SITE-SPECIFIC WORK PLAN FOR THE FORMER ADAZA GRAIN STORAGE SITE (IA-601)

FORMER USDA GRAIN FACILITY SITE SCREENING AND PRELIMINARY ASSESSMENTS/SITE INSPECTIONS, IOWA

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FINAL

Prepared for:

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ACRONYMS AND ABBREVIATIONS

AGEM	Applied Geosciences and Environmental Management
Argonne	Argonne National Laboratories
amsl	above mean sea level
bgs	below ground surface
Bluestone	Bluestone Environmental Group, Inc.
CCC	Commodity Credit Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CSP	Certified Safety Professional
CT	Carbon Tetrachloride
DPT	Direct Push Technology
FTL	Field Team Leader
ft	foot/feet
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GW	Groundwater
HCL	hydrochloric acid
IA	Iowa
IAC	Iowa Administrative Code
IDNR	Iowa Department of Natural Resources
IDW	Investigation-Derived Waste
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
MCL	Maximum Contaminant Level
MeOH	Methanol
mg/L	milligrams per liter
mL	milliliter
$NaHSO_4$	Sodium Bisulfate
NRCS	Natural Resources Conservation Service
NRGIS	Natural Resources Geographic Information System
PA	Preliminary Assessment
PE	Professional Engineer
PG	Professional Geologist
PID	Photoionization Detector
PMP	Project Management Professional
PRI	Project Resources, Inc.
PVC	polyvinyl chloride
QC	Quality Control
ROE	Right of Entry
SI	Site Inspection
SOP	Standard Operating Procedure
SP	Screen Point

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SSHO	Site Safety & Health Officer
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WP	Work Plan

1.0 INTRODUCTION

The United States Department of Agriculture (USDA) started a program in the 1940s through the Commodity Credit Corporation (CCC) that would help to stabilize, support, and protect farm incomes and prices while also distributing and maintaining adequate supplies of agricultural products. The program operated on leased properties in Missouri, Nebraska, Kansas, and Iowa. The grain was stored on these properties for extended periods of time due to high grain production and limited commercial storage facilities.

While stored, the grain was fumigated to control destructive insects. The USDA treated the grain with fumigant mixtures consisting of 80% carbon tetrachloride (CT) and 20% carbon disulfide. According to United States Environmental Protection Agency (USEPA) documents, the liquid fumigant was applied at the top level of the grain bins and allowed to flow through the grain and evaporate, fumigating insects and other organisms. CT was used as a pesticide, until its use as a pesticide was banned by the USEPA in 1985.

Residues, spillage, or leakage of the fumigants from containers and during application resulted in soil and groundwater contamination at some sites. While contamination in surface soil is unlikely due to volatility of the suspected contaminants, a greater potential for contamination exists with increasing depth, depending on site subsurface conditions. CT has been detected in soil and groundwater near former grain storage sites by USDA and state regulators and identified to potentially pose a risk to human health or the environment. Previous investigations at other former grain bin sites in USEPA Region 7 have resulted in contaminant concentrations in groundwater exceeding the Maximum Contaminant Level (MCL) for drinking water of 5.0 micrograms per liter (µg/L).

The CCC/USDA is proposing to conduct groundwater sampling at several sites to confirm the presence or absence of contamination in the shallow groundwater underlying the former facilities and to determine whether the sites need further investigation or can be reclassified to Appendix B of the current Intergovernmental Agreement between the Farm Service Agency and the Iowa Department of Natural Resources (IDNR) (USDA, 2023). USDA is coordinating with IDNR as the lead regulatory agency for the investigations in Iowa (IA).

1.1 TECHNICAL OBJECTIVES AND PROJECT SCOPE

Bluestone Environmental Group, Inc. (Bluestone) has been tasked by USDA, under Contract/Order Number: 12FPC424A0003/12FPC425F0037 to conduct expanded site investigations at the following 11 former grain storage sites in IA:

- Galbraith Former Grain Storage Site (IA-649);
- Bradgate-North Former Grain Storage Site (IA-611);
- Highview-West Former Grain Storage Site (IA-662);
- Lavinia Former Grain Storage Site (IA-680);
- Adaza Former Grain Storage Site (IA-601);
- Lanyon Former Grain Storage Site (IA-679);
- Buckeye Former Grain Storage Site (IA-613);
- Austinville Former Grain Storage Site (IA-608);
- Dewar Former Grain Storage Site (IA-634);
- Dinsdale Former Grain Storage Site (IA-635);
- Green Mountain Former Grain Storage Site (IA-653).

This Work Plan (WP) was prepared to guide and direct field procedures at the Former Adaza Grain Storage Site. Preliminary assessments were completed by USEPA Region 7 Superfund Division between 2000 and 2001 at ten of the above listed sites. Initial findings from the Former Adaza Grain Storage Site in Adaza, IA, are summarized in **Section 3.0**. All work will be completed in accordance with applicable Federal, state, and local regulations, as well as industry standards and best management practices.

Field activities will be conducted in accordance with this WP, the USDA Umbrella WP (Argonne National Laboratories [Argonne], 2021) (**Appendix A**), applicable USDA Standard Operating Procedures (SOPs) (Argonne, 2019) (**Appendix B**), Bluestone's task-specific SOPs (**Appendix C**), the Investigation-Derived Waste (IDW) Management Plan (Bluestone, 2024) (**Appendix D**), and the Bluestone Corporate Health and Safety Policy (Bluestone, 2022) (**Appendix E**).

Site investigations are being conducted to determine presence or absence of groundwater contamination or confirm if a release has occurred and meets the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or IA equivalent requirements. Sites with confirmed groundwater contamination that exceed regulatory screening levels may be recommended for further investigation. Sites with no detected contamination or contamination below screening levels may be recommended to be reclassified to Appendix B of the current Intergovernmental Agreement between the Farm Service Agency and IDNR.

1.2 DESIGNATED PROJECT PERSONNEL

Table 1-1: Project Personnel

Title	Name	Organization	Telephone	Email
Program Manager	Lisa Myers, PE, PMP	Bluestone	484-802-5150	lmyers@bluestoneenviro.com
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Project Manager	Mike Badeau, PE	Bluestone	610-306-2966	mbadeau@bluestoneenviro.com
Quality Control (QC) Manager	Virginia Pohlman, PE	Bluestone	610-647-9500 ext. 1029	gpohlman@bluestoneenviro.com
Alternate QC Manager	Florence Sevold	Bluestone	610-647-9500 ext. 1019	fsevold@bluestoneenviro.com
Technical Lead	Ethan Magee, PG	Bluestone	610-554-1879	emagee@bluestoneenviro.com
Field Team Leader (FTL) and Site Safety and Health Officer (SSHO)	Daniel Albanese, PG	Bluestone	610-647-9500 ext. 1017	dalbanese@bluestoneenviro.com
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Senior Geologist	Craig Welsh, PG	Bluestone	402-708-6766	cwelsh@bluestoneenviro.com
Corporate Safety and Health Officer	John Barnhart, CSP	Bluestone	301-606-8996	jbarhnhart@bluestoneenviro.com
Hazardous Waste Program Manager	Kale Horton	USDA	816-399-9107	Kale.Horton@usda.gov

ABBREVIATIONS:
CSP – Certified Safety Professional
PE – Professional Engineer
PG – Professional Geologist
PMP – Project Management Professional

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2.0 SITE INFORMATION

2.1 SITE DESCRIPTION

The former Adaza Grain Storage Site is located at 249 H Ave near Adaza, Greene County, IA 50050. The legal description for the Site is the Southwest 1/4 of the Northwest 1/4 of Section 8, Township 85 North, Range 31 West in the County of Greene, State of Iowa. See **Figure 2-1** for the Site Location.

Bluestone researched the former Adaza Grain Storage Site location through the County Assessor's Office and County Recorder's Office. Assessor records, Recorder records, and previous site investigation reports were used to identify the parcels, legal descriptions, and property owners of the former CCC grain storage facility. Two historical lease records dated 1960 and 1973 were identified during a review of historical documents in the Greene County Recorder of Deeds office. These records document lease agreements between the property owner(s) and the CCC. The lease agreements are included in **Appendix F**. The current assessors' map is included as **Figure 2-2**.

A 1950 aerial photograph, included as **Figure 2-3**, shows approximately 30 grain bins on the site property. Based on aerial photographs, the cylindrical grain bins occupied the majority of the Site. A majority of the grain bins were removed sometime between 1950 and 1973. **Figure 2-4** shows the progression of the Site from 1950 to 1983. The Site covers approximately 1.56 acres and is located at an elevation of approximately 1,116 feet (ft) above mean sea level (amsl).

Currently, the Site is occupied by nine original grain bins, as well as four new build grain bins and associated agricultural equipment. The Site is bordered to the north, east, and south by agricultural fields. The Site is bordered to the west by H Ave, with agricultural land beyond. The location of the nine original grain bins is bounded by a now-defunct railroad bed.

2.2 PHYSICAL SETTING

The Site is located at approximately 1,116 ft amsl and is fairly level. The water table is approximately 30 to 70 ft below ground surface (bgs) (GeoSam, 2025). A preliminary assessment performed at the Site found groundwater at a depth of 7.5 ft bgs (Project Resources, Inc. [PRI], 2001). Groundwater flow direction is estimated to be west towards Happy Run.

According to the IDNR, a domestic, or private, well is one that is connected to no more than 15 individual connections and provides water to no more than 25 individuals per day (IDNR, 2025a). Any well with more than 15 connections providing water to more than 25 individuals per day is considered a public water supply.

Drinking water for the area surrounding the Site is provided by a number of private water supply wells. The nearest public water supply system that could be located is in the City of Churdan, IA (IDNR, 2025b).

Bluestone conducted research of available online records and identified 30 potential drinking water wells within a two mile radius of the Site (IDNR Natural Resources Geographic Information System [NRGIS], 2025) (**Table 2-1**, presented at end of text). The potential drinking water wells are shown on **Figure 2-5**.

Private wells 2196664, 2196874, and 2210172 are potentially downgradient of the Site to the west and are shaded in **Table 2-1**. Wells 2196874 and 2210172 are proposed to be sampled during the initial field investigation. The remaining wells will not need to be sampled as part of the initial site investigation.

Data provided through IDNR NRGIS suggested that the wells discussed above were advanced to depths of 125 to 181 ft bgs (IDNR NRGIS, 2025).

2.3 GEOLOGY

Surficial soils were mapped using the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey (USDA NRCS, 2025). According to the NRCS Web Soil Survey tool, soils at the Site are categorized as 61.5% Canisteo clay loam, 0 to 2 % slopes and 38.5% Webster clay loam, 0 to 2 % slopes. Canisteo clay loam consists of poorly drained soils formed on rims on depressions and ground moraines. Webster clay loam consists of poorly drained soils formed on ground moraines. Permeability of the most limiting layer in the Canisteo clay loam is moderately high to high, while permeability in the Webster clay loam is moderately low to high. Unconsolidated deposits in the region consist of an assortment of clay, silt, sand, and gravel.

The principal bedrock unit mapped in the vicinity of the Site is the lower Middle Pennsylvanian Cherokee Group, which is principally made up of light to dark gray shale and very fine to medium sandstone (Pope et al., 2002). The Cherokee Group has a maximum thickness of 462 ft. Depth to bedrock beneath the Site and surrounding area is approximately 150 to 200 ft bgs (GeoSam, 2025). The direction of regional groundwater flow is unknown but local topography slopes in a slight westerly direction towards Happy Run. Site groundwater flow direction is anticipated to be the same. Groundwater is expected to be encountered in the overburden deposits around 7.5 ft bgs (IDNR NRGIS, 2025).

3.0 PREVIOUS INVESTIGATIONS

PRI and subcontractor Seagull Environmental Technologies, Inc. were tasked by the USEPA Region 7 in 2000 to conduct a pre-Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) screening assessment at the Former Adaza Grain Storage Site. One on-site soil sample, five on-site soil gas samples, one on-site groundwater sample, and five water supply well samples were collected during assessment activities in 2000 (PRI, 2001). All samples were submitted to the USEPA Region 7 laboratory for volatile organic compound (VOC) analysis, with the water samples also being analyzed for ethylene dibromide, nitrate-nitrite, and perchlorate.

Water supply well samples were taken from five water supply wells found within an approximate 1.25-mile radius of the Site in each cardinal direction of the Site, if possible. VOCs were detected in the three drinking water wells (PRI, 2001). Chloromethane was detected at a concentration of 0.58 µg/L in one well. PRI noted that chloromethane could be a naturally occurring compound. Chloromethane does not have an MCL, and PRI noted that it did not exceed the USEPA Region 9 Preliminary Remediation Goal of 1.5 µg/L. Carbon disulfide was detected at a concentration of 19.0 µg/L in one well. PRI noted that the compound was difficult to associate with the Site given that it was not detected in other wells located closer to the Site. Carbon disulfide does not have an MCL, and PRI noted that it did not exceed the USEPA Region 9 Preliminary Remediation Goal of 1,000 µg/L. Chloroform was detected at a concentration of 14.0 µg/L in the well owned by Ron Toliver. The detection of Chloroform did not exceed its MCL, and PRI noted that it was difficult to associate with the Site given that it was not detected in the on-site groundwater sample. No other VOCs were detected in the water supply well samples.

One groundwater sample was collected from a temporary on-site well (PRI, 2001). Toluene was detected in the on-site groundwater sample at a concentration of 0.15 µg/L, which is below its MCL of 1,000 µg/L. PRI noted that a petroleum source may be the origin of the toluene identified on-site. No other VOCs were detected in the on-site groundwater sample.

Soil gas samples collected from the Site yielded results of 17 VOCs detected (PRI, 2001). Chloroform and CT were not detected in any soil gas samples. Carbon disulfide was detected in two soil gas samples at 25 micrograms per cubic meter (µg/m^3) and 23 µg/m^3. PRI noted that while carbon disulfide is a compound that may be associated with grain fumigants, it is difficult to determine whether the detection is associated with grain fumigants due to the absence of other fumigant-related compounds in the on-site samples. All other VOC detections in soil gas samples were not associated with grain fumigants, and the highest concentration among them was 72 µg/m^3 of acetone, which was found in one sample. At the time of writing the report, there existed no health-based benchmark criteria for PRI to compare soil gas data against.

No VOCs were detected in the on-site soil samples (PRI, 2001).

Upon the completion of their report, PRI concluded that no pre-remedial actions were to be taken at the time, as there were no significant impacts on exposure pathways at the Site and no identifiable threats on the local population and environment (PRI, 2001).

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4.0 PROPOSED SITE-SPECIFIC SAMPLING

4.1 FIELD INVESTIGATION

Sampling locations at each site have been determined based on the results of background research and initial assessment. The sampling will be conducted in accordance with procedures in the Umbrella WP (Argonne, 2021) (**Appendix A**) and USDA SOPs (**Appendix B**) provided from the Master WP (Argonne, 2019). All sampling will be performed in accordance with the following SOPs described in the Master WP and included in **Appendix B**:

- Applied Geosciences and Environmental Management (AGEM)-01 Direct Push, Drilling, and Geologic Logging
- AGEM-03 Installation of Piezometers with Direct-Push Equipment
- AGEM-04 Abandonment of Soil Borings, Monitoring Wells, and Piezometers
- AGEM-10 Soil Sampling
- AGEM-11 Handling and Disposal of IDW
- AGEM-13 Soil Gas Sampling for Chemical Analysis
- AGEM-21 Calibration of Field Instrumentation and Photoionization Detector (PID) Operation
- AGEM-22 Equipment Decontamination
- AGEM-23 Handling, Packing, and Shipping of Samples in the Field
- AGEM-27 Sample and Document Management

Sampling will also be conducted in accordance with Bluestone's task specific SOPs included in **Appendix C**.

Bluestone will contact the current property owner at each property by phone to describe the proposed work and request access for sampling. Access approval letters will then be sent to property owners for signature. Once access is granted, the field work will be scheduled.

Groundwater sampling will be conducted at new shallow locations on-site. Four Direct Push Technology (DPT) sampling locations are proposed to include four source area groundwater sample locations. DPT has been chosen as the drilling method to be used based on the anticipated subsurface conditions and anticipated depth to the uppermost groundwater. The following section includes the site-specific sampling plan. USDA and IDNR will be consulted on changes to proposed sample locations.

As discussed in **Section 2.0**, Bluestone identified 30 potential existing private or public water wells within a two-mile radius of the former grain bins. Wells 2196874, and 2210172 are proposed to be sampled as part of this initial field investigation.

Because there are no occupied structures located within 100 ft of the footprint of the former USDA grain storage facility, soil gas sampling is not planned to be conducted at the Site.

4.1.1 DPT Advancement

Bluestone will collect five groundwater samples at the Former Adaza Grain Storage Site. Sample locations were chosen based on the location of the former grain bins and Quonset huts as depicted on the 1950 aerial photograph. Proposed sample locations are listed in **Table 4-1** and depicted on **Figure 4-1**.

Table 4-1: Proposed Sample Locations	
Sample Location Identification	**Sample Location Description**
GW-01	Source area sampling
GW-02	Source area sampling
GW-03	Source area sampling
GW-04	Source area sampling

GW = Groundwater

Utility Clearance

Prior to any intrusive activities, subsurface utility clearance will be conducted to ensure that no buried utilities are damaged. An initial call to "Iowa One Call" (1-900-292-8989, or locally at 811) will be placed to identify any publicly owned utility lines in the area.

A third-party utility locator will then conduct a series of geophysical field tests to identify any subsurface utilities located on private property (i.e., electrical, gas, communication, water, sewer, steam). The private utility survey will verify and mark underground utilities located proximal to proposed sampling locations and will outline safe zones to advance borings, if one or more boreholes must be off set during the progression of work.

Decontamination

A single decontamination pad will be constructed at the Site. The pad will be constructed using waterproof, heavy-duty materials (i.e., geotextile fabric, crushed stone gravel) for the containment of decontamination fluids. The pad will be constructed so that fluids pooled at the bottom may be pumped into 55-gallon drums. The FTL will coordinate with the landowner as to where to stage the decontamination pad on-site. Heavy equipment with direct contact with potentially impacted soil or groundwater will be decontaminated by the subcontractor between all drilling and/or sampling locations. The bulk of soil/debris will be removed from the equipment and left at the area of intrusive work, and the equipment will be decontaminated in place using multiple wash buckets (one with cleaning solution and potable water mixture, and two with potable water) and plastic sheeting as secondary containment. Decontamination fluids will be collected into 55-gallon drums and staged in a way to minimize public contact. Geoprobe sampling rods will be cleaned between sampling locations. Bluestone will inspect and approve each piece of equipment before subsequent use.

Drilling

Groundwater sampling locations will be advanced using DPT in accordance with applicable procedures set forth in AGEM-01: *Direct Push, Drilling, and Geologic Logging* (Argonne, 2019). The boreholes will be drilled to the first encountered groundwater, geologically logged by a geologist, and photographed. During advancement procedures, the breathing zone will be monitored for potentially high levels of VOCs using a PID with an 11.7 electron volt bulb. If groundwater is not encountered prior to the bedrock interface, up to two soil samples will be collected. Following extraction, the soil cores will be immediately screened with a PID to guide sample collection depths. One soil sample will be collected from the interval with the highest PID reading and the second soil sample will be collected from the bottom interval of the borehole. If there are no PID readings above 15 parts per million, a single soil sample will be collected from the bottom interval of the borehole.

4.1.2 Groundwater Sampling

Groundwater sampling will be conducted using a Screen Point (SP) groundwater sampler. The SP-16 sampler will be pushed to groundwater, anticipated to be no further than 14 ft bgs (based on geologic conditions discussed in **Subsection 2.3**). Bluestone will collect one soil boring sample using the DPT rig to identify where groundwater is encountered in the subsurface. The same location will then be redrilled using the SP-16 sampler to collect groundwater samples. Bluestone will adjust the remaining borings based on the results of the soil sample. If recharge volume is low, the drillers will install temporary 1-inch polyvinyl chloride (PVC) with a 5-ft slotted screen where water is encountered. The PVC will remain in place until enough water is available to collect the VOC samples. Groundwater sampling will be completed in accordance with this approved, final site-specific WP.

A Waterra Hydrolift Pump or bailer will be used to collect the groundwater from the temporary well. Dedicated tubing and check valves will be used in conjunction with the Waterra Hydrolift Pump to sample each temporary well. A water quality meter with flow-through cell will be utilized to measure the following water quality parameters: specific conductance, temperature, hydrogen ion activity, field-measured oxidation-reduction potential, dissolved oxygen, and turbidity. The PID and water quality meter will be calibrated according to manufacture specifications and AGEM-21: *Calibration of Field Instrument and PID Operation* (Argonne, 2019). These parameters will be measured to determine the ambient physical and chemical properties of groundwater at the time of sampling; however, stabilization of the parameters will not be attained via purging as the objective is to collect first groundwater encountered in the vadose zone for analysis.

Bluestone will attempt to sample the potential drinking water wells (2196874 and 2210172) identified during IDNR records research and determined to be the two closest downgradient potential drinking water wells located within two miles of the Site. Property owners will be contacted to determine the current status of the well and to obtain permission to sample if the well is currently in use. If possible, water samples from the private wells will be collected directly from the tap.

Groundwater samples will be collected in laboratory-approved containers, preserved immediately at 4°C, and shipped overnight to an environmental laboratory for analysis. Samples will be shipped to Eurofins Lancaster Laboratories Environmental Testing, LLC in Lancaster, Pennsylvania, for analysis of CT and chloroform via USEPA Method 524.2. Samples will be handled in accordance with SOP AGEM-23: *Handling, Packing, and Shipping of Samples* (Argonne, 2019). This sampling approach is based on procedures in the Umbrella WP (Argonne, 2021) and SOPs provided from the Master WP (Argonne, 2019). The sampling methodology is summarized in **Table 4-2**.

Groundwater samples will be analyzed at the environmental laboratory according to the USEPA Contract Laboratory Program methodology (USEPA, 1995). All laboratory (environmental) data deliverables will meet the minimum reporting requirements necessary in completing a verification and validation review as defined in USEPA 540-R-08-005: *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (USEPA, 2009).

Table 4-2: Proposed Sampling Methodology				
Sample Collected	**Sample Jars**	**Preservative**	**Sample Analysis**	**Hold Time**
Up to four groundwater samples (primary and/or IDW)	3 x 40 mL VOA vials	Ascorbic acid and HCL	CT and chloroform via USEPA Method 524.2	14 days
Soil samples as necessary (primary and/or IDW)	3 x 40 mL VOA vials – Terra Core Plus 1 x 40 mL unpreserved VOA vial to be submitted for moisture content	1 vial with MeOH and 2 vials with $NaHSO_4$; Cool ≤ 6°C	CT and chloroform via USEPA Method 8260B	14 days

$NaHSO_4$ – Sodium Bisulfate MeOH – Methanol VOA – Volatile Organic Analysis
HCL – hydrochloric acid mL – milliliter

4.2 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM

QC samples, for each sampling media, will be collected for the purpose of providing information on variability, matrix interference, and bias. QC samples will include field duplicates (at a frequency of 10%) and matrix spike/matrix spike duplicates (at a frequency of 5%). Field blanks will be collected at a frequency of one per site to detect/identify any ambient contamination resulting from collecting and handling samples in the field. Equipment blanks will be collected at a frequency of one per site to detect/identify any residual contamination during the decontamination process in the field. In addition, trip blanks will accompany all VOC shipments and one temperature blank for every cooler shipping aqueous and/or soil samples. The QC sampling approach is based on the procedures provided in Section 4.2.1.3 of the Master WP (Argonne, 2019).

4.3 IDW MANAGEMENT

IDW containment, characterization, and disposal will be in accordance with the IDW Management Plan (**Appendix D**) and SOP AGEM-11: *Handling and Disposal of Investigation-Derived Waste* (Argonne, 2019), as well as IDNR, Resource Conservation and Recovery Act, CERCLA, and other local, state, and Federal regulations in the handling and disposal of IDW. The IDW Management Plan (Bluestone, 2024) addresses anticipated types and quantities of IDW, waste minimization techniques and responsibilities, segregation, and storage (containment), characterization and manifesting, as well as staging and removal (disposal) of IDW.

Bluestone will coordinate with the property owner regarding where to stage the IDW on-site and will notify USDA of its location. Decontamination water (i.e., drill rod and pump rinsing) will be the primary source of aqueous IDW and excess soil from the soil borings will be the primary source of solid IDW. The IDW will be stored in 55-gallon drums on pallets (as necessary). The 55-gallon drums will be properly labeled. As stated in AGEM-11, IDW will be staged in a way that minimizes public contact while meeting project needs, and that also considers landowner preferences.

Characterization of the IDW will be determined by laboratory analysis of potential contaminants of concern (CT and chloroform).

Aqueous IDW will be characterized based on the analytical results of primary groundwater samples (if collected) or water samples collected directly from the aqueous IDW drums (if no primary groundwater samples are collected). All aqueous samples will be analyzed via USEPA Method 524.2.

Solid IDW will be characterized based on the analytical results of primary soil samples (if collected) or soil samples collected directly from the soil IDW drums (if no primary soil samples are collected). All soil samples will be analyzed via USEPA Method 8260B.

If the results of aqueous IDW characterization are below USEPA MCL values, the aqueous IDW will be discharged on-site away from sensitive receptors as permitted by the property owner. If the results are above USEPA MCL values, the aqueous IDW will be taken off-site for treatment at a facility approved by IDNR.

The results of solid IDW characterization will be compared to USEPA Regional Screening Levels for residential soil. If the results of the solid IDW characterization are below the screening value, the solid IDW will be spread on-site away from sensitive receptors as permitted by the property owner. If the results are above the screening value, the solid IDW will be taken off-site for disposal at a facility approve by IDNR.

4.4 TEMPORARY WELL ABANDONMENT

Temporary wells will be abandoned according to Iowa Administrative Code (IAC) 567.39 within 90 days of installation as required by the IDNR (IAC, 2024). The temporary well will be removed from the borehole and filled with an approved grout from total depth to the ground surface.

4.5 SURVEYING OF SOIL BOREHOLES AND TEMPORARY WELLS

A professional survey of the soil boring and temporary well locations is not currently scoped. The soil boring and temporary well locations will be collected using a mapping-grade Global Positioning System (GPS) of Global Navigation Satellite System (GNSS) receiver. “Mapping-grade” refers to a class of receivers capable of positional accuracy within one meter (approximately 3.28 ft), depending on site conditions. Bluestone commonly uses the EOS Arrow 100 and Trimble Geo 7x GNSS receivers. Surveying with GPS or GNSS will be completed after temporary well sampling but prior to temporary well abandonment.

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5.0 HEALTH AND SAFETY

5.1 ACCIDENT PREVENTION PLAN

The safety and health of site personnel during work activities is a shared responsibility. The designated Bluestone SSHO will be responsible for verifying that safe work practices and conditions are implemented at all times. In addition, the SSHO will facilitate daily safety and health briefings for all crew members prior to the start of work, and again for any visitors that arrive at the Site. Personnel other than those explicitly authorized by contract, subcontract agreement, or specifically mentioned in this WP may not use the Bluestone Corporate Health and Safety Policy without written permission from Bluestone (**Appendix E**).

5.2 SITE-SPECIFIC SAFETY PROCEDURES

In general, work will be conducted in modified Level D Personal Protective Equipment, which will include leather gloves and/or nitrile gloves, safety boots, high-visibility vests, eye protection, ear protection, and hard hats when overhead hazards exist. In addition, work vehicles will be equipped with first-aid kits, infection control kits, eyewash solution, and fire extinguishers, and crews will be appropriately trained to use such equipment. All Bluestone personnel, subcontractors, and authorized visitors must review the Corporate Health and Safety Policy and provide signature of acknowledgement prior to initiating work at the Site.

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6.0 SCHEDULE OF FIELD WORK AND REPORTING

6.1 PROJECT SCHEDULE

Field activities at the Former Adaza Grain Storage Site are scheduled to begin in 2025. The proposed schedule is provided below in **Table 6-1**.

Table 6-1: Project Schedule

Field Task	Proposed Schedule
Right of Entry (ROE) calls and letters	During WP development
Sample location markout and utility clearance	30 days after ROE is granted
Soil borings	After utility clearance
Groundwater sampling	After soil borings
Soil boring and temporary well survey	After groundwater sampling
Temporary well abandonment	Within 90 days of installation
IDW removal	Within 30 days of waste characterization

6.2 PRELIMINARY ASSESSMENT AND SITE INSPECTION REPORT REQUIREMENTS

At the completion of sampling activities, a Preliminary Assessment (PA) and Site Inspection (SI) Report will be prepared. The PA/SI report will analyze existing background information, and present and analyze all data collected to determine the extent and magnitude of potential hazards posed by the Site based on the preliminary conceptual site model and risk screening process. The PA/SI report will include a complete copy of all laboratory data deliverables and associated independent data reviews by attachment or appendix. The PA/SI report will also include a recommendation section.

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7.0 REFERENCES

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TABLES

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Table 2-1
Potential Drinking Water Wells Within a 2-Mile Radius
Adaza Former Grain Storage Site
Adaza, Iowa

Well ID Number	Install Date	Use	Well Owner	Latitude	Longitude
22733	6/19/1970	Unknown	Howard, Dean	42.181226	-94.462478
54645	8/14/2001	Livestock	Koch, Ryan	42.195592	-94.477852
62576	9/18/2006	Public Supply	Juergensen, Chris	42.191823	-94.45634
75881	3/29/2012	Private	Toliver, Ron	42.177438	-94.474172
75949	8/25/2008	Livestock	Gemberling, Wade	42.195455	-94.490529
76368	8/28/2013	Private	Berns, Brian	42.209952	-94.493451
76370	8/26/2013	Private	Hoyle, Marc	42.210088	-94.471793
2099299	1/1/1950	Private	Berns, Brian	42.2098	-94.493
2129832	1/1/1950	Private	Consier, Ruth	42.184093	-94.475346
2132827	1/1/1950	Private	Spencer Farms	42.195635	-94.472388
2135991	8/25/2008	Private	Gemberling, Wade	42.195454	-94.490524
2148884	1/1/1960	Private	Hunter, Clare	42.181154	-94.462498
2148885	1/1/1960	Private	Adams, Terry	42.181285	-94.467005
2159733		Private	Toliver, Ron	42.177375	-94.474155
2170527	8/26/2013	Private	Hoyle, Mark	42.210754	-94.472633
2170622	8/28/2013	Private	Berns, Brian	42.210346	-94.493072
2173437	1/1/1950	Private	Gingery, Robert	42.192674	-94.495218
2184843	Unknown	Private	New Modern Concepts	42.202894	-94.524429
2184849	Unknown	Private	New Modern Concepts	42.179197	-94.495532
2190748	1/1/1950	Private	Koch, Ryan	42.195955	-94.477776
2196664	1/1/1950	Private	King, Karla	42.196074	-94.516575
2196874	10/5/2017	Private	King, Carla	42.195879	-94.51654
2197969	1/1/1940	Private	Deward, Pam	42.194362	-94.497507
2202605	8/14/2018	Private	Parker, Perry	42.2087	-94.48937
2208993	1/1/1940	Private	Clark, Kim	42.203074	-94.513413
2210172	1/1/1950	Private	Rossmanith, Robert	42.194546	-94.523202
2210185	1/1/1950	Private	Fidler, Leigh	42.203039	-94.513364
2212669	1/1/1950	Private	Nichols, Tammy	42.166389	-94.512275
2214052	9/16/2020	Private	Tasler, Terry	42.169989	-94.47423
2224990	1/1/1950	Private	Cousier, Ruth	42.188975	-94.47442

Notes:
Shaded cells indicate a potentially downgradient well from the Site.

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FIGURES

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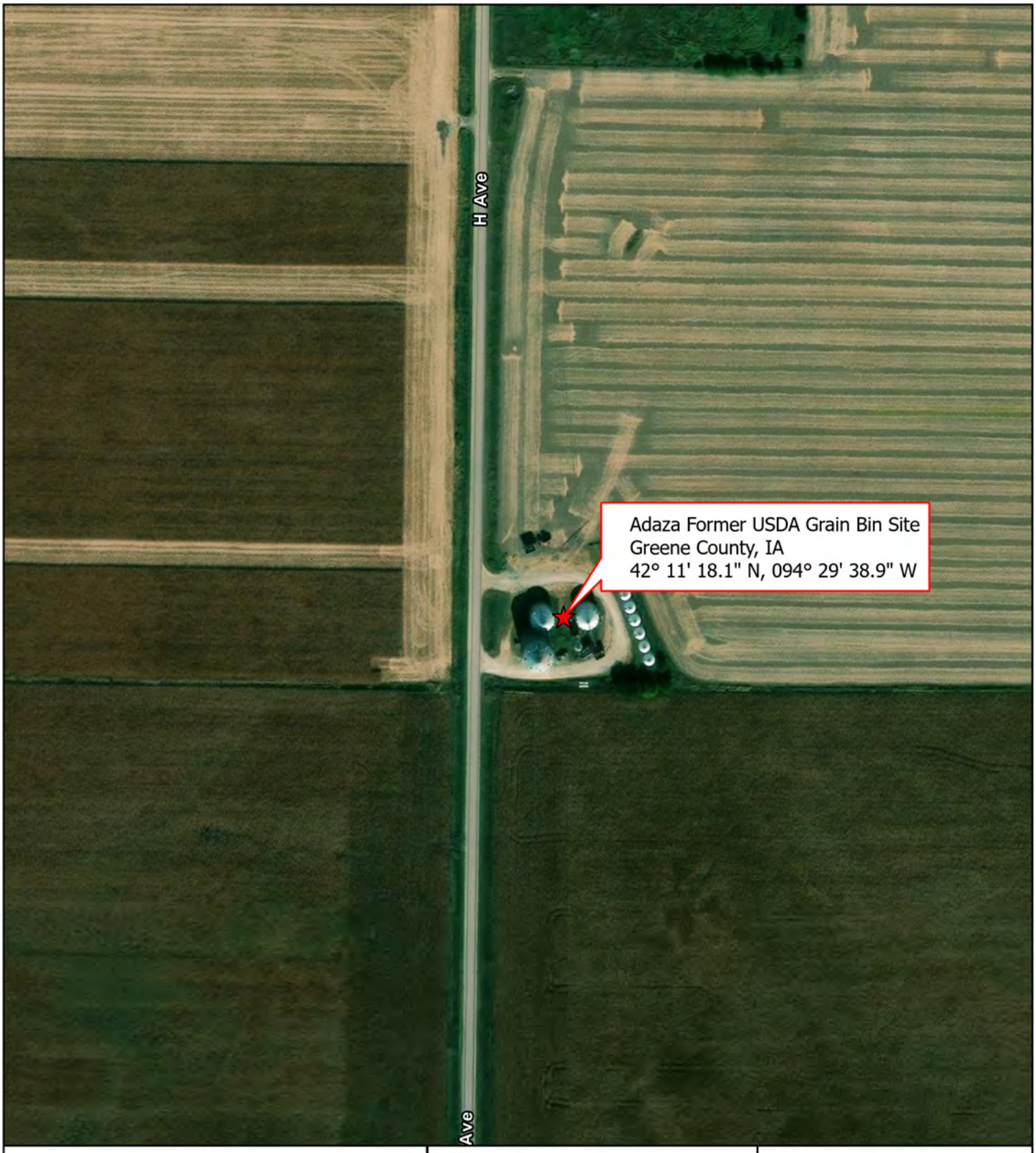

Figure 2-1 - Site Location Map

Former USDA Grain Bin Site
Adaza, IA

Bluestone

0 55 110 220 Feet

N

★ Site Location

Iowa Geospatial Data Clearinghouse County Boundaries and Township and Range, 2021.
https://geodata.iowa.gov/
Esri World Imagery.

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Figure 2-2 - Site Assessor Map

Former USDA Grain Bin Site
Adaza, IA

Site Location
Former Storage Bins
Property Boundaries

Bluestone

0 40 80 Feet

N

Site Assessor Map from Regrid IA
https://app.regrid.com/us/ia#

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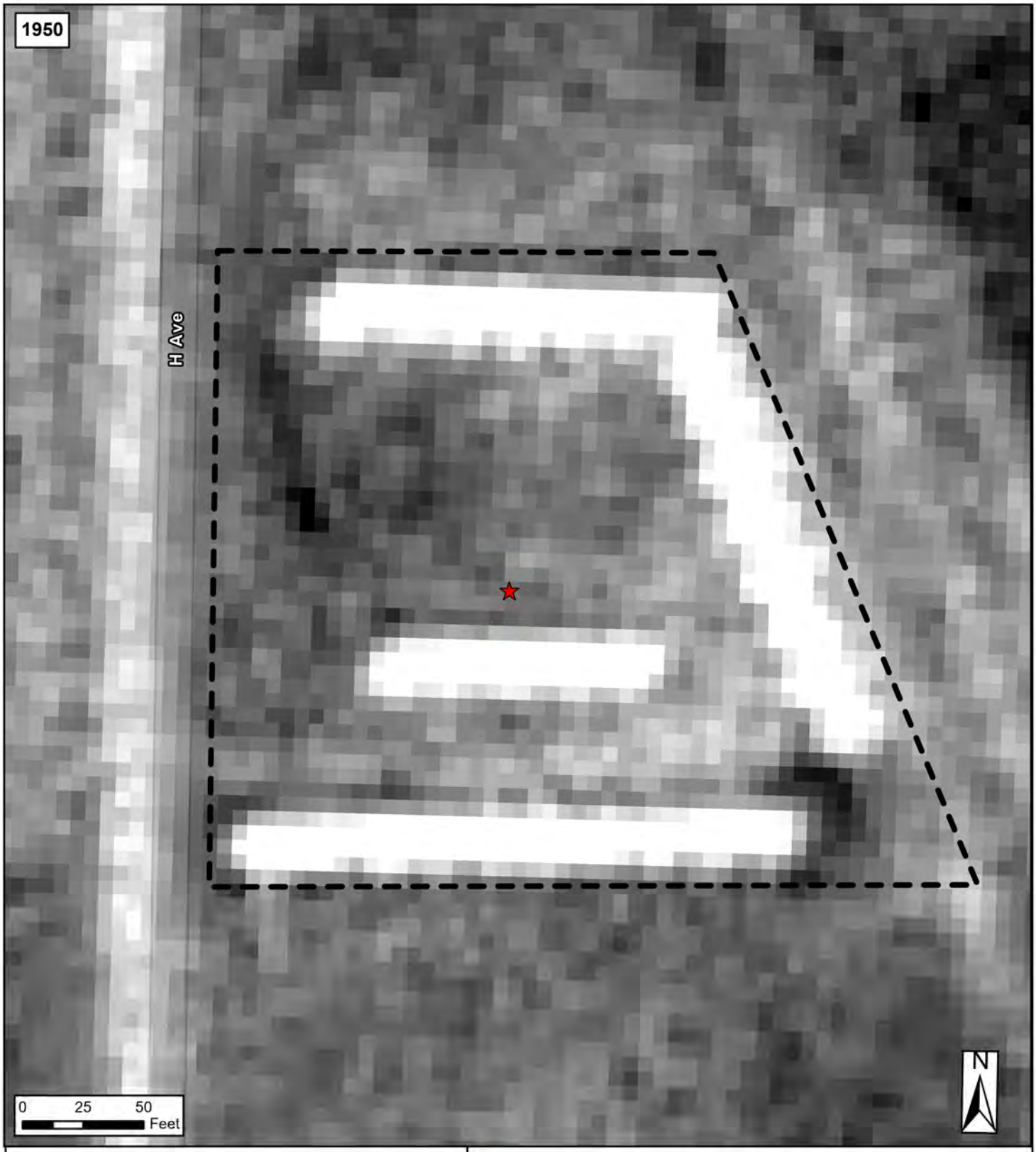

Figure 2-3 - 1950 Aerial Map

Former USDA Grain Bin Site
Adaza, Iowa

Bluestone

Site_Locations

Former Storage Bins

Historic aerial images obtained from
USGS Earth Explorer April 2025:
A000700292912 - 1950

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Site Location

Former Storage Bins

Historic aerial images obtained from USGS Earth Explorer May 2025:
A000700292912 - 1950
1VDCD00030189 - 1973
1VFFK00010028 - 1983

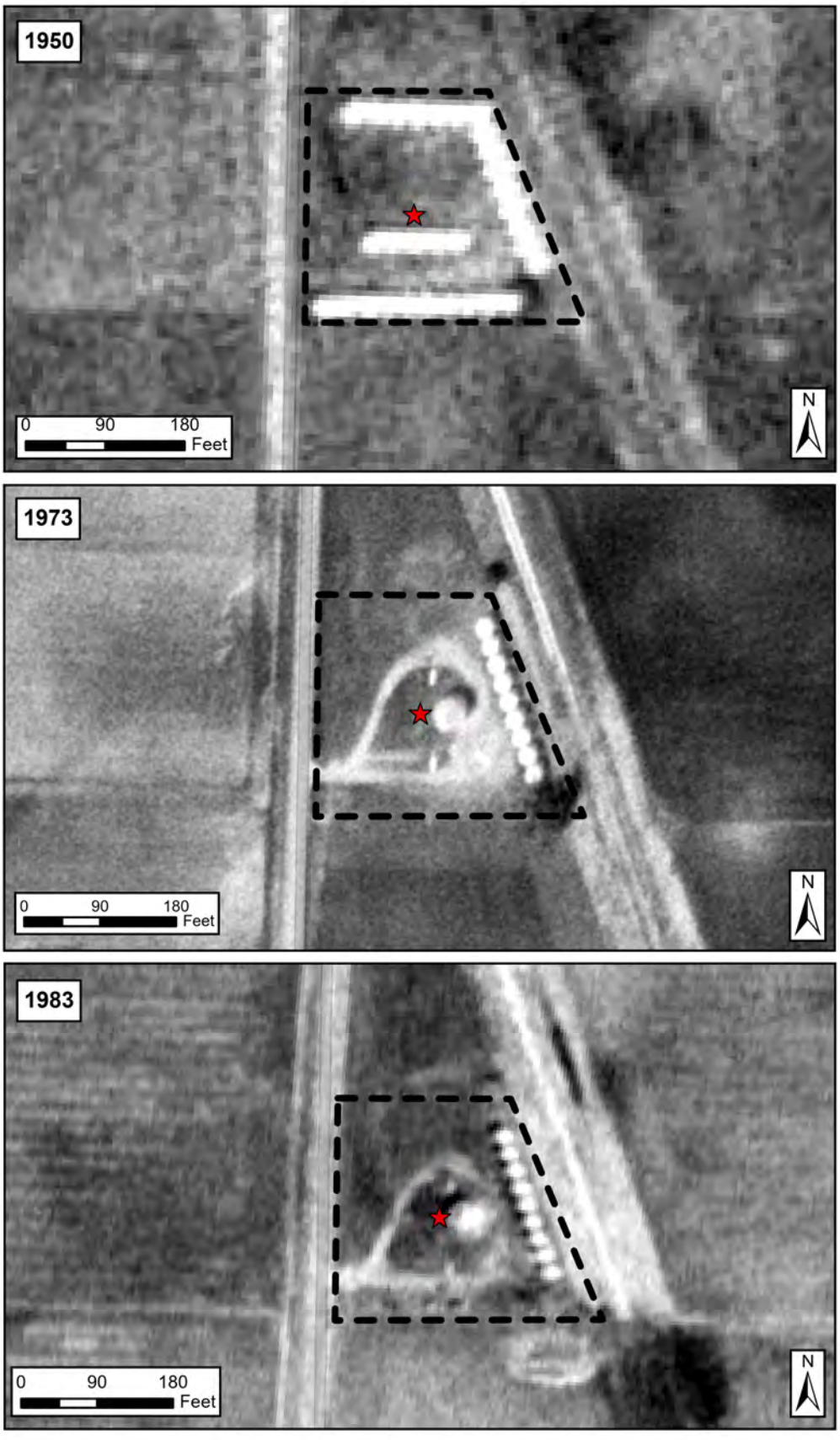

Figure 2-4 - Historic Aerial Maps

Former USDA Grain Bin Site - Adaza, Iowa

Bluestone

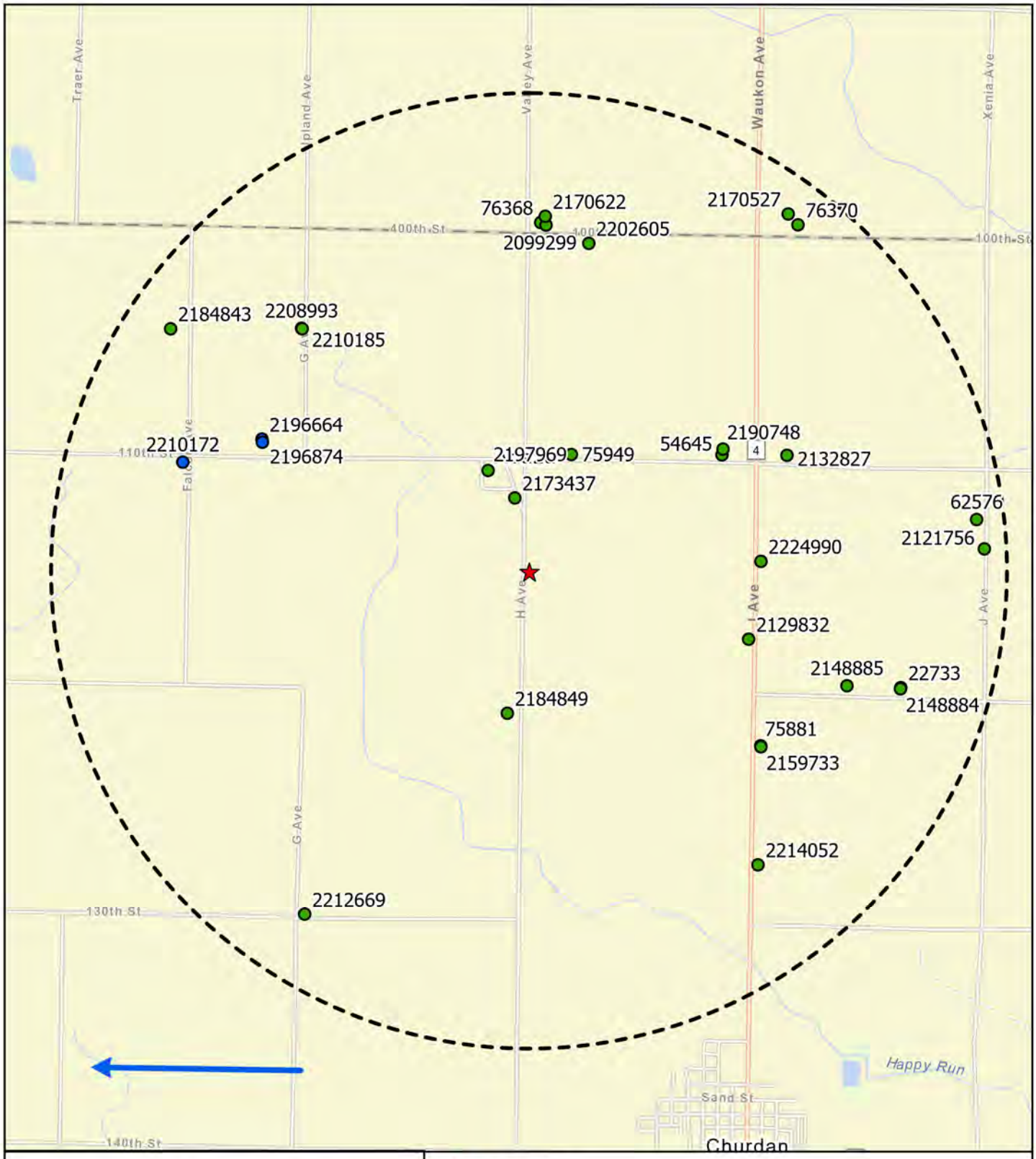

Figure 2-5 - Potential Drinking Water Well Locations

Former USDA Grain Bin Site
Adaza, IA

Site Location
Inferred Groundwater Flow
2-Mile Buffer
Potential Drinking Water Well
Potential Drinking Water Well Proposed to be Sampled

Bluestone

0 1,000 2,000 4,000 Feet

N

Iowa Geological Survey GeoSam Database - https://www.iihr.uiowa.edu/igs/geosam/map
Esri World Street Map

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Figure 4-1 - Sample Location Map

Former USDA Grain Bin Site
Adaza, IA

Site Location
Proposed Sample Location
Property Boundary (Approximate)
Former Storage Bins (Approximate)
Inferred Groundwater Flow

Bluestone

0 15 30 60 Feet

N

Site Assessor Map from Regrid IA
https://app.regrid.com/us/ia#

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APPENDICES

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APPENDIX A
USDA Umbrella Work Plan

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Umbrella Work Plan: Groundwater Sampling at Former CCC/USDA Grain Storage Sites in Iowa

1 Introduction

The Commodity Credit Corporation of the U.S. Department of Agriculture (CCC/USDA) operated grain storage facilities on leased properties in Iowa from the 1950s to the early 1970s. During this time, commercial grain fumigants containing carbon tetrachloride were commonly used by the CCC/USDA and the private grain storage industry to preserve grain in their facilities. In 2020, the Iowa Department of Natural Resources (IDNR) requested that the CCC/USDA conduct groundwater sampling at several sites to confirm the presence or absence of contamination in the shallow groundwater underlying the former facilities and whether the site could be reclassified to 'No Further Action (NFA)'. Sites with positively confirmed contamination that exceed regulatory screening levels *may* be recommended for further investigation. Sites with no detected contamination or contamination below screening levels *may* be recommended for NFA and closure based on the findings of the groundwater sampling and the site operational history.

