May 2, 2019

Mr. Stuart McIntosh
Northern Tire Building, LLC
795 Bullhook Drive Southeast
Havre, Montana 59501

Subject: **Corrective Action Plan for Air Sparging and Soil Vapor Extraction**
Former Northern Tire / Sweetheart Bakery
2 Second Street East
Havre, Hill County, Montana
Facility ID 21-00131, Release 3589, Work Plan ID 33751

Dear Mr. McIntosh:

NewFields Companies, LLC (NewFields) presents this plan for Air Sparging (AS), Soil Vapor Extraction (SVE), and groundwater monitoring at the former Northern Tire site in Havre, Montana (**Figures 1** and **2**). This plan was requested by the Montana Department of Environmental Quality (DEQ) in a letter dated January 10, 2019. The purposes of the proposed work are listed below:

- Improve groundwater quality by providing air into groundwater through AS piping installed during previous backfill operations;
- Limit fugitive vapor movement by pulling vapors from SVE piping previously installed at approximately 7.5 feet below ground surface (bgs);
- Determine the northwestern extent of petroleum impacts to groundwater by installing three additional monitoring wells;
- Assess the impacts of AS on groundwater quality in the former excavation area; and
- Perform alternatives analysis for addressing groundwater quality north of the former excavation area.

The plan is organized into Section 1.0 regarding the proposed AS/SVE system, Section 2.0 regarding well installation and groundwater monitoring, Section 3.0 - Reporting, and proposed schedule with cost estimate in Section 4.0.

1.0 Air Sparge and Soil Vapor Extraction (AS/SVE) System

A chronological summary of the proposed AS/SVE installation is provided below, including discussion of existing piping, proposed piping modifications, power supply and placement of a protective shed, installation of equipment in/on the shed, the startup and tuning phase, and one year of proposed monitoring and maintenance. The primary purposes of the proposed AS system are to infuse oxygen into groundwater to increase biodegradation of petroleum compounds in the former excavation area. The primary purposes of the SVE system are to remove organic vapors from the excavation area, and limit the potential movement of petroleum vapors in the subsurface.

1.1 Installation

Summary of Existing AS/SVE Piping

The network of AS and SVE lines shown on **Figure 3** was installed in the excavation area following removal of accessible contaminated soil in 2016. The AS piping consists of micro-perforated air sparge points placed from 10.5 to 12 feet bgs in the shallow groundwater (static water levels approximately 7-10 feet bgs). They are spaced 20 feet apart throughout the northern lobe of the excavation (**Figure 3**). Each sparge point is connected to its own dedicated piping (i.e. piping from the sparge points is not manifolded together) to allow sparging pressures and flows to be optimized on each line. The piping runs terminate in an existing concrete utility vault on the eastern edge of the former excavation. Piping from the 2-inch-diameter sparge points to the vault consists of 1-inch-diameter solid PVC pipe vertically from the top of each sparge point to approximately 7 feet bgs, horizontal 1-inch-diameter solid PVC pipe extending to the eastern sidewall of the excavation, and remaining connections routing the piping up the former excavation sidewall and into the utility vault. The top of the vault is flush with surrounding paving.

The existing SVE piping system consists of 4-inch-diameter factory slotted PVC pipe installed at approximately 7.5 feet bgs (**Figure 3**) and bedded in pea gravel. The pea gravel bedding is within a sand layer that extends from approximately 7 to 12 feet bgs throughout the excavation area. The sand layer is capped by compacted clayey silt from approximately 7 to 1.5 feet bgs. Base course and asphalt are present at the surface. Similar to the AS piping, the SVE piping climbs the former eastern sidewall of the excavation, and is routed north-south in shallow piping along the extreme eastern edge (**Figure 3**). The shallow SVE piping is at approximately 1.5 feet bgs, is manifolded together, and terminates at a standpipe on the eastern wall of the site building. The standpipe is capped by a wind-driven turbine at 10 feet above ground surface. The existing SVE system passively vents organic vapors from the former excavation to the atmosphere.

Proposed Modification of SVE Piping

In order to allow active SVE from a central enclosure/shed, the following modifications are proposed to existing SVE lines, as shown on **Figure 4**:

- Excavate to expose the southern and central tees on the shallow SVE piping;
- Cut out each tee;

- Cap the pipe running southward toward the site building and wind-driven turbine;
- Replace the southern tee with a 90° elbow, which will route line C northward toward the proposed shed area; and
- At the former location of the northern tee, add 90° elbows and short standpipes on each SVE line, routing the pipes up out of the ground.

Following these modifications, all AS and SVE lines will terminate under the proposed shed footprint.

Installation of Equipment Shed and Power Supply

NewFields proposes to work with Project Level Control to install the AS/SVE system. Information on the design of the remediation shed and power equipment is provided in **Appendix A**. The shed enclosure will be installed at the location shown on **Figure 4**. The shed footprint will be 8 feet by 10 feet with locking door, exhaust vents, and heater for temperature control. Power supply will be extended from a transformer in the alley south of the site building, and will be connected to a dedicated meter powering only the remediation equipment. Power supply will be installed in a shallow trench running along the eastern boundary of the site, and will terminate on a locked breaker box on the outside of the remediation shed.

Installation of Blowers, Manifolds, Monitoring Ports, and Controls

Equipment for the proposed AS/SVE system is summarized in a letter from Product Level Control provided in **Appendix A**. The proposed AS unit will be a 10 horsepower (hp) rotary vane compressor. Each of the 10 AS lines will be equipped with a solenoid, valve, pressure gauge, check valve, and flow meter. The proposed SVE unit will be a 3 hp unit rated for 120 standard cubic feet per minute (scfm) at a vacuum of 40 inches of water. To reduce noise, the SVE unit will have vibration dampers and a discharge silencer. Other SVE equipment that is part of the system and listed in **Appendix A** includes an inlet filter, bleed/dilution valve with silencer, vacuum relief valve, and vacuum gauge; air-water separator and tank with sight tube and level switch; and a thermometer, monitoring port, and flow meter on the SVE exhaust. Proposed system will be connected to a Programmable Logic Controller mounted on the shed exterior.

To install the system, personnel from NewFields will run all AS and SVE pipes into the shed, and will connect to AS and SVE manifolds, which are pre-assembled by Product Level Control. Pre-assembled AS equipment in the shed will include a bank of AS lines with control and monitoring equipment, the AS compressor, and associated controls, electrical lines, and after-cooler for the compressor motor's exhaust. For the SVE system, pre-assembled equipment will include valves for each line, manifold, blower, exhaust through the building roof with flashing, and drain route for the air-water separator tank. Product Level Control will be responsible for wiring the AS and SVE power supply and control systems, and verifying proper configuration of the assembled AS/SVE equipment.

1.2 System Startup and Tuning

Product Level Control will power up the AS/SVE system and conduct a one-day performance evaluation, including verifying that all equipment cycles correctly. Monitoring data to be collected by Product Level Control during start up and tuning will include organic vapor concentrations in the SVE exhaust, and pressures/flows on each AS line. Product Level Control will adjust on-time for each AS line so that the same volume of air runs through each sparge point daily. During performance evaluation, the initial approach for AS operations will be to operate two lines at once, each similar distance from the compressor (lines 1 and 6, for example). Product Level Control will adjust the on-time for each AS valve to ensure that flow during AS operations is sufficient to cool the compressor, that air is delivered to each sparge point for at least 2 hours per day, and that there is a pause each day to allow the SVE system to capture fugitive vapors.

1.3 Performance Inspections, Monitoring and Maintenance for AS/SVE System

The proposed schedule for system monitoring and maintenance will be weekly for the first month, then quarterly. During each monitoring event, a local technician will record the following information:

- SVE exhaust monitoring data: organic vapor concentration, velocity, and temperature;
- AS sparge lines: pressure and flow on each during operation.

AS/SVE operations will continue for one year, after which groundwater quality and operational data will be evaluated. Proposed project schedule is provided in Section 4.0, and shows that two of the AS/SVE monitoring events will be during mobilization for groundwater monitoring.

2.0 Groundwater Monitoring

2.1 Repair of Existing Monitoring Wells

As described in the November 2018 Groundwater Monitoring and Soil Vapor Sampling Report by NewFields, surface completions for many older wells were compromised. As requested by DEQ in a January 10, 2019 letter, NewFields will retain a well driller and oversee the repairs to the following monitoring wells: MW-1 (replace cover plate), MW-4 (replace cover plate), HS-3 (replace surface completion, because current well box has threaded tabs broken off); and MW-1, MW-50, MW-70, MW-NF2, and MW-NF3 (patch concrete surface seals). Well locations are shown on **Figure 2**.

2.2 Installation of New Groundwater Monitoring Wells

Groundwater monitoring wells will be installed at the proposed locations shown on **Figure 2**. The purpose of the proposed wells will be to delineate the northern and western extent of petroleum groundwater impacts. To both control drilling costs and delineate the plume extent in one mobilization, spacing

between new wells will be approximately 180 to 200 feet. Each proposed well is in the public right-of-way. Prior to drilling, NewFields will obtain encroachment approval from the City of Havre Public Works Department, and will set up traffic safety signs and cones to direct traffic away from working crews.

Boreholes will be advanced using a hollow stem auger drilling rig. Using procedures consistent with SOP-14 (**Appendix B)**, soil samples will be retained for observation purposes on a continuous basis from ground surface to total depth of approximately 20 feet bgs. NewFields personnel will describe the subsurface materials encountered in accordance with the Unified Soil Classification System (USCS) per ASTM D2488-00 (Visual-Manual Procedure). NewFields personnel will screen soil samples using a PID to measure organic vapor concentrations in accordance with SOP-17 (**Appendix B**). Field observations will be recorded on individual boring logs in accordance with SOP-1 (**Appendix B**).

In each borehole, NewFields will retain one soil sample for laboratory analysis at the groundwater interface. NewFields personnel will label the soil samples, package them with ice, and ship them under chain-of-custody to Pace Analytical Services, Inc. (Pace) in Billings, Montana in accordance with SOP-3 and SOP-4 (**Appendix B**). Pace will analyze the soil samples for Volatile Petroleum Hydrocarbons (VPH), Extractable Petroleum Hydrocarbons (EPH) Screen, and lead scavengers including 1,2-dichloroethane (1,2-DCA) and ethylene dibromide (EDB). Should the EPH Screen concentration for any borehole soil sample exceed 200 mg/kg, Pace will perform analysis for EPH fractions.

Monitoring wells will be installed in each of the three new boreholes using procedures consistent with SOP-15 (**Appendix B**). Screened intervals will consist of 0.010 factory slotted PVC from 7 to 20 feet bgs. Filter pack will consist of 10/20 mesh silica sand from the bottom of the borehole to 2 feet above the top of the screened interval (i.e. to 5 feet bgs). An annular bentonite seal will be placed from the top of the sand interval to 1 foot bgs. The wells will be fitted with flush mount surface completions set in concrete from ground surface to 1 foot bgs. The northern edge of Top of Casing for each new well and nearby existing wells MW-NF1 and MW-NF2 will be surveyed by a Montana-licensed Professional Land Surveyor.

Each monitoring well will be developed to remove fines from the well casing and sand pack. Development will be completed in accordance with SOP-18 (**Appendix B**) using a surge block agitated across the entire length of the screen, followed by bailing then pumping groundwater from the well. Well development will continue until purge water is visually clear, or until 10 casing volumes have been purged.

