounds, wells shall be checked for the presence of free product prior to purging and sampling.

If specified by the project workplan, field parameters will be measured periodically during well purging. The well is ready for sampling when either or both of the following conditions are met: 1) measured field parameters stabilize at plus or minus five percent of the reading, over three successive readings or, 2) three to five casing volumes have been evacuated from the well.

If the recovery of a low-yield well exceeds two hours after purging, the sample shall be extracted as soon as sufficient volume is available in the well for a sample to be extracted. At no time will 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.

COLLECTING WATER QUALITY SAMPLES

1. Generally, wells shall be sampled from the least contaminated to the most contaminated, if known. Open well and measure water level (SOP-20).

2. Decontaminate sampling equipment using the following procedure: scrub with brush and Liquinox solution; rinse with 10% dilute nitric acid (if sampling for metals); rinse with methanol, if sampling for organic compounds; rinse three times with deionized water. Use disposal latex or vinyl gloves throughout decontamination and sampling procedure and new gloves for each sampling point.

3. Sampling Monitoring Wells

    a. To collect a water quality sample, use a new disposable polypropylene, decontaminated stainless steel, or teflon bailer and a spool of polypropylene rope or equivalent bailer cord (teflon-coated stainless steel cable). Tie a bowline knot through the bailer loop to secure.

    b. Slowly lower bailer or other sample collection device to the bottom of the well and remove an additional 5 feet of rope from the spool. Secure end of rope to steel well casing or wrist.

    c. Purge well by bailing or pumping, collecting evacuated water in a graduated 5 gallon bucket to measure the total volume discharged.

    d. Collect a sufficient quantity of water using the bailer or pump into a decontaminated one gallon sample container to fill all sample bottles.

4. Sampling Domestic Wells

    a. Turn-on household fixture (preferably an outside faucet without a hose connected) that is on the well-side of any household water conditioning device.

    b. Using the above equation, calculate the volume of water to be evacuated. Measure the discharge rate from the faucet in a graduated 5 gallon bucket, or other suitable container, to compute the rate of discharge. Calculate the time needed to evacuate the predicted volume from the well. Record all measurements and calculations on field forms.

    c. Samples should be collected directly from hydrant or faucet and prior to entry of the water through any water conditioning devices. Do not collect samples through rubber hoses.

5. If specified by the project work plan, measure pH and specific conductance (SOP-05 and SOP-06). Continue monitoring field parameters (pH and specific conductance) periodically during purging process. The well is ready for sampling when either or both of the following conditions are met: 1) the purged volume is equal to three to five casing volumes and/or, 2) measured field parameters are within plus or minus five percent ($\pm$ 5%) over three successive readings.

6. If sampling for dissolved metals, field filter sample according to SOP-04.

7. Label each sample container with project number, sample location, well owner, date, military time, sampler's initials, preservative, and analysis required. For inorganics samples, rinse sample containers, without preservatives, three times with sample water before final collection. Do not rinse containers for organics analysis.

8. Pour the sample into the appropriate sample containers and and any needed preservatives in accordance with SOP-42. Also see ("Handbook for Sampling and Sample Preservation of Water and

Wastewater", EPA-600/4-82-029; "Guidelines Establishing Test Procedures for the Analyses of Pollutants Under the Clean Water Act", 40 CFR 136; and "Test Methods for Evaluating Solid Wastes," EPA SW-846). A few common sample preservatives are listed below:

Dissolved Metals	Add 3-4 ml. Nitric Acid to 500 ml. sample
Nutrients	Refrigerate to 4□C; Add 3-4 ml. Sulfuric Acid to 500 ml.sample
Common Ions	Refrigerate to 4□C
Hydrocarbon VOA	Refrigerate to 4□C; Add 3-4 drops HCl*
Diesel Range Organics	Refrigerate to 4□C; Add 80 drops (4ml) HCl
Fluorescent Tracer Dye	Refrigerate to 4□C; Prevent exposure to light

For additional bottling and sample preservation information, consult Tetra Tech laboratory.

9. For volatile analyses add preservative to sample vial and fill vials at the rate of 100 milliliters per minute (24 seconds for 40 milliliter vial); form positive meniscus over vial brim and cap. After capping, invert vial, gently tap and look for air bubbles. If bubbles are present, un-cap vial, add more water and repeat procedure.

10. If required by the project workplan, perform field parameter tests including pH, SC, Eh, and temperature on water sampled from the well. Record field measurements on field forms.

