DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
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August 21, 2015

Environmental Division

Mr. Robert Stroud
NPL/BRAC/Federal Facilities Branch
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029

Dear Mr. Stroud:

Enclosed please find the page replacements necessary to amend the December 2014 *Final Remedial Design (RD)* for FGGM-93, Manor View Dump Site at Fort George G. Meade. The page replacements resolve USEPA comments regarding specific language for Land Use Controls. To prepare the revised document, please follow these actions:

- Replace cover, spine, and cover page;
- Replace pages ES-3, 1-8, and 17-18; and
- Replace the report CD.

Copies of the page replacements have also been furnished to Fran Coulters (U.S. Army Environmental Command), Elisabeth Green (Maryland Department of the Environment), Dan LaHart (Anne Arundel County Schools), and the Fort George G. Meade Restoration Advisory Board, as appropriate.

If you have any questions, please feel free to contact Denise Tegtmeyer at (301) 677-9559 or me at (301) 677-7999.

Sincerely,

George B. Knight, PG
Program Manager, Installation Restoration Program
Directorate of Public Works-Environmental Division

Enclosure

ARCADIS

Imagine the result

REVISED FINAL Remedial Design

FGGM 93, Manor View Dump Site, Fort George G. Meade, Maryland

August 2015

FORT GEORGE G. MEADE
ENVIRONMENTAL DIVISION

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Revised Final Remedial Design FGGM 93, Manor View Dump Site
Fort George G. Meade, Maryland

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Date:
August 2015

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List of Acronyms and Abbreviations

AR	Army Regulation
ARARs	Applicable or Relevant and Appropriate Requirements
ARCADIS	ARCADIS U.S. Inc.
C&D	Construction and Demolition
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
COMAR	Code of Maryland Regulations
DCE	Dichloroethene
ECs	Engineering Controls
FGGM	Fort George G. Meade
FGGM 93	Manor View Dump Site
ft	feet
GIS	Geographical Information System
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
ICs	Institutional Controls
IRP	Installation Restoration Program
LPA	Lower Patapsco Aquifer
LTM	Long Term Monitoring
LUC	Land Use Controls
MDE	Maryland Department of the Environment
MGW	Methane Generating Waste
NTCRA	Non-time Critical Removal Action
RA	Remedial Action

List of Acronyms and Abbreviations (continued)

RAOs	Remedial Action Objectives
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
Site	FGGM 93, Manor View Dump Site
SOPs	Standard Operating Procedures
TCE	Trichloroethene
U.S.	United States
USEPA	United States Environmental Protection Agency
VC	Vinyl Chloride
VOCs	Volatile Organic Compounds

Executive Summary

ARCADIS U.S. Inc. has been retained by the United States (U.S.) Army Environmental Command to perform Installation Restoration Program activities at Fort George G. Meade (FGGM), located in Anne Arundel County, Maryland (**Figure 1**). The Manor View Dump Site, FGGM 93 (hereinafter referred to as "the Site" or FGGM 93) is located near the intersection of MacArthur Road and 2nd Corps Boulevard in the northern portion of FGGM. A Site location map is provided as **Figure 2**, and an aerial map of the Site is presented in **Figure 3**. The Site is bounded by a group of residential housing and an open field to the north, 2nd Corps Boulevard to the south, Hayden Drive to the west, and Manor View Elementary School located at 2900 MacArthur Road to the east.

Landfilled material at the Site was discovered in 2003 during excavation and earth moving activities associated with the housing privatization initiative. Following the discovery of landfilled material, various field activities were completed to determine the nature and extent of the waste mass. Materials recovered in test pits and soil borings were dated as originating from the 1940s and classified into two general categories: methane generating waste (MGW) and construction and demolition (C&D) debris/fill. Results of these preliminary assessment/site investigation activities identified elevated methane concentrations in soil gas. In July and August 2005, a passive gas collection trench was installed along the western and northern extent of the Site to intercept methane migrating from the waste to the housing units and vent it to the atmosphere. In October 2005, soil gas samples were collected to determine the effectiveness of the passive collection trench. Elevated methane concentrations were observed near the housing units; thus, for protection of the residents, the affected housing units located north and west of the Site were evacuated in December 2005. The housing units remain vacant.

The MGW occupied an approximately one-acre area confined to the western portion of the Site; bounded to the east by the north/south oriented drainage swale and to the north and west by the Potomac Place Housing Area. Methane was consistently observed at concentrations exceeding the Lower Explosive Limit of 5 percent in various soil gas monitoring locations in this area. This portion of the Site was the focus of a Non-Time Critical Removal Action (NTCRA) conducted in 2012, which included the excavation and off-Site disposal of approximately 27,700 tons of non-hazardous MGW and soil (**Figure 4**). Following achievement of the vertical and horizontal excavation limits, the Site was backfilled utilizing stockpiled overburden soil, followed by a minimum of 18 inches of clean imported common fill, and 6 inches of top soil to support vegetative growth. The western portion of the Site is currently a vacant grassed lot.

The remaining approximate nine acres (eastern portion of the Site) contains debris/fill and typically consists of C&D debris, rubble, and burned material/ash which is more inorganic in nature and does not significantly contribute to methane generation through decomposition. The buried C&D debris remains on the eastern portion of the Site beneath a vegetative soil cover approximately 2 to 8 feet thick.

The remedy selected in the Record of Decision (ROD; U.S. Army, 2014a) is Alternative 2: Maintenance of Existing Soil Cover, Land Use Controls (LUCs), and Long-term Monitoring (LTM). The remedy was selected to mitigate cancer risks and non-cancer hazards identified in the Human Health Risk Assessment as presented in the Final Remedial Investigation Report Addendum (ARCADIS, 2014b) and posed by contaminants of concern in groundwater (i.e., arsenic, cadmium, chromium, cobalt, lead, selenium, thallium, trichloroethene [TCE], and vinyl chloride), soil (i.e., benzo[a]pyrene, dibenzo[a]anthracene, 2,3,7,8-TCDD, and TCE), and indoor air within the crawl space beneath the Manor View Elementary School (TCE) and physical hazards posed by the remaining buried waste at the Site.

Although the existing soil cover does not comply with the State of Maryland's cap design criteria under Code of Maryland Regulations (COMAR) 26.04.07.21, the U.S. Army, the Maryland Department of the Environment (MDE) and the United States Environmental Protection Agency agree that the selected remedy satisfies the criteria to qualify for a variance from the capping requirements as provided for in COMAR 26.04.07.26, since it would provide the same degree of protection of human health and the environment. The U.S. Army issued a Final Variance Request Report on August 15, 2014, (U.S. Army, 2013) and received concurrence from MDE via a letter sent to the U.S. Army on August 20, 2013 (Green, 2013).

This Remedial Design has been prepared to outline implementation of the selected remedy at FGGM 93 as specified in the ROD (U.S. Army, 2014a). The Remedial Action Objectives (RAOs) for the Site are based on human health and environmental risks posed by buried waste and impacted media at the Site under future land use scenarios, and provided the basis for the formulation and development of the selected remedy. The RAOs for the selected remedy at the Site are as follows:

- To prevent human exposure to groundwater until contaminant levels in groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure;

- To protect human health and the welfare of the surrounding community from the safety hazard posed by methane gas through ensuring the continued effectiveness of the NTCRA;

- To prevent the exposure of buried waste and contaminants in soil that may pose a physical or chemical hazard; and

- To protect the occupants of the school from the potential of vapor intrusion via the crawl space.

The selected remedy will meet RAOs by ensuring the existing soil cover remains protective of human health and the environment through the completion of routine site inspections, cover maintenance, and implementation of LUCs. Furthermore, LTM will be implemented to monitor concentrations of contaminants of concern identified in groundwater and indoor air and to ensure the continued effectiveness of the NTCRA through in-situ methane monitoring. LUCs including administrative (i.e. FGGM Master Plan regulations) and engineering controls (i.e., signage and fencing) will be implemented to prohibit residential land use, groundwater use, uncontrolled intrusive activities, construction of buildings within 100-feet of the Site without appropriate vapor intrusion provisions, and full-time occupancy of the crawl space in the Manor View Elementary School and to ensure the retention and functionality of methane monitors currently in-place at the Manor View Elementary School and housing units adjacent to the western portion of the Site.

1. Introduction

ARCADIS U.S. Inc. (ARCADIS) has been retained by the United States (U.S.) Army Environmental Command to perform Installation Restoration Program (IRP) activities at Fort George G. Meade (FGGM), located in Anne Arundel County, Maryland. This work is being conducted under a Performance Based Contract associated with the environmental restoration program at FGGM. The full scope of services for this contract is defined in Contract W91ZLK-05-D-0015: Task 0005.

The IRP activities at FGGM are conducted under the U.S. Army's Defense Environmental Restoration Program and operate principally under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 and National Oil and Hazardous Substances Pollution Contingency Plan [40 Code of Federal Regulations (CFR) 300]. FGGM was placed on the National Priorities List on July 28, 1998. Coordination and input are provided by the United States Environmental Protection Agency (USEPA) Region III, and as appropriate, by the other signatories of the FGGM Federal Facility Agreement, including the Architect of the Capitol and the Department of Interior. Input and coordination from Maryland Department of the Environment (MDE) was also solicited.

1.1 Purpose and Scope

This Remedial Design (RD) has been prepared to outline implementation of the selected remedy at FGGM 93, Manor View Dump Site (hereinafter referred to as "the Site" or FGGM 93) as specified in the approved Final Record of Decision (ROD; U.S. Army, 2014a). The selected remedy addresses unacceptable risk identified under future use scenarios due to exposure to contaminants in groundwater, soil, and indoor air, and the remaining buried waste at the Site. The selected remedy consists of the following components:

- Semi-annual long-term monitoring (LTM) of contaminants of concern (COCs) in groundwater (i.e., arsenic, cadmium, chromium, cobalt, lead, selenium, thallium, trichloroethene [TCE] and vinyl chloride [VC]);

- Semi-annual LTM of soil gas for methane;

- Annual LTM of indoor air in the crawl space at Manor View Elementary for TCE and its daughter products (i.e., 1,1-dichloroethene [DCE], cis-1,2-DCE, trans-1,2-DCE, and VC);
- Annual site inspections and maintenance of the soil cover; and
- Implementation of land use controls (LUCs).

1.2 Background

FGGM is located midway between the cities of Baltimore, Maryland, and Washington D.C. in Anne Arundel County, Maryland, as shown in **Figure 1**. The Site is located near the intersection of MacArthur Road and 2nd Corps Boulevard in the northern portion of FGGM. A Site location map is provided as **Figure 2**, and an aerial map of the Site is presented in **Figure 3**. The Site is bounded by a group of residential housing and an open field to the north, 2nd Corps Boulevard to the south, Hayden Drive to the west, and Manor View Elementary School located at 2900 MacArthur Road to the east.

Landfilled material at the Site was discovered in 2003 during excavation and earth moving activities associated with the housing privatization initiative. Following the discovery of landfilled material, various field activities were completed to determine the nature and extent of the waste mass. Materials recovered in test pits and soil borings were dated as originating from the 1940s, and classified into two general categories: methane generating waste (MGW) and construction and demolition (C&D) debris/fill.

Results of these preliminary assessment/site investigation activities identified elevated methane concentrations in soil gas. In July and August 2005, a passive gas collection trench was installed along the western and northern extent of the Site to intercept methane migrating from the waste to the housing units and vent it to the atmosphere. In October 2005, soil gas samples were collected to determine the effectiveness of the passive collection trench. Elevated methane concentrations were observed near the housing units; thus for protection of the residents, the affected housing units located north and west of the Site were evacuated in December 2005 (URS, 2008). The housing units have not been reoccupied. The MGW occupied an approximately one-acre area confined to the western portion of the Site; bounded to the east by the north/south oriented drainage swale and to the north and west by the Potomac Place Housing Area. Methane was consistently observed at concentrations exceeding the Lower Explosive Limit of 5 percent in various soil gas monitoring locations in this area. This portion of the Site was the focus of a Non-Time Critical Removal Action (NTCRA) conducted in 2012 (ARCADIS, 2012), which included the excavation and off-Site disposal of approximately 27,700 tons of non-hazardous MGW and soil (**Figure 4**). Following achievement of the vertical and horizontal excavation limits, the Site was backfilled utilizing stockpiled overburden soil, followed by a minimum of 18 inches of clean imported common fill, and 6 inches of top soil to support vegetative growth. The western portion of the Site is currently a vacant grassed lot.

The remaining approximate nine acres of the Site (eastern portion of the Site) contains debris/fill and typically consists of C&D debris including rubble and burned material/ash which is more inorganic in nature and does not significantly contribute to methane generation through decomposition. The buried C&D debris remains on the eastern portion of the Site beneath a vegetative soil cover approximately 2 to 8 feet (ft) thick.

1.3 Previous Investigations

Previous environmental investigation and sampling have been conducted to characterize the nature and extent of contamination and buried waste at the Site. These investigations include the following:

- Preliminary Assessment and Site Investigation (data set summarized in the Remedial Investigation [RI; URS, 2008]);
- RI (URS, 2008);
- Supplemental investigation consisting of cone penetrometer tests and geoprobe borings (ARCADIS, 2014a);
- Supplemental investigations including groundwater investigations conducted in 2009, 2011, and 2012 and sediment samples collected in May 2010; and,
- Design investigations and completion of the NTCRA as documented in NTCRA Work Plan (ARCADIS, 2012) and the Interim Removal Action Report (ARCADIS, 2013), respectively, to address methane concentrations above the lower explosive limit (February – August 2012).

Data obtained during these investigations are documented within the Final Feasibility Study, Revision 1 (ARCADIS, 2014a) and were used to support the development of the Human Health Risk Assessment (HHRA) as presented in the Final RI Report Addendum (ARCADIS, 2014b). The HHRA identified cancer risks and non-cancer hazards exceeding the USEPA's acceptable risk range and hazard index, respectively. Unacceptable cancer risk and non-cancer hazards were due to human exposure to contaminants in groundwater (i.e., arsenic, cobalt, thallium, and VC), subsurface soil (i.e., benzo[a]pyrene and dibenzo[a,h]anthracene), and indoor air (TCE), under future land use scenarios.

1.4 Remedy Selection

The remedy selected in the ROD (U.S. Army, 2014a) is Alternative 2: Maintenance of Existing Soil Cover, LUCs, and LTM. The remedy was selected to mitigate cancer risks and non-cancer hazards identified in the HHRA as presented in the Final RI Report Addendum (ARCADIS, 2014b) and as posed by the remaining waste buried on the eastern portion of the Site and the following COCs:

- Arsenic, cadmium, chromium, cobalt, lead, selenium, thallium, TCE, and VC in groundwater;
- Benzo(a)pyrene, dibenzo(a)anthracene, 2,3,7,8-TCDD, and TCE in soil; and
- TCE in indoor air within the crawl space beneath the Manor View Elementary School.

A public comment period was held during development of the Proposed Plan (U.S. Army, 2014b) to inform the public about the proposed remedial alternatives for the Site and to seek public comments. In addition to the Proposed Plan document a fact sheet was issued to the public (**Appendix A**). No comments were received during the public comment period, and the final remedy was adopted in the ROD (U.S. Army, 2014a).

2. Design Criteria

Various objectives, criteria, and standards, including Applicable or Relevant and Appropriate Requirements (ARARs) as defined by CERCLA, were identified during preparation of the ROD. These objectives, criteria, and standards guided the design of the remedial action (RA).

2.1 Remedial Action Objectives

The Remedial Action Objectives (RAOs), as stated in the ROD (U.S. Army, 2014a), are based on human health and environmental risks, and provided the basis for the formulation and development of the selected remedy. The RAOs for the selected remedy at the Site are as follows:

- To prevent human exposure to groundwater until contaminant levels in groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure;

- To protect human health and the welfare of the surrounding community from the safety hazard posed by methane gas through ensuring the continued effectiveness of the NTCRA;

- To prevent the exposure of buried waste and contaminants in soil that may pose a physical or chemical hazard; and

- To protect the occupants of the school from the potential of vapor intrusion via the crawl space.

2.2 Achieving the RAOs and Other Requirements

The selected remedy will attain the above mentioned RAOs as indicated in the table below:

RAO	Action Implemented Under the Selected Remedy
To prevent human exposure to groundwater until contaminant levels in groundwater have been reduced to levels that allow for unlimited use and unrestricted exposure.	Institutional controls (ICs) will be implemented to restrict residential land use and groundwater use at the Site. Additionally, LTM of groundwater will be conducted to verify that (1) the remaining wastes are not actively contributing to groundwater contamination and (2) the concentrations of contaminants in groundwater continue to decline. Under existing conditions, it is anticipated that chlorinated solvents and their degradation products will decrease below their respective remediation goals within 2 years following remedy implementation.
To protect human health and the welfare of the surrounding community from the safety hazard posed by methane gas through ensuring the continued effectiveness of the NTCRA.	LTM of soil gas will be monitored to ensure the effectiveness of the NTCRA in removing waste capable of generating methane levels above the lower explosive limits. ICs will be implemented to ensure placement and functionality of methane monitors in the Manor View Elementary School and housing units adjacent to the western portion of the Site.
To prevent the exposure of buried waste and contaminants in soil that may pose a physical or chemical hazard.	Annual inspections of the existing soil cover will be conducted to ensure no erosion or subsidence has occurred that may expose impacted soil and waste at the ground surface. ICs and engineering controls (ECs) will be implemented to prohibit uncontrolled intrusive activities at the Site.
To protect the occupants of the school from the potential of vapor intrusion via the crawl space.	ICs will be implemented to prohibit full-time occupancy of the crawl space. Annual land use inspections will be conducted to ensure the use of the crawl space has not changed. LTM of indoor air will be conducted from within the crawl space to monitor concentrations of TCE and its daughter products. Additionally, an IC will be implemented to enforce provisions for the construction of new buildings proposed within 100 feet of the Site to prevent vapor intrusion.

2.3 State and Federal Regulatory Requirements

A comprehensive list of ARARs for implementation of the RD are provided in the ROD (U.S. Army, 2014a). The key regulatory programs considered during the design of the selected remedy include the following:

- Sanitary Landfill – Closure (Code of Maryland Regulations [COMAR] 26.04.21): The selected remedy does not meet the landfill closure cap design promulgated under COMAR 26.04.07.21. However, the State of Maryland granted a variance to the landfill closure requirements (Green, 2013) following submittal of the Variance Request Report (U.S. Army, 2013) and concur that the existing cover provides a level of protection equivalent to that provided by the cap specified in COMAR 26.04.07.21, as provided for by the variance provisions provided in COMAR 26.04.07.26.

- Sanitary Landfills – Post Closure Monitoring and Maintenance (COMAR 26.04.07.22): Establishes post-closure monitoring and maintenance of sanitary landfills.

- Sanitary Landfills – Municipal Landfills – Other Requirements for Permits (COMAR 26.07.09F): Specifies that MDE (the Approving Authority) may set the requirements of a monitoring plan including the number and location of monitoring stations (i.e., monitoring wells); frequency of analyses; sampling procedures; parameters to be monitored; and the reporting period.

- Groundwater Monitoring and Corrective Action (40 CFR 258, Subpart E): During review of the Site decision documents, MDE specified the regulations provided in 40 CFR 258, Subpart E for the post-closure groundwater monitoring program implemented at the Site.

- Groundwater – Safe Drinking Water Act National Primary Drinking Water Regulations (40 CFR141): Specifies Maximum Contaminant Levels (MCLs) required to be met by CERCLA Section 121(d) and NCP (40 CFR 300.430(e)(2)(i)(B)&(C)) for groundwater through remedial actions.

2.4 Site Considerations

In addition to the preceding regulatory considerations, the following Site-specific conditions are also considered during implementation of the RA:

- Site Access: All field activities will be conducted in accordance with the requirements provided by Manor View Elementary School officials and other stakeholders impacted by monitoring activities. Sample locations included in the LTM program and methane monitors requiring an annual inspection are located on the Manor View Elementary School property including one indoor air sample location in the crawl space under the school and on land associated with residential housing leased by the Corvias Group. Thus, the U.S. Army will obtain authorization from the school and the Corvias Group prior to conducting field sampling activities on or around these areas.