2.3 Groundwater Sampling

Groundwater monitoring is proposed twice: once in fall 2019 during presumed low-water conditions, and once in spring or early summer 2020 during presumed high-water conditions. The first sampling event will include all 15 monitoring wells (excluding MW-30, which is outside the plume area beyond clean well MW-60) (**Figure 2**). To reduce cost, the second groundwater monitoring event will be focused on locations potentially affected by the AS/SVE system, and will be limited to 8 wells near the center of the plume (MW-NF2, MW-NF3, MW-20R, HS-3, MW-1, MW-4, MW-50, and MW-70; **Figure 2**).

Wells will be purged prior to sample collection. Prior to purge, depths to water in all monitoring wells except MW-30 will be measured with a decontaminated probe in accordance with SOP-5 (**Appendix B**). Purging and sampling will be conducted in accordance with the Low Flow section of DEQ's Groundwater Sampling Guidance (**Appendix C**) using a bladder pump. Field parameters measured during purge will include water level, temperature, Specific Conductance (SC), pH, Oxidation-Reduction Potential (ORP), Dissolved Oxygen (DO), and turbidity in accordance with SOP-7, -8, -9, and -10 (**Appendix B**). Purging will continue until the field parameters have stabilized in accordance with the thresholds in SOP-12A (**Appendix B**).

Groundwater samples will be collected into laboratory-provided containers, preserved, and shipped under Chain of Custody protocol to Pace. All groundwater samples will be analyzed for VPH, EPH Screen, lead scavengers including 1,2-DCA and EDB, and Intrinsic Biodegradation Indicators (IBIs) consisting of manganese, ferrous iron, nitrates/nitrites, sulfates, and methane. Should the EPH Screen concentration for any well exceed 1,000 micrograms per liter (µg/L), the sample will be analyzed for petroleum fractions.

2.4 Forensic Evaluation

NewFields will also collect additional sample volume in the first monitoring event from wells HS-3, MW-50, and MW-20R (**Figure 2**) to allow forensic analysis. The samples will be submitted for a comprehensive volatile organic compound (VOC) list using the Paraffin, Isoparaffin, Aromatic, Naphthalene, and Olefin (PIANO) method by Alpha Analytical, Inc. of Westborough, Massachusetts. A geochemist will evaluate PIANO data to determine whether groundwater contamination in these three wells appears to be associated with the same source.

2.5 Management of Investigation Derived Waste

Waste soil and water will be managed in accordance with SOP-25 (**Appendix B**). Soil cuttings measuring less than 100 parts per million (ppm) with the PID will be spread on the ground in the alley south of the site building (**Figure 2**). Soil cuttings measuring above 100 ppm will be hauled to the City-County Unified Disposal Facility located at 7055 Road 451 Southeast in Havre, MT. If purge water from well development or sampling has a sheen or contains free-phase petroleum, it will be containerized and then disposed of in the City of Havre sewer system, under approval of the Public Works Director. Purge water that does not have a sheen or free-phase petroleum will be discharged to the ground surface in the vicinity of the well.

3.0 Reporting

Following receipt of the analytical results from the second groundwater monitoring event, NewFields will prepare a report of findings, including data evaluation components summarized below. Methods of investigation and results of field and laboratory testing will be presented in the report, as well as conclusions and recommendations based on the data. The report will include the following supporting information:

- Figures depicting sampling locations and showing as-built locations for the AS/SVE system;
- Laboratory analytical reports and tabulated summaries of the laboratory data, along with a comparison of the data to applicable screening levels;
- Data validation summaries;
- Memorandum regarding forensic evaluation of laboratory data for PIANO constituents;
- Field notes, sampling forms, and investigation photographs;
- A Remedial Alternatives Analysis (RAA) for remediation of downgradient areas north and northwest of the Site;
- Release Closure Plan (RCP); and
- Proposed schedule for continued operation of the AS/SVE system, if warranted.

4.0 Schedule and Cost Estimate

The anticipated project schedule is below, pending subcontractor availability and DEQ/Petroleum Tank Release Compensation Board (PTRCB) approval turnaround time.

DELIVERABLE/ACTION	APPROXIMATE COMPLETION DATES
CAP & Budget Reviewed by DEQ	May 2019
PTRCB Approval of the Budget	July 2019
Procure, install, and test AS/SVE system components; Well Installation	July/August 2019
Quarterly maintenance of AS/SVE System; groundwater monitoring	October 2019
Quarterly maintenance of AS/SVE System	January 2020
Quarterly maintenance of AS/SVE System; groundwater monitoring	April/May 2020
Quarterly maintenance of AS/SVE System	July 2020
Reporting	August 2019

Estimated costs for the work described above are itemized in **Appendix D**. If you have any questions regarding this CAP, please contact me at (406) 218-2564.

Sincerely,

Wilhelm Welzenbach
Project Scientist

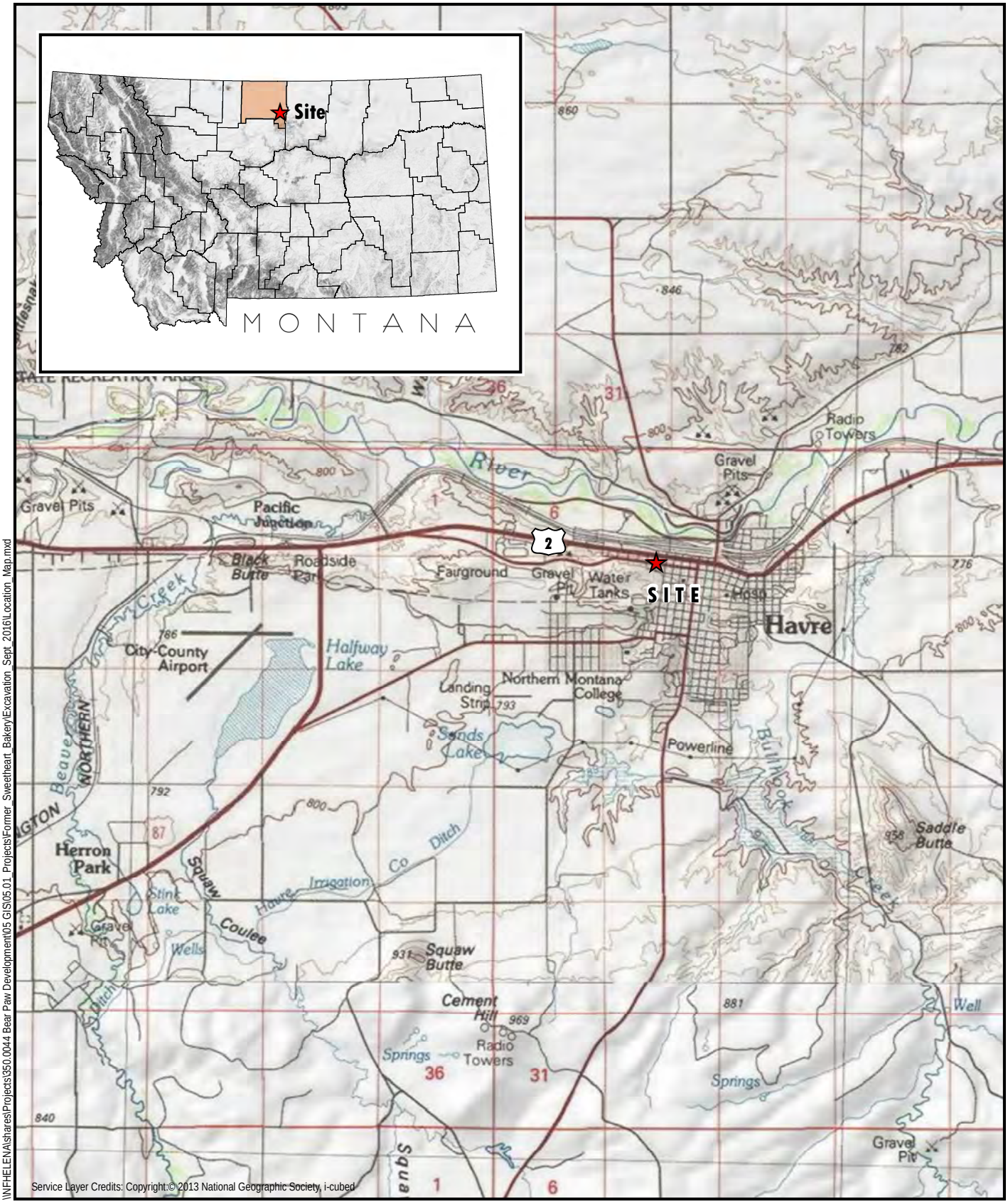
Attachments:

Figure 1 – Location Map
Figure 2 – Proposed Groundwater Sampling Locations
Figure 3 – Existing Air Sparge and SVE Piping
Figure 4 – Proposed Air Sparge and SVE Piping Modifications

Appendix A – Product Level Control, Inc. Quote
Appendix B – Standard Operating Procedures (SOPs)
Appendix C – DEQ Groundwater Sampling Guidance
Appendix D – Cost Estimate

cc: Donnie McCurry – DEQ
Samantha Chagnon – Bear Paw Development Corporation

FIGURES



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NewFields

Location Map
Former Sweetheart Bakery
Havre, Montana
FIGURE 1

P:\BROWNFIELDS\350.0234 Northern Tire Havre\03 GIS & GRAPHICS\Projects\2019 April CAP\FIGURE 2 - Site Map.mxd