11. Complete the necessary shipping and handling paperwork, and record all pertinent information on Field Sampling Form in accordance with SOP-10.

SOP-19

STANDARD OPERATING PROCEDURE

PREPARATION AND PRESERVATION OF ACID SOLUBLE SAMPLES

1. Allow samples arriving from field to adjust to room temperature.

2. Obtain initial pH measurement of sample in accordance with SOP-06. If sample pH is less than 1.65 discard sample.

3. Adjust pH of sample by adding drops of HNO_3 as necessary to attain a pH reading of 1.75 $\pm$ 0.1. This adjustment of sample pH must be completed within 3 days of sample collection time.

4. Cap sample bottles and allow samples to remain idle for at least 16 hours but not longer than 24 hours at room temperature.

5. Filter sample through decontaminated filtration apparatus containing 0.45 u filter. Pour filtered sample back into an acid rinsed sample bottle.

6. Place bottles in cooler and prepare for sample shipment to laboratory.

SOP-20

STANDARD OPERATING PROCEDURE

FIELD MEASUREMENT OF GROUND WATER LEVEL

1. Calibrate well probe to a steel tape prior to and following each data gathering episode. Note any corrections to well probe measurements on field forms.

2. Check well probe prior to leaving for field for defects by placing probe in water and testing buzzer and light. Repair as necessary. Make certain the well probe, a tape measure calibrated to tenths of feet and extra batteries are in the carrying case.

3. 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 distance from measuring point to ground level. Make sure measuring point is labeled on well, so future measurements can be made from the same location.

4. Obtain a depth to water from measuring point to the nearest hundredth of a foot. Record data on appropriate field forms.

5. Decontaminate well probe between each measurement by rinsing with deionized water. Additional decontamination, such as liquinox scrubbing, may be required for certain wells; consult the project work plan.

DATA VALIDATION REPORT

1. Introduction

This should include a brief summary of the number and type of samples.

- This validation applies to ***___number of samples, organic/inorganic analyses, and media (soil/water); i.e. 73 inorganic soil samples and 16 inorganic water samples*** for ***___facility name___*** project ***___date of SAP___***. From the total of 73 soil samples there were 4 field duplicates. Within the 16 water samples there were 2 soil rinsate blanks, 2 water rinsate blanks and 1 duplicate.

- Validation procedures used are generally consistent with:
  ___ EPA CLP National Functional Guidelines for Inorganic Data Review
  ___ Work Plan, Phase I Remedial Investigation ***(may need to be modified based upon specific facility work)***, Field Sampling and Quality Assurance Project Plan for ***facility name***
  ___ Other

- Overall level of validation:
  ___ Contract Laboratory Program (CLP)
  ___ Standard
  ___ Visual

2. Deliverables

- All laboratory document deliverables were present as specified in the CLP-Statement of Work (CLP-SOW), EPA, 1993 and/or the project contract.
  ___ Yes
  ___ No

- All documentation of field procedures was provided as required.
  ___ Yes
  ___ No

3. Condition of Samples Upon Receipt

Review the sample receipt checklist from the laboratory and note any problems.

- Temperature of samples
- VOA vials had zero headspace
- pH of samples
- Proper container/bottle used
- Container intact
- Other

4. Field Quality Control Samples

Blanks: Please note that the highest blank value associated with any particular analyte is the blank value used for the flagging process.

DI, trip, rinsate, or any other field blanks have been carried out at the proper frequency.

___ Yes
___ No
___ NA

Reported results on the field blanks are less than the contract required detection limits (CRDL) or the project required detection limits (PRDL) if project detection limits have been specified.

___ Yes
___ No

Explain the discrepancies, if any are noted. For example:

The DI blank was below the reporting limit of 0.05 (mg/l). However, the reporting limit was not in agreement with the PRDL of 0.003 (mg/l). The consultant requested that the lab rerun the sample to meet the PRDL, but the lab was unable to locate the sample.

Notes: When an analyte is detected in a blank, associated results up to 5 (concentration above a blank concentration that is flagged depends upon the analysis being performed) times the blank level are flagged to indicate that the results may be biased high due to samples collected on the same day as the blank.

- **Field duplicates**

Field duplicates have been collected at the proper frequency.

