Water & Environmental
TECHNOLOGIES

February 14, 2025

Daphne Ryan
Montana Department of Environmental Quality
1520 E 6th Avenue
Helena, MT 59601

Re: **Additional Corrective Action Work Plan Required for the Petroleum Release at Lyons Motor Inc., 3900 Harrison Avenue, Butte, Silver Bow County, Montana; Facility ID 47-08591 (TID 28446), Release 955, Work Plan ID 34990**

Dear Daphne:

This workplan presents Water & Environmental Technologies' (WET's) proposed approach and budget for corrective actions at the above-referenced Facility, as required in a Montana Department of Environmental Quality (DEQ) Work Plan Request letter dated January 14, 2025.

Scope of Work

The scope of work includes installing and developing a new monitoring well near MW-1, conducting up to four groundwater monitoring events, laboratory analysis of soil and groundwater samples, conducting data validation, preparing Interim Data Submittals (three), and preparing an Abbreviated Groundwater Monitoring Report (AR- 01) within 90 days of receipt of analytical data for the final monitoring event. The first monitoring event will occur in 2025 pending approval of this work plan. The Facility release closure plan will also be updated and appended to the AR-01.

Project Management

WET personnel will provide informational status reports to the owner and DEQ on an as-needed basis. Other duties associated with this task include scheduling field work, project reporting administration, monitoring the project budget and deliverables, and any submitted written agreed-upon WP modifications to complete the objectives.

Mobilization

WET personnel will mobilize to the site 8 times to complete the required scope of work. Mobilizations include marking for utility locates, installing the monitoring well, well development, survey (surveyor and technician), and conducting up to four groundwater monitoring events. Each round-trip mobilization is approximately nine miles, 35 minutes of travel time, and includes 30 minutes for loading/unloading.

Well Installation

Despite efforts by the owner to ensure the preservation of MW-1 during ongoing site work, this well could not be located in 2024 and is assumed to be destroyed. The preservation efforts are

documented and included as **Appendix A**. Because groundwater concentrations in this well remained above risk-based screening levels (RBSLs) in 2022, it is necessary to replace this well.

Prior to drilling activities, utility locates will be performed using Montana's One Call system. One soil boring will be installed and completed as a 2-inch diameter monitoring well with a flush-mount monument cemented in place. The well will be constructed with 2-inch, schedule 40 PVC casing and 0.010-inch factory slotted screen installed across the shallow aquifer water table, with a total of 10-feet of screen. Additional completion procedures are outlined in WET SOP-10: Monitoring Well Construction (**Appendix B**). Anticipated total depth of the well based on historical groundwater data is 30 feet below ground surface (bgs); exact screen intervals and total depths will be determined in the field based on observed zones of contamination, lithology, and historical water level data. Three bids were solicited for drilling; Wiley Drilling submitted the lowest bid and will be awarded the work. Bids are included as **Appendix C**.

Field Work

WET personnel will oversee soil boring/monitoring well installation. Soil cores will be logged and continuously screened for evidence of contamination using a PID and the heated headspace method following procedures outlined in WET SOP-12: Procedures for Field Screening Using a Photoionization Detector (**Appendix B**). Soil will be classified according to the unified soil classification system (USCS). One sample and a duplicate will be collected at the soil-water interface in accordance with WET SOP-9B: Subsurface Soil Sampling – Borehole and Excavation (**Appendix B**). All pertinent field investigation and sampling information will be recorded on field sheets or in a field notebook, as described in the WET SOP-1: Field Logbook and Field Sampling Forms (**Appendix B**).

Samples will be placed in an ice filled cooler immediately after collection and shipped to the laboratory for volatile petroleum hydrocarbon (VPH) analysis following the procedures outlined in WET SOP-4: Sample Nomenclature, Documentation, and Chain of Custody and WET SOP-3: Sample Package and Shipping (**Appendix B**).

Well Development

Newly installed wells will be developed in accordance with WET SOP-13: Monitoring Well Development (**Appendix B**). If light non-aqueous phase liquid (LNAPL) is present in a well, that well will not be developed. During development, the following water quality parameters and observations will be recorded:

- Depth to water;
- Development time and volume;
- Flow rate
- pH, temperature, specific conductance, and turbidity;
- Other observations as appropriate (color, presence of odors, sheen).

Development should continue until water quality parameters have stabilized and the turbidity of the discharge is low.

Survey

One survey event is planned to complete the scope of work. The newly installed monitoring well will be surveyed for location and top of casing elevation and tied into the existing survey by a licensed surveyor. The location coordinates will be presented in the 1983 North American Datum (NAD83), Montana State Plane with units of international feet. Elevations will be expressed in units of feet above sea level (AMSL) relative to the 1988 North American Vertical Datum (NAVD88).

Groundwater Monitoring

WET will conduct up to four groundwater monitoring events of wells MW-1R, MW-6, and MW-7 over the course of this workplan. The first event will take place during high groundwater in 2025. Groundwater monitoring scope and frequency will be evaluated after each event. Once concentrations in a well are below RBSLs for at least two consecutive events, that well will be removed from the monitoring network.

Fluid levels will be measured with an oil-water interface meter prior to purging the well in accordance with WET standard operating procedure (SOP) SOP-5: Measurement of Fluid Levels and recorded on the WET Groundwater Sampling Form in accordance with WET SOP-1: Field Logbook and Field Sampling Forms. SOPs are included as **Appendix B**. Any monitoring well containing free product will not be sampled. Monitoring wells will be purged and sampled using a peristaltic pump and following procedures specified in this workplan and WET SOP-8B: Groundwater Sampling – Low Flow Method (**Appendix B**) and DEQ's Groundwater Sampling guidance (2018).

Groundwater field parameters for each well will be measured during purging activities by a YSI® Professional Plus Quatro Cable multi-meter, HACH turbidity meter, and an oil/water interface probe as outlined in WET SOP-6: Measurement of Field Parameters (**Appendix B**). Field parameter measurements consist of recording initial depth to water, temperature, specific conductivity (SC), dissolved oxygen (DO), pH, oxidation reduction potential (ORP), turbidity, final depth to water, and volume during purging. Temperature and drawdown will be monitored but are not subject to stabilization criteria. Field parameter readings should be recorded every 3-5 minutes until three consecutive readings are within stabilization range. Once parameters stabilize according to the criteria in Table 1, a groundwater sample will be collected in laboratory-supplied bottles.

Table 1. Stabilization Parameters

Water Quality Parameter	Unit	Stabilization Range	Exception
pH	standard units (s.u.)	±0.1 s.u.	
Specific Conductance (SC)	microsiemens per centimeter (µS/cm)	±3%	
Dissolved Oxygen (DO)	milligrams per liter (mg/L)	±10%	<0.50 mg/L
Turbidity	nephelometric turbidity units (NTU)	±10%	<5 NTU
Oxidation/Reduction Potential (ORP)	millivolts (mV)	±10 mV	

Reusable equipment (oil-water interface probe) will be decontaminated in accordance with WET SOP-2: Equipment Decontamination (**Appendix B**).

All events will include the collection of a duplicate sample (from MW-6) and a field blank sample for quality assurance and quality control (QA/QC) purposes.

Samples will be placed in an ice filled cooler immediately after collection and shipped to the laboratory following the procedures outlined in WET SOP-4: Sample Nomenclature, Documentation, and Chain of Custody and WET SOP-3: Sample Package and Shipping (**Appendix B**).

Investigation-Derived Waste (IDW) Management, Characterization, and Disposal

Work plan implementation will generate soil IDW through drilling activities, groundwater IDW from well development and purging, and non-indigenous IDW including worker trash, personal protective equipment, and disposable sample tubing. IDW will be managed in accordance with WET SOP-17: Management of Investigation-Derived Waste.

Soil will be continuously screened using a PID. Any soil exhibiting a PID reading greater than 100 parts per million (ppm) will be placed in a labeled bucket with a lid or a drum and sampled. Once analytical results are available, appropriate disposal will be arranged. Soil with PID readings below 100 ppm will be land spread near the point of generation.