- Intrusive Work Activities: In the event intrusive activities are required to repair the existing soil cover, a utility clearance using at least three lines of evidence will be conducted. First, Miss Utility of Maryland will be contacted at least 48 hours in advance of land disturbance. Second, a private utility locator will locate and mark underground utilities within the excavation area and surrounding areas using a combination of ground penetrating radar and electromagnetic location methods. Finally, available Site plans will be reviewed to identify existing utilities within the Site. In addition, the FGGM dig permit will be submitted 30 days prior to initiation of the intrusive activities.

3. Selected Remedy

The remedy selected for FGGM 93 in the ROD (U.S. Army, 2014a) incorporates the following components:

- Annual inspections and maintenance of the existing vegetative soil cover over the Site;
- Semi-annual methane monitoring at 15 existing soil gas sample locations;
- Semi-annual groundwater monitoring at 11 monitoring wells;
- Annual indoor air monitoring in the crawl space at the Manor View Elementary School for TCE and its daughter products;
- Implementation of LUCs; and
- Annual site inspections and maintenance of the soil cover.

The selected remedy will prevent human exposure to buried waste and impacted media (i.e., groundwater, subsurface soil, and indoor air) that may pose physical or chemical hazards through implementation of LUCs, inspection and maintenance of the existing soil cover, and LTM of groundwater, soil gas, and indoor air. The selected RA was chosen based on its ability to protect human health and the environment and to effectively address the environmental impacts posed by buried waste and impacted media at FGGM 93. The components of the selected RA are discussed in further detail in the following sections.

4. Long-Term Monitoring

The following subsections describe the components of the LTM program at FGGM 93 including groundwater, soil gas, and indoor air sampling. All sampling activities described herein will be conducted in accordance with the approved FGGM Site-Wide plans, including the Quality Assurance Project Plan, Sampling Analysis Plan, and Waste Management Plan (ARCADIS, 2011a, 2011b, and 2010a). Applicable Standard Operating Procedures (SOPs) are provided in **Appendix B**. A summary of the LTM program is provided in **Table 1**.

4.1 Groundwater

Groundwater monitoring will be conducted to verify that (1) the remaining wastes are not actively contributing to groundwater contamination and (2) the concentrations of COCs identified in groundwater continue to decline. As indicated in the ROD (U.S. Army, 2014a), COCs in groundwater are arsenic, cadmium, chromium, cobalt, lead, selenium, thallium, TCE, and VC. Following remedy implementation, groundwater monitoring will be implemented in accordance with COMAR 26.04.07.09F, which states that the MDE (Approving Authority) may specify the requirements of the groundwater sampling plan. During review of Site decision documents, the MDE specified analysis of **Table 1** and **Table 2** parameters as referenced in 40 CFR 258.54. **Table 1** and **Table 2** parameters include volatile organic compounds (VOCs), metals, and water quality parameters (i.e., pH, alkalinity, hardness, chloride, specific conductance, nitrate, chemical oxygen demand, turbidity, ammonia, sulfate, and total dissolved solids). The following subsections outline the sampling plan to be implemented at FGGM 93 in accordance with MDE's specifications.

4.1.1 Groundwater Monitoring Locations

Groundwater samples will be collected from 10 of existing 11 monitoring wells depicted on **Figure 5**. MW-1, MW-2, and MW-7 have been identified as "background" monitoring locations and are not anticipated to be impacted by the remaining buried waste at the Site. The remaining monitoring wells are classified as "downgradient" monitoring wells. Groundwater at FGGM 93 occurs under unconfined or water table conditions and is encountered at approximately 50 ft below the ground surface within the Lower Patapsco Aquifer (LPA). Groundwater flow in the LPA is to the southeast as depicted on **Figure 5**. The existing groundwater monitoring wells are screened within the LPA at approximately 23 – 50 ft below ground surface.

MW-8 was located approximately 7 ft from the western limit of excavation during the NTCRA. Following achievement of the vertical and horizontal limits of excavation, the Site was backfilled and grading in the vicinity of MW-8 was sloped toward the southeast to provide adequate drainage of stormwater run-off. Due to settling following the completion of backfill and grading, MW-8 has shifted out of the manhole vault, toward the southeast. Based on a review of groundwater analytical data, it was determined that MW-8 is not a critical component of the monitoring well network (i.e., no COCs exceeded their associated remedial goal during the last three sampling events [2009, 2011, and 2012]); thus, MW-8 was not included in the monitoring program and will be abandoned as part of the remedial design and in accordance with COMAR 26.04.04.11.

4.1.2 Sample Schedule

Site-wide groundwater monitoring locations will be sampled on a semi-annual basis.

4.1.3 Sample Collection

Prior to conducting sampling procedures, all monitoring wells included in the monitoring program will be gauged for synoptic groundwater elevations as part of each monitoring event. Water-level measurements will be measured in accordance with the Water Level Measurement SOP as provided in **Appendix B**. Water-level measurements will be collected in reference to a surveyed elevation point located on the top of the well casing.

Groundwater samples will be collected in accordance with USEPA Region III low-flow groundwater purging methodology (USEPA, 1997) and with the procedures presented in Low-flow Purging and Sampling Procedures for Monitoring Wells presented in **Appendix B** to ensure that a sample representative of the water within formation is collected. Purging will be conducted using a bladder pump placed mid-screen in a manner consistent with historic sampling events.

During well purging, field parameters (i.e., pH, specific conductance, turbidity, dissolved oxygen, temperature, and oxidation-reduction potential) will be monitored using a water quality meter with a flow-through cell in order to determine stabilization for three consecutive readings. Upon stabilization of parameters, groundwater samples will be collected directly from the discharge point of the sample tubing connected to the bladder pump. Field parameter measurements, purging observations, sampling methods and materials, sampling personnel, and bottle requirements will be recorded on a sample log (**Appendix C**).

4.1.4 Analytical Procedures

Groundwater samples will be analyzed for the contaminants provided in Appendix I of 40 CFR 258 and as summarized in **Table 2** of this document**,** which include total metals and VOCs. Additionally, groundwater samples will be analyzed for water quality parameters including pH, alkalinity, hardness, chloride, specific conductance, nitrate, chemical oxygen demand, turbidity, ammonia, sulfate, and total dissolved solids.

4.1.5 Preservation and Chain of Custody

All groundwater samples will be preserved, labeled, and recorded on a Chain of Custody in accordance with SOP Chain of Custody, Handling, Packing and Shipping (**Appendix B**) prior to shipment to selected laboratory.

4.2 Soil Gas

Soil gas monitoring will be conducted semi-annually for methane at a subset of the existing soil gas sample locations in a manner consistent with previous monitoring events and as summarized below. A desktop review of historic monitoring results was conducted to develop the soil gas monitoring network. Monitoring locations exhibiting no measurable detections of methane following completion of the NTRCA were removed from the monitoring network. Fifteen monitoring locations were retained for semi-annual monitoring and are presented on **Figure 6**.

Landfill gas measurements (i.e., methane, carbon dioxide, and oxygen) will be collected in-situ using a LANDTEC GEM™ 2000 or equivalent landfill gas monitoring device. Prior to conducting monitoring activities, the landfill gas monitor will be calibrated in accordance with manufacturer specifications. Two landfill gas readings will be collected at each monitoring point: (1) an initial reading collected from the monitoring point head space and (2) a final reading following a three-volume purge of the monitoring point. Following documentation of the initial reading, a three-volume purge will be conducted at each monitoring point to displace stagnant air within the headspace and to capture a representative sample of the soil vapor from the screened interval. Flow rates and purge times should be recorded following the three-volume purge at each monitoring point. In the event water is identified within the monitoring point, a water collection bottle will be used to collect water and prevent water from entering the landfill gas monitor during purging procedures. Care should be taken to ensure that ambient air within the bottle is purged and that a sample, representative of the air from the terminal depth of the monitoring point, is measured. Monitoring point construction details and volume calculations are provided on **Table 3**. Field forms are provided in **Appendix C**.

All monitoring points will be secured following completion of monitoring and any monitoring point deficiencies will be noted and repaired in a timely manner.

4.3 Indoor Air

One indoor air sample will be collected from the crawl space in the Manor View Elementary School on an annual basis, and analyzed for TCE and its daughter products (i.e., 1,1- DCE, cis – 1,2-DCE, trans-1,2-DCE, VC) via USEPA Method TO-15 (USEPA, 1999). The crawl space is accessible from a floor hatch located in a utility closet in the school cafeteria/gymnasium and is considered a non-permit required confined space, as defined by the Occupational Safety and Health Administration in 29 CFR 1910.146(b). Temporary occupancy of the crawl space during sampling will not be required to place the sample canister; rather, the sample canister will be lowered into the crawl space by a rope from the within the utility closet. This procedure eliminates the potential hazards associated with entering a non-permitted confined space. Prior to conducting indoor air sampling, the U.S. Army will coordinate with Manor View Elementary School officials to obtain access to the crawl space. The sample location, MV-13, is depicted on **Figure 7**.

All field activities associated with the collection of indoor air samples will be conducted in accordance with applicable USEPA Region III guidance using the procedures outlined in the SOP for Indoor Air or Ambient Air Sampling and Analysis Using USEPA Method TO-15 (**Appendix B**). Samples will be collected using a certified pre-cleaned 6-liter Summa® canister placed at the ground surface in the middle of the crawl space. The Summa® canister will be opened and the sample will be collected over a 24-hour period using a flow controller pre-set by the analytical laboratory. All canisters will be labeled with the appropriate contact information and to explicate that the canister should not be disturbed during sampling. The following information will be recorded and documented during indoor air sampling activities:

- Floor plan sketches including the crawl space and sample locations;
- Photographs of sample location;

- Weather conditions (e.g., precipitation before or during the sampling event, indoor and outdoor temperature, and barometric pressure) and ventilation conditions within the crawl space;
- Any pertinent observations, such as chemical storage, spills, floor stains, or odors in the vicinity of the crawl space;
- Sample and sample container identifications;
- Date and time of the sample collections;
- Results of any field measurements collected;
- Vacuum of canister before and after sample collection; and
- Chain of custody protocols and records used to track sample.

A template indoor air sample form is provided in **Appendix D**.

5. Land Use Controls

In addition to the implementation of the LTM program, existing LUCs, including ICs and ECs, at FGGM 93 will be maintained and enhanced. ICs are administrative measures put in place to restrict human activity, in order to control future land use and restrict groundwater use. ECs include a variety of engineered or constructed barriers to control human activity and restrict groundwater use. The LUC boundaries for the Site are shown on **Figure 8**.

5.1 Existing LUCs at FGGM 93

The following LUCs are already in place at FGGM:

- **Master Plan Regulations, Army Regulation (AR) 210-20**: The Army issued Master Planning for Army Installations, AR 210-20, on 16 May 2005 updating an earlier regulation dated 13 July 1987. AR 210-20 "establishes the requirement for an Installation Master Plan and planning board and specifies procedures for developing, submitting for approval, updating, and implementing the Installation Master Plan." This regulation provides for comprehensive planning at Army installations and not only allows, but requires incorporation of existing land use and conditions into the Master Plan. The Master Plan regulations provide a framework for comprehensive planning through the use of component plans, which include, but are not limited to, the following: Natural Resources Plan, Environmental Protection Plan, Installation Layout Vicinity Plan, Land-use Plan, and Future Development Plan. The planned LUCs and their respective locations will be added to the Installation Master Plan.

- **FGGM Geographical Information System (GIS) Database:** FGGM maintains a comprehensive installation-wide GIS database. The database includes descriptions of existing land and environmental restrictions, locations of known contamination, and location and extent of IRP Sites. This information will allow future end-users and tenants of FGGM to make rapid and accurate inquiries regarding sites within FGGM and will specify the LUCs in-place at specific locations. Existing wells, chemical contamination, building restrictions, and many other lines of inquiry will quickly be available to support the decision making process. A GIS layer containing the LUCs planned for FGGM 93, along with their respective locations, will be developed following approval of this document. This GIS layer will be added to the FGGM GIS database, in accordance with AR 200-1, Section 12-3. Other applicable layers may also be added to the FGGM GIS Database, as necessary.

- **FGGM Access Regulations**: Access regulations and controls are in place at FGGM, including identification checks and vehicle inspections. Although not closed to the public, access to FGGM is strictly controlled. Trespassing and unauthorized activities on FGGM are prohibited.

- **Army Military Construction Program Development and Execution**: AR 415-15 outlines pre-construction environmental survey procedures. Prior to construction activities, the Army categorizes the proposed construction site based on an environmental survey. Under this regulation, the Army must determine wetland status of the site, historical significance, and endangered species habitat identification.

- **FGGM Dig Permit Requirements:** The FGGM Directorate of Public Works requires a dig permit (Form #FGGM-DPW-1001) be submitted 30 days prior to initiation of intrusive activities at the Site. The dig permit application specifies the location and the type of intrusive work to be performed. The dig permit process will ensure that unrestricted intrusive activities will not be conducted at the Site.

- **Retention of Existing Chain-Link Fence:** A chain-link fence exists around the western portion of the Site and bisects the Site into two separate land uses: Community Recreational and Community Educational. Portions of the chain-link fence are anticipated to be removed (i.e., the northern, western, and southern sections); however, the north-south oriented fence along the drainage swale will be retained to separate the school yard from the western portion of the Site.

5.2 Land Use Control Implementation

The following ICs were identified in the ROD and will be implemented at the Site as a component of the remedy:

- Restrict intrusive activities to authorized personnel only;

- Prohibit residential use of the eastern and western portion of the Site;

- Prohibit groundwater use throughout the Site until contaminants in groundwater decrease to levels that allow for unlimited use and unrestricted exposure;

- Prohibit full time occupancy of the crawl space at the Manor View Elementary School;

- Ensure the retention and maintenance of the existing methane monitors in the Manor View Elementary School and housing units adjacent to the western parcel; and

- Develop and enforce provisions for the construction of buildings proposed within 100 ft of the Site to prevent vapor intrusion.

The remaining ICs will be implemented through completion of annual land use inspections which will ensure the placement and functionality of the methane monitors in the Manor View Elementary School and the adjacent housing units; confirm that the occupancy of the crawl space at Manor View Elementary has not changed; and identify any building construction planned within the Site boundaries.

The following ECs were identified in the ROD and will be implemented as a component of the remedy:

- Installation of signage prohibiting unauthorized intrusive activities at the Site;

- Installation of warning signs at various conspicuous locations at the Site including common entrances and exits informing Site visitors of environmental concerns at the Site; and

- Retention of the fence bisecting the Site into eastern and western parcels.

Signage will be installed on steel u-channel posts at the locations depicted on **Figure 8**. Signage describing the restrictions of site use at key locations will be manufactured and installed in accordance with Technical Manual 5-807-10 – Signage (U.S. Army, 1983).

5.3 Land Use Control Inspection and Documentation

Annual visual inspections will be performed to establish that all on-Site LUCs (signage and fencing) are in good condition and to confirm that the land use of the Site has not changed. A LUC annual inspection checklist has been included as **Appendix D**.

The Army will be responsible for implementation, maintenance, periodic inspection, reporting on, and enforcement of LUCs in accordance with the ROD. Although the

Army may transfer these responsibilities to another party by contract, property transfer agreement, or through other means, the Army will remain responsible for:

- Conducting CERCLA Section 121(c) five year reviews;
- Notifying USEPA and MDE and/or local government representatives as soon as practical but no longer than ten days after discovery of any known LUC deficiencies or violations;
- Obtaining access to the property to conduct periodic inspections and any necessary response as soon as practical but no longer than ten days after discovery;
- Ensuring that the LUC objectives are met to protect the integrity of the selected remedy;
- Preparing annual reports to document inspection findings, and also present and interpret soil gas, groundwater, and indoor air sampling data;
- Notifying USEPA and MDE 45 days in advance of any proposed land use changes that are inconsistent with LUC objectives or the selected remedy; and
- Seeking prior concurrence from USEPA and MDE before any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs.

The Army will provide notice to USEPA and MDE at least six months prior to any transfer or sale so that USEPA and MDE can ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective ICs. If it is not possible for the facility to notify USEPA and MDE at least six months prior to any transfer or sale, then the facility will notify USEPA and MDE as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to ICs. In addition to the land transfer notice and discussion provisions above, the Army further agrees to provide USEPA and MDE with similar notice, within the same time frames, as to federal-to-federal transfer of property. The Army shall provide a copy of executed deed or transfer assembly to USEPA and MDE."

6. Annual Site Inspection and Maintenance

This section describes the inspection and maintenance requirements of the existing soil cover, monitoring wells, and LUCs installed at the Site.

6.1 Site Inspection, Maintenance, and Land Use Controls

Upon approval of this RD by USEPA and concurrence by MDE, Site inspections will commence on an annual basis to ensure that the integrity and continued effectiveness of the existing soil cover is maintained and to confirm continued compliance with all LUC objectives. Annual inspections will be conducted in tandem with semi-annual LTM events, when possible, to minimize coordination and impact to the Manor View Elementary School. FGGM will maintain the records of these inspections, which will include the following:

- Inspection of Existing Soil Cover – The existing cover will be inspected to identify signs of erosion (i.e., rills and runs), settling, and the condition of vegetation.

- Annual Maintenance of Existing Soil Cover – At a minimum the western portion of the Site will be mowed and the vegetation along the former vapor extraction trench will be cleared annually. Additional maintenance may include the re-establishment of grass on bare spots and/or repair of erosion or subsidence of the soil cover as required based on any deficiencies noted during the annual inspection.

- Operational Testing of Methane Monitors and Soil Vapor Extraction System – During annual inspections the methane monitors in the Manor View Elementary school and housing units adjacent to the western portion of the Site will be tested to ensure that they are fully functional. Prior to conducting annual inspections, the Army will coordinate with both Manor View Elementary School and the Corvias Group to obtain access to the methane monitors. Additionally, the subsurface soil vapor extraction system will be turned on to ensure that it remains operational. Any deficiencies observed during system testing will be noted and repairs will be coordinated in a timely manner.

- Evaluation of Land Use – The site will be inspected to ensure that current land use has been maintained, land use controls (i.e., signage and fencing) are in good condition, and conditions are protective of human health and the environment.

- Identification of New Construction – During the inspection, new construction within the Site boundaries will be noted. Additionally, a desktop review will be conducted to ensure no new construction is planned to begin within the 12 months following the inspection.

- Monitoring Location Inspections – All monitoring wells and vapor monitoring points will be inspected for damage. Any necessary repairs will be noted and will be conducted promptly.

Documentation of annual site inspections will be recorded on the field forms provided in **Appendix D**. An annual report will be developed to summarize the inspection findings and any necessary repairs.

7. Implementation Schedule

The LTM program and implementation of LUCs will commence upon approval of this RD, anticipated in the third and fourth quarters of 2014. Annual inspections of the existing soil cover and LUCs implemented at the Site will be conducted in perpetuity. LTM of groundwater and soil gas will be conducted semi-annually and LTM of indoor air at Manor View Elementary School will be conducted annually. The LTM program will be evaluated during completion of CERLCA 5-year reviews and may be decreased pending USEPA and MDE approval in accordance with COMAR 26.04.07.09F. LTM reports will be submitted to regulators on a semi-annual basis following completion of each sampling event. A comprehensive review of field activities, analytical results, and inspection results, will be provided prior to the end of each calendar year.

8. Health and Safety

All work performed at the Site will be in accordance with the approved Site-Wide Health and Safety Plan (HASP; ARCADIS, 2010b) and with ARCADIS internal health and safety procedures. All Site personnel, contractors, subcontractors, and site visitors shall be vetted for access to FGGM prior to conducting field sampling activities and shall obtain all required training certificates pursuant to the requirements provided in the Site-Wide HASP.

9. References

ARCADIS U.S. Inc. (ARCADIS). 2010a. Waste Management Plan for the Performance Based Acquisition at Fort George G. Meade. Final. October 2010.

