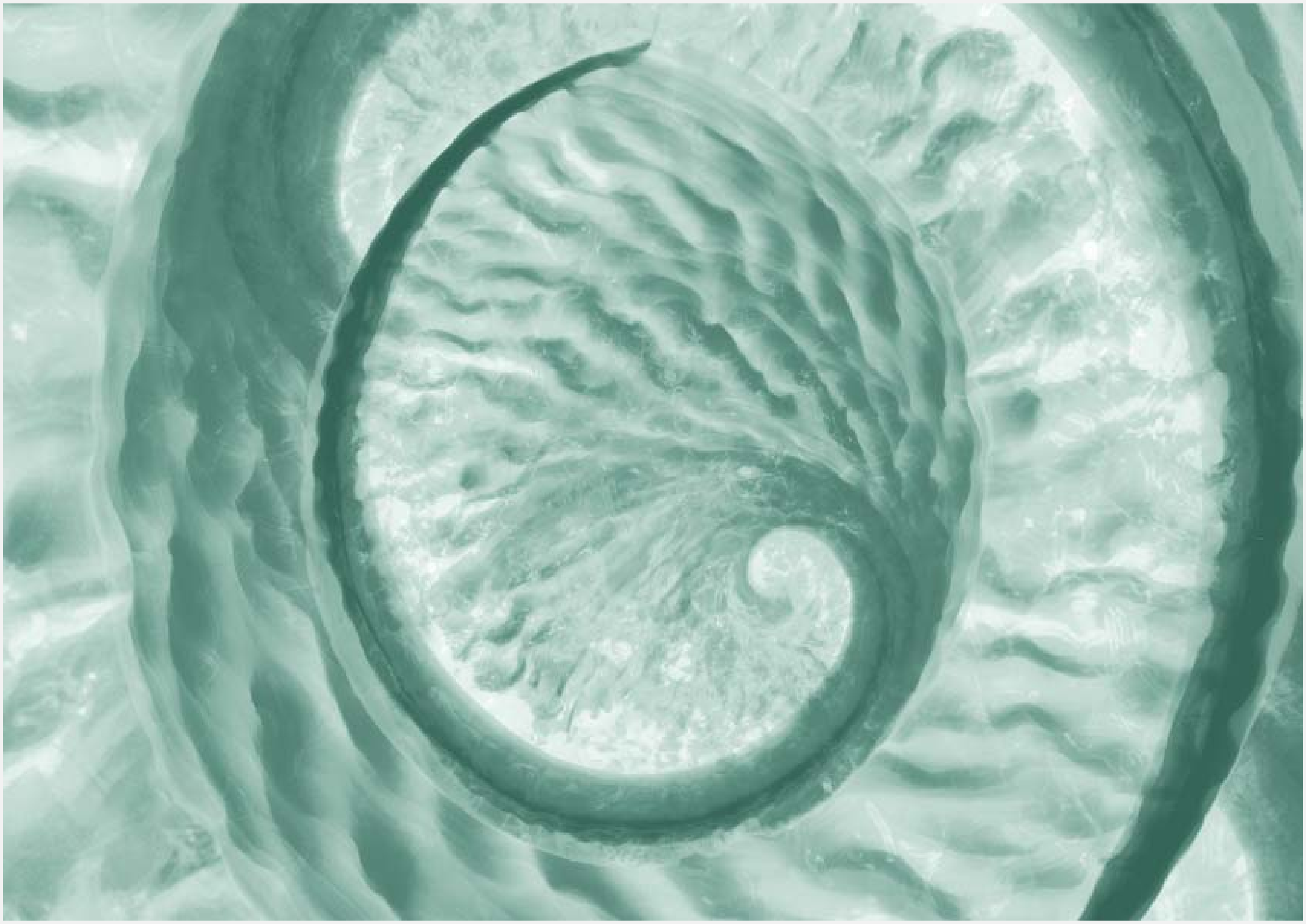

Field Sampling Plan

Macon Naval Ordnance Plant Superfund Site (GAD003302676) Macon, Georgia

18 March 2019

Project No.: 0482419

The business of sustainability

March 18, 2019

Field Sampling Plan

Macon Naval Ordnance Plant Superfund Site (GAD003302676)
Macon, Georgia

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1. INTRODUCTION

Environmental Resources Management (ERM) has prepared this Field Sampling Plan (FSP) on behalf of the performing respondents for the Macon Naval Ordnance Plant Superfund Site to present the field sampling procedures to be implemented as part of the Remedial Investigation / Feasibility Study (RI/FS) to be performed for the Macon Naval Ordnance Plant Superfund Site in Macon, Georgia (Site). The Site location is shown on Figure 1.

This FSP describes the media to be analyzed, sample locations and rationale, sampling procedures, field documentation and sample custody requirements, investigation-derived waste handling procedures, equipment maintenance and calibration procedures, and decontamination procedures. This FSP has been prepared in accordance with Section III of the SOW and *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, October 1988).

This FSP is incorporated by reference with the *RI/FS Work Plan for the Macon Naval Ordnance Plant Superfund Site, Docket No:CERCLA-04-2018-3760* (March 18, 2019). The companion *Quality Assurance Project Plan* (QAPP) contains the quality assurance and quality control (QA/QC) procedures to be followed during the RI/FS. Also included in the SAP is a Quality Assurance Project Plan (QAPP) that provides the organizational structure and quality assurance and quality control procedures that will be followed to achieve project data quality objectives. A companion Site-Specific *Health and Safety Plan* (HASP) outlines the Site hazards, mitigation measures and emergency preparedness and response activities to be followed during execution of the RI/FS.

1.1 PURPOSE

The purpose of this FSP is to develop and maintain sufficient quality control in field operations and to create uniformity between field personnel involved in data collection activities. This FSP is designed to supplement the RI/FS Work Plan and for guidance and reference by field data collection personnel.

1.2 SAMPLING OBJECTIVES

The overall objectives of sample collection are to:

- Further define sources of COPCs and to address the uncertainties and data gaps identified in the CSM;
- Enhance definition of nature and extent of Site-related COPCs in soil and groundwater;
- Understand the transport and fate of COPCs in environmental media at the Site;
- Refine the preliminary identification (provided in this plan) of complete or potentially complete exposure pathways considering current and future land use, evaluate current and future human health and ecological risks posed by the COPCs present at the Site, and complete a risk assessment in accordance with EPA guidance; and
- Support the development and evaluation of remedial alternatives for the Site.

1.3 PROJECT DESCRIPTION

The Site background, history, and preliminary conceptual site model are provided in Section 1, 2 and 3 of the RI/FS Work Plan. The site location is depicted in Figure 1. The Site was used for production operations including manufacturing of metal parts, their assembly and explosive loading to produce ammunition components for the armed services, including flares, small primers, detonators and other triggering mechanisms for 32 years (1941 – 1972). The Site was subsequently used for manufacturing of seat belts for seven years (1973 – 1980). Current use of the Site includes warehousing, as well as industrial manufacturing or commercial uses. The property contains facilities that are both leased by the Macon-Bibb County Industrial Authority (MBCIA), or privately owned. Groundwater at the Site is impacted primarily with trichloroethene (TCE), cis-1,2-dichloroethylene (cDCE), and vinyl chloride (VC). TCE and other volatile organic chemicals (VOCs) have also been identified in sub-slab soil gas and indoor air in some locations.

Potential sources of constituent release during historical operations at the Site were identified and investigated in prior studies, including the following:

- former WWTP;
- storm water drain outfalls;
- metal plating facility (Building 5);
- electrical transformer houses;
- former solvent storage sheds (Buildings 99, 175, 190-193);
- explosives assembly and loading area (Buildings 106, 106A and 109);
- oil recovery area; and
- ASTs and USTs.

The location of each of these areas is shown on Figure 2. Chemical characterization of soil in and around these areas did not reveal the presence of constituents in soil at concentrations above their EPA Regional Screening Levels (RSLs) for industrial soil. TCE was detected at the highest concentrations in soil samples collected near the former WWTP outfall area in 1998 (1.7 mg/kg at ISL-117 0-2') and metals plating facility in 1996 (1.2 mg/kg at ISL-004 1-3'); however, TCE was not confirmed to be present in soil at these concentrations in subsequent sampling events in these or other areas of the Site.

In groundwater, TCE is broadly distributed across the Site, and the maximum detected TCE concentration in subsequent events was 0.0035 mg/kg. Historic drawings (Stevens and Wilkinson, 1957) and interviews (SAIC, 1997) indicate that plating effluent (and possibly metal cleaning effluent) was conveyed via floor drains in Building 5 to the storm sewer system prior to 1973, which may have included TCE that may have been used to clean the metal prior to plating.

Energetic compounds were investigated previously at the site in surface soils, subsurface soils and groundwater (RUST, 1997), with very limited detections identified. Inorganic analytes and pesticides were detected above background concentrations (identified at the time) in disparate locations across the

Site (RUST 1997), and these analyte concentrations and distribution in soil did not indicate the presence of significant source areas for these constituents. Review of site operational history did not indicate processing or management of pesticides and the presence of these constituents appears related to intended beneficial use of the products.

Previous assessments indicate sources of TCE in groundwater were present in the vicinity of the former WWTP (western plume), south of the metal plating facility Building 5 (central plume), and near Building 108 (eastern plume). Reported groundwater concentrations and remediation pilot studies suggest NAPL may remain in the western plume source area (SAIC, 2005).

Industrial operations to the north and west of the Site have the potential to contribute constituents to on-Site surface drainage features. The AWI site to the west and former landfill to south have been identified as sources of constituent release to drainage features and Rocky Creek south of the Site. Groundwater at the former landfill is affected by a variety of constituents including TCE.

Based on results of the previous investigations, groundwater sample results and indoor air concentrations suggest the presence of sources or residual source material near Building 5, Building 6 and Building 108; however, the specific location of the source(s) is not identified. Based on current understanding of the VOC plume distribution, these areas appear to contribute VOCs to groundwater, but to a lesser extent than the former WWTP area. Additionally, historical records and previous investigations indicate that no soil or groundwater data have been collected to assess COPCs derived from five former solvent storage sheds and the former testing area located in the south central portion of the Site. As such, these areas will be the subject of the RI and will be investigated as described further in Section 6.

The primary activities to be completed in the field are:

- passive soil gas surveys (SGS);
- direct push soil and groundwater sampling;
- surface soil sampling;
- sampling of existing groundwater monitoring wells; and
- sub-slab soil vapor, indoor and ambient air sampling.

The table below summarizes the field activities and their use for each of the project objectives.

Objective	Soil Gas Survey	Direct Push Soil and Groundwater Sampling	Surface Soil Sampling	Monitoring Well Sampling	Soil Vapor, Indoor and Ambient Air
Further define sources of COPCs and to address the uncertainties and data gaps identified in the CSM;	●	●			●
Enhance definition of nature and extent of Site-related COPCs in soil and groundwater;		●		●	●
Understand the transport and fate of COPCs in environmental media at the Site;		●		●	●
Support HHRA and ERA		●	●	●	●
Evaluate Remedial Alternatives		●		●	●

2. FIELD PROCEDURES

This section describes the general procedures that will be followed by sampling personnel during all aspects of data collection. A sampling and analysis summary for all data collection tasks is presented on Tables 1 - 5.

2.1 SUBSURFACE CLEARANCE

Prior to conducting the investigation, subsurface clearance (SSC) procedures will be conducted in accordance with ERM's health and safety plan (HASP). Conducting any intrusive investigation task presents a human health and property risk that must be mitigated to prevent someone from being harmed and/or property damaged. The procedure is summarized as follows:

- Hand mark proposed soil boring locations in the field, and outline an area to be cleared that covers 20 feet in all directions from each proposed soil boring location to accommodate potential step-out locations from those originally proposed;
- Review available design drawings for the Site that may show the locations of underground utilities in these areas and discuss with Site personnel who may be familiar with such utilities;
- Contact the public utility locator (dial 811) to have potential underground utilities located and marked, as required by law; and
- Since the public utility locator does not normally come onto private properties, a private utility locator will be retained to locate and mark underground utilities that may be present within the above areas using ground penetrating radar (GPR) possibly in combination with other tools (to be specified by the SSC contractor based on the project objectives and site conditions).