Following the DEQ disposal of untreated purge water from monitoring guidance dated July 15, 2015, the purge water originates from the shallowest aquifer, is not likely to result in an exceedance of soil screening levels, is not discharged to a surface water, and is not from a mine adit or long-term pumping test. Therefore, the purge water from the groundwater sampling event will be discharged to pervious Facility ground.

Non-indigenous IDW such as disposable sampling scoops, bailers, nitrile gloves, ziplock bags will be bagged and placed in a trash receptacle for disposal in a landfill.

Laboratory Analysis

Soil and groundwater samples will be analyzed for VPHs in accordance with the Montana Tier 1 Risk-Based Corrective Action (RBCA) Guidance for Petroleum Release Sites. Additionally, volatile organic compounds (VOCs) and RCRA metals and zinc will be analyzed in samples collected from MW-6 to meet requirements for a waste oil tank as shown in Table B of the guidance.

Quality Assurance Quality Control

Quality assurance/quality control (QA/QC) samples including duplicates (soil and water) and field blanks (water) will be collected at a minimum frequency of 1 per 20 natural samples (5%), or one per event as outlined in the relevant sections of WET SOP-16: Quality Control Sampling. One soil duplicate sample will be collected. One duplicate groundwater sample and one field blank sample will be collected during each event in conjunction with natural groundwater samples. The duplicate will be collected from a well that exhibited evidence of contamination during installation and will be collected simultaneously with its parent sample. The field blank will be collected during representative sampling conditions at the Facility by pouring laboratory provided organic-free deionized water into laboratory provided sample containers. QA/QC samples will be analyzed for the same constituents as the natural samples.

Energy Laboratories will conduct all analyses of collected soil and groundwater samples and provide a laboratory QC report for each analysis. WET personnel will validate all laboratory analytical data in accordance with WET's Data Verification and Data Validation SOG using DEQ's Data Validation Summary Form (DVSF). This summary form will be included in the final report. Up to five laboratory reports and DVSFs will be generated during the completion of this work plan.

Project Reporting

WET will prepare and submit an Interim Data Submittal (IDS) for each interim groundwater monitoring event. The IDS will include a discussion, data, tables, and figures as described in the Groundwater Monitoring Work Plan and Report Guidance for Petroleum Releases. The schedule and scope for future groundwater monitoring events will also be provided as part of the IDS.

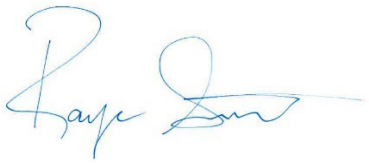
Within 90 days of receipt of analytical data for the final sampling event, WET will prepare and submit a Generic Applications Corrective Action Report (AR-07. soil boring/well completion logs, groundwater monitoring field forms, laboratory analytical data, completed DVSFs, and Release Closure Plan (RCP) will be updated and appended to the report.

Cost and Schedule

Work effort levels have been estimated using best professional judgement and typical scenarios related to work of this type. A detailed cost estimate is included as **Appendix D**. WET will begin implementation of the CAP upon DEQ approval of this CAP.

If you have any questions or concerns, please contact me at rsurratt@waterenvtech.com or 406-782-5220.

Sincerely,



Raye Surratt
Senior Engineer, UST/AST Technical Service Lead

Appendix A

From:	Sarah Jones
To:	Ryan, Daphne; Raye Surratt
Cc:	David Billion; Darwin Lindahl
Subject:	RE: [EXTERNAL] Re: Former Lyon"s Motors - SVE System
Date:	Tuesday, June 27, 2023 4:56:17 PM
Attachments:	image001.png image002.png image003.png image004.png image005.png image006.png

---

Thanks for your response Daphne. I'll advise the contractor. Have a good evening and thanks for all your help on this project.

Sarah Jones, PE
Deluxe Engineering & Construction
Mobile: (406) 310-0618
Fax: (866) 438-4712
sjones@deluxece.com
www.deluxece.com

> On 6/27/2023 4:55:06 PM, Ryan, Daphne <daphne.ryan@mt.gov> wrote:
>
> Hi Sarah,
>
> I would recommend to not remove any of the wells. Since this is an open and active petroleum release I would consider all monitoring wells necessary at this point.
>
> Thanks so much and have a good night!
>
> **Daphne Ryan** | *Environmental Project Officer*
>
> Tanks, Brownfields, and Federal Facilities Bureau
>
> Montana Department of Environmental Quality
>
> Office: 406-444-6728 | Daphne.Ryan@mt.gov
>
> DEQ Montana Department of Environmental Quality
>
> How did we do? »

From: Sarah Jones <sjones@deluxece.com>
Sent: Tuesday, June 27, 2023 3:14 PM
To: Raye Surratt <rsurratt@waterenvtech.com>; Ryan, Daphne <Daphne.Ryan@mt.gov>
Cc: David Billion <dbillion@sio.midco.net>; Darwin Lindahl <darwin@lindahlarchitects.com>
Subject: RE: [EXTERNAL] Re: Former Lyon's Motors - SVE System

Thanks for the clarification. Below is the guidance I gave the contractor.

- All wells on the site need to remain in place and be protected from disturbance or contamination.
- Piping systems between wells can be removed.
- Any penetrations into the well casings, which are caused by removing the connecting pipes, need to be patched by waterproof materials to prevent surface contamination of the wells.
- All well covers need to be surveyed to ensure that we have an accurate record of the well cap elevations prior to disturbance. Once construction is complete, well covers will need to be surveyed again. Results of before and after survey will be provided to WET for their use in future monitoring events. This work will be completed by Deluxe.
- Upon completion of the finished subgrade grade, Deluxe with work with the contractor to determine if any well casings need to be modified to meet finished grade elevations.
- Well caps should be finished into the finished asphalt surfacing, taking care to ensure that asphalt does not cover the well caps and that all caps can be removed for the next monitoring event.

For the most part we tried to keep existing grades the same as finished grades, so I'm hopeful that we won't disturb any PVC casings. However, my instructions to them require them to coordinate with me before adjusting elevations, once the finished subgrade is in place. So, if it is determined that a casing pipe needs to be adjusted I'll take before and after survey shots on it and coordinate with Raye.

The contractor did ask one question, which I told him I'd pass on. Are all the monitoring wells still active and necessary, or are there some that can be removed?

Thanks very much for your coordination on this issue!

Sarah Jones, PE
Deluxe Engineering & Construction
Mobile: (406) 310-0618
Fax: (866) 438-4712
sjones@deluxece.com
www.deluxece.com [deluxece.com]

consideration. I look forward to speaking with you.

> On 6/27/2023 2:30:32 PM, Raye Surratt <rsurratt@waterenvtech.com> wrote:
>
> As long as you don't disturb the PVC well casing while raising the monuments, we shouldn't need to re-survey. Our reference point for the elevation is the top of the PVC.
>
> Thanks,
>
> Raye
>
> ---
>
> **From:** Ryan, Daphne <Daphne.Ryan@mt.gov>
> **Sent:** Tuesday, June 27, 2023 2:25 PM
> **To:** Sarah Jones <sjones@deluxece.com>
> **Cc:** Raye Surratt <rsurratt@waterenvtech.com>; dbillion@sio.midco.net
> **Subject:** RE: [EXTERNAL] Re: Former Lyon's Motors - SVE System
>
> Good afternoon Sarah,
>
> It would be best practice that the monuments be flush with the newly paved surface so there isn't surface water collection resting on top of the monitoring wells, which could lead to damage. If the height of the well monument is changed to become flush with the newly paved surface it is likely that the wells will have to be resurveyed. I am unaware of the survey measuring points were made, if it was from an arbitrary point or some other method. I am also unsure if the PTRCB will cover the costs for resurveying the wells.
>
> Thank you,
>
> **Daphne Ryan** | *Environmental Project Officer*
>
> Tanks, Brownfields, and Federal Facilities Bureau
>
> Montana Department of Environmental Quality
>
> Office: 406-444-6728 | Daphne.Ryan@mt.gov
>
> DEQ Montana Department of Environmental Quality
>
> [facebook.com] [instagram.com] [twitter.com] [youtube.com] How did we do? » [arcg.is]

From: Sarah Jones <sjones@deluxece.com>
Sent: Monday, June 26, 2023 5:02 PM
To: Ryan, Daphne <Daphne.Ryan@mt.gov>
Subject: [EXTERNAL] Re: Former Lyon's Motors - SVE System

Thank you. We will remove the SVE system and finish the wells into the surface of the new asphalt.