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Green, E. 2013. Maryland Department of the Environment. Letter to Paul Fluck, U.S. Army Garrison Fort George G. Meade, August 20, 2013.

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U.S. Army. 2014b. Final Proposed Plan, FGGM 93 Manor View Dump Site, Fort George G. Meade, Maryland. Final. June 2014.

United States Environmental Protection Agency. 1997. Low-Flow Purging and Sampling of Groundwater Monitoring Wells. Region III. October 1997.

URS. 2008. Remedial Investigation Report, Manor View Dump Site, Fort George G. Meade Maryland. Prepared by URS and the Army Corps of Engineers for Fort George G. Meade ANME-PWE, Environmental Division. November.

Tables

Table 1
Long-term Monitoring Program Summary
FGGM 93 Manor View Dump Site
Fort George G. Meade, Maryland

Category	Analytical Parameters	Sampling Frequency	Monitoring Wells	Sampling Method
Groundwater	40 CFR 258, Appendix I Parameters (Volatile Organic Compounds, Total Metals, and Water Quality Parameters²)	Semi-annually	MW-1	Low Flow Sampling
			MW-2	
			MW-3	
			MW-4	
			MW-5	
			MW-6	
			MW-7	
			MW-8	
			MW-9	
			MW-10	
			MW-11	
Soil Gas	Landfill Gases (Methane, Carbon Dioxide, and Oxygen)	Semi-annually, concurrent with groundwater monitoring schedule.	VMP-1	In-Situ Monitoring
			VMP-4	
			VMP-11	
			VMP-26	
			VMP-27	
			VMP-29	
			VMP-30	
			VMP-31	
			VMP-32	
			VMP-33	
			VMP-36	
			MP-A	
			VE-F	
			VE-C	
			SG-82 (S,M,D)	
Indoor Air	Trichloroethene and its daughter products	Annually, concurrent with groundwater monitoring schedule.	MV-13, Manor View Elementary Crawl Space	SUMMA® Canister

Notes:
1. The groundwater monitoring program may be modified over time based on monitoring results, upon concurrence from the Maryland Department of the Environment and the United States Environmental Protection Agency.

2. Water quality parameters include pH, alkalinity, hardness, chloride, specific conductance, nitrate, chemical oxygen demand, turbidity, ammonia, sulfate, and total dissolved solids.

Table 2
Appendix I of 40 CFR 258
FGGM 93 Manor View Dump Site
Fort George G. Meade, Maryland

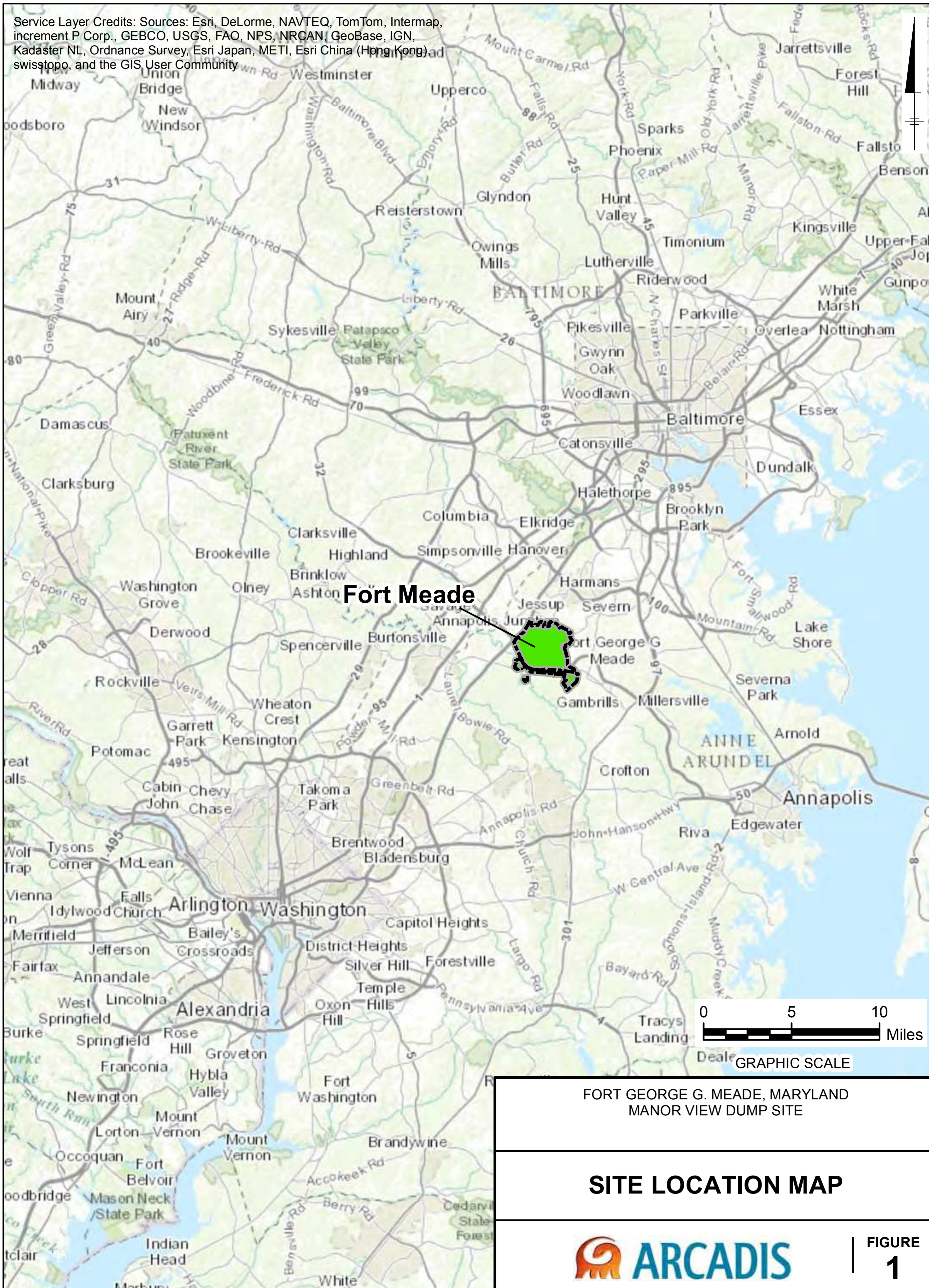
Parameter	CAS No.
Inorganic Constituents:	
(1) Antimony	(Total)
(2) Arsenic	(Total)
(3) Barium	(Total)
(4) Beryllium	(Total)
(5) Cadmium	(Total)
(6) Chromium	(Total)
(7) Cobalt	(Total)
(8) Copper	(Total)
(9) Lead	(Total)
(10) Nickel	(Total)
(11) Selenium	(Total)
(12) Silver	(Total)
(13) Thallium	(Total)
(14) Vanadium	(Total)
(15) Zinc	(Total)
Organic Constituents:	
(16) Acetone	67-64-1
(17) Acrylonitrile	107-13-1
(18) Benzene	71-43-2
(19) Bromochloromethane	74-97-5
(20) Bromodichloromethane	75-27-4
(21) Bromoform; Tribromomethane	75-25-2
(22) Carbon disulfide	75-15-0
(23) Carbon tetrachloride	56-23-5
(24) Chlorobenzene	108-90-7
(25) Chloroethane; Ethyl chloride	75-00-3
(26) Chloroform; Trichloromethane	67-66-3
(27) Dibromochloromethane; Chlorodibromomethane	124-48-1
(28) 1,2-Dibromo-3-chloropropane; DBCP	96-12-8
(29) 1,2-Dibromoethane; Ethylene dibromide; EDB	106-93-4
(30) o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1
(31) p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7
(32) trans-1, 4-Dichloro-2-butene	110-57-6
(33) 1,1-Dichlorethane; Ethylidene chloride	75-34-3
(34) 1,2-Dichlorethane; Ethylene dichloride	107-06-2
(35) 1,1-Dichloroethylene; 1,1-Dichloroethene; Vinylidene chloride	75-35-4
(36) cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene	156-59-2
(37) trans-1, 2-Dichloroethylene; trans-1,2-Dichloroethene	156-60-5
(38) 1,2-Dichloropropane; Propylene dichloride	78-87-5
(39) cis-1,3-Dichloropropene	10061-01-5
(40) trans-1,3-Dichloropropene	10061-02-6
(41) Ethylbenzene	100-41-4
(42) 2-Hexanone; Methyl butyl ketone	591-78-6
(43) Methyl bromide; Bromomethane	74-83-9
(44) Methyl chloride; Chloromethane	74-87-3
(45) Methylene bromide; Dibromomethane	74-95-3
(46) Methylene chloride; Dichloromethane	75-09-2
(47) Methyl ethyl ketone; MEK; 2-Butanone	78-93-3
(48) Methyl iodide; Idomethane	74-88-4
(49) 4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1
(50) Styrene	100-42-5
(51) 1,1,1,2-Tetrachloroethane	630-20-6
(52) 1,1,2,2-Tetrachloroethane	79-34-5
(53) Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4
(54) Toluene	108-88-3
(55) 1,1,1-Trichloroethane; Methylchloroform	71-55-6
(56) 1,1,2-Trichloroethane	79-00-5
(57) Trichloroethylene; Trichloroethene	79-01-6
(58) Trichlorofluoromethane; CFC-11	75-69-4
(59) 1,2,3-Trichloropropane	96-18-4
(60) Vinyl acetate	108-05-4
(61) Vinyl chloride	75-01-4
(62) Xylenes	1330-20-7

Table 3
Soil Gas Monitoring Three Volume Purge Summary
FGGM 93 Manor View Dump Site
Fort George G. Meade, Maryland

Monitoring Location	Diameter (in)	Depth (ft)	Construction Material	Screened Interval (ft bgs)	Volume (cf)	3x Volume (cf)	3x Volume (L)
RI Soil Gas (SG) Monitoring Points:							
SG-82S	0.5	8.2	PVC	Unknown	0.01	0.03	0.95
SG-82M	0.5	19	PVC	Unknown	0.03	0.08	2.20
SG-82D	0.5	37	PVC	Unknown	0.05	0.15	4.28
Monitoring Points (MP)							
MP-A	2	15	PVC	2 - 15	0.33	0.98	27.79
Vapor Monitoring Points (VMP)							
VMP-1 and VMP-4	1	10	PVC	3 - 10	0.05	0.16	4.63
VMP-30 and VMP-31	1	7	PVC	3 - 7	0.04	0.11	3.24
VMP-11	1	15	PVC	3 - 15	0.08	0.25	6.95
Vapor Monitoring Points							
VMP- 26, 27, 29, 32, 33, 36	0.25	5	Polyethylene Tubing	3/4-in diameter screened drive point at 5-ft bgs	0.0017	0.01	0.14
Former Vapor Extraction (VE) Points							
VE-C and VE-F	4	15	PVC	3 - 15	1.31	3.93	111.14

Notes :
bgs - below ground surface
cf - cubic feet
ft - feet
in - inch
L - liter
PVC - polyvinyl chloride

Figures



FORT GEORGE G. MEADE, MARYLAND
MANOR VIEW DUMP SITE

SITE LOCATION MAP

ARCADIS

FIGURE
1

CITY: MPLS DIV/GROUP: IM DB: MG
FORT GEORGE G. MEADE
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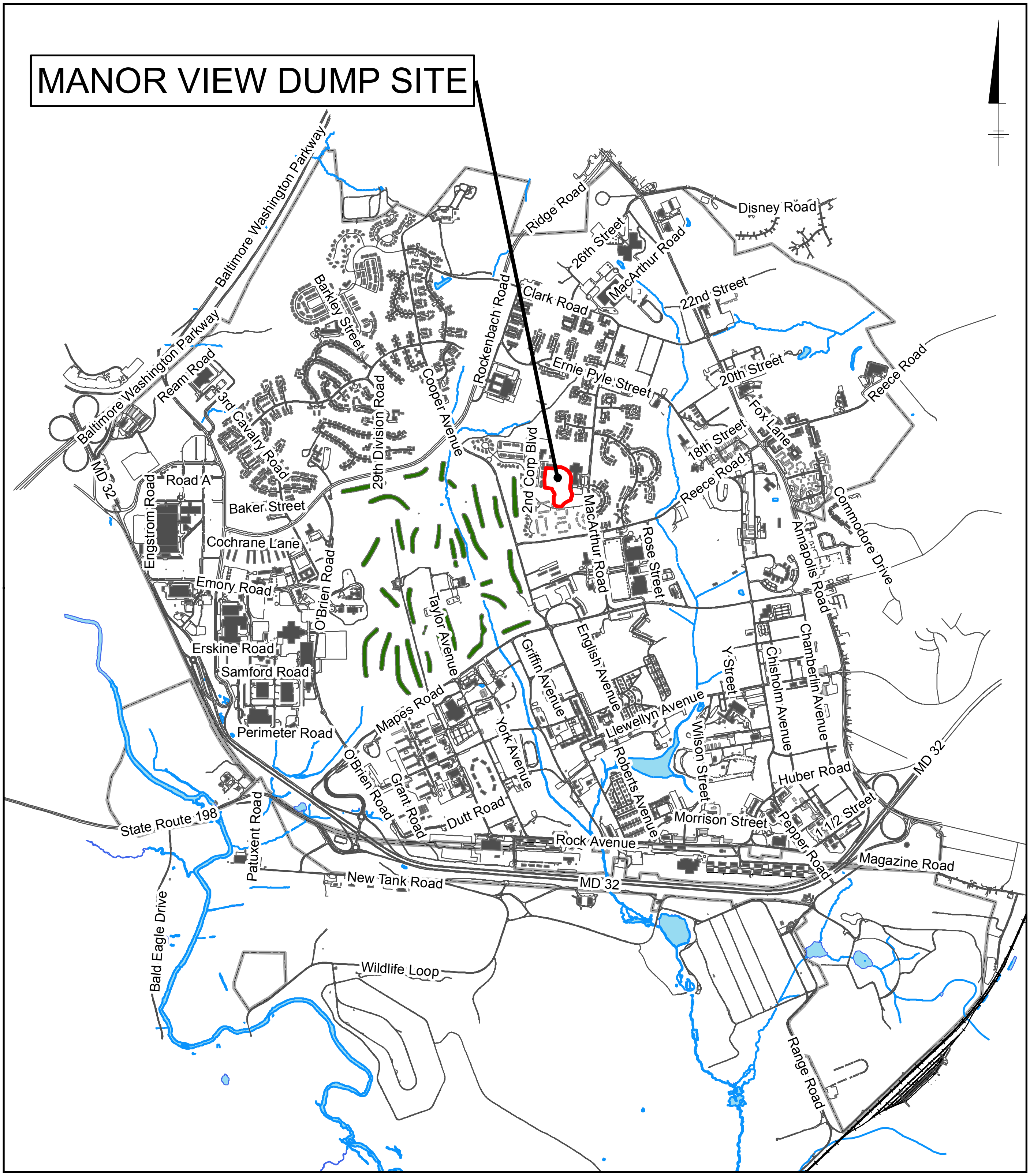

LEGEND:

MANOR VIEW SITE BOUNDARY

0 1,500 3,000 Feet

GRAPHIC SCALE

FORT GEORGE G. MEADE, MARYLAND
MANOR VIEW DUMP SITE

MANOR VIEW DUMP SITE
SITE LOCATION MAP

ARCADIS

FIGURE
2

CITY: MPLS DIV/GROUP: IM DB: MG LD: A. DUGGINS
FORT MEADE
Document Path: Z:\GISPROJECTS_ENV\Fort_Meade\ArcMap\Manor_View\Remedial Design for FGGM 93\02_Manor_View_Loc_2014_0520.mxd

LEGEND:

SITE BOUNDARY

0 200 400 Feet

GRAPHIC SCALE

FORT GEORGE G. MEADE, MARYLAND
MANOR VIEW DUMP SITE

MANOR VIEW DUMP SITE
SITE MAP

ARCADIS

FIGURE
3

CITY: MPLS DIV/GROUP: IM DB: MG LD: HA
FORT MEADE
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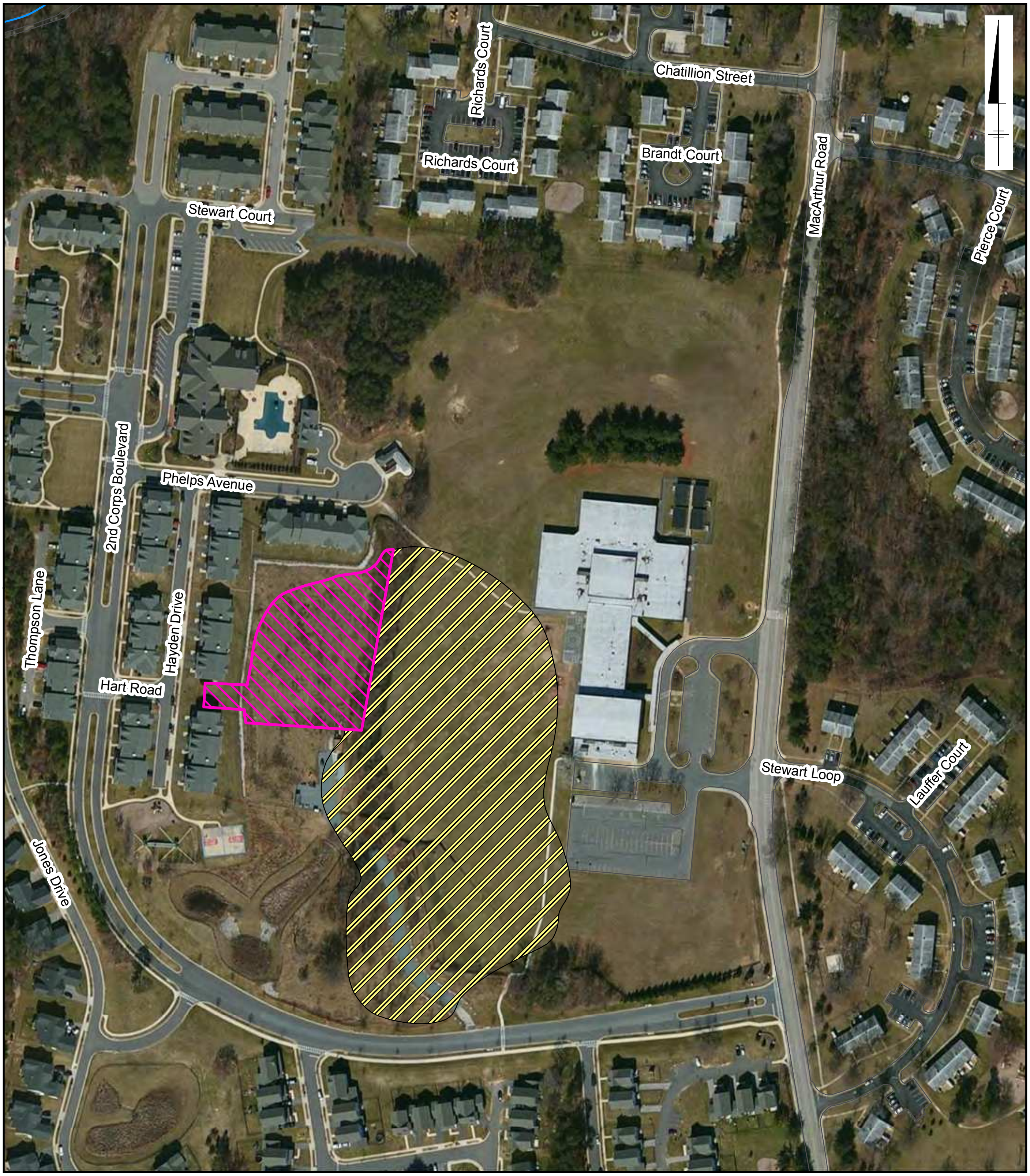

LEGEND:

0 200 400 Feet

GRAPHIC SCALE

DEBRIS/FILL FOOTPRINT

METHANE GENERATING WASTE FOOTPRINT/SOIL REMOVED DURING THE 2012 NON-TIME CRITICAL REMOVAL ACTION (LOCATION IS APPROXIMATE)

NOTE:

IMAGERY ACCESSED THROUGH BING MAPS AERIAL VIA ARCGIS ONLINE LAYER PACKAGES BY ESRI (12/1/2010) (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS ACCESSED ON 6/13/2013 THROUGH ARCGIS 10.