Proposed soil boring locations may need to be adjusted to accommodate potential underground utilities identified by the SSC process, but would be located in the same general area. Prior to advancing a soil boring using a direct-push or hollow-stem auger drilling rig, the soil boring will be manually cleared using a hand-auger to a minimum depth of 5 feet below the ground surface (ft bgs) to provide an additional level of assurance that underground utilities will not be encountered and nobody will be injured.

2.2 PASSIVE SOIL GAS SURVEYS

The purpose of the passive soil gas surveys (SGS) at the Site is to screen areas where groundwater data indicate a potential source, but a specific source has not yet been identified by previous sampling events. Soil gas constituent concentrations often strongly correlate with the locations of soil and groundwater constituent concentrations and are used to identify "hot spots" for traditional subsequent assessment methods (Geoprobe® soil and groundwater sampling). SGS provide a lower-cost method to screen relatively larger areas to identify potential sources before employing higher-cost, more focused investigation methods. Concentrations of TCE in groundwater samples near Building 5, Building 6, and former Building 108 (demolished) and TCE concentrations in indoor air, as well as historic use of the areas are all lines of evidence that a source or residual source material may be present. SGS modules will be used to broadly screen these areas shown on Figure 3, as described below.

Sampling will be conducted in a grid formation over each area with a spacing of 40 ft between samples. A summary of the soil gas sampling protocol by potential source area is provided below in the table, with each of the areas shown in Figure 3.

Summary of Passive Soil Gas Survey Protocol

Area of Concern	Approximate Area (sq/ft)	Number of SGS modules	Grid Spacing
Building 5 Area	60,000	45	40
Building 6 Area	152,000	115	40
Former Building 108 Area	52,500	40	40

sq/ft = Square feet

Passive sample collection will be conducted using a sorbent gas collection device (sampler). The sampler utilizes diffusion and adsorption over time to collect soil gas in the vadose zone. To install the samplers, a small diameter hole (one inch or less) will be made into the underlying soils approximately 18 inches using a hand auger or push probe. After the sampler is installed, the hole is patched with an aluminum foil plug and native soil to seal the sampler in the ground. The samplers will be exposed for approximately 14 days to meet the objectives of the survey. Following the exposure period, the samplers will be retrieved and shipped to the manufacturer (Beacon Environmental Services) for VOC analysis using gas chromatography/mass spectrometry (GC/MS) instrumentation, following modified EPA Method 8260C procedures.

The SGS will provide mass of specific contaminants of potential concern (COPCs) within the soil gas at the sample locations. The locations and mass of the COPCs are interpolated using computer software to produce a color-coded contour map of contaminant mass in soil gas. The contoured and mapped results of the passive soil gas survey will be used to identify areas with the highest soil gas concentrations, which would typically correlate to the highest soil or groundwater concentrations. The areas of highest soil gas concentrations will be targeted for characterization soil and groundwater sampling.

2.3 SOIL SAMPLING

Prior to any ground disturbance activities at the Site, SSC activities will be conducted as described above. In instances where manual subsurface clearance is not possible (e.g., gravelly soil conditions, fill material, or shallow bedrock impenetrable using hand augers or post hole diggers) or discrete samples are to be collected from shallow subsurface soils, subsurface clearance activities may be waived after receiving ERM Principal In Charge (PIC) and District Managing Partner (DMP) approvals. In such an event, the Site-specific Health and Safety Plan (HASP) will be updated and signed by the Field Safety Officer (FSO) and the ERM PIC.

Soil samples in Table 2 will be collected in accordance with USEPA Region 4 SESD operating procedure SESDPROC-300-R3 (USEPA, 2014c). Soil samples for VOC analysis will be collected directly from the hand-auger in samples collected shallower than 5 feet or directly from the acetate liner as grab samples in a manner that minimizes disturbance of the sample. Either a syringe or a Terra Core® Sampler will be used to collect approximately 5 grams of soil transferred to into three 40 milliliter (ml) vials with two preserved with sodium bisulfate and one with methanol. In addition, a 2-ounce jar will be filled to estimate moisture content of the soil sample.

A clean pair of new, non-powdered, disposable nitrile gloves will be worn each time a different sample is collected and the gloves will be donned immediately prior to sampling. The hand-auger and other non-disposable sampling equipment will be decontaminated before and after each boring in accordance with USEPA Region 4 SESD operating procedure SESDPROC-205-R3 (USEPA, 2015) to reduce the potential for cross-contamination. The hand auger will be wiped clean, washed using detergent (Liquinox®) and deionized water, and rinsed using deionized water. The samples will be preserved by storing on ice.

2.3.1 DPT Soil Sampling

Based on the results of the SGS, up to 22 soil borings may be advanced at the Site via Geoprobe® (direct push technology or DPT) in the vicinity of “hot-spot” areas identified by the results of the SGS, if necessary. Additionally one DPT soil boring will also be advanced directly adjacent to the location of each of the former solvent storage sheds located across the Site. Soil samples from these borings will assist with confirmation of potential secondary VOC source areas in the soil.

AOC	No. of Borings	No. of Samples	Depth intervals	Analysis				Rationale
				VOCs	SVOCs	Metals	PCBs	
Building 5 Area	4	8	3-5 10-15	X				Locations will be based on the results of the SGS
Building 6 Area	4	8	3-5 10-15	X				Locations will be based on the results of the SGS
Former Building 108 Area	4	8	3-5 10-15	X				Locations will be based on the results of the SGS
Former Solvent Storage Sheds (5)	10	20	3-5 10-15	X				Collect up to two samples at each former solvent storage shed

Continuous 4-foot long soil cores will be retrieved from the soil boring. Soil cores will be visually surveyed for the presence of staining and other visual indicators of potential COPCs being present. They will also be field screened at 0.5 foot intervals for the presence of organic vapors potentially indicative of volatile COPCs using a portable organic vapor analyzer equipped with a photoionization detector (PID). The soil borings will be filled with bentonite or grout upon completion. Soil boring logs will be prepared for each soil boring documenting the field observations and field screening results.

At least two (2) soil samples will be collected from each soil boring. The final depth of the soil samples may be adjusted based on field PID readings, olfactory indications, and visual survey results. Soil sample intervals will be selected based on the highest PID detections above the water table, but in the absence of any field evidence of the presence of COPCs, they will be collected from 3-5 and 10-15 ft bls.

2.3.2 Surface Soil Sampling

Additional soil samples will be collected to confirm or close potential data gaps. Soil sampling locations are shown on Figure 3 and sample locations and rational summarized below in the table.

Summary of Phase I Soil Sampling Program

AOC	No. of Borings	No. of Samples	Depth intervals	Analysis				Rationale
				VOCs	SVOCs	Metals	PCBs	
Former Recreational Area	3	3	0-0.5				X	One confirmation soil sample will be collected in previously sampled location and two stepout locations

2.4 GROUNDWATER MONITORING

Groundwater samples will be collected and existing monitoring wells, and shallow aquifer samples will be collected from select DPT soil boring locations. Groundwater sampling events will be performed in accordance with the Region 4 EPA Science and Ecosystem Support Division (SESD) *Field Branches Quality System and Technical Procedures* (as referenced below).

The methods for all field procedures, the constituents the samples will be analyzed for and the laboratory analytical methods to be utilized are included below. Table 3 presents the proposed groundwater sampling and analyses frequencies and parameter changes for each well.

Prior to sampling each well, field equipment should be cleaned and decontaminated and any investigative-derived waste should be contained using the following SESD procedures:

- SESDPROC-205-R1 Field Equipment Cleaning and Decontamination, December 18, 2015 (USEPA, 2015)
- SESDPROC-202-R1 Management of Investigation Derived Waste, July 3, 2014 (USEPA, 2014a)

2.4.1 Groundwater Elevation Measurements

Depth to ground water for each well will be recorded prior to sampling. All ground water level and total depth measurements will be made relative to an established reference point on the well casing and should be documented in the field records. To be useful for establishing ground water gradient, the reference point should be tied in with the North American Vertical Datum of 1988 (NAVD 88). The depth to water will be measured from the casing survey mark.

All depth to groundwater measurements used to develop groundwater elevation contour maps will be collected within a 24-hour period. The caps on the monitoring wells will be unlocked and loosened to give each well enough time to allow the water level to equilibrate with atmospheric pressure prior to measuring the depth to groundwater. Measuring the depth to the free groundwater surface and total well depth will be accomplished by the using an electronic water level indicator. An electronic water level indicator consists of a spool of dual conductor wire, a probe attached to the end, and an indicator. When the probe contacts the water, the circuit is closed and a meter light and/or buzzer attached to the spool will signal the contact. Penlight or 9-volt batteries are normally used as a power source. Measurements should be made and recorded to the nearest 0.01 foot.

In order to minimize agitation of potential sediments at the bottom of each well which could increase turbidity of the ground water within each well, total depth measurements will be not be collected until after the well has been sampled. An example field form for recording depth to ground water measurements is included in Appendix A.

2.4.2 Monitoring Well Reconnaissance and Rehabilitation

Based on a preliminary visual assessment of the Site monitor well network, several of the wells, particularly in the former pilot test area on the western portion of the Site, have been or are being destroyed by the current commercial use of the property. Prior to conducting a comprehensive groundwater sampling event, existing monitor wells will be located and an assessment of their accessibility and viability will be completed. The need to replace monitor wells that have been damaged will be evaluated following the assessment.

2.4.3 Groundwater Sampling from Existing Wells

Groundwater samples and purge method identified for existing wells in Table 3 will be collected in accordance to SESD operating procedure SESDPROC-301-R1 Groundwater Sampling, April 26, 2017 (USEPA, 2017d), using low-flow (micro-purging) or passive diffusion bags (PDBs).

Groundwater samples will be collected during a variety of field activities. Proposed sampling locations for specific analyses are depicted on Figure 3. Samples will be collected from all existing monitoring wells and 3 water supply wells located on or downgradient of the Site baseline monitoring.

Groundwater samples collected from monitoring and water supply wells will be analyzed for VOC COPCs via EPA Method 8260B as outlined on Tables 3. The specific analyses to be performed include 1,1-DCE, 1-2-DCE (total) and cDCE, carbon tetrachloride, chloroform, PCE, TCE, and VC.

2.4.4 Direct-Push Boring and Sample Collection

Shallow aquifer sampling will be performed at up to 22 locations to characterize potential secondary source areas. The exact locations of the temporary wells will be determined in the field based on conditions encountered. Borings will be advanced at the Site via Geoprobe® (direct push technology or DPT) in the vicinity of the "hot-spot" areas identified by the results of the SGS.

The direct-push groundwater sampler is a shielded well point sampler of heavy construction. The shield controls cross contamination of the sampler while penetrating soils above the sampling depth. After shield retraction and sampler opening, groundwater flows under in situ pressure conditions through a 20-inch long screen, into the 350 ml sample barrel, and up the rod string. Small diameter pumps can be used with the sampler to acquire adequate volumes of sample for laboratory analysis.

Vertical aquifer samples will be collected as follows:

- The groundwater sampler is deployed to the deepest interval, opened, and sample is pumped to the surface using low-flow sampling techniques.
- The sampler is pulled up to the next shallower interval, purged, and sample is pumped again. This procedure is repeated until the shallowest sample has been obtained.

The soil borings will be advanced through the unconfined water table and groundwater samples will be collected from approximately 10 feet into the water table at each location.

2.4.5 Low-Flow Purging

A peristaltic pump or bladder pump with dedicated tubing will be used to purge each well. The polyethylene/polyvinyl sample tubing should be slowly lowered to the middle of the screened interval or slightly above the middle (e.g., 4.5-5 ft below the top of a 10 ft screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which may have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. The well will be purged at a rate that minimizes drawdown to avoid disturbing the fine-grained soil in the well casing, sand pack, or surrounding formation. During purging, the maximum-pumping rate will be the rate that does not lower the water level in the well by more than 6 inches.