N

0 Feet 100

NewFields

Proposed Monitoring Well

Existing Monitoring Well

Limits of Excavation

Site Map
Former Sweetheart Bakery
Havre, Montana
FIGURE 2

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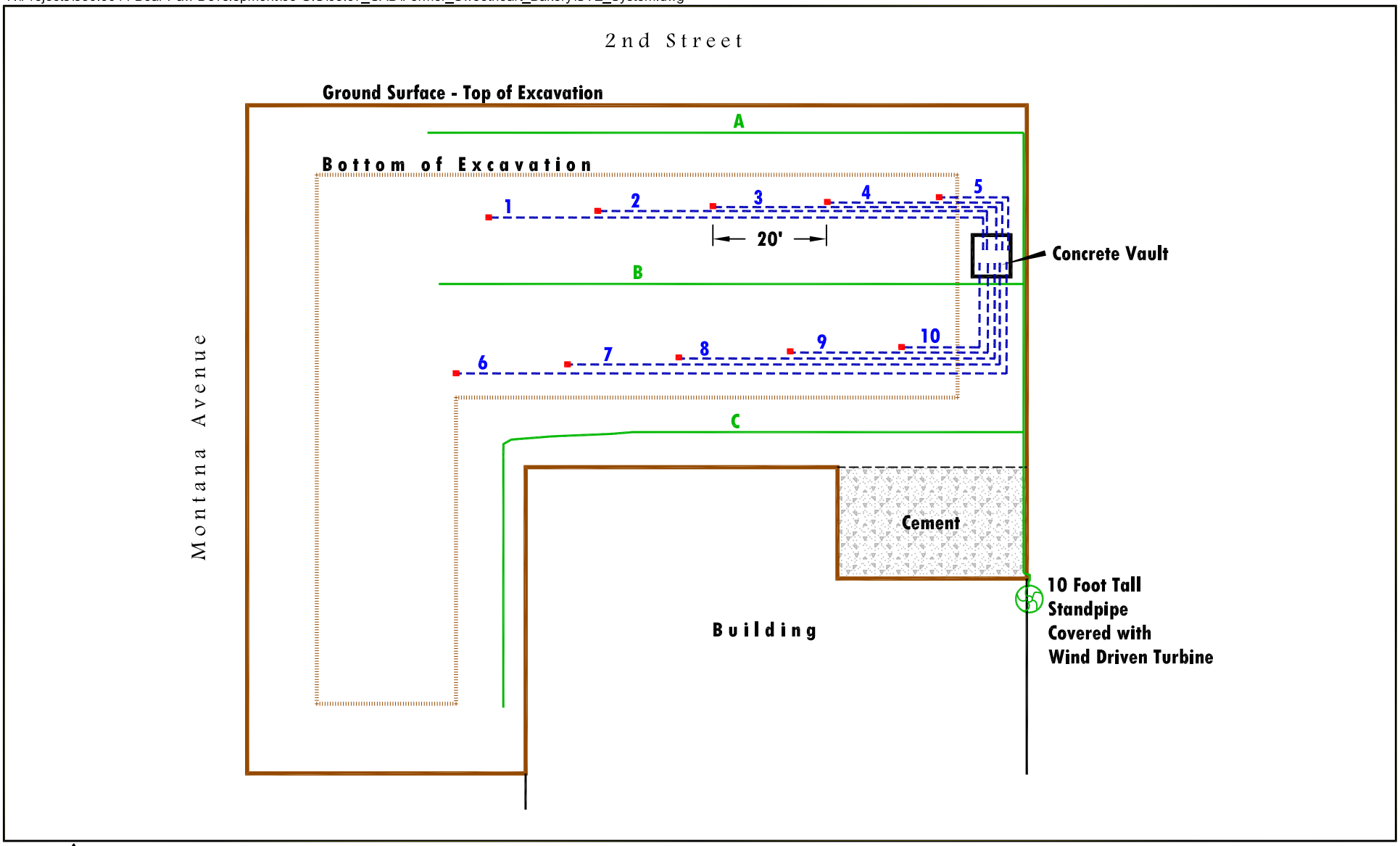

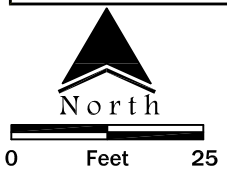

Air-Sparge Lines

SVE Piping

Air Sparge/Bioventing Point

NewFields

Site Map: Air-Sparge and SVE Piping
Former Sweetheart Bakery
Havre, Montana
FIGURE 3

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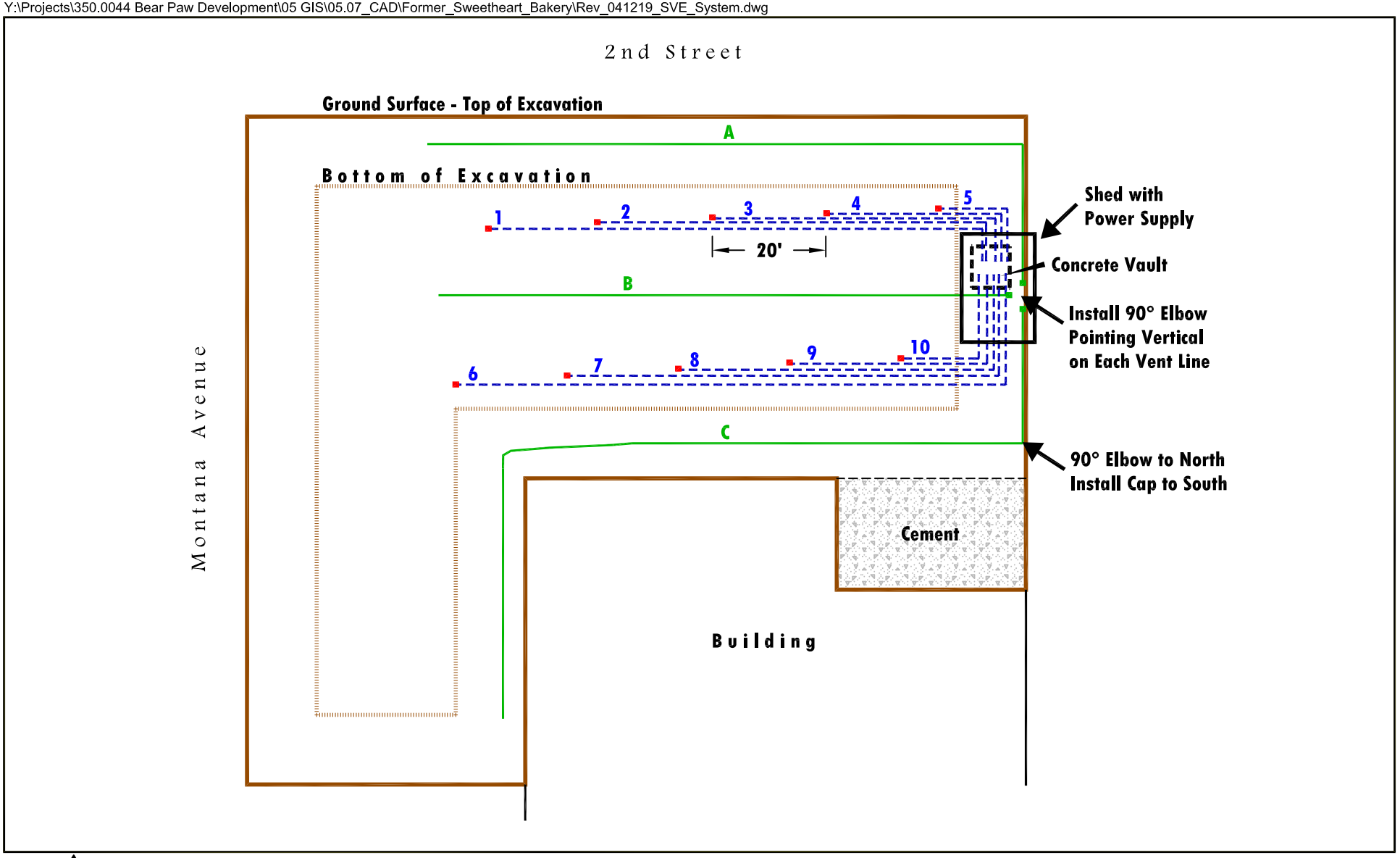

North

0 Feet 25

Air-Sparge Lines

SVE Piping

Air Sparge/Bioventing Point

NewFields

Proposed Air Sparge and SVE Piping Modifications
Former Sweetheart Bakery
Havre, Montana
FIGURE 4

APPENDIX A

PRODUCT LEVEL CONTROL, INC. QUOTE

ENVIRONMENTAL EQUIPMENT & CONTROLS
Product Level Control
11929 Portland Ave. So.
Burnsville, MN 55337
Ph. 952-707-9101
Fax. 952-707-1075
www.productlevel.com

April 17, 2019

Levi McKay
Newfields Mining & Energy
700 SW Higgins Ave STE 15
Missoula, MT 59803

Subject: **SVE/AS System Havre MT, Revised with Startup Services**

Dear Levi:

Thank you for giving Product Level Control the opportunity to submit this equipment quotation to Newfields Mining & Energy. From the specifications provided, I've included a list of your requested equipment, along with a brief description of the item(s) and the associated costs.

As an added advantage of doing business with Product Level Control, our design/build facility allows for one-call accountability, system flexibility and a seamless integration of equipment. I am confident in our ability to provide you with quality systems built specifically for your needs.

If you have any questions or concerns during the consideration of our proposal, please give me a call at 952-707-9101 Ext. 4. I would be happy to assist you any way that I can. I look forward to the opportunity of working with Newfields Mining & Energy.

Sincerely,

Chuck Cernoch
Inside Sales Manager
Product Level Control, Inc

Enclosure(s)

ENVIRONMENTAL EQUIPMENT & CONTROLS
Product Level Control
11929 Portland Ave. So.
Burnsville, MN 55337
Ph. 952-707-9101
Fax. 952-707-1075
www.productlevel.com

QUOTATION

DATE:	April 17, 2019
QUOTATION NUMBER:	190412-CC-NEWFIELDS
SITE REFERENCE:	HAVRE MT
POWER REQUIREMENTS:	BASED ON 460 VOLT 3 PHASE
CLASSIFICATION:	CLASS 1 DIV 2

Equipment Included

> SOIL VAPOR EXTRACTION (SVE) UNIT

		BLOWER 120 SCFM @ 40" WC
1	each	AIRTECH 3BA1530EXP (3HP) 230/460 VOLT 3 PHASE 2" INLET AND DISCHARGE
4	each	Vibration Dampers
		DISCHARGE SILENCER
1	each	SILENCER, ABSORPTIVE TYPE, MINIMAL PRESSURE DROP, REDUCES HIGH FREQUENCY NOISE UP TO 30dBA, LAYERED SOUND ABSORBENT MEDIA, INLET OR DISCHARGE APPLICATION, UP TO 212F, 15 PSIG, 2" MNPT I/O, 18.5" LONG, RATED FOR 460 SCFM, 15 PSIG
		INLET FILTER
1	each	FILTER, AIR, INLINE, 2" FNPT WITH QUICK RELEASE LID-175 ACFM
		BLEED VALVE
1	each	VALVE, GATE, FNPT, 1 1/2", 200 WOG 125 SWP
		BLEED VALVE SILENCER
1	each	FILTER, AIR, INLET SILENCER, DILUTION FILTER SILENCER, 1 1/2" MNPT-85 SCFM
		VACUUM RELIEF VALVE
1	each	2" SPRING LOADED RELIEF VALVE (200-350 SCFM)
		GAUGES
1	each	GAUGE, VACUUM, 0-100" WC 2 1/2" DIAL 1/4" MNPT CBM -20-180°F
		LOW VACUUM TRANSMITTER
1	each	IFM VACUUM TRANSMITTER -14.5 TO 14.5 PSI
1	each	15 FT POWER CORD
1	each	DISCHARGE THERMOMETER, 20-240°F 3" DIAL 2 1/2" STEM 1/2" MNPT CBM
		AIR FLOW METER
1	each	AIR FLOW METER, MAGNEHELIC GAUGE WITH MOUNTING BRACKET AND INLINE AVERAGING PITOT TUBE FLOW DIFFERENTIAL PRESSURE FLOW SENSOR
1	each	3" EXHAUST STACK C/W RAIN CAP

> AIR WATER SEPARATOR

1	each	80 GALLON VESSEL WITH MANUAL DRAIN VALVE, 29" Hg MAX
1	each	DEMISTER ASSEMBLY, TM-1112 MATERIAL W/O GRID COILED CONSTRUCTION 6" X 16"DIAMETER SEG:1, 150-600ACFM
		SIGHT TUBE AND LEVEL SWITCH
1	each	SINGLE LEVEL FLOAT SYSTEM (EACH FLOAT HAS ITS OWN SWITCH THAT CAN BE ADJUSTED) ALL INSIDE A CLEAR PVC SITE TUBE

Proposal prepared for the confidential use and benefit of addressee.
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Burnsville, MN 55337
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SITE REFERENCE:	HAVRE MT
POWER REQUIREMENTS:	BASED ON 460 VOLT 3 PHASE
CLASSIFICATION:	CLASS 1 DIV 2