This umbrella work plan describes a general protocol to conduct groundwater sampling at the former CCC/USDA grain storage sites. The sites will be investigated in clusters, as suggested by the IDNR based on the results of IDNR's site prioritization calculation, locations for effective implementation as a group, and consensus between the CCC/USDA and IDNR. The IDNR's site prioritization calculation was developed considering both potential impact to an aquifer (e.g. the number of bushes, length of operation, and index value for potential of groundwater contamination) and potential receptors (wellhead protection area, on-site/nearby structures, registered domestic wells, and population). A site-specific sampling plan will be developed for each site for IDNR approval prior to implementation.

2 Technical Objective

The technical objective of the proposed field work is to generate screening data that can be used to determine whether the former CCC sites are eligible for a NFA determination on the basis of the presence or absence and levels of carbon tetrachloride and chloroform contamination directly beneath the former CCC/USDA facilities in Iowa.

On the basis of historical records for sites that have been investigated, all the former CCC/USDA facilities were operated during 1950s-1970s. After more than 50 years, surface runoff has eliminated any contaminant source on the surface that could be directly routed to the surface water and rainfall infiltration provide the most predominant mechanism bring the released contaminants into the soil and further flushing them to the uppermost groundwater. CCC/USDA's experience in the past 30 years has demonstrated that little potential for residual contamination in surface runoff and near-surface soils is likely to exist. In the recommended approach, groundwater samples from the uppermost saturated interval beneath each site will therefore be collected for VOCs analysis. Sampling the uppermost groundwater zone will provide data to effectively evaluate presence or absence of contamination associated with the historical grain storage operation at each former CCC/USDA facility. The results of the analyses will provide direct evidence of the current presence (and levels) or absence of carbon tetrachloride contamination in groundwater at the site, as well as an indication of potential vertical contaminant migration from the vadose zone soils into the underlying groundwater.

Similarly, the results of the groundwater analyses, together with information on the depth to groundwater and the local hydrogeologic setting (discussed in Section 3), will offer insights into the potential for carbon tetrachloride vapor intrusion (VI) at the site and in the adjacent, downgradient areas. In this manner, the proposed groundwater sampling program is expected to produce information pertinent to several of the key contaminant migration (and potential exposure) pathways that may influence the risks associated with each site, and hence potential needs for additional assessment, or no further action. The groundwater sampling will follow Argonne's standard operating procedures (SOPs) as provided in Argonne (2019) and reproduced in Appendix A.

3 Proposed Scope of Work

3.1 Background Research for Determining the Scope of Site-Specific Sampling Plans

Each site identified by the Iowa will be researched using the Iowa County Assessors and Parcel Search web site to identify parcels and legal descriptions of properties within the IDNR-determined site boundaries of the former CCC grain storage facility. All properties identified will be evaluated through the county clerk or deed register offices for each site. The historical lease records between grantor (property owner) and grantee (the CCC/USDA) will be obtained to validate the boundaries of the former CCC/USDA facilities and duration of the leases. The validated boundaries for each former CCC/USDA grain storage facility will be used as one of the key factors to guide the groundwater sampling. Information related to site history including its operation, scale and ownership of the grain storage facility and records of any past investigations will be collected, compiled, and evaluated to generate a site-specific work plan for each facility.

An initial assessment will be performed, based on existing available data, to determine the expected hydrostratigraphy and the approximate depth of the uppermost groundwater zone beneath the former CCC/USDA facility as well as the likely groundwater flow direction in the targeted groundwater zone (if available), which will help support the identification of potential migration pathway(s) beneath the facility. Regional geologic and hydrogeological information and data will be compiled and local well logs surrounding the former CCC/USDA facility will be collected for integrated evaluation as part of this assessment. The purpose of this effort is to guide the site-specific sampling plan and hence reduce the uncertainty during the field implementation as much as possible. In addition, the locations of the historical grain storage structures (e.g. bins and Quonsets) at the former CCC/USDA site will be identified from historical aerial photographs wherever available. The site-specific sampling plan will be developed in consideration of the former site boundaries, expected hydrostratigraphy, vertical location of the uppermost groundwater zone, lateral flow direction (if available), the number and locations of grain storage structures, and size of the facility. Any private wells that are located along the projected migration pathway will also be taken into consideration during the development of the sampling plan.

3.2 Groundwater Sampling

Sampling locations at each site will be determined based on the results of the background research and initial assessment and will be specified in each site-specific sampling plan. The CCC/USDA will collect groundwater from each sampling location using direct-push methods (Geoprobe or CPT) as a preferred technology. However, the specific drilling method to be used at each site will be determined on a basis of the anticipated subsurface condition and expected

depth to the uppermost groundwater and identified in the site-specific plan. All sampling will be performed in accordance with the following SOPs described in the *Master Work Plan* (Argonne 2019):

- *AGEM-01 Direct Push, Drilling, and Geologic Logging*
- *AGEM-11 Handling and Disposal of Investigation-Derived Waste*
- *AGEM-21 Calibration of Field Instrumentation and PID Operation*
- *AGEM-22 Equipment Decontamination*
- *AGEM-23 Handling, Packing, and Shipping of Samples in the Field*

All groundwater samples will be obtained through selected drilling methods (AGEM-01, -21, and -22). Samples will then be collected in laboratory-approved containers, preserved immediately at 4ºC, and shipped overnight to an environmental laboratory for analysis (AGEM-23). Groundwater samples for volatile organic compounds will be analyzed at the environmental laboratory according to the U. S. Environmental Protection Agency's (EPA) Contract Laboratory Program methodology (*Method 524.2*, EPA 1995).

Investigation-derived waste will be handled in accordance with SOP AGEM-11. The wastewater derived from sampling will be stored on-site in a 55-gal drum or polyurethane containers and a sample sent for organic analysis. If analytical results for the wastewater indicate concentrations of carbon tetrachloride or chloroform below the EPA's MCL values, the water will be discharged on-site, away from known sensitive receptors. If the analytical results indicate concentrations above the MCL values, the water will be disposed of at a wastewater treatment facility approved by the IDNR.

4 Schedule of Field Work and Reporting

Following regulatory approval of the site-specific work plan, Argonne's community relations representative will contact the current property owner at each site by phone to describe the proposed work and request access for sampling. Access approval letters will then be sent to property owners for signature. Once access is granted, the field work will be scheduled.

An investigation report will be provided to the IDNR for each site or site cluster. The report will contain:

- Summary of site information, facility operation history, previous investigations, physical and hydrogeologic settings, and any records that are relevant to site evaluation and can be used to guide the sampling.
- A brief description of each sampling event;
- Maps depicting the site boundaries, sample locations, and contaminant levels;
- Tables that include all analytical and field data;
- Laboratory analytical data reports;
- Relevant quality assurance/quality control information;
- Data interpretation and recommendation regarding whether the site requires no further action.

Results of the sampling at each site will be provided to the property owner.

5 References

Argonne, 2019, *Environmental Investigations at Former CCC/USDA Facilities: Master Work Plan, Volumes 1 (Main Text) and 2 (Standard Operating Procedures)*, Argonne National Laboratory, ANL/EVS/AGEM/TR-19-01, November.

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APPENDIX B
USDA STANDARD OPERATING PROCEDURES

Appendix A:
Standard Operating Procedures: AGEM-01, -03, -04, -10, -11, -13, -21, -22, -23, and -27

Environmental Investigations at Former CCC/USDA Facilities: Master Work Plan

Volume 2: Standard Operating Procedures

AGEM-01:

Direct Push, Drilling, and Geologic Logging

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Contents

Exhibit

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AGEM-01:

Direct Push, Drilling, and Geologic Logging

Scope and Applicability

This SOP describes the methods used for direct push (CPT and Geoprobe®) and drilling operations, and geologic logging of borings. These methods are conducted primarily to collect soil, rock, and groundwater samples, and to install monitoring wells, observation wells, and piezometers, as needed. Drilling contractors must be licensed by the state to drill and install monitoring wells; and all drilling permits and licenses required by the state must be obtained before field work begins. A geologist designated by the AGEM program manager must be on-site during all drilling operations.

Definitions

The following is a list of the acronyms and abbreviations (including units of measure) used in this SOP.

AGEM	Applied Geosciences and Environmental Management
CPT	cone penetrometer
ft	foot (feet)
gal	gallon(s)
HASP	health and safety plan
PID	photoionization detector
PPE	personal protective equipment
QA/QC	quality assurance/quality control
SOP	standard operating procedure
VOC	volatile organic compound

Responsibilities

The AGEM program manager and the field project manager are responsible for the following:

- Selecting the investigation locations.
- Selecting the optimal method for each investigated location, on the basis of subsurface conditions, the depth to be achieved, surface features, and other considerations.

The field project manager, or other designee of the AGEM program manager, is responsible for the following:

- Verifying that the personnel operating the CPT, Geoprobe®, and drill rigs have the appropriate training and experience and are licensed as required.

- Verifying that the personnel implementing this SOP understand the procedure and are capable of implementing it correctly.

- Verifying that the personnel implementing this SOP understand the specific work planned for each field event.

- Verifying that the work is performed as directed by the AGEM program manager.

- Verifying that the driller has the appropriate license and that the required permits are obtained before field work begins.

- Verifying that an Argonne representative and a geologist are on-site and available to monitor direct push and/or drilling operations.

- Ensuring that the *Master Work Plan*, the site-specific work plan, and the sitespecific HASP are available at the field site.

- Ensuring that the necessary equipment and materials are at the field site.

- Ensuring that all drilling equipment is devoid of gross contamination when it arrives at the site and also is steam cleaned both when it arrives and between borings/wells.

- Acquiring the necessary utilities surveys.

- Delineating and controlling work areas at the site (*Master Work Plan, Volume 1*, Section 6.5).

The on-site geologist is responsible for the following:

- Monitoring all direct push and drilling operations.

- Ensuring that drilling in a surficial aquifer is performed as indicated in Section 5.3 of this SOP.

- Recording the geologic logging information specified in Section 5.8 of this SOP.

All personnel conducting the field work are responsible for the following:

- Implementing this SOP and related procedures, as directed.

- Following additional procedures in both volumes of the *Master Work Plan* and the site-specific work plan and HASP.

- Submitting field notes to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

Method Summary

Direct push methods used by the AGEM program employ the use of a CPT or Geoprobe® (hydraulically-powered) machine with either a DualTube or Macro-Core® continuous soil sampling system.

The preferred drilling method for the AGEM program is sonic drilling. Other methods may be considered on a case-by-case basis, depending on site conditions, the required borehole depth and diameter, equipment availability, the location's accessibility, ease of sample collection, and identification of an interval suitable for screening, time, and cost.

Monitoring well installation is discussed in AGEM-02; the installation of piezometers is discussed in AGEM-03. Abandonment of borings is addressed in AGEM-04.

Procedures

Equipment and Supplies Needed

- CPT and/or Geoprobe® unit, appropriately sized and equipped (as needed)
- Drill rig, appropriately sized and equipped (as needed)
- PPE (*Master Work Plan*, *Volume 1*, Section 6.5)
- Steam cleaner and other decontamination supplies (AGEM-22)
- Steel drums/rolloff, plastic sheeting, absorbent pads
- Logbooks and other documentation material
- Field meters and monitoring equipment

Preparations before Work Begins

1. Put on the approved level of PPE.

2. Inspect all equipment as it arrives at the site to verify that the equipment is devoid — both inside and outside — of gross contamination such as asphaltic, bituminous, or other encrusting or coating material, grease, grout, or soil. Clean, as necessary.

3. Place a temporary berm abound the drilling location. Lay plastic sheeting over the work location and the berm to contain any discharged fluids.

4. Calibrate field meters (e.g., PID; see AGEM-21).

5. Initiate air (PID) monitoring for hazardous materials, as appropriate.

6. Clean all drilling equipment in a designated laydown area before leaving the site (at the driller's and project geologist's discretion).

Preventing Cross-Contamination

When drilling occurs in a surficial aquifer, the following procedures will apply:

- Drilling must be terminated before the confining layer below the aquifer is fully penetrated.

- The on-site geologist will determine the depth drilled into the confining layer on the basis of the site-specific geology.

- If drilling must proceed into a lower aquifer, casing must be set to prevent crosscontamination.

Direct Push Operations

The CPT and Geoprobe® Dual Tube and Macro-Core® soil samplers are direct push methods used to install piezometers or well points (AGEM-03) for the collection of soil samples (AGEM10) and long-term water level data (AGEM-07).

The CPT is to be operated in accordance with the manufacturer's instructions by field personnel with documented training and experience suitable for the task (e.g., Applied Research Associates, Inc. 1996). The manufacturer's SOP is available from the AGEM records manager; a hardcopy can also be found in the AGEM field trailer.

The Geoprobe® is to be operated in accordance with the manufacturer's instructions by personnel with documented training and experience suitable for the task. Operational instructions and sampling protocols for the Geoprobe® devices are detailed in Geoprobe® (2011) and Geoprobe® (2013), which are available through the manufacturer (online) or from the AGEM records manager. A hardcopy of these SOPs can also be found in the AGEM field trailer.

Sonic Drilling

Currently, sonic drilling is the AGEM program's preferred method for all well installation and core recovery. In sonic drilling, a dual line of drill pipe is oscillated through the subsurface. An outer pipe prevents collapse of the borehole and is used in the construction of monitoring wells and piezometers. An inner pipe contains a core bit; the inner pipe can function as a core barrel sampler.

Recover core as follows:

1. Advance the inner drill pipe and core bit approximately 6-30 ft into the subsurface.

2. Advance the outer drill pipe over the inner pipe to hold the boring open.

3. Use the drill head to lift the inner pipe to the surface for core recovery.

4. Vibrate the core out of the inner drill pipe and into a plastic sheath or stainless steel tray.

5. Advance the inner barrel to the next sampling interval.

6. If no well will be installed in a boring, withdraw all equipment from the hole. Abandon the hole as indicated in AGEM-04.

7. Clean all drilling equipment as required, at the driller's and site geologist's discretion.

Geologic Logging

The on-site geologist is responsible for logging each boring. Information to be recorded includes the following:

- Boring number and location (GPS coordinates in decimal degrees)
- Drilling method and borehole diameter
- Lithologic descriptions
- Core recoveries
- Evidence of obvious contamination
- Weather conditions
- Groundwater levels (depth encountered and static)
- Materials placed by humans
- Sample depths and identification numbers An example of a borehole log is in Exhibit 01.1.

Related Internal Procedures

- *Master Work Plan, Volume 1:*
  - Section 6.5 (PPE; work area designation and site control; utilities survey)
- *Master Work Plan, Volume 2:*

- AGEM-02: Monitoring Well Installation and Development
- AGEM-03: Installation of Piezometers with Direct Push Equipment
- AGEM-04: Abandonment of Soil Borings, Monitoring Wells, and Piezometers
- AGEM-05: Purge Groundwater Sampling
- AGEM-10: Soil Sampling
- AGEM-21: Calibration of Field Instrumentation and PID Operation
- AGEM-22: Equipment Decontamination
- AGEM-27: Sample and Document Management

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MDNR, 2019, *Well Installation: Monitoring Well Construction Code*, Missouri Code of State Regulations (CSR), 10 CSR 23-4, prepared by the Missouri Department of Natural Resources, January 29.

Attachment 1 - Section C

NDHHS, 2014, *Water Well Standards: Water Well Construction, Pump Installation, and Water Well Decommissioning Standards,* prepared by the Nebraska Department of Health and Human Services, Nebraska Administrative Code [178 NAC 12], August 26.

Page _____ of _____

Project Name:	Drilling Method:	Date/Time Start:
Borehole Number:	Location:	Date/Time Finish:
Geologist:	First Water:	Date/Time:
Surface Elevation: (ft AMSL)	Static Depth GW:	Date/Time:

Depth (ft)	% Recovery	Interval Desc.	Description (Major Texture, %sand, %granules, %gravel, sorting, rounding, plasticity, carbonates, Fe/Mn, sedimentary structure and other significant features, color, moisture)	Blow Count	Sample Id	Remarks

EXHIBIT 01.1 Sample borehole log.

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Volume 2: Standard Operating Procedures

AGEM-03:

Installation of Piezometers with Direct Push Equipment

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Contents

Exhibits

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AGEM 03:

Installation of Piezometers with Direct Push Equipment[1]

1 Scope and Applicability

This SOP describes the use of CPT or Geoprobe® devices to install piezometers or well points to collect long-term water level data. The installation and use of piezometers must be conducted in accordance with the regulations of the state in which the installation is taking place.

2 Definitions

The following is a list of the acronyms and abbreviations (including units of measure) used in this SOP.

AGEM	Applied Geosciences and Environmental Management
cm^2	square centimeter(s)
CPT	cone penetrometer
ft	foot (feet)
gal	gallon
HASP	health and safety plan
in.	inche(s)
mm	millimeter(s)
PID	photoionization detector
PPE	personal protective equipment
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
SOP	standard operating procedure

3 Responsibilities

The field project manager, or other designee of the AGEM program manager, is responsible for the following:

- Verifying that the personnel implementing this SOP understand the procedure and are capable of implementing it correctly.
- Verifying that the personnel implementing this SOP understand the specific work planned for each field event.

[1] Note that in Nebraska, piezometers cannot be completed as permanent wells; they are to be abandoned within 90 days of installation.

- Ensuring that the necessary equipment and materials are at the field site.
- Delineating and controlling work areas at the site (*Master Work Plan*, *Volume 1*, Section 6.5).

Personnel conducting the field activities are responsible for the following:

- Implementing this SOP and related procedures, as directed.
- Following additional procedures in both volumes of the *Master Work Plan* and the site-specific work plan and HASP.
- Submitting field notes related to waste management to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

4 Method Summary

Direct push methods used by the AGEM program employ the use of a CPT or Geoprobe® (hydraulically-powered) machine with either a DualTube or Macro-Core® continuous soil sampling system.

5 Procedures

5.1 Equipment and Supplies Needed

- CPT or Geoprobe®
- PPE (*Master Work Plan, Volume 1*, Section 6.5)
- Decontamination supplies (AGEM-22)
- Plastic sheeting, absorbent pads
- Logbooks and other documentation material
- Field meters and monitoring equipment

5.2 Preparations before Work Begins

1. Put on the approved level of PPE.

2. Place a temporary berm abound the drilling location. Lay plastic sheeting over the work location and the berm to contain any discharged fluids.

3. Calibrate field meters (e.g., PID; see AGEM-21).

4. Initiate air (PID) monitoring for hazardous materials, as appropriate.

5.3 Flush-Mount Piezometer Installation

To install a flush-mount piezometer, well point, or sand point well, use the following procedure:

- Push a Geoprobe® rod or a non-instrumented CPT cone to depth as specified in Surgnier (2001a), Exhibit 03.1.

- Pull the rod/cone back to the surface.

- For Missouri, attach a 3.25-in.-diameter expendable tip to a 0.5-in. to 1 in.-diameter PVC screen. Attach the rod to the expendable tip and push to the desired depth. The maximum screen length for sampling a discrete interval is 5 ft.

- For Kansas, the hole must be 4 in. in diameter from the ground surface to a depth of 20 ft.

- Use push rods to advance the assembly to the base of the desired sampling interval. The size of the push rods should be 15 cm^2 for 0.5-in. screen or 2.25 in. (60 mm) for 1-in. screen.

- Withdraw the rods enough to expose the 5-ft screen.

- Withdraw a water sample if desired.

- To install a piezometer, sand point well, or well point, lower 0.5- to 1-in.-diameter schedule 40 PVC riser pipe into the hole through the rods. Attach the pipe to the top of the screen and withdraw the rods, 2.5-5 ft at a time, while using a tremie to fill the hole with silica sand or filter pack to a level 2-3 ft above the top of the screen.

- Unless otherwise stipulated, base the filter pack grain size on a formation grain size analysis. Use the value of the D30 (70% retained) sieve size, multiplied by a factor not less than 3 or greater than 6, to determine the appropriate grain size.

- Use a water level meter or other measuring device to determine the location of the top of the sand and ensure that sufficient sand is in place.
- Install 1-2 ft of secondary filter pack on top of the primary filter pack (Missouri).
- Pour bentonite pellets into the hole (to a thickness of 2-3 ft) with some water. Allow the pellets to hydrate for at least 20 min to form an effective seal between the screened interval and the section above.
- Mix grout and tremie it into the hole from the top of the bentonite seal to a depth of 3 ft below ground level. Mix bentonite grout to a minimum density of 9.4 lb/gal.
- For the surface installation, dig out an area 28 in. in diameter and 26 in. deep around the borehole and riser pipe. Place a 6-in.-deep layer of bentonite pellets on top of the grout.
- Set a 12-in. O.D. by 12-in. flush mount. See Exhibit 03.1 for construction details.
- Fill the surface hole outside the flush mount with grout or QuickCrete, and finish to a smooth surface with a 12:1 or 12:2 slope. The concrete pad must be a minimum of 8 in. thick and must extend at least 8 in. beyond the flush mount (28 in. minimum).
- Cut the riser pipe to the appropriate height. For wellhead protection, install a 12-in. Morrison Bros. Co. Model 418XA Flush Mount Cover or similar cover (Morrison Bros. Co. 2015). Fit the top of the casing with a Morrison Bros. Co. "J" Plug Model 678XA or equivalent (Morrison Bros. Co. 2013) and a screened vent with a locking pipe plug and padlock.
- Complete a piezometer installation form (Exhibit 03.2), and give the completed form to the licensed water well contractor so that the installation can be registered with the state regulatory agencies.

5.4 Stick-Up Piezometer Installation

If a stick-up piezometer installation is more appropriate than a flush-mount installation, follow the procedure above (Flush-Mount Piezometer Installation) for all aspects of the subsurface installation. See Exhibit 03.3 for the surface completion details.

Complete a piezometer installation form (Exhibit 03.2), and give the completed form to the licensed water well contractor so that the installation can be registered with the state regulatory agencies.

5.5 State Certifications

The licensed driller must submit all required well completion/certification forms (including apprentice permit application forms and variance requests) within the time indicated by the appropriate state agency.

6 Related Internal Procedures

- *Master Work Plan, Volume 1:*
  - Section 6.5 (PPE; work area designation and site control; utilities survey)
- *Master Work Plan, Volume 2:*
  - AGEM-04: Abandonment of Soil Borings, Monitoring Wells, and Piezometers
  - AGEM-05: Purge Groundwater Sampling
  - AGEM-06: Low-Flow Groundwater Sampling
  - AGEM-10: Soil Sampling
  - AGEM-21: Calibration of Field Instrumentation and PID Operation
  - AGEM-22: Equipment Decontamination
  - AGEM-27: Sample and Document Management

7 References Cited or Consulted

Delta Environmental Services, 2001, *Field Record Form*, Form 120601, prepared by D. Surgnier, proprietor, Delta Environmental Services.

Geoprobe®, 2011, *Geoprobe® Macro-Core® MC5, 1.25-Inch Light-Weight Center Rod Soil Sampling System, Standard Operating Procedure*, Technical Bulletin No. MK3139, January. (The SOP for this and other Geoprobe® instruments can be downloaded from the Geoprobe® literature web page at https://geoprobe.com/literature.)

Geoprobe®, 2013, *Geoprobe® DT22 Dual Tube Soil Sampling System, Continuous Core Soil Sampler, Standard Operating Procedure*, Technical Bulletin No. MK3140, January (originally prepared in November 2006). (The SOP for this and other Geoprobe® instruments can be downloaded from the Geoprobe® literature web page at https://geoprobe.com/literature.)

KDHE, 2011a, *KDHE Geoprobe Operations*, SOP BER-07, in "Quality Assurance Management Plan (QMP), Part II, Appendix A," Kansas Department of Health and Environment, Division of

Environment, Bureau of Environmental Remediation, Topeka, Kansas (SOP BER-07 was originally published on August 14, 2000), January 1. (For links to the various sections and appendices of the QMP [Revision 6], including SOPs, dated February 21, 2019, go to http://www.kdheks.gov/environment/qmp/qmp.htm)

KDHE, 2011b, *Installation of Direct Push Monitoring Wells*, SOP BER-29, in "Quality Assurance Management Plan (QMP), Part II, Appendix A," Kansas Department of Health and Environment, Division of Environment, Bureau of Environmental Remediation, Topeka, Kansas (SOP BER-29 was originally published on August 14, 2000), January 1. (For links to the various sections and appendices of the QMP [Revision 6], including SOPs, dated February 21, 2019, go to http://www.kdheks.gov/environment/qmp/qmp.htm)

Morrison Bros. Co., 2013, *Specification Sheet: Model 678XA Test Well Plug*, Dubuque, Iowa, March. (For link to various specification sheets by Morrison Bros. Co., go to the literature downloads page at http://www.morbros.com)

Morrison Bros. Co., 2015, *Specification Sheet: Model 418 Series Limited Access Test Well Manhole*, Dubuque, Iowa, July. (For link to various specification sheets by Morrison Bros. Co., go to the literature downloads page at http://www.morbros.com)

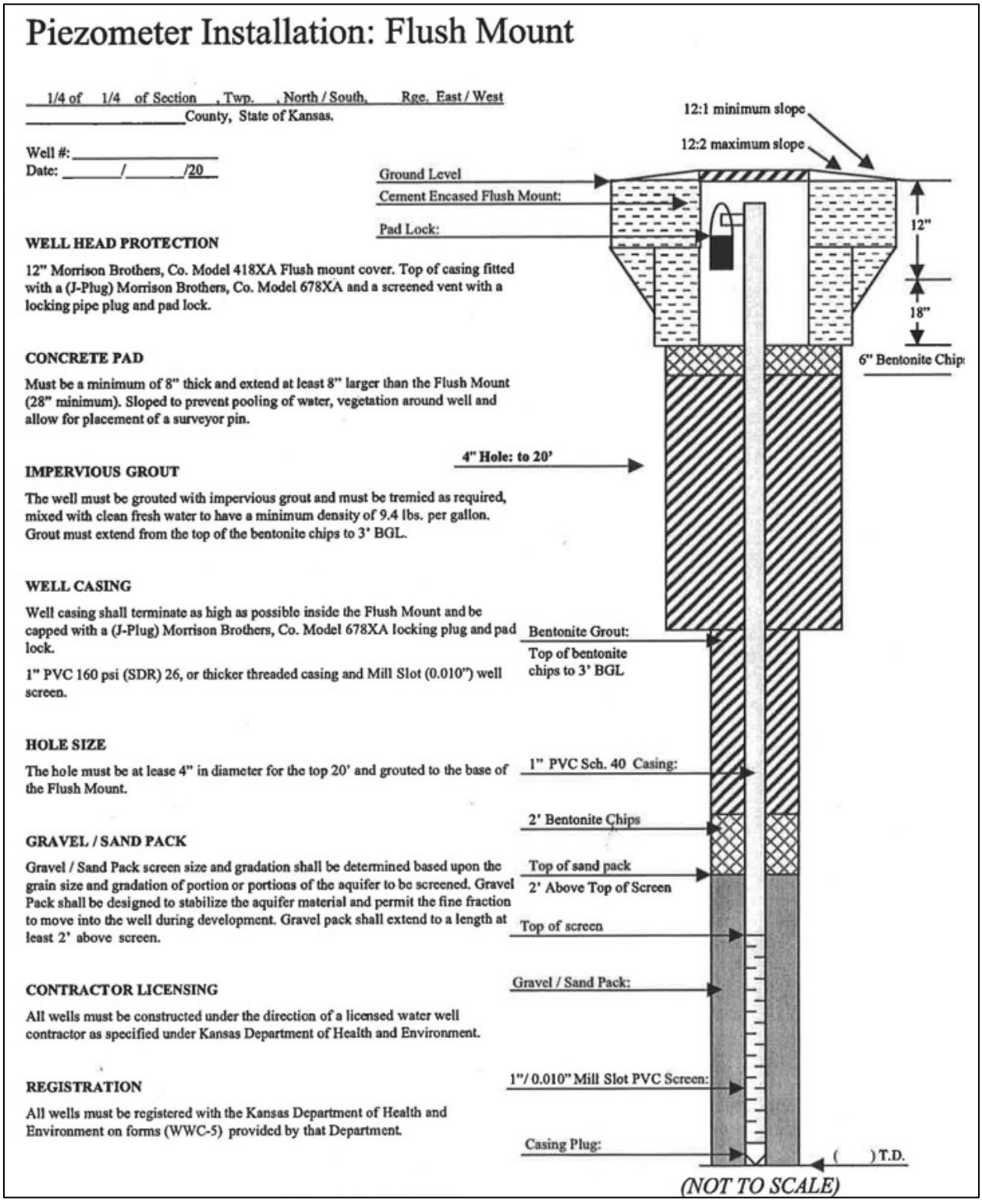

EXHIBIT 03.1 Specifications for flush-mount piezometer installation.

Field Record

Well Schematic

Site Name:_____, State_____, Well Number:_____T.D._____

Date:_____ Prepared By:_____

Location:_____1/4_____1/4_____1/4 of Sec._____,Twp._____ N/S, Rge._____E/W, County_____

GPS Location: Latitude (i.e. 40.1234):_____ Longitude (i.e. – 102.8923):_____

Owner:_____Address_____

Unit operator:_____ Helper:_____

Use: Observation____, Water Sampling____, Soil Sampling ____, Electronics Data_____,Other:_____

Geologist:_____, Registration Number: _____, State: _____

CPT Unit: 680A (40 Ton)_____, 680B (GeoProbe)_____, 680C (22 Ton Crawler)_____

Status:

Depth (s) Groundwater Encountered: 1._____to_____, 2._____to_____, 3._____to_____. SWL._____

Hole Size:_____in. to_____ft. & _____in. to_____ ft. & _____in. to _____ft.

Casing height above ground level:_____inches / Flush Mount / Stick-up, Size_____

Well casing material: PVC_____, Steel_____,Fiberglass_____,Other (specify)_____

Screen Dia.:_____O.D. X I.D._____, Length:_____, Slot size:_____, Type slot:_____, Mfg. By:_____

Prepack Well Screen :Yes/No, From: _____ft. to _____ft. & _____ft. to _____ft. Sand Grade_____

Bentonite Seal Above Screen: Yes / No, From:_____ft. to: _____ft. and From:_____ft. to:_____ft.

J-Plug Well Seal: Yes / No Well Head Properly Vented: Yes / No.

Is well Locked: Yes / No. Lock Number:_____, Key Number:_____, Lock mfg._____

Was Hole Plugged: Yes / No. Was Well Chlorinated: Yes / No. Static Water Level:_____

Grouted: Yes / No with: neat cement_____, cement grout_____, bentonite grout_____, other_____

Grout: _____lbs/gal., Trimed in Hole:Yes / No, Total of_____gals. of slurry pumped.

Field Supervisor: _____, Helper: _____

Nearest pollution/ contamination source:_____

Direction and distance:_____

Comments:_____

_____

_____

(*Use back if needed for additional comments*)

Well Schematic
Explanation:_____

_____

_____

EXHIBIT 03.2 Field record of well construction. Source: Delta Environmental Services (2001)

Piezometer Installation: Stick-up

X 1/4 of X 1/4 of X 1/4 of Section X, Twp. X North / South, Rge. X East / West
X County, State of Kansas

Date: XX/XX/XX

WELL HEAD PROTECTION
A 3' stick-up with a locking lid and padlock. Top of casing is fitted with a Morrison Brothers, Co., lockable J-plug.

CONCRETE PAD
8" thick and extends 8" larger than the stick-up (28" minimum). Sloped to prevent pooling of water and vegetation around well and to allow for placement of a surveyor pin.

IMPERVIOUS GROUT
The well is grouted with cement grout as required, mixed with clean fresh water.

WELL CASING
Well casing is terminated as high as possible inside the stick-up and is capped with a Morrison Brothers, Co. Model 678XA lockable J-plug.

4" PVC Sch 40, threaded casing and PVC, Mill Slot (0.020") well screen.

HOLE SIZE
The hole is X" in diameter from the surface to (XX') T.D. and grouted from the top of the sand pack to the ground surface.

GRAVEL / SAND PACK
Gravel/sand pack is designed to stabilize the aquifer material and permit the fine fraction to move into the well during development. Gravel/sand pack extends to at least 2' above screen.

CONTRACTOR LICENSING
The well was constructed under the direction of a licensed water well contractor as specified under the Kansas Department of Health and Environment regulation.

REGISTRATION
The well was registered with the Kansas Department of Health and Environment on form WWC-5.

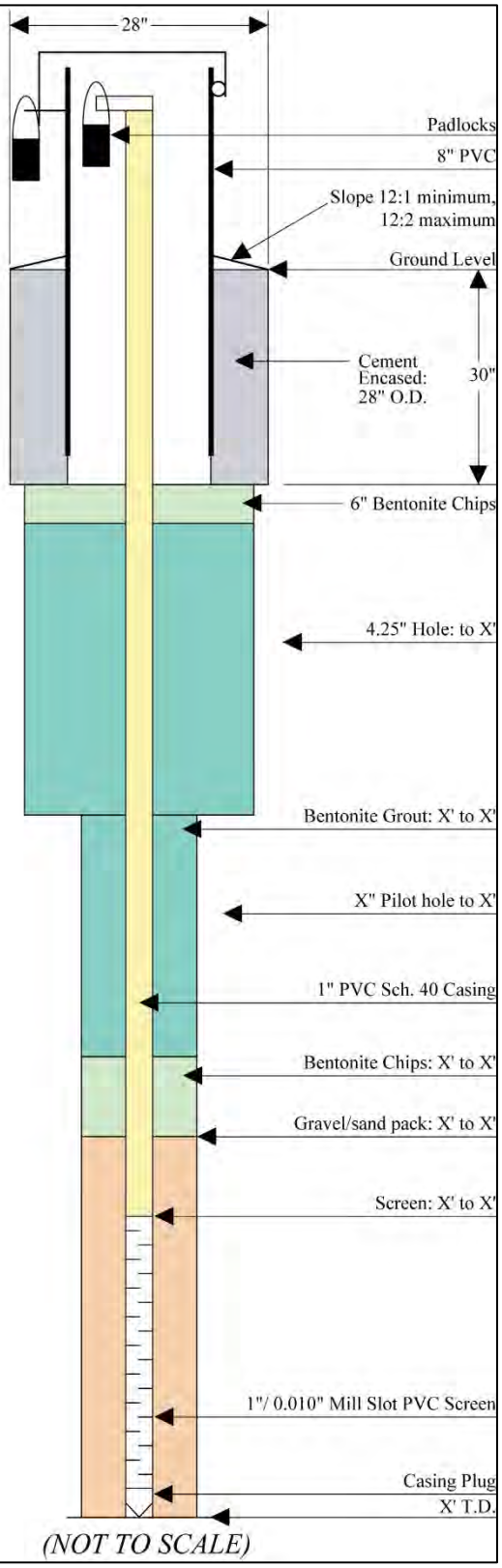

EXHIBIT 03.3 Specifications for stick-up piezometer installation.

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AGEM-04:

Abandonment of Soil Borings, Monitoring Wells, and Piezometers

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AGEM 04:

Abandonment of Soil Borings, Monitoring Wells, and Piezometers

1 Scope and Applicability

This SOP describes the methods used to abandon soil borings, monitoring wells, and piezometers. These methods must be conducted in accordance with the regulations of the state in which the abandonment is taking place.

2 Definitions

The following is a list of the acronyms and abbreviations (including units of measure) used in this SOP.

AGEM	Applied Geosciences and Environmental Management
ft	foot (feet)
gal	gallon(s)
HASP	health and safety plan
in.	inch(es)
PPE	personal protective equipment
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
SOP	standard operating procedure

3 Responsibilities

The field project manager, or other designee of the AGEM program manager, is responsible for the following:

- Verifying that the personnel implementing this SOP understand the procedure and all decommissioning guidelines for the state and are capable of implementing it correctly.
- Ensuring that the necessary equipment and materials are at the field site.
- Delineating and controlling work areas at the site (*Master Work Plan*, *Volume 1*, Section 6.5).

Personnel conducting the field activities are responsible for the following:

- Implementing this SOP and related procedures, as directed.

- Following additional procedures in both volumes of the *Master Work Plan* and the site-specific work plan and HASP.

- Submitting field notes related to waste management to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

4 Method Summary

The abandonment/decommissioning of soil borings, monitoring wells, and piezometers no longer used in the AGEM program (or in a state of disrepair) are to be conducted in accordance with state requirements to ensure they do not become conduits of contamination to the states' groundwater supplies.

5 Procedures

5.1 Plugging and Sealing Decommissioned Borings, Wells, and Piezometers

Procedures for plugging and sealing borings, monitoring wells, and piezometers must conform to applicable state requirements for borehole abandonment (see references in Section 7 of this SOP), including those for completing abandonment/plugging forms (notices and records) and filing them with the appropriate state agencies. The following general guidelines also apply:

- Fill open holes with a bentonite slurry or neat cement. If the hole is deeper than 10 ft, emplace the bentonite or cement grout with a tremie pipe from the bottom of the hole up, until the grout/bentonite displaces all water in the hole and flows onto the ground surface. Shallow holes less than 3 ft deep may be backfilled with native soil or grouted to the surface.

- Abandon wells by removing as much of the casing as possible. Then proceed as for open holes.

- Abandon piezometers by first grouting with a tremie pipe. Then remove the top 3 ft or more of casing. Install a 1-ft-thick cement plug, and backfill to the surface with native soil or grout.

- Fill out abandonment/plugging forms and file with the appropriate state regulators

5.2 Plugging and Sealing Hand Dug Wells

- Remove pumps and clean out debris and ensure they are properly disposed of.
- Disinfect water wells with chorine (at a rate of 1 gal of 5% solution per 500 gal of water in well).
- Slowly knock off about 5 ft of rock lining into the well, alternately filling with rock then sand (to fill the voids).
- Fill with clean sand/gravel to the static water level.
- Keep water in the well pumped down to the static water level.
- Backfill the well with compacted clay (bentonite) to within 5 ft of the surface and seal it with a 6-in. layer of cement or bentonite.
- Fill the remaining 4.5 ft or so with compacted top soil.
- Create a mound at the ground surface to drain water runoff away from the well.
- Fill out abandonment/plugging forms and file with the appropriate state regulators.

6 Related Internal Procedures

- *Master Work Plan, Volume 1:*
  - Section 6.5 (PPE)
- *Master Work Plan, Volume 2:*
  - AGEM-21: Calibration of Field Instrumentation and PID Operation
  - AGEM-22: Equipment Decontamination
  - AGEM-27: Sample and Document Management

7 References Cited or Consulted

KDHE, 2018a, *Procedure for Plugging a Groundwater Monitoring Well*, Procedure #WWP-10, prepared by the Bureau of Water, Geology and Well Technology Section, Kansas Department of Health and Environment, January.

KDHE, 2018b, *Plugging Abandoned Wells*, prepared by the Bureau of Water, Geology and Well Technology Section, Kansas Department of Health and Environment, April.

MDNR, 2019, *Plugging of Monitoring Wells*, Missouri Code of State Regulations (CSR), 10 CSR 23-4.080, prepared by the Missouri Department of Natural Resources, January 29.