Groundwater will be pumped from the well into a sealed, flow-through chamber containing an In-Situ® Troll 9500 multi-parameter water quality meter (or equivalent) to collect field measurements of pH, temperature, specific conductance, DO, ORP, and turbidity at five-minute intervals. At regular intervals, grab samples will be obtained from the outlet of the chamber for turbidity measurements. Field measurements will be collected using the following SESD procedures:

- SESDPROC-106-R2 Field DO Measurement, April 12, 2017 (USEPA, 2017a)
- SESDPROC-113-R0 Field Measurement of Oxidation-Reduction Potential, April 26, 2017 (USEPA, 2017b)
- SESDPROC-100-R2 Field pH Measurement, December 16, 2016 (USEPA, 2016a)
- SESDPROC-101-R2 Field Specific Conductance, June 13, 2016 (USEPA, 2016b)
- SESDPROC-102-R2 Field Temperature Measurement, October 23, 2014 (USEPA, 2014b)
- SESDPROC-103-R2 Field Turbidity Measurement, July 7, 2017 (USEPA, 2017c)
- SESDPROC-105-R1 Groundwater Level and Well Depth Measurement, November 3, 2016 (USEPA, 2016c)

After passing through the flow-through chamber, the water will be discharged to a 5-gallon bucket. When this bucket is full, the water will be transferred to a closed top 55-gallon drum or an on-Site tank. Storage drums or a poly tank will store the purge water at the site for future off-site treatment and/or disposal. Stability is achieved when three consecutive readings do not vary more than 10% for DO, 10% for turbidity when over 10 NTUs, 3% for specific conductance, 0.5 degrees Celsius for temperature, 10 millivolts for ORP, and 0.1 standard units for pH. Stability of field measurements will ensure that the groundwater samples are representative of formation water. In addition, water levels will be measured to ensure that less than 6 inches of drawdown occurs; if drawdown is greater than 6 inches, the flow rate will be reduced to bring the drawdown back in range. Instruments used for the measurement of groundwater parameters will be operated, calibrated, and maintained in the field in accordance with the manufacturer's instructions and Section 5.2 of this document.

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate.

The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well. Generally, volatile (solvents and fuel constituents) and gas sensitive (Fe2+, CH4, H2S/HS-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

Each sample collected will be assigned a unique identification number and placed in an appropriate sample container. The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Sample containers will be pre-preserved by the analytical laboratory and field preservation will not be required. Each sample container will have a sample label affixed to the outside with the date, time of sample collection, project name, sample identification number, and analysis required. The samples will be placed in a Ziploc® bag (or equivalent) and placed in laboratory-supplied coolers with ice. The samples will be shipped to the laboratory.

It should be noted that volatile organic compounds (VOCs) cannot be collected directly from the peristaltic pump head; rather, samples should be collected by withdrawing the tubing from the well (while taking care that tubing does not touch any surface or any point of possible contamination) and then reversing the pump flow direction and allowing the water to be pumped into the proper sample containers.

If during purging a well goes dry before field measurements have stabilized, and the well has a water column of insufficient height to support sample collection, the well will be allowed 24 hours to recharge and then will be sampled with a sampling.

A detailed description of each well's response to purging and all of the field measurements will be recorded electronically or on the hardcopy Low Flow Sampling Field Form (Appendix B).

2.4.6 Passive Diffusion Bag Sampling

This technique involves deploying a no-purge Passive Diffusion Bag (PDB) in the screened interval (or open hole in some bedrock wells) of select wells identified in Table 3, and allowed to equilibrate prior to retrieval. Each PDB will consist of a sealed low density polyethylene (LDPE) bag containing deionized water. The membrane of the bags is semi-permeable and allows free movement of groundwater and VOCs into the bags until reaching equilibrium with the surrounding groundwater. Designated suspension tethers will be purchased for each well sampled and pre-measured to the mid-screen based on well construction or to mid-water column based on groundwater levels, whichever was more representative (i.e., consistent with previous sample collection depths). Tether lines will be connected to special designated expansion plugs with connection rings on the inside to suspend the PDBs inside each well so while preventing runoff or surface water from entering the well.

The bags will be removed from each well by the ERM sampler using nitrile gloved hands, and the groundwater will be transferred from the bags into laboratory-supplied sample containers. PDB deployment and retrieval logs will be included as an appendix in the groundwater monitoring reports.

2.4.7 Active Water Supply Well Sampling

Groundwater samples and purge method identified for active water supply wells in Table 3 will be collected in accordance to SESD operating procedure SESDPROC-305-R3 *Potable Water Supply Sampling* (USEPA, 2013).

This procedure applies to active water supply wells with in-place plumbing. The objective of purging wells with in-place pumps is to collect a water sample representative of aquifer conditions. During the pH, specific conductance and turbidity of the water removed will be monitored. For sampling the active water supply wells, they existing discharge lines will be purged for at least 15 minutes when possible.

An adequate purge is achieved when the pH and specific conductance of the purged water have stabilized and the turbidity has either stabilized or is below 10 Nephelometric Turbidity Units (NTUs). Stabilization occurs when, for at least three consecutive measurements, the pH remains constant within 0.1 Standard Unit (SU) and the specific conductance varies no more than approximately 10 percent.

If, after 15 minutes, the in situ chemical parameters have not stabilized according to the above criteria, additional water can be removed, it is at the discretion of the ERM field manager whether or not to collect a sample or to continue purging.

2.5 SOIL VAPOR SAMPLING

To evaluate potential impacts of vapor intrusion, sub-slab soil gas, indoor air and outdoor ambient air sampling will be completed. Additionally, individual building surveys will be completed to assess building structures. The building surveys will include an evaluation of HVAC system operation and layout, and all chemical uses/storage in the building. This information will be used to evaluate the results of the sampling events.

2.5.1 Vapor Intrusion Building Surveys

Prior to sampling, field personnel will complete an initial building survey included as Appendix C by interviewing someone familiar with the property (i.e., building owner or occupant). During the visit, the field representative will obtain as-built drawings for the buildings, if available, and attempt to verify the location of subsurface utilities. Sampling locations will be selected in cooperation with the building owner/occupant to minimize disruption to Site operations. A separate building survey will be completed for each building selected for further vapor intrusion investigation at the Site as depicted on Figure 3.

This initial building survey will be used to determine property-specific conditions that may affect the design and/or results of the sampling program. Preliminary information regarding building condition and contents will be used to specify equipment needs for the intrusive field investigation and to begin identification of possible background factors that could influence future assessment activities.

A second building survey will be completed prior to sampling which will include a chemical inventory in order to identify potential background indoor air sources as well as an assessment of the heating, ventilation, and air conditioning (HVAC) systems in each building. The chemical inventory will initially focus on potential chemicals stored or used in the room being sampled. If indoor air samples are analyzed for a specific building, then a review of all chemicals used or stored in the building will be completed. This review may include reviewing available safety data sheets.

During this second survey, a separate building survey will be completed for each building selected for further vapor intrusion investigation at the Site as depicted on Figure 3.

2.5.2 Sub-Slab Soil Gas Sample Collection

To evaluate conditions beneath the building slab, sub-slab soil gas samples will be collected from each building designated for further evaluation in Figure 3. The number of sub-slab soil gas samples recommended for each buildings depends on the size of the structure and follows these guidelines:

- 25,000 square feet or less: 3 samples;
- 25,000 to 100,000 square feet: 4-5 samples; and
- Greater than 100,000 square feet: at least 6 samples.

Proposed sample locations are shown on Figure 3. Sample locations will be finalized in the field after an inspection of areas of the floor slab, communication with the building owner, and completion of a subsurface clearance utility program. Subsurface clearance consists of notification to public utility mark-out services, review of available construction plans, utility maps, a site walk, and the use of radio frequency line detection, ground penetrating radar, and/or other methods of private utility location.

To the extent allowed by building and room sizes, sub-slab soil gas samples will be located at least 15 feet away from exterior walls to reduce the influence from outdoor air. Locations will be modified based on access availability, equipment locations and utilities, presence of asbestos containing materials, and potential to reduce the impact to ongoing operations in the buildings. Locations may also need to be modified to avoid subsurface utilities, cracks in the foundation, or other features that may limit the reliability of the sampling results. Duplicate samples will be collected, noted on sampling data sheets provided in Appendix D, and submitted to the laboratory as blind duplicates for QA/QC purposes. One blind duplicate sample will be collected per every ten sub-slab soil gas samples.

The Vapor Pins® will be installed to collect a representative sample of soil gas immediately below the floor slab. Sub-slab sampling points will be installed as follows:

- A pilot 1.5-inch-diameter hole will be drilled to a depth of approximately 1.75 inches deep into the concrete slab using an electric hammer drill;
- A 5/8-inch-diameter hole will be drilled through the remaining thickness of the slab and approximately 1 inch into the sub-slab material to form a void;
- The hole will be cleaned of concrete cuttings and dust using a pipe brush;
- A Vapor Pin™ with a silicone sleeve will be placed over the hole and tapped into place using a dead blow hammer (the silicone sleeve will form a water and air tight seal with the concrete); and
- Sub-slab sampling points will be left in place for at least 2 hours to allow for re-equilibration with the surrounding soil prior to QA checks and soil gas sampling (EPA, 2015).

The standard operating procedure for the installation and extraction of the Vapor Pin™ is included as Appendix E.

Following installation, the sampling locations will be subjected to a water dam test or a helium leak check, and a shut-in leak check to confirm that the connections to the ground and within the sample train are air-tight and do not leak. The shut-in leak test SOP is provided in Appendix F.

After equilibration and leak testing, soil gas samples will be collected using 1-liter Summa® canisters with flow controllers set at 200 milliliters per minute. At the completion of sampling, the Vapor Pins® will covered with stainless steel covers for potential future sampling events. The canisters will be sent to a qualified laboratory for analysis of the VOCs listed in Table 4 by Method TO-15.

2.5.3 Indoor Air Sample Collection

To evaluate conditions in indoor air, indoor air samples will be collected from each building designated for further evaluation in Figure 3. Indoor air sample results will be held pending the comparison of sub-slab soil gas results to PSLs. If sub-slab soil gas concentrations exceed Site PSLs, then the corresponding indoor air samples will be analyzed and results will be reported. Only those constituents exceeding their PSL in the sub-slab soil gas samples will be analyzed for in the corresponding indoor air samples.

Indoor air sample locations will be co-located with sub-slab soil gas sample locations where appropriate (i.e., one sub-slab soil gas sample will be collected at each point where an indoor air sample is collected). Proposed indoor air sampling locations are shown on Figure 3. Duplicate samples will be collected, noted on sampling data sheets, and submitted to the laboratory as blind duplicates for quality assurance (QA)/quality control (QC) purposes. One blind duplicate sample will be collected per every ten indoor air samples.

Prior to indoor air sampling, a PID equipped with a 10.6 electron volt (eV) lamp will be used as a general check for the presence of potential sources of VOC vapors in the vicinity of the sampling location. If VOC-containing products are observed at the time of sampling, they will be documented with a photograph, noted on the air sampling data sheet (Appendix D), and may be removed from the building, if appropriate.

Six-liter Summa® canisters equipped with calibrated 8-hour flow regulators will be used to collect the indoor air samples. An 8-hour sampling period was selected to reflect the typical 8-hour business day of the buildings. The canisters will be batch-certified clean by the laboratory prior to use. A sampling field form will be completed for each sampling location; a template form is included in the SAP.

The air intake of each canister will be located at a breathing zone height of approximately three to five feet above the floor surface. To the extent allowable by building and room sizes, indoor air samples will be collected away from exterior windows or doors. During the sampling period as well as at the time of sample retrieval, noticeable changes in the condition of the sampling area, such as changes to the condition or location of objects in proximity to the canisters, will be noted on the air sampling data sheet (Appendix D).

Sampling personnel will check and record the initial vacuum in each canister at the start of each sample. Vacuum readings will be collected at the end of the sampling period as well as periodically throughout the sampling period. All vacuum readings will be recorded on the air sampling data sheet (Appendix D). A vacuum of no less than approximately 5 inches of mercury (in Hg) will remain in the canister to demonstrate that each canister was collecting air throughout the entire sampling period. Residual vacuum in the canister will also be used to document that no additional air was collected during transport of the canister to the analytical laboratory following sampling completion.

Indoor air samples will be held pending the results of the sub-slab soil gas samples as described in Section 6.3.5.1. Indoor (and corresponding outdoor) air samples will only be analyzed at those buildings, if any, where VOCs are detected in sub-slab soil gas samples above PSLs. If analyzed, indoor air samples will be analyzed via USEPA Method TO-15 SIM for the specific list of VOCs in Table 5.

2.5.4 Outdoor Ambient Air Sample Collection

Outdoor ambient air samples will be collected concurrent with indoor air sampling. One outdoor ambient air sample location will be collected per building, as appropriate. Depending on weather conditions, it may be necessary to cover portions of the Summa® canister.