Equipment Included

> SVE MANIFOLD

		SVE HEADER
1	each	4" PVC SCHEDULE 80 C/W WITH 3 EA 4 " LEGS
3	each	GAUGE, VACUUM, 0-60" WC 2 1/2" DIAL 1/4" MNPT CBM -20-180°F
3	each	1/4" MNPT SPIGOT SAMPLE PORT
3	each	AIR FLOW METER, MAGNEHELIC GAUGE WITH MOUNTING BRACKET AND INLINE AVERAGING PITOT TUBE FLOW DIFFERENTIAL PRESSURE FLOW SENSOR
3	each	4" WAFER BUTTERFLY VALVE CI BODY SS VALVE BLADE
6	each	150 LB PVC FLANGE, GASKETS AND BOLTS

> AIR SPARGE UNIT

		COMPRESSOR 50 CFM AT 20 PSI
1	each	RIETSCHLE DTA 100 ROTARY VANE COMPRESSOR, OIL LESS, CARBON VANES, SUCTION FILTER, AFTERCOOLER, CARBON DUST PRESSURE FILTER, PRESSURE REGULATING VALVE, UP TO 68.3 SCFM AND 21.8 PSIG, INCLUDES MOUNTED 10 HP EXP 3 PHASE 230/460 VAC 1800 RPM 215TC MOTOR
		PRESSURE RELIEF VALVE
		INCLUDED IN COMPRESSOR
		GAUGES
1	each	GAUGE, PRESSURE, 0-30 PSI 2 1/2" DIAL 1/4" MNPT CBM LIQUID FILLED
		HIGH PRESSURE TRANSMITTER
1	each	**IFM MODEL TN2303 C/W DISPLAY**
1	each	15 FT POWER CORD
		HIGH TEMP TRANSMITTER
1	each	**IFM MODEL PN72943 C/W DISPLAY**
1	each	15 FT POWER CORD
		AFTERCOOLER (HE) TO SIT OUTSIDE
1	each	AMERICAN IND MODEL ACA 3182-3 1/4 HP DROP TEMP FROM 155 F TO 120F
		MISC
1	each	PIPING AND HOSE
1	each	SKID
1	each	POWER TERMINATION BOX (FOR HE)

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POWER REQUIREMENTS:	BASED ON 460 VOLT 3 PHASE
CLASSIFICATION:	CLASS 1 DIV 2

Equipment Included

	>	**SPARGE MANIFOLD**
1	each	2" STEEL HEADER C/W 10 EA 1" LEGS
10	each	SOLENOID VALVE, 2 WAY / 2 POSITION, N.C., 120 VAC, 1", 0 PSI CRACKING PRESSURE, 150 PSI MAX AIR, 125 PSI MAX WATER, 180 °F MAX, NON-EXP
10	each	VALVE, GATE, FNPT, 1", 200WOG 125WSP
10	each	GAUGE, PRESSURE, 0-30 PSI 2 1/2" DIAL 1/4" MNPT CBM LIQUID FILLED
10	each	Bronze Swing Check Valve - Class 125, 1" NPT Female, CV FACTOR 31
10	each	ROTAMETER, 0-10 SCFM, WITH METERING VALVE, 1/2" FNPT CONNECTION ON BACK, STAINLESS STEEL VALVE
		ENCLOSURE
1	each	ENCLOSURE, EXTERIOR DIMENSIONS: 8' W X 10' L X 10' H, 2 X 4 X 2' O.C. CONSTRUCTION, SINGLE PITCH STEEL ROOF, ROUGH SAWN T1-11 SIDING, SOLID OIL STAINED SEACOAST GRAY EXTERIOR, R-11 INSULATED, 5/8" FIRE RATED SHEETROCK TAPED ONCE INTERIOR, LESS DOOR, LESS FLOOR
80	sq feet	FLOOR, 8" CHANNEL, C8X11.5 CONSTRUCTION WITH WOOD DECK, PAINTED AND TREATED WITH ANTI-SLIP, LIFTING EYES AND ANCHOR POINTS, UP TO 10' W X 16' L, PER BUILDING FOOTPRINT SQUARE FEET
1	each	DOOR, 36" X 80", PREHUNG FLUSH (NO LIGHT), SINGLE DOOR, STEEL
1	each	DOORKNOB AND DEADBOLT KIT KEYED THE SAME
2	each	EXP LIGHTS
		EXHAUST FAN, VENTS
1	each	24" EXHAUST FAN C/W EXP MOTOR AND LOUVERS
1	each	LINE VOLTAGE HEATING OR COOLING INDUSTRIAL THERMOSTAT, 8' REMOTE BULB, -30 TO +100°F, SPDT, 120-277VAC 22AMPS, NEMA 1
1	each	PASSIVE VENT LD, 24" X 30",
		HEATER
1	each	1800 WATT EXP CONVECTION HEATER, 480V, 3.8AMP, 1PHASE, CLASS 1 GROUP B, C AND D DIVISION 1 AND 2 (T-2A) UL LISTED
1	each	LINE VOLTAGE HEATING OR COOLING INDUSTRIAL THERMOSTAT, 8' REMOTE BULB, -30 TO +100°F, SPDT, 120-277VAC 22AMPS, NEMA 1

Proposal prepared for the confidential use and benefit of addressee.
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Fax. 952-707-1075
www.productlevel.com

QUOTATION

DATE:	April 17, 2019
QUOTATION NUMBER:	190412-CC-NEWFIELDS
SITE REFERENCE:	HAVRE MT
POWER REQUIREMENTS:	BASED ON 460 VOLT 3 PHASE
CLASSIFICATION:	CLASS 1 DIV 2

Equipment Included

	>	**CONTROL SYSTEM**	
		PROGRAMMABLE LOGIC CONTROLLER (MOUNTED OUTSIDE ON END)	
1	each	NEMA 4 ENCLOSURE WITH SWING-OUT PANEL, MOTOR STARTERS, OVERLOAD AND SHORT-CIRCUIT PROTECTION, ILLUMINATED H/O/A SELECTOR SWITCHES, SYSTEM RESET PUSHBUTTON, PANDUIT, WIRES, TERMINALS, AND AUTOMATION DIRECT CONTROLLER. PANEL WILL BE BUILT AND STAMPED FOLLOWING PRODUCT LEVEL CONTROL'S PROCEDURE BY UL FOR UL LISTED INDUSTRIAL CONTROL PANELS.	
4	each	MOTOR STARTERS**(BLOWER, COMPRESSOR, HEAT EXCHANGER, EXHAUST FAN)**	
1	each	FIELD SWITCHES (AWS HIGH LEVEL)	
10	each	SOLENOID VALVES	
3	each	FIELD TRANSMITTERS (4-20 mA INPUT SIGNAL)	
1	each	GFCI	
3	each	HOUR METERS (BLOWER, COMPRESSOR, HEAT EXCHANGER)	
1	each	TRANSFORMER FOR CONTROL POWER ONLY	
1	each	PANEL HEATER	
1	each	HEAVY-DUTY DISCONNECT SWITCH, FUSED, NEMA 3R, 100 AMP, 600V, 3 PHASE, 4 WIRE (USES CLASS R OR H FUSES AS STANDARD, CONVERTS TO J TYPE)	

EQUIPMENT TOTAL	**$54,996**
TAX	**NOT INCLUDED**
FREIGHT	**$2,800**
STARTUP SERVICES (1 – DAY TRAVEL, 2 - DAYS ON SITE)	**$3,600**
TOTAL	**$61,396**

OPTIONS

ABLE TO ADJUST AIR SPARGE SOLENOIDS TIMES AT UNIT OR BY MODEM

REPLACE BASE UNIT WITH UPGRADE LISTED BELOW

		PROGRAMMABLE LOGIC CONTROLLER
1	each	NEMA 4 ENCLOSURE WITH SWING-OUT PANEL, MOTOR STARTERS, OVERLOAD AND SHORT-CIRCUIT PROTECTION, ILLUMINATED H/O/A SELECTOR SWITCHES, SYSTEM RESET PUSHBUTTON, PANDUIT, WIRES, TERMINALS, AND. PANEL WILL BE BUILT AND STAMPED FOLLOWING PRODUCT LEVEL CONTROL'S PROCEDURE BY UL FOR UL LISTED INDUSTRIAL CONTROL PANELS.
1	each	VIEW OPERATOR INTERFACE 10 INCH COLOR DISPLAY
1	each	NETWORK SWITCH

OPTIONS ADDER TOTAL	**$2,610**

Proposal prepared for the confidential use and benefit of addressee.
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ENVIRONMENTAL EQUIPMENT & CONTROLS
Product Level Control
11929 Portland Ave. So.
Burnsville, MN 55337
Ph. 952-707-9101
Fax. 952-707-1075
www.productlevel.com

QUOTATION

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SITE REFERENCE:	HAVRE MT
POWER REQUIREMENTS:	BASED ON 460 VOLT 3 PHASE
CLASSIFICATION:	CLASS 1 DIV 2

Equipment Included

		VIEW FROM COMPUTER OR SMART PHONE)	
		CELL PHONE MODEM	
1	each	CELL PHONE MODEM **(MONTHLY SERVICE NOT INCLUDED)**	
		OPTIONS ADDER TOTAL	**$1,386**

If you have any questions concerning this quotation, please contact Chuck Cernoch at 952-707-9101 Ext. 4, ccernoch@productlevel.com

• • • ASK ABOUT OUR CARBON CHANGEOUT SERVICES • • •

THANK YOU FOR YOUR BUSINESS!

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CLASSIFICATION:	CLASS 1 DIV 2

Terms & Conditions

PAYMENT TERMS

- 30% Down with Purchase Order
- 30% Due Prior to Shipment
- 40% Net 30 from Ship Date

WARRANTY INFORMATION

Product Level Control warrants the equipment manufactured by Product Level Control, and not by others, to be free from defects in workmanship and material under normal use and service for a period of one (1) year from date of delivery. Use or service with corrosive or abrasive chemicals or materials is not deemed normal. Components manufactured by others, including expendable items, are warranted only in accordance with the warranty, if any, issued by such other manufacturer.

SUBSTITUTIONS

Unless a cited product vendor or brand name is specified as “NO EQUAL”, Product Level Control reserves the right to substitute a selection of equal or better quality.

PROPOSAL BASIS

This proposal is based on the information provided to Product Level Control as of the date indicated on this proposal. Additional specifications will require a change order. Product Level Control will only be supplying the equipment as listed in the above quotation.

Proposal prepared for the confidential use and benefit of addressee.
Product Level Control©2004

APPENDIX B

STANDARD OPERATING PROCEDURES (SOPS)

STANDARD OPERATING PROCEDURES TABLE OF CONTENTS	
SOP	**TITLE**
1	Field Records and Field Sampling Forms
3	Sample Nomenclature, Documentation, and Chain-of-Custody Procedures
4	Sample Packaging and Shipping
5	Field Measurement of Groundwater Level
7	Field Measurement of Electric or Specific Conductance
8	Field Measurement of pH
9	Field Measurement of Dissolved Oxygen
10	Field Measurement of Oxidation Reduction Potential (ORP)
12A	Low Flow Groundwater Sampling
14	Subsurface Soil Sampling
15	Monitoring Well Construction
17	Field Screening of VOCs in Soil
18	Monitoring Well Development
25	Management of Investigative-Derived Waste

SOP-1

FIELD RECORDS AND FIELD SAMPLING FORMS

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

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

Purpose

Provide guidance on how to document activities completed in the field

Goal and Objective

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

Equipment Needs

Indelible Ink Pen
Field Log Book
Field Sampling Forms
Field Tablet

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

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

All entries on the daily field log and field sampling forms must be made in indelible ink (if using paper), or entered into field tablets and backed up promptly when service is available. Upon completion of the field effort, the original log book and field forms shall be scanned and maintained in the project file. Electronic forms will be backed up in multiple locations and saved into project folder. Photocopies of original field forms can be used as working documents.