___ Yes
___ No
___ NA

Field duplicate relative percent differences (RPDs) were within the required control limits (RPD of 20% or less for water matrix, 35% or less for soil matrix). If the sample or duplicate result is less than 5 times the PRDL, the RPD criteria are not used. In these cases, the difference between the sample and the duplicate results must be within ± the PRDL for water matrix, within ± 2 times the PRDL for soil matrix.

___ Yes
___ No
___ NA

5. Laboratory Procedures

- **Laboratory procedures followed**
  ___ CLP-SOW
  ___ SW-846
  ___ Methods for Chemical Analysis of Water and Wastes
  ___ XRF Standard Operating Procedures
  ___ Other

- **Holding times met**
  ___ Yes
  ___ No

  Be sure to check both extraction and analysis holding times.

- **Consistency with project requirements**

  Analyses were carried out as requested.
  ___ Yes
  ___ No

  Project specified methods were used.
  ___ Yes
  ___ No
  ___ NA

  Clarify if the lab procedures are not the ones outlined in the SAP. If there were deviations, provide an explanation.

6. Detection Limits

- Reporting detection limits met project required detection limits (PRDLs).
  ___ Yes
  ___ No
  ___ NA

  Provide an explanation for any detection limits outside of the project requirements. For example:

  In the first analyses of the water samples, the reporting limit(0.05) did not meet the PRDL (0.003). After contacting the lab, they agreed to reanalyze the samples at the project required detection limit of 0.003. However, two samples (WLM-GW02 and a DI blank) were not available for reanalysis so the first results were included in the database, and the representative quality control batch was incorporated in the validation.

7. Laboratory Blanks

Please note that the highest blank value associated with any particular analyte is the blank value used for the flagging process.

- **Preparation blanks**

  Preparation blanks were prepared and analyzed at the required frequency.

  ___ Yes
  ___ No

  If no, please provide an explanation. For example:

  The frequency requirements for laboratory quality control samples (1/20) were not met with the exception of analytical batch 00-90835(2-14) of the first analyses. The frequency exceedance of each laboratory batch is as follows: waters—00-90835(1-27) (2^{nd} analysis), 00-90730-1(25), 00-90731(1-25), 00-90732(1-24); there were no exceedances for the soil analyses.

  All the analytes in the preparation blank were less than the CRDL (or the PRDL if a project detection limit has been specified).

  ___ Yes
  ___ No

8. Laboratory Matrix Spikes

- A matrix spike sample (pre-digestion) were prepared and analyzed at the required frequency.

  ___ Yes
  ___ No

  If no, please provide an explanation. For example:

  The frequency requirements for laboratory quality control samples (1/20) were not met with the exception of analytical batch 00-90835(2-14) of the first analyses. The frequency exceedance of each laboratory batch is as follows: water—00-908351(1-27) (2^{nd} analysis), 00-907301(1-25), 00-90731(1-25), 00-90732(1-24); there were no exceedances for the soil analyses.

- Samples were spiked at levels appropriate to the sample concentrations.

  ___ Yes
  ___ No

- Matrix spike recoveries were within the required control limits (75-125%).

  ___ Yes
  ___ No

9. Laboratory Duplicates

- Laboratory duplicate samples were analyzed at the proper frequency.
  ___ Yes
  ___ No

  If no, please provide an explanation. For example:
  The frequency requirements for laboratory quality control samples (1/20) were not met with the exception of analytical batch 00-90835-2-14 of the first analyses. The frequency exceedance of each laboratory batch is as follows: waters—00-90835(1-27) (2^{nd} analysis), 00-90730(1-25), 00-90732(1-24); there were no exceedances for the soil analyses.

- The laboratory duplicate relative percent differences (RPDs) were within the required control limits (RPD of 20% or less for water matrix, 35% or less for soil matrix). For low concentration data, that is if the sample or duplicate result is less than 5 times the PRDL, the RPD criteria are not used. In these cases, the difference between the sample and the duplicate results must be within ± the PRDL for water matrix, within ± 2 times the PRDL for soil matrix
  ___ Yes
  ___ No

10. Laboratory Control Standards

- The reference material used was of the correct matrix and concentration.
  ___ Yes
  ___ No

- LCSs were prepared and analyzed at the proper frequency.
  ___ Yes
  ___ No

  If no, please provide an explanation. For example:
  The frequency requirements for laboratory quality control samples (1/20) were not met with the exception of analytical batch 00-90835(2-14) of the first analyses. The frequency exceedance of each laboratory batch is as follows: 00-90835(1-27) (2^{nd} analysis), 00-90730(1-25), 0090731(1-25), and 0090732(1-24).