The outdoor ambient air sample will be collected upwind of the associated building based on weather conditions the day of the sampling event. If the direction of wind cannot be determined by the sampler, a publicly-available weather service will be used. The air intake of each canister will be located at a breathing zone height of approximately three to five feet above the ground surface. To the extent allowed by Site features, air samples will be collected away from buildings (10 to 15 feet) and away from wind obstructions, such as trees. Sampling locations may need to be adjusted to ensure security of the canister during the sampling period.

The outdoor ambient air sample collection will commence up to one hour prior to initiating the indoor air samples and will continue up to 1 hour after the indoor air monitoring is complete to ensure that the entire indoor air sampling period is covered by the outdoor ambient air sampling period.

Outdoor ambient air samples will be collected in 6-liter Summa® canisters equipped with a 9-hour flow regulator (to capture the full indoor air sampling period). Canisters will be batch-certified clean by the laboratory prior to use. Deployment, documentation, and vacuum monitoring of the outdoor air samples will follow the same procedures detailed for indoor air sample collection (Section 2.5.3).

Outdoor ambient air samples will be held pending the results of the sub-slab soil gas samples. Outdoor (and corresponding indoor) air samples will only be analyzed at those buildings, if any, where VOCs are detected in sub-slab soil gas samples above PSLs. If analyzed, outdoor air samples will be analyzed via USEPA Method TO-15 SIM for the specific list of VOCs in Table 5.

3. QUALITY CONTROL SAMPLING PROCEDURES

Quality control samples will be obtained during the groundwater sample collection activities. As samples are being collected for laboratory analysis, field duplicates, field blanks, equipment rinsate blanks, matrix spike/matrix spike duplicates, and trip blanks will also be collected as part of the PDI. Specific QC sample types, collection methods, and collection frequency are described in the following sections. The results of the QC samples will be used during validation of the investigative samples in accordance with the procedures and requirements presented in the QAPP. Specific field documentation, numbering, and labeling protocols are included in Section 4 of this FSP.

3.1 FIELD DUPLICATES

Field duplicates will be collected at the ratio of one per every 10 or fewer samples of each media type (soil or groundwater). All QA/QC samples will be submitted for analysis of all parameters for which the associated samples are to be analyzed. Field duplicate samples will be collected from the same depth interval (soil or groundwater), at the same time, and with the same sampling procedures as the investigative sample. Field duplicate samples will be collected in an alternating manner (e.g., one investigative sample vial will be collected, then one duplicate sample vial, etc.).

3.2 EQUIPMENT RINSATE BLANKS

Equipment rinsate blanks ensure that sampling equipment is clean and that the potential for cross contamination has been minimized. Equipment rinsate blanks will only be collected from non-dedicated sampling equipment that is to be re-used during the project (e.g., pumps). As appropriate, equipment rinsate blanks will be collected at a rate of one per 20 samples. Equipment rinsate samples will be prepared by collecting distilled or deionized water that has been poured over or pumped through the decontaminated sampling equipment.

3.3 FIELD BLANKS

Field blanks indicate whether the sample containers are clean and contaminants have not been introduced to the sample from background air conditions. Field blanks will consist of distilled water or deionized water poured from one set of containers to the sampling containers at the sampling site. Field blanks will be collected at a frequency of one per 10 samples, and analyzed for the same parameters as the environmental media samples.

3.4 MATRIX SPIKE/MATRIX SPIKE DUPLICATES

Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a ratio of one per every 20 or fewer samples of each media type (soil or groundwater). MS/MSD samples will be preserved, handled, and delivered to the laboratory following the same procedures as those used for the investigative samples. One sample volume will be collected for the investigative groundwater sample and two additional volumes will be collected for the MS/MSD sample. The investigative and MS/MSD samples will be collected in an alternating fashion, as described above for field duplicate samples.

3.5 TRIP BLANKS

One trip blank, prepared by the laboratory, will be included with each sample cooler delivered to the laboratory and containing water samples for VOC analysis.

4. EQUIPMENT CALIBRATION AND MAINTENANCE PROCEDURES

Hand-held field equipment such as water quality meters used as part of the field investigation or air monitors used as part of health and safety activities will be calibrated at least daily following the manufacturer's recommended calibration process. The results of this calibration will be documented in the field notebook, with the instrument model and serial number, date and time of calibration, and the recorded values during initial calibration and confirmation of calibration. Instrument calibration is crucial in maintaining the integrity of environmental data.

4.1 EQUIPMENT HANDLING

After field cleaning, equipment will be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment will be moved away (preferably upwind) from the cleaning area to prevent recontamination. If the equipment is not to be immediately re-used it will be covered with plastic sheeting or wrapped in aluminum foil to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

4.2 WATER QUALITY METER

The water quality meter will be calibrated at least daily according to the manufacturer's instructions. Conductivity, pH, turbidity, and ORP standard solutions, or a single "Quick-Cal" solution will be used to calibrate individual sensors, as appropriate. Maintenance may include replacement of batteries, or focused cleaning/adjustment of sensors. Troubleshooting will be done according to the manufacturer's instructions with the assistance of technical support.

4.3 ELECTRONIC WATER LEVEL AND PRODUCT THICKNESS METERS

Electronic water level meters and interface probes (product thickness meters) are calibrated by the manufacturer and do not require field calibration. The only maintenance anticipated for electronic water level and interface probe meters is replacement of the batteries. If a meter malfunctions, or the measurements are suspect, use of the meter will be discontinued and the malfunctioning unit will be replaced with a functioning equivalent meter.

4.4 PUMPS AND CONTROLLER

Submersible and/or bladder pumps and associated flow rate controllers will be used during low-flow sampling activities. The pumps and controllers do not require calibration. Maintenance, including motor/ bladder replacement will be performed, as needed, according to the manufacturer's instructions. Malfunctioning equipment will be replaced prior to sampling.

4.5 CALIBRATION OF PHOTOIONIZATION DETECTOR

Photoionization detectors (PIDs) will be used to screen for VOCs in the field. Calibration of the PID meters will be in accordance with manufacturers' instructions. The PIDs will be calibrated daily using 100 ppm isobutylene gas. If the calibration does not complete normally, or if the instrument will not produce the expected reading during the calibration verification (i.e. bump test), the calibration will be repeated. If the calibration does not produce the expected result, a replacement, properly calibrated PID will be used.

5. FIELD DOCUMENTATION, SAMPLE CUSTODY, AND SHIPPING PROCEDURES

5.1 FIELD NOTEBOOKS AND SAMPLING FORMS

Bound, weather resistant field notebooks will be used by all field personnel to record daily activities, observations and issues, and data for which a specific form is not available (see Appendix A, B, D and C) for example forms). Field notebook entries will begin each day with the date, personnel on-Site, task(s) to be completed, and general weather conditions.

5.2 SAMPLE NUMBERING SYSTEM

Each sample will be assigned a unique sample number that will allow tracking and cross referencing of sample information. The sample number will be recorded on the sample container label, in the field notebook, on field sampling forms (if used), and on the chain-of-custody. The sample numbering system will follow a location, depth interval, media type, date format as shown below.

NORMAL SAMPLES

Normal Samples Groundwater (WG) - [Location]-[matrix_code]-[yyyymmdd] e.g. *MW-01-WG-20171127*

Surface water (WS) - [Location]-[matrix_code]-[yyyymmdd] e.g. *SW-01-WS-20171127*

Soil (SO) - [Location]-[matrix_code]-[start_depth]-[end_depth]-[yyyymmdd] e.g. *SB-01-SO-0.5-1.0-20171127*

Most Common Matrix Codes (in order of commonality)

WG – Groundwater

WS – Surface Water

WQ – Water Quality Matrix (use this for trip blanks, equipment blanks, field blanks)

SO – Soil

SE – Sediment

SL - Sludge

AA – Air, Ambient

AI – Air, Indoor

AE – Air, Vapor Extraction

AF – Air, Sub-slab

GS – Soil Gas

CC - Concrete

CS – Composite Soil

PTW – Potable Water

EF – Effluent Water

IN – Influent Water

ACM – Asbestos Containing Material

TA – Animal Tissue

TI – Insect Tissue

TP – Plant Tissue

Quality Control Samples

Field Blank – FB-[##]-[matrix_code]-[yyyymmdd] e.g. *FB-01-WQ-20171127*

Trip Blank – TB-[##]-[matrix_code]-[yyyymmdd] e.g. *TB-01-WQ-20171127*

Equipment Blank – EB[##]-[matrix_code]-[yyyymmdd] e.g. *EB-01-WQ-20171127*

Blind Field Duplicates [sample_type_code]-[##]-[matrix_code]-[yyyymmdd] e.g. *FD-01-WG-20171127*

5.3 CONTAINER LABELING

After placing the sample into an appropriate container, the field sampler will affix a properly completed sample label. If not printed by a computer, the information should be hand-written on the label in capital letters, making sure the number 5 and the letter "S" are clearly different. All samples will be identified with labels that are securely attached to the sample containers. Each label will include the following information:

- Unique sample identification, as specified in Section 5.2;
- Site name;
- Name and affiliation of the sampler;
- Date and time of collection;
- Requested analyses; and
- Preservatives used (if any).

All of the information described above will be carefully recorded on the sample label, in the field notebook, field forms (as appropriate), and chain-of-custody for each sample.

5.4 CHAIN-OF-CUSTODY REQUIREMENTS

The possession and proper transfer of samples and sample-related information will be traceable from the time the samples are collected until the data have been accepted for analysis. A person who has samples in custody must comply with these Chain-of-Custody Procedures. During collection, analysis and final disposition, a sample is considered to be under a person's custody when:

- The samples are in a person's physical possession;
- Are in view of the person after taking possession;
- Are secured by that person so that no one can tamper with it; or
- Are secured by that person in an area that is restricted to authorized personnel.

When transferring custody, release of custody and receipt of custody is indicated by a signature on the Chain of Custody form.

5.5 SAMPLE HANDLING AND SHIPPING PROCEDURES

Sample handling and shipping procedures will be performed as follows:

- After sample preservation, where required, wipe off the exterior of the sample containers, tighten caps, complete sample paperwork as indicated in Section 5.3, and attach the sample labels to the sample containers.
- Place the sample containers in a cooler and place packing material around the samples to minimize the possibility of container breakage.
- Add wet ice sealed in plastic bags to maintain the temperature of approximately 4°C.
- Fill the remaining space in the cooler with additional packing material.
- Enclose chain of custody forms and any other shipping or sample documentation accompanying the shipment in a self-sealing plastic bag and place them inside the cooler.
- Close the cooler and seal it with tape. If the cooler has a drain, tape it shut. Seal the coolers with custody seals in such a manner that the custody seal would be broken if the cooler were opened. Then, cover the custody seals with clear plastic tape. If the samples will be delivered by the sampling crew to the laboratory, sealing is not required.

For samples with short hold times, the samples will be shipped on the same day they are collected via an overnight carrier or delivered to the laboratory by the laboratory’s courier. The laboratory will be notified at the time of shipment.

Other samples may be maintained on ice at 4°C or below until a full cooler of samples is accumulated, taking respective holding times into account.

6. REFERENCES

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USEPA, 2017b. *SESD Operating Procedure - Field Measurement of Oxidation Reduction Potential.* SESDPROC-113-R0. Region 4 U.S. Environmental Protection Agency, Science and Ecosystem Support Division. Effective April 26, 2017.

USEPA, 2017c. *SESD Operating Procedure - Field Turbidity Measurement.* SESDPROC-102-R2. Region 4 U.S. Environmental Protection Agency, Science and Ecosystem Support Division. Effective July 7, 2017.

USEPA, 2017d. *SESD Operating Procedure - Groundwater Sampling.* SESDPROC-301-R1. Region 4 U.S. Environmental Protection Agency, Science and Ecosystem Support Division. Effective April 26, 2017.

