Rec'd 7/9/14

DEPARTMENT OF THE ARMY
HEADQUARTERS, 88TH REGIONAL SUPPORT COMMAND
60 SOUTH O STREET
FORT MCCOY, WISCONSIN 54656

REPLY TO
ATTENTION OF

June 18, 2014

Directorate of Public Works

Mr. Matt Jefferson
U.S. Environmental Protection Agency, Region 7
11201 Renner Boulevard
Lenexa, KS 66219

Dear Matt:

Please find enclosed the Final OU-1 Quarterly Groundwater Monitoring Report, October 2013 Sampling Event, The Former St. Louis Ordnance Plant, Regional LTO/LTM for Seven Installations, U.S. Army Corps of Engineers, Kansas City District Contract No. W912DQ-13-D-3000, Task Order 0004.

If you have any questions, please contact Ms. Josephine Newton-Lund at (816) 389-3912, or Mr. Barry McFarland at (316) 681-1759, extension 1419, or by email at Josephine.M.Newton-lund@usace.army.mil, or barry.mcfarland@usar.army.mil.

Sincerely,

David L. Moore
Chief, Public Works- Environmental Division

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Superfund
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FINAL
OU-1 QUARTERLY GROUNDWATER MONITORING REPORT
OCTOBER 2013 SAMPLING EVENT
THE FORMER ST. LOUIS ORDNANCE PLANT
ST. LOUIS, MISSOURI

REGIONAL LTO/LTM FOR SEVEN INSTALLATIONS

Prepared for:

U.S. Army Corps of Engineers
Kansas City District

Contract W912DQ-13-D-3000
Task Order 0004

Prepared by:

HydroGeoLogic, Inc.
6340 Glenwood, Suite 200
Building #7
Overland Park, KS 66202

June 2014

HydroGeoLogic, Inc

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LIST OF ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
Army	U.S. Army
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2 DCE	*cis*-1,2-dichloroethene
COC	chemical of concern
CT	carbon tetrachloride
1,2-DCA	1,2-dichloroethane
DCE	dichloroethene
DD	decision document
FS	feasibility study
ft	feet/foot
HHRA	human health risk assessment
HGL	HydroGeoLogic, Inc.
LTM	long term monitoring
LUC	land use control
LUCIP	land use control implementation plan
MDHSS	Missouri Department of Health and Senior Services
MDNR	Missouri Department of Natural Resources
μg/L	micrograms per liter
OU	operable unit
PCE	tetrachloroethene
PDB	passive diffusion bag
RA	remedial action
RI	remedial investigation
RRC	Regional Readiness Command
RSC	Regional Support Command
SLOP	The former St. Louis Ordnance Plant
1,1,1,2-TeCA	1,1,1,2-tetrachloroethane
1,1,2,2-TeCA	1,1,2,2-tetrachloroethane
1,1,2-TCA	1,1,2-trichloroethane
TCE	trichloroethene

trans-1,2-DCE	*trans*-1,2-dichloroethene
USACE	U.S. Army Corps of Engineers, Northwestern Division, Kansas City District
USAEC	U.S. Army Environmental Command
USEPA	U.S. Environmental Protection Agency
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
VOC	volatile organic compound
ZVI	zero-valent iron

FINAL
OU-1 QUARTERLY GROUNDWATER MONITORING REPORT
OCTOBER 2013 SAMPLING EVENT
THE FORMER ST. LOUIS ORDNANCE PLANT
ST. LOUIS, MISSOURI
REGIONAL LTO/LTM FOR SEVEN INSTALLATIONS

1.0 INTRODUCTION

HydroGeoLogic, Inc. (HGL) is conducting long term monitoring (LTM) at Operable Unit 1 (OU-1) of the former Hanley Area of the Former St. Louis Ordnance Plant (SLOP) in St. Louis, Missouri. This work is being conducted under U.S. Army Corps of Engineers, Northwestern Division, Kansas City District (USACE) contract W912DQ-13-D-3000, task order 0004, Regional LTO/LTM. LTM sampling was completed as required under the *Final Long-Term Management/Land Use Control Implementation Plan – Operable Unit 1* (CH2M HILL, 2012c).

LTM at OU-1 of the former Hanley Area consists of monitoring groundwater contaminated with volatile organic compounds (VOCs) for the 14 chemicals of concern (COCs) identified in the decision document (DD) for OU-1 (CH2M HILL, 2011b):

- Benzene;
- Naphthalene;
- Carbon tetrachloride (CT);
- 1,1,1,2-tetrachloroethane (1,1,1,2-TeCA);
- Chloroform;
- 1,1,2,2-tetrachloroethane (1,1,2,2-TeCA);
- 1,2-dichloroethane (1,2-DCA);
- 1,1,2-trichloroethane (1,1,2-TCA);
- *cis*-1,2-dichloroethene (*cis*-1,2-DCE);
- Tetrachloroethene (PCE);
- *trans*-1,2-dichloroethene (*trans*-1,2-DCE);
- Trichloroethene (TCE);
- Methylene chloride; and
- Vinyl chloride.