- Laboratory control samples (LCSs) were prepared in the same way as the associated samples.
  ___ Yes
  ___ No

- LCS recoveries were within the required control limits (80-120% for water, within the certified range for soils).
  ___ Yes
  ___ No

11. Data Quality Objectives

- Project data quality objectives (DQO's) met.
  ___ Yes
  ___ No

Accuracy
The overall accuracy objectives were met, as 100% of the laboratory matrix spikes and laboratory control standards were within control limits.

Precision
The overall precision objectives were met, as 100% of the field and lab duplicates were within control limits.

Completeness
The overall completeness objectives were met, as 100% of the data were deemed valid.

DATA VALIDATION REPORT

Prepared by:
Reviewed by:

NOTE: This document is modeled after a form used by Hydrometrics, a Helena based consulting firm, in a report submitted to DEQ. It may require modification to meet specific project needs. In addition, DEQ may request additional information regarding the data validation and impacts to specific samples (i.e. are results biased high or low).

APPENDIX C
DATA VALIDATION REPORT

DATA VALIDATION REPORT

1. Introduction

This should include a brief summary of the number and type of samples.

- This validation applies to ***___number of samples, organic/inorganic analyses, and media (soil/water); i.e. 73 inorganic soil samples and 16 inorganic water samples*** for ***___facility name___*** project ***___date of SAP___***. From the total of 73 soil samples there were 4 field duplicates. Within the 16 water samples there were 2 soil rinsate blanks, 2 water rinsate blanks and 1 duplicate.

- Validation procedures used are generally consistent with:
  ___ EPA CLP National Functional Guidelines for Inorganic Data Review
  ___ Work Plan, Phase I Remedial Investigation ***(may need to be modified based upon specific facility work)***, Field Sampling and Quality Assurance Project Plan for ***facility name***
  ___ Other

- Overall level of validation:
  ___ Contract Laboratory Program (CLP)
  ___ Standard
  ___ Visual

2. Deliverables

- All laboratory document deliverables were present as specified in the CLP-Statement of Work (CLP-SOW), EPA, 1993 and/or the project contract.
  ___ Yes
  ___ No

- All documentation of field procedures was provided as required.
  ___ Yes
  ___ No

3. Condition of Samples Upon Receipt

Review the sample receipt checklist from the laboratory and note any problems.

- Temperature of samples
- VOA vials had zero headspace
- pH of samples
- Proper container/bottle used
- Container intact
- Other

4. Field Quality Control Samples

Blanks: Please note that the highest blank value associated with any particular analyte is the blank value used for the flagging process.

DI, trip, rinsate, or any other field blanks have been carried out at the proper frequency.

___ Yes
___ No
___ NA

Reported results on the field blanks are less than the contract required detection limits (CRDL) or the project required detection limits (PRDL) if project detection limits have been specified.

___ Yes
___ No

Explain the discrepancies, if any are noted. For example:

The DI blank was below the reporting limit of 0.05 (mg/l). However, the reporting limit was not in agreement with the PRDL of 0.003 (mg/l). The consultant requested that the lab rerun the sample to meet the PRDL, but the lab was unable to locate the sample.

Notes: When an analyte is detected in a blank, associated results up to 5 (concentration above a blank concentration that is flagged depends upon the analysis being performed) times the blank level are flagged to indicate that the results may be biased high due to samples collected on the same day as the blank.

- **Field duplicates**

Field duplicates have been collected at the proper frequency.

___ Yes
___ No
___ NA

Field duplicate relative percent differences (RPDs) were within the required control limits (RPD of 20% or less for water matrix, 35% or less for soil matrix). If the sample or duplicate result is less than 5 times the PRDL, the RPD criteria are not used. In these cases, the difference between the sample and the duplicate results must be within ± the PRDL for water matrix, within ± 2 times the PRDL for soil matrix.

___ Yes
___ No
___ NA

5. Laboratory Procedures

- **Laboratory procedures followed**
  ___ CLP-SOW
  ___ SW-846
  ___ Methods for Chemical Analysis of Water and Wastes
  ___ XRF Standard Operating Procedures
  ___ Other

- **Holding times met**
  ___ Yes
  ___ No

  Be sure to check both extraction and analysis holding times.