SOP-3

SAMPLE NOMENCLATURE, DOCUMENTATION, AND CHAIN-OF-CUSTODY PROCEDURES

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

Purpose

Identify specific requirements for labeling and documenting sample collection

Goal and Objective

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

Equipment Needs

Indelible Ink Pen

Chain-of-Custody Forms

Field Log Book

Field Sampling Forms

SAMPLE NOMENCLATURE

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

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

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

SAMPLE DOCUMENTATION

In addition to the chain-of-custody forms discussed below, field personnel must keep a list of samples collected at the field in the field log book and on appropriate field sampling forms (see SOP-1). This allows you to go back and verify sample locations and numbers should there be any confusion at a later time. Upon returning to the office, the field log book and forms should be scanned and maintained in the project file, and subsequent copies sent to the laboratory, or other designated parties, as needed.

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

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

CHAIN-OF-CUSTODY PROCEDURES

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

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

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

- Comments or special instructions to the laboratory

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

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

SOP-4

SAMPLE PACKAGING AND SHIPPING

SAMPLE PACKAGING

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

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

Purpose

Ensure samples are properly packaged for shipment to the analytical laboratory

Goal and Objective

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

Equipment Needs

Indelible Ink Pen

Chain-of-Custody Forms

Custody Seals

Sample Labels from Lab

Coolers and Ice

Strapping Tape

Field Sampling Forms

Ziploc Bags

SHIPPING HAZARDOUS MATERIALS/WASTE

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

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

> Class 1: explosives; Class 2: gases-compressed, liquefied, dissolved under pressure, or deeply refrigerated; Class 3: flammable liquids; Class 4: substances susceptible to spontaneous combustion; Class 5: oxidizing substances; Class 6: poisonous (toxic and infectious); Class 7: radioactive materials; and/or Class 8: corrosives.

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

SOP-5

FIELD MEASUREMENT OF GROUNDWATER LEVEL

Purpose

Ensure groundwater levels are accurately measured in the field

Goal and Objective

To obtain accurate and precise water level measurements

Equipment Needs

Water Level Indicator

Extra Set of Batteries

Indelible Ink Pen

Field Sampling Form

Field Log Book

Decontamination Supplies

FIELD PROCEDURE

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

SOP-7

FIELD MEASUREMENT OF ELECTRIC CONDUCTIVITY (EC) OR SPECIFIC CONDUCTANCE (SC)

Purpose

To ensure measurement of EC/SC is done consistently and correctly in the field

Goal and Objective

To obtain accurate EC/SC measurements in the field

Equipment Needs

EC/SC Meter

Calibration Standard(s)

Measurement Container

Extra Set of Batteries

Indelible Ink Pen

Field Sampling Form

Deionized/Distilled Water

INSTRUMENT CALIBRATION

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

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

FIELD MEASUREMENT PROCEDURE

Rinse a decontaminated glass container or plastic flow-through cell with sample water. Fill the container or flow-through cell with sample water, with enough available space to insert the EC/SC probe without undesired overflow.

Rinse the EC/SC or multi-parameter probe with deionized or distilled water and place it in the beaker of sample water. Immerse the probe in sample and move it around to displace any air bubbles. Keep the probe tip off of the sides of the beaker. Record the conductivity value from the meter on the field form.

Be sure to recognize the units of the meter reading value (i.e., microsiemens/centimeter (µS/cm), micromhos/centimeter (µmhos/cm), or millisiemens/centimeter (mS/cm)). Record the reading on the field sampling form and field log book. If the reading is being taken in-situ or using a flow-through cell, wait until the reading stabilizes and record it on the sample field form.

Remove the probe from sample and decontaminate probe. Store the probe following the manufacturer's recommendations. Refer to SOP-2 for complete decontamination procedures.

SOP-8

FIELD MEASUREMENT OF PH

Purpose

Provide guidelines for pH measurements in water samples

Goal and Objective

To obtain accurate pH measurements in the field

Equipment Needs

pH Meter

Calibration standards

Glass container or flow-through cell

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

INSTRUMENT CALIBRATION

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

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

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

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

FIELD MEASUREMENT PROCEDURE

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

SOP-9

FIELD MEASUREMENT OF DISSOLVED OXYGEN (DO)

INSTRUMENT CALIBRATION

Before each use, clean and rinse the dissolved oxygen (DO) electrode tip in accordance with decontamination procedures outlined in SOP-2. Verify that the membrane cap has been filled with DO electrolyte in accordance with manufacturers required maintenance schedule.

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

FIELD MEASUREMENT PROCEDURE

Place the probe directly into the stream or well to be measured. If possible, place the probe into a flow-through cell receiving a continuous stream of water from the source being measured. Allow sufficient time for the probe to stabilize to sample temperature and DO concentration. Record the DO value on the field form. Rinse probe with deionized or distilled water when measurement is complete.

If sensor will not calibrate, becomes sluggish or erratic:

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

Purpose

Provide guidelines for dissolved oxygen measurements in water samples

Goal and Objective

To obtain accurate dissolved oxygen measurements in the field

Equipment Needs

Dissolved Oxygen Meter

Deionized/Distilled Water

Calibration Cup

Extra Set of Batteries

Indelible Ink Pen

Field Sampling Form

SOP-10

FIELD MEASUREMENT OF OXIDATION-REDUCTION POTENTIAL (ORP)

Purpose

Provide guidelines for ORP measurements in water samples

Goal and Objective

To obtain accurate ORP measurements in the field

Equipment Needs

ORP Meter

Deionized/Distilled water

Calibration solution with table of temperature adjustment information

Extra set of batteries

Indelible Ink Pen

Field Sampling Form

INSTRUMENT CALIBRATION

The oxidation-reduction potential (ORP) meter should be calibrated prior to each sampling event following the manufacturer's recommendations. If the instrument is a multi-parameter meter, follow the instructions for measurement and calibration of ORP. Use table of temperature adjustment information provided with the instrument instructions.

FIELD MEASUREMENT PROCEDURE

- Decontaminate a clean plastic or glass container with deionized or distilled water.
- Rinse the ORP electrode with deionized or distilled water and then with sample water prior to inserting it into the sample beaker.
- If possible, obtain an in-situ measurement of ORP. If not possible, preferably use a flow-through cell receiving a constant stream of water from the well or sample source material. If obtaining a sample for ORP measurement, minimize agitation of the sample in an effort to limit exposure to oxygen.
- Immerse the ORP electrode in the sample and allow at least one minute for the probe to equilibrate with the water.
- Obtain a reading to the nearest 10 millivolts (mV).
- Record the reading on standardized field form. Note any problems such as erratic or drifting readings.
- Decontaminate the probe in accordance with SOP-2.

SOP-12A

LOW FLOW GROUNDWATER SAMPLING

Prior to initiating groundwater sampling, all equipment should be inspected for damage and repaired/replaced, if necessary. Have on-hand: copies of well logs; sampling and analysis plan or work plan; any previous site sampling information/data; field planning worksheet; and field forms. Check with project manager to be sure you understand what type of pump(s) will be used to purge and sample groundwater. Equipment to be placed down-hole must be decontaminated in accordance with SOP-2.

Begin sampling at the well containing the lowest level of contamination, and sample wells in succession based on increasing contaminant concentrations. If the relative degree of concentrations cannot be determined, wells should be sampled in order of increasing proximity to the suspected source of contamination, preferably from the perimeter towards the center of the site.

A standard field sampling form must be completed for each well to document purging and sampling in accordance with relevant SOPs; individual sampling forms must also be completed for any field quality control samples (e.g., duplicates, rinsate blanks, and field blanks).

WATER LEVEL MEASUREMENT

Before purging each well, record the depth to water from the designated measuring point on the top of the well casing (or the north side of the top of casing if a measuring point is not identified) to the nearest 0.01-foot using an electronic water level meter in accordance with SOP-5. If sampling at a site where there may be free product, wells shall be checked for the presence of free product prior to purging and sampling using an oil-interface probe in accordance with SOP-6. Determine the thickness of free product by subtracting the depth to free product from the depth to water.

Record the following dimensions on the groundwater sampling form: depth to water; total well depth; depth to top of screened interval; depth to bottom of screened interval; depth to top of filter pack interval; and depth to bottom of filter pack interval. Well and filter pack depth information should be referenced from the well log; do not measure total depth of the well prior to purging and sample collection to avoid resuspension of any settled solids which may have accumulated within the casing. Use the following formula to calculate the volume of water present in the well casing (casing volume):

Purpose

Provide guidelines for low flow sampling of groundwater

Goal and Objective

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

Equipment Needs

- 5-gallon Bucket, graduated in gallons
- Purge/Sampling Pump(s)
- Oil-Interface Probe, as necessary
- Water Level Meter
- Meters or Flow-through cell to measure temperature, pH, EC/SC, DO, and ORP.
- Filtering apparatus/pump (if filtering samples)
- Sample Containers
- Preservatives, as required
- Field Planning & Sampling Forms
- Decontamination Supplies
- Tubing for pump (include air-line and water-line for bladder pump)
- Disposable bladders and O-ring kit for bladder pump
- Generator or Power Supply; controller for bladder pumps
- Coolers and Ice
- Stop-watch
- Rope and Bailer (for backup)

$$V = 3.14*(r^2)*d*7.48$$

Where:

V = volume (gallons)

r = well radius (feet)

d = depth of water or saturated thickness in well (feet)

The radius of the filter pack will be used for the well radius (r) for calculating borehole volumes, if required. For example, a 2-inch diameter PVC monitoring well installed in a 6-inch diameter hole with sand filter pack would use a well radius of 3 inches or 0.25 foot.

LOW FLOW PURGING

The goal of low flow purging is to collect water samples that reflect the total mobile organic and inorganic loads transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. During low flow purging, emphasis is placed on minimizing hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations. Low flow purging can be completed using a submersible pump and low flow controller, an air or nitrogen powered bladder pump, or a peristaltic pump where appropriate (e.g., shallow wells; sampling for non-volatile constituents). The specific pumping method shall be chosen based on depth to groundwater, diameter of well, existing well configuration, and contaminant(s) of concern.

Decontaminated or dedicated low flow sampling equipment shall be used for purging and sampling. The pump and disposable tubing should be lowered gently and slowly, and set within the upper third or fourth of the screened interval. If the static water level is below the top of the screen, then the pump shall be lowered to within the upper third or fourth of the water column. In either case, the pump intake will be placed a sufficient distance above the bottom of the well to avoid mobilization of any accumulated sediment.

Purge at a rate of 0.1 to 0.5 liter per minute (Lpm) while monitoring drawdown of the water level in the well using an electronic water level meter every 5 minutes. If drawdown exceeds 0.3 foot (0.1 meter), reduce the purge rate accordingly. Purging rates should, as needed, be reduced to the minimum capabilities of the pump to ensure drawdown of less than 0.3 foot or stabilization of the water level. If the minimal drawdown that can be achieved exceeds 0.3 foot, but remains stable, continue purging until three casing volumes are removed and/or water quality parameters stabilize (see below).