FORT GEORGE G. MEADE, MARYLAND
MANOR VIEW DUMP SITE

DEBRIS/FILL FOOTPRINT

ARCADIS

FIGURE 4

CITY: MPLS DIV/GROUP: IM DB: MG LD: HA
FORT MEADE
Path: G:\GIS\Projects\Fort_Meade\ArcMap\Manor_View\2013-06\Waste_Footprint_20130613.mxd

LEGEND

MONITORING WELL

DAMAGED, WELL ABANDONMENT PROPOSED

GROUNDWATER FLOW DIRECTION

0 200 400 Feet

GRAPHIC SCALE

FORT GEORGE G. MEADE, MARYLAND
MANOR VIEW DUMP SITE

MONITORING WELL LOCATIONS

ARCADIS

FIGURE
5

CITY: MPLS DIV/GROUP: IM DB: MG LD: HA
FORT MEADE
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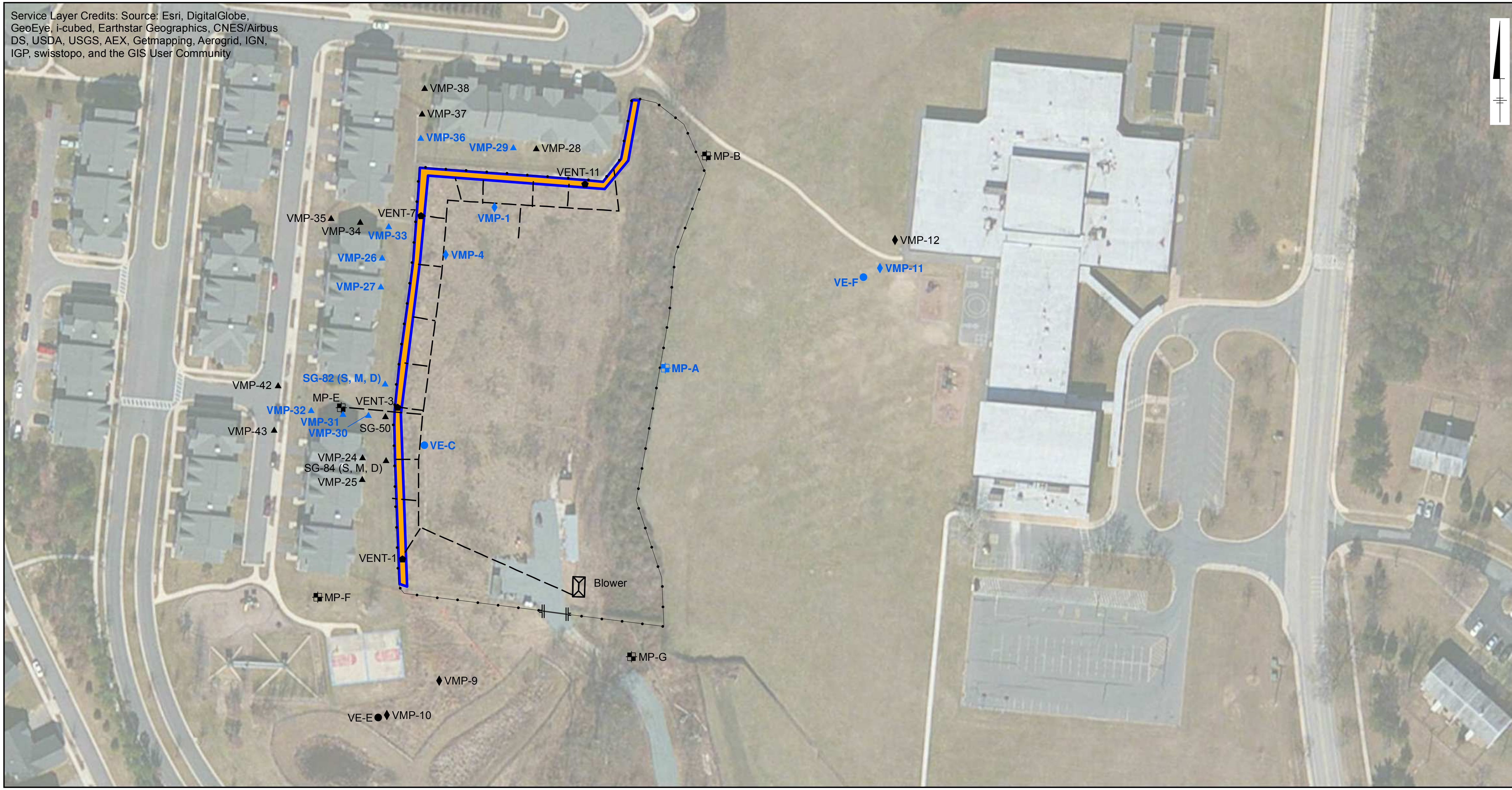

LEGEND:

- Monitoring Point
- Trench Well
- Deep Vapor Monitoring Point
- Shallow Vapor Monitoring Point
- Former Vapor Extraction Well
- Perimeter Fence
- Gate
- Subsurface Piping Network Associated with the Dormant Soil Vapor Extraction System (February 2012 - Present)
- Capped Passive Gas Collection Trench

0 100 200 Feet

GRAPHIC SCALE

Notes:
1. The soil vapor extraction system was shutdown on August 17, 2012. The system has remained off but in an operational status.
2. Monitoring locations included in the long-term monitoring program are displayed as a blue symbol with blue labels.

FORT GEORGE G. MEADE, MARYLAND
MANOR VIEW DUMP SITE

SOIL GAS MONITORING LOCATIONS

ARCADIS

FIGURE 6

CITY: MPLS DIV/GROUP: IM DB: MG LD: HA
FORT MEADE
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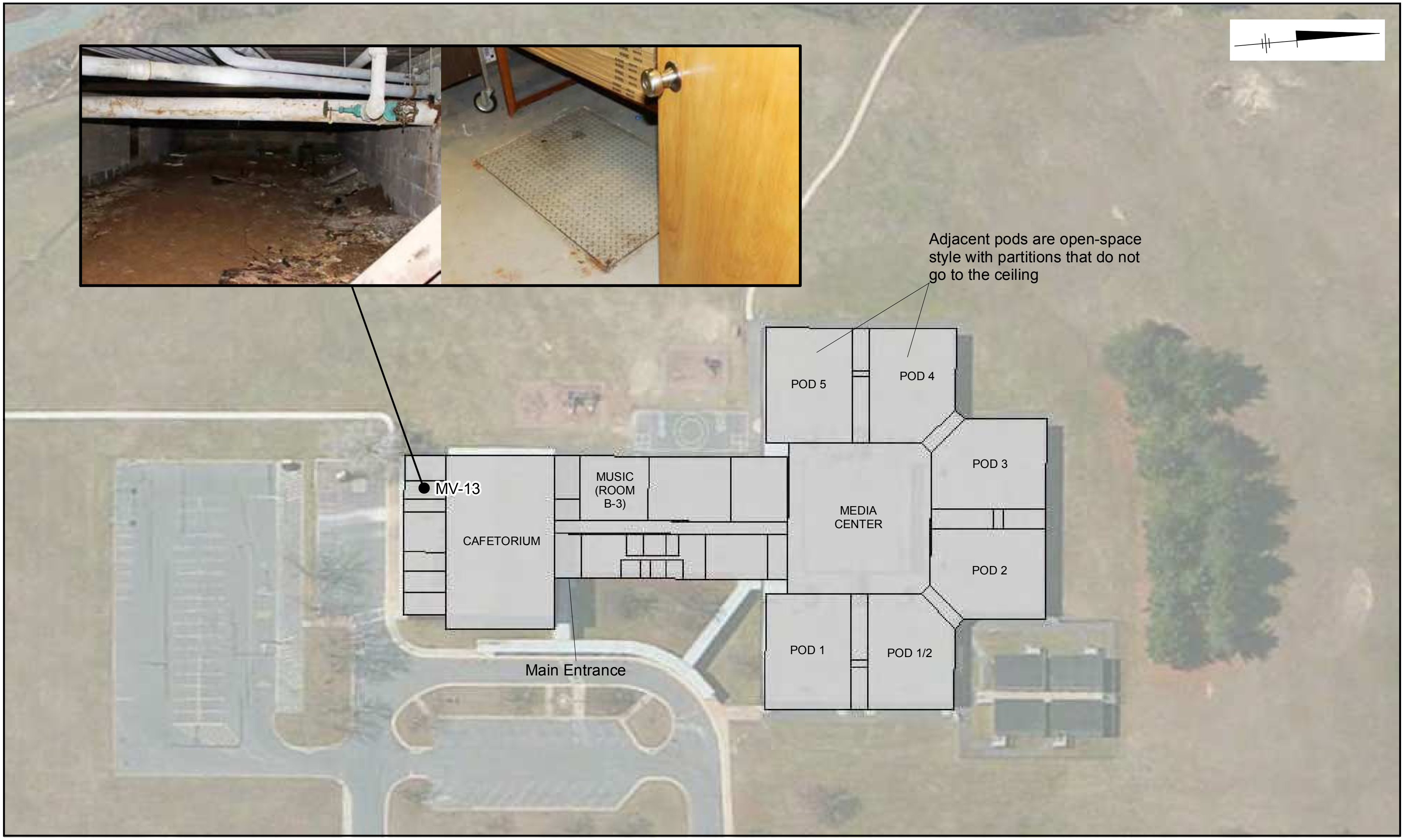

LEGEND:

● Indoor Air Sample

NOTE:
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 100 200 Feet
GRAPHIC SCALE

FORT GEORGE G. MEADE, MARYLAND
MANOR VIEW DUMP SITE

INDOOR AIR SAMPLE LOCATIONS SITE SCHOOL

ARCADIS

FIGURE 7

CITY: MPLS DIV/GROUP: IM DB: MG LD: HA
FORT MEADE
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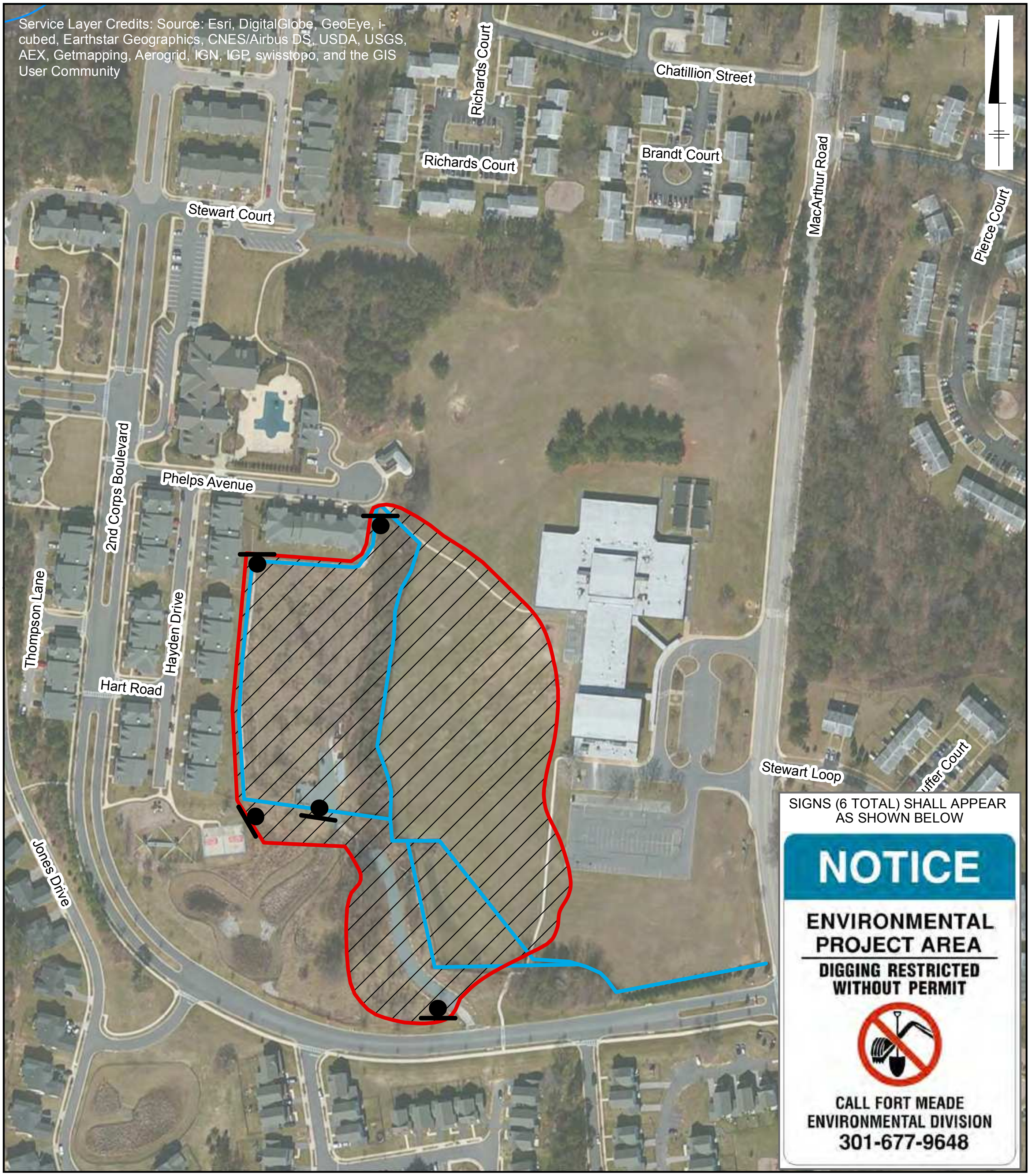

LEGEND:

- SIGN LOCATIONS
- CURRENT ENGINEERING CONTROL / FENCE
- SITE BOUNDARY
- EXTENT OF LAND USE CONTROLS

0 200 400 Feet

GRAPHIC SCALE

FORT GEORGE G. MEADE, MARYLAND
MANOR VIEW DUMP SITE

EXTENT OF LAND USE CONTROLS

ARCADIS

FIGURE
8

CITY: MPLS DIV/GROUP: IM DB: MG LD: HA
FORT MEADE
Path: Z:\GISPROJECTS_ENV\Fort_Meade\ArcMap\Manor_View\Remedial Design for FGGM 93\07_LandUse_2014_0813.mxd

Appendix A

Fact Sheet

FACT SHEET

Fort George G. Meade, Maryland
Manor View Dump Site

March 2014

Overview

The U.S. Army at Fort George G. Meade has released a Proposed Plan for public comment on the final environmental response plan for the Manor View Dump Site (Site). This fact sheet summarizes the investigations performed by the Army, past actions, alternatives presented in the Proposed Plan, and the preferred alternative. This fact sheet also provides information on how you can submit your comments.

Site History & Background

The Manor View Dump Site is an approximately 10-acre site near the intersection of MacArthur Road and 2nd Corps Boulevard in the central portion of Fort Meade (see map to left). The Site is surrounded by residential housing (Potomac Place) to the north along Phelps Avenue, to the west along Hayden Drive, and to the south along 2nd Corps Boulevard. Manor View Elementary School is to the east.

In 2003, construction workers discovered buried wastes and fill material when moving soil during the construction of military housing. Fort Meade began environmental investigations at the Site to determine the nature and extent of buried waste. As a result of the investigations, methane was detected at the Site in 2004, and safety measures were implemented.

Fort Meade has not found any records describing the operation of the dump or identifying the nature of the waste placed in the dump. The Army conducted several environmental investigations to categorize the age, type, and location of waste within the former dump. The investigations found organic material buried in the western parcel of the Site in an area about one acre in size (pink striped area in figure at left). Some of the waste is from the 1940s. The rest of the Site (eastern parcel) contains construction debris. The decomposition of the organic material in the one-acre area was generating methane, and the Army's initial actions focused on the methane.

Extensive Safety Measures Taken

The Army has taken extensive actions to ensure the safety of Potomac Place housing, Manor View Elementary School, and the surrounding community. First, the Army installed methane monitors within some of the military houses and Manor View Elementary School. Methane has not been detected at hazardous levels inside the homes or above normal background levels at the school. Second, the Army installed a temporary landfill gas migration control system to prevent the methane from moving beyond the Site boundary. The system consists of a vacuum blower which draws methane from the landfill and away from the residential properties. The methane was then safely discharged to the atmosphere at very low concentrations. To monitor the methane levels, the Army collected samples weekly from the system and from soil locations surrounding the Site. Third, when it was determined the control system was not capturing all the methane, the Army relocated military families in the houses nearest the Site, while it sought a more permanent solution.

Methane Facts

Methane (also known as natural gas) is an odorless and colorless gas. Methane can form within landfills as a natural byproduct when organic waste biodegrades. Although methane is not toxic, methane from landfills can pose a safety hazard at certain concentrations in the atmosphere that make it potentially flammable or explosive in the presence of an ignition source. To be dangerous, the methane would have to be at a significant concentration and have contact with an ignition source. Methane may displace oxygen in an enclosed space and present an asphyxiation hazard.

Developing a Permanent Solution

To address the source of the methane, the Army excavated the methane-generating waste at the site and disposed of it in an off-site landfill specifically designed to accept these wastes. The Army removed approximately 30,000 tons of waste, soil, and materials during the removal action in 2012. Air monitoring was conducted during the more than two-months of excavation activities, and no readings exceeded an action level.

The excavated area was backfilled and covered with 18 inches of clean imported fill and 6 inches of clean, imported topsoil. The remaining portion of the site containing the construction debris also has a soil cover ranging from two feet to eight feet in depth.

The Army has continued to sample and monitor for methane. Almost all locations now show no detection, while a few have continued to detect low-levels of residual methane. The Army will continue to sample and monitor.

Photo of the site during the excavation of the approximately 30,000 tons of waste.

COMPREHENSIVE INVESTIGATIONS COMPLETED

While the Army took interim actions to protect the community from the methane detected at the Site, it also conducted the full environmental investigations required by law, specifically the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The Army conducted a thorough Remedial Investigation of the Site to determine if any residual contamination was present, and if so, whether the contamination presented a risk to human health or the environment. It also developed a Feasibility Study to look at alternatives for addressing any identified risks.

The investigations found some sporadic detections of metals and solvents in the groundwater. However, drinking water is not impacted because drinking water at Fort Meade is supplied by a community water system which does not draw water from this area.

Trichloroethlyene (TCE), a solvent, was detected in one sample collected in 2005 during indoor air sampling at the Manor View Elementary School in a crawl space and could present a risk if the crawl space was ever occupied on a full-time basis by a student or teacher in the future. TCE was not detected in 12 other samples of occupied spaces at the school, nor was it detected in five sub-slab samples collected from beneath occupied spaces.

The Army's Feasibility Study looked at alternatives for controlling these potential future risks and continuing to provide protection from the waste still buried at the Site. The removal of approximately 30,000 tons of soil and methane-generating waste substantially addressed the methane issue; however, inspections and long-term monitoring will continue to ensure the effectiveness of the action.

RESPONSE ALTERNATIVES EXAMINED

The Army conducted a detailed analysis of various response alternatives and associated costs for the Site. The selected alternative will include a five-year review as required by CERCLA to ensure it continues to be effective.