Have a good day!

Sarah Jones, PE

Deluxe Engineering and Construction

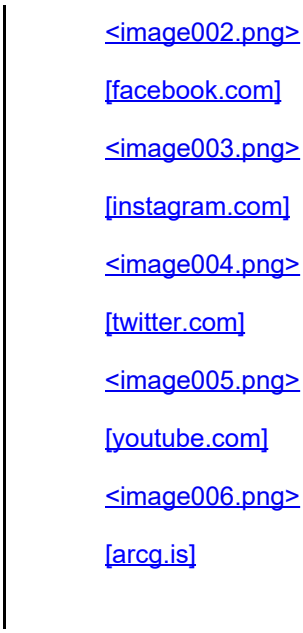
sjones@deluxece.com

Mobile: 406-310-0618

Fax: 866-438-4712

www.deluxece.com [deluxece.com]

> On Jun 26, 2023, at 4:47 PM, Ryan, Daphne <Daphne.Ryan@mt.gov> wrote:
>
> Good afternoon Sarah,
>
> I heard back from Rachel at WET and she let me know that the SVE system is ok to be removed.
>
> Let me know if you have any more questions.
>
> Thank you,
>
> **Daphne Ryan** | *Environmental Project Officer*
>
> Tanks, Brownfields, and Federal Facilities Bureau
>
> Montana Department of Environmental Quality
>
> Office: 406-444-6728 | Daphne.Ryan@mt.gov
>
> <image001.png>


<image002.png>
[facebook.com]
<image003.png>
[instagram.com]
<image004.png>
[twitter.com]
<image005.png>
[youtube.com]
<image006.png>
[arcg.is]

From:	Sarah Jones
To:	Rick Hoffman; David Billion
Cc:	Ty Inglis; Darwin Lindahl; Raye Surratt
Subject:	Butte GM Monitoring Wells and SVE System
Date:	Friday, July 7, 2023 12:15:00 PM
Attachments:	Monitoring Well Locations.pdf C-1_7-7-23.pdf

Hello All -

I met with Raye Surratt, with WET yesterday to discuss the monitoring wells and SVE system and received some good news. Only 6 of the current wells need to be kept. Most of the wells on-site are part of the SVE system, which can be removed. Only 6 are monitoring wells, as shown on the map attached.

The onsite foreman has a copy of the attached map and I showed him how to tell the difference between the two types of wells. The 6 monitoring wells are not close to each other so they shouldn't pose a significant problem to paving. Each of the 6 wells will need to have to their top elevation adjusted, but the casings are 2-inch PVC, so it will be easy to accomplish that task. On the day the wells are adjusted, I'll need to be on-site, so I can provide WET with accurate data on the adjusted elevations of each monitoring well.

The remaining wells are SVE wells and can be removed. These wells include a 4-inch pvc casing with cover. The covers can be removed and disposed of. The casings can be removed if possible. If not possible, they should be cut at least 6-inches below the bottom of the asphalt. Any casings or holes remaining should be filled with either bentonite chips or flowable fill concrete.

Further good news is that the wooden shed on the south side of the site, which houses, the SVE blower, can also be removed. Nothing in the shed needs to be salvaged, unless desired by Butte GM. This allows us to simplify the curb in that area, as shown on the attached updated plan sheet. I'll provide a copy of this updated plan and the updated model to Forrest for staking purposes.

Because we are not reduced to 6 wells which remain, I don't believe it is worth pursuing closure of the UST Site at this time. Based on my research, I believe that process would cost more than paving around the 6 remaining wells. However, I'll defer to Raye's guidance and Butte GM's final decision on that issue.

Thank you all for your patience as we addressed the presence of these wells on our project. I believe we ended up with an excellent and low impact solution.

Have a good day! Feel free to give me a call if you'd like to discuss the information herein in more detail.

Sarah Jones, PE
Deluxe Engineering & Construction
Mobile: (406) 310-0618
Fax: (866) 438-4712
sjones@deluxece.com
www.deluxece.com

From: Rick Hoffman
To: Raye Surratt
Cc: Tim Kohntopp
Subject: Re: Wells in parking lot
Date: Wednesday, December 18, 2024 4:50:36 PM

Ryan,
Tim was going to search late last week, I'll circle back with him in the morning. I attached him to this email also
Sent from my iPhone

> On Dec 18, 2024, at 4:13 PM, Raye Surratt <rsurratt@waterenvtech.com> wrote:
>
> Did you end up finding this sucker after we talked?
>
> ---
>
> **From:** Rick Hoffman <rick@hoffmansmt.com>
> **Sent:** Wednesday, November 13, 2024 10:04 AM
> **To:** Raye Surratt <rsurratt@waterenvtech.com>
> **Subject:** Re: Wells in parking lot
>
>
>
> I guessing it's gone then we did find a couple extra can they be used in place of that well?
> You can give me a buzz to discuss
> 1-406-490-7777
> Sent from my iPhone
>
> > On Nov 12, 2024, at 3:16 PM, Raye Surratt <rsurratt@waterenvtech.com> wrote:
> >
> > Hey Rick,
> > My sampler is out there today and did not see MW-1. He believes it should be located where the dumpster area is.
> > Thanks,

Raye

From: Rick Hoffman <rick@hoffmansmt.com>
Sent: Tuesday, November 5, 2024 4:17 PM
To: Raye Surratt <rsurratt@waterenvtech.com>
Subject: Re: Wells in parking lot

Raye,
Yes I believe we did.
Thanks rick

Sent from my iPhone

> On Nov 5, 2024, at 3:10 PM, Raye Surratt <rsurratt@waterenvtech.com> wrote:
>
> Did you get the other one uncovered?
>
> ---
>
> **From:** Rick Hoffman <rick@hoffmansmt.com>
> **Sent:** Thursday, October 24, 2024 1:23 PM
> **To:** Raye Surratt <rsurratt@waterenvtech.com>
> **Subject:** Re: Wells in parking lot
>
>
>
> Raye,
> We found one the other day. I will be running around there tomorrow, let see what we have going on.
> Thanks my contact 1-406-490-7777
> Sent from my iPhone

On Oct 24, 2024, at 12:19 PM, Raye Surratt <rsurratt@waterenvtech.com> wrote:

Hi Rick,
Ty Inglis directed me to talk to you about uncovering monitoring wells that were paved over at Butte GM. It looks like just one still needs to be uncovered, though I am not sure which one it is. The wells that were covered were MW-1 and MW-6 (see attached). Can you let me know when you can get to that?
Thanks,
Raye

From: Corey Markovich <cmarkovich@markovichinc.com>
Sent: Tuesday, October 22, 2024 2:31 PM
To: Ty Inglis <tyinglis62@gmail.com>; Raye Surratt <rsurratt@waterenvtech.com>; John Frankovich <jcfrankovich@markovichinc.com>; Rick Hoffman <rick@hoffmansmt.com>
Cc: Danny Leas <dleas@waterenvtech.com>
Subject: RE: Wells in parking lot

Greetings.

One well was uncovered last week. Rick can coordinate on any additional and is included here.

Corey Markovich
Markovich Inc.
2827 Lexington Avenue

Appendix B

Water & Environmental
TECHNOLOGIES

SOP-1

FIELD LOGBOOK AND FIELD SAMPLING FORMS

All pertinent field investigation and sampling information will be recorded on a field form during each day of the field effort and at each sample site. The field crew leader will be responsible for ensuring that sufficient detail is recorded on the field forms. No general rules can specify the extent of information that must be entered on the field form. However, field forms must contain sufficient information such that someone could reconstruct all field activities without relying on the memory of the field crew. All entries shall be made in indelible ink weather conditions permitting. Each day's or site's entries will be initialed and dated at the end by the author.