Indicator field parameters (see below) are monitored every 5 minutes during purging in order to determine when sample collection may begin in accordance with the stabilization goals specified in the table below. Indicator field parameters, including pH, Oxidation/Reduction Potential (ORP), Electrical Conductivity (EC) or Specific Conductance (SC), Temperature, and Dissolved Oxygen (DO) should be measured using a flow-through cell. Turbidity should be measured using discharge from a T-valve located upstream of the flow-through cell. Turbidity should not be measured downstream of the flow-through cell because it can entrain suspended solids resulting in inaccurate turbidity readings.

Indicator Parameter	Units	Stabilization Goal	Comment
pH	standard units (s.u.)	+/- 0.1 s.u. between three readings	
Electrical Conductivity (EC) or Specific Conductance (SC)	microsiemens, millisiemens, or micromhos per centimeter (µS/cm, mS/cm or µmhos/cm)	+/- 3% between three consecutive readings	
Oxidation/Reduction Potential (ORP)	millivolts (mV)	+/- 10 mV between three consecutive readings	
Temperature	degrees Celsius (°C)	+/- 3% between three consecutive readings	
Dissolved Oxygen (DO)	milligrams per liter (mg/L)	+/- 10% between three readings or <0.5 mg/L	Considered stable if three DO values are less than 0.5 mg/L
Turbidity	Nephelometric Turbidity Units (NTU)	+/-10% between three readings and <10 NTU	If turbidity is >10 NTU, consider stable if three turbidity values are +/- 10%

Note that the stabilization criteria listed in the table above are goals, and may not be achievable under all situations. Dissolved oxygen and turbidity generally require the longest time to stabilize. A turbidity value of 10 NTU may not be achievable in all monitoring wells. In the event that turbidity stabilizes (+/- 10% between three readings) above 10 NTU, proceed with sample collection and note the suspected reason(s) for the elevated turbidity. Attempt to remedy the elevated turbidity for subsequent sampling events at a given monitoring well or site. Remedies for elevated turbidity may include: well re-development, slightly higher pump placement, slower submersion of the sampling pump and tubing, and/or a reduced purge rate.

If the water level recovery of a low-yield well exceeds 2 hours after purging, a sample shall be extracted as soon as sufficient volume is available in the well. At no time should a monitoring well be pumped dry if the recharge rate results in formation water to cascade down the well screen, causing an accelerated loss of volatiles and possible change in pH.

COLLECTING WATER QUALITY SAMPLES

Label each sample container with project number, sample location, well owner, date, military time (24-hour), sampler's initials, preservative, and analysis required. Wear new disposable latex or nitrile gloves immediately prior to obtaining the sample.

Verify that the appropriate preservatives were added by the analytical laboratory, or should be added by field personnel. If required, add the necessary preservative to the appropriate sample container prior to sample collection (see table below).

Prior to filling the sample container, disconnect the flow-through cell from the pump discharge tubing while the well is still being purged. Water quality samples should never be collected downstream of the flow-through cell because the flow-through cell can entrain suspended sediment and result in a cross-contaminated sample volume with a biased concentration of analytes. Place the pump's discharge tubing directly above the receiving sample container and add the sample volume directly to the bottle, minimizing turbulence as much as possible. For volatile analyses, fill appropriate vials at the rate of about 100 milliliters

per minute (mL/min) (24 seconds to fill a 40 mL vial) or less. Fill each sample vial completely so the water forms a convex meniscus at the top to ensure that no head space exists in the vial after it has been capped. After filling, immediately cap, invert, and gently tap the vial to check for trapped air. If air bubbles are present, un-cap vial, add slightly more sample water and repeat procedure. If air bubbles are still present, discard the vial and fill another sample vial.

If analyzing for dissolved constituents, add field filter (usually 0.45 micron (μm) pore size) to the end of the pump's discharge line, and then fill the appropriate container(s).

Samples should be preserved as described in the table below, unless otherwise specified by the laboratory.

Parameter	Number of Bottles	Container	Preservation	Maximum Holding Time Extraction/ Analysis
VOCs	3	40 mL glass vial	≤6°C & HCL	14 days to analysis
SVOCs	2	1 L glass	≤6°C	7 days / 40 days from extraction to analysis
Metals	1	500 mL plastic	≤6°C & HNO_3	6 months to analysis; mercury 28 days to analysis
Nutrients	1	500 mL plastic	≤6°C & H_2SO_4	Varies – contact laboratory for additional information
Common Ions	1	1 L plastic	≤6°C	7 days / 40 days from extraction to analysis

Note: VOC = volatile organic compound; SVOC = semi-volatile organic compound; mL = milliliter; L = liter; HCL = hydrochloric acid; HNO_3 = nitric acid; H_2SO_4 = sulfuric acid; C = Celsius.

Properly cap and lock the well when sampling is complete. In the field notebook, record any damage to the well, monument, or items related to the well that need attention or repair prior to the next sampling event.

Purge water must be handled in accordance with SOP-25 for management of investigative-derived wastes. Groundwater purged from a well during purging or sampling that has a sheen or contains free product must be containerized in an appropriately labeled 55-gallon drum or tank pending receipt of analytical results. A drum should be dedicated to each well sampled so that analytical results of the groundwater sample can be used to characterize the water in the drum. Groundwater that contains no free product, sheen, or odors may be discharged directly to the ground if approved by the property owner. If groundwater is discharged directly to the ground, attention must be given to avoid direct recharge of shallow groundwater with purge water near the well. Purge water must be discharged downgradient and at an adequate distance from the well to be sampled to avoid mounding and interference with the water table.

Complete the necessary sample handling paperwork (SOP-3), sample handling, packaging, and shipping (SOP-4), and record all pertinent information on field sampling forms and field logbook (SOP-1).

SOP-14

SUBSURFACE SOIL SAMPLING

SUBSURFACE SOIL SAMPLING

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

Hand Auger

- Arrive on-site equipped with stainless-steel auger rod and hand auger. If samples are to be collected from different intervals below grade, bring several sizes of stainless-steel augers (e.g., 2-inch, 4-inch, 6-inch, etc.).
- Hand-auger holes can be drilled as one size or in a telescoping manner, if desired, to collect discreet samples at intervals below grade, and prevent risk of cross-contamination between intervals. If a single depth sample is required, advance the auger bucket to the desired sampling interval depth and empty the contents of the auger in a stainless steel mixing bowl. Mix and place soil into appropriate sample containers.
- For the telescoping method, advance the largest auger first to the desired depth, collecting a specified depth increment sample as the auger bucket is advanced. Install temporary decontaminated PVC casing with a diameter slightly smaller than the borehole to keep the hole open and reduce possible cross-contamination between depth intervals. Using the next size smaller auger bucket, repeat the process.
- Fill-out appropriate sample labels, field forms, and chain-of-custody forms, and place samples for laboratory analysis in a cooler with ice in accordance with SOP-3 and SOP-4.
- Decontaminate all equipment between sample locations in accordance with procedures described in SOP-2.

Purpose

Provide guidelines for sampling subsurface soil.

Goal and Objective

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

Equipment Needs

Will depend on sampling method

Stainless Steel Mixing Bowl and Sampling Trowel

Hand-Lens (10 power)

Munsel Color Book (if required)

Latex or Nitrile gloves

Locating Flags

GPS Unit

Coolers and Ice

Field Forms and Field Book

Decontamination Supplies

Split-Spoon Sampler

- Arrive on-site equipped with at least two standard 1.4-inch inside diameter (ID) split-spoon samplers. If geotechnical information is desired, a 140-pound drop hammer is required.
- Install split-spoon sampler into borehole and advance to the desired depth with the 140-pound drop hammer. Record number of blow counts to complete sampling over each 18-inch or 24-inch interval, as necessary.

- Retrieve sampler and place on work table. Using the other sampler, repeat this sequence.
- Record lithology and percent recovery from cores retrieved from split-spoon sampler on a field form.
- If required by the project work plan, composite like core intervals by mixing in stainless-steel bowl in a similar manner as described for surface soil sampling (SOP-13). When sampling for volatile organic compounds (VOCs), the sample should not be mixed.
- Decontaminate sampling equipment between each interval sampled, if required, and/or between sample sites, in accordance with procedures described in SOP-2.

Direct-Push Drilling Equipment

- Locate the site to be sampled and ensure that drilling equipment can safely access the site.
- Minimize off-road travel to prevent off-site damage to surrounding vegetation.
- Advance direct-push sampling rods lined with acetate sleeves to the prescribed depth. Retrieve the rods, remove the sample sleeves, and secure sample on the work table.
- Record lithology and percent recovery from the retrieved sample sleeve.
- If required by the project work plan, composite like core intervals by mixing in stainless-steel bowl in a similar manner as described for surface soil sampling (SOP-13). When sampling for VOCs, the sample should not be mixed.
- Decontaminate sampling equipment between each interval sampled, if required, and/or between sample sites, in accordance with procedures described in SOP-2.

Backhoe or Hand-Dug Excavations

- Locate the site to be sampled and ensure that equipment can safely access the site.
- Minimize off-road travel to prevent off-site damage to surrounding vegetation.
- Orient excavation to maximize use of the angle of the sun to illuminate the pit for photographs.
- Excavate to the depth specified in the work plan. Place excavated material a sufficient distance from the excavation. If the pit exceeds 5 feet in depth, OSHA construction standards for shoring or sloping must be observed to prevent accidental burials. Sampling personnel should avoid entering any pit to collect samples, and if required to do so, strict adherence to all OSHA standards must be implemented.
- Soil profile descriptions shall be made from a hand-cleaned surface along the pit wall.
- Complete profile descriptions and take photographs before pit is sampled.
- Soil samples shall be collected from depth intervals specified in the work plan. When a depth interval is sampled, an equal volume of soil should be collected from the entire interval exposed on the pit wall by the excavating bucket. When the bucket is brought to the surface, soil samples should be collected from the bucket with the stainless-steel trowel and placed in the mixing bowl according to methods described for surface soil sampling (SOP-13). When sampling for VOCs, the sample should not be composited or mixed.
- After sampling is completed, the pit should be backfilled with excavated material in the reverse order that it was excavated so that topsoil material is returned to the top of the pit. When

backfilling is complete, the area should be cleaned-up to its original condition. If a test pit is left open overnight, temporary fencing and appropriate signs and flagging tape should be used to prevent access to the excavation.

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

SAMPLE CONTAINERS AND PRESERVATION

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

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

Note: VOC = volatile organic compound; VPH = volatile petroleum hydrocarbons; EPH = extractable petroleum hydrocarbons; SVOC = semi-volatile organic compound; oz = ounce; °C = degrees Celsius.

SOP-15

MONITORING WELL CONSTRUCTION

FIELD PROCEDURE

The following is a generalized procedure for installing a typical monitoring well. Refer to the project-specific work plan which should include more details about the design and method of completing monitoring wells on a project site.