MDNR, 2014, *Plugging Your Abandoned Well*, Publication 2281, prepared by the Missouri Department of Natural Resources, May.

NDHHS, 2014, *Water Well Standards: Water Well Construction, Pump Installation, and Water Well Decommissioning Standards*, prepared by the Nebraska Department of Health and Human Services, Nebraska Administrative Code (NAC), Title 178, Chapter 12 [178 NAC 12], August 26.

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AGEM-10:

Soil Sampling

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Contents

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AGEM-10:

Soil Sampling

1 Scope and Applicability

This SOP describes the methods used to collect representative soil samples for chemical analyses (usually for VOCs) and geotechnical analyses. Various methods are used to recover soil samples, depending on the depth of the desired sample, the soil type, and the type of analysis for which the soil sample is collected. Site-specific work plans contain details about sampling media, modes, intervals, and frequencies for each sampling event.

2 Definitions

The following is a list of the acronyms and abbreviations (including units of measure) used in this SOP.

AGEM	Applied Geosciences and Environmental Management
CPT	cone penetrometer
HASP	health and safety plan
hr	hour(s)
ID	sample identification
in.	inche(s)
PPE	personal protective equipment
QA/QC	quality assurance/quality control
SOP	standard operating procedure
VOC	volatile organic compound

3 Responsibilities

The field project manager, or other designee of the AGEM program manager, is responsible for the following:

- Verifying that the personnel implementing this SOP understand the procedure and are capable of implementing it correctly.
- Verifying that the personnel implementing this SOP understand the specific work planned for each field event.
- Ensuring that the necessary equipment and materials are at the field site.
- Acquiring the necessary utilities surveys.

- Delineating and controlling work areas at the site (*Master Work Plan*, *Volume 1*, Section 6.5).
- Ensuring that monitoring for hazardous materials and noise is conducted as appropriate.
- Documenting the results of instrument calibration and air monitoring.

Personnel conducting the field sampling are responsible for the following:

- Implementing this SOP and related procedures, as directed.
- Following additional procedures in both volumes of the *Master Work Plan* and the site-specific work plan and HASP.
- Submitting field notes to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

4 Method Summary

Various methods are used to recover soil samples for geotechnical and chemical analyses. The principal methodology consists of sonic drilling, used to reach depth. The principal direct push configuration consists of a Geoprobe® Dual Tube or Macro-Core® continuous soil sampler that is pushed hydraulically with a CPT rig, Geoprobe®, or rotary sonic rig. Push cores are normally sleeved in plastic.

Hydraulic-push technology, a hand-driven coring device such as an ESP™ sampler, a hand-pushed coring device, or hand tools such as shovels, can be used to recover near-surface soil, as appropriate. All equipment is to be used in accordance with the manufacturer's directions.

5 Procedures

5.1 Supplies Needed

- PPE *(Master Work Plan, Volume 1*, Section 6.5)
- Decontamination supplies (AGEM-22)
- Logbooks and other documentation material
- Field meters and monitoring equipment

- Sampling device(s)
- Sample containers, dry ice, and cooler(s) (AGEM-23)

5.2 Preparations before Sampling

1. Delineate and control field work areas.
2. Secure a utilities survey (48 hr before drilling, with a 10-day refresh).
3. Calibrate field instruments and initiate air monitoring for hazardous materials, as appropriate.
4. Put on the approved level of PPE.
5. Lay plastic sheeting around the work location to minimize the likelihood of cross-contamination.
6. For soil samples collected for VOCs analysis, fill the cooler with dry ice for immediate preservation to cryogenically lock in VOCs.

5.3 Collecting and Handling Soil Samples for VOCs Analyses

5.3.1 Handling Soil Samples for VOCs Analyses

1. Place the soil sample in a jar. Secure the cap tightly, label the jar (with the sample ID), and immediately place the jar on dry ice in a cooler.
2. Maintain cryogenic conditions until the samples are removed for analysis in the laboratory.
3. Ship the samples to the laboratory via an overnight delivery service.
4. Consult AGEM-23 for details on handling, packing, and shipping.

5.3.2 Soil Sampling near the Ground Surface by Hand

The following procedure can be used in most soil types to collect soil samples near the ground surface:

1. Carefully remove the top layer of soil or debris to the desired sample depth with a clean spade or trowel.

2. Immediately use a clean spoon or scoop to collect and transfer the sample directly into a labeled sample container.

3. Decontaminate reusable equipment before proceeding to the next location.

5.3.3 Soil Sampling at Shallow Depth with Augers and Thin-Wall Tube Samplers

Use a sampling system consisting of an auger or a thin-wall tube sampler, a series of extensions, and a T handle as follows:

1. Attach the auger bit to a drill rod extension, and attach the T handle to the drill rod.

2. Clear the area to be sampled of surface debris (twigs, rocks, litter). If appropriate, remove the first 3-6 in. of near-surface soil in over a radius of approximately 6 in. around the drilling location.

3. Begin advancing the auger. Periodically remove accumulated soils and deposit them onto a plastic sheet spread near the hole to prevent loose material from falling back into the borehole.

4. At the desired sampling depth, slowly and carefully remove the auger from the hole.

5. Use a clean laboratory spoon or scoop to transfer soil from the auger directly into the labeled sample container.

6. To collect another sample at greater depth in the same hole, continue advancing the auger with additional extensions, and repeat step 5.

7. Abandon the shallow hole by backfilling with removed soil material.

8. Decontaminate reusable equipment before proceeding to the next location.

5.3.4 Soil Sampling at Depth with the Geoprobe® Dual Tube and Macro-Core® Soil Sampling Systems

1. The Geoprobe® Dual Tube soil sampler is a direct push system used to collect continuous core samples of unconsolidated material (soil) from within a sealed casing of Geoprobe® 2.25-in. outside diameter probe rods. Operational instructions and sampling protocols for this device are detailed in the *Geoprobe® DT22 Dual Tube Standard Operating Procedure*, *Technical Bulletin No. MK3140* (Geoprobe 2013), which is available through the manufacturer (online) or from the AGEM records manager. A hardcopy of the SOP can also be found in the AGEM field trailer.

2. The Geoprobe® Macro-Core® soil sampler is a solid barrel, direct push device used to collect continuous core samples of unconsolidated material (soil) at depth. Sample tubes come in lengths of 48 in. and 60 in. with an outside diameter of 2.25 in. Soil samples are collected inside a removable liner. Operational instructions and sampling protocols for this device are detailed in the *Geoprobe® Macro-Core® Standard Operating Procedure*, *Technical Bulletin No. MK3139* (Geoprobe 2011), which is available through the manufacturer (online) or from the AGEM records manager. A hardcopy of the SOP can also be found in the AGEM field trailer.

5.4 Collecting Soil Samples for Geotechnical Analysis

Soil samples for geotechnical analysis are collected as described in Sections 5.3.2 through 5.3.4 of this SOP; however, the methods for packaging and preservation are as follows:

1. If the analytical parameters include moisture, seal the ends of the sample in a tube with a nonpenetrating, nonshrinking wax and store in a cool, dark location until shipped.

2. Place soil samples for geotechnical analyses such as grain size in labeled bags or jars and store in a cool, dark location until shipped.

6 Related Internal Procedures

- *Master Work Plan, Volume 1:*
  - Section 4.2 (QA/QC for sampling)
  - Section 6.5 (PPE; work area designation and site control; utilities survey)
- *Master Work Plan, Volume 2:*
  - AGEM-01: Direct Push, Drilling, and Geologic Logging
  - AGEM-04: Abandonment of Soil Borings, Monitoring Wells, and Piezometers
  - AGEM-11: Handling and Disposal of Investigation-Derived Waste
  - AGEM-22: Equipment Decontamination
  - AGEM-23: Handling, Packing, and Shipping of Samples in the Field
  - AGEM-27: Sample and Document Management

7 References Cited or Consulted

EPA, 2001, *Soil Sampling,* SOP#2012, U.S. Environmental Protection Agency, Environmental Response Team, Emergency Division, Office of Emergency and Remedial Response, Washington D.C., July 11. (The most current versions of this and other EPA ERT SOPs are available online at: https://response.epa.gov; click on the link "ERT Standard Operating Procedures.")

Geoprobe®, 2011, *Geoprobe® Macro-Core® MC5, 1.25-Inch Light-Weight Center Rod Soil Sampling System, Standard Operating Procedure*, Technical Bulletin No. MK3139, January. (The SOP for this and other Geoprobe® instruments can be downloaded from the Geoprobe® literature web page at https://geoprobe.com/literature.)

Geoprobe®, 2013, *Geoprobe® DT22 Dual Tube Soil Sampling System, Continuous Core Soil Sampler, Standard Operating Procedure*, Technical Bulletin No. MK3140, January (originally prepared in November 2006). (The SOP for this and other Geoprobe® instruments can be downloaded from the Geoprobe® literature web page at https://geoprobe.com/literature.)

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AGEM-11:

Handling and Disposal of Investigation-Derived Waste

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AGEM-11:

Handling and Disposal of Investigation-Derived Waste

Scope and Applicability

This SOP describes the management of the small amounts of wastes generated in the field by AGEM investigations. These wastes include cuttings from borings and well installation, well development fluids, purge water, disposable sampling materials, and decontamination rinsates.

Soil cores collected during sampling are not considered waste; they are placed in core boxes and transported to an Argonne facility for lithologic description, research, and storage.

Definitions

The following is a list of the acronyms and abbreviations (including units of measure) used in this SOP.

AGEM	Applied Geosciences and Environmental Management
gal	gallon
HASP	health and safety plan
IDW	investigation-derived waste
PPE	personal protective equipment
QA/QC	quality assurance/quality control
SOP	standard operating procedure

Responsibilities

The field project manager, or other designee of the AGEM program manager, is responsible for the following:

- Verifying that the personnel implementing this SOP understand the procedure and are capable of implementing it correctly.
- Verifying that the personnel implementing this SOP understand the specific work planned for each field event.
- Ensuring that the necessary equipment and materials are at the field site.
- Delineating and controlling work areas at the site (*Master Work Plan, Volume 1*, Section 6.5).

Personnel conducting the field activities are responsible for the following:

- Implementing this SOP and related procedures, as directed.

- Following additional procedures in both volumes of the *Master Work Plan* and the site-specific work plan and HASP.

- Submitting field notes related to waste management to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

Method Summary

The general approach to management of IDW involves (1) leaving the site in a condition no worse than before the project began, (2) minimizing waste generation, (3) complying with federal and state regulations for wastes requiring permitted off-site disposal, and (4) keeping wastes on-site that do not require off-site disposal or extended aboveground containerization.

Procedures

Supplies Needed

- PPE *(Master Work Plan, Volume 1,* Section 6.5)
- Decontamination supplies (AGEM-22)
- Logbooks and other documentation material
- Field meters and monitoring equipment
- 55-gal drums, roll-off container(s), and/or polyethylene tank(s)
- Steel or plastic containers or plastic bags for small volumes of solids • Labeling materials

Preparations before Work Begins

1. Lay plastic sheeting around the work location to minimize the likelihood of crosscontamination, as needed.
2. Put on the approved level of PPE.
3. Calibrate field meters.
4. Initiate air monitoring for hazardous materials, as appropriate.

Handling Waste Soil

1. Store waste soil from drilling activities on-site in 55-gal drums or a roll-off container.

2. Remove or destroy old labels on the containers.

3. Label the top and side of each container with a weather-resistant label and indelible ink. Include the following information:

   f. A general description of the contents, such as "Waste Awaiting Characterization"

   g. Project name

   h. Origin of the material

   i. Container identification number

   j. Initials of the labeler

4. Re-label the container if the status of the IDW changes.

5. Stage waste containers in a way that minimizes public contact while meeting project needs, and that also considers landowner preferences.

6. Collect a representative sample of the IDW for analysis in accordance with applicable state and federal regulations and with requirements of the wastehandling facility.

7. If the analytical data indicate that the IDW may be placed in a permitted landfill, propose this method.

8. If the analytical data preclude placing the IDW in a permitted landfill, propose alternative disposal methods.

9. Submit the proposed disposal action to the state regulatory agency for approval and a permit where necessary.

10. Following approval (and permitting where necessary), obtain a disposal receipt from the permitted landfill and retain the record in the program archives.

Handling Wastewater

1. Place all wastewater suspected of being contaminated (including purge water) in 55-gal drums or a portable polyethylene tank.

2. Label and stage the containers on-site as in steps 2-5 of Section 5.3 of this SOP.

3. Aerate the wastewater, if acceptable to the state regulatory agency.

4. Collect a representative sample of the wastewater for analysis in accordance with applicable state and federal regulations.

5. If the analytical data indicate contaminant concentrations below applicable regulatory levels, propose discharge of the wastewater on-site, away from known sensitive receptors.

6. If the analytical data indicate concentrations above applicable regulatory levels, propose transport of the wastewater to a treatment facility approved by the state regulatory agency.

7. Submit the proposed disposal action to the state regulatory agency for approval.

8. Following approval, obtain a disposal receipt from the treatment facility and retain the record in the program archives.

Non-Hazardous Trash

1. Place non-hazardous trash in plastic bags for later disposal in a sanitary landfill.

2. Include used PPE and expendables with the non-hazardous trash.

Related Internal Procedures

- *Master Work Plan, Volume 1:*
  - Sections 2.1 and 2.2 (regulations and performance standards)
  - Section 4.2 (QA/QC for sampling)
  - Section 6.5 (PPE; work area designation and site control)
- *Master Work Plan, Volume 2:*
  - AGEM-27: Sample and Document Management
  - AGEM-10: Soil Sampling
  - AGEM-05: Purge Groundwater Sampling
  - AGEM-22: Equipment Decontamination
  - AGEM-23: Handling, Packing, and Shipping of Samples in the Field

References Cited or Consulted

BBL, Inc., 2006, "Standard Operating Procedure: Investigation Derived Waste Handling and Storage," in *McGuire's Ranch Sampling and Analysis Plan*, prepared for Regional Water Quality Control Board, North Coast Region, Santa Rosa, California, by Blasland, Bouck, and Lee, Inc., Petaluma, California.

EPA, 2014, *Management of Investigation Derived Waste*, SESDPROC-307-R3, prepared by the U.S. Environmental Protection Agency, Region 4, May 14.

KDHE, 2011, *Characterization and Disposal of Investigation-Derived Waste*, SOP BER-08, in "Quality Assurance Management Plan (QMP), Part II, Appendix A," Kansas Department of Health and Environment, Division of Environment, Bureau of Environmental Remediation, Topeka, Kansas (SOP BER-08 was originally published on August 14, 2000), January 1. (For links to the various sections and appendices of the QMP [Revision 6], including SOPs, dated February 21, 2019, go to http://www.kdheks.gov/environment/qmp/qmp.htm)

NDEQ, 2016, *Investigation-Derived Waste (IDW) & Remediation Waste Considerations*, 05-161, Nebraska Department of Environmental Quality, Lincoln, Nebraska, December.

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AGEM-13:

Soil Gas Sampling for Chemical Analysis

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Contents

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AGEM-13:

Soil Gas Sampling for Chemical Analysis

1 Scope and Applicability

This SOP describes the techniques used to collect, from the unsaturated zone of the subsurface, representative soil gas samples of known quality for chemical analysis.

2 Definitions

The following is a list of the acronyms and abbreviations (including units of measure) used in this SOP.

AGEM	Applied Geosciences and Environmental Management
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
ft	foot (feet)
HASP	health and safety plan
hr	hour(s)
in.	inche(s)
min	minutes(s)
mL	milliliter
PID	photoionization detector
PPE	personal protective equipment
PRT	post running tube
SOP	standard operating procedure

3 Responsibilities

The field project manager, or other designee of the AGEM program manager, is responsible for the following:

- Verifying that the personnel implementing this SOP understand the procedure and are capable of implementing it correctly.
- Verifying that the personnel implementing this SOP understand the specific work planned for each field event.
- Ensuring that the necessary equipment and materials are at the field site.
- Acquiring the necessary utilities surveys.

- Delineating and controlling work areas at the site (*Master Work Plan*, *Volume 1,* Section 6.5).

Personnel conducting the field sampling are responsible for the following:

- Implementing this SOP and related procedures, as directed.
- Following additional procedures in both volumes of the *Master Work Plan* and the site-specific work plan and HASP.
- Submitting the field notes to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

4 Method Summary

A soil gas sample is collected by actively withdrawing an aliquot of vapor from the subsurface, typically with a sampling probe. The sample is then analyzed as desired.

Soil gas probes can be installed either temporarily or permanently/semi-permanently. Installation of soil gas probes is discussed in AGEM-12.

5 Procedures

5.1 Supplies Needed

- PPE (*Master Work Plan, Volume 1*, Section 6.5)
- Decontamination supplies (AGEM-22)
- Logbooks and other documentation material
- Field meters and monitoring equipment
- Vacuum pump and gauge
- Leak check compound
- Sampling device(s) and monitoring instruments
- Sample containers: Summa canisters, Tedlar bags, or sorbent (Tenax) tubes
- Carbon dioxide (CO_2) cylinder, regulator, and tubing

5.2 Preparations before Sampling

1. Lay plastic sheeting around the sampling location to minimize the likelihood of contamination, as needed.

2. Put on the approved level of PPE.

3. Calibrate field meters.

4. Prepare to protect the soil gas samples from heat, light, and physical damage.

5. Initiate air monitoring for hazardous materials, as appropriate.

5.3 Steps for Collecting Soil Gas Samples

5.3.1 Equilibration

During installation of a soil gas probe, unavoidable disturbance of subsurface conditions occurs. Allow the soil gas profile to equilibrate after probe installation and before soil gas collection, as follows:

1. For probes installed by a direct-push method, equilibration for at least 20 min if the drive rod remains in the ground and at least 30 min if the drive rod is withdrawn is normally sufficient; however, up to 2 hr (or longer) may be required under certain subsurface conditions.

2. If necessary, verification that equilibrium has been re-established can be obtained by collecting time-series data. Soil gas samples, along with oxygen and carbon dioxide measurements, should be collected shortly after installation, and periodically thereafter, to demonstrate the equilibration time needed to recover representative samples. A field instrument (PID, FID, etc., as appropriate) may be used to screen the soil gas samples for this purpose. For multiple sampling points in a relatively homogeneous lithology, evaluation of one monitoring point may be sufficient.

5.3.2 Shut-In Test

Before purging and sampling, a shut-in test should be performed to check for leaks in the above-ground sampling apparatus. The required tubing, valves, and fitting to be used in connecting the soil vapor probe to the sample container should be assembled, and include a pressure/vacuum gauge. A vacuum is applied to the sampling train (using a suitable pump or gas-tight syringe) and then the system is isolated. Components of the sampling train should be adjusted, if necessary,

so that no loss of vacuum is observed from the system over a minimum period of 1-30 min or longer (to be determined based on the anticipated duration of each sample collection event).

If temporary, direct-push soil gas sampling points are installed by using the post-run tubing PRT method, the shut-in test as described above can be performed on the entire above-and below-ground sampling system after connection of the post-run tubing to the expendable point holder and above ground sampling train, but *prior to retraction of the rod string and release of the O-ring sealed expendable drive point* from point holder.

5.3.3 Determining the Purging and Sampling Rate

Flow rates and applied vacuum levels must be kept low to limit stripping and reduce the probability of leakage. An initial flow rate of 100-200 mL/min and vacuums less than 100-in. water should ideally be employed. A flow rate greater than 200 mL/min may be used to reduce purging times under certain conditions (for example, when purging deep locations using large-diameter tubing; however, a vacuum level of 100-in. water should generally not be exceeded. A vacuum gauge should be used to confirm the applied levels. Record vacuum and flow rate measurements in the sampling log.

If soil gas permeability is too low to sustain a reasonable flow rate at less than or equal to 100-in. water applied vacuum, alternative purging and sampling methods, as outlined in Appendix D of the *Advisory – Active Soil Gas Investigations* report (California EPA 2012), may be used to obtain representative samples.

5.3.4 Purging

Soil gas probes must be purged before sampling to ensure that stagnant or ambient air is removed from the system and that the samples collected are representative of subsurface conditions. Purge the system as follows:

1. Calculate the volume of the sampling system as the sum of:

    a. The volume of the probe's screened or open void interval accounting for the porosity of sand pack, if installed)

    b. The volume of tubing from the probe tip to the ground surface

    c. The volume of above-ground tubing connecting the soil probe to the sample collection device

2. Withdraw at least three volumes of the full sampling system, at flow rates and vacuum conditions similar to those used for sample collection (see Section 5.3.3 of this SOP). For small required purge volumes, a large gas-tight syringe may be used for purging (within the vacuum limits noted above) in lieu of a vacuum pump.

5.3.5 Leak Testing

A leak test must be conducted each time a soil gas sample is collected to demonstrate that the sample is not diluted or contaminated as a result of leakage. The leak test must use a tracer compound, such as CO_2, isopropanol, pentane, isobutane, propane, or butane, that is not otherwise associated with the site. The preferred tracer for the AGEM program is CO_2. Conduct the leak test as follows:

1. Immediately before sampling, place the tracer compound at each location where ambient air could be entering the sampling system or cross-contamination could occur. For liquid tracer compounds (e.g., isopropanol), wet a paper towel with the compound, and place the paper towel over each location to be tested. For gaseous tracer compounds, a suitable enclosure must be placed around the sampling train and sampling probe head, and flooded with the tracer throughout the sample collection process. Areas to be tested include the base of the probe at the ground surface, the connection from the probe to the sampling line, and connections in the sampling line.

2. Analyze the samples for the tracer compound, in addition to other analytes of significance to the investigation. If field analysis methods are available, test samples should be collected and analyzed, and any identified system leaks corrected, prior to the collection of representative soil gas samples.

5.3.6 Collecting the Samples

Collect soil gas samples after purging as follows:

1. If samples are to be analyzed off-site, collect the samples in gas-tight containers such as Summa canisters, Tedlar bags, or sorbent tubes.

    a. When certified clean, pre-evacuated Summa canisters are used, place a flow regulator and pressure/vacuum gauge (often supplied with canisters as a single unit) between the probe and the container to ensure that the flow rate is maintained as indicated in Section 5.3.4 of this SOP. Measure and record the canister vacuum upon initial opening of the inlet valve, and upon completion of sample collection, and the time and duration of sampling (using the soil gas sampling log shown in Exhibit 11.1).

    b. When a vacuum pump is used with sorbent tubes, collect the samples on the intake side of the pump. Handle, fill, and store the sorbent tubes in accord with the tube manufacturer's instructions.

    c. If Tedlar bags are used, samples may be (1) collected from the sampling train and injected into the bags using gas-tight syringes, or (2) by directly connecting the bag to the sampling train, placing the bag in a suitable

enclosure (vacuum box), and applying an external vacuum to inflate the bag. Filled bags should be placed in an empty cooler at ambient temperature (not chilled) to maintain an ambient temperature and minimize exposure to light.

2. If samples are to be analyzed promptly on-site, collect the samples by using gas-tight syringes.

    a. Syringes should be checked for leaks before each use by closing the inlet valve and attempting to draw (or expel) ambient air through the needle. Gas-tight glass syringes with Teflon seals are preferred.

6 Related Internal Procedures

- *Master Work Plan, Volume 1:*
    - Section 4.2 (QA/QC for sampling)
    - Section 6.5 (PPE; work area designation and site control; ambient air monitoring; utilities survey)
- *Master Work Plan, Volume 2:*
    - AGEM-12: Installation of Soil Gas Probes
    - AGEM-22: Equipment Decontamination
    - AGEM-23: Handling, Packing, and Shipping of Samples in the Field
    - AGEM-27: Sample and Document Management

7 References Cited or Consulted

California EPA, 2012, *Advisory — Active Soil Gas Investigations*, prepared by the California EPA in coordination with the Department of Toxic Substances Control, the San Francisco Bay Regional Water Quality Control Board, and the Los Angeles Regional Water Quality Control Board, April 30.

EPA, 2014, *Soil Gas Sampling*, SESDPROC-307-R3, prepared by the U.S. Environmental Protection Agency, Region 4, May 14.

Geoprobe® Systems, Inc., 2006, *Direct Push Installation of Devices for Active Soil Gas Sampling and Monitoring (Manual)*, Tech. Bull. MK3098, May.

Hartman Environmental Geoscience, 2015, *The Vapor Intrusion Risk Pathway: A Practical Guide*, May.

Soil Gas Log Sheet				
Date:			Site:	
Well ID:			Sample ID:	
Beginning Gauge Reading:				
CO2 Flood Start:		:	Stop:	:
11 Liter GeoProbe Vacuum Pump Storage Tank Gauge Readings				
Start		Hg psi at	:	hour
1st Tank Volume				
Stop		Hg psi at	:	hour
Start		Hg psi at	:	
2nd Tank Volume				
Stop		Hg psi at	:	hour
Start		Hg psi at	:	hour
3rd Tank Volume				
Stop		Hg psi at	:	hour
Start		Hg psi at	:	hour
4th Tank Volume				
Stop		Hg psi at	:	hour
Sample Can #		Flow Control #:		
Can starting at		Hg psi at	:	hour
Can stopping at		Hg psi at	:	hour
Sampler's Initials:				

EXHIBIT 13.1 Soil Gas Log Sheet

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AGEM-21:

Calibration of Field Instrumentation and PID Operation

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Contents

Exhibit

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AGEM-21:

Calibration of Field Instrumentation and PID Operation

Scope and Applicability

This SOP describes the general techniques used for calibrating, maintaining, and operating field meters, with greater detail on the operation of the PID for ambient air monitoring when hazardous materials might be present. Other equipment used for safety-related field (air) monitoring is listed in the *Master Work Plan, Volume 1*, Section 6.5. Note that *all meters must be operated in accordance with the manufacturer's instructions.*

Field parameters measured during groundwater sampling and surface water sampling include temperature, pH, electrical conductivity, dissolved oxygen, and oxidation-reduction potential. Additional information about the use of field meters for these applications is in AGEM-05, AGEM-06, and AGEM-17. Techniques and equipment for measuring groundwater levels are described in AGEM-07 and are not included here.

Definitions

The following is a list of the acronyms and abbreviations (including units of measure) used in this SOP.

AGEM	Applied Geosciences and Environmental Management
EPA	U.S. Environmental Protection Agency
HASP	health and safety plan
PID	photoionization detector
PPE	personal protective equipment
ppm	part(s) per million
sec	second(s)
SOP	standard operating procedure
QA/QC	quality assurance/quality control
UV	ultraviolet
VOC	volatile organic compound

Responsibilities

The field project manager, or other designee of the AGEM program manager, is responsible for the following:

- Verifying that the personnel implementing this SOP understand the procedure and are capable of implementing it correctly.

- Verifying that the personnel implementing this SOP understand the specific work planned for each field event.

- Ensuring that the necessary equipment and materials are at the field site.
- Establishing calibration standards and frequencies for field instruments.
- Designating responsibilities for calibration and maintenance of field instruments.

Personnel conducting the field sampling are responsible for the following:

- Implementing this SOP and related procedures, as directed.
- Following additional procedures in both volumes of the *Master Work Plan* and the site-specific work plan and HASP.
- Submitting field notes to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

Calibration and Maintenance of Field Instruments

Field instruments that measure a quantity or must meet defined performance criteria require calibration and preventive maintenance and are therefore subject to the following provisions:

1. For each field instrument, determine the following:

   a. The standard to which the instrument is to be calibrated. This depends on the equipment's stability, the required accuracy and precision, and the potential effects of measurement error.

   b. The frequency of calibration. This depends on the equipment's stability, manufacturer's recommendations, the intended use, and the potential effects of measurement error.

2. Designate an individual to be responsible for overseeing the care and maintenance of each field instrument.

3. Establish the unique identity of each instrument by using the manufacturer's serial number or another identifier that is permanently attached to the instrument.

4. Attach a label to each instrument (except those used for groundwater field parameters) indicating when the next calibration is due.

5. Calibrate field equipment used for groundwater measurements before each use, by using fresh calibration standards and following the manufacturer's instructions.

6. Establish a calibration log for each instrument; store the log with the instrument. Include the following information:

a. Unique instrument identifier, type, model, and serial number

b. Date and time of calibration

c. Individual and organization performing the calibration

d. Reference equipment or standards used in calibration

e. Instrument reading with respect to each calibration standard

f. Certificates or statements of calibration provided by manufacturers or outside organizations

g. Comments regarding instrument performance

h. Maintenance and repair records

7. If an instrument does not meet calibration requirements, take it out of service until acceptable performance can be verified through maintenance or recalibration by the manufacturer.

8. Maintain an inventory of spare parts.

9. As required, establish a program of periodic operational checks in additional to formal calibration, to be implemented in conjunction with data acquisition.

10. Establish an organized program of preventive maintenance including equipment cleaning, lubrication, reconditioning, adjustment, and/or testing, in order to maintain proper performance, prevent equipment failure during use, and maintain the equipment according to the owner's manual.

11. Designate a temperature-controlled storage space for each instrument, in accordance with the manufacturer's instructions.

12. Clean equipment probes and electrodes before storage.

PID Operation Procedures

Operate PIDs in the field as follows:

Field Calibration

1. Use pre-calibrated, leased PID, specific to the contaminants of concern.

2. Conduct and record field calibration according to the PID manufacturer specifications (see Exhibit 21.1).

3. Obtain a "clean air" reading daily, before testing for possible contamination at the target drilling location(s).

Operation

1. Refer to EPA's SOP #2114 (EPA 1994) for information on interferences and potential problems with PID operation.

2. When the start-up procedure is complete, set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0-20 ppm range. Adjust if necessary.

3. Monitor the work activity as specified in the *Master Work Plan* and the site-specific health and safety plan. Avoid exposing the PID to excessive moisture, dirt, or contamination.

4. Position the probe assembly close to the area being monitored. Slowly sweep the probe from side to side. The instrument readout has a delay of 3-5 sec, depending on sensitivity to the contaminant.

5. During drilling, perform PID monitoring at regular intervals downhole, at the headspace, and in the breathing zone. In addition, where elevated organic vapor levels are encountered, monitor the breathing zone during actual drilling.

6. For activities other than drilling, emphasize monitoring of the breathing zone.

7. As needed, wrap the instrument (except for the probe's inlet and exhaust) in clear plastic to protect it from contamination or to keep it dry in the event of precipitation.

8. At the end of the monitoring period, clean the outside of the instrument with a damp disposable towel to remove visible dirt.

Care after Operation

1. Turn the function switch to the OFF position.

2. Complete logbook entries or download (Section 4, item 6, of this SOP).

3. Recharge the PID batteries on the docking station, located in a secure area.

Related Internal Procedures

- *Master Work Plan, Volume 1:*
  - Section 6.5 (PPE; air monitoring)
- *Master Work Plan, Volume 2:*
  - AGEM-05: Purge Groundwater Sampling
  - AGEM-06: Low-Flow Groundwater Sampling
  - AGEM-07: Measuring Water Levels in Wells
  - AGEM-14: Geoprobe and Sub-Slab Gas Detection
  - AGEM-17: Surface Water Sampling
  - AGEM-27: Sample and Document Management

References Cited or Consulted

EPA, 1994, *Photoionization Detector (PID) HNU*, SOP#2114, U.S. Environmental Protection Agency, Environmental Response Team, Emergency Division, Office of Emergency and Remedial Response, Washington D.C., October 6. (The most current versions of this and other EPA ERT SOPs are available online at: https://response.epa.gov; click on the link "ERT Standard Operating Procedures.")

BBL, Inc., 2006, "Calibration and Maintenance Procedures," Section B.5 in *McGuire's Ranch Sampling and Analysis Plan*, prepared for Regional Water Quality Control Board, North Coast Region, Santa Rosa, California, by Blasland, Bouck, and Lee, Inc., Petaluma, California.

PID Calibration Record

Date:		Calibrated By:	
Equipment Manufacturer:			
Model:		Serial Number:	
Lamp Intensity (eV):			
Battery Fully Charged:	Yes	No	
Temperature (°F):		Relative Humidity (%):	
Calibration Location:			
Fresh or Zero Air Calibration:	Yes	No	

CALIBRATION GASES		
Manufacturer (if applicable)	Calibration/Span Gas	Shelf-Life Specified on Cylinder (if applicable)

EQUIPMENT CALIBRATION			
Calibration/Span Gas [e.g., isobutylene, methane, other (specify)]	Instrument Reading (units)	Calibration/Span Gas Concentration (span value)	Instrument Adjustment (span value change) (Yes/No/Selfadjusts*)

* Specify "self-adjusts" when the equipment sets its own sensitivity to the calibration gas.

Comments:

EXHIBIT 21.1 PID Calibration Record

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AGEM-22:

Equipment Decontamination

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AGEM-22:

Equipment Decontamination

Scope and Applicability

This SOP defines a consistent process for decontaminating field equipment to prevent crosscontamination between sampling locations and minimize the transfer of hazardous substances from the work area to unaffected areas. This procedure does not address decontamination of personnel.

Sample containers are certified clean by the analytical laboratory or a supplier before they arrive in the field.

Definitions

The following is a list of the acronyms and abbreviations (including units of measure) used in this SOP.

AGEM	Applied Geosciences and Environmental Management
BER	Bureau of Environmental Remediation (KDHE)
EPA	U.S. Environmental Protection Agency
HASP	health and safety plan
KDHE	Kansas Department of Health and Environment
PPE	personal protective equipment
QA/QC	quality assurance/quality control
SOP	standard operating procedure

Responsibilities

The field project manager, or other designee of the AGEM program manager, is responsible for the following:

- Verifying that the personnel implementing this SOP understand the procedure and are capable of implementing it correctly.
- Ensuring that the necessary equipment and materials are at the field site.
- Delineating and controlling decontamination areas at the site (*Master Work Plan, Volume 1*, Section 6.5).

Personnel conducting the field sampling are responsible for the following:

- Implementing this SOP and related procedures, as directed.

- Following additional procedures in both volumes of the *Master Work Plan* and the site-specific work plan and HASP.

- Submitting the field notes to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

Method Summary

To minimize the potential for contamination, select work practices that minimize contact with hazardous substances, use appropriate PPE (*Master Work Plan, Volume 1*, Section 6.5) when handling contaminated equipment, and use disposable sampling equipment as appropriate.

The location(s) of decontamination station(s) will be determined by the field project manager. Work area designation is discussed in the *Master Work Plan, Volume 1*, Section 6.5.

Gross contamination can be removed initially by using brushes. Washes with various cleaning agents and rinses follow. Tap water from any municipal or industrial water treatment system is acceptable for use in initial washing and rinsing of sampling equipment. Commercially available distilled is acceptable for final rinsing. Collection of field blank samples is discussed in the *Master Work Plan, Volume 1,* Section 4.2.1.

Procedures

Supplies Needed

- PPE (*Master Work Plan, Volume 1*, Section 6.5)
- Large containers for decontamination water
- Source of tap water (designated for decontamination only)
- Distilled water
- Soft- and stiff-bristled brushes with long handles
- Detergent (solid or liquid)
- Spray bottles for rinsing
- Paper towels or other disposable cleaning cloths
- Plastic garbage bags for disposal of solid/hazardous wastes
- Hand pump sprayer

- Plastic drop cloth

Preparations before Decontamination Begins

1. Lay plastic sheeting around the decontamination area to minimize the likelihood of cross-contamination, as needed.

2. Put on the approved level of PPE.

Daily Decontamination of Reusable Sampling Equipment

Decontaminate reusable sampling equipment (pumps and bailers) after each monitoring well is sampled and at the end of each working day, as follows.

1. Scrape the equipment and wipe it clean of any mud, grease, or oil.

2. Rinse the equipment with distilled water.

3. Retrieve a grab (rinsate) sample as needed.

4. Dispose of contaminated materials as indicated in AGEM-11.

End of Event Decontamination of Reusable Sampling Equipment

Decontaminate reusable sampling equipment such as pumps, bailers, vegetation tools, and direct push tooling according to the following procedure:

1. Scrape and wipe the equipment clean of any mud, grease, or oil.

2. Wash and scrub the equipment thoroughly with nonionic detergent and water.

3. Rinse with tap water.

4. Rinse with distilled water.

5. Repeat steps 2-4, if necessary.

6. Air dry.

7. Dispose of contaminated materials as indicated in AGEM-11.

Replacing Plastic Tubing in Sampling Equipment

For sampling equipment that uses plastic tubing, disassemble the equipment and install clean tubing between sample locations.

Related Internal Procedures

- *Master Work Plan, Volume 1:*
  - Section 4.2 (QA/QC for sampling)
  - Section 6.5 (PPE; work area designation and site control)
- *Master Work Plan, Volume 2:*
  - AGEM-11: Handling and Disposal of Investigation-Derived Waste

References Cited or Consulted

EPA, 1994, *Sampling Equipment Decontamination*, SOP#2006, in "Compendium of ERT Waste Sampling Procedures," EPA/540/P-91/008, OSWER Directive 9360.4-07, U.S. Environmental Protection Agency, Environmental Response Team, Emergency Division, Office of Emergency and Remedial Response, Washington D.C. (originally published in January 1991), August 11.

KDHE, 2011, *Decontamination of Equipment*, SOP BER-05, in "Quality Assurance Management Plan (QMP), Part II, Appendix A," Kansas Department of Health and Environment, Division of Environment, Bureau of Environmental Remediation, Topeka, Kansas (SOP BER-05 was originally published August 14, 2000), January 1. (For links to the various sections and appendices of the QMP (Revision 6), including SOPs, dated February 21, 2019, go to http://www.kdheks.gov/environment/qmp/qmp.htm)

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AGEM-23:

Handling, Packing, and Shipping of Samples in the Field

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Tables

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AGEM-23:

Handling, Packing, and Shipping of Samples in the Field

Scope and Applicability

This SOP defines AGEM's process for ensuring consistency and reliability in the preparation of field samples for shipment to a laboratory for analysis.

Definitions

The following is a list of the acronyms and abbreviations used in this SOP.

AGEM	Applied Geosciences and Environmental Management
ASAP	as soon as possible
ºC	degrees Celsius
CFR	Code of Federal Regulations
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
g	gram(s)
mL	milliliter(s)
mm	millimeter(s)
PPE	personal protective equipment
QA/QC	quality assurance/quality control
SOP	standard operating procedure
VOC	volatile organic compound

Responsibilities

The field project manager, or other designee of the AGEM program manager, is responsible for the following:

- Verifying that the personnel implementing this SOP understand the procedure and are capable of implementing it correctly.
- Verifying that the personnel implementing this SOP understand the specific work planned for each field event.
- Ensuring that the necessary equipment and materials are at the field site.
- Delineating and controlling work areas at the site (*Master Work Plan, Volume 1,* Section 6.5).

Personnel conducting the field sampling are responsible for the following:

- Implementing this SOP and related procedures, as directed.
- Shipping verification samples to a reference laboratory as directed in the *Master Work Plan, Volume 1*, Sections 3.2.2 and 4.2.2.
- Following additional procedures in both volumes of the *Master Work Plan* and the site-specific work plan and HASP.
- Submitting the field notes to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

Method Summary

This procedure describes the containers, preservatives, and holding times needed for various sample media and analyses, as well as the methods for using those materials to ensure sample integrity. Sample documentation requirements are specified in AGEM-27.

Procedures

Supplies Needed

- PPE (*Master Work Plan, Volume 1*, Section 6.5)
- Logbooks and other documentation material
- Disposable non-talc gloves
- Shipping supplies (e.g., tape, markers, sealable plastic bags, bubble wrap, trash bags, coolers)
- Preservatives (e.g., ice, dry ice, sulfuric acid), as appropriate
- Sample containers, labels, appropriate forms, and custody seals

Sample Containers

Use sampling containers that are certified to have been cleaned to EPA specifications, either in the analytical laboratory or by a supplier. Sample size, container specifications, and preservation requirements for various media and analyses are summarized in Table 23.1.

23:

TABLE 23.1 AGEM Program sampling containers, preservation requirements, and holding times.

Parameter	Sample Matrix	Shipping Destination	Holding Time	Preferred Sample Container and Size	Preservative	Minimum Volume[1]
Volatile Organics	Water (primary)	AGEM	10 days	4 x 20-mL vial, Teflon-lined cap	Ice, 4°C	40 mL
	Water (confirmation; 10% of samples)	TestAmerica-Burlington	10 days	2 x 40-mL vial, Teflon-lined cap	Ice, 4°C	80 mL
	Sediment/Soil (primary)	AGEM	–	Glass jar	Dry ice	50 g
	Soil (confirmation; 10% of samples)	TestAmerica-Burlington	30 days	Glass jar	Dry ice	50 g
Air	AGEM	–	Prepared at AGEM for TestAmerica Canister from TestAmerica[b]	None	–	–
Cations	Water	TestAmerica-Burlington	180 days	Plastic (1 x 500 mL)	Ice, 4°C	100 mL
Anions	Water	TestAmerica-Chicago	28 days	Plastic (1 x 500 mL)	Ice, 4°C	100 mL
Ammonia	Water	TestAmerica-Chicago	28 days	Plastic (1 x 500 mL)	Ice, 4°C	100 mL
Nitrate (Total)	Water	TestAmerica-Chicago	28 days	Plastic (2 x 500 mL)	pH < 2, H_2SO_4	200 mL
Nitrate	Water	TestAmerica-Chicago	48 hr	Plastic (2 x 250 mL)	None	100 mL
Tritium	Water	Miami	6-12 mo	Plastic (1000 mL)	None	1 L
Isotopes	Water	Kruger	14 days	Plastic (2 x 40 mL)	Ice, 4°C	80 mL
Total Organic Carbon	Soil	TestAmerica-Burlington	14 days	Glass jar	Ice, 4°C	20 g
	Water	TestAmerica-Burlington	28 days	2 x 40-mL vial	pH < 2, H_2SO_4	80 mL
Methane, Ethane, Ethene	Water	TestAmerica-Burlington	14 days	2 x 40-mL vial	Ice, 4°C	80 mL

Sulfide	Water	TestAmerica-Burlington	30 days	Plastic (1 x 250 mL) from TestAmerica[b]	NaOH/Zn	250 mL
Hydrogen	Water	Microseeps	ASAP	Sampling tube from Microseeps[b]	None	–

[1] If the indicated minimum volume is less than the preferred volume, the analysis is possible with the smaller volume, but the results will be subject to quality limitations. [b] Allow 7 days for the laboratory to provide the container.

Preparations before Sample Handling Begins

1. Create a clean and safe working environment for sample handling.

2. Put on the approved level of PPE.

Packing Samples for Shipment

1. Place the containers constituting each individual sample in a sealable plastic bag and then in a sturdy cooler double-lined with unscented plastic trash bags.

2. Preserve analytical samples with specific holding temperatures as indicated in Section 5.5 of this SOP.

Preserving Samples

Water Samples

For tritium analysis: **Prevent the sample from freezing.**

- *For total nitrate-nitrite analysis:* Preserve with sulfuric acid, pH < 2. Because calcareous solids react with acid, attempts to adjust the pH of turbid water can result in the use of excessive acid (enough to affect results via dilution), foaming, container pressurization with consequent leakage, and a sample pH outside the preservation range. Handle turbid sample as follows:
  - Remove solids before acidification by placing the sample in a settling container.
  - Wait for the water to become clear.
  - Decant the clarified water into a sample bottle, and adjust the pH.
- *For other chemical analyses, including VOCs:* old and ship at 4°C, as follows:
  - Layer the sample containers with crushed conventional (water) ice inside the trash bag.
  - Include a water trip blank.
  - Close and seal the outer trash bag.
  - Take care to prevent the samples from freezing in transit to the laboratory.

Soil and Sediment Samples for VOCs Analyses

1. Place the sample containers with chunks of dry ice inside the trash bag in the cooler.

2. Include a soil trip blank.

3. Close the trash bag, and then *cut ventilation slits in its top to prevent a buildup of gas pressure*.

Vegetation Samples for VOCs Analyses

1. Place the sample containers with chunks of dry ice inside the trash bag in the cooler.

2. No trip blank is used.

3. Close the trash bag, and then *cut ventilation slits in its top to prevent a buildup of gas pressure*.

Air Samples for VOCs Analyses

To return cannisters to the laboratory, package and ship them according to vendor's instructions (see also AGEM-16).

Shipping Samples

1. Complete a chain-of-custody record (AGEM-27) inventorying the contents of the cooler. Place the record inside a clearly marked plastic bag or pouch, and affix the bag or pouch to the inside lid of the cooler.