The groundwater remedy selected for the SLOP Site in the OU-1 DD was in situ treatment using chemical processes and soil mixing, with groundwater monitoring. Zero-valent iron (ZVI), a chemical reductant, was applied to soil and groundwater in place and mechanically mixed to distribute the chemical amendment throughout the soil column within the treatment zone. Future investigation and potential mitigation of contamination associated with the vapor intrusion pathway will be conducted under OU-2. LTM and land use control (LUC)

implementation activities associated with OU-2 will be addressed in a future revision to the OU-1 LTM//LUC Implementation Plan (LUCIP) (CH2M HILL, 2012c).

The remedial action (RA) implementation was conducted February 2012 through June 2012 in accordance with the final RA work plan (CH2M HILL, 2011a). The 12 wells in the LTM network are to be sampled on a quarterly basis for the first 2 years following remedy implementation and annually thereafter. The initial LTM sampling event was conducted in July 2012 by CH2M HILL (CH2M HILL, 2012a). Groundwater monitoring was then performed by USACE in November 2012 (USACE, 2013a), March 2013 (USACE, 2013b), and August 2013. An annual report summarizing the results of the first four quarters of LTM sampling was prepared by USACE (USACE, 2013c).

This quarterly report provides the results of the October 2013 (4th quarter 2013) sampling event performed by HGL. Discussion and evaluation of all LTM data will be included in the 2014 annual report.

1.1 REGULATORY FRAMEWORK

As authorized under Executive Order 12580, the U.S. Army (Army) is the lead agency for the former Hanley Area. The U.S. Army Environmental Command (USAEC) is the Army agency responsible for cleanup activities at the former Hanley Area, which is owned by the 88th Regional Support Command (RSC). USACE manages the environmental cleanup at the former Hanley Area on behalf of USAEC. Environmental remediation activities at this site are being performed with support from the Missouri Department of Natural Resources (MDNR) and Missouri Department of Health and Senior Services (MDHSS). The U.S. Environmental Protection Agency (USEPA) Region 7 provides regulatory assistance to MDNR. Although the former Hanley Area is not on the National Priorities List, the Army follows the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process and the National Oil and Hazardous Substances Pollution Contingency Plan.

1.2 SITE DESCRIPTION AND HISTORY

1.2.1 Location

The former Hanley Area (Army Reserve Facility ID MO030, CERCLIS ID MO3210090038) is a 14.68-acre industrial site located at 6400 Stratford Avenue on the western boundary of the city limits of St. Louis. The site is 0.25 mile south of the intersection of I-70 and Goodfellow Boulevard (Figure 1.1).

The site is north of the Sverdrup U.S. Army Reserve Center (Facility ID MO028), located at 4301 Goodfellow Boulevard. The site is bordered by the Job Corps facility on the west and residential areas to the north, west, and southwest. The area to the east was formerly part of the SLOP and is now owned by the General Service Administration.

1.2.2 Site History and Background

The former SLOP operated from 1941 to 1945 as a small arms ammunition production facility, producing primarily .30- and .50-caliber ammunition. The plant was divided into two areas designated Plant Area No. 1 (east of Goodfellow Boulevard) and Plant Area No. 2 (west of Goodfellow Boulevard). Production at Plant Area No. 2 consisted of blending primary explosives, incendiary compounds, and tracer charging .30 caliber and .50 caliber projectiles as part of the assembly of the final product. From 1941 through 1945, powder wells provided sediment collection for wastewater prior to discharge in the sanitary sewer.

From 1945 through 1959, some buildings within Plant Area No. 2 were used by the U.S. Army Adjutant General's Office for maintaining service records. Other buildings within Plant Area No. 2 were used as classrooms by the U.S. Department of Defense Finance Center.

The Hanley Area takes its name from Hanley Industries, Inc., which leased 14.68 acres at the northeastern end of Plant Area No. 2 in 1959 and conducted operations there through 1979. Hanley used the site for research, development, manufacture, and testing of explosives, and produced specialty ordnance and nonordnance devices for the U.S. military and the National Aeronautics and Space Administration.

Most of the Hanley Area housed a series of warehouses, bunkers, and related buildings. Hanley used most of the buildings to load detonators and primers and to mix explosives. Explosives were dried in magazines in cans left exposed to the air. Buildings 219E and 219F housed Hanley's lead azide reactor. Hanley reportedly did not use the powder wells or sumps on the property for wastewater disposal.