- Arrive on site with the appropriate drilling equipment and materials for site conditions. Be sure to review the work plan or SAP to determine anticipated lithology. Filter pack material and well-screen slotting size should be based on the lithology. Ensure that the driller has properly decontaminated all drilling equipment and materials prior to arrival on-site in accordance with SOP-2.
- Many states now require certification and licensing for monitoring well drillers. Verify the driller is licensed in the state (if required) prior to beginning field work.
- Safety equipment required on-site for the drill rig is mandatory. Personal protective equipment includes (at a minimum): hardhat, safety glasses, steel-toed boots, gloves, first aid kit, and site health and safety plan (with routes to nearest hospital known by all personnel on-site).
- Acceptable drilling techniques for the installation of monitoring wells include air-rotary, cable-tool, and hollow-stem auger. If unconsolidated material is encountered, it may be necessary to drive steel casing during drilling to maintain borehole integrity.
- Appropriate decontamination of the auger flights or drill string and other down-hole equipment, between boreholes is required.
- Drilling mud or drilling solutions are not to be used during drilling activities in conjunction with monitoring well construction, unless necessary and approved for the project (e.g., biodegradable material with no petroleum-based constituents). Water used for drilling purposes should be potable quality.
- Hydraulic jacks or the drill rig can be used to pull-back steel casing following emplacement of plastic casing.
- Subsurface samples must be collected by the driller at intervals specified in the work plan. When

Purpose

Provide guidelines for installing monitoring wells in the field

Goal and Objective

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

Equipment Needs

Drilling System (appropriate for well design and site conditions)

Well Completion Material (e.g., screen, filter pack, borehole seal, and surface seal) consistent with anticipated lithology

Hand-Lens (10 power)

USGS Soil Classification Chart and Munsel Color Book

Latex or Nitrile Gloves

Boring Log Forms and Field Log Book

drilling with cable tool or hollow-stem auger, down-hole soil samples should be collected using a standard 1.4-inch inside diameter split-spoon sampler and 140-pound drive hammer. The number of blows necessary to obtain an 18-inch or 24-inch length of sampler by the driller should be recorded on the boring log. When drilling with an air or mud rotary rig, cuttings will be collected from the discharge stream.

- A detailed lithologic boring log must be completed during drilling activities. Soils and geologic cuttings should be described on the log according to the procedures outlined in the United Soil Classification System (USCS; method ASTM D2487) or the Soil Conservation Service (SCS) classification system. Soil texture should be classified by either the USCS or the U.S. Department of Agriculture (USDA) classification. Water-bearing characteristics of the formations should also be noted on the boring log. In addition, details of monitoring well construction should be described on the well log, including total depth, perforated interval, sizes and types of construction materials, etc.
- When completing the well, install factory-slotted well screen (size dependent on lithology) and blank PVC (stainless-steel or teflon for organics) well casing into the borehole. Emplace chemically inert silica sand at least 2 feet above and below any perforated sections and install a bentonite plug above the sand. Backfill remaining well annulus with bentonite slurry, grout, or chips to the ground surface. Measure and record the depth of filter pack and sealing material at regular intervals during installation to document well construction details.
- Develop the well prior to sample in accordance with procedures described in SOP-18.
- Place locking protective well cover over well casing(s) after outer steel casing has been removed from the borehole (if performed). Place bentonite plug below bottom of well cover; grout cover in place and install lock on cover.

SOP-17

FIELD SCREENING OF VOLATILE ORGANIC COMPOUNDS IN SOIL

Purpose

Provide guidelines for field screening of volatile organic compounds in soil

Goal and Objective

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

Equipment Needs

FID, PID, or GCI, as required

Indelible Ink Pen

Ziplock Bags

Latex or Nitrile gloves

Field Log Book and Sampling Forms

FIELD METHOD

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

PID Lamp Selection

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

SOP-18

MONITORING WELL DEVELOPMENT

FIELD PROCEDURE

Prior to sampling groundwater from a new monitoring well, the well must be developed to remove excess fines and set the filter pack installed during well construction. The following is a general procedure for performing well development:

- Visually inspect all well development equipment for damage, and repair, as necessary.
- Decontaminate all down-hole equipment, including stingers, air hoses, and surge blocks following procedures described in SOP-2.
- If using compressed air method for well development, verify the compressor utilized does not produce air laden with hydraulic fluid for lubricating purposes. This may affect the integrity of the monitoring well for producing viable water quality data.
- Develop well by using surging techniques (surge block or bailer), followed by evacuation of water and sediment. Place the surge block or bailer in the well and lower to bottom. Move the surge block or bailer up and down over the entire length of the well screen several times. Remove and evacuate water from the well. Repeat this procedure until evacuated water is visibly clean and essentially sand-free. Measure clarity of water using a properly calibrated turbidity meter (turbidimeter) and record measurements on the well development form. If a turbidimeter is not available during well development activities, describe water clarity in field log book or on a well development form using a turbidity tube, and collect a sample for future analysis.
- Record general water quality parameters (e.g., pH, conductivity, temperature) with a properly calibrated meter(s) during evacuation on a well development field form.
- Evacuated water should be disposed following the process defined in the project work plan.
- Report field observations and volume of water removed on well development form.

Purpose

Provide guidelines for developing monitoring wells

Goal and Objective

To ensure wells are properly developed prior to groundwater sampling

Equipment Needs

Decontamination Supplies

Latex or Nitrile gloves

Well Development Form

Turbidity Meter

Water Quality Meter for pH, conductivity, temperature

SOP-25

MANAGEMENT OF INVESTIGATIVE-DERIVED WASTE

Prior to the field sampling event, review the project-specific work plan to understand how wastes generated during the investigation should be handled. This SOP is applicable to non-hazardous wastes. If hazardous wastes may be generated, consult with the project manager.

Purpose

Outline the procedure for handling wastes generated during site investigation

Goal and Objective

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

Equipment Needs

PID

Field Forms and Field Book

DOT Approved 55-gallon Drums

Drum Wrench

SOIL

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

To determine appropriate method for handing drill cuttings from soil borings or monitoring well installation, soil exhumed from the borehole should be monitored for staining and field screened for volatile organic compounds (VOCs) using a photoionization detector (PID) in accordance with SOP-17. Based on the PID screening, cuttings with VOC concentrations greater than 100 parts per million (ppm) should be containerized in labeled 55-gallon drums (or roll-off containers if large volumes of cuttings are anticipated), pending further characterization. Alternatively, project personnel may elect to containerize all drill cuttings based on the presence of known contamination and contaminant concentrations. Containerized soil must be disposed in accordance with state and federal regulations based on soil analytical results.

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

GROUNDWATER

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

APPENDIX C

DEQ GROUNDWATER SAMPLING GUIDANCE

REMEDIATION DIVISION
Petroleum Cleanup Section

DEQ-PRS
Technical Guidance Documents

This guidance was developed to assist with remediation and cleanup actions at petroleum releases overseen by the Petroleum Tank Cleanup section.

Groundwater Sampling Methodologies

Groundwater samples are routinely collected during site assessments, remedial investigations and corrective action activities. The Department of Environmental Quality Petroleum Release Section (DEQ-PRS) has developed the following specifications to address acceptable well purging methodologies and acquisition of groundwater samples.

General Requirements

Monitoring wells should be evacuated and sampled beginning from the least contaminated to the most contaminated well to minimize the potential for cross-contamination. The sampling order of the wells from least to most contaminated should be based on historical data or knowledge of the existing site conditions.

Measuring and recording groundwater geochemistry is necessary during groundwater sampling. These parameters should include, at a minimum, pH, temperature and conductivity. Other parameters that should be considered would include dissolved oxygen, oxidation-reduction potential (ORP) and turbidity.

Prior to initiating sampling activities at a given location, depth to water should be measured at all existing wells that are accessible. The static water level in a well will be measured using an electronic water-level indicator or an electronic oil/water interface probe to the nearest one hundredth of a foot (0.01 foot). The water level will be measured from a scribed mark at the top of the steel or PVC well casing that corresponds to the point at which the elevation for the well

was surveyed to in accordance with Technical Guidance Document #2 (Licensed Surveyor Required for Determining Monitoring Well Elevations). All measurements will be recorded.

Field meters used during sampling will be checked for calibration consistent with manufacturer-recommended procedures. At a minimum, field instrument and equipment calibration should be conducted at the beginning of each day of sampling. Calibration is the process of establishing a relationship of a measured output to a known input and provides a point of reference to which other sample analyses can be correlated. More frequent calibration will be conducted as necessary, based on instrument performance checks and operator judgment. All calibrations will be performed using standard industry practices and/or equipment manufacturer recommendations.

Care should be taken to ensure the cleanliness of all sampling equipment. Non-disposable sampling equipment should be decontaminated between each different monitoring well. An acceptable decontamination protocol should be included in the firms Standard Operating Procedure (SOP) documents on file with the DEQ-PRS and strictly adhered. If a current SOP is not on file with the DEQ-PRS, a detailed decontamination procedure will be included in the work plan.

Purge water should be handled in a manner consistent with Technical Guidance #10 (Options for the Discharge of Petroleum-Contaminated Wastewater). Sampling consistency will produce repeatable results and data of a higher quality. Multiple purging methods will not be accepted at a site unless approval is granted by the DEQ-PRS.

Once one of the following methods is used for sample acquisition, Technical Guidance Document #8 (Laboratory Analytical Requirements for Petroleum Releases Regulated by the DEQ Petroleum Release Section) should be consulted to determine the appropriate analytical requirements for individual samples. Also refer to Technical Guidance #11 (Filtering or Decanting Samples Prior to Laboratory Analysis).

Methods

Low-Flow or Micropurging

Low-flow or Micropurge sampling is the preferential methodology for groundwater sampling. Low-flow sampling allows wells to be purged and sampled without causing excess agitation within the water column and reduces concerns associated with turbidity. It also allows for greater sample consistency. Specially designed pumps and equipment should be used for true low-flow sampling protocol. Pre-cleaned or dedicated, low-flow bladder pumps should be used for purging and sampling. The disposable tubing and pump should be lowered gently and set at approximately the upper third or fourth of the screened interval. If the static water level is below the top of the screen, then the pump will be lowered to the upper third or fourth of the water column. In either case, the pump intake will be placed a sufficient distance above the bottom of

the well to avoid mobilization of any accumulated sediment. Well purging should begin at a rate of 0.2 to 0.5 L/min while continuing under a maximum purge rate of 1.0 L/min. The optimum pumping rate should be determined with continuous water level measurements using an electronic water-level indicator. The appropriate rate must be equal to or less than the natural recovery rate of the well. Drawdown in the well should be minimized. The pump intake may be adjusted as the water level responds to pumping. During low-flow purging, pH, specific conductance, dissolved oxygen and temperature will be monitored approximately every three to five minutes using a flow through cell. Well purging should be considered complete when at least three consecutive readings of pH, temperature, dissolved oxygen and specific conductance have been collected and have stabilized to within ten percent of the last series of measurements (or one tenth of a unit in the case of pH). Once field parameters have stabilized, samples should be collected directly from the end of the discharge tube after disconnecting the flow-through cell.

Submersible Pumps

Submersible pumps (e.g. Grundfos or Whaler type) can be used for well purging and groundwater sampling. The flow rate of the pump should be regulated to the lowest flow possible during purging. Disposable polyethylene or similar tubing should be affixed securely to the submersible pump. The pump and tubing should be gently lowered into the well bore so as not to cause undue agitation. The depth of the purge pump intake will depend on well yields and construction details. The ideal intake will be below the static water level in the well and in the upper third or fourth of the screened section. If the static water level is below the top of the screen, then the pump will be lowered to the to the upper third or fourth of the water column. The pump should never be placed directly at the bottom of the well. The pump intake may be adjusted as the water level responds to pumping. If wells are purged that have very slow recovery rates, the well can be pumped dry and allowed to recover before sampling. Standard purge protocols require measurements of pH, temperature and specific conductance, and a visual determination of groundwater turbidity. Other parameters that may be measured include dissolved oxygen and oxidation/reduction potential. These parameter readings should be collected after the evacuation of one well volume. Well purging should be considered complete when at least three well volumes are evacuated and readings of pH, temperature and specific conductance have stabilized to within ten percent of the last series of measurements (or one tenth of a unit in the case of pH). Once purging is complete, samples should be collected directly from the pump discharge tubing. Disposable tubing should be used only once and should not be reused for subsequent sampling events. It is imperative that non-disposable pumping equipment be thoroughly decontaminated between each location.