- **Consistency with project requirements**

  Analyses were carried out as requested.
  ___ Yes
  ___ No

  Project specified methods were used.
  ___ Yes
  ___ No
  ___ NA

  Clarify if the lab procedures are not the ones outlined in the SAP. If there were deviations, provide an explanation.

6. Detection Limits

- Reporting detection limits met project required detection limits (PRDLs).
  ___ Yes
  ___ No
  ___ NA

  Provide an explanation for any detection limits outside of the project requirements. For example:

  In the first analyses of the water samples, the reporting limit(0.05) did not meet the PRDL (0.003). After contacting the lab, they agreed to reanalyze the samples at the project required detection limit of 0.003. However, two samples (WLM-GW02 and a DI blank) were not available for reanalysis so the first results were included in the database, and the representative quality control batch was incorporated in the validation.

7. Laboratory Blanks

Please note that the highest blank value associated with any particular analyte is the blank value used for the flagging process.

- **Preparation blanks**

  Preparation blanks were prepared and analyzed at the required frequency.

  ___ Yes
  ___ No

  If no, please provide an explanation. For example:

  The frequency requirements for laboratory quality control samples (1/20) were not met with the exception of analytical batch 00-90835(2-14) of the first analyses. The frequency exceedance of each laboratory batch is as follows: waters—00-90835(1-27) (2^{nd} analysis), 00-90730-1(25), 00-90731(1-25), 00-90732(1-24); there were no exceedances for the soil analyses.

  All the analytes in the preparation blank were less than the CRDL (or the PRDL if a project detection limit has been specified).

  ___ Yes
  ___ No

8. Laboratory Matrix Spikes

- A matrix spike sample (pre-digestion) were prepared and analyzed at the required frequency.

  ___ Yes
  ___ No

  If no, please provide an explanation. For example:

  The frequency requirements for laboratory quality control samples (1/20) were not met with the exception of analytical batch 00-90835(2-14) of the first analyses. The frequency exceedance of each laboratory batch is as follows: water—00-908351(1-27) (2^{nd} analysis), 00-907301(1-25), 00-90731(1-25), 00-90732(1-24); there were no exceedances for the soil analyses.

- Samples were spiked at levels appropriate to the sample concentrations.

  ___ Yes
  ___ No

- Matrix spike recoveries were within the required control limits (75-125%).

  ___ Yes
  ___ No

9. Laboratory Duplicates

- Laboratory duplicate samples were analyzed at the proper frequency.
  ___ Yes
  ___ No

  If no, please provide an explanation. For example:
  The frequency requirements for laboratory quality control samples (1/20) were not met with the exception of analytical batch 00-90835-2-14 of the first analyses. The frequency exceedance of each laboratory batch is as follows: waters—00-90835(1-27) (2^{nd} analysis), 00-90730(1-25), 00-90732(1-24); there were no exceedances for the soil analyses.

- The laboratory duplicate relative percent differences (RPDs) were within the required control limits (RPD of 20% or less for water matrix, 35% or less for soil matrix). For low concentration data, that is if the sample or duplicate result is less than 5 times the PRDL, the RPD criteria are not used. In these cases, the difference between the sample and the duplicate results must be within ± the PRDL for water matrix, within ± 2 times the PRDL for soil matrix
  ___ Yes
  ___ No

10. Laboratory Control Standards

- The reference material used was of the correct matrix and concentration.
  ___ Yes
  ___ No

- LCSs were prepared and analyzed at the proper frequency.
  ___ Yes
  ___ No

  If no, please provide an explanation. For example:
  The frequency requirements for laboratory quality control samples (1/20) were not met with the exception of analytical batch 00-90835(2-14) of the first analyses. The frequency exceedance of each laboratory batch is as follows: 00-90835(1-27) (2^{nd} analysis), 00-90730(1-25), 0090731(1-25), and 0090732(1-24).

- Laboratory control samples (LCSs) were prepared in the same way as the associated samples.
  ___ Yes
  ___ No

- LCS recoveries were within the required control limits (80-120% for water, within the certified range for soils).
  ___ Yes
  ___ No

11. Data Quality Objectives

- Project data quality objectives (DQO's) met.
  ___ Yes
  ___ No

Accuracy
The overall accuracy objectives were met, as 100% of the laboratory matrix spikes and laboratory control standards were within control limits.

Precision
The overall precision objectives were met, as 100% of the field and lab duplicates were within control limits.

Completeness
The overall completeness objectives were met, as 100% of the data were deemed valid.