TABLES

Table 1
Passive Soil Gas Sample Analysis Summary

Constituents	1,1-Dichloroethene 1,2-Dichloroethene (total) cis-1,2-dichloroethene Carbon tetrachloride Chloroform TCE PCE Vinyl chloride
Area	
Building 5 SGS Area	●
Building 6 SGS Area	●
Building 108 SGS Area	●

SGS = Passive Soil Gas Survey

Table 2
Soil Sample Analysis Summary

Method	EPA SW8260B	EPA SW8082
Constituents	1,1-Dichloroethene	Aroclor 1016
	1,2-Dichloroethene (total)	Aroclor 1221
	cis-1,2-dichloroethene	Aroclor 1232
	Carbon tetrachloride	Aroclor 1242
	Chloroform	Aroclor 1248
	TCE	Aroclor 1254
	PCE	Aroclor 1260
	Vinyl chloride	
Soil Sample Location		
Surface Soil Samples in former recreation area		●
DPT subsurface Soil Samples in Building 5 SGS area	●	
DPT subsurface Soil Samples in Building 6 SGS area	●	
DPT subsurface Soil Samples in Building 108 SGS area	●	
DPT Subsurface soil samples adjacent to former solvent storage buildings	●	

Table 3
Groundwater Sample Analysis Summary

Method	EPA SW8260B	EPA SW6010D	EPA RSK-175	NEMI SM AN2320B	NEMI SM4500-CO2 D	EPA SW9056
Constituents	1,1-Dichloroethene	manganese	ethane	carbonate/bicarbonate alkalinity	CO2	nitrate
	1,2-Dichloroethene (total) cDCE	ferrous iron	ethene			sulfate
	Carbon tetrachloride					
	Chloroform					
	TCE					
	PCE					
	Vinyl chloride					
Well ID						
MW-09	●	●	●	●	●	●
MW-10	●	●	●	●	●	●
MW-14	●					
MW-19	●					
MW-20	●					
MW-21	●					
MW-28	●					
MW-29	●					
MW-30	●					
MW-31	●					
MW-32	●					
MW-33	●					
MW-34R	●	●	●	●	●	●
MW-35	●					
MW-36	●					
MW-37	●					
MW-38	●					
MW-39	●	●	●	●	●	●
MW-40	●					
MW-42	●					
Well ID	●					
MW-43	●					
MW-44	●					
MW-45	●					
MW-47	●	●	●	●	●	●
MW-48R	●	●	●	●	●	●
MW-49	●	●	●	●	●	●
MW-51	●	●	●	●	●	●

Table 3
Groundwater Sample Analysis Summary

Method	EPA SW8260B	EPA SW6010D	EPA RSK-175	NEMI SM AN2320B	NEMI SM4500-CO2 D	EPA SW9056
Constituents	1,1-Dichloroethene	manganese	ethane	carbonate/bicarbonate alkalinity	CO2	nitrate
	1,2-Dichloroethene (total) cDCE	ferrous iron	ethene			sulfate
	Carbon tetrachloride					
	Chloroform					
	TCE					
	PCE					
	Vinyl chloride					
Well ID						
MW-55	●					
MW-56	●	●	●	●	●	●
MW-57	●					
MW-58	●					
MW-60	●					
MW-61	●					
MW-62	●	●	●	●	●	●
MW-62A	●	●	●	●	●	●
MW-63	●					
MW-64	●					
MW-65	●					
MW-66	●	●	●	●	●	●
MW-67	●					
MW-68	●	●	●	●	●	●
MW-69	●					
MW-70	●	●	●	●	●	●
MW-70A	●	●	●	●	●	●
MW-71	●					
MW-72	●					
MW-73	●	●	●	●	●	●
MW-75	●					
MW-75A	●					
MW-76	●					
MW-76A	●					
MW-80	●	●	●	●	●	●
MW-80A	●					
MW-82	●					

Table 3
Groundwater Sample Analysis Summary

Method	EPA SW8260B	EPA SW6010D	EPA RSK-175	NEMI SM AN2320B	NEMI SM4500-CO2 D	EPA SW9056
Constituents	1,1-Dichloroethene	manganese	ethane	carbonate/bicarbonate alkalinity	CO2	nitrate
	1,2-Dichloroethene (total) cDCE	ferrous iron	ethene			sulfate
	Carbon tetrachloride					
	Chloroform					
	TCE					
	PCE					
	Vinyl chloride					
Well ID						
DPT groundwater samples in Building 5 SGS area	●					
DPT groundwater samples in Building 6 SGS area	●					
DPT groundwater samples in Building 108 SGS area	●					
DPT groundwater samples adjacent to former solvent storage buildings	●					
Inactive on-Site water supply well	●					
Active water supply well GHW-01	●					
Active water supply well AWL-06	●					

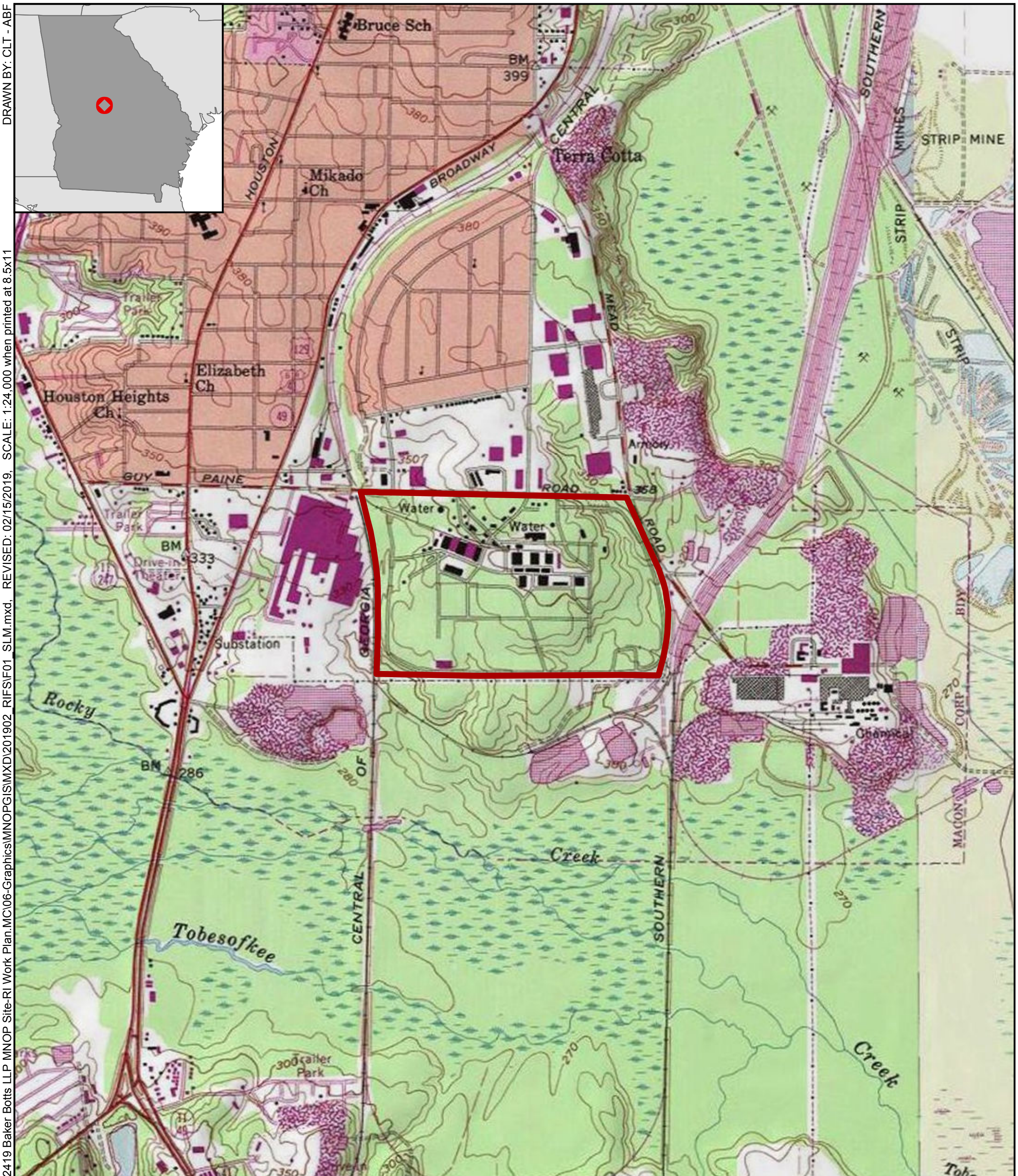
Table 4
Sub-Slab Soil Vapor Sample Analysis Summary

Method	EPA TO-15
Constituents	tetrachloroethene
	trichloroethene
	1,1-dichloroethene
	cis-1,2-dichloroethene
	trans-1,2-dichloroethene
	vinyl chloride
Building	
Building 5 Vapor Pin Samples	●
Building 6 Vapor Pin Samples	●
Wolseley Industrial Group Building Vapor Pin Samples	●
Freudenberg SW Building Vapor Pin Samples	●
Synergy Logistics LLC Building Vapor Pin Samples	●
Gulfeagle Supply Building Vapor Pin Samples	●
NotNorth LLP Building Vapor Pin Samples	●
Building 106 Vapor Pin Samples	●

Table 4
Indoor Air / Outdoor Air Sample Analysis Summary

Method	EPA TO-15 SIM
Constituents	tetrachloroethene trichloroethene 1,1-dichloroethene cis-1,2-dichloroethene trans-1,2-dichloroethene vinyl chloride
Building	
Building 5 Indoor Air	●
Building 6 Indoor Air	●
Wolseley Industrial Group Building Indoor Air	●
Freudenberg SW Building Indoor Air	●
Synergy Logistics LLC Building Indoor Air	●
Gulfeagle Supply Building Indoor Air	●
NotNorth LLP Building Indoor Air	●
Building 106 Indoor Air	●
Building 5 Outdoor Air	●
Building 6 Outdoor Air	●
Wolseley Industrial Group Building Outdoor Air	●
Freudenberg SW Building Outdoor Air	●
Synergy Logistics LLC Building Outdoor Air	●
Gulfeagle Supply Building Outdoor Air	●
NotNorth LLP Building Outdoor Air	●
Building 106 Outdoor Air	●

FIGURES



Legend

Site Boundary

Environmental
Resources
Management
www.erm.com
ERM

N

0 3,000

Feet

1:24,000 1 inch = 2,000 feet

Figure 1
Site Location Map
Field Sampling Plan
Macon Naval Ordinance
Plant Superfund Site
Bibb County, Georgia

DRAWN BY: CLT - ABF

\\usatldc01\data\Atlanta\Projects\0482419 Baker Botts LLP MNOP Site-RI Work Plan.MC\06-Graphics\MNOPGIS\MXD\201902_RIFS\F01_SLM.mxd, REVISED: 02/15/2019, SCALE: 1:24,000 when printed at 8.5x11