Alternative 1: No Action. The law requires the Army evaluate taking no action to establish a baseline for comparison with other alternatives. **Cost: $0.**

Alternative 2: Maintenance of Existing Soil Cover, Land Use Controls, and Long-Term Monitoring. The existing soil cover over the Site will be inspected and maintained. Land use controls include signage at the Site, fencing, prohibiting residential use of the Site, prohibiting groundwater use throughout the Site, prohibiting full-time occupancy of the crawl space at the Manor View Elementary School, and developing and enforcing provisions for the construction of buildings within 100 feet of the Site to prevent the possibility of vapor intrusion. The long-term monitoring would include soil gas monitoring for methane, groundwater sampling, indoor air sampling in the crawl space at the school, and site inspections. **Cost: $241,000.**

Alternative 3: Installation of a Low Permeability Cap, Land Use Controls, and Long-Term Monitoring. A low permeability cap would be installed over the eastern parcel of the Site where buried construction debris remains (approximately nine acres). Land use controls and long-term monitoring would be similar to the activities discussed for Alternative 2.
Cost: $6,566,105.

Photo of the site after the removal action

ALTERNATIVES EVALUATED AGAINST CRITERIA

As required by law, the Army evaluated the above alternatives against nine criteria. The criteria are:

1. Overall protection of human health and the environment
2. Compliance with applicable or relevant and appropriate requirements
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, and volume
5. Short-term effectiveness
6. Implementability
7. Cost
8. State acceptance
9. Community acceptance

PREFERRED ALTERNATIVE SELECTED

The Army's preferred alternative is **Alternative No. 2, Maintenance of Existing Soil Cover, Land Use Controls, and Long-Term Monitoring.** The existing soil cover prevents direct contact with the buried waste and sub-surface soil. The land use controls would mitigate other Site risks, and long-term monitoring would ensure the soil cover continues to be effective and provide ongoing groundwater data.

OPPORTUNITIES FOR PUBLIC INPUT

The Army, in consultation with the U.S. Environmental Protection Agency and the Maryland Department of the Environment, can change the preferred alternative based on public comments. The Army encourages interested citizens to review and comment on the proposed action.

The Proposed Plan, can be viewed online, at www.ftmeade.army.mil/environment; click on "Clean-up Program", and then "Program Sites."

The Proposed Plan, as well as the full Administrative Record, also can be viewed at:

Fort Meade Environmental Division
4215 Roberts Avenue, Suite 320
Fort Meade, MD 20755
(301) 677-9559
Hours: 8 a.m. to 4 p.m.
(Monday—Friday)
(photo I.D. required to gain access onto Fort Meade)

Anne Arundel County Library
West County Area Branch
1325 Annapolis Road
Odenton, MD 21113
(410) 222-6277
Hours: 9 a.m. to 9 p.m. (Monday-Thursday)
9 a.m. to 5 p.m. (Friday and Saturday)
1 p.m. to 5 p.m. (Sunday)

The 30-day public comment period on the proposed action extends from March 20 to April 19, 2014. Written comments, postmarked by April 19, can be mailed to the address below (a comment form is enclosed for convenience) or sent by email to:

Ms. Mary Doyle
U.S. Army Garrison Fort George G Meade
Public Affairs Office
4409 Llewellyn Avenue
Fort Meade, MD 20755-7058
mary.l.doyle.civ@mail.mil

Or

Mr. John Burchette
Remedial Project Manager
U.S. EPA
1650 Arch Street
Philadelphia, PA 19103-2029
burchette.john@epa.gov

Or

Ms. Elisabeth Green, Ph.D.
Maryland Department of the Environment
Federal Facilities Division
1800 Washington Blvd., Suite 625
Baltimore, MD 21230-1719
elisabeth.green@maryland.gov

Appendix B

Standard Operating Procedures

Appendix B – Standard Operating Procedures

Table of Contents

Imagine the result

Indoor Air or Ambient Air Sampling and Analysis Using USEPA Method TO-15

SOP # 765199

Rev. #: 2

Rev Date: July 7, 2010

Approval Signatures

Prepared by: ______________________ Date: 07/07/2010

Mitch Wacksman and Andrew Gutherz

Approved by: ______________________ Date: 07/07/2010

Christopher Lutes and Nadine Weinberg

I. Scope and Application

This standard operating procedure (SOP) describes the procedures to collect indoor air or ambient air samples for the analysis of volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA® canister (<28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5 liters when allowed to fill to a vacuum of 6 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and provide detailed instructions for placing the sampling device and collecting indoor air samples for VOC analysis.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. ARCADIS field sampling personnel will be well versed in the relevant SOPs and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS personnel responsible for leading indoor air sample collection activities must have previous indoor air sampling experience.

III. Health and Safety Considerations

All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. The following are examples of hazards that are often encountered in conducting indoor air sampling:

- In crawl spaces, hazards often include low head room, limited light, poisonous insects, venomous snakes, and sharp debris.
- In residential buildings and neighborhoods unfamiliar dogs can pose a hazard. Even though proper permission for sampling may have been secured, it is still possible to encounter persons suspicious of or hostile to the sampling team.
- In occupied industrial buildings be aware of the physical hazards of ongoing industrial processes. Examples include moving forklifts and equipment pits.

IV. Equipment List

The equipment required for indoor air sample collection is presented below:

- 6-liter, stainless steel SUMMA® canisters (order at least one extra, if feasible);

- Flow controllers with in-line particulate filters and vacuum gauges (flow controllers are pre-calibrated by the laboratory to a specified sample duration [e.g., 8-hour]). Confirm with lab that flow controller is equipped with an in-line particulate filter and pressure gauge (order an extra set for each extra SUMMA® canister, if feasible);

- Appropriate-sized open-end wrenches (typically 9/16-inch);

- Chain-of-custody (COC) form;

- Building survey and product inventory form (example attached);

- Portable photoionization detector (PID) (for use identifying potential background sources during building survey described below);

- Sample collection log (attached);

- Camera if photography is permitted at sampling locations;

- Portable weather meter, if appropriate;

- Box, chair, tripod, or similar to hold canister above the ground surface; and

- Teflon sample tubing may be used to sample abnormal situations (i.e., sumps, where canisters must be hidden, etc.). In these situations ¼-inch Swagelok fittings or other methods may be appropriate to affix tubing to canister. Staff should check this before heading out into field.

V. Cautions

Care must be taken to minimize the potential for introducing interferences during the sampling event. As such, keep ambient air canisters away from heavy pedestrian traffic areas (e.g., main entranceways, walkways) if possible. If the canisters are not to be overseen for the entire sample duration, precautions should be taken to maintain the security of the sample (e.g., do not place in areas regularly accessed by the public, fasten the sampling device to a secure object using lock and chain, label the canister to indicate it is part of a scientific project, notify local authorities, place the canister in secure housing that does not disrupt the integrity/validity of the sampling event). Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens (sharpies), wear/apply fragrances, or smoke cigarettes before and/or during the sampling event.

Ensure that the flow controller is pre-calibrated to the proper sample collection duration (confirm with laboratory). Sample integrity can be compromised if sample collection is extended to the point that the canister reaches atmospheric pressure. Sample integrity is maintained if sample collection is terminated prior to the target duration and a measurable vacuum (e.g., 5–inches Hg) remains in the canister when sample collection is terminated.

VI. Procedure

Initial Building Survey for Indoor Air Samples (if applicable to project)

1. Complete the appropriate building survey form and product inventory form (e.g., state-specific form, USEPA form, or ARCADIS form, [Attachment A]) as necessary in advance of sample collection.

2. Survey the area for the apparent presence of items or materials that may potentially produce or emit constituents of concern and interfere with analytical laboratory analysis of the collected sample. Record relevant information on survey form and document with photographs.

3. Record date, time, location, and other relevant notes on the sampling form.

4. Items or materials that contain constituents of concern and/or exhibit elevated PID readings shall be considered probable sources of VOCs. Request approval of the owner or occupant to have these items removed to a structure not attached to the target structure at least 48 hours prior to sampling if possible.

5. Set a date and time with the owner or occupant to return for placement of SUMMA® canisters.

Preparation of SUMMA®-Type Canister and Collection of Sample

1. Record the following information on the sampling form (use a hand-held weather meter, contact the local airport or other suitable information source [e.g., weatherunderground.com] to obtain the following information):

   - ambient temperature;

- barometric pressure;
- wind speed; and
- relative humidity.

2. Choose the sample location in accordance with the sampling plan. If a breathing zone sample is required, place the canister on a ladder, tripod, box, or other similar stand to locate the canister orifice 3 to 5 feet above ground or floor surface. If the canister will not be overseen for the entire sampling period, secure the canisters as appropriate (e.g., lock and chain). Canister may be affixed to wall/ceiling support with nylon rope or placed on a stable surface. In general, areas near windows, doors, air supply vents, and/or other potential sources of “drafts” shall be avoided.

3. Record SUMMA® canister serial number and flow controller number on the sampling log and chain of custody (COC) form. Assign sample identification on canister ID tag, and record on the sample collection log (Attachment B), and COC form.

4. Remove the brass dust cap from the SUMMA® canister. Attach the flow controller with in-line particulate filter and vacuum gauge to the SUMMA® canister with the appropriate-sized wrench. Tighten with fingers first, then gently with the wrench. Use caution not to over tighten fittings.

5. Open the SUMMA® canister valve to initiate sample collection. Record the date and local time (24-hour basis) of valve opening on the sample collection log, and COC form. Collection of duplicate samples will include collecting two samples side by side at the same time.

6. Record the initial vacuum pressure in the SUMMA® canister on the sample log and COC form. If the initial vacuum pressure registers less than -25 inches of Hg, then the SUMMA® canister is not appropriate for use and another canister should be used.

7. Take a photograph of the SUMMA® canister and surrounding area, if possible.

8. Check the SUMMA canister approximately half way through the sample duration and note progress on sample logs.

Termination of Sample Collection

1. Arrive at the SUMMA® canister location at least 1-2 hours prior to the end of the sampling interval (e.g., 8-hour, 24-hour).

2. Stop collecting the sample when the canister vacuum reaches approximately 7 inches of Hg (leaving some vacuum in the canister provides a way to verify if the canister leaks before it reaches the laboratory) or when the desired sample time has elapsed.

3. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valve. Record the date, local time (24-hour basis) of valve closing on the sample collection log, and COC form.

4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install brass cap on canister fitting, and tighten with wrench.

5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.

6. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with string).

7. Complete COC form and place requisite copies in shipping container. Close shipping container and affix custody seal to container closure. Ship to laboratory via overnight carrier (e.g., Federal Express) for analysis.

VII. Waste Management

No specific waste management procedures are required.

VIII. Data Recording and Management

Notes taken during the initial building survey will be recorded on the sample log, with notations of project name, sample date, sample time, and sample location (e.g., description and GPS coordinates if available) sample start and finish times, canister serial number, flow controller number, initial vacuum reading, and final vacuum reading. Sample logs and COC records will be transmitted to the Task Manager or Project Manager. A building survey form and product inventory form (Attachment A) may also be completed for each building within the facility being sampled during each sampling event as applicable.

IX. Quality Assurance

Indoor air or ambient air sample analysis will be performed using USEPA Method TO-15. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5 ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode.

Duplicate samples should be collected in the field as a quality assurance step. Generally, duplicates are taken of 10% of samples, but project specific requirements should take precedence.

Building Survey and Product Inventory Form

Directions: This form must be completed for each residence or area involved in indoor air testing.

Preparer's Name: ___________________________________

Date/Time Prepared: ________________________________

Preparer's Affiliation: _______________________________

Phone No.: ____

Purpose of Investigation: ____

1. OCCUPANT:

Interviewed: Y / N

Last Name: _________________________ First Name: _________________________

Address: ____

County: ___________________________________

Home Phone: _______________________ Office Phone: ________________________

Number of Occupants/Persons at this Location: _________________

Age of Occupants: ______________________

2. OWNER OR LANDLORD: (Check if Same as Occupant ___)

Interviewed: Y / N

Last Name: _________________________ First Name: _________________________

Address: ____

County: _________________________________

Home Phone: ____________________ Office Phone: ____________________

3. BUILDING CHARACTERISTICS:

Type of Building: (circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: ________________

If the Property is Residential, Type? (circle appropriate response)

Ranch		2-Family 3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:______________

If Multiple Units, How Many? ___________

If the Property is Commercial, Type?

Business Type(s) ____________________________________

Does it include residences (i.e., multi-use)? Y / N If yes, how many? _________

Other Characteristics:

Number of Floors______ Building Age______

Is the Building Insulated? Y / N How Air-Tight? Tight / Average / Not Tight

4. AIRFLOW:

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow Between Floors

____

____

____

Airflow Near Source

____

____

____

Outdoor Air Infiltration

____

____

____

Infiltration Into Air Ducts

____

____

____

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS: (circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other ________
c. Basement floor:	concrete	dirt	stone	other ________
d. Basement floor:	uncovered	covered	covered with ______________	
e. Concrete floor:	unsealed	sealed	sealed with ________________	
f. Foundation walls:	poured	block stone	other ______________________	
g. Foundation walls:	unsealed	sealed	sealed with ________________	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	

j. Sump present? Y / N

k. Water in sump? Y / N / NA

Basement/lowest level depth below grade: ________(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

____

Are the basement walls or floor sealed with waterproof paint or epoxy coatings? Y / N

6. HEATING, VENTILATING, AND AIR CONDITIONING: (circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard
Space heaters	Stream radiation	Radiant floor
Electric baseboard	Wood stove	Outdoor wood boiler
Other __________		

The primary type of fuel used is:

Natural base	Fuel oil	Kerosene
Electric	Propane	Solar
Wood coal		

Domestic hot water tank fueled by: ______________________________

Boiler/furnace located in: Basement Outdoors Main Floor Other____________

Air conditioning: Central Air Window Units Open Windows None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

____

____

____

7. OCCUPANCY:

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

General Use of Each Floor (e.g., family room, bedroom, laundry, workshop, storage):

Basement ____

1st Floor ____

2nd Floor ____

3rd Floor ____

4th Floor ____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY:

a. Is there an attached garage? Y / N

b. Does the garage have a separate heating unit? Y / N / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, ATV, car)?

Y / N / NA Please specify: ______________________________________

d. Has the building ever had a fire? Y / N When? ________________________

e. Is a kerosene or unvented gas space heater present? Y / N Where? ________________

f. Is there a workshop or hobby/craft area? Y / N Where & Type? ______________

g. Is there smoking in the building? Y / N How frequently? ______________________

h. Have cleaning products been used recently? Y / N When & Type? _______________

i. Have cosmetic products been used recently? Y / N When & Type? _______________

j. Has painting/staining been done in the last 6 months? Y / N Where & When? __________

k. Is there new carpet, drapes or other textiles? Y / N Where & When? _____________

l. Have air fresheners been used recently? Y / N When & Type? ___________________

m. Is there a kitchen exhaust fan? Y / N If yes, where _____________________

n. Is there a bathroom exhaust fan? Y / N If yes, where vented?___________________

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type?______________________

q. Are there odors in the building? Y / N

If yes, please describe: ____

Do any of the building occupants use solvents (e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist) at work? Y / N

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (circle appropriate response)

Yes, use dry-cleaning regularly (weekly) No

Yes, use dry-cleaning infrequently (monthly or less) Unknown

Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Y / N

Date of Installation: ______________________

Is the system active or passive? Active/Passive

Are there any Outside Contaminant Sources? (circle appropriate responses)

Contaminated site with 1000-foot radius? Y / N Specify ________________________________

Other stationary sources nearby (e.g., gas stations, emission stacks, etc.): ___________________

____

Heavy vehicle traffic nearby (or other mobile sources): __________________________________

9. WATER AND SEWAGE:

Water Supply:	Public Water	Drilled Well	Driven Well	Dug Well	Other: _______
Sewage Disposal:	Public Sewer	Septic Tank	Leach Field	Dry Well	Other: _______

10. RELOCATION INFORMATION: (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: ___________________________________

____

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS:

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:

First Floor:

12. OUTDOOR PLOT:

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s), and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

13. PRODUCT INVENTORY FORM:

Make and Model of field instrument used: ____

List specific products found in the residence or area that have the potential to affect indoor air quality (e.g., gasoline or kerosene storage cans, glues, paints, cleaning solvents/products, polishes/waxes, new furniture/ carpet, nail polish/hairspray/cologne).

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo** Y/N

ARCADIS		# Indoor Air/Ambient Air Sample Collection Log	
		Sample ID:	
Client:		**Outdoor/Indoor:**	
Project:		**Sample Intake Height:**	
Location:		**Tubing Information:**	
Project #:		**Miscellaneous Equipment:**	
Samplers:		**Time On/Off:**	
Sample Point Location:		**Subcontractor:**	

Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)

(a) Record canister information at a minimum at the beginning and end of sampling

SUMMA Canister Information:

Size (circle one):	**1 L 6 L**
Canister ID:	
Flow Controller ID:	
Notes:	

General Observations/Notes:

ARCADIS
Infrastructure, environment, facilities

Imagine the result

Field Equipment Decontamination

Rev. #: 3

Rev Date: April 26, 2010

Approval Signatures

Prepared by: ______________________ Date: 4/26/2010
Keith Shepherd

Reviewed by: ______________________ Date: 4/26/2010
Richard Murphy (Technical Expert)

I. Scope and Application

Equipment decontamination is performed to ensure that sampling equipment that contacts a sample, or monitoring equipment that is brought into contact with environmental media to be sampled, is free from analytes of interest and/or constituents that would interfere with laboratory analysis for analytes of interest. Equipment must be cleaned prior to use for sampling or contact with environmental media to be sampled, and prior to shipment or storage. The effectiveness of the decontamination procedure should be verified by collecting and analyzing equipment blank samples.

The equipment cleaning procedures described herein includes pre-field, in the field, and post-field cleaning of sampling tools which will be conducted at an established equipment decontamination area (EDA) on site (as appropriate). Equipment that may require decontamination at a given site includes: soil sampling tools; groundwater, sediment, and surface-water sampling devices; water testing instruments; down-hole instruments; and other activity-specific sampling equipment. Non-disposable equipment will be cleaned before collecting each sample, between sampling events, and prior to leaving the site. Cleaning procedures for sampling equipment will be monitored by collecting equipment blank samples as specified in the applicable work plan or field sampling plan. Dedicated and/or disposable (not to be re-used) sampling equipment will not require decontamination.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, and site-specific training, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and possess the skills and experience necessary to successfully complete the desired fieldwork. The project HASP and other documents will identify any other training requirements such as site specific safety training or access control requirements.

III. Equipment List

- health and safety equipment, as required in the site Health and Safety Plan (HASP)
- distilled water

- Non-phosphate detergent such as Alconox or, if sampling for phosphorus phosphorus-containing compounds, Luminox (or equivalent).
- tap water
- rinsate collection plastic containers
- DOT-approved waste shipping container(s), as specified in the work plan or field sampling plan (if decontamination waste is to be shipped for disposal)
- brushes
- large heavy-duty garbage bags
- spray bottles
- (Optional) – Isoprophyl alcohol (free of ketones) or methanol
- Ziploc-type bags
- plastic sheeting

IV. Cautions

Rinse equipment thoroughly and allow the equipment to dry before re-use or storage to prevent introducing solvent into sample medium. If manual drying of equipment is required, use clean lint-free material to wipe the equipment dry.

Store decontaminated equipment in a clean, dry environment. Do not store near combustion engine exhausts.

If equipment is damaged to the extent that decontamination is uncertain due to cracks or dents, the equipment should not be used and should be discarded or submitted for repair prior to use for sample collection.

A proper shipping determination will be performed by a DOT-trained individual for cleaning materials shipped by ARCADIS.

V. Health and Safety Considerations

Review the material safety data sheets (MSDS) for the cleaning materials used in decontamination. If solvent is used during decontamination, work in a well-ventilated area and stand upwind while applying solvent to equipment. Apply solvent in a manner that minimizes potential for exposure to workers. Follow health and safety procedures outlined in the HASP.

VI. Procedure

A designated area will be established to clean sampling equipment in the field prior to sample collection. Equipment cleaning areas will be set up within or adjacent to the specific work area, but not at a location exposed to combustion engine exhaust. Detergent solutions will be prepared in clean containers for use in equipment decontamination.

Cleaning Sampling Equipment

1. Wash the equipment/pump with potable water.

2. Wash with detergent solution (Alconox, Liquinox or equivalent) to remove all visible particulate matter and any residual oils or grease.