DATA VALIDATION REPORT

Prepared by:
Reviewed by:

NOTE: This document is modeled after a form used by Hydrometrics, a Helena based consulting firm, in a report submitted to DEQ. It may require modification to meet specific project needs. In addition, DEQ may request additional information regarding the data validation and impacts to specific samples (i.e. are results biased high or low).

APPENDIX D
HOUSEHOLD SURVEY

TETRA TECH

INDOOR AIR QUALITY ASSESSMENT
BUILDING SURVEY FORM

Project Information

Preparer's name: _____ Date: _____

Project Number: _____ Phone #: _____

Site Name: _____

Part I – Occupant Information

Building Address: _____

Property Contact:_____Owner / Renter / other: _____

Contact's Phone: home ( )_____ work ( )_____ cell ( )_____
(Check primary number if more than one supplied)

Number of building occupants: Children under age 13 _____ Children age 13-18 _____Adults _____

Part II – Building Characteristics

1) Building type:
residential / multi-family residential / mixed use residential / office / strip mall / commercial / industrial

2) Describe building: _____

_____

3) Building use:

Floor	**General use of each floor (e.g., family room, bedroom, workshop, storage)**
Basement:	
Ground floor:	
2nd Floor:	
3rd Floor:	
4th Floor:	

4) Municipal Zoning:_____ Year constructed: _____

5) Number of floors below grade:_____ (includes full basement / crawl space / slab on grade)

6) Number of floors at or above grade: _____

7) Depth of basement below grade surface: _____ft. Basement size: _____ ft^2

This questionnaire was prepared using guidelines published by the California Department of Toxic Substances Control, the New Jersey Department of Environmental Protection, the New York State Department of Health, and the Oregon Department of Environmental Quality (CADTSC 2005, NJDEP 1997; ORDEQ 2010; NYSDOH 2005)

8) Basement and Construction Characteristics (Circle all that apply):

Above Grade Construction:	Wood frame	Concrete	Brick	Other_____
Basement type:	Full	Crawlspace	Slab	Other_____
Basement Floor:	Bare earth	Concrete	Stone	Other:_____
Concrete floor (slab on grade):	Unsealed	Sealed	Seal Material:_____	
Foundation walls:	Poured	Block	Stone	Other:_____
Foundation wall finish	Unsealed	Sealed	Seal Material:_____	
The basement is:	Unfinished	Finished	Partially finished:_____	
The basement is :	Wet	Damp	Dry	Moldy
Sump present?	Yes	No	If yes is water present? Y/N/Not accessible	

9) If the basement is finished or partially finished does it include a bathroom or half-bath? Yes / No

10) Type of heating system(s) (circle all that apply):

hot air circulation	hot air radiation	subfloor radiant	steam radiation
heat pump	hot water radiation	kerosene heater	electric baseboard

other (specify): _____

11) Where is the furnace/boiler located?_____

12) Type of ventilation system(s) (circle all that apply):

central air conditioning	mechanical fans	bathroom ventilation fans	outside air intake
individual AC units	kitchen range hood fan	other (specify):_____	

_____

13) Are there whole house fans, kitchen fans, or bath fans? List each if present and where it is vented:_____

_____

_____

14) Types of heating / cooking fuel utilized (circle all that apply):

Natural gas / electric / fuel oil / wood / coal / kerosene / other:_____

15) Is a private irrigation or drinking water well on site? Yes / Yes (but not used) / No

16) Taste and/or odor problems noticed with water? Yes / No

If yes, describe taste/odor:_____

_____

If yes, how long has it been present?_____

17) Is the water chlorinated, brominated, or ozonated? Yes / No _____

18) Is there a septic system? Yes / Yes (but not used) / No

Distance of septic system from building/home:_____

Distance of septic system from site water well (if present): _____

19) Type of ground cover outside of building: grass / concrete / asphalt / other (specify)

_____

20) Is an existing subsurface depressurization (radon) system in place? Yes / No If yes: active / passive

21) Is a sub-slab vapor/moisture barrier in place? Yes / No
If yes, type of barrier: _____

Part III - Outside Contaminant Sources

22) Regulated contaminated site (1000-ft. radius): _____

23) Other stationary sources nearby (gas stations, emission stacks, etc.): _____

24) Heavy vehicular traffic nearby (or other mobile sources): _____

Part IV – Miscellaneous

25) Do any occupants of the building smoke? Yes / No How often? _____
Last time someone smoked in the building? _____hours / days ago