At a minimum, entries on the field sheet or in field notebook must include:

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

For sampling efforts, specific details for each sample should be recorded using a standardized field form designed specifically for the sampling activity being conducted (ex., low-flow groundwater monitoring). Sampling field forms contain fill-in-the-blank type information in order that all pertinent information will be recorded. In addition to the items listed above, the following information is recorded on field forms during sampling efforts:

- Time and date samples were collected.
- Number and type (natural, duplicate, QA/QC) of samples collected.
- Analysis requested.
- Preservative added to samples.
- Sampling method, particularly deviations from standard operating procedures.

Strict custody procedures will be maintained with the field forms. Field forms must always remain with the field team while being used in the field. Upon completion of the field effort, photocopies of the original field forms will be made and used as working documents; original field forms will be filed in an appropriately secure manner.

Water & Environmental
TECHNOLOGIES

SOP-2

EQUIPMENT DECONTAMINATION

INTRODUCTION

The purpose of this section is to describe general decontamination procedures for field equipment. Decontamination will be performed on all nondedicated and non-disposable sampling equipment that may contact potentially contaminated media. Field personnel must wear disposable latex or nitrile gloves while decontaminating equipment at the project site and 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.

EQUIPMENT

- 5-gallon plastic tubs
- Liquinox (detergent)
- 5-gallon plastic water containers
- Hard bristle brushes
- 5-gallon carboy containing deionized water
- Garbage bags
- 1-gallon cube of 10% HN03
- Latex or nitrile sample gloves
- 1-gallon container or spray bottle of 10%
- Methanol or pesticide grade Acetone for organics
- Spray bottles
- Paper towels
- Aluminum foil

PROCEDURES

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 wind borne contamination.
2. Visually inspect sampling equipment for contamination; use stiff brush to remove visible mate rial.
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; rinse with deionized water three times.
4. Rinse equipment with methanol in place of the nitric acid rinse if sampling for organic contam ination. Follow with a deionized water rinse.
5. Decontaminated equipment that is used for sampling organics should be wrapped in alumi num 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), as well as rinse and wash water generated during decontamination, should be disposed in accordance with SOP-17 – Management of Investigation-Derived Waste.

Water & Environmental
TECHNOLOGIES

SOP-3

SAMPLE NOMENCLATURE, DOCUMENTATION, AND CHAIN OF CUSTODY

INTRODUCTION

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, several forms will need to be filled out. Most sample documentation forms are preprinted carbonless triplicates, enabling copies to be filled 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. Responsibility for completing the 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 indelible ink for each sample generated include:

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

A chain-of-custody form will be generated for all samples collected in the field for laboratory analysis. The sampler may use a project-specific chain-of-custody form or a chain-of-custody form provided by the laboratory.

FIELD EQUIPMENT

- Indelible ink pen
- Chain-of-custody forms
- Custody seals

PROCEDURES

Sample custody records must be maintained from the time of sample collection until the time of sample delivery to the analytical laboratory and should accompany the sample through analysis and final disposition. The information to be included on the chain-of¬ custody form will include, but is not limited to:

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

Each sample will be assigned a unique sample identification number or name. The information on the chain-of-custody form, including the sample identification number or name, must correspond to the information recorded by the sampler on the field forms (refer to SOP 1) and the label on the sample container.

A sample is considered under a person's control when it is in their possession such that tampering is prevented. This includes placing the samples in an area of controlled access such as a building or locking the samples in a vehicle. When custody of a sample is relinquished by the sampler, the sampler will sign and date the chain-of-custody form and note the time that custody was relinquished. The person receiving custody of the sample will also sign and date the form and note the time that the sample was accepted into custody. Samples will be shipped to the analytical laboratory following the procedures in SOP 4. If an overnight shipping service is used to transport the samples to the laboratory, custody of the samples will be relinquished to the shipping service. The shipping service will not sign the chain-of-custody form; however, the samples can be tracked while in the custody of the shipping service. More than one sample may be included on a chain-of-custody form, as long as all of the samples are for the same project. Copies of the chain-of-custody form will be maintained in the project file, in accordance with standardized or project-specific data management procedures.

Water & Environmental
TECHNOLOGIES

SOP-4

SAMPLE PACKAGE AND SHIPPING

PACKAGING

All environmental samples collected should be packaged and shipped using the following procedures:

1. Label all sample containers with indelible ink (on the side, not on the cap or lid). Place labeled sample bottles in a high-quality cooler containing an adequate amount of ice (sealed inside two Ziploc bags) to maintain a temperature of 4°C or less inside the cooler. Freeze packs, or "Blue Ice" is NOT to be used. Ensure the cooler drain plug is taped shut.
2. Place the samples in an upright position and wrap the samples with absorbent, cushioning material for stability during transport. Samples should not be loose; the cooler should be able to withstand tough handling during shipment without sample breakage.
3. Fill out the appropriate shipping forms and place in a Ziploc bag then tape it to the inside lid of the shipping container. Shipping forms usually consist of a chain-of-custody form, which documents the samples included in the shipment and specifies the laboratory analyses for each sample.

Note - A chain-of-custody form should be totally unique to a single cooler or shipping container. A cooler should only contain samples that are listed on the chain-of-custody form inside that cooler, and the chain-of-custody form should not list any samples that are not in that particular cooler. For large sample efforts requiring samples be shipped in two or more coolers, DO NOT fill out a single chain-of-custody form for the entire set of samples and place multiple copies of the same form in multiple coolers. Place only one chain-of-custody in one of the coolers.

4. Close and seal the cooler using strapping tape.
5. Place completed sample custody seals on the cooler such that the seals will be broken when the cooler is opened. The custody seal must contain, at minimum, the signature of the person relinquishing custody of the samples and the date the cooler is sealed. Secure the custody seals on the cooler with clear strapping tape.
6. Secure the shipping label with address, phone number, and return address clearly visible.

SHIPPING HAZARDOUS MATERIALS/WASTE

Hazardous materials need to be shipped using procedures specified under Federal Law. Samples need to be shipped in Ziploc bags or paint cans filled with packing material, depending on the level of hazard. Special package labeling may be needed. Consult the project manager for specific shipping procedures.

Water & Environmental TECHNOLOGIES

SOP-5

FIELD MEASUREMENT OF GROUNDWATER LEVELS/LIGHT NON-AQUEOUS PHASE LIQUID LEVELS

INTRODUCTION

In general, groundwater levels [and Light Non-Aqueous Phase (LNAPL) levels, if applicable] in wells will be measured prior to commencing development, purging, sampling, pumping tests, or other activities that disturb the fluid pressure relationships in the well. Measurements may be taken during such events for purposes other than determining static conditions and may also be taken to determine static conditions after such activities if an appropriate period of time has elapsed to allow steady-state conditions to return.

EQUIPMENT

- Electronic water level monitoring probe (for water levels only)
- Electronic multi-phase interface monitoring probe (for measuring water levels and LNAPL levels)
- Keys for well locks
- Tools to open well covers (e.g., socket wrench, spanner wrench, etc.)
- Watch or stopwatch
- Pens and field logbook or other appropriate field forms (e.g., groundwater purge and sample forms)
- Monitoring well construction data (for total depth and screen intervals of well)
- Personnel and equipment decontamination supplies (refer to SOP-2)

PROCEDURES

1. If more than one well will be measured, conduct measurements in the order of lowest to highest chemical concentrations previously detected in samples from the monitoring wells.
2. Allow the well to equilibrate by removing the protective cap and leaving the well open for a period before beginning taking measurements. Generally, removing all site well caps prior to collecting the first liquid level measurement provides sufficient time to reach equilibrium.
3. Examine the monitoring well for any structural damage, poorly fitting caps, and leaks into the inner casing. Record all well maintenance issues on the appropriate field sampling form or field log book.
4. If LNAPL is not present, use a pre-cleaned water level probe or equivalent to measure depth to water from the indicated survey mark on the well casing. If a mark is not present, measure from the top of the northern side of the well casing.
5. If LNAPL may be present, use a pre-cleaned, electric, multi-phase interface probe to measure the depth of the LNAPL and depth to water. Record both measurements on the sampling form or field logbook. Unless otherwise instructed, always measure depths to LNAPL layer and groundwater from the indicated survey mark. If a mark is not present, measure from the top of the northern side of the well casing.