2. Tape the cooler securely with fiber filament (or equivalent strength) tape.

3. Affix two custody seals (AGEM-27), signed and dated by the shipping coordinator, to the outside of the cooler so that the cooler cannot be opened without breaking the seal.

4. Complete a standard Federal Express or equivalent airbill. Retain a copy of the airbill until receipt of the shipment is verified.

5. If the package contains dry ice, indicate that in the "Special Handling" section of the Federal Express airbill. For air shipment, the package must comply with the International Air Transport Association's Dangerous Goods Regulations. Attach the required Class 9 shipping label (shown in Exhibit 23.1).

6. Select priority overnight delivery for samples to be analyzed for VOCs.

U.S. Department of Transportation Regulations

Samples of substances listed in the DOT's hazardous materials table (see 49 CFR, Regulation 172.101) must be identified, packaged, marked, labeled, documented, and shipped according to the regulations listed for that substance. A letter of understanding between the EPA and DOT states that preservatives in water samples are exempt if the reagents do not exceed the concentrations specified in Table 23.2.

TABLE 23.2 Maximum concentrations of hazardous materials used as preservatives in water samples that are exempt from DOT hazardous materials regulations

Preservative	Concentration
Hydrochloric acid (HCl)	0.4% by weight
Mercuric chloride ($HgCl_2$)	0.004% by weight
Nitric acid (HNO_3)	0.15% by weight
Sulfuric acid (H_2SO_4)	0.35% by weight
Sodium Hydroxide (NaOH)	0.08% by weight
Phosphoric acid (H_3PO_4)	pH between 4 and 2

Related Internal Procedures

- *Master Work Plan, Volume 1:*
  - Section 4.2 (QA/QC for sampling)
  - Section 6.5 (PPE; hazardous materials shipment training; work area designation and site control)
- *Master Work Plan, Volume 2:*
  - AGEM-11: Handling and Disposal of Investigation-Derived Waste
  - AGEM-22: Equipment Decontamination
  - AGEM-27: Sample and Document Management

References Cited or Consulted

BBL, Inc., 2006, "Attachment B: Standard Operating Procedures — Sampling Handling and Shipping," in *Supplemental Sediment Investigation Work Plan for Brownfield Cleanup AgreementWest Parcel, Former General Motors Assembly Plant Site, Sleepy Hollow, New York*, prepared for General Motors Corporation, Detroit, Michigan, by Blasland, Boucek, and Lee, Inc., Syracuse, New York, September.

California EPA, 1995, *Representative Sampling of Groundwater for Hazardous Substances: Guidance Manual for Groundwater Investigations*, prepared by the California EPA in coordination with the Department of Toxic Substances Control, Sacramento, California, July (revised February 2008).

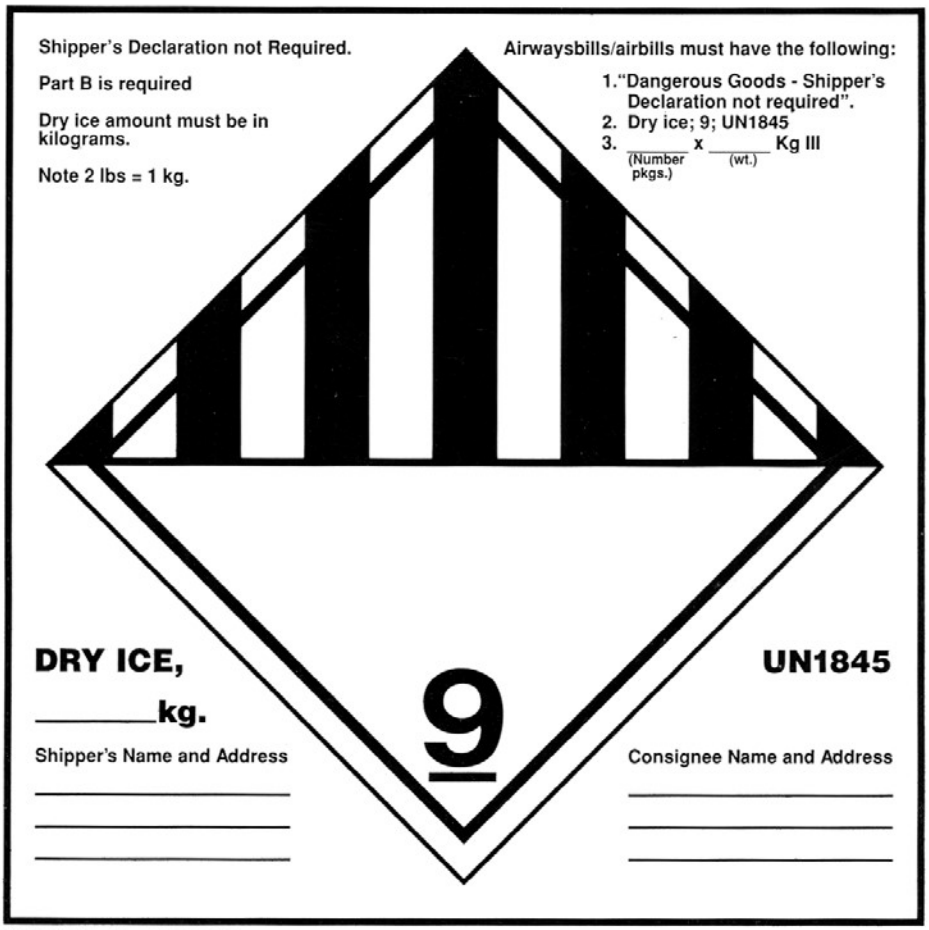

EXHIBIT 23.1 Dry ice label for shipping

Environmental Investigations at Former CCC/USDA Facilities: Master Work Plan

Volume 2: Standard Operating Procedures

AGEM 27:

Sample and Document Management

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Contents

Exhibits

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AGEM 27:

Sample and Document Management

1 Scope and Applicability

This procedure provides a framework and specific guidance for maintaining control of samples and documentation. These procedures are needed to (1) establish the authenticity of information generated, (2) facilitate interpretation of sampling and analysis results, and (3) maintain the program archives to objectively demonstrate the research, administrative, and operational activities of AGEM.

2 Definitions

The following is a list of the acronyms and abbreviations used in this SOP.

AGEM	Applied Geosciences and Environmental Management
BER	Bureau of Remediation (KDHE)
COC	chain-of-custody (form)
DOE	U.S. Department of Energy
EVS	Environmental Sciences (Division at Argonne National Laboratory)
hr	hour(s)
ID	identification
KDHE	Kansas Department of Health and the Environment
PPE	personal protective equipment
QA/QC	quality assurance/quality control
SOP	standard operating procedure
VOC	volatile organic compound

3 Responsibilities

3.1 AGEM Program Manager

The AGEM program manager is responsible for the following:

- Delegating responsibility for sample and document management to accomplish the tasks indicated in this SOP.
- Determining when samples and other physical evidence or project information may be discarded.

3.2 Field Project Manager

The field project manager, or another designee of the AGEM program manager, is responsible for the following:

- Verifying that the personnel implementing this SOP understand the procedure and are capable of implementing it correctly.
- Verifying that the personnel implementing this SOP understand the specific work planned for each field event.
- Gathering the sample labels, logbooks, and other forms needed for the field project and transporting them to the work site.
- Verifying that quality checks are performed on sample labels and other sampling records.
- Verifying that COC records have been reviewed and are properly signed before sample shipment.
- Verifying that the original signed COC record is shipped with samples to the laboratory in a prominently labeled plastic pouch in the shipping container and that a copy is retained in a temporary field file until the original reaches the laboratory.
- Verifying that the custody seals are signed and dated.
- Verifying that custody seals are affixed to sample shipping containers in a way that can demonstrate the integrity of the samples when the shipment arrives at the analytical chemistry laboratory.
- Maintaining an inventory of all project documents, including the *Master Work Plan* and site-specific work plan, field records, sample labels, COC records, shipping forms, correspondence, notes, legal documents, illustrations, software programs, and analytical data.
- Verifying that all required field records are completed and made available for review by the AGEM QA/QC coordinator.

3.3 Field Personnel

Personnel conducting the field program are responsible for the following:

- Implementing this SOP and related procedures, as directed.
- Completing field records as described in this procedure.

- Recording water level measurements as directed in Section 4.8 of this SOP.
- Following additional procedures in the *Master Work Plan* and the site-specific work plan.
- Submitting field notes to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

Personnel handling samples in the field are responsible for the following:

- Completing sampling records (Section 4.4 of this SOP).
- Labeling samples so that they can be easily identified and distinguished from other similar samples, from collection to analysis (Section 4.5 of this SOP).
- Assigning sample identification codes in accordance with Section 4.3 of this SOP.
- Shipping verification samples to a reference laboratory as directed in the *Master Work Plan*, *Volume 1*, Section 4.1.1.
- Initialing COC records (Section 4.6 of this SOP).
- Placing the original COC record in the shipping container with the samples sent to the laboratory, in a prominently labeled plastic pouch, and making a copy of the COC record for the temporary field file.

3.4 Records Coordinator and QA/QC Coordinator

The AGEM records coordinator is responsible for the following:

- Maintaining the environmental data management system of field, laboratory, and other data.
- Logging in samples and entering sample information into the environmental data management system.
- Identifying documents comprising records from among information generated or received by the program consistent with Argonne and DOE policy.
- Placing field and program records in the electronic recordkeeping system in accord with the established organizational hierarchy.
- Preserving the reliability, authenticity, integrity, usability, content, context and structure of archived field and program records, objectives articulated in federal records management policy.

- Coordinate with the division records coordinator to retain and dispose of records on schedules defined by Argonne and DOE policy.

The AGEM QA/QC coordinator is responsible for the following:

- Verifying the completeness and accuracy of recorded information by performing a cross-check of sample documentation in the field sampling records, reported on the COC record, and included in the environmental data management system.
- Resolving discrepancies in project documentation and recording the outcome.

3.5 Analytical Laboratory Personnel

Analytical laboratory personnel are responsible for the following:

- Recording the condition of samples and documentation received in the laboratory.
- Conducting analyses as prioritized by the AGEM project manager or designee and within holding times.
- Maintaining documentation to demonstrate that analyses were conducted according to QA/QC protocols.
- Submitting documentation to the AGEM QA/QC coordinator for review and to the AGEM records coordinator for retention in the program archives.

4 Documentation of Field Activities

4.1 Supplies Needed for Field Documentation

- Pens with waterproof ink
- Pencils
- Forms, serialized sample labels, logbooks, COC forms, custody seals

4.2 Procedures for Completing Documentation

- Use waterproof ink unless weather conditions prohibit the use of ink. In that case, use a pencil and note the reason.

- If an error is made on any field document, make a correction by drawing a single line through the error and entering the correct information. Initial and date all corrections.

- If a field document is damaged, lost, or destroyed, record the serial number of the document and the nature of the problem. Keep voided documents so that they can be maintained in the files for accountability.

4.3 Assigning Sample Identification Codes

Assign each sample collected for analysis a unique five-digit number selected from a continuous number series, plus encoded information, to create an alphanumeric identifier (sample ID). The encoded information must identify the work site and sample matrix. Additional information normally specifies the sample location designation (for environmental samples) or the sample type (for QC samples).

The general system is as follows:

Sample ID:	AABBB-C-DDDDD
A	Site name (two letters)
B	Additional information (letters, numbers, or both; variable number of characters)
-C-	Sample medium (one letter)
D	Unique serial number (five digits)

Though the serial number alone distinguishes the sample uniquely, the additional information facilitates sample handling and data processing and provides a safeguard against transcriptional errors. In practice, the AGEM records coordinator (before mobilization to the field) assigns a block of numbers from a continuous series to an event at a site. A preprinted label carrying a number from this series is assigned to each sample at the time of sampling.

Examples are as follows:

Sample ID:	MRSB01-S-10445
MR	Morrill, Kansas
SB01	Soil boring number 01, a formally named and mapped location
-S-	Soil
10445	Unique number assigned from continuous series

Sample ID:	MRQCTB-W-10446
MR	Morrill, Kansas
QC	Quality control sample
TB	Trip blank
-W-	Water
10446	Unique number assigned from continuous series

4.4 Documenting Sample Collection

For all sampling activities, field personnel are responsible for recording (1) the sequence of activities (for later reconstruction of the sampling event) and (2) the location and size of each sample collected. Record the following information on a suitable form:

- The unique sample ID (Section 4.3).
- Sample medium.
- Size and type of sample container.
- Analysis to be performed.
- Type and volume of preservative(s) added (if applicable) and the preservation conditions.
- Day, month, and year of sample collection.
- Time (based on the 24-hr clock) of sample collection.
- Site name.
- General location of the sampled area.
- Exact point where the sample was collected.
- Depth below the ground surface level where the sample was collected.
- Visual or other observations relevant to the sampling area, the waste source, or the sample itself, such as the following:
  - Soil — color, texture, moisture, cohesiveness, odor

  - Sediment — exposed or lying under water, texture, color, cohesiveness, viscosity
  - Water — turbidity, water level, flow, flow rate
  - Drum — container type, size, shape, markings, volume of contents, viscosity
  - Sampling site — terrain, topography, landforms
- Results of quantitative field measurements of the site or the sample (e.g., pH, conductivity).
- Type of sample (e.g., waste, quality control, branch, leaf, surface water).
- Deviations from procedures specified in the *Master Work Plan, Volumes 1 and 2* (main text and SOPs) or in the site-specific work plan.
- Signature to verify recording of the entries on the form.
- Signature to verify performance of the QA check on the completed form.

4.5 Sample Label

To maintain sample identity, beginning at the time of sample collection, use self-adhesive labels preprinted with the site identifier and unique five-digit numbers incorporated into sample IDs (Section 2.3 of this SOP). Add other portions of the sample identification code indicated in Section 2.3. If more sample aliquots are collected for analysis than preprinted labels are available, use standard commercially available sample labels.

The sample label must be completed by the person collecting the sample. After a review of the sample documentation by the AGEM QA/QC coordinator, the AGEM records coordinator enters the label information into the environmental data management system during sample log-in. An example of a sample label is shown in Exhibit 27.1.

4.6 Chain-of-Custody Record

The purpose of the serialized COC record (Exhibit 27.2) is to document, as evidence admissible in a court of law, transfers in the possession and custody of samples. Properly completed, the COC record demonstrates that, from sample collection to laboratory analysis, the sample was continuously under custody. The COC record unequivocally links samples collected in the field with the data reported by the analytical laboratory. Responsibilities are summarized in the main text of this volume.

The process for initiating and handling the COC record is as follows:

- The sampler initially completes the COC record; individuals accepting or relinquishing custody of the sample subsequently review and sign the COC record.
- The field project manager or designee reviews and signs the COC record.
- The original signed COC record is placed, with the samples, in a prominently labeled plastic pouch inside the shipping container for transfer to the primary laboratory.
- Analytical laboratory personnel review and sign the original COC record and send it to the AGEM records coordinator.
- The AGEM records coordinator enters the COC information in the environmental data management system, scans the original signed COC record to an electronic format, and retains a copy in the electronic recordkeeping system.
- The field project manager keeps a copy of the COC record until the original is received at the laboratory.

The serialized COC record form must contain the following information:

- The medium (soil/sediment or groundwater) sampled.
- The name of the laboratory to which the sample is being sent.
- The identifying number or physical description of the shipping container.
- Carrier airbill number or other pertinent shipping detail.
- The name and telephone number of an individual who can provide information about the sample(s).
- The name of the site where the sample was collected.
- The signature(s) of individual(s) who physically collected the sample.

- The day, month, and year of sample collection.
- The ID number(s) of the sample(s).
- The total number of containers used for each respective sample.
- The analysis to be performed on the sample(s).
- Comments about the individual sample(s), such as “Sample container was broken and discarded.”
- The names of the individual who relinquished custody of the sample(s) and the individual who accepted custody, together with the date and time of transfer. The first person to relinquish the sample(s) must be one of the sample collectors.
- Comments about all of the samples inventoried on the COC record, such as, “High-priority sample. Please analyze first and fax preliminary results to field project manager.”
- Verification by analytical laboratory personnel that the custody seal and sample containers were intact when they were received; that the shipment was at the required temperature; and that the sample labels, tags, and COC record agree.

4.7 Custody Seal

During shipment from the field to the analytical chemistry laboratory, samples pass through the hands of unidentified individuals. The purpose of the custody seal (Exhibit 27.3) is to maintain the security of the samples during this period, so that signatures of the unidentified intermediate handlers are not required on the COC record. The custody seal must be affixed to the shipping container in a way that can demonstrate, upon arrival at the analytical laboratory, that the samples were secure during shipment. The custody seal must be signed and dated when the container is prepared for shipping from the field site. Responsibilities are defined in the main text of this volume.

4.8 Recording Water Level Measurements

Water levels measured *during drilling and construction* are not entered into the environmental data management system and are recorded separately from that system. Measure pre-completion water levels relative to the ground surface level; enter the results in field records for drilling, sampling, or both if relevant.

Once a well has been completed, measure all water levels relative to the accurately surveyed reference point for each well. Water levels measured in this way are entered into the environmental data management system for a site. During the sampling of newly completed and

developed wells, enter the measurements in the field sampling record initially, and then transcribe the data to the environmental data management system, when appropriate. For long-term water level monitoring programs, incorporate water level measurements into the environmental data management system.

4.9 Discarding Samples

A sample and its container may be discarded only as authorized by the AGEM program manager, in writing, in response to a written request.

5 Documentation of Program Activities

Procedures for managing program records include:

- Identifying documents comprising records from among information generated or received by the program that are required to be retained consistent with applicable Argonne and DOE policy.
- Classifying the record within the hierarchy of the established filing scheme and retaining it in the electronic recordkeeping system.
- Saving each record's metadata to document the provenance and contextual information of the record. Types of metadata include the purpose; method of creation; date of creation; creator or author; standards used in creation; origin location; and retention location of the record.
- Observing retention periods specified in applicable Argonne and DOE policy to manage each record throughout its entire lifecycle, from receipt or generation of information, to disposition at the end of its lifecycle.

6 Related Internal Procedures

- *Master Work Plan, Volume 1:*
  - Section 4.2 (QA/QC for sampling)
  - Section 6.5 (PPE; work area designation and site control)
- *Master Work Plan, Volume 2:*
  - AGEM-05: Purge Groundwater Sampling
  - AGEM-06: Low-Flow Groundwater Sampling

  - AGEM-07: Measuring Water Levels in Wells
  - AGEM-10: Soil Sampling
  - AGEM-11: Handling and Disposal of Investigation-Derived Waste
  - AGEM-13: Soil Gas Sampling for Chemical Analysis
  - AGEM-15: Sub-Slab Soil Vapor Sampling for Vapor Intrusion Applications
  - AGEM-16: Air Sampling for Chemical Analysis
  - AGEM-17: Surface Water Sampling
  - AGEM-18: Sediment Sampling
  - AGEM-19: Vegetation Sampling for Chemical Analysis
  - AGEM-21: Calibration of Field Instrumentation and PID Operation
  - AGEM-22: Equipment Decontamination
  - AGEM-23: Handling, Packing, and Shipping of Samples in the Field

- Other:
  - Argonne National Laboratory: *Guidelines to Policies and Practices, Project Records Management*, EVS Division.
  - Argonne National Laboratory: *Records Management and Control*, Laboratory-Wide Argonne Procedure, Laboratory Management System PROC-2.
  - DOE, 2013: *Records Management Program, Attachment 1: Contractor Requirements Document*, U.S. Department of Energy Order DOE O 243.1B, March 11.

7 References Cited or Consulted

KDHE, 2011, *Chain of Custody*, SOP BER-19, in "Quality Assurance Management Plan (QMP), Part II, Appendix A," Kansas Department of Health and Environment, Division of Environment, Bureau of Environmental Remediation, Topeka, Kansas (SOP BER-19 was originally published on October 15, 2000), January 1. (For links to the various sections and appendices of the QMP [Revision 6], including SOPs, dated February 21, 2019, go to http://www.kdheks.gov/environment/qmp/qmp.htm)

EPA, 2002, *Standard Operating Procedure for Chain of Custody of Samples*, prepared by the Office of Environmental Measurement and Evaluation, EPA New England, Region 1, North Chelmsford, Massachusetts, March 25.

APPENDIX C

Bluestone Standard Operating Procedures

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Standard Operating Procedure Number 01
ABANDONMENT OF MONITORING WELLS AND PIEZOMETERS

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone) to document the methodology to properly abandon or remove a monitoring well or piezometer using a standard drill rig. The associated rationale and project objectives (i.e., locations and depths of wells to be abandoned, drilling methods, and final site restoration) will be detailed in the Work Plan and/or Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP). Bluestone does not self-perform well abandonment activities; therefore, the requirements described in this SOP apply to the oversight and Quality Control (QC) of work performed by subcontractors.

The abandonment of monitoring wells and piezometers is regulated in most states. It is the responsibility of both the Project Manager and site personnel to ensure that work is performed in accordance with applicable state and federal regulations; that the driller is properly licensed for work in that state; and that required paperwork is completed by the responsible party (typically the drilling contractor) and submitted to the applicable regulatory agency.

Monitoring wells and piezometers are similar in construction but are intended for different uses. Monitoring wells are designed for the long-term monitoring of groundwater quality while piezometers are designed for monitoring groundwater elevation. Throughout this SOP, the term "monitoring well" is used interchangeably with "piezometer."

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. Field personnel will complete a minimum of 40 hours of field training prior to working independently on environmental sites. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards created by drill rigs and associated drilling tasks include working around heavy machinery, excessive noise, overhead rotating parts, pinch points, heavy lifting, projectiles, etc. Modified Level D Personal Protective Equipment (PPE) is generally appropriate for work associated with drilling tasks, and includes a hard hat, safety glasses, steel-toed boots, leather and/or nitrile gloves, high-visibility vests, and hearing protection. Additional details regarding site safety and health must be provided in the APP and/or SSHP.

4.0 WELL ABANDONMENT

Monitoring wells and piezometers are typically installed at project sites to evaluate hydrogeologic conditions and determine the presence of environmental contaminants in groundwater. When a well or piezometer is no longer needed, or has been damaged or compromised, it will be properly removed and/or sealed (i.e. abandoned). If not properly abandoned, monitoring wells and piezometers may provide pathways for contaminant migration in the subsurface. In addition, improperly abandoned monitoring wells and piezometers have the potential to become a physical hazard to both humans and animals.

Monitoring well abandonment consists of either removing the components of a monitoring well and backfilling the borehole with a relatively impermeable material, or simply backfilling the screen and casing in place with relatively impermeable fill material. In either case, the surface appurtenances of the well (i.e., flush-mount cover or stick-up casing and protective bollards) are removed. The selected method of abandonment must consider the size of the monitoring well; construction materials and current condition; total depth; hydrogeologic setting; known impacts; and regulatory requirements, as applicable. Specifications for methods used and the corresponding rational will be detailed in the site-specific Work Plan.

5.0 CAUTIONS

Well abandonment is a standard process but has the potential to become complex during the progression of tasks due to circumstances such as unknown well conditions or data gaps in the surrounding lithology. Site personnel will be prepared for issues that may arise and remain in communication with the Project Manager and/or project stakeholders as needed during the progression of work.

6.0 DEFINITIONS

For the purposes of this SOP the following definitions apply:

- **Annulus** - The cylindrical space between the well casing and surrounding borehole.
- **Bentonite** - Any type of commercial sodium bentonite clay used in the construction or sealing of groundwater wells.
- **Bentonite Cement Grout** - A cement grout slurry, generally consisting of one 94-pound bag of Portland cement, mixed with approximately seven gallons of potable water and two pounds of bentonite.
- **Borehole** - Any hole drilled into the subsurface for the purpose of identifying lithology, collecting soil samples, and/or installing groundwater wells.
- **Casing/Riser** - An impervious durable pipe placed in a borehole, which extends from the top of the well screen to ground surface. The casing/riser pipe protects the well from collapse of the surrounding formation and provides a seal from upper level water-bearing zones and/or surface contaminants. Well casing/riser pipe is typically composed of polyvinyl chloride (PVC) or stainless steel.
- **Filter Pack** - Granular sediment (i.e., sand, or fine gravel) placed in the well annulus around the screened portion of casing to increase the effective diameter of the well and prevent fine-grained sediment from entering the well.

- **Monitoring Well** - A groundwater well installed for the purpose of collecting representative groundwater quality samples and groundwater elevation data. In addition, monitoring wells may be used to determine the presence (or absence) of light or dense non-aqueous phase liquids (LNAPL or DNAPL, respectively), and for measurement of free product levels in a contaminant plume.
- **Piezometer** - A shallow, small-diameter groundwater well installed for the purpose of obtaining groundwater elevation data and evaluating hydrogeologic properties pertaining to the interaction between shallow water-bearing zones and local surface water features.
- **Project-Specific Work Plan** - A plan that details the scope of work, rationale, and techniques to be employed at the site to achieve the project objectives. Work Plans may include field sampling plans, UFP-QAPP, technical memorandums, and other documentation of proposed work.
- **Tremie pipe -** A section of 1- to 2-inch PVC pipe used during well or piezometer construction or abandonment. The Tremie pipe extends to the bottom of the borehole, and is used to place grout, bentonite, and/or the filter pack in the annulus continuously from the bottom of the borehole to the surface. This method prevents any bridging or gaps in the well anulus or borehole during the backfilling process.
- **Well Screen** - The prefabricated component of a well that is designed to maximize the entry of water from the producing zone, while minimizing the entrance of sand from the filter pack. Well screens may be constructed of stainless-steel mesh (i.e., wire-wound or continuous-wrap), or slotted PVC casing, and vary in length depending on hydrogeologic conditions.

7.0 EQUIPMENT AND SUPPLIES

Equipment used during the oversight and direction of monitoring well abandonment may include the following:

- Water level meter (or interface probe)
- Fiberglass or steel measuring tape with weight
- Field logbook and appropriate field forms
- PPE and safety equipment per the project-specific safety and health plans.

8.0 WELL ABANDONMENT PROCEDURES

Monitoring well abandonment will be performed by a Bluestone subcontractor in accordance with applicable federal, state, and local regulatory requirements and with the terms and conditions of Bluestone's prime contract with the client. For sites overseen by the United States Army Corps of Engineers (USACE), well abandonment procedures will follow the guidance document EM 1110-1-4000, *Engineering and Design – Monitor Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites* (USACE, 1994).

8.1 Inspection and Preparation for Well Abandonment

Prior to the start of well abandonment activities, Bluestone will inspect the well head and surrounding area for any visible damage or disturbance. Once the well is accessed, Bluestone will record any observations made with respect to the condition of the well, and record depth-to-

water and total depth measurements. Any dedicated equipment inside the well casing, such as in-situ pumps or sampling tethers, will be removed.

8.2 Well Abandonment with Casing Removal

To achieve a competent seal in the subsurface, and subsequently reduce the risk of contaminant migration through the well site, both the casing and well screen will be removed from the subsurface, where practicable. This applies to any sites with known environmental impacts, any damaged well that is suspected of having a compromised seal, and any well cased through multiple water-bearing zones. Well casings can be removed in a variety of methods, as described below.

8.2.1 Removal of Casing by Pulling

Shallow monitoring wells may be deconstructed by pulling up or gently bumping the casing with the drill rig. The condition of the screen and casing must be known to be structurally sound prior to applying force. Crews will be prepared with a grout slurry and Tremie pipe in the event the borehole begins to collapse as the screen and riser pipe are removed. Casing removal and backfilling will be conducted in sequence to ensure a proper subsurface seal.

8.2.2 Removal of Casing by Over-drilling

Over-drilling is a technique ideal for the removal of small-diameter wells. The process involves the advancement of large-diameter hollow-stem augers around the well casing to a depth slightly greater than the total depth of the well to ensure that all components are recovered. Once the target depth is reached, the casing and screen are removed, and the borehole is Tremie-grouted to grade.

8.2.3 Removal of the Casing by Drilling through the Well

Well abandonment by drilling through a well can be done only on wells constructed with plastic or Teflon® materials. For this method, a solid-stem auger or rotary bit is advanced though the casing, which destroys the materials and brings the cuttings to the surface. The bit must be larger than the diameter of the original borehole and will be advanced to a depth slightly greater than the total well depth. Extra care and caution must be used to ensure that the bit is centered during the advancement through casing. Cuttings can be difficult to remove using this method.

8.2.4 Backfilling of a Borehole

The backfilling of boreholes may be performed using a variety of materials, include bentonite pellets, bentonite chips, high solids bentonite grout, cement slurry, etc. Any materials intended for backfilling must be approved for environmental use. In general, a borehole will be backfilled to a minimum of three feet below ground surface (feet bgs). This depth is based on the expanding properties of bentonite/cement grout slurry as the materials sets inside the borehole. Bluestone field personnel will verify the quantities of the mixture/slurry and document the amounts of materials used.

Boreholes will be backfilled by lowering a Tremie pipe to the bottom of the borehole. The pipe is slowly raised as the grout slurry fills the borehole from the bottom to the surface, while keeping the end of the Tremie pipe submerged below the surface of the slurry. Bentonite pellets or chips may be poured through a Tremie pipe; however, the pellets/chips will be hydrated every foot to ensure a proper seal. Bentonite pellets/chips will not be poured from the surface into a

borehole with a large water column, as the material may hydrate too quickly and create voids or bridged sections in the borehole.

After a period of at least 24 hours, the abandoned borehole will be inspected for grout settlement. If the top of grout is deeper than three feet bgs, an additional volume of grout will be pumped into the borehole. No Tremie pipe is required for this step if the distance between ground surface and the top of slurry is less than 15 feet, at which point the additional grout can be poured into the borehole from the surface.

8.3 Well Abandonment by Sealing in Place

Monitoring wells may be sealed without casing removal when the construction details are known, the annular seal is intact, and the filter pack does not penetrate more than one water-bearing zone. Some environmental sites or wells may be too hazardous to safely remove casing; therefore, well abandonment by sealing the well in place is appropriate.

Situations that warrant sealing in place rather than casing removal will be evaluated in advance and may require a formal request for variances from regulatory agencies. Depending on state regulations and site conditions, it may be appropriate to perforate the casing prior to sealing the well. If applicable, the procedures for the perforation of well casing will be addressed in the site-specific Work Plan.

If the screened interval intersects a high-permeability formation, the monitoring well may be backfilled with clean, well-rounded silica sand from the bottom of the well to the top of the screen. In all other cases, the backfill requires the use of grout consisting of a bentonite cement, bentonite slurry, or bentonite chips/pellets installed through a Tremie pipe.

8.4 Site Restoration

To the extent practicable, the site will be restored to its original condition at the completion of well abandonment activities. The borehole will be finished to grade with like materials (i.e., topsoil, asphalt patching, or concrete). In addition, any voids created by the removal of stick-up casing and/or the concrete pad will be filled accordingly. Areas surrounding the well and any pathways that were disturbed by accessing the well may require regrading, placement of sod, or re-seeding, as preferred by the client. The disposal of well construction materials and drill cuttings will be handled as investigation-derived wastes (IDW). The characterization and disposal of IDW is discussed in Bluestone SOP Number 10 – *Storage and Sampling of IDW*.

9.0 EQUIPMENT DECONTAMINATION

Decontamination procedures for re-usable field equipment must be performed in accordance with Bluestone SOP Number 05 – *Decontamination of Field Equipment*.

10.0 DATA MANAGEMENT

Data collected during well abandonment activities (i.e., depth to groundwater, total well depth, and volume of materials used for production of grout) will be recorded in the field logbook and on field data sheets, as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be included in the site-specific Work Plan. Photographs are a preferred method of documenting pre- and post-work

conditions; however, the collection of photographs must be in accordance with contract requirements and site-specific security requirements.

11.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the site-specific Work Plan, UFP-QAPP, and all applicable SOPs.

Standard Operating Procedure Number 02
EQUIPMENT CALIBRATION AND MAINTENANCE

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the methodology for performing routine calibrations of equipment used in environmental investigations. This SOP also includes necessary steps for equipment long-term care and maintenance.

[NOTE: Bluestone SOP Number 2 incorporates a project-specific equipment list.]

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. Field personnel will complete a minimum of 40 hours of field training prior to working independently on environmental sites. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the Project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards associated with equipment calibration and maintenance include splashing from calibration fluids, operating compressed gas cylinders, and gas fumes. Modified Level D Personal Protective Equipment (PPE) is generally appropriate for equipment calibration and maintenance, and includes safety glasses, safety shoes, and nitrile gloves. Additional details regarding site safety and health will be provided in the APP and/or SSHP.

4.0 PROJECT-SPECIFIC EQUIPMENT

4.1 Water Level Indicator

Procedures for the maintenance of an electronic water level indicator is described in the following sections. The operation manual supplied by the manufacturer will be reviewed for instructions concerning the variations pertinent to specific equipment brands and models.

4.1.1 Preventative Maintenance

The water level indicator will be rinsed with soapy water, followed by distilled water after each use to avoid cross contamination between groundwater wells. The probe will be kept free of silt and product coatings. Dye-free paper towels will be used to wipe the probe.

4.2 Water Quality Meter (YSI ProDSS, or similar model)

The procedures for calibration, operation, and maintenance of the YSI ProDSS multiparameter water quality meter are described in the following sections. This meter may be used to measure pH, specific conductance, temperature, turbidity, oxidation-reduction potential (ORP), and

dissolved oxygen (DO). The operation manual supplied by the manufacturer will be consulted for instructions concerning the operation for other water quality parameters.

4.3 Calibration

Calibration will be performed each day prior to sample collection activities or when variability is noted. The YSI ProDSS requires a one-point calibration for DO, ORP, and specific conductance; a two-point calibration for turbidity; and a three-point calibration for pH. A separate calibration solution is required for most of the parameters. Each parameter will be calibrated on an individual basis as outlined in the instruction manual.

4.3.1 Preventative Maintenance

The YSI ProDSS will be cleaned and inspected daily before and after use. The handheld will be charged at the end of every workday, and the sensors will be replaced when damaged or when the instrument cannot maintain a calibration to the manufacturer specifications. To prevent sensor drift, always store the DO sensor in a wet or water-saturated air environment. If the DO sensor has accidentally been left dry for longer than 8 hours, it must be rehydrated by soaking the sensor cap in room temperature tap water for approximately 24 hours.

4.4 Photoionization Detector (MiniRAE® 3000, or similar model) & Multi-Gas Meter (MultiRAE®, or similar model)

Procedures for the calibration, operation, and maintenance of a MiniRAE® 3000 photoionization detection (PID) and a MultiRAE® multi-gas meter are described in the following sections. At a minimum, these meters will be calibrated daily; however, more frequent calibrations may be necessary if the instrument begins to drift from background (0 parts per million [ppm]). Justification and rationale for performing additional calibrations will be noted in the field logbook. Directions for calibrating are listed below and are available in the operation manual supplied by the manufacturer.

4.4.1 Calibration

The calibration gas used for calibration is isobutylene at a concentration of 100 ppm. The use of this calibration gas will result in a reading of 100 ppm during the calibration mode.

To calibrate the MiniRAE® PID:

1. Activate the MiniRAE® unit by pressing the [MODE] key.
2. The unit will perform a self-diagnostic routine.
3. After the MiniRAE® has gone through its self-diagnostic routine, simultaneously press [N/-] and [MODE] keys for three seconds. This will put the meter in Programming Mode.
4. The meter will prompt “Calibrate /Select Gas”. Press [Y/+] key.
5. The meter will prompt “Fresh air cal?” Press [Y/+] key. The display shows “zero in progress” followed by “wait...” and a countdown timer.
6. After about 15 seconds, the display will show the message “update data…zeroed…reading = X.X ppm…”. Record this reading in the field logbook or calibration log sheet. Note: Make sure the Fresh Air Cal is done outside because this is the value the meter will use as zero.
7. The meter will prompt “Span cal?’ Press [Y/+] key.

8. The meter will prompt if the cal gas is Isobutylene. Press [Y/+] key.
9. The meter will then ask the user to "Apply gas now!" Note: Make sure the meter is connected to the Isobutylene canister and open the pressure valve to release the gas.
10. The display will show "wait…30" with a countdown timer showing the number of remaining seconds. When the countdown timer reaches 0, the display shows the calibrated value. Record this value in the field logbook or calibration log sheet.
11. The reading should be close to the actual concentration of the gas. If not, wait a few seconds and press the [Mode] key. This process may need to be repeated until the calibration gas as stabilized to within 1 to 2 ppm of the calibration gas range.
12. Press the [MODE] key to exit the standard gas calibration mode, turn off the gas, and disconnect the calibration gas from the MiniRAE®.

4.4.2 Preventative Maintenance

The MiniRAE® unit will be charged at the end of every workday.

4.5 Direct Soil pH Probe

Procedures for the calibration and maintenance of a direct soil pH probe are described in the following sections. The operation manual supplied by the manufacturer will be reviewed for instructions concerning the variations pertinent to specific equipment brands and models.

4.5.1 Calibration

Calibration will be performed each day prior to sample collection activities or when variability is noted. The Hanna Instruments® 99121 (HI 99121) model (or similar) will be calibrated using two calibration buffers for pH, first using pH 7 buffer followed by pH 4 buffer.

4.5.2 Preventative Maintenance

The HI 99121 will be cleaned and inspected daily before and after use. The battery life indicator will be inspected daily, and batteries will be replaced if the battery life is low. The electrode will be inspected before use for scratches and cracks, and to ensure the reference junctions are flowing. Any salt deposits will be rinsed with water. The electrolyte filling solution (3.5M KCl with AgCl reference electrolyte) will be topped off, as necessary. The electrode will be cleaned by soaking with vendor-supplied cleaning solution for 20 minutes each day to remove soil deposits.

4.6 Soil ORP Probe

Procedures for the calibration, maintenance, sample preparation, and sample calculations associated with a dedicated soil ORP probe are described in the following sections. The operation manual supplied by the manufacturer will be reviewed for instructions concerning the variations pertinent to specific equipment brands and models.

4.6.1 Calibration

Calibration will be performed each day prior to sample collection activities or when variability is noted. The Hach® Pocket Pro ORP Tester (or similar) will be calibrated with a one-point calibration. When the measurement is stable, the displayed ORP value will be adjusted until it is equivalent with the calibration solution.

4.6.2 Preventative Maintenance

The Hach® Pocket Pro will be cleaned and inspected daily before and after use. The sensor will be cleaned when stabilization is slow, or results drift or are not accurate. The sensor will be soaked in vendor-supplied cleaning agent and rinsed with deionized water for one minute. The battery life indicator will be inspected daily, and batteries will be replaced if the battery life is low.

4.6.3 Sample Preparation

Soil reduction potential (Eh) can be measured by creating a soil suspension with the ratio of one part soil to two parts distilled water (e.g., 50 g of soil to 100 mL of water). The sample volume should be sufficient to fully immerse the sensor. The slurry should be well mixed with a stirring tool.

4.6.4 Sample Calculations

The voltage obtained as ORP readings can be converted to Eh by correcting for the electrode potential of the reference electrode. Generally, reference values for electrodes range from +236 mV for 1M KCL to +197 mV for saturated KCl solutions. The Hach® ORP Standard Solution is 220 mV; therefore, to convert ORP readings collected with the Hach® to Eh, 220 mV will be added to the ORP voltage.

5.0 EQUIPMENT DECONTAMINATION

Decontamination procedures for reusable field equipment must be performed in accordance with Bluestone SOP Number 05 – *Decontamination of Field Equipment.*

6.0 DATA MANAGEMENT

Equipment calibration values will be recorded in the field logbook or on calibration log sheets, as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the site-specific Work Plan.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel will read and acknowledge the site-specific Work Plan, Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), and any applicable SOPs.

Standard Operating Procedure Number 03
DESIGN AND INSTALLATION OF MONITORING WELLS AND WELL DEVELOPMENT

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) was prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the methodology for the installation of monitoring wells and well development. Information obtained during the installation of monitoring wells, including soil type, lithology, hydrogeologic data (i.e., water-bearing zones, groundwater elevation and gradient), fracture zones, and visual evidence of contamination, will be compiled and interpreted by the site geologist. Copies of geologic field logs and formal Well Construction Logs will be prepared and compiled for reporting purposes. In accordance with local or state regulatory agencies, the drilling contractor must register the monitoring well or piezometer in the appropriate drilling database. Bluestone does not self-perform well installation activities; therefore, the requirements described in this SOP apply to the oversight and Quality Control (QC) of work performed by subcontractors.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel will complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the Project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards created by drill rigs and associated drilling tasks include, but are not limited to, working around heavy machinery, excessive noise, overhead rotating parts, pinch points, heavy lifting, projectiles, and biological hazards (e.g., poison ivy, bees/wasps, spiders, and ticks). Modified Level D Personal Protective Equipment (PPE) is generally appropriate for work associated with drilling tasks, and includes a hard hat, safety glasses, steel-toed boots, leather and/or nitrile gloves, high-visibility vests, and hearing protection. Additional details regarding site safety and health must be provided in the APP and/or SSHP.

4.0 MONITORING WELL INSTALLATION PROCEDURES

Monitoring wells and piezometers installed during field investigations will be constructed in accordance with the site-specific Work Plan and/or Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), in addition to and any local or state regulations. Drilling locations will be determined in advance and will be cleared of subsurface utilities prior to mobilization (refer to Bluestone SOP Number 18 – *Utility Clearance*). Well construction and materials may vary; however, the following installation procedures and construction requirements will generally be implemented:

1. Monitoring wells/piezometers will be constructed with National Sanitation Foundation (NSF) potable water, and flush-threaded PVC riser and screen that conforms to American Society of Testing and Materials (ASTM)-D 1785 standards.
2. PVC monitoring well/piezometer screen and riser pipe will be flush-threaded. The joints will be tightened to form a watertight seal. Screen bottoms will be sealed with a flush-threaded PVC cap or slip-on cap secured with three stainless-steel, self-tapping screws. No glues or solvents will be used in the construction of PVC monitoring wells or piezometers.
3. PVC well screen will be factory slotted and sized to be compatible with the respective filter pack and surrounding formation media. Field slotted or cut screens will not be used.
4. The well annulus must be a minimum of 2 inches wide to provide space for tools and well construction materials.
5. Boreholes will be checked for plumbness and alignment prior to monitoring well construction. A 10-foot section of pipe ½- to ¾-inch smaller in diameter than the inner diameter of the riser pipe and screen will be extended through the entire length of the well to check the alignment.
6. Centralizers will be used to stabilize the casing inside the borehole. Note, no centralizers will be installed in the filter pack or bentonite seal, and centralizers will not be used on wells installed using hollow stem auger (HSA) methods, or in wells less than 30 feet deep.
7. The filter pack will consist of clean, inert, silica-based, homogenous sand. In general, wells constructed with a 0.010-inch screen will utilize a filter pack of OOO sand with an effective size of 0.254 millimeters. Lithology in the immediate area of the well will govern the size of the wells screen and filter pack. The filter pack will be installed from the bottom of the borehole to at least two feet above the top of the well screen to allow for settlement. The site geologist will confirm that the filter pack is properly placed, and that no bridging or gaps are present. This task will be accomplished by frequently recording borehole depth measurements during installation using a weighted tape measure. Open borehole wells will not utilize screen or filter pack.
8. Approximately two feet of bentonite pellets or chips will be placed in the annulus above the sand pack to create a proper well seal. The bentonite will not be Tremie-piped into place within the borehole but will be poured from the ground surface into the annulus and continually checked with a weighted tape to verify that no bridging has occurred. When the interval of bentonite is above the water table, the pellets or chips will be hydrated every foot using potable water. The bentonite seal will be a minimum of two feet thick.
9. The bentonite pellets and chips will be allowed to hydrate for a minimum of four hours.
10. A high-solids bentonite grout slurry mixed to manufacturer's specifications will be used to fill the annulus above the bentonite seal to within three feet of the ground surface. The grout slurry will be emplaced using a Tremie pipe with a side discharge port. The grout may be poured into the borehole from the surface if the depth to the bentonite seal is less than 15 feet and the top of the bentonite seal is above the water table. The grout will be allowed to cure for a minimum of 24 hours before well development begins. If the top of the primary seal is above the water table, bentonite chips or pellets may be used to

backfill the remainder of the borehole, rather than grout.