26) Does the building have an attached garage directly connected to living space? Yes / No
If so, is a car usually parked in the garage? Yes / No
Are gas-powered equipment/machines stored in the garage? Yes / No
If yes, what types (mower, ATV, PWC, etc.):_____
Are cans of gasoline/fuels stored in the garage? Yes / No
Are paints or chemicals stored in the garage? Yes / No
Does the garage have a separate heating system? Yes / No

27) Do the occupants of the building have their clothes dry cleaned? Yes / No
If yes, how often? weekly / monthly / 3-4 times a year

28) Do any of the occupants use solvents or volatile chemicals in their workplace? Yes / No
If yes, what types of solvents are used? _____
If yes, where are their clothes washed? At work At home Other:_____

29) Has the building/home been fumigated for termites/other pests within the last 12 months? Yes / No
If yes, when and which chemicals? _____
_____

30) Have any pesticides/herbicides been applied around the building or in the yard? Yes / No
If yes, when and which chemicals? _____
_____

31) Has there ever been a fire in the building? Yes / No If yes, when? _____

32) Has painting or staining been done in the building (including basement) within the last 6 months? Yes / No
If yes, when _____and where? _____

33) Are new carpets, drapes, other textiles, or upholstered furniture in the building? Yes / No
If yes, when _____and where? _____

34) Have cleaning chemicals been used in the building recently? Yes / No
If yes, what types? _____

35) Have cosmetic products been used in the building recently? Yes / No
If yes, what types? _____

36) Have air fresheners been used in the building recently (including basement)? Yes / No
If yes, what types? _____

37) Have any "hobby" chemicals (glues, paints) been used in the building recently (including basement)? Yes / No
If yes, what types? _____

38) Have any other chemicals been used in the building recently (including basement)? Yes / No
If yes, what types? _____

Part V – General Observations

Provide any additional information that may be pertinent to the survey and may assist in the data interpretation process below, and include floor plan(s) on a separate sheet.

Part VI – Indoor Contaminant Sources

Identify all potential indoor sources found in the building (including attached garages), the location of the source (floor and room), and whether the item was removed from the building 48 hours prior to indoor air sampling event. Any ventilation implemented after removal of the items should be completed at least 24 hours prior to commencement of the indoor air sampling event.

Potential Sources	Location(s)	Volatile Ingredients in Product, Container Type, and Size	Removed (Yes/No/NA)
Gasoline storage cans			
Gas-powered equipment			
Kerosene storage cans			
Paints / thinners / strippers			
Cleaning solvents			
Oven cleaners			
Carpet / upholstery cleaners			
Other house cleaning products			
Moth balls			
Polishes / waxes			
Insecticides			
Furniture / floor polish			
Nail polish / polish remover			
Hairspray			
Cologne / perfume			
Air fresheners			
Fuel tank (inside building)			NA
Wood stove or fireplace			NA
New furniture / upholstery			
New carpeting / flooring			NA
Hobbies - glues, paints, etc.			

Floor Plan

Building Address:_____Floor:_____

SUB-SLAB DEPRESSURIZATION SYSTEM INSPECTION CHECKLIST

Inspection Item	Yes	No	NA	Comment
System Operation				
Is the manometer or pressure gauge indicating a vacuum?				Vacuum:_____inH_2O
Pipe Integrity				
Is the piping free of any visible damage?				
Do pipe joints appear to be sealed?				
Slab-Integrity				
Is the seal around the pipe penetrating the slab intact?				
Is the slab free of visible cracks or other damage?				

Note:

NA Not applicable

If a leak is suspected, perform a smoke test to confirm.

APPENDIX E
LABORATORY CHAIN-OF-CUSTODY

Air Toxics LTD.

Chain-of-Custody Record

Contact Person Company Address City State Zip Phone FAX Collected By: (Signature)	Project Information: P.O. # Project # Project Name	Turn Around Time: ☐ Normal ☐ Rush Specify	Pressurized by: Date: Press. Gas: N2 He

Lab I.D.	Field Sample I.D.	Canister I.D.	Date & Time	Analysis Requested	Canister Pressure/Vacuum Initial	Final	Receipt	Final (psi)
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			
					"Hg			

Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time
Relinquished By: (Signature) Date/Time	Received By: (Signature) Date/Time

Notes:

Shipper Name	Air Bill #	Opened By	Temp ©	Condition	Custody Seals	Work Order #
					Yes No None	