6. Repeat measurements at least once by lifting the probe tape at least one foot out of the well allowing the measurer to confirm the accurate foot, tenth-of-a-foot, and hundredth-of-a-foot mark on the tape.
7. Follow personnel and equipment decontamination procedures outlined in SOP-2.

Water & Environmental TECHNOLOGIES

SOP-6

MEASUREMENT OF FIELD PARAMETERS: pH, DISSOLVED OXYGEN, SPECIFIC CONDUCTANCE, TURBIDITY, OXIDATION RE DUCTION POTENTIAL, AND TEMPERATURE

INTRODUCTION

This guideline describes the procedures typically used to measure the pH, dissolved oxygen, specific conductance, turbidity, oxidation reduction potential (ORP, also referred to as redox potential), and temperature of ground- or surface water.

EQUIPMENT

- Multi-parameter water quality meter
- Flow-through cell or plastic cup
- Transport/calibration cup
- Probe sensor guard
- Operations manual
- Spare batteries
- Standard conductivity calibration solutions [447, 1413, 2074, 8974 microSiemens per centi meter (µS/cm)]
- pH buffers (4.00, 7.00, 10.00)
- ORP calibration solution
- Pens, field logbook, and/or appropriate field forms (e.g., groundwater purge and sample form)
- Personnel and equipment decontamination supplies

PROCEDURES

Calibrate multi-parameter water quality meter at the office prior to commencement of field activities to check instrument is in proper working order. At a minimum, calibrate before use each day (or more frequently as necessary) as indicated below. The initial daily calibration may be performed at the office (if located in proximity to the site), motel, or in the field.

1. Press the On/Off Key. Check the battery charge indicator located at the bottom of the liquid crystal display (LCD) screen. Replace batteries if the battery charge indicator is low.
2. Calibrate the meter according to the manufacturer's instructions. Note: The meter must be calibrated for each field parameter in accordance with the instructions in the operations manual at the beginning of each sampling day. Additional calibrations may be performed during the day if deemed necessary.
3. Connect the probe sensor to the flow-through cell. If the flow cell is not used, make sure the probe sensor guard is installed.
4. Begin passing water into the flow-through cell. If the flow-through cell is not used, place the probe module into a sample of the water or directly into the body of water being evaluated. Be sure to completely immerse all sensors into the water.
5. Provide a constant flow of fresh water across the probe module to actuate readings.
6. Observe the meter's LCD display and record the values on the groundwater purge and sample form or field logbook.

7. Remove the probe from the water and rinse (soak) with distilled water.
8. Place the probe sensor in the transport/calibration cup with 1/2 inch of potable water for short-term storage. The transport/calibration cup should be sealed to prevent evaporation.

Water & Environmental TECHNOLOGIES

SOP-08B

GROUNDWATER SAMPLING—LOW FLOW METHOD

INTRODUCTION

These instructions are in general accordance with the United States Environmental Protection Agency (EPA) Region One Low-Stress (Low-Flow) Standard Operating Procedure (September 2017) and are applicable for using a peristaltic or bladder pump with the pump's intake placed at the midpoint of a 10 foot or less well screen or an open interval. Field instruments are already calibrated. The equipment is set up according to the diagram at the end of these instructions.

SUPPLIES

Documentation Items

- Field sampling forms or field tablet with appropriate electronic sampling forms
- Pens and indelible markers

Sampling Items

- Sample bottle(s)
- Preservative(s)
- Coolers for sample bottle(s)
- Ice for cooler(s)
- Filter(s) (if required)

Equipment/Instrumentation

- Water level or interface meter
- Pump (peristaltic or bladder)
- Pump controller with built-in compressor
- Tubing
- Appropriately sized t-splitter
- Multi-parameter meter (temperature, dissolved oxygen [DO], specific conductance [SC], pH, oxidation/reduction potential [ORP]) with flow through cell
- Turbidity meter
- Graduated container

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

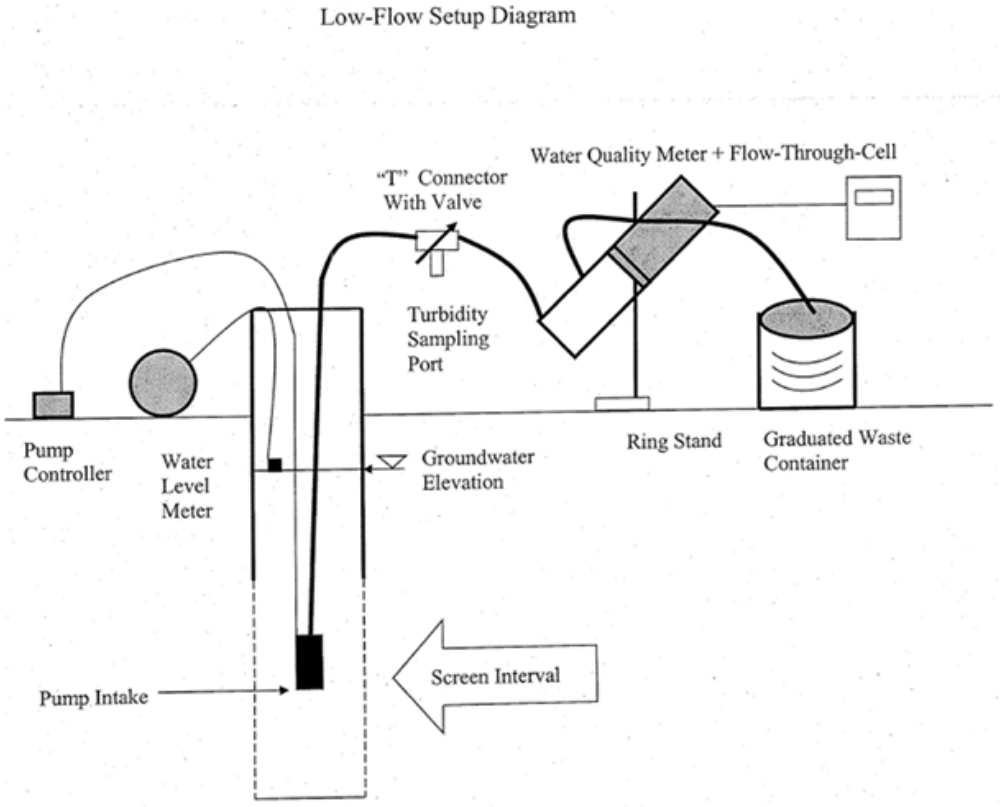
GENERAL PROCEDURES—PURGING

1. Review well installation information. Record well depth, length of screen or open interval, and depth to top of the well screen. Determine the pump's intake depth (e.g., mid-point of saturated screen /open interval).
2. On the day of sampling, check security of the well casing, perform any safety checks needed for the site, and set up the equipment.
3. Check well casing for a reference mark. If missing, make a reference mark. Measure the water level (initial) to 0.01 ft. and record this information.
4. Measure product level, if present, and water level and record this information on the field sampling form. The water level or interface meter will have to be removed from the well to install the pump, but then lowered back down the well after the pump is installed to monitor water level during the purge.
5. Install the pump's intake to the appropriate depth (e.g., midpoint) of the saturated well screen, which is often the midpoint of the screen interval for fully submerged well screens, or at the midpoint of the portion of screen penetrating the saturated zone for well screens straddling the water table. The pump should be installed slowly to minimize disturbance to the water column.
   a. attach the pump discharge line to the t-splitter.
   b. Attach tubing between the other side of the t-splitter to the lower stem of the multi-parameter meter flow through cell. Tubing lengths should be kept as short as possible to minimize heating of the groundwater. Heat may cause the groundwater to degas and adversely affect data quality.
   c. Attach tubing to the lower part of the t-splitter and either a valve end or a clamp on the end of the tubing for the collection of turbidity readings prior to entry to the flow through cell.
   d. Attach tubing from the upper stem of the multi-parameter meter flow through cell and direct it to a purge tank or pervious ground in accordance with the site sampling and analysis plan or DEQ's Disposal of Untreated Purge Water from Monitoring Wells flow chart (if applicable).
6. Start the pump at a low rate and slowly increase the flow rate until the water level begins to drop. Flow rate should not exceed milliliters per minute (mL/min).
   a. Slow the rate if drawdown occurs until water level stabilizes. Water levels should not drop below 0.3 feet of the initial water level.
   b. If the rate cannot be reduced enough to avoid excess drawdown (>0.3 ft), pump at the lowest achievable rate and record on the sampling form. If the water level stabilizes after exceeding 0.3 ft, calculate the volume of water between the initial water level and the stabilized water level and purge at least that amount of water before collecting a sample.
   c. If the well runs dry or the water level gets to a point where the pump can no longer produce water, then a bailer can be used. Collect sample for containers in order of priority, and if enough water is left in the well, collect a sample for the multi-parameter storage cup for a single set of parameters.
   d. Once the water level is stable, record the pump settings and purge rate using a graduated container and a timing device.
7. After starting the pump, turn on the multi-parameter and turbidity meters and take readings every three to five minutes. Three consecutive readings must be within stabilization criteria before collecting a sample. Stabilization criteria may be set by the specific project, but otherwise, use the stabilization criteria defined in Table 1 below.