3. If equipment is very dirty, precleaning with a brush and tap water may be necessary.

4. (Optional) – Flush with isopropyl alcohol (free of ketones) or with methanol. This step is optional but should be considered when sampling in highly impacted media such as non-aqueous phase liquids or if equipment blanks from previous sampling events showed the potential for cross contamination of organics.

5. Rinse with distilled/deionized water.

Decontaminating Submersible Pumps

Submersible pumps may be used during well development, groundwater sampling, or other investigative activities. The pumps will be cleaned and flushed before and between uses. This cleaning process will consist of an external detergent solution wash and tap water rinse, a flush of detergent solution through the pump, followed by a flush of potable water through the pump. Flushing will be accomplished by using an appropriate container filled with detergent solution and another contained filled with potable water. The pump will run long enough to effectively flush the pump housing and hose (unless new, disposable hose is used). Caution should be exercised to avoid contact with the pump casing and water in the container while the pump is running (do not use metal drums or garbage cans) to avoid electric shock. Disconnect the pump from the power source before handling. The pump and hose should be placed on or in clean polyethylene sheeting to avoid contact with the ground surface.

VII. Waste Management

Equipment decontamination rinsate will be managed in conjunction with all other waste produced during the field sampling effort. Waste management procedures are outlined in the work plan or Waste Management Plan (WMP).

VIII. Data Recording and Management

Equipment cleaning and decontamination will be noted in the field notebook. Information will include the type of equipment cleaned, the decontamination location and any deviations from this SOP. Specific factors that should be noted include solvent used (if any), and source of water.

Any unusual field conditions should be noted if there is potential to impact the efficiency of the decontamination or subsequent sample collection.

An inventory of the solvents brought on site and used and removed from the site will be maintained in the files. Records will be maintained for any solvents used in decontamination, including lot number and expiration date.

Containers with decontamination fluids will be labeled.

IX. Quality Assurance

Equipment blanks should be collected to verify that the decontamination procedures are effective in minimizing potential for cross contamination. The equipment blank is prepared by pouring deionized water over the clean and dry tools and collecting the deionized water into appropriate sample containers. Equipment blanks should be analyzed for the same set of parameters that are performed on the field samples collected with the equipment that was cleaned. Equipment blanks are collected per equipment set, which represents all of the tools needed to collect a specific sample.

X. References

USEPA Region 9, Field Sampling Guidance #1230, Sampling Equipment Decontamination.

USEPA Region 1, Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.

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Water Level Measurement

Rev. #: 2

Rev Date: February 24, 2011

Approval Signatures

Prepared by: ______________________________ Date: 02/24/2011

Reviewed by: ______________________________ Date: 02/24/2011
(Technical Expert)

I. Scope and Application

The objective of this Standard Operating Procedure (SOP) is to describe procedures to measure and record groundwater and surface-water elevations. Water levels may be measured using an electronic water-level probe, oil-water level indicator, or a pressure transducer from established reference points (e.g. top of casing). Reference points will be surveyed to evaluate fluid elevations relative to mean sea level (msl). This SOP describes the equipment, field procedures, materials, and documentation procedures to measure and record groundwater and surface-water elevations using the aforementioned equipment.

This is a standard (i.e., typically applicable) operating procedure which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project work plans or reports.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and posses the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following materials, as required, shall be available during water level measurements:

- Appropriate personal protective equipment as specified in the Site Health and Safety Plan
- Equipment decontamination supplies
- Electronic water-level indicator
- Electronic oil-water level indicator
- Mini-Troll® or Troll® pressure transducer
- In-Situ™ data logger

- Laptop computer with the Win-Situ software package installed
- Photoionization detector (PID) and/or organic vapor analyzer
- Non-phosphate laboratory soap (Alconox or equivalent)
- Deionized/distilled water
- 150-foot measuring tape
- Solvent (methanol/acetone) rinse
- Portable containers
- Hacksaw
- Pliers
- Plastic sheeting
- “Write-in-the-Rain” Field logbook and or PDA (Personal Digital Assistant)
- Indelible ink pen.

IV. Cautions

Electronic water-level probes and oil-water interface probes can sometimes produce false-positive readings. For example, if the inside surface of the well has condensation above the water level, then an electronic water-level probe may produce a signal by contacting the side of the well rather than the true water level in the well. To produce reliable data, the electronic water level probe and/or interface probe should be raised and lowered several times at the approximate depth where the instrument produces a tone indicating a fluid interface to verify consistent, repeatable results.

The graduated tape or cable with depth markings is designed to indicate the depth of the electronic sensor that detects the fluid interface, but not the depth of the bottom of the instrument. When using these devices to measure the total well depth, the additional length of the instrument below the electronic sensor must be added to the apparent well depth reading, as observed on the tape or cable of the instrument, to obtain the true total depth of the well. If the depth markings on the tape or cable are worn or otherwise difficult to read, extra care must be taken in obtaining the depth readings.

V. Health and Safety Considerations

The HASP will be followed, as appropriate, to ensure the safety of field personnel. Access to wells may expose field personnel to hazardous materials such as contaminated groundwater or oil. Other potential hazards include stinging insects that may inhabit well heads, other biologic hazards, and potentially the use of sharp cutting tools (scissors, knife). Appropriate personal protective equipment (PPE) will be worn during these activities. Field personnel will thoroughly review client-specific health and safety requirements, which may preclude the use of fixed/folding-blade knives.

VI. Procedure

Electronic Water-Level Indicators and Oil-Water Indicators

Calibration procedures and groundwater level measurement procedures for electronic water-level indicators and oil-water indicators are described in the sections below.

Calibration Procedures

The indicator probe will be tested to verify that the meter has been correctly calibrated by the manufacturer. The following steps will be used to verify the accuracy of the indicator:

1. Measure the lengths between each increment marker on the indicator with a measuring tape. The appropriate length of indicator measuring tape, suitable to cover the depth range for the wells of interest, will be checked for accuracy.

2. If the indicator measuring tape is inaccurate, the probe will be sent back to the manufacturer.

3. Equipment calibration will be recorded in the field logbook and/or PDA.

Groundwater Level Measurement Procedures

A detailed procedure for obtaining water elevations will be as follows:

1. Identify site and monitoring well number in field notebook along with date, time, personnel and weather conditions using indelible ink.

2. Use safety equipment as specified in the Health and Safety Plan.

3. Decontaminate the indicator probe and tape in accordance with the appropriate cleaning procedures.

4. Place clean plastic sheeting on the ground next to the well.

5. Unlock and open the monitoring well cover while standing upwind from the well.

6. Measure the volatile organics present in the monitoring well head space with a PID and record the PID reading in the field logbook.

7. Allow the water level in the well to equilibrate with atmospheric pressure for a few minutes. Locate a measuring reference point on the monitoring well casing. If one is not found, create a reference point by notching the highest point on the inner casing (or outer if an inner casing is not present) with a hacksaw. All downhole measurements will be taken from the reference point. Document the creation of any new reference point or alteration of the existing reference point.

8. Measure to the nearest 0.01 foot and record the height of the inner and outer casing from reference point to ground level.

9. Slowly lower the level indicator probe until it touches the bottom of the well. Record the total depth of the well from the top of the inner casing (or outer casing if inner casing is not present). Measure depth to water level as the probe is drawn back up through the water column. If used to measure the level of surface water, slowly lower from the surveyed reference point, as appropriate. Double check all measurements and record depths to the nearest 0.01 foot.

10. Decontaminate the instrument using appropriate cleaning procedures.

11. Lock the well when all activities are completed.

Pressure Transducers

The detailed procedure for obtaining water elevations using a Mini-Troll® or Troll® pressure transducer with an In-Situ™ data logger and the Win-Situ software package will be as follows:

Setup Procedures

1. Connect the Mini-Troll® or Troll® transducer to a laptop computer serial port.

2. Open the Win-Situ software package on the laptop computer.

3. Verify that the Win-Situ software recognizes the transducer.

4. Synchronize the clock on the laptop computer with that of the transducer.

5. Add a test to the transducer and input the specifications of the test (e.g., frequency of data collection, start data collection).

6. Disconnect the transducer from the laptop computer, and prepare the transducer for field deployment.

Field Procedures

1. Decontaminate all equipment entering the monitoring well using appropriate cleaning procedures.

2. Connect transducer to laptop computer, and start the Win-Situ program.

3. Lower the transducer gently below the water table or surface-water level.

4. Take a water level reading from the transducer using the Win-Situ software package. Lift the transducer approximately 1-foot, and verify the transducer response on the Win-Situ program (i.e. depth to water should be 1-foot less).

5. Upon verification, set the transducer to the desired depth. Position the instrument below the lowest anticipated water level, but not so low that its range will be exceeded at the highest anticipated water level. The maximum operating depth below water is equal to 2.31 feet times the psi rating of the transducer (e.g., 23.1 feet for a 10 psi transducer).

6. Secure the cable at the well head or fixed object adjacent to surface-water body to prevent drift and movement.

7. Obtain a manual water-level reading using the procedure noted above, and record the measurement in the field notebook or PDA.

8. Set reference point (e.g. depth to water, groundwater elevation) and input it into the Win-Situ software package.

9. Periodically download data and collect additional manual depth-to-water measurements using the same water-level or oil-water indicator probe used during the equipment setup to verify the accuracy of the transducer.

VII. Waste Management

Decontamination fluids, PPE, and other disposable equipment will be properly stored on site in labeled containers and disposed of properly. Be certain that waste containers are properly labeled and documented in the field log book. Review appropriate waste management SOPs, which may be state- or client-specific.

VIII. Data Recording and Management

Groundwater level measurements should be documented in the field logbook and/or PDA. The following information will be documented in the field logbook:

- Sample identification
- Measurement time
- Total well depth
- Depth to water

Groundwater elevations recorded using a Mini-Troll® or Troll® pressure transducer with an In-Situ™ data logger and the Win-Situ software package will be downloaded and stored in the central project file.

IX. Quality Assurance

As described in the detailed procedure, the electronic water-level meter and/or oil-water interface probe will be calibrated prior to use versus an engineer's rule to ensure accurate length demarcations on the tape or cable. Fluid interface measurements will be verified by gently raising and lowering the instrument through each interface to confirm repeatable results.

X. References

No literature references are required for this SOP.

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Chain-of-Custody, Handling, Packing and Shipping

Rev. #: 2

Rev Date: March 6, 2009

Approval Signatures

Prepared by: ______________________ Date: 3/6/09
Caron Koll

Reviewed by: ______________________ Date: 3/6/09
Jane Kennedy(Technical Expert)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the chain-of-custody, handling, packing, and shipping procedures for the management of samples to decrease the potential for cross-contamination, tampering, mis-identification, and breakage, and to insure that samples are maintained in a controlled environment from the time of collection until receipt by the analytical laboratory.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, Department of Transportation (DOT) training, site supervisor training, and site-specific training, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and possess the skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following list provides materials that may be required for each project. Project documents and sample collection requirements should be reviewed prior to initiating field operations:

- indelible ink pens (black or blue);
- polyethylene bags (resealable-type);
- clear packing tape, strapping tape, duct tape;
- chain of custody
- DOT shipping forms, as applicable
- custody seals or tape;
- appropriate sample containers and labels,;
- insulated coolers of adequate size for samples and sufficient ice to maintain 4°C during collection and transfer of samples;
- wet ice;
- cushioning and absorbent material (i.e., bubble wrap or bags);

- temperature blank
- sample return shipping papers and addresses; and
- field notebook.

IV. Cautions

Review project requirements and select appropriate supplies prior to field mobilization.

Insure that appropriate sample containers with applicable preservatives, coolers, and packing material have been supplied by the laboratory.

Understand the offsite transfer requirements for the facility at which samples are collected.

If overnight courier service is required schedule pick-up or know where the drop-off service center is located and the hours of operation. Prior to using air transportation, confirm air shipment is acceptable under DOT and International Air Transport Association (IATA) regulation

Schedule pick-up time for laboratory courier or know location of laboratory/service center and hours of operation.

Understand DOT and IATA shipping requirements and evaluate dangerous goods shipping regulations relative to the samples being collected (i.e. complete an ARCADIS shipping determination). Review the ARCADIS SOPs for shipping, packaging and labeling of dangerous goods. Potential samples requiring compliance with this DOT regulation include:

- Methanol preservation for Volatile Organic Compounds in soil samples
- Non-aqueous phase liquids (NAPL)

V. Health and Safety Considerations

Follow health and safety procedures outlined in the project/site Health and Safety Plan (HASP).

Use caution and appropriate cut resistant gloves when tightening lids to 40 mL vials. These vials can break while tightening and can lacerate hand. Amber vials (thinner glass) are more prone to breakage.

Some sample containers contain preservatives.

- The preservatives must be retained in the sample container and should in no instance be rinsed out.

- Preservatives may be corrosive and standard care should be exercised to reduce potential contact to personnel skin or clothing. Follow project safety procedures if spillage is observed.

- If sample container caps are broken discard the bottle. Do not use for sample collection.

VI. Procedure

Chain-of-Custody Procedures

1. Prior to collecting samples, complete the chain-of-custody record header information by filling in the project number, project name, and the name(s) of the sampling technician(s) and other relevant project information. Attachment 1 provides an example chain-o- custody record

2. Chain-of-custody information MUST be printed legibly using indelible ink (black or blue).

3. After sample collection, enter the individual sample information on the chain-of-custody:

   a. Sample Identification indicates the well number or soil location that the sample was collected from. Appropriate values for this field include well locations, grid points, or soil boring identification numbers (e.g., MW-3, X-20, SB-30). When the depth interval is included, the complete sample ID would be “SB-30 (0.5-1.0) where the depth interval is in feet. Please note it is very important that the use of hyphens in sample names and depth units (i.e., feet or inches) remain consistent for all samples entered on the chain-of-custody form. DO NOT use the apostrophe or quotes in the sample ID. Sample names may also use the abbreviations “FB,” “TB,” and “DUP” as prefixes or suffixes to indicate that the sample is a field blank, trip blank, or field duplicate, respectively. NOTE: The sample nomenclature may be dictated by the project database and require unique identification for each sample collected for the project. Consult the project data management plan for additional information regarding sample identification.

b. List the date of sample collection. The date format to be followed should be mm/dd/yy (e.g., 03/07/09) or mm/dd/yyyy (e.g. 03/07/2009).

c. List the time that the sample was collected. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.

d. The composite field should be checked if the sample is a composite over a period of time or from several different locations and mixed prior to placing in sample containers.

e. The "Grab". field should be marked with an "X" if the sample was collected as an individual grab sample. (e.g. monitoring well sample or soil interval).

f. Any sample preservation should be noted.

g. The analytical parameters that the samples are being analyzed for should be written legibly on the diagonal lines. As much detail as possible should be presented to allow the analytical laboratory to properly analyze the samples. For example, polychlorinated biphenyl (PCB) analyses may be represented by entering "PCBs" or "Method 8082." Multiple methods and/or analytical parameters may be combined for each column (e.g., PCBs/VOCs/SVOCs or 8082/8260/8270). These columns should also be used to present project-specific parameter lists (e.g., Appendix IX+3 target analyte list. Each sample that requires a particular parameter analysis will be identified by placing the number of containers in the appropriate analytical parameter column. For metals in particular, indicate which metals are required.

h. Number of containers for each method requested. This information may be included under the parameter or as a total for the sample based on the chain of custody form used.

i. Note which samples should be used for site specific matrix spikes.

j. Indicate any special project requirements.

k. Indicate turnaround time required.

l. Provide contact name and phone number in the event that problems are encountered when samples are received at the laboratory.

m. If available attach the Laboratory Task Order or Work Authorization forms

n. The remarks field should be used to communicate special analytical requirements to the laboratory. These requirements may be on a per sample basis such as “extract and hold sample until notified,” or may be used to inform the laboratory of special reporting requirements for the entire sample delivery group (SDG). Reporting requirements that should be specified in the remarks column include: 1) turnaround time; 2) contact and address where data reports should be sent; 3) name of laboratory project manager; and 4) type of sample preservation used.

o. The “Relinquished By” field should contain the signature of the sampling technician who relinquished custody of the samples to the shipping courier or the analytical laboratory.

p. The “Date” field following the signature block indicates the date the samples were relinquished. The date format should be mm/dd/yyyy (e.g., 03/07/2005).

q. The “Time” field following the signature block indicates the time that the samples were relinquished. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.

r. The “Received By” section is signed by sample courier or laboratory representative who received the samples from the sampling technician or it is signed upon laboratory receipt from the overnight courier service.

3. Complete as many chain-of-custody forms as necessary to properly document the collection and transfer of the samples to the analytical laboratory.

4. Upon completing the chain-of-custody forms, forward two copies to the analytical laboratory and retain one copy for the field records.

5. If electronic chain-of-custody forms are utilized, sign the form and make 1 copy for ARCADIS internal records and forward the original with the samples to the laboratory.

Handling Procedures

1. After completing the sample collection procedures, record the following information in the field notebook with indelible ink:

   - project number and site name;
   - sample identification code and other sample identification information, if appropriate;
   - sampling method;
   - date;
   - name of sampler(s);
   - time;
   - location (project reference);
   - location of field duplicates and both sample identifications;
   - locations that field QC samples were collected including equipment blanks, field blanks and additional sample volume for matrix spikes; and
   - any comments.

2. Complete the sample label with the following information in indelible ink:

   - sample type (e.g., surface water);
   - sample identification code and other sample identification information, if applicable;
   - analysis required;
   - date;
   - time sampled; and
   - initials of sampling personnel;

- sample matrix; and
- preservative added, if applicable.

3. Cover the label with clear packing tape to secure the label onto the container and to protect the label from liquid.

4. Confirm that all caps on the sample containers are secure and tightly closed.

5. In some instances it may be necessary to wrap the sample container cap with clear packing tape to prevent it from becoming loose.

6. For some projects individual custody seals may be required. Custody seal evidence tape may be placed on the shipping container or they may be placed on each sample container such that the cooler or cap cannot be opened without breaking the custody seal. The custody seal should be initialed and dated prior to relinquishing the samples.

Packing Procedures

Following collection, samples must be placed on wet ice to initiate cooling to 4°C immediately. Retain samples on ice until ready to pack for shipment to the laboratory.

1. Secure the outside and inside of the drain plug at the bottom of the cooler being used for sample transport with "Duct" tape.

2. Place a new large heavy duty plastic garbage bag inside each cooler

3. Place each sample bottle wrapped in bubble wrap inside the garbage bag. VOC vials may be grouped by sample in individual resealable plastic bags). If a cooler temperature blank is supplied by the laboratory, it should be packaged following the same procedures as the samples. If the laboratory did not include a temperature blank, do not add one. Place 1 to 2 inches of cushioning material (i.e., vermiculite) at the bottom of the cooler.

4. Place the sealed sample containers upright in the cooler.

5. Package ice in large resealable plastic bags and place inside the large garbage bag in the cooler. Samples placed on ice will be cooled to and maintained at a temperature of approximately 4°C.

6. Fill the remaining space in the cooler with cushioning material such as bubble wrap. The cooler must be securely packed and cushioned in an upright position and be surrounded (Note: to comply with 49 CFR 173.4, filled cooler must not exceed 64 pounds).

7. Place the completed chain-of-custody record(s) in a large resealable bag and tape the bag to the inside of the cooler lid.

8. Close the lid of the cooler and fasten with packing tape.

9. Wrap strapping tape around both ends of the cooler.

10. Mark the cooler on the outside with the following information: shipping address, return address, “Fragile, Handle with Care” labels on the top and on one side, and arrows indicating “This Side Up” on two adjacent sides.

11. Place custody seal evidence tape over front right and back left of the cooler lid, initial and date, then cover with clear plastic tape.

Note: Procedure numbers 2, 3, 5, and 6 may be modified in cases where laboratories provide customized shipping coolers. These cooler types are designed so the sample bottles and ice packs fit snugly within preformed styrofoam cushioning and insulating packing material.

Shipping Procedures

1. All samples will be delivered by an express carrier within 48 hours of sample collection. Alternatively, samples may be delivered directly to the laboratory or laboratory service center or a laboratory courier may be used for sample pickup.