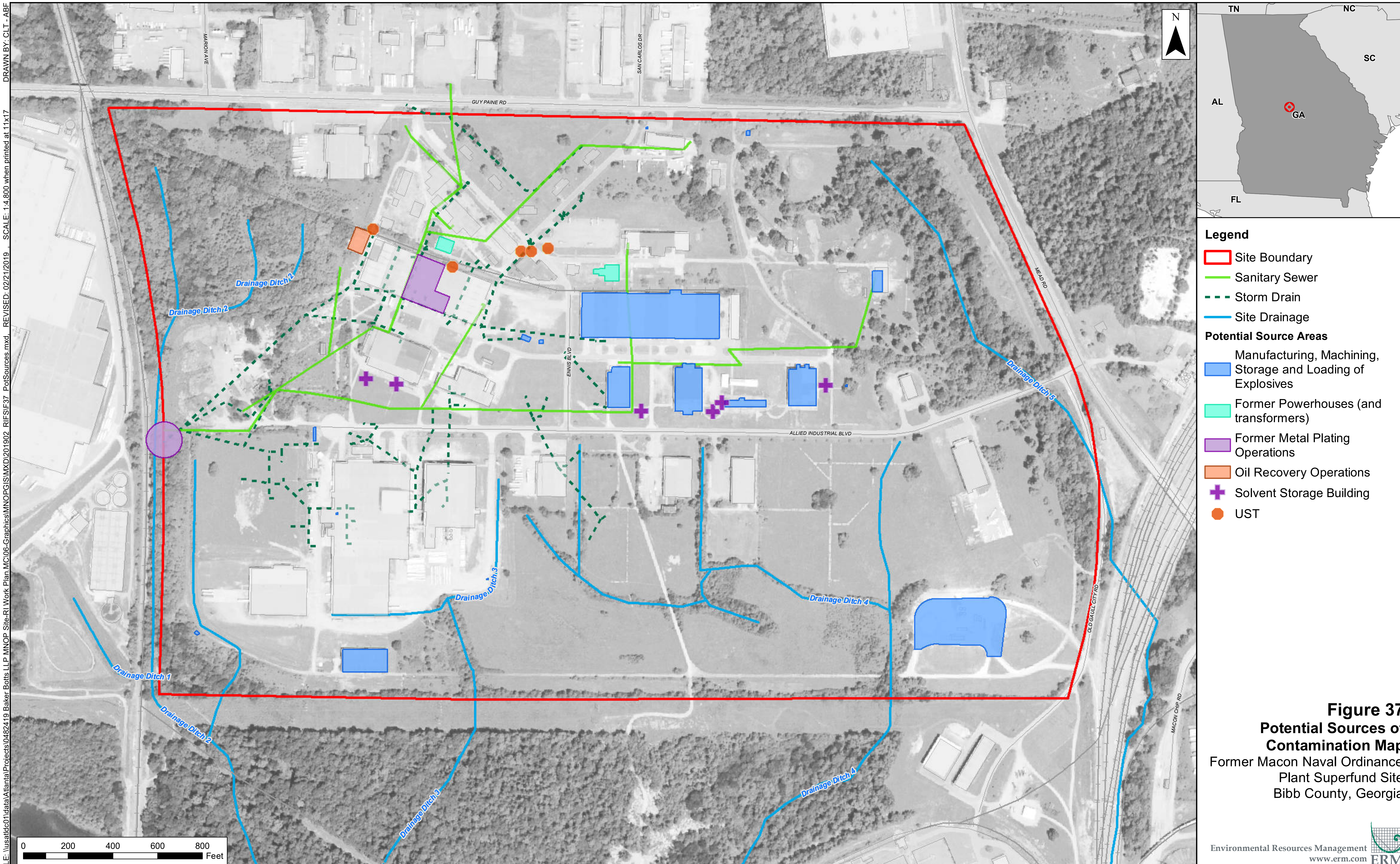
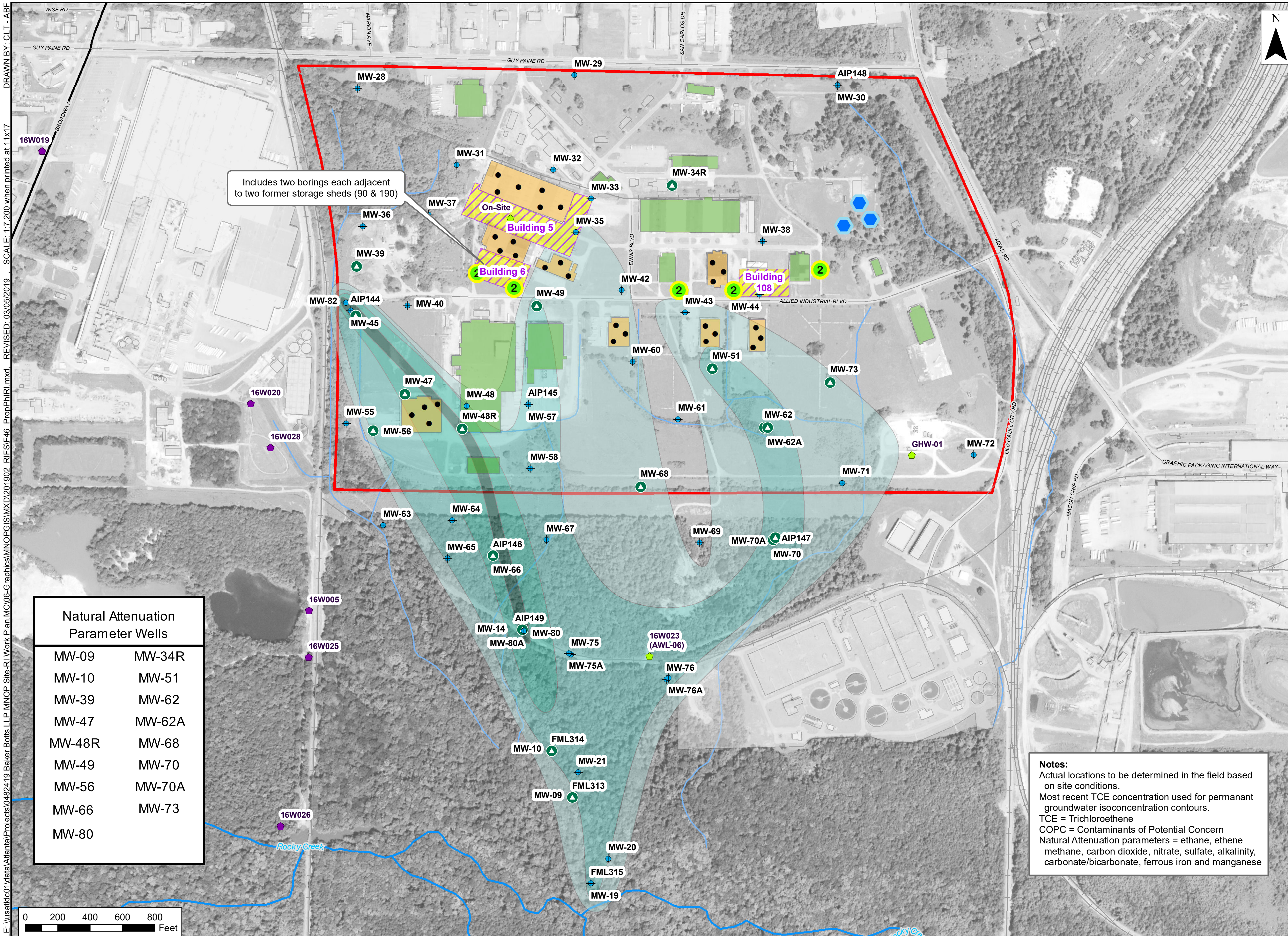


Figure 37
Potential Sources of Contamination Map
Former Macon Naval Ordinance Plant Superfund Site
Bibb County, Georgia

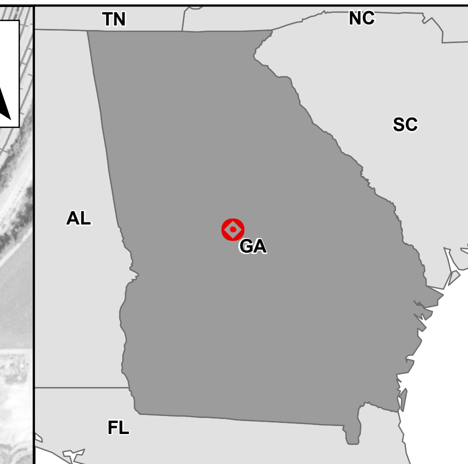
Source: , Bibb County GIS

FILE: \\usatldc01data\Atlanta\Projects\0482419 Baker Botts LLP MNOP Site-RI Work Plan.MC\06-Graphics\MNOPGIS\MXD\201902_RIFS\F37_PotSources.mxd, REVISED: 02/21/2019, SCALE: 1:4,800 when printed at 11x17, DRAWN BY: CLT - ABF



Natural Attenuation Parameter Wells

MW-09	MW-34R
MW-10	MW-51
MW-39	MW-62
MW-47	MW-62A
MW-48R	MW-68
MW-49	MW-70
MW-56	MW-70A
MW-66	MW-73
MW-80	



Legend

Proposed Sample Locations

- Two DPT Borings Adjacent to each Former Solvent Storage Shed
- Proposed Surface PCB Sample Location (shallow)
- Proposed Area of Passive Soil Gas Survey & DPT Investigation
- Wells to be Sampled for COPCs
- Wells to be Sampled for COPCs and Natural Attenuation Parameters
- Water Supply Wells to be sampled for COPCs
- Other Water Supply Wells
- Site Boundary
- River / Stream
- Site Drainage

TCE Isoconcentration Contours

- > 5,000 ug/L
- > 500 ug/L
- > 50 ug/L
- > 5 ug/L
- Building included for further VI evaluation
- Building excluded from further VI evaluation
- Building no longer exists
- Proposed co-located indoor air and sub-slab soil gas sample location

Notes:
Actual locations to be determined in the field based on site conditions.
Most recent TCE concentration used for permanant groundwater isoconcentration contours.
TCE = Trichloroethene
COPC = Contaminants of Potential Concern
Natural Attenuation parameters = ethane, ethene methane, carbon dioxide, nitrate, sulfate, alkalinity, carbonate/bicarbonate, ferrous iron and manganese

Figure 3
Proposed Phase I Remedial Investigation
Field Sampling Plan
Macon Naval Ordinance Plant Superfund Site
Bibb County, Georgia

Environmental Resources Management
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FILE: \\usatldc01data\Atlanta\Projects\0482419 Baker Botts LLP MNOP Site-RI Work Plan.MC\06-Graphics\MNOPGIS\MXD\201902_RIFS\F46_PropPhRI.mxd REVISED: 03/05/2019 SCALE: 1:7,200 when printed at 11x17 DRAWN BY: CLT - ABF

Source:

APPENDIX A WATER LEVEL SURVEY / WELL INSPECTION FIELD FORM

Macon Naval Ordnance Plant Water Level Survey / Well Inspection Form

Water levels gauged on: *Samplers:*

Well ID	Time gauged	Water level	Total depth	Date/time sampled	Well Condition	Duplicate collected?	Comments/ well condition issues
MW-09					good ☐ damaged ☐	Y☐ N☐	
MW-10					good ☐ damaged ☐	Y☐ N☐	
MW-14					good ☐ damaged ☐	Y☐ N☐	
MW-19					good ☐ damaged ☐	Y☐ N☐	
MW-20					good ☐ damaged ☐	Y☐ N☐	
MW-21					good ☐ damaged ☐	Y☐ N☐	
MW-28					good ☐ damaged ☐	Y☐ N☐	
MW-29					good ☐ damaged ☐	Y☐ N☐	
MW-30					good ☐ damaged ☐	Y☐ N☐	
MW-31					good ☐ damaged ☐	Y☐ N☐	
MW-32					good ☐ damaged ☐	Y☐ N☐	
MW-33					good ☐ damaged ☐	Y☐ N☐	
MW-34R					good ☐ damaged ☐	Y☐ N☐	
MW-35					good ☐ damaged ☐	Y☐ N☐	
MW-36					good ☐ damaged ☐	Y☐ N☐	
MW-37					good ☐ damaged ☐	Y☐ N☐	
MW-38					good ☐ damaged ☐	Y☐ N☐	
MW-39					good ☐ damaged ☐	Y☐ N☐	
MW-40					good ☐ damaged ☐	Y☐ N☐	
MW-42					good ☐ damaged ☐	Y☐ N☐	

NOTE:
Well condition recconnaissance includes observation of casing integrity, lock, label and survey mark. If all are present and in good condition, mark 'good'. If not, mark 'damaged' and specify the condition in 'comments'.

Macon Naval Ordnance Plant Water Level Survey / Well Inspection Form

Well ID	Time gauged	Water level	Total depth	Date/time sampled	Well Condition	Duplicate collected?	Comments/ well condition issues
MW-43					good □ damaged □	Y☐ N☐	
MW-44					good □ damaged □	Y☐ N☐	
MW-45					good □ damaged □	Y☐ N☐	
MW-47					good □ damaged □	Y☐ N☐	
MW-48R					good □ damaged □	Y☐ N☐	
MW-49					good □ damaged □	Y☐ N☐	
MW-51					good □ damaged □	Y☐ N☐	
MW-55					good □ damaged □	Y☐ N☐	
MW-56					good □ damaged □	Y☐ N☐	
MW-57					good □ damaged □	Y☐ N☐	
MW-58					good □ damaged □	Y☐ N☐	
MW-60					good □ damaged □	Y☐ N☐	
MW-61					good □ damaged □	Y☐ N☐	
MW-62					good □ damaged □	Y☐ N☐	
MW-62A					good □ damaged □	Y☐ N☐	
MW-63					good □ damaged □	Y☐ N☐	
MW-64					good □ damaged □	Y☐ N☐	
MW-65					good □ damaged □	Y☐ N☐	
MW-66					good □ damaged □	Y☐ N☐	
MW-67					good □ damaged □	Y☐ N☐	
MW-67					good □ damaged □	Y☐ N☐	

NOTE:
Well condition recconnaissance includes observation of casing integrity, lock, label and survey mark. If all are present and in good condition, mark 'good'. If not, mark 'damaged' and specify the condition in 'comments'.