Table 1. Stabilization Criteria

Parameter	Unit	Stabilization Criteria	Exception
Dissolved Oxygen (DO)	milligrams per liter (mg/L)	±10%	<0.50 mg/L
Oxidation/Reduction Potential (ORP)	millivolts (mV)	±10 mV	
pH	standard units (s.u.)	±0.1 s.u.	
Specific Conductance (SC)	microsiemens per centimeter (µS/cm)	±3%	
Turbidity	nephelometric turbidity units (NTU)	±10%	<5 NTU

8. Once criteria are met to collect a sample, turn off the multi-parameter and turbidity meters and disconnect the pump discharge tubing from the t-splitter and begin collecting water in the sample containers in order of priority. Collect, preserve, close, and store samples as soon as possible and according to the analytical method(s).
   Note: For sites requiring capture of all purge water, make sure sample collection takes place over a containerized area (sampling tote or bucket) so that spills are captured.
   a. If collecting samples for organic compounds, including petroleum hydrocarbons, ensure that all engines (vehicles, generators, etc.) operate 30 feet downwind of the sampling area. Engines will be shut down prior to opening sample collection containers. During sample collection, pumps and meters should be powered using the vehicle battery or a portable battery.
   b. Volatile organic compound samples and dissolved gas samples should be collected first, followed by semi-volatile organic compounds, then inorganic parameters, or as required by the sampling and analysis plan.
9. Once samples are collected, acquire a final depth-to-water measurement, and turn off the pump. Record the total purged volume by calculating the time from pump start to stop with the purge rate. Remove the pump from the well and decontaminate the sampling equipment.



Water & Environmental TECHNOLOGIES

SOP-9B

SOIL, SEDIMENT, AND ROCK SAMPLING

SUBSURFACE SOIL SAMPLING – Borehole and Excavation

The purpose of this section is to provide procedures which may be employed in a subsurface sampling program to obtain samples of materials that are: (1) representative of subsurface conditions at the site, (2) appropriate to the types of analyses to be performed, and (3) cost effective toward meeting goals of the project. Sampling may consist of either a general survey or detailed exploration and may often encompass both. A general survey is designed to obtain preliminary information about subsurface conditions such as depth to rock and soil classification.

Borehole Sampling

Equipment

- Drill rig and associated drilling and sampling equipment as specified in project specific work plans.
  -Hollow stem auger
  -Air-rotary casing hammer
  -Dual tube percussion hammer
  -Sonic
  -Cable tool
  -Mud rotary
  -Reverse rotary
  -Direct push technology
- Continuous-core barrels.
- Split-spoon drive sampler.
- Large capacity stainless steel borehole bailer.
- Photoionization detector (PID) or flame ionization detector (FID).
- Sample containers (laboratory-supplied).
- Sample labels, pens, and field logbook or appropriate field forms (e.g., boring and well con struction logs).
- Personnel and equipment decontamination supplies.
- Sample shipping and packaging supplies.

Procedures

1. Obtain applicable drilling and well construction permits prior to mobilization.
2. Mark boring locations specified in the project-specific sampling and analysis plans (SAPs). Sampling locations may need to be relocated based on presence of underground utilities (see Procedure 3). Invasive activities may not begin until utility marking is complete or notification from the utility company has been received that marking is unnecessary.

Procedures

1. Identify and mark the test pit location(s). Invasive activities may not begin until utility marking is complete or notification from the utility company has been received that marking is unnecessary.
2. Identify overhead obstructions and underground utilities that may interfere with the backhoe excavation.
3. Clear test pit locations for underground utilities and structures by notifying Montana's one-call notification center (1-800-424-5555) (required) at least 2 but not more than 10 business days prior to commencement of field activities. In addition, contact knowledgeable site operations personnel and use a private utility locator service (if necessary) to identify possible underground utilities.
4. Excavate the test pit to the desired depth and length using the backhoe. Excavator bucket will be decontaminated between test pit locations by either brushing off residual soil and/or steam cleaning. Actual sampling depths and locations will vary from test pit to test pit, as described in the project-specific sampling and analysis plans (SAPs). Collect the sample by either driving a split-spoon sampler into the unearthed material, driving a brass or stainless-steel liner with a rubber mallet into the material, or collecting a representative sample using a stainless steel or plastic scoop. In any case, collect the sample in a way that will minimize headspace in the sample container. Where possible and practicable, subsurface soil samples will be collected from the test pit sidewalls and/or excavation floor using a hand auger or similar device without entering the excavation. If attempts to retrieve a sample using a hand auger or similar device fail, then a sample may be collected from the excavator bucket.

NOTE: Field personnel will not enter a test pit unless a detailed hazard assessment has been conducted and adequate safety equipment is used during excavation.

5. Record the physical and lithologic conditions of the test pit and sampling location within the test pit in the field logbook or other appropriate field forms (i.e., test pit log).
6. If no visible indications of contamination are present, backfill the excavation with the material removed or backfill and compact with imported clean fill. If visible indications of contamination are present, cover or otherwise secure the test pit pending decisions from Project Manager regarding appropriate backfilling procedures. Contaminated soil from an excavation will be placed on an appropriate liner, bermed, and covered with an impermeable cover pending decisions from the Project Manager regarding appropriate sampling/handling/disposal.

Water & Environmental TECHNOLOGIES

SOP-10

MONITORING WELL CONSTRUCTION

INTRODUCTION

This guideline describes procedures to construct and develop monitoring wells. Monitoring well construction will be consistent with applicable state and local requirements, such as Administrative Rules of Montana—Montana Board of Water Well Contractors guidance (ARM 36.21.801 to 809) for work in Montana.

Monitoring wells will be constructed using a contractor licensed in the state in which the work is being conducted, such as a licensed monitoring well constructor as defined by Montana Code Annotated (MCA 85-2-516) for work in Montana.

EQUIPMENT

- Drill rig
- Schedule 40 polyvinyl chloride (PVC) blank casing
- Schedule 40 PVC slotted casing, of appropriate slot size
- Schedule 40 PVC threaded and slip caps
- Schedule 40 stainless steel blank casing
- Schedule 40 stainless steel, wire-wrapped casing, of appropriate slot size
- Stainless steel threaded and slip caps
- Stainless steel well centralizers (for deep wells)
- Mild steel isolation casing with welded centralizers
- Locking standpipes
- Ground-level, traffic-rated, watertight well housing enclosure
- Locking expansion plugs
- Combination or key lock
- Filter pack sand
- Type I or II Portland cement
- Concrete
- Bentonite powder
- Bentonite pellets or chips
- Personnel and equipment decontamination supplies
- Personal protective equipment as specified in the Site-Specific Health and Safety Plan (HASP)