11. When the grout has cured, a concrete pad will be installed around the monitoring well/piezometer. The surface of the concrete pad will slope gently away from the protective cover to prevent ponding of rainwater at the well head. A permanent well label will be placed in the concrete pad or on top of the well head, with the well number on the label.
12. Depending on the location of the well and contractual requirements, the well head may be finished as either a flush mount well or with a stick-up casing. In either case, the well will be equipped with an expandable plug in the riser pipe and a protective outer cap and lock.
13. If necessary, three or four three-inch diameter steel or concrete-filled bollard posts may be placed around the concrete pad as an extra measure of protection for the stick-up well head. The bollards will be positioned at least two to three feet outside the well pad and equally spaced. The bollards must be driven a minimum of two feet below ground surface (bgs) and extend at least three feet above ground surface. Stick-up casings and bollards will be painted with highly visible colors.
14. At locations where a monitoring well/piezometer is targeted but groundwater is not apparent in the unconsolidated overburden during drilling, the borehole may be left open for a period of 24 hours to monitor for seepage. The borehole will be bermed and covered during this period to reduce the potential for entry of surface water runoff or contamination. After the 24 hour-period (unless specified otherwise in the site-specific Work Plan or UFP-QAPP), the site geologist will consult with the Project Manager to determine if the borehole should be advanced further.
15. Prior to the collection of groundwater samples, a monitoring well must be developed.

4.1 Screen Size and Filter Pack

Screen size and length and filter pack size will be specified in the Work Plan or UFP-QAPP.

5.0 TYPES OF MONITORING WELLS

5.1 Overburden Monitoring Wells

An overburden monitoring well refers to a well that is constructed in unconsolidated material. Depending on depth, overburden wells may penetrate multiple water-bearing zones. The following sections describe various types of overburden wells and the rationale for installation based on local lithology. Site-specific details for construction of overburden wells will be included in the site-specific Work Plan or UFP-QAPP.

5.2 Water Table Monitoring Wells

Water table wells are ideal for the evaluation of groundwater quality in the shallow subsurface, with known impacts of volatile and/or semi-volatile organic compounds (VOCs and SVOCs, respectively) with a specific gravity less than 1.0. These ‘light’ compounds are referred to as light non-aqueous phase liquids (LNAPLs) and tend to accumulate on the surface of the water table.

Wells designed to monitor the presence of LNAPL must be screened across the top of the water table and have sufficient screen length to accommodate the seasonal fluctuation of local groundwater. To install water table monitoring wells, the borehole is advanced to the target depth

below the water table, to drilling refusal, or to bedrock, whichever is encountered first, and the screened interval is centered across the water table surface.

5.3 Monitoring Wells with Submerged Screens

Submerged screen wells are ideal for monitoring groundwater impacted with dense non-aqueous phase liquid (DNAPL) constituents, which have a specific gravity greater than 1.0, and therefore may accumulate at the bottom of the well. The total depth of the well will be estimated prior to drilling by evaluating available information (i.e., geophysical survey interpretations, adjacent borehole data, published literature, etc.).

To construct a submerged screen well, the borehole is advanced to the target depth or refusal, whichever is encountered first, and the bottom of the screen is set at or directly below the overburden/bedrock interface. In some cases, the well boring may be terminated at a predetermined depth for the purpose of intersecting a specific water-bearing zone. The monitoring well is constructed in the same manner as described previously.

5.4 Bedrock Monitoring Wells

Bedrock monitoring wells are ideal for monitoring specific fracture zones or deep water-bearing zones. Bedrock monitoring well construction requirements include the following, in addition to the items listed above:

1. Prior to the start of drilling, the depth of the overburden/bedrock interface will be estimated using available information such as geophysical survey interpretations, adjacent borehole data, and published literature.
2. The borehole will be advanced at least five feet into competent bedrock.
3. A six-inch stainless-steel surface casing will be installed through the unconsolidated overburden and set at a minimum of five feet into competent bedrock. The casing maintains the integrity of the borehole and isolates the bedrock zone from groundwater in the overburden while drilling into underlying bedrock.
4. If the scope of work includes bedrock coring, the rock core will be obtained as detailed in the site-specific Work Plan and/or UFP-QAPP. Once the core is extracted, the borehole will be reamed to a nominal six-inch diameter to the target depth.
5. If no bedrock core is needed, a nominal six-inch diameter roller bit, or similar will be advanced to the target depth.
6. Screen will be installed at the bottom of the borehole, as detailed in the site-specific Work Plan and/or UFP-QAPP. Depending on the lithology, some bedrock wells may be finished as open borehole wells, and do not require a screen.
7. For screened bedrock wells, the filter pack will extend to a minimum of two feet above the top of the screen.

6.0 DEVELOPMENT OF MONITORING WELLS AND PIEZOMETERS

Newly installed monitoring wells and piezometers, or wells that have been damaged, will be developed to remove excessive fine particles and sediment from the well screen and filter pack. Well development methods vary; however, this SOP describes the procedures for swabbing with a surge block or similar apparatus, followed by pumping and/or bailing the well. Swabbing consists of raising and lowering a surge block inside the casing, while targeting the screened

interval. Caution will be exercised when swabbing within the screened interval so as not to damage the screen. The sediment load and volume of water removed from the well will be monitored and recorded regularly until the well is fully developed. The development of a monitoring well will be initiated between 48 hours and seven days after well installation is complete. The initial static water level and total well depth will be measured and recorded in the field logbook and/or field data sheets (refer to Bluestone SOP Number 06 – *Field Documentation*). In addition, the length of the water column will be recorded.

The pH, specific conductance, temperature, and turbidity of the water will be recorded before the start of well development. After approximately three volumes of water have been removed, a second set of water quality parameters will be recorded. The data will be recorded in the field logbook and/or field data sheets (refer to Bluestone SOP Number 06 – *Field Documentation*). Well development activities will continue until the well or piezometer stabilizes, based on the attainment of specified standards for turbidity, pH, specific conductance, and temperature. The required standard criteria for water quality parameters will be detailed in the site-specific Work Plan and/or UFP-QAPP.

The well development sequence is as follows:

1. Collect water sample and record pH, specific conductance, temperature, and turbidity.
2. Record the depth-to-water and total well depth.
3. Swab the well with a surge block for a 10- to 15-minute period.
4. Re-measure and record the total well depth.
5. Bail and/or pump the well to remove any suspended sediment in the water column.
6. Repeat Steps 3-5 until the water bailed or pumped meets the required turbidity standard set forth in the site-specific Work Plan and/or UFP-QAPP. Values for pH, specific conductance, and temperature must not vary by more than 10 percent. At a minimum, three to five times the volume of any water introduced during drilling and installation must be removed. Monitoring wells or piezometers that are purged dry during development activities will be purged dry three times and considered adequately developed.
7. If stabilization of the water quality parameters cannot be achieved, the site geologist will consult with the Project Manager and cease well development at the conclusion of an agreed upon site-specific time. Stabilization of parameters is typically obtainable; however, elevated turbidity readings may persist due to a variety of circumstances.
8. Once well development is completed, a sample of the last development water withdrawn from the well will be collected in a clear glass jar and immediately photographed for documentation purposes. The color photograph will be back lit and taken within close range. A sample label will be visible in the photograph.

The disposal of well construction materials, drill cuttings, and development waters will be handled as investigation-derived wastes (IDW). The characterization and disposal of IDW is discussed in Bluestone SOP Number 10 – *Storage and Sampling of IDW*.

7.0 EQUIPMENT DECONTAMINATION

Decontamination procedures for re-usable field equipment must be performed in accordance with Bluestone SOP Number 05 – *Decontamination of Field Equipment*.

8.0 DATA MANAGEMENT

Data collected during well construction and development activities (i.e., depth to groundwater, total well depth, volume of materials used for production of grout, etc.) will be recorded in the field logbook and on field data sheets, as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the site-specific Work Plan. Pre-existing conditions and post-work site restoration will be documented through photographs with approval from the client. Field data and observations will be provided to the Project Manager at least daily throughout the progression of work.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the site-specific Work Plan, UFP-QAPP, and any applicable SOPs.

Standard Operating Procedure Number 04
GEOSPATIAL DATA COLLECTION

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe two approaches to geospatial data collection: using a mapping-grade Global Navigation Satellite System (GNSS) receiver, and oversight of a subcontractor performing a professional survey.

"Mapping-grade" refers to a class of GNSS or Global Positioning System (GPS) receivers capable of positional accuracy within one meter (approximately 3.28 feet), depending on site conditions. Bluestone commonly uses the EOS Arrow 100 and Trimble Geo 7x GNSS receivers. Accuracy and capabilities vary between manufacturers and models. Appropriate uses for mapping-grade data include inventory or documentation of site features for informational or conceptual design purposes; navigation to predefined locations; stake out of locations prior to vegetation or utility clearance; stake out of sampling grids and locations; and documentation of photo locations.

A mapping-grade receiver is not a replacement for tasks that require high accuracy and precision, which that can be provided by a licensed surveyor. Bluestone does not self-perform land survey activities; therefore, the requirements described in this SOP apply to the oversight and Quality Control (QC) of work performed by subcontractors. Conventional land survey techniques utilized by a Professional Licensed Surveyor (PLS) can collect horizontal and vertical locations (X, Y, and Z coordinates) with centimeter or better accuracy. A professional survey should be conducted when high accuracy is required, such as for monitoring well installation and topographic survey. Bluestone subcontracts professional survey services as required.

2.0 PERSONNEL QUALIFICATIONS

Personnel qualifications vary based on site-specific Performance Work Statement (PWS) requirements and are subject to other SOPs. Bluestone will enter into a subcontract with a company that provides PLS services in the appropriate state if required by the project. Bluestone will provide oversight and documentation of surveying activities; however, the subcontractor will be responsible for the collection and interpretation of all survey data. In addition, the subcontractor must provide a written SOP and perform the survey in accordance with the policies and procedures set forth by their respective company.

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the Project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards associated with performing geospatial data collection include working around heavy machinery, excessive noise, uneven terrain, and biological hazards (e.g., poison ivy, bees/wasps, spiders, and ticks). Modified Level D Personal Protective Equipment (PPE) is generally appropriate for the associated tasks, and may include a hard hat, safety glasses, safety shoes,

leather gloves, high-visibility vests, and hearing protection. Additional details regarding site safety and health must be provided in the APP and/or SSHP.

4.0 EQUIPMENT LIST

The following equipment may be required for collecting mapping-grade GNSS data:

- Field logbook
- Indelible black-ink pens
- GNSS receiver set to the appropriate horizontal and vertical datum and coordinate system
- GNSS receiver accessories (e.g. range pole, charging cable, stylus, etc.)
- Tablet or smartphone if GNSS receiver is bring your own device (BYOD)
- Reference locations pre-loaded into device, if needed
- Site map
- Measuring tape
- Compass
- Flagging tape, stakes

The following equipment may be required for oversight of a professional survey:

- Field logbook
- Indelible black-ink pens
- Site map

5.0 GNSS RECEIVER SET-UP AND OPERATION

This section provides a general summary of mapping-grade GNSS data collection procedures. These procedures shall be supplemented by the specific instrument manufacturer's recommendations.

Set up the device to collect data in the project coordinate system and to record GNSS metadata (average horizontal and vertical accuracy, number of positions averaged, and receiver information). Record the coordinate system and make, model, and serial number of the GNSS device in the field logbook. Allow the receiver adequate time to obtain satellite connections before proceeding with data collection. Average a minimum of 30 positions at each location and include a descriptive note. If points are collected to represent the vertices of a line or area, include a sequential number in the note to aid digitization. Flag or stake locations as needed. At the end of each day of data collection, back up the data to the cloud or a computer, depending on the make and model of the receiver. If real-time corrections are not used, conduct post-processing (differential correction) according to the manufacturer's recommendations after data collection is complete.

If the coordinates at a location cannot be determined due to the presence of tree cover or other sources of interference/obstructions that prohibit adequate signal reception, coordinates will be obtained at a minimum of two alternate locations (off-sets) in close proximity to the original location. The distance and bearing from each of the alternate locations to the original location will be manually measured using a measuring tape and compass to acquire distance and bearing and will be recorded in the field logbook along with a sketch.

6.0 SURVEY OVERSIGHT

This section provides a general summary of field oversight of subcontracted surveyors.

Prior to fieldwork, Bluestone will provide the surveyor with relevant information including but not limited to site access procedures, the project datum and coordinate system, maps or digital files showing the locations of relevant site features, a list of features to be surveyed, and the required deliverables.

As the survey is conducted, Bluestone will facilitate access to site locations and provide location descriptions. Bluestone will document each day's activities in the field logbook as described below.

7.0 DATA MANAGEMENT

Documentation of GNSS data collection or survey oversight will be recorded in the field logbook and on field data sheets, as necessary. Bluestone SOP Number 06 – *Field Documentation* details the documentation requirements, and additional information will be included in the site-specific planning documents.

Photographs are a preferred method of documenting pre- and post-work conditions and site features; however, the collection of photographs must be in accordance with contract requirements and site-specific security requirements. Ask the Project Manager (PM) before taking any photos if you are unsure of the requirements. Project photographs may include survey locations and activities and surrounding areas.

8.0 COMMUNICATION AND TECHNICAL DIRECTION

Field personnel should support one another and maintain open communications during all aspects of the field activities. When a technical point is in question, field personnel should communicate with the PM or technical lead for clarification and/or additional direction. Deviations, exceptions, and/or omissions from the project Work Plan or generally accepted practice must be communicated to the PM in a timely manner. Maintain records of all such communications in a field book detailing the issue, the outcome, and individuals involved in the decision.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the site-specific planning documents such as the Work Plan, Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), and any applicable SOPs.

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Standard Operating Procedure Number 05
DECONTAMINATION OF FIELD EQUIPMENT

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the methodology used to perform decontamination activities during an environmental investigation. All reusable sampling and investigation equipment that comes in contact with soil or groundwater must be decontaminated prior to use in the field, between sampling locations, and at the completion of field activities.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site-Specific Health and Safety Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards associated decontamination activities include contact with potentially impacted media, splashing of decontamination fluids, pinch points, and slip/trip/fall hazards. Modified Level D Personal Protective Equipment (PPE) is generally appropriate for work associated with decontamination tasks, and includes safety glasses, safety shoes, and nitrile gloves. Additional details regarding site safety and health must be provided in the APP and/or SSHP.

4.0 DECONTAMINATION EQUIPMENT

Standard decontamination supplies include:

- Distilled water
- Potable water
- Spray bottle
- 5-gallon pail
- Scrub brush
- Non-phosphate laboratory-grade detergent
- Plastic sheeting
- Contractor bags
- Nitrile gloves
- Paper towels

5.0 EQUIPMENT-SPECIFIC DECONTAMINATION PROCEDURES

5.1 Decontamination of Non-Dedicated Pumps

Well pumps will be decontaminated using to the following procedure:

1. Disassemble the pump and place on clean plastic sheeting. Note, plastic sheeting must be replaced between each location.
2. Use a mixture of distilled water and non-phosphate laboratory-grade detergent to spray down the inner and outer pump and use a scrub brush to wipe away any visual sediment or residual contaminants.
3. Rinse all pieces of the pump with distilled water twice before reassembling. Containerize all decontamination water in a bucket.
4. Place the equipment on clean plastic and allow it to air dry.
5. Wrap equipment in plastic or aluminum foil to store until next use.
6. Retain decontamination fluids for disposal as described in site-specific planning documents and Bluestone SOP Number 10 – *Storage and Sampling of IDW*.

5.2 Decontamination of Sampling Equipment

Non-disposable and other non-dedicated equipment used to collect soil, sediment, and/or groundwater samples will be decontaminated prior to use. This equipment includes, but is not limited to, stainless steel knives and spoons, split-spoon barrels, direct-push shoes and rods, and stainless-steel bowls used to homogenize soil samples.

Sampling equipment will be decontaminated using the following procedures:

1. Fill a non-metallic wash tub or bucket with approximately six inches of distilled water. Mix a detergent solution in the tub. The solution shall consist of approximately one tablespoon of non-phosphate laboratory-grade detergent (e.g. Liquinox®) per gallon of water.
2. Scrub all sampling equipment with a stiff-bristled brush and detergent solution.
3. Transfer the equipment to a separate tub partially filled with distilled water and thoroughly rinse each piece of equipment.
4. Perform a second rinse using fresh distilled water and collect fluid into the dedicated rinse tub.
5. Place the equipment on clean plastic sheeting and allow it to air dry.
6. Wrap equipment in plastic or aluminum foil to store until next use. Retain decontamination fluids for disposal as described in site-specific planning documents and Bluestone SOP Number 05 – *Decontamination of Field Equipment*.

5.3 Decontamination of Drilling Equipment and Heavy Machinery

Drilling tools including drill string, augers, drill bits, direct-push rods, etc., in addition to heavy equipment (i.e., drill rigs, excavators, etc.), will be decontaminated between each borehole according to the following procedures:

1. Construct a decontamination pad using heavy plastic sheeting other waterproof materials or use a decontamination trailer or tank.
2. Back the drill rig or direct-push rig into the decontamination pad/trailer/tank or place equipment in a rack off the ground inside the unit, as appropriate.

3. Remove all visible soil and contamination from equipment surfaces by steam cleaning. Include the inside of drill string, augers, and direct-push rods. If necessary, use a stiff-bristled brush to physically remove residual soils and contamination.
4. Transport the unit to an area free of IDW and known impacts and allow the equipment to air dry.
7. Retain all decontamination fluids for disposal as described in in site-specific planning documents and Bluestone SOP Number 10 – *Storage and Sampling of IDW*.

6.0 EQUIPMENT BLANK SAMPLING

For quality control purposes, an equipment blank sample must be collected if analytical samples are being collected. Equipment blanks are typically collected at a frequency of 1 per every 10 to 20 field samples. Equipment blank samples are collected by pouring a volume of laboratory-prepared deionized water over a freshly decontaminated piece of equipment and into the sample bottle to determine the effectiveness of decontamination procedures. The equipment blank sample will be collected after sampling in contaminated areas, rather than after sampling background areas.

7.0 DATA MANAGEMENT

Pertinent information obtained during decontamination activities (i.e., times and methods used) will be recorded in the field logbook. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the Work Plan. Photographs are a preferred method of documenting pre- and post-work conditions; however, the collection of photographs must be in accordance with contract requirements and site-specific security requirements.

8.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the site-specific Work Plan, Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), and any applicable SOPs.

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Standard Operating Procedure Number 06
FIELD DOCUMENTATION

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) was prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the methods for recording and managing data obtained by performing field tasks associated with environmental investigation and/or long-term monitoring activities. Data management is a critical part of any field investigation, and requires diligence in maintaining accuracy, organization, and confidentiality.

Every sample, field measurement, and investigative activity conducted during a project must be properly documented using the official field logbook or approved field data sheets including, but not limited to, geologic logs, well construction logs, soil boring logs, calibration logs, field sampling forms, and health and safety tailgate sheets. The use of electronic field data sheets must be consistent with contract requirements and the site-specific Work Plan. Field documentation must be adequate to support each step of the investigation, from the point of sample collection to final validated data reporting. Records must be available to identify, track, and monitor individual samples and provide details for all investigative activities.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

2.1 Field Logbooks

Information pertinent to an investigation or long-term monitoring must be recorded in a bound logbook with consecutively numbered, water-resistant pages (Rite-in-the-Rain®, or similar). All site activities must be recorded in the field logbook including, but not limited to, arrival and departure times, a chain of events, progression of work tasks, and a list of site visitors. The field personnel responsible for the entries will sign and date each entry or page. All logbook entries will be made in indelible ink. The time and date of each entry will be noted in the logbook.

Field logbooks must be kept in the field personnel's possession or in a secure location during field operations. Following the investigation or monitoring activities, logbooks will become part of the project file, and will serve as the official site document in the event of legal action. The following list contains typical field logbook entries:

- Date
- Weather conditions
- Client
- Names of all field personnel, including subcontractors
- Site name, municipality, and state
- Location of samples (may include a sketch)

- Sample media
- Time (military) of sample collection
- Sample nomenclature
- Interval and depth of sample
- Sample collection methods
- Sample physical description
- Field observations
- Quality Control (QC) sample information
- Number assigned to chain-of-custody (COC)

In addition to pertinent sampling information, details with respect to anticipated health and safety hazards, required personal protective equipment (PPE), and a record of daily field safety briefings will be included in the field logbook.

2.2 Field Data Sheets

Sampling data will be recorded on either paper or electronic field data sheets. The following information will be recorded:

- Sample ID
- Sample location
- Sample date/time
- Sample collection method
- Sample description
- Sample type
- Sampled by

3.0 PHOTOGRAPHIC DOCUMENTATION

Photographs are a preferred method of documenting pre- and post-work conditions; however, the collection of photographs must be in accordance with contract requirements and site-specific security requirements. Project photographs may include the sample, sample collection activities, surrounding areas, disturbances caused by access of heavy equipment or intrusive activities, and final site restoration. Photographs taken to document sampling points will include two or more reference points to facilitate a potential return to the sample point, if necessary.

4.0 SAMPLE DOCUMENTATION

4.1 Sample Nomenclature

In accordance with the site-specific Work Plan and/or Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), each sample will be assigned a unique sample identification (ID) (also known as sample tracking number) that appears on all sample labels, COCs, field logbooks, and all other applicable documentation forms.

The sample ID nomenclature typically consists of three to four alphanumeric code segments, each separated by hyphens. The sample ID identifies the site, sample type or medium, location, depth (for soil samples), and sampling date. QC sample designations will be added, as appropriate, following the nomenclature presented below. However, the Work Plan and/or UFP-QAPP will be consulted to determine the if there any site-specific requirements. Other pertinent information regarding sample identification will be recorded in the field logbooks or on sample log sheets. The sample IDs will be in the following format: "AA-BBCCC_QEEEE_QC Indicator".

The sample ID format is designated as follows:

1) Location ID

AA: Area of Concern (AOC) identifier (AOC 1 = 01; AOC 3 = 03, etc.)

BB: Sample media, including:

- SS: Surface Soil
- BS/BD: Subsurface Soil [S=shallow (1-5 ft bgs); D=deep (5-10 ft bgs)]
- GW: Groundwater
- PW: Pore water

2) Sample location number

CCC: Sequential sample location number (e.g., 001, 002, etc.)

2) Unique timeframe indicator

Q: Quarter identifier (first quarter = 1Q; second quarter = 2Q)

EEEE: Year (e.g., 2019)

3) QC indicator (if applicable)

DUP: Field duplicate samples will be collected with 'DUP' instead of the 'AOC identifier' in position AA. The actual location of the duplicate sample will be noted in the field logbook.

MS: Matrix spike samples will be labeled with the standard sample convention, followed by 'MS' to clearly indicate to which sample the spike sample correlates.

MSD: Matrix spike duplicate (MSD) samples will be labeled with the standard sample convention, followed by 'MSD' to clearly indicate to which sample the spike sample correlates.

4.2 Sample Labels and Tags

Each sample collected at a site and transported to a laboratory for analysis will be identified by a sample label, with specific information regarding the sample. Completed sticker labels must be securely attached to the sample container and include the following information:

- Date
- Time (military) of sample collection
- Type of analyses requested
- Sample ID

- Sample collection depth
- Location of sample collection
- Type of preservative
- Initials of sampler

4.3 Chain-of-Custody Records

The COC serves as physical evidence of sample custody over the life of the sample batch. Field personnel will initiate a COC at the time of sample collection. All custody transfers of the sample batch will be recorded on the COC by the individual relinquishing and the receiver of the samples, and signed, dated, and time stamped at the time of transfer. Each cooler is assigned a separate COC on which only the samples packed in that cooler are listed.

Laboratory-specific COCs will be provided and, in general, include the following information:

- Sample ID
- Signature(s) of field personnel
- Date of collection
- Time (military) of collection
- Sample type (solid, liquid, etc.)
- Number of containers per sample
- Preservative(s) used
- Requested analytes
- Signatures of all sample handlers
- Inclusive dates and times of possession
- Description of compromised sample integrity (if applicable)
- Temperature of cooler upon receipt by laboratory

After completing the COC, the original will be enclosed in a plastic bag and taped to the inside lid of the cooler.

4.4 Custody Seals

Custody seals will be placed over the lid of the cooler and remain in place from the time the coolers are packed until they are opened by laboratory personnel in order to preserve the integrity of the cooler during shipment. Custody seals must be attached so that it is necessary to break the seals to open the cooler. The custody seals will be secured with clear tape. If a cooler is not sealed with custody labels at the time of transfer to a laboratory courier service or when dropped off at a laboratory, the courier or laboratory personnel must sign and date the COC at the time of transfer.

5.0 DAILY REPORT

A daily report will be generated at the end of each sampling day, and will include the following information:

- Date

- Prepared by
- Project and site name
- Weather conditions
- Level of PPE
- Description of project activities
- Employees and subcontractors present on site
- Documentation of tailgate safety meetings
- Daily equipment and material deliveries
- Material(s) shipped off site
- List of samples collected
- Submittals
- Planned activities for the next day

6.0 CORRECTIONS TO DOCUMENTATION

Data entries will be recorded with indelible ink. Accountable serialized documents will not be destroyed or discarded, even if they are illegible or contain inaccuracies that require a replacement document. Errors will be corrected by marking a single line through the error, entering the correct information, and initialing and dating the correction. The erroneous information will not be whited out. Any subsequent errors discovered later will be corrected, initialed, and dated by the individual who made the original entry.

7.0 COMMUNICATION AND TECHNICAL DIRECTION

Field personnel will support one another and maintain open communication during all aspects of the field activities. When a technical point is in question, field personnel will communicate with the Project Manager (PM) or technical lead for clarification and/or additional direction. Deviations, exceptions, and/or omissions from the Work Plan or best management practices must be communicated to the Project Manager in a timely manner. Maintain records of all such communications in a field logbook, describing the issue, the outcome, and individuals involved in the decision.

8.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the site-specific Work Plan, UFP-QAPP, and any applicable SOPs.

Standard Operating Procedure Number 07
FIELD SCREENING SOILS USING A PHOTOIONIZATION DETECTOR (PID)

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the methodology for screening soil cores and collecting soil headspace measurements using a photoionization detector (PID). The purpose of screening soils is to determine the presence (or absence) of organic vapors, and subsequently identify potential zones of subsurface contamination.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards associated with field screening of soils include inhalation of vapors, pinch points, and biological hazards including, but not limited to, poison ivy, bees/wasps, spiders, and ticks. In addition, drilling hazards such as working around heavy machinery, overhead rotating parts, and excessive noise may apply because PID screening is often performed in conjunction with drilling tasks. Modified Level D Personal Protective Equipment (PPE) is generally appropriate, and includes a hard hat, safety glasses, steel-toed boots, leather and/or nitrile gloves, high-visibility vests, and hearing protection. Additional details regarding site safety and health must be provided in the APP and/or SSHP.

4.0 SOIL CORE FIELD SCREENING METHODOLOGY

Soil cores will be screened for the presence of organic vapors using a PID. The procedures for collecting measurements with a PID are provided below:

1. Calibrate the PID instrument (MiniRAE® 3000, or similar) in accordance with the manufacturer's instructions.
2. Cut the acetate sleeve or open the split-spoon sampler (method specific) to expose the soil core and use a clean, decontaminated soil knife or equivalent to split sections of the core. Position the PID approximately 1 to 2 inches away from soil surface and record measurements every 6 inches to 1 foot, and at any intervals with visible contamination.
3. This method is repeated for every soil core and may be used in the determination of sample collection intervals. An alternative method (headspace) may be used if readings or observations suggest high concentrations of volatile organic constituents (VOCs) and is

described in the following section.

5.0 SOIL HEADSPACE FIELD SCREENING METHODOLOGY

Soil headspace measurements will be collected and analyzed using the following procedures:

1. Calibrate the PID unit in accordance with the manufacturer's instructions.

2. Add a small volume of soil to a quart size Ziploc® bag (approximately ¼ to ½-full) and seal the bag. Although the amount of soil is estimated, care will be taken to be generally consistent for all headspace samples.

3. Allow the sample to sit for up to five minutes to reach the ambient temperature. Samples will be analyzed before significant condensation forms inside the bag.

4. After the headspace in the bag has come to equilibrium, open a 1- to 2-inch section of the bag to insert the sample probe of the PID unit. The highest PID measurement (recorded in parts per million [ppm]) observed within the first twenty seconds will be recorded in the field logbook and/or on the drilling log form. Note, headspace readings may be affected by low ambient temperatures. If low temperatures occur during headspace measurements, an alternative method to warm the samples may be required. Generally, if the ambient temperature is below 32 degrees Fahrenheit, the sample will be placed in a heated vehicle or building during the volatilization period and subsequent data recording.

6.0 DATA MANAGEMENT

Data collected during field screening activities (i.e., organic vapor concentrations and corresponding depths/locations) will be recorded in the field logbook and on field data sheets, as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the site-specific Work Plan. Photographs are a preferred method of documenting pre- and post-work conditions; however, the collection of photographs must be in accordance with contract requirements and site-specific security requirements.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the Work Plan, Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), and any applicable SOPs.

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Standard Operating Procedure Number 09
GROUND-PENETRATING RADAR (GPR) GEOPHYSICAL SURVEY

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) was prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the technical guidance and procedures that will be employed to conduct oversight of a Ground-Penetrating Radar (GPR) geophysical survey by a qualified subcontractor. Bluestone does not self-perform GPR surveys; therefore, the requirements described in this SOP apply to the oversight and Quality Control (QC) of work performed by subcontractors. The subcontractor typically will use a GSSI SIR 3000 or similar instrument to perform the geophysical survey.

GPR operates by transmitting an electromagnetic (EM) pulse or wave into the subsurface and receiving portions of the reflected wave, which produces a digital image of underground objects (i.e., buried drums, subsurface utilities, underground storage tanks [UST], etc.), and any changes in the subsurface media (i.e., lithologic contacts, former UST 'graves', etc.). The accuracy and range of GPR depends on the conductivity of subsurface media, with the greatest results achieved from low conductivity materials (i.e., dry sand or granite), where features up to 100 feet below ground surface (feet bgs) can be detected. High conductivity subsurface media (i.e., clay, shale, or other saturated media) limit the accuracy and range of GPR to a depth of three feet bgs or less.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards associated GPR surveys include working around heavy machinery, excessive noise, slip/trip/fall hazards, uneven ground, and heavy lifting. Modified Level D Personal Protective Equipment (PPE) is generally appropriate for work, and includes safety glasses, safety boots with ankle support, leather gloves, and high-visibility vests. Additional details regarding site safety and health must be provided in the APP and/or SSHP.

4.0 DATA MANAGEMENT

Pertinent information obtained during the survey (i.e., subsurface features, anomalies, and corresponding depths, etc.) will be recorded in the field logbook and on field data sheets, as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the Work Plan. Photographs are a preferred method of documenting pre- and post-work conditions; however,

the collection of photographs must be in accordance with contract requirements and site-specific security requirements.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the Work Plan, Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), and any applicable SOPs.

6.0 REFERENCES

GPR Operating Manual, Geophysical Survey Systems, Inc.

Daniels, D.J. 1996. *Surface Penetrating Radar*. London, U.K.: The Institution of Electrical Engineers.

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Standard Operating Procedure Number 10
STORAGE AND SAMPLING OF INVESTIGATION-DERIVED WASTES (IDW)

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) was prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the methodology for characterization and handling of investigation-derived wastes (IDW). A field investigation typically generates solid and/or liquid wastes to be stored and characterized for disposal purposes. This material is classified as IDW, and typically includes soil cuttings generated through soil borings and monitoring well installations, groundwater sampling purge water, and decontamination fluids generated during investigation or long-term monitoring activities.

Waste management procedures for IDW are based on the requirements specified in Title 40 of the Code of Federal Regulations (CFR), Part 262 (40 CFR 262) *Standards Applicable to Generators of Hazardous Waste* and industry best management practices. This SOP describes the proper on-site disposal, containerization, labeling, and storage of solid and liquid IDWs. Site-specific IDW disposal requirements will be detailed in the Work Plan, Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) and/or Accident Prevention Plan (APP).

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operators (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. In addition, the site safety and health officer (SSHO) must be certified in first aid and CPR.

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards associated with waste characterization and disposal include exposure to contaminants via direct contact, inhalation or splashing; heavy lifting; pinch points; and slip/trip/fall hazards. Modified Level D Personal Protective Equipment (PPE) is generally appropriate for work associated with IDW sampling tasks, and includes safety glasses, safety shoes, leather and/or nitrile gloves, and high-visibility vests. Additional details regarding site safety and health must be provided in the APP and/or SSHP.

4.0 IDW CHARACTERIZATION

4.1 Liquid IDW

Liquid IDW includes well development water, decontamination fluids, and groundwater monitoring purge waters. Liquid IDW may be characterized using associated groundwater quality data generated from the respective samples or direct sampling, and typically qualifies as non-hazardous waste. Liquid IDW may be stored in a large capacity portable storage tank (i.e., a frac tank) or containerized separately in drums.

On-site disposition of liquid IDW is acceptable in some states, provided the wastes qualify as non-hazardous and do not pose a threat to surrounding properties. All liquid waste known or suspected to be hazardous waste must be contained. Drums and polyethylene totes may be used for interim storage and transport of liquid IDW. Labels will be prepared in accordance with applicable regulations and the guidelines outlined below. Containers must be kept closed and secured except when filling or disposing of the contents. Manufacturer Department of Transportation (DOT) specifications will be followed when sealing containers in preparation for transport.

United Nations (UN)-approved drums (49 CFR 173.3), polyethylene tanks, and 5-gallon pails may be used to collect liquid IDW, as task appropriate. Liquid IDW collected in 5-gallon pails will be transferred to drums or totes as soon as possible after collection. Hazardous (or suspected hazardous) liquid IDW must be containerized in UN-approved drums.

Containers of liquid IDW will be labeled to indicate the source and nature of the waste material. The following information must be visible on the top or sides of each container: container number(s), facility name, associated monitoring well or borehole ID, date of generation, container contents, estimated quantity, and the client point of contact (POC).

Containers will be marked with two-inch letters and numbers using a waterproof paint pen. A complete inventory of the IDW will be maintained by the Field Team Leader to facilitate identification and tracking of liquid IDW for appropriate disposal. This inventory will document the information listed above, in addition to the location of the container, and initials of the responsible POC. The total number of containers of liquid IDW generated will be recorded in the field logbook at the end of each workday. Containers of liquid IDW characterized as hazardous or non-hazardous transported off-site for disposal will be labeled in accordance with applicable state and federal requirements including, but not limited to, Resource Conservation and Recovery Act (RCRA) guidelines, the Toxic Substances Control Act (TSCA), and DOT (40 CFR 171-179).

Containers of liquid IDW will be staged temporarily on site until characterization is complete. Containers of liquid IDW stored during winter months will be under-filled to allow for expansion during freezing. IDW will be stored in secure areas of the site, where containers are protected from flooding, traffic, and unauthorized access or tampering.

For IDW pending characterization, all containers must be properly sealed and labeled, and may be staged on pallets until characterization is complete. If possible, IDW containers will be secured with temporary chain-link fencing; however, caution tape and/or temporary orange construction fencing may also be used as need to protect the IDW containers.

Containers of liquid IDW will be characterized and disposed of accordingly in a timely manner. If liquid-filled containers remain in storage for 30 days or more, the containers must be staged on polyethylene sheeting that is surrounded by a retention berm (i.e., 2x4 lumber), and positioned with enough separation so all sides of the containers can be monitored for leaks.

4.2 Solid IDW

Solid IDW includes soil cuttings from sources such as, but not limited to, direct-push sampling, soil borings, and installation of monitoring wells. Solid IDW must be containerized and staged pending proper characterization. To characterize solid IDW, a composite sample consisting of

aliquots from each container will be submitted for analysis. In addition, the quality of solid IDW will be evaluated based on data generated from primary sample and historical site data.

Expended personal protective equipment (PPE) may also be considered IDW, depending on site conditions and/or state regulations, in addition to disposable sampling equipment (i.e., bailers, string, acetate liners, etc.), depending on the nature of site contaminants. In most cases, expended PPE and sampling equipment may be double bagged and disposed with other municipal waste at a local sanitary landfill. All gross contamination removed from the PPE and disposable equipment will be added to the appropriate IDW drums/totes.

Solid IDW consisting of soil cuttings and excess soil volume will be placed in a lined roll-off dumpster or in UN-approved drums. Five-gallon pails may be used for interim handling and transport of solid IDW. On-site disposition of solid IDW (soil cuttings and excess soil volume) may be appropriate, provided the material is characterized as non-hazardous and such disposition is acceptable under state and local regulations. Any soils suspected of being hazardous must be drummed rather than placed into a roll-off dumpster. Containers must be kept closed and sealed except when adding to or disposing of the contents. Manufacturer DOT specifications must be followed when sealing containers in preparation for transport.

Based on the size of the site, each area of concern (AOC) may require a staging area for solid IDW. Each staging area will be characterized separately, in accordance with the *Management of Investigation Derived Waste During Site Inspections*, EPA/540/G-91/009 (USEPA, 1991). However, solid IDW generated from multiple soil borings within a single AOC may be characterized as a single waste stream.

Containers of solid IDW must be labeled to indicate the source and nature of the waste media. The following information will be marked on the top or sides of each container: container number(s), site name, associated monitoring well or soil boring ID, borehole number, date of generation, container contents, estimated quantity, and the client POC.

Containers will be marked with 2-inch letters and numbers using a waterproof paint pen. A complete inventory of IDW will be maintained by the Field Team Leader to facilitate identification and tracking of solid IDW for characterization and disposal. This inventory will document the details list above, in addition to the location of the container, and initials of the responsible POC. The IDW inventory and the total number of containers of solid IDW generated will be recorded in the field logbook at the end of each workday.

Solid IDW characterized as hazardous (based on laboratory analytical results) will be re-labeled in accordance with applicable state and federal requirements including, but not limited to, RCRA, TSCA, and DOT. Containers of solid IDW will be staged temporarily at the site until characterization is complete. Solid IDW will be stored in secure areas of the site, where containers are protected from flooding, traffic, and unauthorized access or tampering. Secondary containment structures will be implemented as required for the storage of solid IDW.

For solid IDW pending characterization, all containers must be properly sealed and labeled, and may be staged on pallets until characterization is complete. If possible, IDW containers will be secured within temporary chain-link fencing; however, caution tape and/or temporary orange construction fencing may also be used as need to protect the IDW containers. Containers of solid IDW will be characterized and disposed of accordingly in a timely manner.

5.0 IDW CHARACTERIZATION SAMPLING

The sampling procedures for liquid and solid IDW contained in drums are described in the following sections. Within two weeks of the completion of field activities, an aliquot from each waste stream will be collected and composited except for samples to be analyzed for volatile organics constituents (VOCs). VOC analysis requires the collection of one representative grab sample from each source. For new monitoring well installations, the composite IDW sample will include aliquots only from drums associated with that well; however, aliquots from other composite samples may be grouped by AOC or field task. The list of analytes for the composite sample will match that of the primary investigation samples. If significant impacts are encountered during the field investigation, the IDW generated from these sampling locations will be stored in separate containers.

5.1 Liquid IDW Drum Composite Sampling Procedures

The procedures for collecting a sample from liquid IDW drums with a known source are listed below:

1. Conduct field screening with a photoionization detector (PID) near the drum storage area. If elevated concentrations are detected, then increase PPE level to C or B based on the APP.
2. Wearing clean nitrile gloves, remove bung or drum lid and store on plastic sheeting.
3. Dip sample collector/bailer into center of drum and lower the device into the middle section of the drum.
4. Slowly raise the sampling device and decant the appropriate volume into the bottleware.
5. Repeat Steps 3 and 4 until the correct sample volume has been collected. Cap the bottleware between sampling containers.
6. Replace bung or drum lid.
7. Dispose of, or decontaminate, the sampling device.

5.2 Solid IDW Drum Composite Sampling Procedures

The procedures for collecting a sample from solid IDW drums with a known source are listed below:

1. Conduct field screening with a PID near the drum storage area. If elevated concentrations are detected, then increase PPE level to C or B based on the APP.
2. Wearing clean nitrile gloves, remove bung or drum lid and store on plastic sheeting.
3. Using a decontaminated trowel, gently scrape the top portion of the drum contents to one side.
4. Place sample collector into center of drum contents and slowly advance the device into the middle section of the drum to a depth of approximately four inches below the surface.
5. Extract the sampling device and transfer the soil to the sample jar.
6. Repeat Steps 4 and 5 until the correct sample volume has been collected. Cap the bottleware between sampling containers.
7. Replace bung or drum lid.
8. Decontaminate sampling device and dispose of plastic as solid PPE, as needed.

Procedures for appropriate sampling nomenclature are presented in Bluestone SOP Number 06 – *Field Documentation.*

6.0 EQUIPMENT DECONTAMINATION

Decontamination procedures for reusable field equipment must be performed in accordance with Bluestone SOP Number 05 – *Decontamination of Field Equipment.*

7.0 DATA MANAGEMENT

Pertinent information obtained during IDW characterization sampling and handling included, but not limited to, sample IDs, sample collection times, methods of collection, and PID screening results will be record in the field logbook and on field data sheets as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the Work Plan. Photographs are a preferred method of documenting pre- and post-work conditions; however, the collection of photographs must be in accordance with contract requirements and site-specific security requirements.

8.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the Work Plan, UFP-QAPP, and any applicable SOPs.

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Standard Operating Procedure Number 11
GEOLOGIC LOGGING

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) was prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the methodology for logging subsurface materials during drilling activities, including soil borings, groundwater monitoring well installations, and geotechnical borings. All boreholes advanced during an environmental investigation will be logged by an experienced geologist in accordance with the United States Army Corps of Engineers (USACE, 1994) Engineering Manual (EM) 1110-1-4000 Engineering and Design: *Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste* [HTRW] *Sites*; American Society for Testing and Materials (ASTM) Method D5434-12: Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock (ASTM, 2012a); ASTM Method D2488-17E1 (2017a): *Standard Practice for the Description and Identification of Soils (Visual-Manual Procedures)*; ASTM Method 2487-17 (2017b): *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)*; and ASTM Method D6286-19 (2019): *Standard Guide for Selection of Drilling and Direct Push Methods for Geotechnical and Environmental Subsurface Site Characterization*.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards created by drill rigs and associated drilling tasks include working around heavy machinery, excessive noise, overhead rotating parts, pinch points, heavy lifting, projectiles, and biological hazards (e.g., poison ivy, bees/wasps, spiders, and ticks). Modified Level D Personal Protective Equipment (PPE) is generally appropriate for work associated with drilling tasks, and includes a hard hat, safety glasses, steel-toed boots, leather and/or nitrile gloves, high-visibility vests, and hearing protection. Additional details regarding site safety and health must be provided in the APP and/or HASP.

4.0 GEOLOGIC LOGGING

The procedures and requirements listed below must be implemented for all drilling activities:

1. Geologic logging for soil borings and bedrock boreholes will be completed simultaneously with the progression of drilling. Geologic logs will be prepared using USACE HTRW Drilling logs known as MRK Forms 55 and 55-2.

2. The MRK forms will include all relevant and available information. “NA” may be entered on the forms for data that are not applicable. Specifically, “NA” is recorded in the Depth to Bedrock Section if bedrock is not encountered in the borehole.
3. Stratigraphic or lithologic changes encountered in the borehole will be shown in Column C as a solid line. Gradational changes in stratigraphy and lithology will be shown as a dashed line in Column C. The scale of the log will be one-inch equals one foot.
4. The bottom of the borehole will be represented on the form as a solid double line with the notation “Bottom of Borehole.“ Note in Column H if the bottom of the borehole was at refusal.
5. Results of headspace air monitoring will be reported in Column D. Any evidence of contamination will be noted in the remarks section under Column H, including color, odor, or staining.
6. During the progression of drilling activities, depth-to-water measurements will be collected frequently and recorded in Column H with respective times of measurement. Any dry boreholes will be noted in Column H. The depth to water will be recorded in Column H and Box 15 at the time when the first water-bearing zone is encountered. Depth-to-water measurements will be recorded in Column H and in Boxes 16 and 17 after the completion of drilling and again after additional time has elapsed and groundwater elevation has stabilized.
7. The depth of each run (core or soil sample) will be measured with a weighted tape to the nearest 0.1 feet and recorded in Column H. Borehole depths and times of measurement will be recorded frequently on the MRK form. In addition, the start and stop times of drilling will be recorded throughout each workday. The weighted tape will be constructed of materials such that contaminants will not be introduced into the borehole.
8. Intervals of no recovery (i.e., lost bedrock core or soil) will be measured and recorded in Column E. The length of the core or soil sample (recovery) will be measured to the nearest 0.1 feet and recorded in Column H.
9. The size and type of sampler or coring bit and barrel will be noted and recorded in the remarks section of Column H and Box 7. Geologic logs will indicate borehole and sample diameters in Column H, along with depths at which sampling methods or equipment change.
10. The source of the water used for coring or monitoring well installation will be recorded in Column H.
11. Drilling fluid volumes, loss or gain, brand, and product name (as applicable) will be recorded in the remarks section in Column H.
12. If compressed air is used during the drilling process, the type of air filter will be recorded in Column H.
13. The depth and material of any temporary casing used during the well installation procedure will be recorded in Column H.
14. Depth intervals of borehole instability observed during drilling will be recorded in Column H.