Macon Naval Ordnance Plant Water Level Survey / Well Inspection Form

Well ID	Time gauged	Water level	Total depth	Date/time sampled	Well Condition	Duplicate collected?	Comments/ well condition issues
MW-69					good ☐ damaged ☐	Y☐ N☐	
MW-70					good ☐ damaged ☐	Y☐ N☐	
MW-70A					good ☐ damaged ☐	Y☐ N☐	
MW-71					good ☐ damaged ☐	Y☐ N☐	
MW-72					good ☐ damaged ☐	Y☐ N☐	
MW-73					good ☐ damaged ☐	Y☐ N☐	
MW-75					good ☐ damaged ☐	Y☐ N☐	
MW-75A					good ☐ damaged ☐	Y☐ N☐	
MW-76					good ☐ damaged ☐	Y☐ N☐	
MW-76A					good ☐ damaged ☐	Y☐ N☐	
MW-80					good ☐ damaged ☐	Y☐ N☐	
MW-80A					good ☐ damaged ☐	Y☐ N☐	
MW-82					good ☐ damaged ☐	Y☐ N☐	
					good ☐ damaged ☐	Y☐ N☐	
					good ☐ damaged ☐	Y☐ N☐	
					good ☐ damaged ☐	Y☐ N☐	
					good ☐ damaged ☐	Y☐ N☐	
					good ☐ damaged ☐	Y☐ N☐	
					good ☐ damaged ☐	Y☐ N☐	
					good ☐ damaged ☐	Y☐ N☐	

NOTE:
Well condition recconnaissance includes observation of casing integrity, lock, label and survey mark. If all are present and in good condition, mark 'good'. If not, mark 'damaged' and specify the condition in 'comments'.

APPENDIX B LOW FLOW GROUNDWATER SAMPLING FIELD FORM

GROUNDWATER SAMPLING LOG SHEET

Client: ____________________ Project No.: ____________________ Sampling Date: ____________________

Site: ____________________ Location: ____________________ Sampler's Name: ____________________

Well ID: ____________________ Pump Type/Model: ____________________ Sample Collection Time: ____________________

Total Depth (ft)[1]: ____________________ Tubing Material: ____________________ Sample Purge Rate (L/min)[3]: ____________________

Depth to Water (ft): ____________________ Pump Intake Depth (ft): ____________________ Sample ID: ____________________

Well Diameter (in): ____________________ Start/Stop Purge Time: ____________________ Laboratory Analyses: ____________________

Well Volume (gal) = $0.041d^2h$: ____________________ Purge Rate (L/min)[2]: ____________________

Well Volume (L) = gal * 3.785: ____________________ Total Purge Volume (L): ____________________

d = well diameter (inches) h = length of water column (feet) Purge Method: Low-Flow Well Volume Other: __________ QA/QC Collected? ____________________

Well Type: Flush Stick Up Sampling Method: Pump Discharge Other: __________ QA/QC I.D. ____________________

Well Lock: Yes No

Well Bolted: Yes No Bolts Needed: __________

Well Cap Condition: Good Replace Other __________ **All sample containers requiring chemical preservation properly preserved prior to demob from well? Yes No**

Well Tag Present: Yes No Water in Vault: Yes No

Time	Temp. (°C)	Spec. Cond. (µS/cm)	DO (mg/L)	pH (SU)	ORP (mV)	Turbidity (NTUs)	Purge Rate (mL/min)	Purged Volume (L)	H_2O Depth (ft btoc)	Notes (Purge method, water clarity, odor, purge rate, issues with pump/well/weather/etc.)
Stabilizing Criteria[4, 5]		**+/- 3%**	**10% (see note below) [9]**	**+/- 0.1 unit**		**+/- 10% or <10 NTUs**	**>100 mL < 500 mL**	**>3L**	**<0.33 ft**	

(1) - Maximum purge rate of 250 mL/min
(2) - Sample rate to be between 100 mL/min and 250 mL/min
(3) - Collect sample from pump discharge without tubing contacting sample container
(4) - Field parameter measurements to be recorded every 3 to 5 minutes.
(5) - Stabilization criteria based on three most recent consecutive measurements.
(6) - Monitor depth to water every 3 to 5 minutes. Well drawdown to be 0.5 ft or less. Purge/sampling rate to be lowered as necessary to keep drawdown below 0.5 ft.
(7) - Contact field team lead if drawdown > 0.5 ft - do not switch to 3 well volume method until instructed
(8) - Preserve all samples as appropriate immediately following collection
(9) - DO is not a stabalization criteria for the "Groundwater Sampling" SESD Standard Operating Procedure.

Purge Log QA/QC'd By:
Date:

Purge Log QA/QC'd By:
Date:

APPENDIX C INDOOR AIR QUESTIONAIRE AND BUILDING SURVEY FORM

Environmental Resources Management
1 Beacon Street, 5th Fl
Boston, MA 02108

PRE SAMPLING QUESTIONNAIRE AND BUILDING SURVEY

Preparer's name: ______________________________ Date: ______________________

Preparer's affiliation: ___________________________ Phone #: ___________________

Site Name: __________________________________ Project #: __________________

Part I – Occupants/Property Owners

Occupant Address: ____

Occupant Contact: ___________________ Owner / Renter / other: ___________________

Contact's Phone: home ( )__________ work ( )______________ cell ( )____________

# of occupants in space: Children under age 13 ______ Children age 13-18 ______ Adults _____

Property Owner Address (if different): ____

Property Owner Contact: _______________ Owner / Renter / other: ___________________

Contact's Phone: home ( )__________ work ( )______________ cell ( )____________

# of occupants in building(total):Children under age 13 _ Children age 13-18 ______ Adults _____

Part II – Building Characteristics

Building type: residential / multi-family residential / office / strip mall / commercial / industrial

Describe building: ________________________________ Year constructed: _________

Sensitive population: day care / nursing home / hospital / school / other (specify): ______________

Number of floors below grade: ______ (full basement / crawl space / slab on grade)

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Number of floors at or above grade: _______

Depth of basement below grade surface: _______ ft. Basement size: ________ ft^2

Basement floor construction: concrete / dirt / floating / stone / other (specify): __________________

Foundation walls: poured concrete / cinder blocks / stone / other (specify) __________________

Basement sump present? *Yes / No* Sump pump? *Yes / No* Water in sump? *Yes / No*

Groundwater on floor? *Yes / No*

Type of heating system (circle all that apply):

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

other (specify): ___________________________

Type of ventilation system (circle all that apply):

central air conditioning	mechanical fans	bathroom ventilation fans
individual air conditioning units	kitchen range hood fan	outside air intake

other (specify): ___________________

Type of fuel utilized (circle all that apply):

Natural gas / electric / fuel oil / wood / coal / solar / kerosene

Describe duct work if any (include supply and cold air return ductwork, and its current condition where visible, including whether there is a cold air return and the tightness of duct joints)

____
____
____
____
____

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Boston, MA 02108

Provide a general description of activities in the space. Include commercial activities of business by floor or general use of each floor of each residence.

____
____
____
____
____

Are the basement walls or floor sealed with waterproof paint or epoxy coatings? *Yes / No*

Is there a whole house fan? *Yes / No*

Septic system? *Yes / Yes (but not used) / No*

Irrigation/private well? *Yes / Yes (but not used) / No*

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

Existing subsurface depressurization (radon) system in place? *Yes / No* *active / passive*

Sub-slab vapor/moisture barrier in place? *Yes / No*
Type of barrier: ______________________________

Part III - Outside Contaminant Sources

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

Heavy vehicular traffic nearby (or other mobile sources): ____

____

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Boston, MA 02108

Part IV – Indoor Contaminant Sources (if Indoor Air sampling is occurring)

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

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

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Boston, MA 02108

List specific products found that have the potential to affect indoor air quality (if indoor air samples are to be collected). Do not open a container to determine the contents or to take a field instrument reading. If field measurements are collected they will be from around the closed container only.

Location	**Product Description**	**Size (units)**	**Chemical Ingredients**	**Field Instrument Reading (units)**	**Removed?** <u>**Y/N**</u>

* Describe the condition of the product containers as Unopened (UO), Used (U), or Deteriorated (D)

** Photographs of the front and back of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible

Part V – Miscellaneous Items

Do any occupants of the building smoke? *Yes / No* How often? _______________

Last time someone smoked in the building? ____________ hours / *days ago*

Does the building have an attached garage directly connected to living space? *Yes / No*

If so, is a car usually parked in the garage? *Yes / No*

Are gas-powered equipment or cans of gasoline/fuels stored in the garage? *Yes / No*

Do the occupants of the building have their clothes dry cleaned? *Yes / No*

If yes, how often? weekly / monthly / 3-4 times a year

Do any of the occupants use solvents in work? *Yes / No*

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? *Yes / No*

Have any pesticides/herbicides been applied around the building or in the yard? *Yes* / No

If so, when and which chemicals? ____

Has there ever been a fire in the building? *Yes / No* If yes, when? ______________

Has painting or staining been done in the building in the last 6 months? *Yes / No*

If yes, when ___________________ and where? ______________________________

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Boston, MA 02108

Part VI – Sampling Information

Sample Technician: ___________________________________ Phone number: ( ) _______ - __________

Company: ____

Sample Type (check all that apply): Indoor Air / Sub-Slab / Near Slab Soil Gas / Exterior Soil Gas

Sample locations (floor, room):

SAMPLING DATA – See Air sampling Data Sheet

Environmental Resources Management
1 Beacon Street, 5th Fl
Boston, MA 02108

-Drawing of Sample Location(s) in Building

Type of field instrument used (include summary of results): ______________________________

Part VII - Meteorological Conditions

Was there significant precipitation within 12 hours prior to (or during) the sampling event? *Yes / No*

Describe the general weather conditions: ____

____

Part VIII – General Observations

Provide any information that may be pertinent to the sampling event and may assist in the data interpretation process.

____

____

____

APPENDIX D AIR SAMPLE COLLECTION FIELD FORM

Project #:	
Project Name:	
Location:	
Project Manager:	

Sample Location:		**Collector(s):**	
Address:			
PID Meter Used: (Model, Serial #)		**Date:**	

Sample ID:

Duplicate Sample? (Y/N) **Duplicate Sample ID:**

Type of sample (circle one): INDOOR AIR AMBIENT AIR SOIL GAS

Photograph description:

Summa® Information - Sampling Duration:

Canister Serial Number:	Flow Controller Number:
Start Date/Time:	Stop Date/Time:
Start Pressure: (inches Hg)	Stop Pressure: (inches Hg)

Other Sampling Information:

Story/Level		Ground Surface (pavement, flooring)		Depth of Vapor Probe (if applicable)	
Room		Slab thickness (if applicable)		Distance to building (if applicable)	
Air Temp (ºC)		Potential Vapor Pathways Observed?		Intake Tubing used?	
Intake Height Above Ground Level (m)		PID Reading (ppm)?		Distance to nearest Roadway (m)	
Noticeable Odor?		Barometric Pressure ("Hg or mb)		Other	

Interim Monitoring - Check pressure periodically during sampling event and record below:

Initial Sample Purge (soil gas only):	**Time:**	**PID Reading (ppm):**	**Noticeable Odor? (Y/N)**	**Summa Pressure (inches Hg):**
Reading #1:				
Reading #2:				
Reading #3:				
Reading #4:				
Reading #5:				

Sketch of Sample Location:

Comments:

Signature: ____

APPENDIX E VAPOR PIN STANDARD OPERATING PROCEDURE

Standard Operating Procedure
Installation and Extraction
of the Vapor Pin™

December 3, 2013

Scope:

This standard operating procedure describes the installation and extraction of the Vapor Pin™ for use in sub-slab soil-gas sampling.

Purpose:

The purpose of this procedure is to assure good quality control in field operations and uniformity between field personnel in the use of the Vapor Pin™ for the collection of sub-slab soil-gas samples.