PROCEDURES

1. Arrive on-site with the appropriate drilling equipment and materials for site conditions. The driller shall properly decontaminate all drilling equipment and materials prior to arrival on-site. Decontamination usually includes steam or hot water cleaning methods.
2. Drilling muds or drilling solutions of any kind are not to be used during drilling activities in conjunction with monitoring well construction. Acceptable drilling techniques include air-rotary, cable tool, roto sonic, and hollow-stem auger. If unconsolidated material is encountered, it may be necessary to drive steel casing during drilling to maintain borehole integrity.
3. Hydraulic jacks or the drill rig can be used to pull back the steel casing following emplacement of plastic casing.
4. A detailed lithologic log shall be completed during drilling activities. Water bearing characteristics of the formations should also be denoted on the log. In addition, details of monitoring well construction should also be described on the well log including total depth, perforated interval, sizes and types of construction materials, etc.
5. After completing a boring, verify the monitoring well screen and blank casing specifications stated in the task-specific work plans (if applicable). Assemble and install the monitoring well
6. screen and blank casing through the center of the hollow stem auger, drive casing, or open boring. The assemblage typically consists of a slotted section of threaded Schedule 40 PVC or stainless-steel wire-wrapped screen with a threaded bottom cap and a threaded blank
7. section of well casing long enough to reach the ground surface (or higher if a standpipe monument is used). Affix a slip cap or watertight expansion plug to the top of the casing during
8. installation to prevent debris from entering the well. Typically, the casing string is held in tension and supported with a wire line while it is being lowered into the boring and, if possible, while the drilling string is being removed.
9. If appropriate based on formation characteristics, place clean, appropriately sized, commercial sand (filter pack) around and to 2 or 3 feet (as specified in the task specific work plans)
10. above the slotted section of the monitoring well casing. If pre packed screens are used, it may not be necessary to place extra sand above the pre-packed screened casing.
11. However, this step may still be appropriate to prevent well-seal materials from entering the filter-pack. Carefully pour the filter pack through the drill string annular space as the auger or temporary casing is removed from the boring. If possible, use a measuring device to observe the height of the sand column and monitor for bridging of the material.
12. Place a 2- to 3-foot-thick bentonite seal above the sand or natural filter-pack while the auger and conductor casing is removed from the boring. If required in the well construction permit, notify the appropriate inspector before placing the well seal.
13. Fill the remainder of the annulus between the well casing and the borehole wall with bentonite chips, cement/bentonite grout (with approximately 5 percent bentonite), or a high-solids bentonite slurry (typically 11 to 13 pounds per gallon), to a depth of approximately 1 foot bgs.
14. If the water level is higher than the seal, use a tremie pipe to place the grout/slurry. In sand and gravel formations, a minimum of 10 feet of surface seal shall be used unless the zone of monitoring is higher.
15. Install a protective well monument over the casing.
    a. For a flush-mounted monument, cut off the blank well casing so that it is approximately 4 inches below the ground surface (unless otherwise specified by local requirements). Install a threaded cap or a locking, watertight, expansion plug on the monitoring well. Cover the casing opening and pour rapid-setting cement into the upper foot of the boring around the casing. Set a traffic-rated, pre-cast concrete or steel, well enclosure with a watertight rubber seal into the cement (to approximately 1 foot bgs), with the upper rim of the monument extending approximately 1 inch above grade (unless otherwise specified by local requirements). Construct a concrete apron around the monument to

direct precipitation runoff away from the well.

b. For aboveground completion, extend the well casing to a sufficient height above the ground surface (2 to 2.5 feet) (unless otherwise specified by local requirements). Pour cement into the upper 1 foot of the well boring and install a 5 to 6-foot-long, locking, steel well housing in the cement around the well casing so that the monument extends approximately 2 to 3 feet bgs. Construct a circular or square concrete pad (approximately 4 square feet) around the monument and extending approximately 4 inches above grade. Install at least 3 traffic bollards (at least 3-inches in diameter around the well monument pad in a triangular array, if the well is located in an area where vehicular traffic may reasonably be expected. Install a threaded cap or a locking, watertight, expansion plug on the monitoring well and a padlock on the monument lid hasp.

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

Water & Environmental TECHNOLOGIES

SOP-12

PROCEDURES FOR FIELD SCREENING USING A PHOTOIONIZATION DETECTOR

This guideline describes the procedures typically followed during operation of a photoionization detector (PID).

EQUIPMENT

- RAE Systems model Plus, Classic, or equivalent
- Calibration gas with regulator and tubing
- Locking storage bags or pint plastic jars with aluminum foil covering
- Toolkit
- Operations manual
- Spare batteries
- PPE including gloves
- Pens, field logbook, and/or appropriate field forms

PROCEDURES

Calibrate PID at the office prior to commencement of field activities to check instrument is in proper working order. At a minimum, calibrate before use each day (or more frequently as necessary) as indicated below. The initial daily calibration may be performed at the office (if located in proximity to the site), motel, or in the field. Calibration checks must also be completed at the end of each sampling day.

1. Check the battery charge level. If in doubt, charge the battery as described in the manual. The battery should typically be recharged daily after use.
2. Turn unit on. Do not look into the sensor (ultraviolet radiation hazard)—the probe or pump should make an audible sound (whine or solid tone) confirming operation.
3. Perform zero and calibration procedures as described in the operating manual. Calibration can be performed for specific compounds so that the instrument response is proportional to calibration gas concentration. If typical isobutylene calibrant is utilized; the instrument manual provides response factors for other compounds.

Note: Verify that the ionizing lamp in the PID is suitable for the compounds being evaluated. Consult the table below, or the operator's manual for ionization potentials and response factors for common compounds. A PID is not suitable for detecting methane. The instrument should be calibrated under ambient conditions to account for temperature and humidity. Use instrument manufacturer designed moisture trap on probe when testing saturated soil or water samples.

4. Once calibrated, the unit is ready for use. Place a filter on the intake before use! Position the filtered intake assembly close to the area in question because the sampling rate allows only for localized readings.
5. A slow, sweeping motion of the intake assembly helps to prevent the bypassing of problem areas.

6. Use the heated headspace method below:
   - Place a consistent amount of soil into a sealable plastic bag (i.e., approximately 100 grams of soil).
   - Seal the plastic bag. If environmental conditions are warm/hot (vehicle heater use unneces sary), then set the bag outside to warm up, preferably in the sun. If environmental conditions are cool/cold (vehicle heater use necessary), then set the bag on the windshield vent heater.
   - Wait a consistent amount of time (typically several minutes).
   - Open the bag slightly, insert the intake assembly into bag, and observe the peak reading.

   Note: Static voltage sources, such as power lines, radio transmissions, or transformers, may interfere with measurements. Consult the operating manual for a discussion of necessary considerations.
7. Record the measurements on the field logbook or other appropriate field form.

SPECIAL NOTES

Read the operator's manual thoroughly. As with any field instrument, accurate results depend on the operator being completely familiar with the unit. Be aware that moisture may affect readings. Clean and maintain the instrument and accessories to obtain representative readings.

In the event the instrument must be shipped via a courier service (i.e., UPS, FedEx, etc.) from the office to a field location, ship the instrument (including calibration gas) via ground in accordance with Department of Transportation regulations and courier service requirements.

PID Lamp Selection

Lamp	Description	Typical Compounds Detected
9.8 eV	Most Selective Lamp	Benzene, aromatic compounds, and amines.
I0.6 eV	Standard PID Lamp	All compounds detected by 9.8 eV lamp as well as chlorinated compounds, including vinyl chloride, DCE, TCE, PCE, and chlorobenzene.
11.7 eV	Detects Broadest Range of Analytes	All compounds detected by 10.6 eV lamp as well as methy-lene chloride, carbon tetrachlo-ride, chloroform, and 1,1,1-tri-chloroethane.