The Goodfellow U.S. Army Reserve Center (now the Sverdrup U.S. Army Reserve Center) was established on the remaining 13 acres of Plant Area No. 2. Some of the western parts of the 13 acres subsequently were transferred to the U.S. Department of Labor, and the land is currently occupied by the Job Corps.

Soil and groundwater contamination observed at the former Hanley Area is suspected to be related to previous waste generation, handling, and disposal processes. The explosives manufacturing process may have resulted in metal contamination in soil, and laboratory and maintenance activities at former Building 220 may have released polynuclear aromatic hydrocarbons in soil and VOCs in soil and groundwater. A leaking transformer south of the Building 228C barricade wall resulted in polychlorinated biphenyl contamination in surface soil (Aroclor 1260). Hanley Industries is reported to have disposed of explosives-contaminated paper and cloths by burning them in the basement of Building 218C (U.S. Army Toxic and Hazardous Materials Agency [USATHAMA], 1981). Open burning of explosives was also conducted in magazines 219F and 219J.

The former Hanley Area is used for industrial purposes. With the exception of Buildings 219A, 219D, 219G, and 236, onsite buildings and bunkers were demolished by an 89th Regional Readiness Command (RRC) contractor from 2004 through 2007. The 89th RRC owned the former Hanley Area until it was disestablished in June 2009. The 88th RSC

currently owns the former Hanley Area and occupies the Army Reserve Center. According to the 88th RSC, Building 219G is occupied during business hours. Buildings 219A, 219D, and 236 are used for storage only. The site is completely fenced, partially with iron fencing and the remainder with 6 foot-tall chain-link fencing.

According to the City of St. Louis Zoning Department and Assessor's Office, the former SLOP encompasses 125 acres and includes the Job Corps property to the west of the former Hanley Area and Plant No. 2, and the property east of Goodfellow Boulevard (Plant No. 1). The entire site, as described by the City of St. Louis Zoning Department, is zoned industrial, commercial, and residential.

In 2005, the St. Louis Planning Commission adopted a strategic land use plan for the City of St. Louis, which provides a roadmap for future development. It identifies established neighborhoods, historic districts, and business areas that the City intends to maintain and enhance, as well as areas where future development and land use changes are encouraged. The St. Louis Strategic Land Use Plan identifies the former Hanley Area and neighboring parcels to the south and east as a "business and industrial development area." Residential properties to the north of the former Hanley Area, across Stratford Avenue, are designated as a "neighborhood preservation area." Parcels north of the former Hanley Area along Goodfellow Boulevard are designated as a "neighborhood commercial area" (USACE, 2013b). Although the General Services Administration and 88th RSC do not have immediate plans for developing the property, the City of St. Louis has expressed interest in obtaining and redeveloping the former Hanley Area in the future.

City-supplied drinking water is provided to residents and industries in the area. The city draws water from the Mississippi River from intakes upstream of the site. At its closest point, the Mississippi River is located about 3 miles from the site. Although it is not part of the selected remedy, City of St. Louis Ordinance 66777 provides protection against exposure to contaminated groundwater. The ordinance prohibits the use or attempted use of groundwater as a potable water supply and the drilling or installation of wells for a potable water supply within the corporate limits of the City of St. Louis.

1.2.3 Environmental Setting

1.2.3.1 Topography

The site is located in northern St. Louis, which lies in the dissected till plains region of the Central Lowlands Physiographic Province (Miller et al., 1974). The topography of the dissected till plains province is gently sloping, with elevations ranging from 500 feet (ft) to 700 ft above mean sea level (amsl). Local slopes are the result of dissection of the plains and the general dip of the plain, which is to the northeast.

The site consists of a relatively flat terrace, which slopes steeply down to Goodfellow Boulevard to the east and Stratford Avenue on the north (Appendix A, Figure 1-2). There is evidence of grading, with high points cut and low areas filled to generally level out the site.

Ground elevations range from 532 to more than 558 ft amsl. An elevation change of greater than 18 ft occurs between the northern part of the site and Stratford Avenue.

1.2.3.2 **Site Geology and Hydrogeology**

Figures 1-3 and 1-4, provided by USACE and presented in Appendix A, show a geologic cross-section through the area of concern. In the northern portion of the site, fill material, including gravel, concrete rubble, brick debris, and sand, was observed as deep as 11 ft below ground surface (bgs), likely the result of demolition of former Building 220, backfilling, and grading activities. Otherwise, overburden at the former Hanley Area consists of residuum from the ground surface to 25 ft bgs. Soil lithology is relatively consistent across the site.

The uppermost soils consist primarily of lean clay with discontinuous lenses of silt. A fat clay layer with discontinuous lenses of lean clay underlies the lean clay, and decreases in thickness offsite to the north until pinching out near MW-108 (Figure 1.4).