15. Difficulties experienced during drilling (e.g., changes in drilling speed, rates, or downhole torque) and any issues in sampling will be noted in Column H, with corresponding descriptions of problem resolutions.
16. The depth interval over which samples are collected for lithologic analysis will be noted and recorded in Column E. The depth interval over which samples are collected for chemical analysis will be noted and recorded in Column F.
17. Each geologic log will be legibly signed by the preparer after proof-reading the log for completeness.

5.0 MEDIA-SPECIFIC LOGGING

5.1 Geologic Logging of Soil (Unconsolidated Material)

Unconsolidated material will be logged using the Unified Soil Classification System (USCS). All items in this section are noted in Column C of the MRK form:

1. The moisture content, in relative terms (i.e., dry, moist, wet/saturated), will be noted. If the sample is saturated (i.e., encountered groundwater), the groundwater level will be recorded to the nearest 0.1 feet as noted above.
2. The standardized color of the unconsolidated material will be logged using the Munsell Soil Color Chart.
3. The angularity, grain size, and grading of soil classified as coarse will be logged. An estimate, by percent of quantities of components (e.g., sand versus silt, silt versus clay), will be logged.
4. The consistency of materials classified as fine (e.g., ML or CH) and the density of materials classified as coarse (e.g., SW or GM) will be noted.
5. Bedding characteristics, evidence of bioturbation, root holes, and fractures will be noted and logged.
6. When known, the depositional type (i.e., alluvium, till, loess) will be noted.

5.2 Geologic Logging of Competent Bedrock (Consolidated Material)

All items from this section are noted in Column C of the MRK forms:

1. The geologic formation name will be noted.
2. The rock type (i.e., limestone, sandstone, shale) will be noted and logged.
3. The relative hardness of the consolidated material will be measured and logged.
4. The texture and grain angularity of the consolidated material will be examined with a hand lens and noted.
5. The standardized color of the consolidated material will be logged using a Munsell Rock Color Chart.
6. The consolidated material will be inspected for apparent weathering and noted accordingly.
7. The moisture content, in relative terms (e.g., dry, moist, wet/saturated), will be noted. If the sample is saturated (i.e., encountered groundwater), the groundwater level will be recorded to the nearest 0.1 feet as noted above.

8. Evidence of bedding, bedding planes, fractures, and joints will be logged. The approximate angle of the dip of bedding, fracture, and joint planes will be noted.
9. Other significant features (i.e., fossils, crystalline minerals, voids, solution cavities) will be noted.
10. The reaction of the consolidated material to the application of 10% weight by volume hydrochloric acid (HCl), if any, will be recorded. (Note: the molarity of the 10% HCl may vary due to the manufacturer. No more than 100 mL will be maintained onsite by the SSHO or geologist. An SDS will be included in the SSHP).
11. Bedrock coring information will be recorded in consecutively numbered runs in Column H and will include the start and stop time of each run, depth to the top and bottom of each run, length of recovery, and size and type of coring bit and barrel.
12. For cored intervals, the Rock Quality Designation (RQD) will be calculated. The RQD represents the degree of jointing or fracturing in a rock mass, expressed as a percentage. It is measured by adding the lengths of full core sections that are four inches or greater and dividing by the total length of the core run.

6.0 EQUIPMENT DECONTAMINATION

Decontamination procedures for reusable field equipment must be performed in accordance with Bluestone SOP Number 05 – *Decontamination of Field Equipment.*

7.0 DATA MANAGEMENT

Data collected during drilling activities (i.e., depth-to-water measurements, borehole depths, photoionization detector (PID) measurements, refusal depth, bedrock depth) will be recorded in the field logbook and on field data sheets as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the site-specific Work Plan. Photographs are a preferred method of documenting pre- and post-work conditions; however, the collection of photographs must be in accordance with contract requirements and site-specific security requirements.

8.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel will read and acknowledge the Work Plan, Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), and any applicable SOPs.

Standard Operating Procedure Number 12
LOW-FLOW GROUNDWATER SAMPLING AND SAMPLING WITH A BAILER

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) was prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the procedures for the collection of groundwater samples using low-flow sampling techniques in both permanent and temporary groundwater monitoring wells. This procedure is consistent with the USEPA SOP: Low Flow (Minimal Drawdown) Groundwater Sampling Procedures (USEPA, 2017). Groundwater samples will be collected from monitoring wells using stainless-steel or polyvinyl chloride (PVC) bladder pumps equipped with Teflon bladders and either polyethylene or Teflon®-lined polyethylene high density tubing. Bladder pumps allow groundwater samples to be retrieved with little disturbance to the sample matrix and minimal exposure to the atmosphere, while employing low-flow techniques.

Groundwater and quality control (QC) samples will be collected and containerized in the order of the volatilization sensitivity of each constituent. If insufficient volume is available to collect the full analytical suite and designated QC samples, the available volume will be allocated at the discretion of the Project Manager and Project Chemist. This hierarchy of samples necessary for low yield/recharged wells will consider factors including, but not limited to, site-specific priorities, sample size, and effect of turbidity on analytical results.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operators (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. In addition, the site safety and health officer (SSHO) must be certified in first aid and CPR.

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the Project Accident Prevention Plan (APP) and/or Health and Safety Plan (HASP), the Bluestone Corporate Safety and Health Program and site and/or client-specific requirements. Potential health and safety hazards associated with low-flow or bailer groundwater sampling include biological hazards (poison ivy, bees/wasps, spiders, ticks, etc.) associated with access the well, twisting and repetitive motion (bailing), heaving lifting, nicks and cuts, uneven ground, acid preservatives, contact with contaminated water, etc. Modified Level D Personal Protective Equipment (PPE) is generally appropriate for work associated with groundwater sampling, safety glasses, safety boots with ankle support, leather and/or nitrile gloves, and high-visibility vests. Additional details regarding site safety and health must be provided in the APP and/or HASP.

4.0 PRE-SAMPLING ACTIVITIES

4.1 Depth-to-Water and Total Well Depth Measurements

Prior to the start of sampling, a synoptic round of depth-to-water measurements will be collected to evaluate the potentiometric surface of groundwater at the site. An electric water-level indicator with an accuracy of +0.01 feet will be used to collect measurements. In addition, the total depth of each well will be measured, and described as a 'hard' or 'soft' bottom to indicate the presence of sediment that may have accumulated at the bottom of the well.

The procedures for collecting depth-to-water measurements include the following:

1. Measurements will be recorded in field logbooks. Depth-to-water and total depth measurements will be collected using the following procedures: Decontaminate the water level probe.
2. Check for proper instrument response by inserting the probe in cup of water. Replace the batteries, as needed.
3. Document observations with respect to the condition of the well pad, surface or protective casing, well locks, obstructions inside the well casing, total well depth, and other well conditions in the field logbook, or on a well assessment field form. Recommendations for maintenance actions should be reported.
4. Don a pair of clean nitrile gloves.
5. Unlock the well cover and remove the cap.
6. Locate the reference point on the riser pipe (notch, mark, or highest point on the riser pipe).
7. Slowly lower the probe down the well until the signal indicates that the water has been contacted.
8. Record the reading at the reference point as depth-to-water.
9. Withdraw the probe and repeat steps 7 & 8. Duplicate measurements should agree within 0.02 feet. If not, continue with measurements until 0.02 feet precision is achieved.
10. Turn the meter to the off position and lower the probe gently until the bottom of the well is encountered. Record the reading at the reference point as the total well depth and observe and record the condition of the bottom of the well (i.e., hard or soft).
11. Remove the probe from the well and decontaminate the unit.

4.2 Field Measurements for Groundwater Sampling

Immediately after removing the well cap, collect a headspace reading using a PID from the top 6 inches inside the well casing. This information will be utilized in conjunction with the site health and safety plan to determine the personal safety level required during sampling. The headspace readings must be recorded in the field logbook. If readings exceed background (0.0 parts per million [ppm]), air monitoring must continue for the duration of the sampling event. Once the headspace reading is recorded, the pump array may be set up and the pump lowered

into the well at the target depth.

During the well purging process, water will pass through the flow-through cell at a controlled low rate, and water quality parameters (i.e., temperature, pH, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity) must be recorded every five minutes. The flow-through cell chamber and sample tubing should remain free of air bubbles during the purge process. Tighten or replace the sampling elbow if air bubbles are introduced.

5.0 LOW-FLOW SAMPLING EQUIPMENT

A list of equipment needed for the collection field measurements is summarized below:

- PID
- Multi-parameter water meter (i.e., HORIBA, YSI, or similar) capable of measuring pH, specific conductance, turbidity, temperature, DO, and ORP
- Flow-through cell
- Graduated cylinder
- High-density polyethylene tubing
- 5-gallon pails
- Nitrile gloves
- Pump control box
- Compressed air source

6.0 CALIBRATION OF MULTI-PARAMETER METER

The multi-parameter water meter (HORIBA, YSI or similar) and PID unit must be calibrated at the start of each workday in conformance to the equipment's manual and using the factory calibration standards provided by the manufacturer for specific equipment. In addition, ORP will be checked for accuracy using standard redox solution (200-275 millivolts [mV] at 25 degrees Celsius [°C]). Note: Standard Hydrogen Electrode (SHE) corrections for ORP field measurements will be completed at the end of the sampling event. DO measurements will be verified both before and after each well. An accuracy check will be performed on the ferrous iron colorimeter once per day. The manual will be consulted if the reading is not within ±0.25 milligrams per liter (mg/L) of the standard solution. Calibration will be performed in conformance to the USEPA SOP Calibration of Field Instruments (USEPA, 2017)

If field equipment malfunction occurs in the field, or the equipment is giving inconsistent readings, the calibration of the equipment will be checked. At the end of each day, a calibration check will be performed to verify the equipment remained in calibration throughout the day. This check will be performed while the instrument is in measurement mode, not calibration mode.

All calibrations and calibration checks will be recorded in the field logbook and appropriate field forms. Extreme cold or hot weather may affect the performance of the YSI meter. In these conditions, the meter may require more frequent checks for instrument drift. Equipment manuals will be available for each instrument, and field personnel should consult the manual for

additional technical details. Additional information regarding calibration procedures is available in Bluestone's SOP Number 02 – *Equipment Calibration and Maintenance*.

7.0 LOW-FLOW SAMPLING TECHNIQUES

7.1 Bladder Pump Sampling

A freshly developed monitoring well must be allowed to stabilize for a minimum of 14 days prior to purging and sampling. To the extent possible, monitoring wells will be purged and sampled using bladder pumps. Non-dedicated bladder pumps will be decontaminated prior to and after each use. For bladder pumps used to collect volatile organic constituents (VOCs) or dissolved gas samples, the pump should be started at a slow speed and slowly increased to deliver a stable low pumping rate. No flow constriction devices should be used to decrease the flow rate. Begin the task by removing the dedicated pump (if applicable) and collecting the depth-to-water and total well depth measurements, as described above. The pump should not be removed from the well except during the initial round of measurements. Leave the water level indicator in the well and connect the pump and hose assembly to a pump control box. Connect the controller to a compressed gas cylinder containing either nitrogen or carbon dioxide or to a portable air compressor. Connect the flow-through cell to the pump discharge tube so that the sample flows into the bottom of the flow-through cell. Direct the discharge from the flow-through cell into a 5-gallon pail. Groundwater purging will be conducted in accordance with applicable State and/or Federal regulations, as indicated below.

If the project objectives require metal concentrations to be field-filtered, an in-line filter (transparent housing preferred) will be used, in addition to the same low flow procedures. Pre-rinse the filter (0.45 µm) and verify that the filter is free of air bubbles prior to sample collection.

7.2 Procedures for a Sustainable Recovery Well

For this SOP, a sustainable recovery well is defined as a well capable of maintaining a stable water level during pumping at a constant flow rate, at an elevation above the pump intake such that there is sufficient volume for all required samples (including any extra volume required for quality assurance/quality control [QA/QC) purposes], plus two additional sampling system volumes. Excessive drawdown refers to drawdown of the water column at a constant flow rate, such that a stabilized water level cannot be obtained at an elevation above the pump intake.

7.3 Standard Sustainable Recovery Well

For this SOP, a standard sustainable recovery well is defined as a well in which stabilized water levels can be obtained at a pumping rate equal to or greater than 100 milliliters per minute (mL/min). The following procedures are used for low flow sampling:

1. Obtain well casing and borehole diameters, and filter pack percent-porosity from available well construction records (may be needed for calculations if the well is determined to be a low- recovery well).
2. Calibrate any electronic water-quality equipment in accordance with manufacturer's

instructions and record calibration data in the field logbook and on the calibration form.

3. Check the function of the electronic water level meter in accordance with the manufacturer's instructions.
4. Assemble equipment at the well and perform field preparatory activities.
5. Measure the total well depth. Using the electronic water level meter, measure and document the depth of the well [to the nearest 0.01 foot (ft)] from the reference mark on the top of the inner well casing.
6. Pump type specific steps.
    a. If using a non-dedicated pump, the following steps are applicable:
        i. Measure water level. Using the electronic water level meter, measure and document the water level to the nearest 0.01 ft. from the reference mark on the top of the inner well casing.
        ii. Assemble the pump and sampling line components, taking care not to contact any of the components with potentially-contaminated media, and ensure that the discharge line is affixed such that initial discharge is captured in either a graduated 5-gallon pail or a purge water collection/disposal drum.
        iii. Determine the depth of the portable pump intake. Measure length of pump from intake to tubing and cable attachment. Measure length of tubing and cable needed to set pump at target depth within the screened interval.
        iv. Slowly lower the pump into the well casing to the target depth, taking care not to encounter the bottom of the well and cause unnecessary agitation of sediment. Affix the pump in this position by fastening the supporting cable. Record depth of pump intake from the reference mark on the top of the inner well casing.
    b. If using a dedicated pump, the following steps are applicable:
        i. Obtain well depth and depth of pump intake from well construction records.
        ii. Measure water level with pump in place. Using the electronic water level meter, measure and document the depth to water (to the nearest 0.01 ft) from the reference mark on the top of the inner well casing.
7. Determine the saturated casing volume and saturated borehole volume (standing volume of groundwater in the casing + volume of groundwater saturated filter pack). This may be needed for calculations if the well is determined to be a low recovery well.
8. Determine the standing volume of groundwater in the casing above the pump intake. This may be needed for calculations if the well is determined to be a low recovery well.
9. Determine sampling system volume (volume capacity of pump, tubing, and flow-through cell). This may be needed for calculations if the well is determined to be a low recovery well.
10. Determine volume necessary to collect all required samples, including QA/QC samples. This may be needed for calculations if the well is determined to be a low recovery well.

11. Connect the flow-through cell and multi-meter to the pump tubing.
12. If the sustainable flow rate is not known for the well, begin purging at 100 mL/min. For wells with historical sustainable flow rate data, use the historical rate.
13. Ensure that no air bubbles are entrained in the pump tubing. Raise the level of the flow-through cell above the well such that water must pump upward through the intake tubing of the cell. This will purge any bubbles through the tubing. After the cell fills with water, it may be lowered.
14. Measure and record the water level and an initial set of water quality parameter measurements.
15. Determine the initial purge flow rate from the well. Using a graduated cylinder, bucket, or other suitable container of known volume and a stopwatch, time the rate of filling.
16. Determine whether the initial purge flow rate causes excessive water level drawdown in the well. Measure and record the water level and water quality parameters at 500 mL or five-minute intervals. The water level will be considered stable if water level readings do not decrease more than 0.3 ft over three successive measurements (it is acceptable for the water level to remain unchanged or to increase) and if the volume of water in the casing above the pump intake is equal to or greater than the volume needed for all required samples plus two sampling system volumes.
17. If the initial purge rate of 100 mL/min does not cause excessive drawdown and is an appropriate rate for project analytes and purposes, document that sustainable recovery has been achieved at this rate and skip to Number 21 and obtain stabilized water quality parameter readings.
18. If the initial purge rate of 100 mL/min does not cause excessive drawdown and a higher rate is desirable for project-specific reasons, adjust the flow rate and determine whether sustainable recovery can be obtained using the higher flow rate. Record each adjustment made to the pumping rate, the water level, and the multi-meter readings measured immediately after each adjustment. The water level and water quality parameters should be measured and recorded approximately every five minutes. When sustainable recovery has been documented at the higher flow rate, skip to Number 21 and obtain stabilized water quality parameter readings. (Note: Assuming a highly transmissive formation, one liter/minute is the maximum purge rate that will preserve laminar flow in the screened interval).

If the initial purge rate of 100 mL/min causes excessive drawdown and the well is less than 30 feet deep, the procedure may be repeated using a peristaltic pump to determine whether sustainable recovery can be obtained at flow rates less than 100 mL/min (See alternative sustainable recovery well section below).

19. If the initial purge rate of 100 mL/min causes excessive drawdown and alternative equipment with flow rates less than 100 mL/min cannot be used, see Low-Recovery Wells Section below.
20. Once a stabilized water level has been obtained, the field parameters will be monitored

for stabilization. If the flow rate is equal to or greater than 100 mL/min, measure and record the water quality parameters at five-minute intervals. If the flow rate is less than 100 mL/min, record the water quality parameters at time intervals of 500 mL divided by the purge rate. Field parameters will be considered stable when three consecutive measurements within the following ranges are obtained:

a. Turbidity: (10% for values greater than 5 Nephelometric turbidity units (NTU), if three turbidity values are less than 5 NTU, consider the values as stabilized),
b. Dissolved Oxygen: (10% for values greater than 0.5 mg/L, if three DO values are less than 0.5 mg/L, consider the values as stabilized),
c. Oxidation/Reduction Potential: (+/- 10 millivolts),
d. Specific Conductance: (3%),
e. pH: (+/- 0.1 unit), and
f. Temperature: (3%).

21. Once water quality parameters have stabilized, the groundwater sample may be collected.

If parameters other than turbidity stabilize, but turbidity stabilization cannot be attained, the Project Manager will be consulted.

7.4 Alternative Sustainable Recovery Well

An alternative sustainable recovery well is defined as a well in which stabilized water levels can be obtained at a pumping rate less than 100 mL/min using alternative equipment capable of lower flow rates (e.g., peristaltic pump, mini bladder pump). The following procedures will be used for alternative sustainable recovery wells:

1. If stabilized water levels can be obtained at a pumping rate less than 100 mL/min using alternative equipment, refer to Number 21 above, and obtain stabilized water quality parameters. Note that for flow rates of less than 100 mL/min, the parameter measurement interval is determined by 500 mL divided by the purge rate.

7.5 Procedures for Sampling Low-Recovery Wells

A low recovery well is defined as a well in which stabilized water levels cannot be obtained as described for sustainable wells, regardless of pumping rate or equipment type. The following procedures will be used for low recovery wells:

1. If a purge rate of 100 mL/min causes excessive drawdown and/or alternative equipment with flow rates less than 100 mL/min cannot be used, the following procedures should be used.
2. The following information (see previous steps 1, 7, 8, 9) is needed:
   - Obtain well casing and borehole diameters, and filter pack percent-porosity from well construction records.
   - Determine standing volume of groundwater in the casing and volume of groundwater saturated filter.
   - Determine standing volume of groundwater in the casing above the pump intake.

- Determine sampling system volume (volume capacity of pump, tubing, and flow-through cell).
- Determine volume necessary to collect all required samples, including QA/QC samples.
- Determine whether the standing volume of groundwater in the casing above the pump intake is sufficient for at least two sampling system volumes plus required samples.

3. If the standing volume of groundwater in the casing above the pump intake is sufficient for at least two sampling system volumes plus required samples, purge slowly at a constant flow rate. measure and record water levels and field parameters every 500 mL until two (or available) system volumes have been removed; collect samples; document conditions and procedures. (Note: water level will not be stable (i.e., drawdown will occur) and water quality parameters may not be stable).
4. If the standing volume of groundwater in the casing above the pump intake is not sufficient for at least two sampling system volumes plus required samples but is sufficient for at least one sampling system volumes plus required samples, purge slowly at a constant flow rate. measure and record water levels and water quality parameters every 500 mL until one (or available) system volumes have been removed; collect samples; document conditions and procedures. (Note: water level will not be stable (i.e., drawdown will occur) and water quality parameters may not be stable).
5. If the standing volume of groundwater in the casing above the pump intake is sufficient for required samples only, determine whether it is acceptable to collect samples without purging. If this is acceptable for project purposes, collect samples at a constant flow rate without purging, document conditions and procedures.
6. If the standing volume of groundwater in the casing above the pump intake is not sufficient for required samples, determine whether samples can be prioritized and if it is acceptable to collect priority samples without purging. If this is acceptable for project purposes, collect the priority samples at a constant flow rate without purging, document conditions and procedures.
7. If the standing volume of groundwater in the casing above the pump intake is not sufficient for all required samples, samples cannot be prioritized, and/or it is not acceptable for project purposes to collect samples without purging, do not collect a sample, and document conditions.
8. If the well cannot be sampled using the low-recharge procedure:
   - Determine whether diffusion samplers or other passive methods are acceptable for project purposes and can be used.
   - Determine whether the well can be removed from the monitoring network.

8.0 GROUNDWATER SAMPLING DECISION TREES

The following decision tree will be used for purging monitoring wells (see Figures 1 and 2 below):

1. Wells with historical purge rate data:

- For a consistent, sustainable recovery well (i.e., stabilized water level can always be achieved) using either standard or alternative equipment.
    - Use historical sustainable flow rate and equipment.
    - Obtain stabilized water level.
    - Obtain stabilized water quality parameters; and
    - Collect samples.
- For a well with inconsistent recovery across multiple sampling events, determine whether a sustainable flow rate can be achieved during this sampling episode using standard or alternative equipment.
    - If yes, use sustainable rate and appropriate equipment; obtain stabilized water level; obtain stabilized water quality parameters; and collect samples.
    - If no, use low recharge procedure.

2. Wells without historical purge rate data but with information from well development or redevelopment:
    - Does well development or redevelopment record indicate a sustainable recovery well using either standard or alternative equipment?
        - If yes, determine a sustainable flow rate and use sustainable rate procedures and appropriate equipment; obtain stabilized water level; obtain stabilized water quality parameters; and collect samples.
        - If no, use low recharge procedures.
3. Wells without either historical purge rate or well development or redevelopment data:
    - Determine whether a sustainable flow rate can be achieved during this sampling event using standard or alternative equipment.
        - If yes, use the sustainable rate and appropriate equipment; obtain stabilized water level; obtain stabilized water quality parameters; and collect samples.
        - If no, use low recharge procedures.

9.0 EQUIPMENT MALFUNCTION PROCEDURES

Every effort will be made to procure and maintain properly functioning equipment; however, equipment malfunctions may occur. In these instances, the field team leader will be contacted immediately, followed by the Project Manager. To the extent practicable, field crews will be equipped with backup sets of equipment. Any necessary replacement items will be ordered for next-day delivery. Since the measurement of DO is the most frequent failure point, subsequent wells will be purged and sampled at or below historical purge rates until 125 percent of the maximum volume purged during the previous three sampling events is removed from the well. All other stabilization parameters must also meet stabilization criteria prior to sample collection.

Any other equipment malfunctions will be brought to the attention of the Project Manager and a temporary site-specific sampling protocol will be implemented. In addition, any equipment malfunctions and remedies must be noted in the field logbook and on the daily report.

Figure 1 Groundwater Sampling Decision Flowchart - Wells Screened Below Water Table

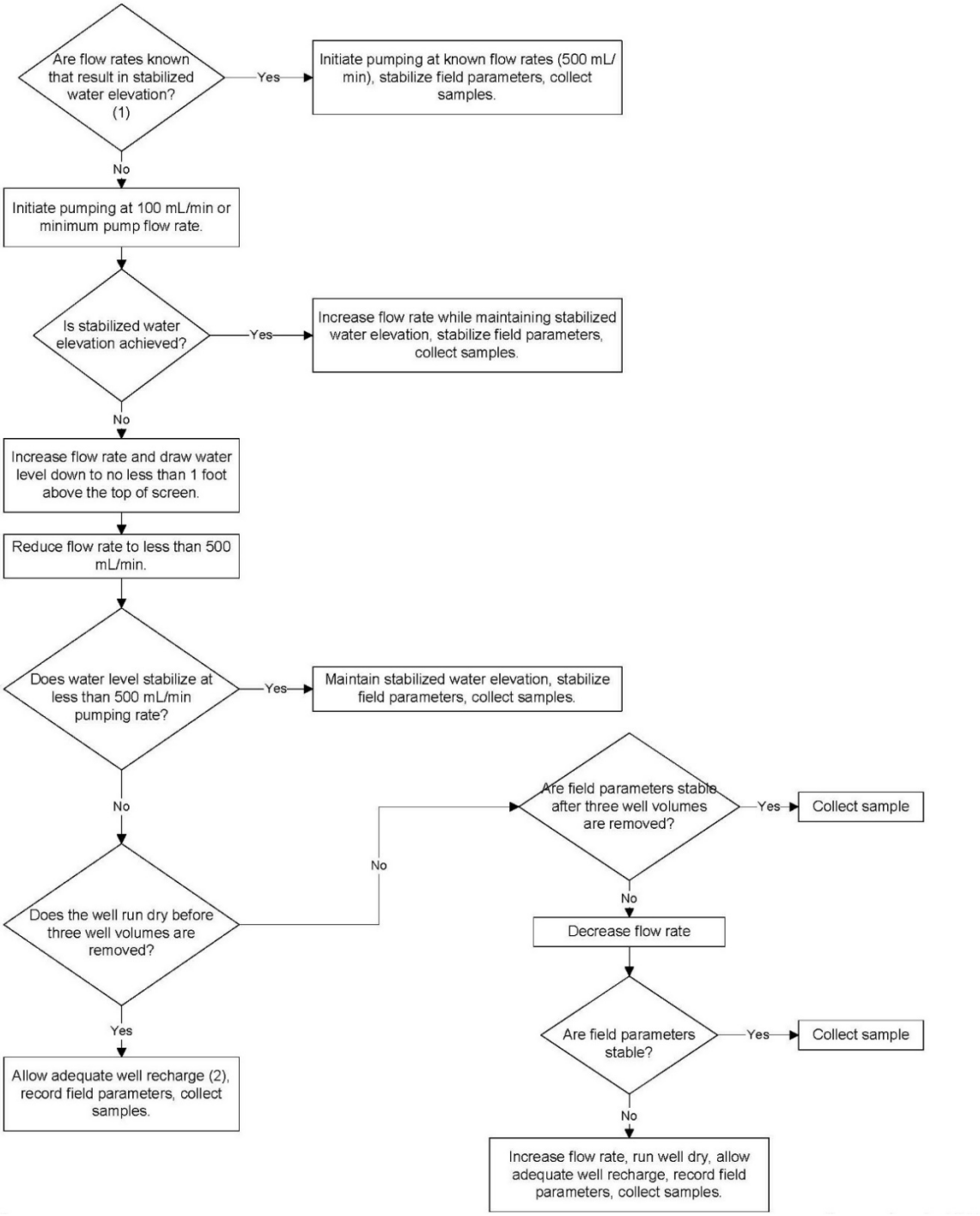
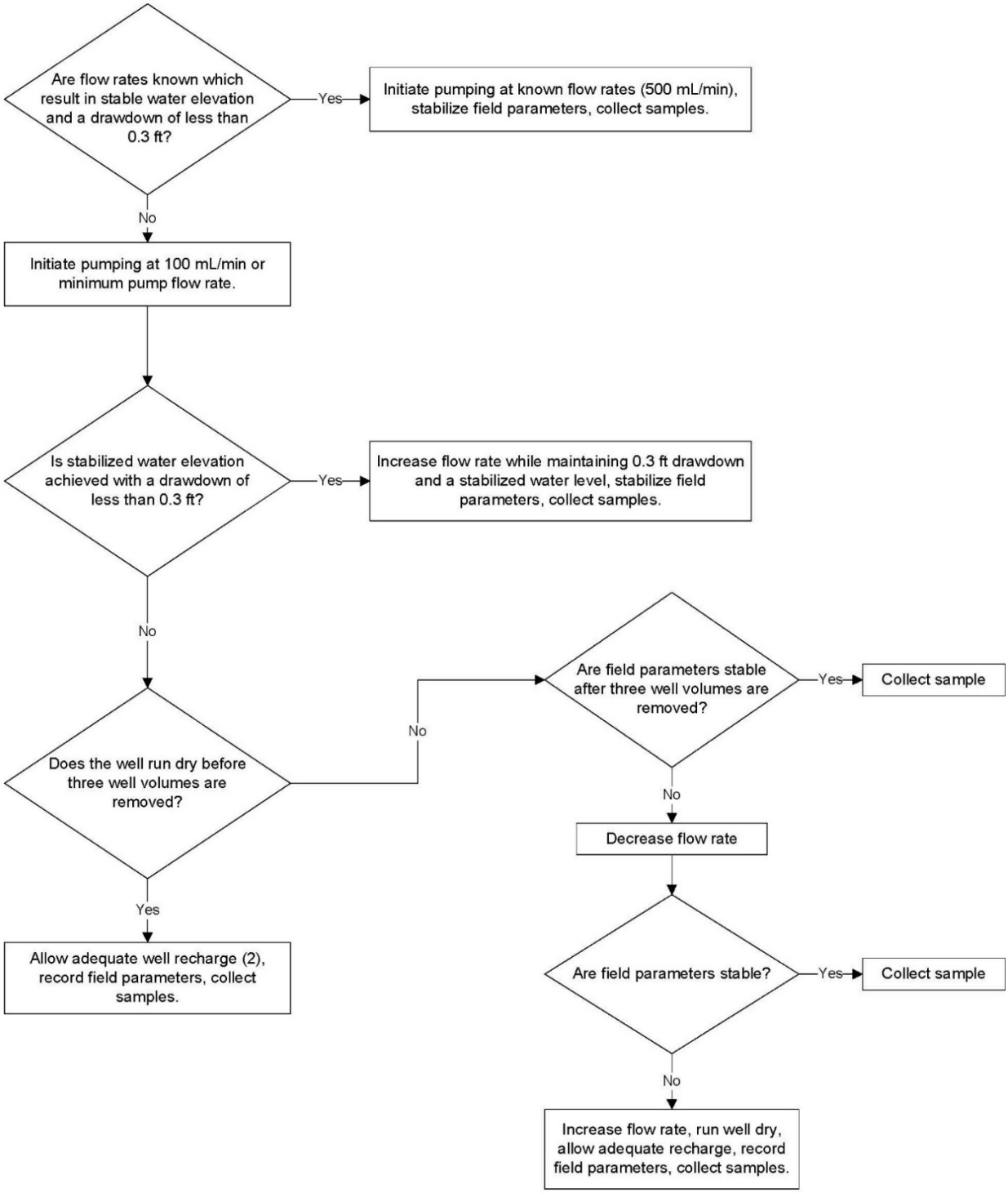


Figure 2 Groundwater Sampling Decision Flowchart - Wells Screened Across Water Table



10.0 GROUNDWATER SAMPLE COLLECTION USING A BAILER

For groundwater samples collected with a bailer, a standard cleaned closed-top polyethylene or Teflon® bailer with Teflon® coated stainless-steel leaders must be used. A new piece of nylon rope or twine must be used for each bailer. The bailer will be lowered slowly into the well to the top of the water column, allowed to fill, and removed. It is critical that the bailer be slowly and gently lowered into the water column, particularly during the final stages of purging, to minimize turbidity and disturbance of any VOCs. A straight tube should be used to displace the check valve at the bottom of the bailer to decant the water into the appropriate sample containers.

11.0 EQUIPMENT DECONTAMINATION

Decontamination procedures for re-usable field equipment must be performed in accordance with Bluestone's SOP Number 05 – Decontamination of Field Equipment.

12.0 DATA MANAGEMENT

Data collected during well sampling activities (i.e., depth-to-groundwater measurements, total well depth, sampling IDs, sample collection times, etc.) will be recorded in the field logbook and on field data sheets as necessary. Bluestone's SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information should be specified in the Work Plan. Pre-existing conditions and post-work site restoration should be documented through photographs with approval from the Client. Field data and observations should be provided to the Project Manager periodically throughout the progression of work.

13.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the Work Plan, UFP-QAPP, and any applicable SOPs. Field personnel will complete a minimum of 40 hours of field training prior to working independently on environmental sites.

Standard Operating Procedure Number 13
SAMPLE PACKING AND SHIPPING

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) was prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the procedures for the proper packing and shipping of environmental samples. All samples must be shipped priority overnight in accordance with the U.S. Environmental Protection Agency (USEPA) specifications and U.S. Department of Transportation (DOT) regulations (49 Code of Federal Regulations [CFR] Parts 172 and 173). Samples will be handled as a low hazard level and packed and shipped within 24 hours of collection.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY

Activities as detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards associated with packing and shipping samples includes nicks and cuts and heavy lifting. Modified Level D is generally appropriate, and may be limited to nitrile gloves, safety glasses, and safety shoes. High visibility vests or clothing will be worn when packing coolers in a parking lot or near traffic. Additional details regarding site safety and health must be provided in the APP and/or SSHP.

4.0 SAMPLE PACKAGING

The following procedure will be used to pack samples for overnight shipment:

1. To the extent possible, group samples by sample identification (ID) (also known as sample tracking number), with the exception of bottleware designated for volatile organic constituents (VOC) analysis. Group aqueous VOC samples in a common shipping container.
2. At the time of sample collection, wipe the outside of each sample bottle/jar with a paper towel and place a label on each container. Each glass bottle/jar will be wrapped with bubble wrap or the protective sleeves provided by the laboratory. Place all sample bottles in a Ziploc® bag. All VOC vials collected for each sample will be placed in the same plastic bag, if practicable. Trip blank quality control (QC) samples will be packed in the same manner as the VOC bottleware.

3. Remove as much air as possible from the plastic bag prior to sealing.
4. Seal the drains on the shipping coolers with tape.
5. Place an absorbent pad in the bottom of the cooler, followed by a layer of bubble wrap.
6. Insert a plastic liner/contractor bag into the cooler.
7. Place the sample containers inside the liner in an upright position and place bubble wrap in between sample bottles. Group all aqueous VOC samples in a common cooler. Place one trip blank set (two 40-mL volatile organic analysis [VOAs] vials) in each cooler containing aqueous VOC samples. Place one temperature blank in each cooler.
8. Preserve the samples with ice. This may be completed by placing the ice chips directly inside the liner around all sample bottles or by double-bagging ice chips in Ziploc® bags and placing the bags at the bottom, top, and in the interstitial spaces of sample batch.
9. Sign and date the chain of custody (COC) and record the information in the field logbook.
10. If a cooler is not sealed with custody labels at the time of transfer to a laboratory courier service or when dropped off at a laboratory, the courier or laboratory personnel must sign and date the COC at the time of transfer. The sampler must then take a photo of the COC before sealing it inside the cooler. Photographs of COCs will be provided to the sample manager at the end of each workday.
11. Place the completed COC inside a Ziploc® bag and tape the bag to the inside of the cooler lid.
12. Affix signed custody seals over lid openings (opposite corners of the cooler).
13. Seal both ends of the cooler by wrapping three times with clear packing tape. Make sure that the address, phone number, and contact information for the receiving laboratory is placed prominently on the cooler, and wrap the shipping label with packing tape.
14. For shipments through FedEx or UPS, provide the representative with the laboratory shipping and receiving addresses and the Bluestone or laboratory account number, depending on responsible party. In addition, provide any shipping procedures or restrictions the laboratory may require (i.e. no Saturday delivery).

5.0 DATA MANAGEMENT

Notes associated with sampling packing and shipping will be recorded in the field logbook and on field data sheets as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information should be specified in the Work Plan.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the Work Plan, Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), and any applicable SOPs.

Standard Operating Procedure Number 15
SUBSURFACE SOIL SAMPLING

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the methodology for collecting representative subsurface soil samples. Data generated from chemical analysis of subsurface soils will be used to determine the nature and extent of contamination, if present. In addition, the data will aid in the determination of associated risk posed to human health and the environment, and the most appropriate remedial measures. A subsurface soil investigation is often performed in conjunction with a shallow groundwater investigation, as a borehole may be converted into a temporary groundwater well, through which water quality and groundwater elevation may be evaluated.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. Field personnel will complete a minimum of 40 hours of field training prior to working independently on environmental sites. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards associated subsurface soil sampling are similar to drilling hazards and include working around heavy machinery, excessive noise, overhead rotating parts, pinch points, heavy lifting and twisting, projectiles, and biological hazards (e.g., poison ivy, bees/wasps, spiders, and ticks). Modified Level D Personal Protective Equipment (PPE) is generally appropriate for work associated with subsurface soil sampling, and includes a hard hat, safety glasses, steel-toed boots, leather and/or nitrile gloves, high-visibility vests, and hearing protection. Additional details regarding site safety and health must be provided in the APP and/or SSHP.

4.0 PRE-SAMPLING ACTIVITIES

Locations for subsurface soil sampling will be selected based on project objectives, source location, suspected contaminant mobility, and available analytical data. Sample locations will be identified in the Work Plan, Sampling Plan, or Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP).

4.1 Discrete Soil Sampling Requirements

Subsurface soil samples may be collected using a Geoprobe® rig and direct-push technology (DPT), which retrieves soil cores in four- or five-foot barrels lined with acetate sleeves. Subsurface samples collected using higher-power drill rigs may be collected in 5- or 10-foot intervals. Soil cores must be logged by a qualified geologist, as described in Bluestone SOP Number 11 – *Geologic Logging*.

Discrete subsurface soil samples typically target a known or suspected zone of contamination. Soil cores will be screened for the presence of organic vapors every 0.5 to 1.0 foot, and the sample interval will be centered on the area of the soil core exhibiting the highest photoionization detector (PID) concentrations (for volatile organic compound [VOC] analysis) unless specified in the Work Plan or UFP-QAPP. Methods can be found in Bluestone SOP Number 07 – *Field Screening Soils Using a PID.*

4.2 Background Samples

Based on project objectives, background subsurface soil samples may be collected to evaluate areas that are located topographically upgradient of source activities and are representative of site soils and subsurface conditions. Background samples will be collected using like procedures as other subsurface soil samples. Background samples will be analyzed for the same constituents as the remainder of site samples and will be used to evaluate the impact of source activities on surrounding areas.

4.3 Utility Clearance

Prior to any intrusive field activities, subsurface utility clearance must be performed to ensure that no buried utilities are damaged or compromised during a subsurface investigation. Clearance activities will be performed by the respective state service (i.e., One-Call, Dig-Safely, etc.) and by a third-party utility locator. Utility clearance may be completed using a variety of geophysical methods, as described in Bluestone SOP Number 18 – *Utility Clearance.*

5.0 SUBSURFACE SOIL SAMPLING TECHNIQUES

5.1 Subsurface Sampling Using a Hand-Auger

Investigation of shallow soils may be conducted using a stainless-steel hand-auger. A hand-auger requires physical labor or an electrical source to advance a small-diameter sampling auger into unconsolidated subsurface material. Hand-auger sampling is generally reserved for depths less than five feet below ground surface (bgs), although greater depths are possible. All material extracted from the soil boring must be contained on plastic sheeting. Procedures for the disposal of cuttings will be described in the Work Plan or UFP-QAPP, in addition to soil sampling depth(s). Subsurface soil samples are recovered from the hand-auger using a clean, gloved hand, or a decontaminated soil knife. Subsurface soil samples submitted for chemical analysis will be collected from the intervals specified in the UFP-QAPP but will not be collected below the groundwater surface.

5.1.1 Equipment

The following equipment may be used for the collection of subsurface samples using a hand-

auger:

- Sample bottleware
- Camera
- Munsell Soil Color Chart
- Soil boring logs and field forms
- PID (MiniRAE® 300, or similar)
- Direct soil pH probe (Hanna Instruments® 99121 [HI99121], or similar)
- Soil oxidation-reduction potential (ORP) probe (Hach® Pocket Pro ORP Tester, or similar)
- 6-foot measuring tape
- Field logbook
- Spray bottle
- Contractor bags
- Card table
- Duct tape
- Hand lens
- Caution tape
- Spray paint, flagging tape, pin flags
- Lath
- Aluminum foil
- Utility knife
- Stainless-steel bowl
- Stainless-sampling spoons
- Hand-auger with attachable extensions
- Decontamination supplies (refer to Bluestone SOP Number 05 – *Decontamination of Field Equipment*)
- Safety equipment as needed (refer to the project APP/SSHP)

5.1.2 Soil Sample Collection Procedures

Subsurface soil samples may be collected either at discrete intervals as specified in the Work Plan or UFP-QAPP, or continuously until refusal is encountered. If the water table is encountered prior to reaching the target depth, the saturated sample will be analyzed for geologic logging and headspace measurements only, and the subsurface soil sample will be collected from the interval directly above the water table. If insufficient volume is available, the sampler may reach into the borehole and scrape the sidewall with a scoop at the target depth or offset slightly and hand-auger a second boring to the target depth. PID measurements will be recorded every foot of the soil core. Prior to sample collection, record field parameters for soil (pH and ORP) using the appropriate meters, as specified in Bluestone SOP Number 02 – *Equipment Calibration and Maintenance*. Note, collection and frequency of soil parameters will be project-specific.

5.2 Subsurface Soil Sampling Using Direct-Push Technology (DPT)

Investigation of shallow soils will be conducted using a Geoprobe® rig and DPT. As discussed above, this method employs a hydraulically powered percussion/probing machine to advance

two to three-inch barrels lined with acetate sleeves (Macro-Core® or large-bore) into unconsolidated subsurface material. Subsurface soil samples will be collected at the depth(s) specified in the Work Plan or UFP-QAPP. The soil sample is recovered by removing the Macro-Core® from the sampler and extracting soils from the target interval. No subsurface soil samples will be collected from below the groundwater surface.

5.2.1 Equipment

The following equipment may be needed for collection of subsurface samples using DPT methods:

- Sample bottleware
- Camera
- PID (MiniRAE® 300, or similar)
- Direct soil pH probe (Hanna Instruments® 99121 [HI99121], or similar)
- Soil ORP probe (Hach® Pocket Pro ORP Tester, or similar)
- Munsell Soil Color Chart
- Soil boring logs and field forms
- 6-foot measuring tape
- Field logbook
- Spray bottle
- Contractor bags
- Hand lens
- Caution tape
- Spray paint, flagging tape, pin flags
- Lath
- Aluminum foil
- Utility knife
- Stainless-steel bowl
- Stainless-sampling knife and spoon
- Geoprobe® track rig
- Decontamination supplies (refer to Bluestone SOP Number 05 – *Decontamination of Field Equipment*)
- Safety equipment as needed (refer to the project APP/SSHP)

5.2.2 Soil Sample Collection Procedures

DPT soil samples may be used for physical/geotechnical and/or chemical analyses. The type of liner used will be selected based on site conditions and project objectives. Acetate liners are suitable for most types of sampling and are less expensive and easier to use than Teflon® liners. However, they may potentially introduce phthalate contamination into the samples. Hence, acetate liners will not be used at sites where phthalates are considered a constituent of potential concern (COPC), and instead Teflon® liners will be used.

Analytical samples may be collected at discrete intervals as specified in the Work Plan or UFP-QAPP, or continuously using the large-bore (1 ⅜-inch outer diameter [OD]) or Macro-Core® sleeves (2-inch OD). If the water table is encountered prior to reaching the target depth, the

saturated portion of soil in the liners will be evaluated for logging purposes and headspace measurements only, and the sample will be collected from the interval directly above the water table. PID concentrations will be recorded every 0.5 to 1.0 foot of the soil core. Prior to sample collection, record field parameters for soil (pH and ORP) using the appropriate meters, as specified in Bluestone SOP Number 02 – *Equipment Calibration and Maintenance*. Note, collection and frequency of soil parameters will be project-specific. If an insufficient volume of soil is collected during sampling, the borehole will be offset slightly, and another soil boring will be advanced to extract the required soil volume.