2. If parameters with short holding times are required (e.g., VOCs [EnCore™ Sampler], nitrate, nitrite, ortho-phosphate and BOD), sampling personnel will take precautions to ship or deliver samples to the laboratory so that the holding times will not be exceeded.

3. Samples must be maintained at 4°C±2°C until shipment and through receipt at the laboratory

4. All shipments must be in accordance with DOT regulations and ARCADIS dangerous goods shipping SOPs.

5. When the samples are received by the laboratory, laboratory personnel will complete the chain-of-custody by recording the date and time of receipt of samples, measuring and recording the internal temperature of the shipping container, and checking the sample identification numbers on the containers to ensure they correspond with the chain-of-custody forms.

Any deviations between the chain-of-custody and the sample containers, broken containers, or temperature excursions will be communicated to ARCADIS immediately by the laboratory.

VII. Waste Management

Not applicable

VIII. Data Recording and Management

Chain-of-custody records will be transmitted to the ARCADIS PM or designee at the end of each day unless otherwise directed by the ARCADIS PM. The sampling team leader retains copies of the chain-of-custody forms for filing in . the project file. Record retention shall be in accordance with project requirements.

IX. Quality Assurance

Chain-of-custody forms will be legibly completed in accordance with the applicable project documents such as Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), Work Plan, or other project guidance documents. A copy of the completed chain-of-custody form will be sent to the ARCADIS Project Manager or designee for review.

X. References

Not Applicable

Attachment 1

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ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:	
Contact & Company Name:	Telephone:
Address:	Fax:
City State Zip	E-mail Address:
Project Name/Location (City, State):	Project #:
Sampler's Printed Name:	Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ________
G. Other: ________
H. Other: ________

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ________
10. Other: ________

Matrix Key:
SO - Soil SE - Sediment NL - NAPL/Oil
W - Water SL - Sludge SW - Sample Wipe
T - Tissue A - Air Other: ________

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix								REMARKS

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name:	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm:	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: ________	Date/Time:	Date/Time:	Date/Time:	Date/Time:

20730826 CofC AR Form 01.12.2007 **Distribution:** **WHITE – Laboratory returns with results** **YELLOW – Lab copy** **PINK – Retained by BBL**

Infrastructure, environment, facilities

Imagine the result

Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells

Rev. #: 4

Rev Date: February 2, 2011

Approval Signatures

Prepared by: David S. Liprie Date: 2/2/2011

Reviewed by: Michael J. Gefell Date: 2/2/2011
(Technical Expert)

I. Scope and Application

Groundwater samples will be collected from monitoring wells to evaluate groundwater quality. The protocol presented in this standard operating procedure (SOP) describes the procedures to be used to purge monitoring wells and collect groundwater samples. This protocol has been developed in accordance with the United States Environmental Protection Agency (USEPA) Region I Low Stress (Low Flow) Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells (USEPA SOP No. GW0001; July 30, 1996). Both filtered and unfiltered groundwater samples may be collected using this low-flow sampling method. Filtered samples will be obtained using a 0.45-micron disposable filter. No wells will be sampled until well development has been performed in accordance with the procedures presented in the SOP titled Monitoring Well Development, unless that well has been sampled or developed within the prior 1-year time period. Groundwater samples will not be collected within 1 week following well development.

II. Personnel Qualifications

ARCADIS personnel directing, supervising, or leading groundwater sample collection activities should have a minimum of 2 years of previous groundwater sampling experience. ARCADIS personnel providing assistance to groundwater sample collection and associated activities should have a minimum of 6 months of related experience or an advanced degree in environmental sciences, engineering, hydrogeology, or geology.

The supervisor of the groundwater sampling team will have at least 1 year of previous supervised groundwater sampling experience.

Prior to mobilizing to the field, the groundwater sampling team should review and be thoroughly familiar with relevant site-specific documents including but not limited to the site work plan, field sampling plan, QAPP, HASP, and historical information. Additionally, the groundwater sampling team should review and be thoroughly familiar with documentation provided by equipment manufacturers for all equipment that will be used in the field prior to mobilization.

III. Equipment List

Specific to this activity, the following materials (or equivalent) will be available:

- Health and safety equipment (as required in the site Health and Safety Plan [HASP]).

- Site Plan, well construction records, prior groundwater sampling records (if available).
- Sampling pump, which may consist of one or more of the following:
  - submersible pump (e.g., Grundfos Redi-Flo 2);
  - peristaltic pump (e.g., ISCO Model 150); and/or
  - bladder pump (e.g., Marschalk System 1, QED Well Wizard, Geotech, etc.).
- Appropriate controller and power source for pump:
  - Submersible and peristaltic pumps require electric power from either a generator or a deep cell battery.
  - Submersible pumps such as Grundfos require a pump controller to run the pump
  - Bladder pumps require a pump controller and a gas source (e.g., air compressor or compressed N_2 or CO_2 gas cylinders).
- Teflon® tubing or Teflon®-lined polyethylene tubing of an appropriate size for the pump being used. For peristaltic pumps, dedicated Tygon® tubing (or other type as specified by the manufacturer) will also be used through the pump apparatus.
- Water-level probe (e.g., Solinist Model 101).
- Water-quality (temperature/pH/specific conductivity/ORP/turbidity/dissolved oxygen) meter and flow-through measurement cell. Several brands may be used, including:
  - YSI 6-Series Multi-Parameter Instrument;
  - Hydrolab Series 3 or Series 4a Multiprobe and Display; and/or
  - Horiba U-10 or U-22 Water Quality Monitoring System.
- Supplemental turbidity meter (e.g., Horiba U-10, Hach 2100P, LaMotte 2020). Turbidity measurements collected with multi-parameter meters have been shown to sometimes be unreliable due to fouling of the optic lens of the

turbidity meter within the flow-through cell. A supplemental turbidity meter will be used to verify turbidity data during purging if such fouling is suspected. Note that industry improvements may eliminate the need for these supplemental measurements in the future.

- Appropriate water sample containers (supplied by the laboratory).
- Appropriate blanks (trip blank supplied by the laboratory).
- 0.45-micron disposable filters (if field filtering is required).
- Large glass mixing container (if sampling with a bailer).
- Teflon® stirring rod (if sampling with a bailer).
- Cleaning equipment.
- Groundwater sampling log (attached) or bound field logbook.

Note that in the future, the client may acquire different makes/models of some of this equipment if the listed makes/models are no longer available, or as a result of general upgrades or additional equipment acquisitions. In the event that the client uses a different make/model of the equipment listed, the client will use an equivalent type of equipment (e.g., pumps, flow-through analytical cells) and note the specific make/model of the equipment used during a sampling event on the groundwater sampling log. In addition, should the client desire to change to a markedly different sampling methodology (e.g., discrete interval samplers, passive diffusion bags, or a yet to be developed technique), the client will submit a proposed SOP for the new methodology for USEPA approval prior to implementing such a change.

The maintenance requirements for the above equipment generally involve decontamination or periodic cleaning, battery charging, and proper storage, as specified by the manufacturer. For operational difficulties, the equipment will be serviced by a qualified technician.

IV. Cautions

If heavy precipitation occurs and no cover over the sampling area and monitoring well can be erected, sampling must be discontinued until adequate cover is provided. Rain water could contaminate groundwater samples.

Do not use permanent marker or felt-tip pens for labels on sample container or sample coolers – use indelible ink. The permanent markers could introduce volatile constituents into the samples.

It may be necessary to field filter some parameters (e.g., metals) prior to collection, depending on preservation, analytical method, and project quality objectives.

Store and/or stage empty and full sample containers and coolers out of direct sunlight.

To mitigate potential cross-contamination, groundwater samples are to be collected in a pre-determined order from least impacted to impacted based on previous analytical data. If no analytical data are available, samples are collected in order of upgradient, then furthest downgradient to source area locations.

Be careful not to over-tighten lids with Teflon liners or septa (e.g., 40 mL vials). Over-tightening can cause the glass to shatter or impair the integrity of the Teflon seal.

V. Health and Safety Considerations

Use caution and appropriate cut resistant gloves when tightening lids to 40 mL vials. These vials can break while tightening and can lacerate hand. Amber vials (thinner glass) are more prone to breakage.

If thunder or lighting is present, discontinue sampling and take cover until 30 minutes have passed after the last occurrence of thunder or lighting.

Use caution when removing well caps as well may be under pressure, cap can dislodge forcefully and cause injury.

Use caution when opening protective casing on stickup wells as wasps frequently nest inside the tops of the covers. Also watch for fire ant mounds near well pads when sampling in the south or western U.S.

VI. Procedure

Groundwater will be purged from the wells using an appropriate pump. Peristaltic pumps will initially be used to purge and sample all wells when applicable. If the depth to water is below the sampling range of a peristaltic pump (approximately 25 feet), submersible pumps or bladder pumps will be used provided the well is constructed with a casing diameter greater than or equal to 2 inches (the minimum well diameter capable of accommodating such pumps). Bladder pumps are preferred over peristaltic and submersible pumps if sampling of VOCs is required to prevent volatilization. For smaller diameter wells where the depth to water is below the sampling range of a peristaltic pump, alternative sampling methods (i.e., bailing or small diameter bladder pumps) will be used to purge and sample the groundwater. Purge water will be collected and containerized.

1. Calibrate field instruments according to manufacturer procedures for calibration.

2. Measure initial depth to groundwater prior to placement of pumps.

3. Prepare and install pump in well: For submersible and non-dedicated bladder pumps, decontaminate pump according to site decontamination procedures. Non-dedicated bladder pumps will require a new Teflon® bladder and attachment of an air line, sample discharge line, and safety cable prior to placement in the well. Attach the air line tubing to the air port on the top of the bladder pump. Attach the sample discharge tubing to the water port on the top of the bladder pump. Care should be taken not to reverse the air and discharge tubing lines during bladder pump set-up as this could result in bladder failure or rupture. Attach and secure a safety cable to the eyebolt on the top of bladder pump (if present, depending on pump model used). Slowly lower pump, safety cable, tubing, and electrical lines into the well to a depth corresponding to the approximate center of the saturated screen section of the well. Take care to avoid twisting and tangling of safety cable, tubing, and electrical lines while lowering pump into well; twisted and tangled lines could result in the pump becoming stuck in the well casing. Also, make sure to keep tubing and lines from touching the ground or other surfaces while introducing them into the well as this could lead to well contamination. If a peristaltic pump is being used, slowly lower the sampling tubing into the well to a depth corresponding to the approximate center of the saturated screen section of the well. The pump intake or sampling tube must be kept at least 2 feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well.

4. If using a bladder pump, connect the air line to the pump controller output port. The pump controller should then be connected to a supply line from an air compressor or compressed gas cylinder using an appropriate regulator and air hose. Take care to tighten the regulator connector onto the gas cylinder (if used) to prevent leaks. Teflon tape may be used on the threads of the cylinder to provide a tighter seal. Once the air compressor or gas cylinder is connected to the pump controller, turn on the compressor or open the valve on the cylinder to begin the gas flow. Turn on the pump controller if an on/off switch is present and verify that all batteries are charged and fully operating before beginning to pump.

5. Connect the pump discharge water line to the bottom inlet port on the flow-through cell connected to the water quality meter.

6. Measure the water level again with the pump in the well before starting the pump. Start pumping the well at 200 to 500 milliliters (mL) per minute (or at lower site-specific rate if specified). The pump rate should be adjusted to cause little or no water level drawdown in the well (less than 0.3 feet below the initial static depth to water measurement) and the water level should stabilize. The water level should be monitored every 3 to 5 minutes (or as appropriate, lower flow rates may require longer time between readings) during pumping if the well diameter is of sufficient size to allow such monitoring. Care should be taken not to break pump suction or cause entrainment of air in the sample. Record pumping rate adjustments and depths to water. If necessary, pumping rates should be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to stabilize indicator parameters. A steady flow rate should be maintained to the extent practicable. Groundwater sampling records from previous sampling events (if available) should be reviewed prior to mobilization to estimate the optimum pumping rate and anticipated drawdown for the well in order to more efficiently reach a stabilized pumping condition.

   If the recharge rate of the well is very low, alternative purging techniques should be used, which will vary based on the well construction and screen position. For wells screened across the water table, the well should be pumped dry and sampling should commence as soon as the volume in the well has recovered sufficiently to permit collection of samples. For wells screened entirely below the water table, the well should be pumped until a stabilized level (which may be below the maximum displacement goal of 0.3 feet) can be maintained and monitoring for stabilization of field indicator parameters can commence. If a lower stabilization level cannot be maintained, the well should be pumped until the drawdown is at a level slightly higher than the bentonite seal above the well screen. Sampling should commence after one well volume has been removed and the well has recovered sufficiently to permit collection of samples.

   During purging, monitor the field indicator parameters (e.g., turbidity, temperature, specific conductance, pH, etc.) every 3 to 5 minutes (or as appropriate). Field indicator parameters will be measured using a flow-through analytical cell or a clean container such as a glass beaker. Record field indicator parameters on the groundwater sampling log. The well is considered stabilized and ready for sample collection when turbidity values remain within 10% (or within 1 NTU if the turbidity reading is less than 10 NTU), the specific conductance and temperature values remain within 3%, ORP readings remain within ± 10 mV and pH remains within 0.1 units for three consecutive readings collected at 3- to 5-minute intervals (or other appropriate interval, alternate stabilization goals may exist in different geographic regions, consult the site-specific Work Plan for stabilization criteria). If the field indicator parameters do not stabilize within 1 hour of the start of purging, but the groundwater turbidity is below the goal of 50 NTU and the values for all other parameters are within 10%, the well can be sampled. If the parameters have stabilized but the turbidity is not in the range of the 50 NTU goal, the pump flow rate should be decreased to a minimum rate of 100 mL/min to reduce turbidity levels as low as possible. Dissolved oxygen is extremely susceptible to various external influences (including temperature or the presence of bubbles on the DO meter); care should be taken to minimize the agitation or other disturbance of water within the flow-through cell while collecting these measurements. If air bubbles are present on the DO probe or in the discharge tubing, remove them before taking a measurement. If dissolved oxygen values are not within acceptable range for the temperature of groundwater (Attachment 1), then again check for and remove air bubbles on probe before re-measuring. If the dissolved oxygen value is 0.00 or less, then the meter should be serviced and re-calibrated. If the dissolved oxygen values are above possible results, then the meter should be serviced and re-calibrated.

During extreme weather conditions, stabilization of field indicator parameters may be difficult to obtain. Modifications to the sampling procedures to alleviate these conditions (e.g., measuring the water temperature in the well adjacent to the pump intake) will be documented in the field notes. If other field conditions exist that preclude stabilization of certain parameters, an explanation of why the parameters did not stabilize will also be documented in the field logbook.

7. Complete the sample label(s) and cover the label(s) with clear packing tape to secure the label onto the container.

8. After the indicator parameters have stabilized, collect groundwater samples by diverting flow out of the unfiltered discharge tubing into the appropriate labeled sample container. If a flow-through analytical cell is being used to measure field parameters, the flow-through cell should be disconnected after stabilization of the field indicator parameters and prior to groundwater sample collection. Under no circumstances should analytical samples be collected from the discharge of the flow-through cell. When the container is full, tightly screw on the cap. Samples should be collected in the following order: VOCs, TOC, SVOCs, metals and cyanide, and others (or other order as defined in the site-specific Work Plan).

9. If sampling for total and filtered metals and/or PCBs, a filtered and unfiltered sample will be collected. Install an in-line, disposable 0.45-micron particle filter on the discharge tubing after the appropriate unfiltered groundwater sample has been collected. Continue to run the pump until an initial volume of “flush” water has been run through the filter in accordance with the manufacturer’s directions (generally 100 to 300 mL). Collect filtered groundwater sample by diverting flow

out of the filter into the appropriately labeled sample container. When the container is full, tightly screw on the cap.

10. Secure with packing material and store at 4°C in an insulated transport container provided by the laboratory.

11. Record on the groundwater sampling log or bound field logbook the time sampling procedures were completed, any pertinent observations of the sample (e.g., physical appearance, and the presence or lack of odors or sheens), and the values of the stabilized field indicator parameters as measured during the final reading during purging (Attachment 2 – Example Sampling Log).

12. Turn off the pump and air compressor or close the gas cylinder valve if using a bladder pump set-up. Slowly remove the pump, tubing, lines, and safety cable from the well. Do not allow the tubing or lines to touch the ground or any other surfaces which could contaminate them. .

13. If tubing is to be dedicated to a well, it should be folded to a length that will allow the well to be capped and also facilitate retrieval of the tubing during later sampling events. A length of rope or string should be used to tie the tubing to the well cap. Alternatively, if tubing and safety line are to be saved and reused for sampling the well at a later date they may be coiled neatly and placed in a clean plastic bag that is clearly labeled with the well ID. Make sure the bag is tightly sealed before placing it in storage.

14. Secure the well and properly dispose of personal protective equipment (PPE) and disposable equipment.

15. Complete the procedures for packaging, shipping, and handling with associated chain-of-custody.

16. Complete decontamination procedures for flow-through analytical cell and submersible or bladder pump, as appropriate.

17. At the end of the day, perform calibration check of field instruments.

If it is not technically feasible to use the low-flow sampling method, purging and sampling of monitoring wells may be conducted using the bailer method as outlined below:

1. Don appropriate PPE (as required by the HASP).

2. Place plastic sheeting around the well.

3. Clean sampling equipment.

4. Open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting. Insert PID probe approximately 4 to 6 inches into the casing or the well headspace and cover with gloved hand. Record the PID reading in the field log. If the well headspace reading is less than 5 PID units, proceed; if the headspace reading is greater than 5 PID units, screen the air within the breathing zone. If the breathing zone reading is less than 5 PID units, proceed. If the PID reading in the breathing zone is above 5 PID units, move upwind from well for 5 minutes to allow the volatiles to dissipate. Repeat the breathing zone test. If the reading is still above 5 PID units, don appropriate respiratory protection in accordance with the requirements of the HASP. Record all PID readings. For wells that are part of the regular weekly monitoring program and prior PID measurements have not resulted in a breathing zone reading above 5 PID units, PID measurements will be taken monthly.

5. Measure the depth to water and determine depth of well by examining drilling log data or by direct measurement. Calculate the volume of water in the well (in gallons) by using the length of the water column (in feet), multiplying by 0.163 for a 2-inch well or by 0.653 for a 4-inch well. For other well diameters, use the formula:

   Volume (in gallons) = π TIMES well radius (in feet) squared TIMES length of water column (in feet) TIMES 7.481 (gallons per cubic foot)

6. Measure a length of rope or twine at least 10 feet greater than the total depth of the well. Secure one end of the rope to the well casing and secure the other end to the bailer. Test the knots and make sure the rope will not loosen. Check bailers so that all parts are intact and will not be lost in the well.

7. Lower bailer into well and remove one well volume of water. Contain all water in appropriate containers.

8. Monitor the field indicator parameters (e.g., turbidity, temperature, specific conductance, and pH). Measure field indicator parameters using a clean container such as a glass beaker or sampling cups provided with the instrument. Record field indicator parameters on the groundwater sampling log.

9. Repeat Steps 7 and 8 until three or four well volumes have been removed. Examine the field indicator parameter data to determine if the parameters have stabilized. The well is considered stabilized and ready for sample collection when turbidity values remain within 10% (or within 1 NTU if the turbidity reading is less than 10 NTU), the specific conductance and temperature values remain

within 3%, and pH remains within □0.1 units for three consecutive readings collected once per well volume removed.

10. If the field indicator parameters have not stabilized, remove a maximum of five well volumes prior to sample collection. Alternatively, five well volumes may be removed without measuring the field indicator parameters.

11. If the recharge rate of the well is very low, wells screened across the water table may be bailed dry and sampling should commence as soon as the volume in the well has recovered sufficiently to permit collection of samples. For wells screened entirely below the water table, the well should only be bailed down to a level slightly higher than the bentonite seal above the well screen. The well should not be bailed completely dry, to maintain the integrity of the seal. Sampling should commence as soon as the well volume has recovered sufficiently to permit sample collection.