Equipment Needed:

- Assembled Vapor Pin™ [Vapor Pin™ and silicone sleeve (Figure 1)];
- Hammer drill;
- 5/8-inch diameter hammer bit (Hilti™ TE-YX 5/8" x 22" #00206514 or equivalent);
- 1½-inch diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent) for flush mount applications;
- ¾-inch diameter bottle brush;
- Wet/dry vacuum with HEPA filter (optional);
- Vapor Pin™ installation/extraction tool;
- Dead blow hammer;
- Vapor Pin™ flush mount cover, if desired;
- Vapor Pin™ protective cap; and
- VOC-free hole patching material (hydraulic cement) and putty knife or trowel.

Figure 1. Assembled Vapor Pin™.

Installation Procedure:

1) Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding.

2) Set up wet/dry vacuum to collect drill cuttings.

3) If a flush mount installation is required, drill a 1½-inch diameter hole at least 1¾-inches into the slab.

4) Drill a 5/8-inch diameter hole through the slab and approximately 1-inch into the underlying soil to form a void.

5) Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.

6) Place the lower end of Vapor Pin™ assembly into the drilled hole. Place the small hole located in the handle of the extraction/installation tool over the Vapor Pin™ to protect the barb fitting and cap, and tap the Vapor Pin™ into place using a dead blow hammer (Figure 2). Make sure

the extraction/installation tool is aligned parallel to the Vapor Pin™ to avoid damaging the barb fitting.

Figure 2. Installing the Vapor Pin™.

For flush mount installations, unscrew the threaded coupling from the installation/extraction handle and use the hole in the end of the tool to assist with the installation (Figure 3).

Figure 3. Flush-mount installation.

During installation, the silicone sleeve will form a slight bulge between the slab and the Vapor Pin™ shoulder. Place the protective cap on Vapor Pin™ to prevent vapor loss prior to sampling (Figure 4).

Figure 4. Installed Vapor Pin™.

7) For flush mount installations, cover the Vapor Pin™ with a flush mount cover, using either the plastic cover or the optional stainless-steel Secure Cover.

8) Allow 20 minutes or more (consult applicable guidance for your situation) for the sub-slab soil-gas conditions to equilibrate prior to sampling.

9) Remove protective cap and connect sample tubing to the barb fitting of the Vapor Pin™ (Figure 5).

Figure 5. Vapor Pin™ sample connection.

10) Conduct leak tests in accordance with applicable guidance. If the method of leak testing is not specified, an attractive alternative can be the use of a water dam and vacuum pump, as described in SOP Leak Testing the Vapor Pin™ via Mechanical Means (Figure 6).

Figure 6. Water dam used for leak detection.

11) Collect sub-slab soil gas sample. When finished sampling, replace the protective cap and flush mount cover until the next sampling event. If the sampling is complete, extract the Vapor Pin™.

Extraction Procedure:

1) Remove the protective cap, and thread the installation/extraction tool onto the barrel of the Vapor Pin™ (Figure 7). Continue turning the tool to assist in extraction, then pull the Vapor Pin™ from the hole.

Figure 7. Removing the Vapor Pin™.

2) Fill the void with hydraulic cement and smooth with the trowel or putty knife. Urethane caulk is widely recommended for installing radon systems and can provide a tight seal, but it could also be a source of VOCs during subsequent sampling.

3) Prior to reuse, remove the silicone sleeve and discard. Decontaminate the Vapor Pin™ in a hot water and Alconox® wash, then heat in an oven to a temperature of 130° C.

The Vapor Pin™ to designed be used repeatedly; however, replacement parts and supplies will be required periodically. These parts are available on-line at www.CoxColvin.com.

Replacement Parts:

Vapor Pin™ Kit Case - VPC001
Vapor Pins™ - VPIN0522
Silicone Sleeves - VPTS077
Installation/Extraction Tool - VPIE023
Protective Caps - VPPC010
Flush Mount Covers - VPFM050
Water Dam - VPWD004
Brush - VPB026
Secure Cover - VPSCSS001
Spanner Wrench - VPSPAN001

APPENDIX F SHUT-IN TEST KIT INSTRUCTIONS

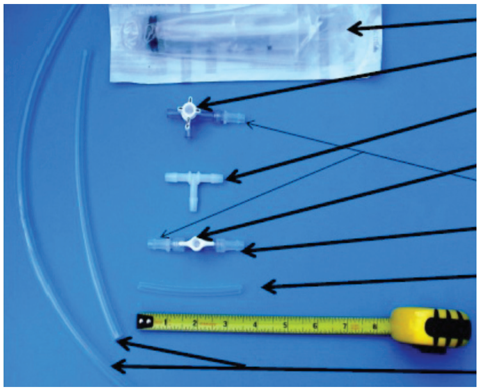
Shut-in Check Kit Instructions

Purpose: To demonstrate above-ground sampling assembly integrity prior to collection of soil gas and sub-slab samples

Important Notice

Alpha Analytical, Inc. provides the components for Shut-in Check assembly with no actual or implied warrantee. The directions are intended to supplement users' standard operating procedures for conducting field sample collection. Alpha Analytical provides this as a service and is not directly or indirectly responsible for the field performance of these checks. The components are supplied from Laboratory vendors and it is recommended that they are stored in an environment free from VOC sources prior to single use. Any substitutions of components should be checked before use as they may affect the performance of the checks.

Sample Kit



A. **Syringe**
B. **Stopcock-3 Way**
C. **Nylon T**
D. **Stopcock-1 Way**
E. **2 Male luer Locks**
F. **Female luer Locks**
G. **Teflon ¾ OD Tubing**
H. **Teflon Lined Tygon**

Shut-In Components

The kit contains the basic tubing & fittings, additional tubing and fittings maybe required to meet site specifics sampling needs. It is highly recommended that a practice set up is put together and tested before going into the field.

	Components for Single point Shut-in/Leak check for 1/4" OD sample tubing for Soil Gas Flow Restrictor (<200mls/min) setup	ColePalmer Part #	Quantity
A	60ml disposable Syringe Luer**	EW-07940-30	1
B	Stopcock 3-Way Valve Luer lock	R-30600-02	1
C	Nylon barbed T Connectors – ¼"	R-30623-72	1
D	Stopcock 1-Way Valve Luer lock	EW-30600-00	1
E	Male Luer Lock x ¼" barb hose connection	EW-30800-22	2
F	Female Luer Lock x ¼" barb hose connection	EW-30800-06	1
G	Nalgene® 890 Teflon® FEP Tubing, ¼" OD .	VWR 63014-714	4 ins
H	Teflon-lined Tygon tubing, ¼" ID x ⅜" OD	VWR 63010-224	1 ft & 6ins

Shut in Check Only

Assembly

Tubing should be cut to accommodate the dimensions of the field sampling assembly. For Soil Gas/sub-surface samples typically a 1 liter canister is used. See picture of set up.

¼" OD Teflon Tubing will slide into the ⅜" OD Teflon lined/Tygon tubing. A gas tight seal is made between the tubing surfaces. Care must be taken to ensure that the over lapping surfaces are not damaged or contaminated while the connections are made. Before other manufacturers or types of tubing are used they must be checked for seal tightness: Not all tubing will make gas tight seals!

Use tubing cutters and care should be taken to avoid rough or jagged edges on the cut ends.

Procedure

- Take the 1 liter fused silica-lined canister and attach the pre-set Flow controller (200ml/min) for 1 liter following the canister set up instructions. Finger tighten the connecting nut until the connection is tight and the does not move.
- Slide the Swagelok nut and Teflon ferrule carefully over a short length of Teflon tubing until the tubing protrudes out of the ferrule.
- Cut 2 x 2 ½"lengths of the Teflon-lined Tygon tubing. Carefully slide each length on each of the barb fittings of the "T" fittings. See Picture above. Tygon tubing should be pushed on the barb until it butts up against the stop on the T. These will connect to the FC and the syringe.
- Measure and cut 1 length of Teflon-lined Tygon tubing this will connect the T to the Surface 1 way Stop valve. The tubing should be long enough that the T is horizontal to the inlet of the FC when assembled.
- Attach the a Male Luer lock connector to the Tubing that will connect to the syringe and the Female connector that will connect to the 1 way valve.

Sub-surface probe is installed per the users established protocol, a ¼" tube then protrudes from the subsurface

The 1 way stopcock should be positioned between the sub-surface sample tubing and the above surface sampling assembly.

- Male & female luer lock connectors are attached to the 1-Way stop cock by rotating luer ends into the appropriate fittings on the stop cock. Cut a 2 ½" length of Teflon-lined Tygon and carefully fit on the barb connector of the male Luer lock. This fitting is connected to the tube from the sub-surface.
- Connect the female luer lock fitting (on the above ground assembly side of the valve) is connected to the tubing from the T.
- Attach the 3- Way valve to the male Luer lock on the tubing from the T.
- Attach the Syringe to the 3-Way valve. See completed assembly picture.

The sampling assembly is setup and ready to conduct the shut-in check.

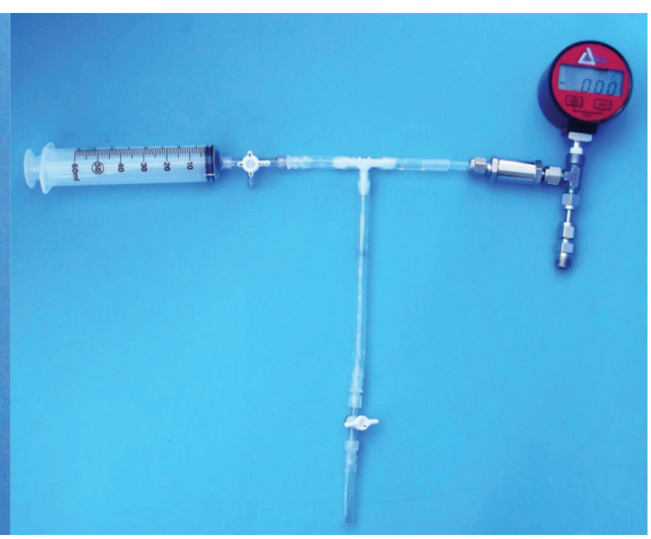
Shut in Check

Important: Practice using the 3–way Stopcock. It's important that vapor is only pulled through the assembly from the sub-surface into the syringe. Whenever the syringe is purged the 3-Way Stopcock position ***must*** isolate the syringe from the sampling assembly..

NOTE: It is recommended that after the sub-surface vapor point (Probe) has been installed and initial purged that a minimum of 2 hours is allowed for sample equilibrium to be reached.

Purge approximately 3–5 volumes of soil gas through the above ground sampling assembly.

[¼" OD thin walled tubing has approximately 5.5mls per foot. When calculating purging volume consideration should be given to the volume of the sampling probe and how the probe has been installed.]



Shut-in Check Procedure

The Canister Valve remains closed through the Shut-in Check procedure.

- Close surface valve, rotate 3-way to isolate the syringe, (Assembly is open to atmosphere) turn on and zero the pressure gauge.
- Rotate the 3-Way stopcock to close connection to atmosphere, isolating the sampling assembly.
- Slowly pull a vacuum on the assembly until the pressure gauge is reading approximately -10" of Mercury. Approx. 10-15 mls measured on the syringe.
- Quickly rotate the 3-Way Stopcock to isolate the sampling assembly. Note the reading on the pressure gauge [~ -10inches for mercury]. Wait a minimum of 1 minute.
- Read the pressure gauge:
  If there is less than > 0.5" mercury drop in pressure. Then the test has demonstrated sufficient integrity to continue sampling. If the pressure drops quicker then stop the test and check / re-tighten the connections in the system and repeat the check until it passes.

When the Shut-in Check passes:

- Open ***only*** the surface 1-Way stopcock slowly. The pressure gauge will return to zero.
- Slowly open the sampling Canister valve while watching the pressure gauge: Record the initial vacuum. The digital meter responds instantaneous record the high number.
  [It should be within 10% of the noted vacuum recorded at the Laboratory on the label attached to the Canister.]

Sampling collection will be completed in approx. 5 minutes.

- Record final vacuum
- Close Canister valve and close surface valve
- Disconnect sampling assembly and replace cap on Canister ensuring that O ring is in place
- Complete documentation and return canister to Alpha Labs.

References:

ASTM D7663 - *12 Standard Practice for Active Soil Gas Sampling in the Vadose Zone for Vapor Intrusion Evaluations*

New Jersey DEP, *Vapor intrusion technical guidance,* Section 3.3.1, 3.5.7 (2013)
CA DTSC, ADVISORY ACTIVE SOIL GAS INVESTIGATIONS Section 4.2 (2012)

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