5.3 Subsurface Soil Sampling Using Split-Barrel and Sonic Drilling

Additional methods for the collection of subsurface soil samples include split-barrel samplers or Shelby tubes, which provide geologic information for logging and/or samples for geotechnical and chemical analyses. Samples collected using a split-barrel sampler are ideal for the drilling of disturbed soils, and if the project objectives include chemical analysis and physical characterization of sediment including, but not limited to, grain size distribution and moisture content. Samples may also be collected using the sonic drilling method, which is ideal in unconsolidated media.

5.3.1 Equipment

The following equipment may be needed to collect subsurface soil samples using split-barrel or sonic drilling methods:

- Sample containers
- Camera
- Munsell Soil Color Chart
- Soil boring logs and field forms
- 6-foot measuring tape
- PID (MiniRAE® 300, or similar)
- Direct soil pH probe (Hanna Instruments® 99121 [HI99121], or similar)
- Soil ORP probe (Hach® Pocket Pro ORP Tester, or similar)
- Field logbook
- Spray bottle
- Contractor bags
- Hand lens
- Caution tape
- Spray paint, flagging tape, pin flags
- Lath
- Aluminum foil
- Utility knife
- Stainless-steel bowl
- Stainless-steel sampling knife and spoon
- Drill rig (project-specific); must be capable of sampling the unconsolidated material for chemical analysis using split-barrel sampler

5.3.2 Decontamination supplies (refer to Bluestone SOP Number 05 – *Decontamination of Field Equipment*)

5.3.3 Safety equipment as needed (refer to the project APP/SSHP)

5.3.4 Split-Barrel Soil Sample Collection Procedures

A spit-barrel (split-spoon) sampler operates similarly to DPT, in that no circular drilling is performed; however, it requires a higher-power rig capable of advancing to greater depths. Subsurface soil sampling using split-spoon drilling methods are described below:

1. Depending on the COPCs, the ambient air surrounding the borehole will be monitored using a PID. Air quality measurements will be recorded after each run, or more frequently if levels are increasing or the alarm is activated.
2. The split-spoon sampler will be removed from the borehole and placed on clean plastic sheeting on a table or ground surface.
3. The split-spoon is opened, and the soil core is screened for the presence of organic vapors in accordance with Bluestone SOP 07 – *Field Screening Soils Using a PID* and logged accordingly.
4. Prior to sample collection, record field parameters for soil (pH and ORP) using the appropriate meters, as specified in Bluestone SOP Number 02 – *Equipment Calibration and Maintenance*. Note, collection and frequency of soil parameters will be project-specific.
5. To collect a sample, the core may be extracted from the split-spoon using a decontaminated knife or spoon. Samples for VOC and/or total volatile petroleum hydrocarbons (TVPH) analyses will be collected first from the interval exhibiting the highest PID concentrations or any visual signs of contamination. Samples for VOC analysis will be collected using sampling equipment identified in the Work Plan or UFP-QAPP directly from the core. Samples will be immediately transferred to the appropriate sample container and placed in an iced cooler to minimize volatilization. In the event no contamination or elevated PID concentrations are detected, the sample will be collected at the midpoint of the target interval.
6. For all other chemical analyses, the sample will be homogenized to generate a representative sample by hand mixing (using nitrile gloves) or stirring the remaining soils in a stainless-steel bowl. The sample volume must be sufficient to fill all required sample containers including associated quality assurance (QA)/quality control (QC) analysis. Subsurface soil samples will be collected and preserved as described above.
7. Decontaminate all stainless-steel equipment (including split-spoon barrels) using methods described in Bluestone SOP Number 05 – *Decontamination of Field Equipment*.

5.3.5 Sonic Drilling Soil Sample Collection Procedures

Sonic drilling is ideal for the investigation of unconsolidated materials and is known for producing high-quality continuous soil samples. This technique employs two core barrels, the inner barrel of which is advanced into the subsurface first to obtain an undisturbed soil sample. The outer barrel is then advanced over the inner barrel to the same depth to provide stability of

the surrounding formation while the inner barrel is extracted from the borehole. The advancement of the boreholes is accomplished through high-frequency resonant energy. The barrels are advanced in this manner until the target depth or refusal is encountered. Subsurface soil samples collected using sonic drilling techniques will be follow the procedures listed below:

1. Depending on the COPCs, the ambient air surrounding the borehole will be monitored using a PID. Air quality measurements will be recorded after each run, or more frequently if levels are increasing or the alarm is activated.
2. Soil/unconsolidated material is extracted from the inner barrel that is lined with a heavy-duty plastic sleeve. Sections of core are typically 10 feet in length and 3½-inch diameter. The plastic sleeve is pulled from the inner barrel and placed on plastic sheeting. Field sampling crews will split the lining and core vertically using a stainless-steel knife and log each section as described above.
3. Soil cores will be screened for the presence of VOCs using a PID in accordance with Bluestone SOP 07 – *Field Screening Soils Using a PID*. Prior to sample collection, record field parameters for soil (pH and ORP) using the appropriate meters, as specified in Bluestone SOP Number 02 – *Equipment Calibration and Maintenance*. Note, collection and frequency of soil parameters will be project-specific.
4. The field sampler will select soil from the core at target sampling depths (and intervals of visual contamination, as applicable) and homogenize as described above.
5. For all other chemical analyses, the sample interval will be homogenized to generate a representative sample by hand mixing (using nitrile gloves) or stirring the remaining soils in a stainless-steel bowl. The sample volume must be sufficient to fill all required sample containers including associated QA/QC analysis. Subsurface soil samples will be collected and preserved as described above.
6. Decontaminate all stainless-steel equipment (including split-spoon barrels) using methods described in Bluestone SOP Number 05 – *Decontamination of Field Equipment*.

6.0 PRIORITY OF TARGET ANALYTES

Soil samples and QC samples will be collected in the order of the volatilization sensitivity of respective analytes. In general, the following order will be prioritized: VOCs, TVPH, semi-volatile organic compounds (SVOCs), total extractable petroleum hydrocarbons (TEPH), pesticides, herbicides, inorganics, and lastly, soil properties.

Geotechnical analysis of soil properties will be conducted following chemical analysis. Soil aliquots intended for analysis of physical properties, including moisture content, will be placed in clean glass jars (American Society for Testing and Materials [ASTM] Method D2216-19: *Standard Test Methods for Laboratory Determination of Water [Moisture] Content of Soil and Rock by Mass*, if required). Remaining sample material will be placed in sealable plastic bags, labeled with the date, associated soil boring ID, and depth. Depending on project objectives, the soil may be tested for Atterberg limits (ASTM Method D4318-17E1: *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*) or sieve analysis with U.S. Department of Agriculture (USDA) Classification (ASTM D422-63): *Standard Test Method for Particle-Size Analysis of Soils*, if requested.

Many geotechnical analyses require undisturbed samples, which can be acquired using a Shelby tube sampler. Shelby tubes samples are ideal for collection subsurface soil samples in cohesive silts and soft clays. Once collected, the Shelby tube must remain upright and undisturbed during transport and analysis.

7.0 EQUIPMENT DECONTAMINATION

Decontamination procedures for reusable field equipment must be performed in accordance with Bluestone SOP Number 05 – *Decontamination of Field Equipment.*

8.0 DATA MANAGEMENT

Data collected during subsurface soil sampling activities (i.e., sample ID, location, depths, media type, etc.) will be recorded in the field logbook and on field data sheets as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the Work Plan. Pre-existing conditions and post-work site restoration will be documented through photographs with approval from the client. Field data and observations will be provided to the Project Manager periodically throughout the progression of work.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the Work Plan, UFP-QAPP, and any applicable SOPs.

Standard Operating Procedure Number 18
UTILITY CLEARANCE

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the methodology for performing subsurface utility clearance activities. Since Bluestone does not self-perform utility clearance, these procedures describe the requirements and quality assurance (QC) protocols that must be followed during oversight of utility clearance subcontractors.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. Field personnel will complete a minimum of 40 hours of field training prior to working independently on environmental sites. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

Site personnel will be familiar with the specific contact telephone numbers, standard utility-specific color codes (provided below), and appropriate response actions in the event a utility line is compromised or damaged. Site personnel will be able to identify utility markings and communicate to emergency responders, if needed.

RED	ELECTRIC
YELLOW	GAS, OIL, STEAM
ORANGE	COMMUNICATIONS
BLUE	POTABLE WATER
PURPLE	RECLAIMED WATER
GREEN	SEWER / DRAINAGE
PINK	SURVEY MARKS
WHITE	PROPOSED EXCAVATION

3.0 HEALTH AND SAFETY HAZARDS

Field activities as detailed in this SOP will be performed in accordance with the Project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards associated with oversight of utility clearance activities include slip/trip/fall, uneven terrain, electrical hazards, and biological hazards (e.g., poison ivy, bees/wasps, spiders, and ticks). Modified Level D Personal Protective Equipment (PPE) is generally appropriate for work associated with oversight of utility clearance, and includes a hard hat, safety glasses, safety shoes, and high-visibility vests. Additional details regarding site safety

and health must be provided in the APP or the SSHP.

4.0 UTILITY CLEARANCE ACTIVITIES

Prior to any intrusive field activities, subsurface utility clearance must be performed to ensure that no buried utilities are damaged or compromised during a subsurface investigation. First, the anticipated work area will be marked in the field using white paint that encompasses the area to be disturbed, whether it be a boring, test pit, or excavation. The appropriate local/regional utility location service (i.e., PA One-Call, Dig-Safely New York, etc.) will then be notified. The call to local/regional utility locators will be placed a minimum of 72 hours in advance. The approval period may be extended beyond the typical 10 days or renewed as required for the duration of the project. Pertinent information, including the regional call ticket number, utilities notified and responded, period of approval, and names of all personnel on site will be recorded in the field logbook, in accordance with Bluestone SOP Number 06 – *Field Documentation*.

As an added measure of precaution, and to identify subsurface utilities on privately-owned parcels, a third-party utility locator will be subcontracted. Utility clearance will be performed using a variety of geophysical methods, including ground-penetrating radar (GPR), precision utility locating (PUL), and metered magnetic locating.

5.0 INTRUSIVE ACTIVITIES

No intrusive activities will be performed within five feet of a marked utility. Any proposed sample locations, as specified in the site-specific Work Plan or Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), within five feet of a utility will be shifted accordingly. In addition, drill rigs will be positioned so that the mast is kept a minimum of 30 lateral feet from overhead powerlines. Vehicles will be parked a minimum of 30 lateral feet from overhead utilities/powerlines to reduce the possibility of arcing. The minimum lateral distance may be adjusted based on known voltages of overhead lines, or if specified in the APP and/or SSHP.

The relocation of soil borings to avoid subsurface utilities must be approved by the Field Team Leader (FTL) and documented in the field logbook. A daily report with the proposed boing locations will be provided to the Project Manager; however, approval to proceed with work is not required.

6.0 EQUIPMENT AND SUPPLIES

Equipment used during utility clearance oversight may include:

- Project documents (Work Plan, UFP-QAPP, APP, SSHP)
- Field logbook, field data sheets
- Handheld GPS unit (TDS Trimble® Ranger 3L, or as determined by the subcontractor)
- Marking paint (designated industry colors)
- Pin flags, stakes, ribbon flagging (designated industry colors)
- Geophysical instruments (provided by the subcontractor) may include:
  - GSSI® Utility Scan Pro GPR, or similar
  - Schonstedt® Magnetic locator, or similar

- PUL equipment (RD5100™), or similar

7.0 DATA MANAGEMENT

Data collected during utility clearance activities will be recorded in the field logbook and on field data sheets, as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the Work Plan. Photographs are a preferred method of documenting pre- and post-work conditions; however, the collection of photographs must be in accordance with contract requirements and site-specific security requirements.

8.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel will read and acknowledge the Work Plan, UFP-QAPP, and any applicable SOPs.

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Standard Operating Procedure Number 19
GROUNDWATER ELEVATION MONITORING

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) was prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the methodology for collecting depth-to-water measurements from monitoring wells and piezometers (terms used interchangeably). Hydrogeologic data gathered during a field investigation may be used to determine hydraulic gradient, interpret the migration rate and direction of contaminants (if present), produce groundwater contour maps, determine purge volumes for groundwater sampling, and design slug tests, packer tests, and constant-rate pumping tests.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. Field personnel will complete a minimum of 40 hours of field training prior to working independently on environmental sites. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Potential health and safety hazards associated with groundwater elevation monitoring include slip/trip/fall hazards, pinch points, and biological hazards (e.g., poison ivy, stinging insects, spiders, and ticks). Modified Level D Personal Protective Equipment (PPE) is generally appropriate for work associated with groundwater elevation monitoring, and includes a hard hat, safety glasses, leather/nitrile gloves, safety shoes, and high-visibility vests.

4.0 EQUIPMENT

Equipment used in the collection of depth-to-water measurements:

- Electronic water level indicator (Solinst® Model 101 P7 Water Level Meter or similar)
- Oil/water interface probe (Solinst® Model 122 or similar)
- Alconox®, Liquinox® or other non-phosphate concentrated laboratory grade soap
- Distilled water
- Spray bottles
- PPE
- Air Monitoring instruments as required (i.e. MiniRAE®, Thermo TVA 1000 Flame Ionization Detector [FID]/Photoionization Detector [PID])
- Field logbook, field data sheets
- Well keys

- Decontamination supplies (refer to Bluestone SOP Number 05 – *Decontamination of Field Equipment)*
- Previous depth-to-water measurements (if available)

5.0 PROCEDURES FOR MEASURING DEPTH-TO-WATER

The procedures for collecting depth-to-water measurements include the following:

1. Record the condition of the well (protective casing, concrete collar, lock in place, etc.).
2. Check the water level tape has no obvious kinks or damage.
3. Wearing nitrile gloves, decontaminate the water level meter in accordance with Bluestone SOP Number 05 – *Decontamination of Field Equipment.*
4. Stand upwind of the well; unlock and open the well, being cautious of biological hazards. Remove the well cap and collect a headspace reading using a PID. Record pertinent air monitoring data (sustained, dissipating, background, odor) in the field logbook in accordance with Bluestone SOP Number 06 – *Field Documentation*.
5. Identify the survey notch on the riser or casing (if present). Record this location in the field logbook or field data sheet.
6. Activate the water level meter, check the audible indicator, reel the electronic probe into the well riser (with the increments visible) slowly until the meter sounds, grasp the tape with hand, withdraw the tape and lower it again slowly until the sound is again audible. Check the depth to water on the tape and make a mental note of the depth to within .01 feet. Lower the probe again slowly and repeat the measurement for accuracy, with care to measure from the correct direction.
7. Record the depth-to-water measurements in the field logbook or field data sheets and corresponding time of measurement.
8. Procedures implemented in the presence of free phase petroleum products (light non-aqueous phase liquids [LNAPL]) on the surface of the water table will be modified to include the use of the oil/water interface probe. The procedures during the use of this probe will be implemented similarly and by manufacturers' specifications. Typically, the procedure to collect depth-to-product measurements is similar to measuring depth-to-water, where the oil/water interface probe will be equipped with a dual alarm that distinguishes between contact with oil and contact with water. Depth-to-oil and depth-to-water measurements will be recorded, which in turn provides the thickness of the free product layer.

6.0 EQUIPMENT DECONTAMINATION

Decontamination procedures for reusable field equipment must be performed in accordance with Bluestone SOP Number 05 – *Decontamination of Field Equipment.*

7.0 DATA MANAGEMENT

Data collected during groundwater elevation monitoring (i.e., depth-to-groundwater and total depth measurements, and corresponding times, etc.) will be recorded in the field logbook and on field data sheets, as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the

Work Plan. Photographs are a preferred method of documenting pre- and post-work conditions; however, the collection of photographs must be in accordance with contract requirements and site-specific security requirements.

8.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the Work Plan, Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), and any applicable SOPs.

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Standard Operating Procedure Number 29
SOIL VAPOR SAMPLING

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone) to establish methodologies for various types of active and passive soil vapor sampling.

These procedures were written in accordance with the following guidance documents:

- Applicable State Regulatory Vapor Intrusion Technical Guidance;
- Beacon Environmental (Beacon), sampling instructions; and
- Amplified Geochemical Imaging, LLC's (AGI) survey protocols.

The methodologies described below include the minimum required steps and quality checks that employees will follow when sampling for soil vapor concentrations. In addition, this SOP addresses technical requirements and required documentation to be completed during soil vapor sampling activities.

2.0 INTRODUCTION

Soil vapor sampling techniques may vary widely, and therefore, this SOP describes passive sampling using Beacon samplers or universal AGI® samplers; and active sampling using a SUMMA® canister. Depending on the project objectives, active and passive techniques may be implemented to evaluate soil vapor both indoors and outdoors. Each method is described below.

3.0 PERSONNEL QUALIFICATIONS

Field personnel will be familiar with the specific equipment that will be used to conduct each type of sampling, and common issues that may occur throughout the sampling process. All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. Field personnel will complete a minimum of 40 hours of field training prior to working independently on environmental sites. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

4.0 HEALTH AND SAFETY

Field activities as detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Modified Level D Personal Protective Equipment (PPE) is generally appropriate for active and passive soil vapor sampling, and includes safety glasses, steel-toe boots, high-visibility apparel, and nitrile gloves. Additional details regarding site safety and health will be provided in the APP and/or SSHP.

This SOP does not address all of the hazards and environmental conditions that are typically associated with active and passive soil vapor sampling.

5.0 EQUIPMENT AND SUPPLIES

Equipment used for active and passive soil vapor sampling may include:

Beacon Sampling:

- Passive soil-gas samplers
- Extra transport vials
- Sampling caps (in containers)
- Cap storage containers
- Tapping dowels
- 12” lengths of metal pipe
- Wire cutters
- Gauze cloths
- Pipe cutter
- Scratch Awl
- Vise grips

AGI® Sampling:

- Universal AGI® samplers
- AGI® sampler installation device (string and cork with attached screw eye hook)
- Rotary hammer drill/bit (¾-inch diameter by 36-inch)

SUMMA® Canister Sampling:

- 1-liter SUMMA® canisters
- Flow controller
- OEM® hand vacuum pump
- SKC air sampling pump
- Tedlar bags
- Assembly kit from lab (with valves, tubing, fittings)
- Multi-gas detector helium meter
- Helium gas
- Helium shroud (with four holes drilled)
- Miscellaneous fittings (Luer locks, rubber grommets)
- 3/8-inch and 1/8-inch outer diameter (OD) Teflon-lined tubing
- Flexible tubing of different sizes
- Tube cutters
- Threaded brass, stainless steel, or plastic fittings (e.g., Fip to Mip Street Elbow)
- Two-way brass, stainless steel, or plastic valve

- Brass, stainless steel, or plastic T-valves
- Modeling clay for sealant

Universal Equipment:

- Dry erase board with marker
- Site-Specific APP/Site Safety and Health Plan (SSHP)
- Sampling SOP
- Maps
- Field logbook and Field Sample Data Sheets
- Indelible pen
- Chain of custody
- PPE appropriate to the hazard level
- Aluminum foil to seal borings installed in soil

6.0 PROCEDURES

6.1 Office Preparation and Mobilization

The week prior to field work, appropriate project documents will be reviewed by the sampling team including the Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), SOPs, APP/SSHP, Work Plan, etc. Prior to mobilization, any necessary site access must be obtained, and the sampler shall ensure that all equipment and supplies required for the field effort are on-hand (or en route), are operational, and are appropriate for the intended tasks. During preparation and mobilization, supplies and equipment should be kept away from potential sources of contamination.

6.2 Field Procedures for Passive Sampling

A soil vapor investigation can utilize passive sampling techniques as a means of testing for vadose zone impacts. The scope of work will include the installation, equilibration, retrieval, and analysis of the passive samplers. The location of the soil vapor samples will be determined based on land use considerations and a review of historical documents.

The passive samplers will be installed in accordance with either Beacon Environmental's Instructions for Passive Soil Gas Sampler Deployment, Retrieval and Return or AGI's Storage, Installation, and Retrieval Guidelines for Indoor, Outdoor, and Crawlspace Air Sampling using the AGI® Universal Sampler. In order to maximize efficiency, multiple samplers may be installed under a single mobilization.

The samplers are shipped under standard chain-of-custody protocols and analyzed by either GC/MSD by EPA Method 8260C or Modified SW-846 Method 8260M. Shipment of samples is detailed in Bluestone's SOP Number 13 – *Sample Packing and Shipping*.

6.2.1 Field Procedures for Active Sampling using Beacon Field Kits

The following procedure will be used when deploying Beacon samplers:

1. At each survey point, clear vegetation as necessary and, using a hammer drill and drill bit, create a 1¼”- to 1½”-diameter hole approximately 12 inches deep. Then, using the ½” drill bit, extend the hole to a three-foot depth.

2. When the holes have been drilled, take a 12-inch length of 1”-diameter metal pipe and lower it into the sample hole, being careful not to touch the inside of the pipe. Any portion of pipe above grade is cut flush with the ground surface, using the pipe cutter. With the tapping dowel and a hammer, push or tap the pipe one inch into the base of the drilled hole.

3. Remove one of the Beacon Samplers and unwind the retrieval wire wrapped around it. Holding the capped end of the vial in one hand, pull the wire tight with the other hand. Remove the solid cap on the Sampler Vial and replace it with a Sampling Cap. Place the solid cap in the Field Kit.

4. Lower the Sampler, open-end down, into the metal pipe approximately four inches so that the retrieval wire sticks out of the hole. Cover the open end of the pipe with a ball of aluminum foil, pressing it tightly on top of the pipe with the tapping dowel. Next, cover the hole to grade with local soils or sand, leaving the end of the wire exposed above the surface of the ground. Using the hammer, collapse the soils above the Sampler. Coil the wire and lay it flat on the ground surface. Place the solid cap in the Cap Storage Container. Clearly mark the sample location with a pin flag or wooden stake.

5. Close the Field Kit, and on the Field Deployment Report record:

    a. Sample-point number;

    b. Date/time of emplacement (to nearest minute); and

    c. Other relevant information (e.g., soil type, vegetation, proximity to potential source areas). Mark the sample location and take detailed notes (i.e., compass bearings and distances from fixed reference points).

The following procedure will be used to collect the Beacon samplers:

1. At each sample location, open the Field Kit and place it and the wire cutters within easy reach. Remove a square of gauze cloth and place it and a clean towel on the open Kit. Remove a solid cap from the Cap Storage Container and place it on the Kit, also.

2. Remove the aluminum foil plug, using vise grips and the scratch awl, if necessary, and retrieve the Sampler from the hole.

3. Holding the Sampler upright, clean the sides of the vial with the clean towel. Remove the Sampling Cap, cut the wire from the vial with the wire cutters, and clean the vial threads completely with the gauze cloth.

4. Firmly screw the solid cap on the Sampler Vial and clean the vial completely with the gauze cloth. With a ballpoint pen record the sample number, corresponding to the sample location, on the cap’s label. Note: Do not use a Sharpie marker.

5. Return the sampling cap to the Sampling Cap container. Place the sealed and labeled Sampler Vial in the smaller 3" x 4" plastic Sampler Bag. Then place the individually bagged and labeled sampler into the larger bag labeled "Return Shipment Bag."
6. On the Field Deployment Report, record:
    a. Date and time of retrieval (to nearest minute); and
    b. Any other relevant information.

6.2.2 Field Procedures for Active Sampling using AGI®

Pilot holes for sampler installations can be created using a rotary hammer drill with a ¾-inch diameter by 36-inch drill bit. The AGI samplers are inserted to a depth of approximately 3 feet below ground surface (ft bgs) utilizing string and a cork with attached screen eye hook to facilitate their retrieval in 7 to 10 days. It is recommended that sampler spacing be kept between 25 and 75 ft, with many surveys utilizing a 50-ft sample spacing. A smaller sample spacing is recommended when the objective of sampling is to identify specific source areas. When the sampler is removed, the hole may be backfilled with the original soil.

6.3 Field Procedures for Active Sampling using SUMMA® Canisters

Prior to sampling at each sub-slab sampling port, a shut-in check and leak test will be performed to ensure the sample assembly and sub-slab sampling port are free of leaks. The following procedure will be used to perform the shut-in check:

1. Attach the vacuum pump to the assembly kit which is attached to the SUMMA® canister.
2. Verify the canister valve is closed and close the 1- and 3-way stopcocks to the atmosphere.
3. Activate the vacuum pump until the gauge shows a minimum of -10 inches of mercury (inHg) pressure. If the pressure drops more than 0.5-inch within one minute, check the connections and repeat the test.
4. After the shut-in check passes, purge the line by opening the valves and attaching the helium detector (run for one minute or three volumes; note, methane in the soil vapor can cause a spike).
5. Record any helium concentrations from the detector.

The following procedure will be used to perform the helium leak test:

1. Position the canister, tubing, and shroud.
2. Fill the shroud 20% by volume with helium gas.
3. Attach the helium detector to the sample assembly line. If measured gas is greater than 10% of the concentration under the shroud, a leak is occurring.
4. Check connections, seal the port with modeling clay if needed, and re-run the test.
5. Record any helium concentrations from the detector.

Once the leak test has passed, the following procedure will be used to collect sub-slab soil vapor:

1. Open the stainless-steel SUMMA® canister valve to collect a 15-minute to one-hour sub-slab soil vapor sample. Sample collection rates may vary per project requirements.
2. Ensure that the starting pressure is approximately -30 inHg or no more than 10% of the laboratory's stated reading. *If pressure loss is greater than 10%, the canister should not be used.* Record the initial vacuum on the Field Sample Data Sheet.
3. After the 15-minutes to one hour sample collection time, complete sample collection by closing the regulator on the SUMMA® canister. The regulator should read approximately between -5 and -8 inHg but no less than 0 inHg. Record the residual vacuum on the Field Sample Data Sheet.
4. Disconnect setup.
5. Remove the regulator from the SUMMA® canister and attach the plastic cap.
6. Complete the chain of custody from the laboratory and make sure the Field Sample Data Sheet is complete.
7. Place cap on vapor probe.

Duplicate samples will be collected by adding an additional "T" fitting to the end where the Summa canister would be connected. This allows for the SUMMA® canister and the duplicate canister to receive the same soil vapor and collect a representative duplicate sample.

7.0 DATA AND RECORDS MANAGEMENT

Bluestone's SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be specified in the site-specific Work Plan. Bluestone will review the field notes and other project-specific field data (such as field analyses completed) on a daily basis. Discrepancies and/or omissions will be addressed as soon as possible, preferably the same day. Hard copies of field forms will be backed up electronically at the end of each workday.

8.0 COMMUNICATION AND TECHNICAL DIRECTION

Field personnel will support one another and maintain open communication during all aspects of the field activities. When a technical point is in question, field personnel should communicate with the Project Manager (PM) or technical lead for clarification and/or additional direction. Deviations, exceptions, and/or omissions from the project work plan or generally accepted practice should be communicated to the project manager as soon as possible. Maintain records of all communications in a field logbook detailing the issue, the outcome, and individuals involved in the decision. All issues will be reported to the client and reported in the indoor air reports.

9.0 DEMOBILIZATION

The field team is responsible for ensuring that all required data has been collected and that the site is secured before demobilization. Ensure that all instruments and equipment are accounted for and either stowed for future use or transported to the appropriate location.

10.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel will read and acknowledge the site-specific Work Plan, UFP-QAPP, and any applicable SOPs.

11.0 REFERENCES

AGI, 2022. General Guidelines for Survey Design and Sample Spacing Soil Gas and Sub-slab Soil Gas Sampling.

Beacon, 2021. Instructions for PSG Sampler Deployment, Retrieval and Return to Beacon Environmental.

Standard Operating Procedure Number 35
NOISE AND HEARING CONSERVATION

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone), to document the appropriate methods and best management practices for protecting personnel who may be exposed to excessive noise (noise in excess of 85 decibels [dB]), measured using an A-weighted scale (dBa), as an 8-hour time-weighted average (TWA). The purpose of this program is to protect employees from noise induced hearing loss and meet Occupational Safety and Health Administration (OSHA) requirements. The following guidelines have been established in compliance with OSHA 29 Code of Federal Regulations (CFR) 1910.95. Implementation of this SOP is the responsibility of the Bluestone Project Manager directing activities of the facility, site, or project location.

2.0 PERSONNEL QUALIFICATIONS

All Bluestone field personnel must complete the Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training course and maintain the required 8-Hour annual refresher courses. Field personnel will complete a minimum of 40 hours of field training prior to working independently on environmental sites. In addition, the site safety and health officer (SSHO) must be certified in first aid and cardiopulmonary resuscitation (CPR).

3.0 HEALTH AND SAFETY REQUIREMENTS

Field activities detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements. Additional specifications are provided below:

A. General

1. Employees will be trained in the use and proper fitting procedures for all hearing protection made available to them by Bluestone.
2. Where employees are exposed to an 8-hour TWA of 85 dBa or above, all feasible administration and/or administrative controls shall be used to reduce these levels. Hearing protection shall be used under the following circumstances:
    a. While engineering and/or administrative controls are being evaluated or installed.
    b. Where engineering and/or administrative controls are found not to be feasible.
3. Hearing protection shall meet the following guidelines:
    a. Hearing protection shall attenuate each employee's exposure below an 85 dBa, 8-hr TWA.

b. Evaluation of hearing protection shall be completed by converting the A-weighted dose to TWA, subtracting 7 from the Noise Reduction Rating (NRR), then subtracting this number from the TWA to obtain the estimated A-weighted TWA under the hearing protection.

B. Noise Controls

Eliminate noise sources to the extent possible. Examples of controls that shall be considered include:

1. Adding or replacing mufflers on motorized equipment.
2. Following equipment maintenance procedures to lubricate dry bearings and replace worn or broken components.
3. Isolating loud equipment with barriers.
4. Replacing loud equipment with newer and quieter models.
5. Using caution signs and Hearing Protection Required signs to designate noisy work areas.

C. Audiometric Exams

Any person meeting the requirements described in 29 CFR 1910.95(g)(3) will be entered into an audiometric medical surveillance program. A baseline will be established within six months of the employee's first exposure. Testing to establish a baseline audiogram will be preceded by 14 hours without exposure to noise. Hearing protectors may be used as a substitute for the requirement that a baseline audiogram will be preceded by 14 hours without exposure to workplace noise. The medical surveillance provider will notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

For multi-year projects, an annual audiogram will be obtained for each employee exposed at or above an 8-hour TWA of 85 dBa. Once in the monitoring program, each employee's annual audiogram will be compared to that employee's baseline audiogram to determine if the audiogram is valid, and if there is a standard threshold shift (STS). An STS is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 hertz (Hz) in either ear. If the annual audiogram shows that an employee has suffered an STS, the employer will obtain a retest within 30 days, and consider the results in assessing an STS as the annual audiogram. The audiologist, otolaryngologist, or physician will review problem audiograms, and will determine whether there is a need for further evaluation. If an STS has occurred, the medical surveillance provider will notify the employee within 21 days of the determination.

D. Standard Threshold Shifts

If an employee's test results show a confirmed STS, their hearing protection will be evaluated and refitted, and a medical examination will be required.

E. Training

Employees who must work in a noisy environment will be provided with Hearing Conservation training. Training shall include the following:

1. The effects of noise on hearing
2. The purpose of hearing protectors
3. The advantages and disadvantages of various types of hearing protectors
4. The attenuation of various types of hearing protection
5. The selection, fitting, care, and use of hearing protectors
6. The purpose of audiometric testing
7. An explanation of the audiometric testing procedure

4.0 DATA COLLECTION AND MANAGEMENT

Noise surveys will be conducted using a decibel meter at 10, 30, and 50 feet from the source at the start of work, and at each location around the site. Additional survey distances may be necessary in sensitive areas (residential, commercial areas, etc.), and will be conducted at the discretion of the Bluestone Project Manager. Hearing protection for all personnel will be appropriate to the level of noise documented at the source.

Manual data collected during noise surveys (decibels and distance from source) will be recorded in the field logbook and on field data sheets, as necessary. Bluestone SOP Number 06 – *Field Documentation* details the methods for data collection and management, and additional information will be included in the site-specific Work Plan. In addition, training records will be updated as necessary, and copies for all Bluestone personnel will be included in project safety documents.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the site-specific Work Plan, Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), and all applicable SOPs.

6.0 RESOURCES

- U.S. OSHA Standard - Occupational Noise Exposure - 29 CFR 1910.95
- U.S. OSHA Construction Standard - Occupational Noise Exposure - 29 CFR 1926.52 and 1926.101
- U.S. MSHA - Occupational Noise Exposure 30 CFR 62
- U.S. FRA - Occupational Noise Exposure 49 CFR 227
- U.S. OSHA Technical Links - Noise and Hearing Conservation
- American Industrial Hygiene Association: Protect Yourself from Noise - Induced Hearing Loss
- National Hearing Conservation Association website

Standard Operating Procedure Number 36
VEHICLE AND TRAFFIC SAFETY

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone), to document the policies and regulations applicable to personnel who operate motor vehicles that are owned, rented, or leased by Bluestone and to employees who use personal vehicles while conducting Bluestone business. This SOP defines the policies that minimize losses, injury, and legal liabilities associated with improper vehicle use. In addition, this policy provides information for required training and makes all applicable employees aware of their respective duties and obligations when driving on Bluestone business. Implementation of this SOP is the responsibility of the Bluestone Project Manager directing activities of the facility, site, or project location.

2.0 HEALTH AND SAFETY REQUIREMENTS

Field activities detailed in this SOP will be performed in accordance with the project Accident Prevention Plan (APP) and/or Site Safety and Health Plan (SSHP), the Bluestone Corporate Safety and Health Program, and site and/or client-specific requirements.

3.0 VEHICLE OPERATION REQUIREMENTS

A. Authorized Drivers

1. Authorized drivers are those individuals permitted to drive Bluestone-owned, -rented, or -leased vehicles, client vehicles, and employees driving a personal vehicle for work purposes.
2. The Authorized Driver must be at least 18 years of age (noncommercial license) or 21 years of age (commercial license) and have a current driver's license for the appropriate class of vehicle (unless more stringent requirements are established by the leasing/renting agency).

Bluestone will conduct an authorized background check, which includes a driving record, and will obtain a copy of the state-issued driver's license for all Authorized Drivers during the new hire process. The employee will not be permitted to be an Authorized Driver if the background check indicates legal action involving alcohol or drug use (e.g., driving under the influence [DUI]), a driving without a license violation, or a hit-and-run/leaving the scene of an accident within the past two years.

Bluestone employees that are Authorized Drivers will produce their driver's license upon request at any time. Authorized drivers that lose their driver's license through legal action or are otherwise unauthorized to drive must notify Bluestone’s President immediately.

B. Authorized drivers must:

1. Report any conviction for driving under the influence of drugs or alcohol to the Bluestone President.

2. Report all incidents.
3. Cooperate with Bluestone investigation concerning the incident.

C. General Operating Policy and Procedure (Applies to Authorized Drivers and Passengers Operating Motor Vehicles on Official Bluestone Business):

1. Only properly licensed employees who are specifically authorized to drive Bluestone vehicles may operate motor vehicles owned, rented, or leased by Bluestone.
2. The use of cellular phone/devices while driving is prohibited. If you need to make a call on a cellular phone, pull over and park in a safe area. This prohibition includes text messaging and other wireless devices.
3. Drivers/operators will know and obey all federal, state, and local motor vehicle laws applicable to the operation of their vehicle.
4. A driver will not permit unauthorized persons to operate a vehicle owned, rented, or leased by Bluestone.
5. Only Authorized Drivers may be reimbursed mileage for the use of a personal vehicle on Bluestone business.
6. Personal vehicles driven by Authorized Drivers for business use must satisfy the state's registration and inspection requirements and may not be modified beyond manufacturer's specifications.
7. All cargo extending four feet or more beyond the end of a truck, trailer, or similar vehicle will be clearly marked with a red warning flag or cloth measuring no less than 16 inches square. Red lights must be used at night.
8. Bluestone-owned, -rented, or -leased vehicles are for official business use only and are not to be used for personal activities. Exceptions to this requirement can be made only with the specific approval of the Bluestone President.
9. Seat belts and shoulder harnesses (occupant restraint systems) will be worn or used whenever the vehicle is in operation. The vehicle may not move until all passengers have fastened their restraints.
10. When parking or leaving a vehicle, the following procedures must be followed: Shut off the engine, engage the transmission in park (automatic transmission) or first gear (standard transmission), set the parking brake, remove the ignition keys, and lock the vehicle.
11. The vehicle's engine is to be turned off during refueling. Smoking or cellular phone use is not allowed while refueling.
12. Drivers/operators will not drive or operate vehicles while under the influence of alcohol or illegal drugs.
13. Drivers/operators will not drive or operate vehicles while under the influence of medications when told by a physician, another healthcare provider, or the

manufacturer (i.e., instructions on the label) that the activity is unsafe.

14. Vehicle operators are responsible for any fines levied by law enforcement agencies for the operation of their vehicles.
15. Driver/operators may not deactivate or muffle any backup warning device.
16. Distractions while driving are a major cause of incidents. Distractions include the use of cellular phones (including texting), eating, drinking, smoking, and engaging in intense conversations. Bluestone Authorized Drivers must exercise proper control of the vehicle at all times, including the management of possibly distracting actions and behaviors. If you have to eat, pull over and park. If you become engaged in an intense conversation to the point of distraction, pull over and park or end the conversation.
17. The use of motorcycles on Bluestone business is prohibited.

D. Field/Site Vehicle Safety

1. Define specific vehicle travel routes and parking areas at field sites. Use fencing, cones, or other markings to define roads and parking.
2. If parking on the shoulder of an active road, park as far off the road as possible.
3. If work is required alongside an active road, park the vehicle behind the area of work to provide a barrier against out-of-control vehicles.
4. Bluestone will not transport DOT-placard quantities of hazardous materials. However, small quantities of hazardous materials (e.g., sample coolers) may be transported if properly packaged. Take precautions to prevent chemical contamination of the vehicle.
5. No employee may ride in the bed of a pickup truck unless seating and restraints are provided for this specific use.
6. Articles, tools, equipment, etc. placed in vehicles will be stored so as not to interfere with vision or the proper operation of the vehicle in any way. All items in the vehicle must be secured to prevent them from flying about or out of the vehicle during sudden stops, turning, etc. Company equipment shall be removed from the vehicle when parking overnight, unless parked in a secure area.

E. Incident Response and Reporting

1. In case of injury, call or have someone else call 9-1-1 immediately for emergency assistance. If you are involved in an incident and are not injured, the following requirements apply:
    a. Protect the scene.
    b. Do not admit liability or place any blame for the incident.
    c. Provide only your name, address, driver's license number, and

vehicle insurance information.

d. Obtain the following information:

1. Name(s), addresses, and telephone number(s) of the owner(s).
2. Name(s) of the driver and any occupants of other vehicle(s).
3. The owner's insurance company.
4. Driver's license number.
5. Year, make, model, and license number of the vehicle(s).
6. Name(s) and addresses of any witnesses.

2. **DO NOT**:

a. Make any admissions of guilt or culpability.

b. Call the insurance company unless the incident involves your personal vehicle.

c. Give a statement to the press.

d. Give a signed statement to the claims adjuster representing the other driver's insurance company.

3. Notifications

All incidents with a Bluestone-owned, -rented, or -leased vehicle or client vehicle or with a personally owned vehicle used for business must be reported to the Bluestone President within 24 hours of the incident. Traffic violations received while operating a Bluestone-owned, -rented, or -leased vehicle or with a personally owned vehicle used for business must be reported to the Bluestone President within 24 hours of the violation.

F. Incident Review

1. A violation of this vehicle safety SOP is subject to disciplinary action, including termination.
2. Bluestone may suspend the privilege to operate vehicles on Bluestone business because of noncompliance with the Bluestone Vehicle Safety Program, involvement in a motor vehicle incident, or resulting citations or other legal actions associated with motor vehicle violations. Personnel authorized to suspend an employee's status as an Authorized Driver include the following:

a. A Project Manager with responsibility for dedicated vehicles on a site. The suspension is applicable to those site vehicles only.

b. The Bluestone President.

3. The employee's driving privileges will be suspended for any of the following:

a. Accidents or legal action involving alcohol or drug use (e.g., DUI).

b. Driving without a license.

c. Hit-and-run driving or leaving the scene of an accident.

d. Unauthorized use of Bluestone vehicles (i.e., using a Bluestone vehicle for moving personal items, carrying passengers who are not associated with work activities, etc.).

4. The employee's driving privileges may be suspended for any of the following:

    a. Two or more at-fault accidents involving the same Authorized Driver within a 12-month period.

    b. Multiple complaints from other employees or members of the public about driving performance.

    c. Any accident caused by a Bluestone Authorized Driver where damages exceed $2,000.

    d. Failure to comply with the cellular phone use policy.

    e. Gross misconduct or violation of policy.

5. An Authorized Driver’s driving privileges may be reinstated as follows:

    a. For any suspension resulting from law enforcement agency legal action involving drugs and alcohol on the part of the former Authorized Driver, driving privileges may be reinstated only by concurrent agreement from the Bluestone President.

    b. For those Authorized Driver’s privilege suspensions that are not related to driving under the influence of drugs or alcohol, privileges may be reinstated with concurrent agreement by the Bluestone President.

6. Disciplinary action may include the following:

    a. Loss of Bluestone driving privileges.

    b. Additional driver safety training.

    c. Disciplinary warning.

    d. Termination.

G. Inspection

1. The driver is responsible for inspecting the vehicle prior to use and not driving a vehicle with obvious safety defects.

2. Basic safety checks must include the following:

    a. Tire condition/pressure.

    b. Lights/turn signals.

    c. A clean windshield and adequate window washer fluid.

d. Gauges/warning lights indicating a normal condition.

e. Mirrors properly adjusted.

f. Brakes with adequate pedal pressure for proper braking.

3. Any defects must be reported to the Project Manager.

H. Vehicle Maintenance

1. The Office Administrator (or designee) is to ensure that all vehicles owned or leased by Bluestone are properly maintained.
2. Routine maintenance must be performed in accordance with the schedule provided in the owner's manual stored in the vehicle.
3. Reported defects/problems with vehicles must be repaired promptly.

4.0 DOCUMENTATION SUMMARY

The following documentation will be maintained in the Bluestone office and/or project file:

1. Auto Claim Reports.
2. Vehicle inspections for company-owned vehicles.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Prior to the start of any field activity, Bluestone personnel must read and acknowledge the site-specific Work Plan, Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), and all applicable SOPs.

6.0 RESOURCES

- National Safety Council, Information on Defensive Driving Courses http://www.nsc.org/psg/ddc.htm
- AAA Foundation for Traffic Safety http://www.aaafts.org/
- Smith Driving System http://smith-system.com/

Standard Operating Procedure Number 37
USE OF PORTABLE GAS MONITORS/DETECTORS

1.0 INTRODUCTION AND PURPOSE

This Standard Operating Procedure (SOP) has been prepared by Bluestone Environmental Group, Inc. (Bluestone) to describe the use of portable gas monitors and detectors. When facing unknown environmental hazards invisible to the body's senses, a gas detector is the first line of defense for worker safety. Portable gas detectors are integral components mandated by Bluestone as part of their individual personal protective equipment (PPE) designed to keep them safe in unknown environments. Personal four-gas monitors or detectors continuously evaluate a worker's environment for multiple gas hazards. They can provide an alarm at the real-time action level concentration, short-term exposure limit (STEL) or time-weighted average (TWA) for the monitored substance. Toxic gases are often fast acting and, depending on the concentration, can impact systems within the body very quickly or can pose a longer-term health risk. Oxygen, volatile organic compounds, carbon monoxide and hydrogen sulfide are the four prominent gases Bluestone will monitor with a multi-gas detector system when required by the site-specific Work Plan or Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), or when site conditions indicate their potential presence, for example during intrusive operations. Additional gas detector systems may be warranted based on initial findings from site inspection or pre-planning meetings.