Peristaltic Pumps

In some instances, the use of a peristaltic pump for groundwater sampling may be warranted. Peristaltic pumps should be used minimally for well purging as they may contribute to agitation

of the water column and excess volatilization of constituents of concern (COCs). Disposable tubing should be used at each well and should never be reused. Standard purge protocols require measurements of pH, temperature and specific conductance, and a visual determination of groundwater turbidity. Other parameters that may be measured include dissolved oxygen and oxidation/reduction potential. These parameter readings should be collected after the evacuation of one well volume. Well purging should be considered complete when at least three well volumes are evacuated and readings of pH, temperature and specific conductance have stabilized to within ten percent of the last series of measurements (or one tenth of a unit in the case of pH). Groundwater samples may be collected directly from the tubing once purging is complete.

Bailing

If low-flow purging or other appropriate sampling methodologies are not practical due to field conditions, monitoring wells may be evacuated using a disposable or pre-cleaned bailer. Bailers should be used minimally for well purging as they may contribute to agitation of the water column causing excess volatilization of COCs and may cause turbidity concerns. The DEQ-PRS strongly discourages the use of bailers for groundwater sample acquisition and this method should be discussed with the appropriate Case Manager before sampling is conducted. Standard purge protocols require measurements of pH, temperature and specific conductance to be collected during well purging. These parameter readings should be collected after the evacuation of one well volume. Well purging should be considered complete when at least three well volumes are evacuated and readings of pH, temperature and specific conductance have stabilized to within ten percent of the last series of measurements (or one tenth of a unit in the case of pH). Surging of the water column with the bailer should be avoided. Disposable bailers should not be reused. Non-disposable bailers should be thoroughly decontaminated between locations.

Temporary Well or Hydropunch™ Sample Collection

A temporary well or Hydropunch™ sampler may be used at locations to collect shallow groundwater samples with approval or at the request of the DEQ-PRS. A Hydropunch™ or similar well point may be used to collect a one-time groundwater sample only. A temporary well will be allowed for use up to 180 days. Once this time period has expired, the temporary well must be abandoned or replaced with a permanent well that meets the specifications outlined in Technical Guidance #13 (Monitoring Well Construction Requirements). For Hydropunch™ or similar technology sampling, a stainless steel sampler should be pushed to the desired depth and the push-rod pulled back to expose a porous screen. For a temporary well point, the well screen should be set at the first encountered groundwater. Depth-discrete groundwater entering the sampler or temporary well may be collected by one of two methods: 1) by use of a decontaminated stainless steel bailer and/or a disposable polyethylene bailer 2) or with disposable polyethylene tubing and a peristaltic pump. Parameter stabilization should be

attempted before sample acquisition, but it is understood that this may not be possible under certain circumstances.

Other Technologies - Diffusion Bags, Multi-Port Systems (Westbay® or Solinst®)

The DEQ-PRS will consider the use of other methodologies for acquisition of groundwater samples on a site-by-site basis. It should be demonstrated to the DEQ-PRS that the proposed methodology is technically sound and cost effective for use at the site.

Residential Wells

In some instances, samples will be acquired from residential wells. Several factors should be considered when collecting samples from a residential well. It should be determined if the residence is equipped with a water softener or other filtration system. Samples should be collected before any type of treatment systems, if possible. Samples should also be collected from as close to the well influent as possible. Sampling through hoses or tubing should be avoided. The sample should be collected directly from spigots or faucets. In residences, the size of the holding tank should be determined. The volume of the holding tank should be purged before sample acquisition, if feasible. Water quality parameters should be collected after sample acquisition. Sample analysis requirements are case specific; however when sampling for petroleum compounds, total petroleum hydrocarbons should be targeted in addition to Volatile Organic Compounds utilizing EPA method 524.2.

Irrigation Wells

Groundwater samples may also be collected from irrigation wells. If possible, these wells should be purged for a sufficient length of time to evacuate the casing of all stagnant water before a sample is collected. Water quality parameters should be collected after sample acquisition.

APPENDIX D
COST ESTIMATE

Cost Estimate
Air Sparging and Soil Vapor Extraction (AS/SVE) with Groundwater Monitoring
Northern Tire, Havre, Montana

May 2019

PROJECT TASK	UNITS	RATE	COST
TASK 1: WORK PLAN			
Principal Review	4	$155 /hour	$620
Senior Scientist	5	$143 /hour	$715
Project Scientist	23	$127 /hour	$2,921
GIS/CAD	6	$95 /hour	$570
Administrative Assistant	1	$69 /hour	$69
		TOTAL TASK 1	**$4,895**
TASK 2: PROJECT MANAGEMENT			
Senior Scientist	65	$142 /hour	$9,214
		TOTAL TASK 2	**$9,214**
TASK 3: INSTALLATION AND OPERATION OF AS/SVE SYSTEM			
Task 3A: Mobilization (AS/SVE System Install, Well Installation, and maintenance)			
Mileage (Travel from Missoula to Havre for install, startup, and tuning event)	554	$0.585 /mile	$324
Staff Scientist, including prep	15	$103 /hour	$1,545
Technician II, monitoring and maintenance	0	$85 /hour	$0
		Subtotal Task 3A	**$1,869**
Task 3B: Installation, Startup, and Tuning			
Labor			
Staff Scientist:			
Oversee modification of existing SVE piping	3	$103 /hour	$309
Oversee installation of equipment shed and power supply	5	$103 /hour	$515
Connect AS/SVE lines to pre-assembled system	4	$103 /hour	$412
Assist with system startup and tuning (2 days)	16	$103 /hour	$1,648
Monitoring and maintenance (2 quarterly events)	6	$103 /hour	$618
Technician II, monitoring and maintenance (4 weekly events, 2 quarterly events)	24	$85 /hour	$2,040
		Labor Total	$5,542
Direct Costs			
Contractor, expose and retrofit existing SVE lines	1	$2,354 /lump sum	$2,354
Parts, modification of SVE lines	1	$650 /lump sum	$650
System Components and Installation (Product Level Control, Inc.)	1	$69,969 /lump sum	$69,969
Electrician	1	$5,698 /lump sum	$5,698
Maintenance Parts (quarterly filters for AS compressor)	1	$300 /lump sum	$300
		Direct Costs Total	$78,971
		Subtotal Task 3B	**$84,513**
Task 3C: Lodging/Per Diem (AS/SVE System Install)			
Per Diem (4 days install, setup, and tuning; plus mobe and return)	6	$23 /day	$138
Lodging (4 days install, setup, and tuning; plus the night before)	5	$120 /day	$600
		Subtotal Task 3C	**$738**
		TOTAL TASK 3	**$87,120**

Cost Estimate
Air Sparging and Soil Vapor Extraction (AS/SVE) with Groundwater Monitoring
Northern Tire, Havre, Montana

May 2019

PROJECT TASK	UNITS	RATE	COST
TASK 4: SOIL BORING, WELL INSTALLATION, AND WELL REPAIR			
Task 4A: Subcontractors			
Driller	1	$7,428 /lump sum	$7,428
Surveyor	1	$803 /lump sum	$803
	Subtotal Task 4A		**$8,230**
Task 4B: Oversight and Soil Sampling			
Staff Scientist	20	$103 /hour	$2,009
	Subtotal Task 4B		**$2,009**
Task 4C: Laboratory Analysis (Soil Sampling, interface sample from 3 borings, QC samples including duplicate, blank, and MS/MSD)			
VPH	6	$85 /sample	$510
EPH Screen	6	$75 /sample	$450
EPH Fractionation	6	$110 /sample	$660
Lead Scavengers Soil (1,2 DCA and EDB)	6	$75 /sample	$450
Petrofund Sample Fee	6	$10 /sample	$60
	Subtotal Task 4C		**$2,130**
Task 4D: Lodging/Per Diem (Well Installation and Development)			
Per Diem (2 long days install and development; already mobilized to site)	2	$23 /day	$46
Lodging (2 nights)	2	$120 /day	$240
	Subtotal Task 4D		**$286**
	TOTAL TASK 4		**$12,655**
TASK 5: GROUNDWATER MONITORING (15 wells sampled in first event, 8 wells in second event; 15 water level measurements in each)			
Task 5A: Mobilization			
Vehicle and Fuel	1,108	$0.585 /mile	$648
Technician III, labor for prep and driving	28	$96 /hour	$2,688
	Subtotal Task 5A		**$3,336**
Task 5B: Monitoring Well Sampling			
Labor			
Technician III, collect groundwater samples for 15 monitoring wells in fall 2019, and	40	$96 /hour	$3,792
8 monitoring wells in spring 2020 (measure water levels on all 15 wells)		Labor Total	$3,792
Direct Costs			
Water Level Meter	5	$55.18 /day	$276
Bladder Pump	5	$54.25 /day	$271
Water Physical Parameters Meter with flow-through cell	5	$73.52 /day	$368
Turbidity Meter	5	$36.76 /day	$184
Tubing	690	$0.77 /foot	$531
	Direct Costs Total		$1,630
	Subtotal Task 5B		**$5,422**
Task 5C: Lodging/Per Diem			
Per Diem (sampling days, plus mobe and return day on each event)	9	$23 /day	$207
Lodging (sampling days, plus night before on each event)	7	$100 /day	$700
	Subtotal Task 5C		**$907**
Task 5D: Laboratory Analysis, Groundwater			
Intrinsic Biodegradation Indicators (Mn, Fe II, Nitrates/Nitrites, Sulfates, Methane)	23	$130 /sample	$2,990
VPH	23	$85 /sample	$1,955
EPH Screen	23	$75 /sample	$1,725
EPH Fractionation (assumed 1/2 of results will need fractionation)	12	$110 /sample	$1,320
Lead Scavengers Soil (1,2 DCA and EDB)	23	$75 /sample	$1,725
Shipping (samples)	6	$75 /each	$450
Petrofund Sample Fee	23	$10 /sample	$230
	Subtotal Task 5D		**$10,395**
Task 5E: Forensic Evaluation			
Estimate with 7% markup	1	$3,943 /lump sum	$3,942.95
	Subtotal Task 5E		**$3,943**
	TOTAL TASK 5		**$24,003**

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PROJECT TASK	UNITS	RATE	COST
TASK 6: REMEDIAL ALTERNATIVES ANALYSIS (RAA) FOR NORTHERN PLUME AREA			
Project Scientist	20	$127 /hour	$2,535
Staff Scientist	2	$103 /hour	$165
		TOTAL TASK 6	**$2,700**
TASK 7: REPORTING (System Installation, Forensics, and Groundwater Monitoring)			
Principal Scientist	5	$155 /hour	$775
Project Scientist	10	$127 /hour	$1,268
Staff Scientist	50	$103 /hour	$5,150
GIS/CAD	10	$95 /hour	$950
Administrative	4	$69 /hour	$274
		Labor Total	$8,417
Direct Costs			
Document Production	1	$150 lump sum	$150
		Direct Costs Total	$150
		TOTAL TASK 7	**$8,567**
TASK 8: RELEASE CLOSURE PLAN (RCP)			
Principal Scientist	2	$155 /hour	$310
Project Scientist	22	$127 /hour	$2,725
		TOTAL TASK 8	**$3,035**
		GRAND TOTAL	**$152,188**