12. Following purging, allow water level in well to recharge to a sufficient level to permit sample collection.

13. Complete the sample label and cover the label with clear packing tape to secure the label onto the container.

14. Slowly lower the bailer into the screened portion of the well and carefully retrieve a filled bailer from the well causing minimal disturbance to the water and any sediment in the well.

15. The sample collection order (as appropriate) will be as follows:

    a. VOCs;

    b TOC;

    c. SVOCs;

    d. metals and cyanide; and

    e. others.

16. When sampling for volatiles, collect water samples directly from the bailer into 40-mL vials with Teflon®-lined septa.

17. For other analytical samples, remove the cap from the large glass mixing container and slowly empty the bailer into the large glass mixing container. The

sample for dissolved metals and/or filtered PCBs should either be placed directly from the bailer into a pressure filter apparatus or pumped directly from the bailer with a peristaltic pump, through an in-line filter, into the pre-preserved sample bottle.

18. Continue collecting samples until the mixing container contains a sufficient volume for all laboratory samples.

19. Mix the entire sample volume with the Teflon® stirring rod and transfer the appropriate volume into the laboratory jar(s). Secure the sample jar cap(s) tightly.

20. If sampling for total and filtered metals and/or PCBs, a filtered and unfiltered sample will be collected. Sample filtration for the filtered sample will be performed in the field using a peristaltic pump prior to preservation. Install new medical-grade silicone tubing in the pump head. Place new Teflon® tubing into the sample mixing container and attach to the intake side of pump tubing. Attach (clamp) a new 0.45-micron filter (note the filter flow direction). Turn the pump on and dispense the filtered liquid directly into the laboratory sample bottles.

21. Secure with packing material and store at 4°C in an insulated transport container provided by the laboratory.

22. After sample containers have been filled, remove one additional volume of groundwater. Measure the pH, temperature, turbidity, and conductivity. Record on the groundwater sampling log or bound field logbook the time sampling procedures were completed, any pertinent observations of the sample (e.g., physical appearance, and the presence or lack of odors or sheens), and the values of the field indicator parameters.

23. Remove bailer from well, secure well, and properly dispose of PPE and disposable equipment.

24. If a bailer is to be dedicated to a well, it should be secured inside the well above the water table, if possible. Dedicated bailers should be tied to the well cap so that inadvertent loss of the bailer will not occur when the well is opened.

25. Complete the procedures for packaging, shipping, and handling with associated chain-of-custody.

VII. Waste Management

Materials generated during groundwater sampling activities, including disposable equipment, will be placed in appropriate containers. Containerized waste will be disposed of by the client consistent with the procedures identified in the HASP.

VIII. Data Recording and Management

Initial field logs and chain-of-custody records will be transmitted to the ARCADIS PM at the end of each day unless otherwise directed by the PM. The groundwater team leader retains copies of the groundwater sampling logs.

IX. Quality Assurance

In addition to the quality control samples to be collected in accordance with this SOP, the following quality control procedures should be observed in the field:

- Collect samples from monitoring wells in order of increasing concentration, to the extent known based on review of historical site information if available.

- Equipment blanks should include the pump and tubing (if using disposable tubing) or the pump only (if using tubing dedicated to each well).

- Collect equipment blanks after wells with higher concentrations (if known) have been sampled.

- Operate all monitoring instrumentation in accordance with manufacturer's instructions and calibration procedures. Calibrate instruments at the beginning of each day and verify the calibration at the end of each day. Record all calibration activities in the field notebook.

- Clean all groundwater sampling equipment prior to use in the first well and after each subsequent well using procedures for equipment decontamination.

X. References

United States Environmental Protection Agency (USEPA). 1986. RCRA Groundwater Monitoring Technical Enforcement Guidance Document (September 1986).

USEPA Region II. 1998. *Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling*.

USEPA. 1991. Handbook Groundwater, Volume II Methodology, Office of Research and Development, Washington, DC. USEPN62S, /6-90/016b (July, 1991).

U.S. Geological Survey (USGS). 1977. National Handbook of Recommended Methods for Water-Data Acquisition: USGS Office of Water Data Coordination. Reston, Virginia.

Attachment 1

Groundwater Sampling Log

Attachment 2

Oxygen Solubility in Fresh Water

Temperature (degrees C)	**Dissolved Oxygen** (mg/L)
0	14.6
1	14.19
2	13.81
3	13.44
4	13.09
5	12.75
6	12.43
7	12.12
8	11.83
9	11.55
10	11.27
11	11.01
12	10.76
13	10.52
14	10.29
15	10.07
16	9.85
17	9.65
18	9.45
19	9.26
20	9.07
21	8.9
22	8.72
23	8.56
24	8.4
25	8.24
26	8.09
27	7.95
28	7.81
29	7.67
30	7.54
31	7.41
32	7.28
33	7.16
34	7.05
35	6.93

Reference: Vesilind, P.A., *Introduction to Environmental Engineering*, PWS Publishing Company, Boston, 468 pages (1996).

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In-Situ Soil Gas Monitoring using a Landtec GEM™ 2000

Rev. #: 01

Rev Date: September 19, 2014

Approval Signatures

Prepared by: ______________________________ Date: ________________________

Reviewed by: ______________________________ Date: ________________________
(Project Manager)

Article I. Scope and Application

The objective of this Standard Operating Procedure (SOP) is to describe procedures to measure and record concentrations of landfill gas (methane, carbon dioxide [CO_2], and oxygen [O_2]) in soil gas at the Manor View Dump Site (hereinafter referred to as FGGM 93 or "the Site") located at Fort George G. Meade, Maryland. Methane concentrations will be measured using an in-situ landfill gas monitor following a three volume purge procedure specific to the Site.

This SOP may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations posed by the procedures. The ultimate procedure employed will be documented in the project work plans or reports.

Article II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and possess the required skills and experience necessary to successfully complete the desired field work.

Article III. Equipment List

The following materials, as required, shall be available during landfill gas measurements:

- Health and safety equipment (as required in the Health and Safety Plan [HASP]);
- Site map and well construction details including three volume purge calculations;
- Pump to purge air to complete three volume purge (e.g., Gilian AirCon-2 Area Air Sampling Pump or peristaltic pump);
- Landtec GEM™ 2000 Landfill Gas Monitor with associated tubing and filters;
- Socket wrench with $^{1}/_{2}$" or $^{9}/_{6}$" socket attachments;
- Screw driver;
- Water knockout bottle;
- Field forms;

- Site access key.

Article IV. Cautions

The sensors within the Landtec GEM™ 2000 are highly sensitive to moisture; thus, special care shall be taken to ensure no water or moisture is pulled from the monitoring locations into the monitor. A new filter should be installed in line with the sample tubing prior to each sampling event. If the filter is compromised during sampling activities, a new filter shall be installed.

At monitoring locations were excessive water is encountered a water knockout bottle shall be utilized. The water knockout bottle shall be placed in a manner that will facilitate the collection of water and moisture during sampling. Water collected within the bottle shall be discharged to the ground surface. When using the water knockout bottle, three volume purge times shall be adjusted to account for the additional volume within the knock out bottle.

Article V. Health and Safety Considerations

The HASP will be followed, as appropriate, to ensure the safety of field personnel. Access to wells may expose field personnel to hazardous materials such as contaminated groundwater or oil. Other potential hazards include stinging insects that may inhabit well heads, other biologic hazards, and potentially the use of sharp cutting tools (scissors, knife). Appropriate personal protective equipment (PPE) will be worn during these activities. Field personnel will thoroughly review client-specific health and safety requirements, which may preclude the use of fixed/folding-blade knives.

Article VI. Procedure

1. Ensure equipment is fully charged prior to sampling. Equipment should be charged overnight before each sampling event.

2. Don appropriate PPE. This includes but is not limited to a high visibility safety vest, safety glasses, and latex gloves.

3. Calibrate Landtec GEM™ 2000 according to manufacturer procedures for calibration.

4. Zero out the Landtec GEM™ 2000 pressure readings.

    a. Disconnect the sampling hose

b. From the main screen, press the number (5).

c. When prompted to enter the initial temperature reading, press the enter key (arrow).

d. When prompted to enter the initial flow reading, press enter key again.

e. On the next screen prompt you will see differential and static pressure readings. Wait for the pressure to stabilize. You may need to cover the intake port with your finger as the Landtec GEM™ 2000 is very sensitive to changes in pressure.

f. Press enter to zero transducers.

g. Press (1) to continue.

h. Press (5) to measure gases/return to the home screen.

5. Visually inspect the monitoring location to ensure that it is undamaged and properly secured. Damage or other conditions that may affect the integrity of the monitoring point will be recorded as a component of the annual site inspection and reported in the annual monitoring report.

6. Open monitoring vault using a socket wrench and $^{1}/_{2}$" or $^{9}/_{6}$"socket if required; attach one end of $^{1}/_{4}$" Materflex tubing to the end of the probe and/or lab cock and the other end to the gas intake port of the Landtec GEM™ 2000.

7. Once a secure connection is obtained, use the Landtec GEM™ 2000 to measure the vacuum at the sample port.

a. From the home screen, press (5)

b. When prompted to enter the initial temperature reading, press the enter key (arrow).

c. When prompted to enter the initial flow reading, press enter key again.

d. On the next screen prompt you will see differential and static pressure readings. Wait for the pressure to stabilize. Record the static pressure on the field data spreadsheet.

e. Press (1) to continue.

f. Press (5) to measure gases/return to the main menu.

8. Turn on the monitoring system by pressing the button labeled with a fan. Allow the system to run for 0.5 minutes to collect an initial methane concentration.

9. Refer to Article IV Cautions for information pertaining to the collection of water and moisture in the sample tubing during monitoring activities and the use of the water knockout bottle.

10. Record the sample time, Methane, CO_2 and oxygen O_2 on the sampling log and shut the system off.

11. Connect the selected purge pump to the sample port. Turn the pump on and record the flow rate. Use the flow rate and the volume of the monitoring point to determine the appropriate total flow time. Once a three volume purge of the monitoring location has been completed, turn off the pump. Record the start and stop purge times and the flow rate.

12. Following the completion of purge activities, repeat steps 8 and 9.

13. Secure the manhole lid closed with bolts or lock.

Article VII. Waste Management

With the exception of PPE and used moisture filters, no waste will be generated during implementation of the procedures presented herein. All PPE and filters shall be discarded in municipal waste receptacles.

Article VIII. Data Recording and Management

Methane, CO_2 and O_2 concentrations should be documented in the field logbook and/or applicable field forms. The following information should be documented:

- Sample identification
- Measurement time
- Start/stop time of three-volume purge,
- Flow rate during three-volume purge,

- Initial vacuum reading,

Article IX. Quality Assurance

As described in the detailed procedure, the landfill gas monitor will be calibrated prior to use and in accordance with the procedures provided by the manufacturer. If methane concentrations are observed at concentrations that are not consistent with typical results, the location will be resampled. If the concentrations are still inconsistent, the instrument will be recalibrated and the monitoring location will be resampled.

Article X. References

No literature references are required for this SOP.

Appendix C

Field Forms

Methane Monitoring Purge Summary

FGGM 93 - Manor View Dump Site

Fort George G. Meade, Maryland

Date: ______________________ **Weather:** ______________________

	Start Time	Stop Time	Vacuum	Flow	Purge Duration (minutes)	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Total Purge Time (minutes)	Approximate Volume Purged (ft^3)
INITIAL										
FINAL										
INITIAL										
FINAL										
INITIAL										
FINAL										
INITIAL										
FINAL										
INITIAL										
FINAL										
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FINAL										

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Groundwater Sampling Form

Page ____ of ____

Project No. ______________________ Well ID ______________________ Date ______________

Project Name/Location ______________________ Weather ______________

Measuring Pt. Description ____________ Screen Setting (ft-bmp) ____________ Casing Diameter (in.) ____________ Well Material ____ PVC ____ SS ____ Other

Total Depth (ft-bmp) ____________ Static Water Level (ft-bmp) ____________ Water Column in Well ____________ Gallons in Well ____________

Calc.Gallons Purged ____________ Pump Intake (ft-bmp) ____________ Purge Method: Centrifugal ____________ Submersible ____________ Sample Method ____________

Gallons Purged ____________ MP Elevation ____________ Disp. Bailer ____________ Pump On/Off ____________

Sample Time: Label ________ Replicate/ Code No. ____________ Other ____________ Sampled by ____________

Time	Minutes Elapsed	Rate (gpm) (mL/min)	Depth to Water (ft) TOC	Gallons Purged	pH	Cond. (μmhos) (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C) (°F)	Redox (mV)	Appearance	
											Color	Odor

Constituents Sampled	**Container**	**Number**	**Preservative**

Well Information

Well Location: ______________________ Well Locked at Arrival: Yes / No

Condition of Well: ______________________ Well Locked at Departure: Yes / No

Well Completion: Flush Mount / Stick Up Key Number To Well:

NOTES:

Well Casing Volumes

Gallons/Foot	1" = 0.04	1.5" = 0.09	2.5" = 0.26	3.5" = 0.50	6" = 1.47
	1.25" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65	

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Indoor Air Sample Log

Sample ID ______________________ Project/No. ____________________

Date ______________________ Sampling Personnel ____________________

Weather ______________________ ____________________

Precipitation w/in preceeding 12 hours? Y / N Amount:_______in ____________________

Current Building Type: Residential Commercial Industrial

Building Construction Characteristics (e.g., rancher, apartment): ____________________

General Description of Building Materials (e.g., concrete, cinder block): ____________________

Characteristics of basement:

Finished	**Floor:**	**Foundation Walls:**	**Moisture:**
Unfinished	Concrete	Concrete	Wet
	Dirt	Block	Damp
	Other __________	Layed up stone	Dry

DESCRIPTION OF SAMPLE LOCATION:

Location ______________________

Floor Level: Basement / 1st Floor

Room size ft x ft: ______________

Location Sketch:

SAMPLE COLLECTION:

Sample Time: ______________

Sample Rate: ______________

Sample Volume: ______________

CONTAINER DESCRIPTION:

_____ L Summa Canister

ANALYTICAL METHOD:

____

Appendix D

Annual Inspection Forms

Annual Inspection Checklist
FGGM 93 Manor View Dump Site
Fort George G. Meade, Maryland

Inspector: ____________________ **Weather/Temperature (°F):** ____________________
Date/Time: ____________________ **Ground Conditions:** ____________________

Land Use

Inspector walked over entire site. ____ Yes ____ No

Reason why not?

Signs appropriately posted:

Sign Number	Location	In-place (Y/N)	Legible (Y/N)	Corrective Action Taken
1				
2				
3				
4				
5				

Are any visual signs of disturbance or construction activities noted during inspection? If yes, please describe in detail below: ____ Yes ____ No

Is the fence separating the school yard from the western portion of the Site intact? Describe the condition of the fence and any necessary repairs below:

Are there any visual signs that indicate the designated use of the crawl space has changed. If yes, please describe in detail below: ____ Yes ____ No

Soil Cover

Check for any signs of the following conditions - note whether corrective action was taken:

Condition	Yes/No	Corrective Action Taken	Designation of Location Shown on Attached Map
Intrusive Activities			
Construction Activities			
Signs of Settling, Subsidence, or Erosion			
Changes in Land Use			
Other			

Are there any signs of stressed vegetation of areas with no vegetation? If yes, please note the area and provide additional detail below: ____ Yes ____ No

Are there any signs of burrowing animals in the soil cover? If yes, please note the area and provide additional detail below: ____ Yes ____ No

Are there any surface disturbances from vehicles or other physical actions? If yes, please note the area and provide additional detail below: ____ Yes ____ No

Is there any precipitation ponding on the soil cover? If yes, please note the area and provide additional detail below: ____ Yes ____ No

Are there any gullies, washouts, or other disturbances caused by water erosion? If yes, please note the area and provide additional detail below: ____ Yes ____ No

Is the subsurface soil vapor extraction system operational? If no, please note the operational issues encountered : ____ Yes ____ No

Is any new construction currently being conducted on the Site and/or planned to begin in the next 12 months: ____ Yes ____ No

Soil Cover (continued)

When was the last mowing/vegetation clearing event conducted: ______________________________

When is the next annual mowing/vegetation clearing event scheduled: __________________________

Describe the soil cover with respect to vegetation growth (i.e., grass height, amount of vegetation along the trench, etc.):

Does the existing vegetation growth necessitate an additional mowing/vegetation clearing event before the next annual event: ____ Yes ____ No

Monitoring Well Inspection

Monitoring Well	Visible	Accessible	Undamaged	Secured	Comments
MW-1					
MW-2					
MW-3					
MW-4					
MW-5					
MW-6					
MW-7					
MW-9					
MW-10					
MW-11					

Soil Gas Monitoring Point Inspection

Monitoring Well	Visible	Accessible	Undamaged	Secured	Comments
VMP-1					
VMP-4					
VMP-11					
VMP-12					
VMP-26					
VMP-27					
VMP-29					
VMP-30					
VMP-31					
VMP-32					
VMP-33					
MP-A					
VE-C					
VE-E					
SG-82 (S, M,D)					

Photo Log

Photo Number	Description	Direction Facing

Miscellaneous Observations:

Methane Monitor Inspection Summary
FGGM 93 Manor View Dump Site
Fort George G. Meade, Maryland

Number	Location Description	Inspection Date	Condition of Monitor[1]	Green Light On (Y/N)	Buzzer Sounds When Test Button Pressed (Y/N)	Replacement Required (Y/N)	Comments
1	Crawl Space at Manor View Elementary School						
2	4964 Hartell Court						
3	4963 Hartell Court						
4	4962 Hartel Court						
5	4961 Hartel Court						
6	4960 Hartel Court						
7	4959 Hayden Drive						
8	5958 Hayden Drive						
9	4957 Hayden Drive						
10	4956 Hayden Drive						
11	4955 Hayden Drive						
12	4954 Hayden Drive						
13	4953 Hayden Drive						
14	4952 Hayden Drive						
15	4951 Hayden Drive						
16	4950 Hayden Drive						
17	4949 Hayden Drive						
18	4948 Hayden Drive						
19	4947 Hayden Drive						
20	4946 Hyden Drive						
21	4945 Hayden Drive						

Notes:
1. Condition of monitor should be evaluated as Good, Fair, or Poor.
Y - Yes
N - No

Appendix E

Response to Comments

Response to Comments Table								
Draft Remedial Design, FGGM Manor View Dump Site								
September 2014								
Response Code: A = Agree with comment D = Disagree with comment C = Comment requires clarification N = Comment noted, no action required or taken								
Comment No.	**Commenter**	**Date of Comment**	**Page(s)**	**Section**	**Line(s)**	**Comment**	**Response Code**	**Response**
1	MDE	10/29/14		General		There is no mention of how frequently monitoring reports for groundwater, soil gas, and indoor air will be submitted to regulators for review. Please submit a data report after each monitoring event, along with an annual report with summaries of sampling of all media over the prior year.	A	Agreed. Reports will be submitted on a semi-annual basis following completion of each sampling event. A comprehensive review of field activities and analytical results will be conducted annually. Revised text in Section 7 to clarify.
2	MDE	10/29/14	11	Paragraph 1		The text mentions that monitoring well MW-8 will be abandoned as part of the remedial design. Well abandonment should be conducted in accordance with Code of Maryland Regulations 26.04.04.11.	A	Agreed. The COMAR regulation was referenced in Section 4.1.1.
3	EPA	12/8/2014		General		The LUC RD should be revised to meet the items 10-19 of the OSWER Guidance 9355.6-12 attached. This model language must be included in the RD. If you would like a model document of how and where in the document to incorporate it let me know and I can send you an approved LUC RD from another Army Fed. Fac. Site in Region 3: http://www2.epa.gov/sites/production/files/documents/luc_checklist_oswer_directive_9355_6_12.pdf.	D	Disagree. Based on Army legal review of the referenced guidance document and subsequent discussions between the Army and EPA, the Army has determined that the document is sufficient without revision.