2.0 AIR MONITORING

Organic vapor and/or concentrations are monitored in the field with a photoionization detector (PID). Flammable vapors and/or toxic gasses are monitored with an electrochemical (EC) oxygen sensor connected to a real-time instrument. If required by site conditions, air monitoring results will be documented in the field logbook or on a field sheet such as the Real Time Aerosol Monitoring Log, attached.

Read and understand the owner's manual before operations. Conduct the initial calibration and any re-calibration or maintenance in accordance with the manufacturer's specifications. Document and annotate calibration and any maintenance into the field logbook or on calibration log field sheets.

Air monitoring action levels (see Table 1) have been developed that stipulate the chemical concentrations in the breathing zone that require an upgrade in level of PPE. Action levels are typically set at one-half of the OSHA Permissible Exposure Limit (PEL), National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (REL), or the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) based on manufacturer's directive. The rationale for establishing action levels is based on the available data that characterizes contaminants of concern (COCs) in soil or water.

Air monitoring measurements will be taken in the breathing zone of the worker most likely to have the highest exposure. Transient peaks will not automatically trigger action but will be annotated in the logbook or field sheet. Action will be taken when levels are consistently exceeded the setpoint action level or the designated 15-minute STEL setting. Similarly, if chemical odors are detected that are a nuisance, bothersome, or irritating, contact the SSHO,

Project Manager (PM), and Corporate Health and Safety Manager.

3.0 AIR MONITORING FREQUENCY GUIDELINES

Conduct background readings of the four prominent gases before work begins. Continue to conduct incremental air monitoring as required by the site conditions.

Conduct incremental surface air monitoring when:

- There is an indication that exposures may have risen over established action levels, permissible exposure limits, or published exposure levels since the last monitoring.
- There is a change in site area – work begins on a different section of the site.
- There is a change in contaminants – handling contaminants other than those first identified.
- Visible signs of particulate exposure from intrusive activities such as drilling/boring and excavation are observed.
- Perceptible chemical odors or symptoms of exposure are observed.
- There is a change in on-site activity – one operation ends, and another begins.
- Handling leaking drums or containers.
- Working with obvious liquid contamination (e.g., a spill or lagoon).
- The possibility of volatilization exists (such as with new monitoring well or a well containing known product).

4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE requirements are discussed in the Site Safety and Health Plan (SSHP). Air movers or other engineering controls that exhaust or dilute solvent vapors emanating from monitoring wells or present when conducting intrusive activities can be used to down-grade PPE requirements.

4.1 Respiratory Protection

Air purifying respiratory protection may be needed for protection against dust and organic vapors during the project. Pre-planning is mandated so that designated Bluestone employees can be enrolled into the Bluestone Respiratory Protection Program. The need for respiratory protection will be determined during the development of the SSHP and/or Accident Prevention Plan (APP) for the project, or during any planning meetings. If the need for additional respiratory protection is determined, elevation to an EPA Level C PPE standard will be initiated with site-specific instruction. Engineering controls and administrative controls must always first be evaluated for use as the primary controls for protection against site respiratory hazards prior to the elevation to EPA Level C. In the event engineering controls and administrative controls are deemed to not be feasible, respiratory protection will be required and the site workers will contact Bluestone's Corporate Safety and Health Manager to clarify enrollment status in the respiratory protection program.

Table 1 – Monitoring Criteria

Instrument	Function	Measurement	PPE Level / Action
PID (10.6 eV lamp)	Measures Total Organic Vapors Always take a background reading before the startup of activities and periodically thereafter.	0 – 5 ppm	Level D
		5 – 10 ppm	Modified Level D
		10 – 25 ppm	Upgrade to Level C. Coordinate with SSHO, PM, and Corporate H&S for guidance.
		>25 ppm	Stop work required. Leave work area, contact SSHO, PM, and Corporate H&S for guidance.
Oxygen/ Combustimeter (O_2/LEL)	Measure oxygen level (O_2) and lower explosive limit (LEL) Conduct air monitoring for O_2/LEL when conditions exist where flammable vapors/gases and/or oxygen deficiency or enrichment can occur.	O_2 >22 %	Leave area immediately; this atmosphere is extremely flammable. Notify SSHO, PM, and Corporate H&S for guidance.
		O_2 >20.9 % – 22 %	Verify reasons for O_2 enrichment before entering area. Utilize appropriate engineering controls/PPE to control O_2 enriched atmosphere.
		O_2 = 20.9 %	Acceptable
		O_2 >19.5% – 20.8%	Verify reasons for O_2 depletion with appropriate air monitoring instrumentation before work continues. Utilize appropriate engineering controls/PPE once atmospheric contaminants have been verified.
		O_2 <19.5%	Implement engineering controls. Contact SSHO, PM, and Corporate H&S for guidance.
		LEL <5%	Acceptable conditions. Continue normal activity.
		LEL >5%	Leave area immediately. Contact SSHO, PM, and Corporate H&S for guidance on venting and other safety measures.
CO – Carbon Monoxide	Electrochemical gas sensor measures concentration	Action Level – 20 ppm Low Alarm – 25 ppm High Alarm – 100 ppm STEL – 100 ppm TWA – 25 ppm	Workers are to evacuate the area when elevated levels of CO are detected in the breathing zone for a minimum of 30 seconds or per manufactures recommendations to ensure reliable readings. Action Level – Gas is detected above background or elevated concentration. Annotate site and levels in logbook. Low Alarm – Move away from location. Contact PM. STEL / TWA – Stop work required. Leave work area, contact SSHO, PM, and Corporate H&S for guidance.

Instrument	Function	Measurement	PPE Level / Action
H_2S – Hydrogen Sulfide	Electrochemical gas sensor measures concentration	Action Level – 5 ppm Low Alarm – 10 ppm High Alarm – 15 ppm STEL – 15 ppm TWA – 10 ppm	Workers are to evacuate the area when elevated levels of H_2S are detected in the breathing zone for a minimum of 30 seconds or per manufactures recommendations to ensure reliable readings. Action Level – Gas is detected above background or elevated concentration. Annotate site and levels in logbook. Low Alarm – Move away from location. Contact SSHO, PM, and Corporate H&S for guidance. STEL / TWA – Stop work required. Leave work area, contact PM and HSR for guidance.

REAL TIME AEROSOL MONITORING LOG

Project Name_____ Project No._____ Date_____

Sampled By	Instrument Type (Mfg/Model/ Serial No.)	Battery Charged (Y/N)	Zeroed (Y/N)	Sample Time		Sample Readings (mg/m^3)			Comments
				Start	Finish	TWA	Shift Average	Direct	

General Weather Conditions:

_____

_____

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APPENDIX D

Investigation-Derived Waste Management Plan

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INVESTIGATION-DERIVED WASTE (IDW) MANAGEMENT PLAN

FORMER USDA GRAIN BIN CERCLA SITE SCREENING INVESTIGATIONS, IOWA

Contract Number: GS-00F-117DA
Order Number: 12FPC424Q0009

January 2024

Prepared for:

United States Department of Agriculture

Farm Production and Conservation Business Center
Environmental Activities Division
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ACRONYMS AND ABBREVIATIONS

Bluestone	Bluestone Environmental Group, Inc.
CCC	Commodity Credit Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CT	carbon tetrachloride
DOT	Department of Transportation
DPT	Direct Push Technology
IA	Iowa
IDNR	Iowa Department of Natural Resources
IDW	Investigation Derived Waste
MCL	Maximum Contaminant Level
NFA	No Further Action
PID	Photoionization Detector
PPE	Personal Protective Equipment
RCRA	Resource Conservation and Recovery Act
SOP	Standard Operating Procedure
TSCA	Toxic Substances Control Act
UN	United Nations
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency

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1.0 INTRODUCTION

The United States Department of Agriculture (USDA) Commodity Credit Corporation (CCC) operated a large-scale grain storage program from the years 1933 until 1972. The program operated on leased properties in Missouri, Nebraska, Kansas, and Iowa. Grain was stored on these properties for extended periods of time due to high grain production and limited commercial storage facilities.

While stored, the grain was fumigated to control destructive insects. The USDA treated the grain with fumigant mixtures consisting of 80% carbon tetrachloride (CT) and 20% carbon disulfide. According to United States Environmental Protection Agency (USEPA) documents, the liquid fumigant was pumped or dumped onto the top of the grain bins and allowed to flow through the grain and evaporate, fumigating insects and other organisms. CT has been detected in soil and groundwater near former grain storage sites by state regulators and identified to potentially pose a risk to human health or the environment. Around 433 sites have been identified for further investigation in Missouri, Nebraska, Kansas, and Iowa.

The Iowa Department of Natural Resources (IDNR) and the CCC/USDA are proposing to conduct groundwater sampling at several sites to confirm the presence or absence of contamination in the shallow groundwater underlying the former facilities and determine whether the site needs further investigation or can be reclassified to 'No Further Action' (NFA).

Bluestone Environmental Group, Inc. (Bluestone) has been contracted by the USDA under Contract/Order Number: GS-00F-117DA/12FPC424Q0009, to conduct site investigations at the following 11 former grain storage sites in Iowa (IA):

- Burchinal Former Grain Storage Site (IA-615).
- Cartersville Northeast Former Grain Storage Site (IA-617).
- Curlew South Former Grain Storage Site (IA-627).
- Denhart South Former Grain Storage Site (IA-633).
- Hanna Former Grain Storage Site (IA-657).
- Hurley Former Grain Storage Site (IA-688).
- Irvington Former Grain Storage Site (IA-672).
- Langdon Former Grain Storage Site (IA-678).
- Plessis Former Grain Storage Site (IA-717).
- Portland Former Grain Storage Site (IA-718).
- Rockwell Former Grain Storage Site (IA-724).

Site Investigations consist of the collection of groundwater samples. This Investigation Derived Waste (IDW) Management Plan has been prepared by Bluestone for management of IDW produced during sampling activities and addresses anticipated types and quantities of IDW, waste minimization techniques and responsibilities, segregation and storage (containment), characterization and manifesting, as well as staging and removal (disposal) of IDW.

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2.0 IDW MANAGEMENT

IDW containment, characterization, and disposal will be in accordance with this IDW Work Plan and USDA Standard Operating Procedure (SOP) AGEM-11 Handling and Disposal of Investigation-Derived Waste Procedures, as well as IDNR, Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and other local, state, and federal regulation in the handling and disposal of IDW.

2.1 FIELD INVESTIGATION

Sampling will be conducted in accordance with procedures in the Bluestone Site Specific Work Plans, Umbrella Work Plan (Argonne, 2021), and USDA SOPs provided from the Master Work Plan (Argonne, 2019). All sampling will be performed in accordance with the following SOPs described in the Master Work Plan:

- AGEM-01 Direct Push, Drilling, and Geologic Logging
- AGEM-11 Handling and Disposal of IDW
- AGEM-21 Calibration of Field Instrumentation and Photoionization Detector (PID) Operation
- AGEM-22 Equipment Decontamination
- AGEM-23 Handling, Packing, and Shipping of Samples in the Field

Sampling of the sites will include installing soil borings, sampling of groundwater and/or soil media at new shallow locations and potentially existing private or public water wells within a two-mile radius of the former silos, and potential soil gas sampling. Groundwater sampling locations will be advanced using Direct Push Technology (DPT). Soil gas locations will be advanced using a Geoprobe Post-Run Tubing sampler. Bluestone will collect up to six groundwater samples at each site. In the event that groundwater is not encountered prior to the bedrock interface, up to two soil samples will be collected.

A single decontamination pad will be constructed at the site. The pad will be constructed using waterproof, heavy-duty materials (i.e., geotextile fabric, crushed stone gravel) for the containment of decontamination fluids. The pad will be constructed so that fluids pooled at the bottom may be pumped into 55-gallon drums. Heavy equipment with direct contact with potentially impacted soil or groundwater will be decontaminated by the subcontractor between all drilling and/or sampling locations. Drilling equipment will be cleaned between sampling locations. Bluestone will inspect and approve each piece of equipment before subsequent use.

Whenever possible, Bluestone will use single-use, disposable Personal Protective Equipment (PPE) and other equipment during work activities in an effort to reduce the amount of decontamination required. Bluestone will collect expended PPE in plastic trash bags and disposed of as municipal solid waste given that any contamination would be residual and not be regulated by RCRA or Toxic Substances Control Act (TSCA).

2.2 TYPES OF IDW

Bluestone assumes that aqueous and solid IDW will be produced during the site investigation activities and containerized in 55-gallon drums. Solid IDW is expected to be produced from the excess soil from the soil borings. Purge water is not expected to be produced since the objective is to collect the first groundwater

encountered in the vadose zone for analysis. Therefore, water from decontamination procedures is the only aqueous IDW expected during the sampling conducted.

2.3 IDW CONTAINERIZATION

Containerized IDW will be staged in accordance with RCRA, IDNR, CERCLA and all other applicable Federal and State Laws.

United Nations (UN)-approved drums (49 CFR 173.3), polyethylene tanks, and 5-gallon pails may be used to collect liquid IDW, as task appropriate. Liquid IDW collected in 5-gallon pails will be transferred to drums or totes as soon as possible after collection. Hazardous (or suspected) liquid IDW must be containerized in UN-approved drums.

Containers of solid or aqueous IDW will be labeled to indicate the source and nature of the waste material. The following information must be visible on the top or sides of each container: container number(s), facility name, associated monitoring well or borehole ID, date of generation, container contents, estimated quantity, and the client point of contact.

Containers will be marked with two-inch letters and numbers using a waterproof paint pen. A complete inventory of the IDW will be maintained by the Field Team Leader to facilitate identification and tracking of liquid IDW for appropriate disposal. This inventory will document the information listed above, in addition to the location of the container, and initials of the responsible point of contact. The total number of containers of liquid IDW generated will be recorded in the field logbook at the end of each workday. Containers of liquid IDW characterized as hazardous or non-hazardous transported off-site for disposal will be labeled in accordance with applicable State and Federal requirements including, but not limited to, RCRA guidelines, the TSCA, and Department of Transportation (DOT) (40 CFR 171-179).

2.4 IDW STAGING

Containers of IDW will be staged temporarily on site until characterization is complete. Containers of aqueous IDW stored during winter months will be under-filled to allow for expansion during freezing. IDW will be stored in secure areas of the site, where containers are protected from flooding, traffic, and unauthorized access or tampering.

For IDW pending characterization, all containers must be properly sealed and labeled, and may be staged on pallets until characterization is complete. If possible, IDW containers will be secured with temporary chain-link fencing; however, caution tape and/or temporary orange construction fencing may also be used as needed to protect the IDW containers.

Containers of solid and aqueous IDW will be characterized and disposed of accordingly in a timely manner. If liquid-filled containers remain in storage for 30 days or more, the containers must be staged on polyethylene sheeting that is surrounded by a retention berm (i.e., 2x4 lumber), and positioned with enough separation so all sides of the containers can be monitored for leaks.

Bluestone will coordinate with the property owner regarding where to stage the IDW on site and notify USDA of its location. Decontamination water (i.e., drill rod and pump rinsing) will be the sole source of aqueous IDW and will be stored in 55-gallon drums on pallets (as necessary). The 55-gallon drums will be

properly labeled. As stated in AGEM-11, IDW will be staged in a way that minimizes public contact while meeting project needs, and that also considers landowner preferences.

2.5 IDW CHARACTERIZATION

Characterization of the IDW will be determined by laboratory analysis of the potential contaminants of concern (CT and chloroform).

Aqueous IDW will be characterized based on the analytical results of primary groundwater samples (if collected) or water samples collected directly from the aqueous IDW drums (if no primary groundwater samples are collected). All aqueous samples will be analyzed via USEPA Method 524.2.

Solid IDW will be characterized based on the analytical results of primary soil samples (if collected) or soil samples collected directly from the soil IDW drums (if no primary soil samples are collected). All soil samples will be analyzed via USEPA Method 8260B.

The procedures for collecting a sample from aqueous IDW drums, with a known source are listed below:

1. Wearing clean nitrile gloves, remove bung or drum lid and store on plastic sheeting.
2. Dip sample collector/bailer into center of drum and lower the device into the middle section of the drum.
3. Slowly raise the sampling device and decant the appropriate volume into the bottleware.
4. Repeat Steps 3 and 4 until the correct sample volume has been collected. Cap the bottleware between sampling containers.
5. Replace bung or drum lid.
6. Dispose of, or decontaminate, the sampling device.

The procedures for collecting a sample from soil IDW drums, with a known source are listed below:

1. Wearing clean nitrile gloves, remove bung or drum lid and store on plastic sheeting.
2. Using a decontaminated trowel, gently scrape the top portion of the drum contents to one side.
3. Place sample collector into center of drum contents and slowly advance the device into the middle section of the drum to a depth of approximately four inches below the surface.
4. Extract the sampling device and transfer the soil to the sample jar.
5. Repeat Steps 4 and 5 until the correct sample volume has been collected. Cap the bottleware between sampling containers.
6. Replace bung or drum lid.
7. Decontaminate sampling device and dispose of plastic as solid PPE, as needed.

Samples will be shipped to a certified laboratory for laboratory analysis of CT and chloroform via USEPA Method 524.2 (aqueous) and/or USEPA Method 8260B (soil).

2.6 IDW DISPOSAL

If the results of IDW characterization are below EPA Maximum Contaminant Level (MCL) values, the aqueous and/or solid IDW will be discharged or spread on site away from sensitive receptors as permitted by the property owner. If results are above EPA MCL values, the aqueous and/or solid IDW will be taken off site for treatment or disposal at a facility approved by IDNR.

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3.0 REFERENCES

Argonne, 2019. *Environmental Investigations at Former CCC/USDA Facilities: Master Work Plan, Volumes 1 (Main Text) and 2 (Standard Operating Procedures), Argonne National Laboratory, ANL/EVS/AGEM/TR-19-01*, November 2019.

Argonne, 2021. *Umbrella Work Plan: Groundwater Sampling at Former CCC/USDA Grain Storage Sites in Iowa, ANL/EVS/AGEM/TR-20-05, prepared for the Commodity Credit Corporation, US Department of Agriculture, by Argonne National Laboratory.* February 2021.

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APPENDIX E

Bluestone Corporate Health and Safety Policy

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Bluestone

Bluestone Environmental Group Inc.

Corporate Health and Safety Policy

For Compliance With
29 Code of Federal Regulations (CFR) 1910

Revised January 2020

Table of Contents

I. Purpose

This Policy outlines the foundation and philosophy of Bluestone Environmental Group, Inc, Corporate Occupational Safety and Health Management Program. It represents the corporate's commitment to actively promote a comprehensive and effective Occupational Safety and Health Program and provides the foundation for the development and maintenance of the various program components.

II. Policy

Bluestone Environmental Group is dedicated to providing a safe, accident-free, and healthy work environment for employees. Bluestone understands their employee are the most important asset within their organization. Bluestone will make all reasonable efforts to comply with government regulations pertaining to health and safety issues. We will maintain a health and safety program conforming to the best practices of organizations of this type. The program is designed to encourage all employees to promote the safety of their fellow employees. To accomplish our health & safety goals, all Bluestone employees are informed at the time of their hire and after each revision of this policy that they are ultimately responsible for their own safety and accountable for implementing this policy

III. Scope

The objectives and responsibilities set forth in this policy are applicable to all Bluestone Environmental Group, Inc employees and are directed toward providing a comprehensive and effective Occupational Safety and Health Program. Each program is written to be in compliance with Public Law 91-596, the *Occupational Safety and Health Act of 1970*, (DOL, n.d.).

The Owner, Directors, Supervisors and Managers will actively support the Occupational Safety and Health Programs within their respective areas of responsibility and comply with the specified directives and responsibilities. All employees will comply with applicable regulations, guidelines and local policies; perform their duties in the safest possible manner and report hazards, accidents, injuries and illnesses to the appropriate Bluestone Environmental Group, Inc authorities.

IV. Responsibilities

Bluestone Environmental Group, Inc provides engineering consulting services that is identified under the following NAICS Codes (NAICS Association, 2018),

541330 Engineering Services;
541620 Environmental Consulting Services
562910 Remediation Services.

The majority of Bluestone Environmental Group, Inc employees are assigned to permanent locations distant to the corporate office. These employees will then be involved in a multi-employer environment that requires them to become aware of the lead employer's emergency response plan.

We understand that some of our operations are regulated under Occupational Safety and Health Administration (OSHA) General Industry Standards, Title 29 of the Code of Federal Regulations [CFR] Chapter 1910 (DOL - OSHA, n.d.) and several other parts of our operations are regulated under the Construction Industry Standards, Title 29 of the Code of Federal Regulations [CFR] Chapter 1926 (DOL - OSHA, n.d.).

The promotion of safety and health policies, practices and procedures are the responsibility of each member of the Bluestone Environmental Group, Inc. Employees are expected to perform their work in a safe manner and to ensure that they do not place themselves, coworkers, visitors or support services personnel at risk of injury or illness due to unsafe or unhealthful conditions, actions or infractions. When operating a vehicle as part of their assigned duties, employees are expected to wear seatbelts and obey traffic regulations. When representing Bluestone Environmental Group, Inc on official business, employees should ensure that their contributions exhibit safety and health concerns.

A. President:

Provides executive leadership in the development and implementation of occupational safety and health policies, standards and procedures applicable to the company.

B. Site Safety and Health Officials and Project Managers*:*

Provides site-specific leadership, administrative support and training to effectively and efficiently establish and maintain the projected site-specific occupational safety and health procedures.

C. Supervisors (all levels)

Shall ensure and promote safety in the work area under their jurisdiction.

Shall comply with and enforce all applicable occupational safety and health standards, rules, regulations and orders by competent authority pertaining to the activities under their jurisdiction.

Shall ensure that employees are instructed and/or trained in safe practices and methods of job performance as such pertain to their assignments. Ensure that all visitors and support services personnel are appropriately informed about the existence of hazards present and special precautions required to prevent adverse exposure to these hazards. Acquire the knowledge and information needed to recognize and control hazardous conditions in the workplace. Select and employ standard operating procedures that reduce the potential for injury or illness to the lowest practicable level.

Shall ensure that personnel correctly use necessary and/or prescribed personnel protective equipment while conducting work in their designated assigned area of responsibilities.

Shall ensure that employees performing official duties and who become ill or are injured on the job have access to appropriate first aid and/or medical attention.

Shall investigate and report each accident, injury or near-miss event in accordance with established procedures. Initiate within the limit of their authority and capability, such actions that are necessary to correct unsafe or unhealthful working conditions determined to exist and promptly advise management when such conditions require corrective actions beyond their jurisdiction.

Shall review work practices to ensure compliance with such standards, codes, regulations, rules, and orders identified by occupational safety and health personnel as being applicable to the work area concerned.

Shall obtain assistance from the appropriate occupational safety and health personnel on the interpretation and application of specific standards, codes, regulations, or rules.

Shall ensure that employees under their supervision are aware of their responsibilities and follow the appropriate procedures for conducting their work safely.

D. Employees

Shall ensure that employees under their supervision are aware of their responsibilities and follow the appropriate procedures for conducting their work safely.

Must promptly report to their immediate supervisor, and/or appropriate occupational safety and health personnel, any unsafe or unhealthful conditions in the work environment.

Are responsible for ensuring a safe and secure work environment by complying with safety, health and security standards, rules, regulations, orders, practices, and procedures of the Accident Prevention Plan.

Are responsible for using necessary and/or prescribed personal protective equipment (PPE) during performance of work and while in the proximity of the conduct of work with potentially hazardous materials.

Must perform their work in a safe manner and ensure they do not place themselves or others at risk of injury or illness due to unsafe practices. In the performance of all job duties, all employees must ensure their work exhibits the best safety practices and that they have been trained to perform the work safely.

V. Reporting Occupational Safety and Health Concerns

Bluestone Environmental Group, Inc is a company with 20 or more employees but fewer than 250 employees at any time during the previous calendar year, and our establishment

is not classified in an industry listed in Appendix A to Subpart E of Part 1904-Designated Industries for Recording and Reporting Occupational Injuries and Illness, [(DOL - OSHA, n.d.)].

Employees are encouraged to report legitimate concerns for their occupational safety and health to their immediate supervisor and may do so without fear of any form of reprisal.

Employees may request an inspection of their workplace by giving notice of alleged unsafe or unhealthful conditions directly to corporate management. Employees may request such an inspection anonymously to the corporate occupational safety and health manager.

VI. Layout plans

The Bluestone program manager of each facility will coordinate with the site owner to establish an accurate site plan that identify the scope of the project area and the adequate route of egress and evacuation.

The site plan will identify the location of all fire suppression devices, first aid kits and AED, evacuation routes. The different routes of egress will remain free of all obstructions through the completion of the project. All emergency equipment will be inspected and documented according to manufacture recommendation. When a unit is required to be use, the operation of such unit and the rationale for using the unit must be reported to corporate manage at the earliest timeline. Corporate will document the use of the unite and schedule to have the unit replenish or replace at the earliest timeline.

VII. Emergency Response Plan

Bluestone Environmental Group employees are routinely assigned to several facilities throughout the United States. The need for a central written emergency response plan is not warranted since there are fewer than 10 employees located at any one location. Each employee is responsible to ensure effective and efficient safety communication is provided to all personnel within their area of operation.

When an employee reports to another worksite, it is their responsibility to seek out training from the reporting official on the local specific emergency response plan.

The specific elements they should inquire from the customer prior to entering their facility for the first time are specify in Title 29 of the Code of Federal Regulations - (DOL - OSHA, n.d.)

1910.38(c)(1) - Procedures for reporting a fire or other emergency;
1910.38(c)(2) - Procedures for emergency evacuation, including type of evacuation and exit route assignments;
1910.38(c)(3) - Procedures to be followed by employees who remain to operate critical plant operations before they evacuate;
1910.38(c)(4) - Procedures to account for all employees after evacuation;

1910.38(c)(6) - The name or job title of every employee who may be contacted by employees who need more information about the plan or an explanation of their duties under the plan.

The following general written plans are considered fluid and dynamic in nation. They provided the means to promote dialogue among colleagues and customer to establish a stronger and more cohesive specific written plan for each work site were Bluestone employees are assigned a task.

A. ***Spill Plan***

The Bluestone Program Manager for each project will develop a site-specific spill plan with the assistance from the Corporate Safety Officer. This plan will incorporate the use of appropriate containment material to slow the progression of the material from the immediate spill site. The site-specific plan shall incorporate all written emergency response policies and plans established by the work site's local emergency management organizations through our established customer.

B. ***Site Sanitation Plan***

The Bluestone Program Manager for each project will develop a site-specific sanitation plan with the assistance from the Corporate Safety Officer and the customer. Based on the needs and demand of the project, a means to remove garbage, recycle waste material and solid waste generated by Bluestone will be handled according to local regulations. The entire work site will be maintained in sanitary conditions to prevent the migration of wild animals into the work site.

No hazardous material will be relocated or transported using a personal vehicle.

All identified hazardous waste will be reported to the customer for handling, transporting and disposal according to their EPA permit.

Uni-sex rest rooms (i.e., public toilets) will be made available as established by the contract.

Potable water will be made available to all personnel for handwashing and eating utensils cleaning.

In construction zones and sites - All storm water will be maintained according to the local regulations to permit adequate draining and to prevent the harboring of vector-bore insects.

C. ***Thermal Stress Monitoring Plan.***

The program manager will consult with the corporate safety officer to establish a site-specific program to protect all personnel from severe cold or heat conditions base on the time, location and contractual requirements of the project. The work environment may be in inclement natural weather conditions or in a man-made

temperature-controlled environment, (i.e., incubator rooms, hot rooms, walk-in refrigerator/freezer rooms).

The site-specific plan will include procedures for monitoring the work environment with a mean to effective communication changes in the climatic conditions. A Job Hazard Analysis (JHA) will address the necessary personal protective equipment need for the assigned task. A maximum occupational thermal exposure limit will be established base on personnel acclimation and actual monitored environmental conditions.

Bluestone has adopted the thermal stress threshold limit values described in the ACGIH TLVs and BEIs publication, latest edition, (American Conference of Governmental Industrial Hygienists, 2018) as the reference for developing a site-specific plan.

D. ***Contingency Plan for severe weather***

The program manager, with the assistance from the corporate safety officer, will establish a site-specific program to protect all personnel working on the site from severe weather conditions base on the time of year, location of the site and contractual requirements of the project.

The contingency plan will include specific procedures provided by the customer, the local emergency management office, and/or the local fire and rescue service. This includes the main evacuation routes from the site of work to a pre-determined designated safe harbor location. The contingency plan will include the name, address and telephone number of the safe harboring locations for easy access using a handheld GPS mapping device or smartphone. All potential conditions that can be expected for the work area will be considered for the plan to include severe weather conditions, (i.e., hurricanes, tornados, flash flooding) or other potential natural disaster events, (i.e., earthquakes, tsunami, sink holes).

The plan will provide a means for effective emergency management communication with the customer during the time of the event and to keep the corporate office aware of the current location of all employees affected by the emergency conditions.

VIII. Recordkeeping and Reporting

The Occupational Safety and Health Act (OSH Act) of 1970 as amended requires each employee to make, keep, preserve and make available records regarding causes and prevention of occupational related accidents and illness (DOL, n.d.). The US Department of Labor promulgated this act by publishing the recordkeeping and reporting requirements in 29 Code of Federal Regulations Part 1904. (DOL - OSHA, n.d.).

All establishments covered by Part 1904 must also complete the OSHA 301A Summary form, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.

Employees, former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

The growth of Bluestone in 2019 has cause the implementation of several 2017 revision to 29 CFR 1904 in the reporting requirements. This section will provide some guidance with the development and processing of the OSHA 300 form, the OSHA 300A form and the OSHA 301 form.

Bluestone must record information about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. We must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. We must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR 1904.8 through 1904.12. We are legally obligated to complete an injury and illness incident report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. The Corporate Safety and Health Officer will acquire the necessary information through the year and prepare the OSHA 300A form for distribution and posting by February 1 following reporting year.

Bluestone will post a copy of the OSHA 301A form from February 1 to April 30 of the year following the year covered by the form is a conspicuous place at their Corporate office currently located in Malvern, PA 19355. This form will represent Bluestone as an establishment and represent all employee on payroll as defined by 29 CFR 1904.35 as amended in 2017.

According to Public Law 91-596 and 29 CFR 1904, OSHA's recordkeeping rule, Bluestone is required to keep a copy of the OSHA 301 form on file for 5 years following the year to which it pertains.

Each year, the Corporate Safety and Health Officer will acquire the necessary data to compile the stated OSHA forms for process and distribution. This individual will submit the compiled annual report electronically to the Bureau of Labor Statistics as indicated in their postal request documentation.

IX. References

A. Title 10 CFR Part 21, Reporting of Defects and Noncompliance; Section 21.21, Notification of failure to comply or existence of a defect and Section 21.61, Failure to notify; Nuclear Regulatory Commission

B. Title 29 CFR Part 1903.2, Posting of notice; availability of the Act, regulations and applicable standards.; OSHA, Department of Labor

C. Title 29 CFR Part 1910, Occupational Safety and Health Programs and Related Matters; OSHA, Department of Labor

D. Title 29 CFR Part 1925, Safety and Health Standards for Federal Service Contracts; OSHA; Department of Labor

E. Title 29 CFR Part 1952, Approved State Plans for Enforcement of State Standards; OSHA, Department of Labor

F. Title 29 CFR Part 1960, Basic Program Elements for Federal Employees OSHA; OSHA, Department of Labor

X. Works Cited

American Conference of Governmental Industrial Hygienists. (2018). *Threshold Limit Values (TLV®) and Biological Exposure Indices (BEI®)* (2018 ed.). Cincinnati, Ohio 45240, USA.

DOL - OSHA. (n.d.). *29 CFR 1904 Subpart E*. Retrieved December 2018, from Recording and Reporting Occupational Injuries and Illness: https://www.osha.gov/laws-regs/regulations/standardnumber/1904/1904.41

DOL - OSHA. (n.d.). *29 CFR 1910.38*. Retrieved December 2018, from Emergency action plans.: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.38

DOL - OSHA. (n.d.). *Title 29 CFR Part 1910*. Retrieved December 2018, from General Industry Standards: https://www.osha.gov/laws-regs/regulations/standardnumber/1910

DOL - OSHA. (n.d.). *Title 29 CFR Part 1926*. Retrieved December 2018, from Construction Industry Standards: https://www.osha.gov/laws-regs/regulations/standardnumber/1926

DOL. (n.d.). *Public Law 91-596*. Retrieved December 2018, from "Occupational Safety and Health Act of 1970.": https://www.osha.gov/laws-regs/oshact/completeoshact

NAICS Association. (2018). *NAICS Identification Tools*. (M. Feldman, Producer, & NAICS Association, LLC) Retrieved December 2018, from https://www.naics.com/search/

US Department of Labor. (1999, December 101). *OSHA Instruction*. Retrieved from DIRECTIVE NUMBER: CPL 2-0.124: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=2024&p_table=DIRECTIVES

APPENDIX F

CCC Lease Agreements

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U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURE STABILIZATION AND CONSERVATION
COMMODITY CREDIT CORPORATION

No. 3662
Recording fee $2.60
VCH

LEASE OF PROPERTY

THIS LEASE, made and entered into this 1st day of October, 1959, by and between Margaret Lightner of Jefferson, Iowa, Lessor, and Commodity Credit Corporation, Lessee.

WITNESSETH THAT:

1. The Lessor leases to the Lessee, and the Lessee hereby leases from the Lessor, upon the terms and conditions hereinafter stated, the following described real estate (hereinafter called "property") situated in the County of Greene and state of Iowa:

NW¼ 8-85-31 containing 1 acres, more or less.

2. The term of the Lease shall be for a period of 10 years, commencing the 1st day of October, 1959, and ending the 1st day of October, 1969, with the right of the Lessee, during such term or any extension thereof, to terminate said lease, and liability for any further rent, on the 1st day of October of any year, by giving 60 days' previous notice in writing to the Lessor.

3. As rent for said property, the Lessee shall pay the Lessor Fifty and No/100----- Dollars ($50.00) per year, such rent to be payable in advance, but to be apportionable in the event the lease is terminated as provided in paragraph 2 hereof:

4. The Lessor warrants that he is the owner of the property, has the right to give the Lessee possession under this lease, and will, so long as this lease remains in effect, warrant and defend the Lessee's possession against any and all persons whomsoever.

5. The Lessee shall have the right, during this lease, to erect storage structures or facilities, make alterations, install scales, fences, or signs, in or upon the premises hereby leased and, as the expiration of said lease or any renewal or extension thereof or at any time this lease is in effect, may remove said storage structures, facilities, scales, fences or signs or any part thereof, whether or not such structures, facilities, scales, fences or signs have become legally a fixture.

6. The Lessee shall not assign this lease without the written consent of the Lessor. The Lessee, may, however, sublet the structures on the premises leased hereunder, or any one or more of them for the term of the lease or any part thereof upon such terms and conditions as Lessee may wish to so sublet.

7. The Lessee, if required by the Lessor, shall, upon the expiration of this lease, or renewal thereof, restore the premises to the same condition as that existing at the time of entering upon the same under this lease, reasonable and ordinary wear and tear and damages by the elements or by circumstances over which the Lessee has no control excepted; Provided, however, That if the Lessor requires such restoration, the Lessor shall give written notice thereof to the Lessee_____days before the termination of the lease.

8. The Lessor grants and gives the Lessee the option as a consideration of this lease and for the further consideration of one dollar, the receipt of which is hereby acknowledged, to renew said lease for a period of_____years from the Lessor, his heirs,

executors, administrators, and assigns for the sum of_____Dollars ($_____) Per year.

9. As a consideration of this lease and for the further consideration of one dollar, the receipt of which is hereby acknowledged, the Lessor grants and gives the Lessee the option, at any time while this lease is in effect, to purchase said property from the Lessor, his heirs, executors, administrators, and assigns, for the sum of_____Dollars ($_____). In the event the Lessee shall exercise this option to purchase said property, the Lessor agrees to furnish at his own expense an abstract of title, certificate of title, or other evidence of title satisfactory to CCC and to execute a good and sufficient warranty deed conveying fee simple title to said property free and clear of all taxes, liens, or encumberances except for the following, and no others.

10. In the event any increased tax assessment is made against the Lessor or the property by virtue of the erection of storage structures and facilities thereon by the Lessee, the Lessor agrees to cooprate fully in any contest of such increased assessment which the Lessee feels should be made. The Lessee agrees that the rental hereunder shall be adjusted upward by the amount of any such increased tax assessment which the Lessor and Lessee mutually agree to be proper or which is determined to be legally valid in court proceedings.

11. No member of or Delegate to Contress or Resident Commissioner, shall be admitted to any share or part of this lease or purchase or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this lease or purchase if made with a corporation for its general benefit.

12. The Lessor warrants that he has not employed any person to solicit or secure this lease upon any agreement for a commission, percentage, brokerage, or contingent fee and that no such consideration or payment has been or will be made. Breach of this Warranty shall give CCC the right to annul the lease, or, in its discretion, to deduct from the rental or purchase price the amount of such commission, percentage, brokerage, or contingent fees. This warranty shall not apply to commissions payable by the Lessor if the lease is secured or made through a bona-fide agent maintained by the Lessor for the purpose of leasing or selling his property.

(Seal) Margaret Lightner LESSOR

(Seal) by Glen S. Lightner LESSOR
Guardian

Approved William C. Allen

COMMODITY CREDIT CORPORATION, LESSEE

By Roger J. Finnegan
Chairman, Greene County ASC Committee

June 20 1960
Date

AMENDMENT OF LEASE

This is an amendment of a lease by and between Margaret Lightner by Glen S. Lightner, Gdn. Jefferson, Iowa, Iowa, hereinafter called lessor and Commodity Credit Corporation hereinafter called lessee. Said lease being recorded in Book 31, # 2371 of_____ (Type of Record) records of Greene County, Iowa under date of Oct. 7 1959.

(Enter detailed description)

A tract of land beginning at the SW Corner of the NW¼ of Sec. 8, 85-31 then east 276 feet, then in a north westerly direction 679 feet, West 28 feet then south on west line of NW¼ of Sec 8-85-31 632 feet to starting point.

All other terms and conditions of the original contract including beginning and ending dates shall remain unchanged.

In witness whereof, the parties hereto have executed this Amendment on August 1, 1960.

Margaret Blanchfield
Lessor

Verle Blanchfield
Lessor's Spouse

Commodity Credit Corporation

by Don A. McCormick
Contracting officer

I, a Notary Public in and for Greene County do Hereby Certify that Margaret Blanchfield & Verle Blanchfield to me known to be the persons who executed the foregoing instrument, personally appeared before me and acknowledged that they executed the sane as their free act and deed.

Given under my official hand and seal this 1st day of Aug. 1960.

Notarial Seal

Alice M. Johnston
(Notary Public)

My Commission Expires July 4, 1963.

Filed August 3, 1960 at 1:10 o'clock P. M.

Orphe Thompson
Recorder

No. 826
Recording fee $2.50

Adaza Site 311 C.H.
12 B & T Binns and 10 small round bins
1 mile south of Adaza, Ia.

U. S. DEPARTMENT OF AGRICULTURE
Agricultural Stabilization and Conservation Service
Commodity Credit Corporation

LEASE OF PROPERTY

THIS LEASE, made and entered into this 15th day of June, 1970, by and between Francis Lightner of Lohrville, Iowa (hereinafter called the "Lessor"), and Commodity Credit Corporation, (hereinafter called the "Lessee").

WITNESSETH THAT:

1. The Lessor leases to the Lessee, and the Lessee hereby leases from the Lessor, upon the terms and conditions hereinafter stated, the following described real estate (hereinafter called "property") situated in the County of Greene and State of Iowa (Enter here a complete legal description of the site)

A tract of land starting at a point 172 ft. south of the NE Corner of the SE¼ of Sec. 7-85-31, then west 294 feet and six inches, south 171 feet and 6 inches, east 291 feet and six inches and north along east line of Sec. 7 149 feet to starting point.

containing 1.0 acres, more or less.

2. The term of the lease shall be for a period of 5 years, commencing the 1st day of July 1970, and ending the 30th day of June, 1975, with the right of the Lessee, at any time during such term or any extension thereof, to terminate said lease, and liability for any further rent, by giving 30 days' previous notice in writing to the Lessor.

3. As rent for said property, the Lessee shall pay the Lessor One Hundred Dollors Dollars ($100.00) per year, such rent to be payable in advance, but to be apportionable in the event the lease is terminated as provided in paragraph 2 hereof.

4. The Lessor warrants that he is the owner of the property, has the right to give the Lessee possession under this lease, and will, so long as this lease remains in effect, warrant and defend the Lessee's possession against any and all persons whomsoever.

5. The Lessee shall have the right, during this lease, to erect storage structures or facilities, make alterations, install scales, fences, or signs, in or upon the premises hereby leased and, at the expiration of said lease or any renewal or extension thereof or at any time this lease is in effect, may remove said storage structures, facilities, scales, fences or signs or any part thereof, whether or not such structures, facilities, scales, fences or signs have become legally a fixture.

6. The Lessee shall not assign this lease without the written consent of the Lessor. The Lessee, may, however, sublet the structures on the premises leased hereunder, or any one or more of them for the term of the lease or any part thereof upon such terms and conditions as Lessee may wish to so sublet.

7. The Lessee, if required by the Lessor, shall upon the expiration of this lease, restore the premises to the same condition as that existing at the time of first entering upon the same under this lease or under any prior lease from the Lessor to the Lessee which has been continuous, reasonable and ordinary wear and tear and damages by the elements or by circumstances over which the Lessee has no control excepted: Provided, however, That if the Lessor requires such restoration, the Lessor shall give written notice thereof to the Lessee 60 days before the termination of the lease.

8. The Lessor grants and gives the Lessee the option as a consideration of this lease and for the further consideration of one dollar, the receipt of which is hereby acknowledged, to renew said lease for a period of xx years from the Lessor, his heirs, executors, administrators, and assigns, for the sum of xxxxxx Dollars ($ xxxxxx) per year.

9. As a consideration of this lease and for the further consideration of one dollar, the receipt of which is hereby acknowledged, the Lessor grants and gives the Lessee the option, at any time while this lease is in effect, to purchase said property from the Lessor, his heirs, executors, administrators, and assigns, for the sum of xx Dollars ($ xx). In the event the Lessee shall exercise this option to purchase said property, the Lessor agrees to furnish at his own expense an abstract of title, certificate of title, or other evidence of title satisfactory to CCC and to execute a good and sufficient warranty deed conveying fee simple title to said property free and clear of all taxes, liens, or encumbrances except for the following, and no others.

10. In the event any increased tax assessment is made against the Lessor or the property by virtue of the erection of storage structures and facilities thereon by the Lessee, the Lessor agrees to cooperate fully in any contest of such increased assessment which the Lessee feels should be made. The Lessee agrees that the rental hereunder shall be adjusted

upward by the amount of any such increased tax assessment which the Lessor and Lessee mutually agree to be proper or which is determined to be legally valid in court proceedings.

11. No member of or Delegate to Congress or Resident Commissioner, shall be admitted to any share or part of this lease or purchase/if made with a corporation for its general benefit.

12. The Lessor warrants that he has not employed any person to solicit or secure this lease upon any agreement for a commission, percentage, brokerage, or contingent fee and that no such consideration or payment has been or will be made. Breach of this warranty shall give CCC the right to annul the lease, or, in its discretion, to deduct from the rental or purchase price the amount of such commission, percentage, brokerage, or contingent fees. This warranty shall not apply to commissions payable by the Lessor if the lease is secured or made through a bona-fide agent maintained by the Lessor for the purpose of leasing or selling his property.

COMMODITY CREDIT CORPORATION, LESSEE

By Don A. McCormic
Don A. McCormick
Chairman, Greene ASC County Committee
Contracting Officer

Francis Lightner, LESSOR
Francis Lightner

Jeanne Lightner, LESSOR
Jeanne Lightner

Alice M. Johnston, WITNESS

I, a Notary Public in and for Greene County do Hereby Certify that Francis Lightner & Jeanne Lightner, to me known to be the persons who executed the foregoing instrument, personally appeared before me and acknowledged that they executed the same as their free act and deed.

Given under my official hand and seal this 1st day of July 1970.

My commission expires 7-4-72.

Alice M. Johnston
(Notary Public) Alice M Johnston

Notarial Seal

*or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this lease or purchase

Filed July 9, 1970 at 9:39 o'clock A.M.

Orphia Thompson
Recorder

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APPENDIX G

IDNR Concurrence Letter

(Placeholder for Work Plan Approval)

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