Water & Environmental TECHNOLOGIES

SOP-13

MONITORING WELL DEVELOPMENT

EQUIPMENT

- 2- or 4-inch-diameter vented surge block
- Centrifugal surface pump
- Submersible pump (4-inch-diameter wells or larger)
- 55-gallon Department of Transportation (DOT)-approved drums
- Teflon®, stainless steel, or PVC bailer
- Teflon®-coated bailer retrieval wire
- Airlift pump with foot valve and compressor
- Bladder pump (2-inch-diameter wells only)
- Electric water level monitoring probe
- Multi-phase interface monitoring probe
- Multi-parameter water quality meter
- Sample labels, pens, and field logbook or other appropriate field forms (e.g., groundwater well development form)
- Personnel and equipment decontamination supplies
- Personal protective equipment as specified in the Site-Specific Health and Safety Plan (HASP)

PROCEDURES

1. After allowing the well seal and monument to cure for a sufficient period, develop the well unless development will compromise the potential usability of the well or exacerbate turbidity problems. [Note: In general, wells containing light non-aqueous phase liquid (LNAPL) should not be developed.] The purpose of developing a monitoring well is to remove drilling fluids and fines from the borehole/filter pack.
2. Prior to development activities, measure and record the total casing and groundwater depth.
3. If applicable, evaluate the well for the presence of LNAPL.
4. If the depth to water in the monitoring well is less than 25 feet bgs, the well may be developed using a centrifugal surface pump with flexible, discharge tubing. If the depth to water in the well is greater than 25 feet bgs, a submersible impeller or airlift pump (with an oil trap and filter) may be used. In some cases, a well may be developed by hand bailing using either a pre-cleaned stainless steel or PVC bailer.
5. A surge block of appropriate size can be moved up and down inside the screened section of the well casing to create a surging action that hydraulically stresses the filter pack. When an impeller pump is used for development, the pump itself can be moved up and down in the casing to create a surging action.

6. During development of the well, record the following water quality parameters and observations on a groundwater well development form:

    a. Depth to water
    b. Development time and volume
    c. Development (flow) rate
    d. pH, temperature, specific conductance, and turbidity
    e. Other observations, as appropriate (e.g., color, presence of odors, or sheen)

7. Continue developing the well until water quality parameters have stabilized and the turbidity of the discharge water is low.

Note: If fine-grained materials are present, low turbidity may not be achievable. Stop development if the development process is causing an increase in the turbidity of the produced groundwater.

8. Follow personnel and equipment decontamination procedures outlined in SOG-2.

Note: It is customary to wait 1 to 3 days after developing a well before sampling; however, the appropriateness of sampling a well after development should be determined on a case-by-case basis. In general, wells completed in highly transmissive formations can be sampled immediately following development without concern that development will introduce bias into sampling results.

Water & Environmental TECHNOLOGIES

SOP-16

QUALITY CONTROL SAMPLING

INTRODUCTION

Quality Control (QC) samples are submitted along with natural samples to provide supporting laboratory data to validate laboratory results. QC samples are submitted blind except for matrix spikes and trip blanks, 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:

Code	Type	Description
N	Natural Sample	Soil, water, air, or other of interest material from a field site.
SP	Split Sample	A portion of a natural sample collected for independent analysis; used in calculating laboratory precision.
FD	Duplicate Sample	Two samples taken from the same media under similar conditions; also used to calculate precision.
FB	Field Blank	Deionized water collected in sample bottle; used to detect contamination introduced during the sampling process.
RB	Rinsate Blank	Deionized water run through or over decontaminated equipment; used to verify the effectiveness of equipment decontamination procedures.
TB	Trip Blank	Inert material (deionized water or diatomaceous earth) included in sample cooler; sent by the lab, the sample is used to detect any contamination or cross-contamination during handling and transportation.

In general, selected QC samples will be inserted into the sample train within a group of twenty samples. QC samples will be prepared in the field, apart from trip blanks. Trip blanks will be supplied by the laboratory and will accompany each sample cooler containing samples for analysis of volatile organic compounds.

Typical QC sample collection frequencies are presented in the table below. Refer to the project-specific sampling and analysis plan or quality assurance plan for the appropriate QC sample frequency. Each field crew leader will be responsible for all QC samples prepared by that crew.

QC Sample	Purpose	Collection Frequency
Field Duplicate	Measure field precision.	1 per 20 natural samples per media
Rinsate Blanks	Evaluate effectiveness of equipment decontamination and sample handling procedures.	1 per 20 natural samples per media
Field Blank	Assess possible cross-contamination of samples due to ambient conditions during sample collection.	1 per 20 natural samples per media, or 1 per day
Trip Blank	Evaluate sample preservation, packing, shipping, and storage.	1 per cooler containing samples with volatile constituents

Water & Environmental TECHNOLOGIES

SOP-17

MANAGEMENT OF INVESTIGATION-DERIVED WASTE

INTRODUCTION

This SOP describes the management of investigation-derived waste (IDW). The project specific Sampling and Analysis Plan should be referenced for additions or deletions to the methods noted below.

EQUIPMENT

- Department of Transportation (DOT)-approved packaging (typically DOT 17E or 17H drums) or other appropriate containers
- Funnel
- Bushing wrench
- 15/16-inch socket wrench
- Shovel
- Appropriate markers (spray paint, paint pen) and labels
- Plastic sheeting
- Drip pans
- Pallets
- Personal protective equipment as specified in the Site-Specific Health and Safety Plan (HASP)

PROCEDURES

Preparing Containers

1. Place each container on a pallet if it is to be moved with a forklift after it is full.
2. Ensure that packaging materials are compatible with the wastes to be stored in them. Bung-type drums should be used to contain liquids. If a liquid is corrosive, a plastic or polymer drum should be used.
3. Solids should be placed in open-top drums. Liners are placed in the drums if the solid material is corrosive or contains free liquids (other than water). Gaskets are also used on open-top drum lids.

KNOWN OR ASSUMED NON-HAZARDOUS WASTE

1. As waste materials are generated, place them directly into storage containers. Alternatively, depending on quantity, soils may be contained onsite on plastic sheeting and covered pending analytical results. In certain instances, if it is known that the IDW is not hazardous, it can be disposed of onsite (e.g., dispose the purge water on the ground, place soils back into test pits).
2. If the IDW is placed into a container, do not fill storage containers/drums completely. Provide sufficient space so that containers will not be overfull if their contents expand.
3. After filling a storage container/drum, seal it securely. Use a bung wrench or socket wrench, for a bung-type or open-top drum, respectively.
4. Label the container indicating its content, date, and origin/location.
5. If it is known that the IDW is not hazardous, arrange for disposal of the IDW as a solid waste.

6. If no information exists as to determine whether the IDW is hazardous (e.g., records, analytical results, of other knowledge of the IDW properties), the IDW must be profiled to determine disposal options.
7. To profile the waste:
   a. Contact the proposed disposal facility to obtain the type of information the disposal facility will need before accepting the IDW, including necessary analytical data.
   b. If analytical data are needed, collect a sample or samples of the IDW and submit to an analytical laboratory.
   c. Upon receiving the analytical results, arrange for the proper disposal of the IDW.

Note: The disposal facility will rely on you to provide information regarding the types of constituents that may be present in the IDW.

HAZARDOUS WASTES

1. As waste materials are generated, place them directly into storage containers.
2. Do not fill storage containers/drums completely. Provide sufficient space for expansion.
3. After filling a storage container/drum, seal it securely. Use a bung wrench or socket wrench, for abung-type or open-top drum, respectively.
4. Label drums or other packages containing hazardous waste. To comply with marking and labeling requirements, affix a properly filled out yellow hazardous waste marker. Do not mark drums with Water & Environmental Technologies' name. All waste belongs to the client. Include the accumulation start date on the label.
5. During an ongoing investigation, use a paint marker to mark the contents, station number, date, and approximate quantity of material on each drum or other container.
6. Do not mix IDW with one another or with other materials. Do not place items such as Tyvek® suits, gloves, equipment, or trash into drums containing soils or liquids, and do not mix water and soil. Disposable protective clothing, trash, soil, and water materials should be disposed of in separate containers.
7. Place the containers in a secured area equipped with a secondary containment system, if appropriate.
8. While storing the IDW, the substantive standards in 40 Code of Federal Regulation (CFR) Parts 264 and 265 Subparts I and J or State equivalent must be complied with.
9. Dispose the IDW upon completion of the field work or incorporate the IDW into the remedial action upon initiation of the final remedy. If the IDW will be disposed offsite, the IDW will need to be manifested for transportation in accordance with federal or state requirements.

SUPERFUND REQUIREMENTS

Testing and management of IDW originating from within a Superfund area, such as operable of the Butte/Anaconda NPL Sites, must be addressed in Site-Specific SAPs.

REFERENCE

Montana Department of Environmental Quality. (Undated). Technical Guidance Document #10 - Options for Discharge of Hydrocarbon-Contaminated Wastewater. Montana Department of Environmental Quality, Remediation Division, Petroleum Release Section, Helena, Montana.