Approximately 6 to 12 ft of weathered shale with discontinuous lenses of silt and clay underlies the lean and fat clay layers. Competent shale bedrock (Lagonda Formation) was encountered at 34 ft bgs in the MW-116 borehole and 38.3 ft bgs in the MW-117 borehole. A 6-inch thick coal layer was observed at 45 ft bgs in the MW-117 boring.

Groundwater is present within the discontinuous, more permeable silt and clay lenses within the upper (lean) clay unit. Groundwater flow is generally from the south and west to the northeast. Depth to groundwater varies from less than 1 ft bgs at MW-110 to approximately 23 ft bgs at MW-115. During July 2012, a groundwater low was observed within the Plume A treatment zone, centered on MW-119. This groundwater low did not continue after July 2012.

With the exception of the 6-inch coal seam, saturated conditions were not observed within the underlying weathered and competent shale layers. Groundwater within the coal does not appear to be hydraulically connected to groundwater observed in the more permeable, discontinuous lenses in the overlying clay units.

1.2.4 Environmental Investigation and Remediation History

Since 1979, the following environmental investigations and remedial activities have been conducted at the former SLOP site:

1.2.4.1 **Preliminary Assessments / Site Inspections**

- *Survey of Hazardous/Chemical Area No. 2 of the Former St. Louis Ordnance Plant* (USATHAMA, 1981).
- *St. Louis Ordnance Plant Environmental Study, Status Report* (USATHAMA, 1991).
- *Site Investigation Report, Former St. Louis Ordnance Plant, St. Louis, Missouri* (HARZA Environmental Services, Inc., 1998).

- *Preliminary Assessment/Site Inspection Report for Former St. Louis Ordnance Plant, St. Louis County. Missouri* (TapanAm Associates, Inc., 2001).
- *Limited Phase II Environmental Assessment Report for the Investigation of Impacted Groundwater, U.S. Army Reserve Center 4301 Goodfellow Blvd. St. Louis, Missouri* (Shaw Environmental, Inc., 2003).
- *Phase I Environmental Site Assessment. Former St. Louis Ordnance Plant, 6400 Stratford Ave., St. Louis, Missouri* (Pangea Inc., 2003).

1.2.4.2 **Remedial Investigations**

- *Asbestos Inspection, former St. Louis Ordnance Plant, St. Louis, Missouri 63104* (NPN Environmental Engineers, 2004).
- *Pre-Demolition Environmental Site Investigation Report, St. Louis Ordnance Plant* (SCS Engineers, February 2004).
- *Building 220, Guard House, and Harboad Street Bridge Demolition and Site Restoration Report* (SCS Engineers, May 2007).
- *Technical Memorandum—Final, Hanley Area Phase I Remedial Investigation (RI), Former St. Louis Ordnance Plant, St. Louis. Missouri* (USACE, 2005).
- *Supplemental Groundwater Remedial Investigation Technical Memorandum, Hanley Area, Former St. Louis Ordnance Plant, St. Louis, Missouri* (USACE, 2006a).
- *Supplemental Groundwater Remedial Investigation, Phase II Field investigation, Addendum #4, Hanley Area, Former St. Louis Ordnance Plant St. Louis, Missouri* (USACE, 2006b).
- *Supplemental Soil and Groundwater Phase II Remedial Investigation Technical Memorandum, Hanley Area, Former St. Louis Ordnance Plant, St. Louis, Missouri* (USACE, 2007).
- *Remedial Investigation, St. Louis Ordnance Plant, St. Louis, Missouri* (CH2M HILL, 2009).
- *Pre-Design Groundwater Investigation at the St. Louis Ordnance Plant, former Hanley Area*. Technical Memorandum (CH2M HILL, 2010a).

A summary of previous investigations and findings is provided in the final RA work plan (CH2M Hill, 2011a).

1.2.4.3 **Other Site Reports**

- *Feasibility Study Report, St. Louis Ordnance Plant, Former Hanley Area* (FS) (CH2M HILL, 2010b).
- *Decision Document – Operable Unit 1*, *St. Louis Ordnance Plant, Former Hanley Area* (CH2M HILL, 2011b).
- *Long-Term Management/Land Use Control Implementation Plan, St. Louis Ordnance Plant, Former Hanley Area* (CH2M HILL, 2012c).
- *Interim Remedial Action Completion Report – Operable Unit 1*, *St. Louis Ordnance Plant, Former Hanley Area* (CH2M HILL, 2012b).

1.2.4.4 **Groundwater Investigation Results**

Groundwater contamination in the northern part of the former Hanley Area consists of three distinct plumes comprising one or more VOCs.

Plume A:
Plume A, northeast of former Building 220, consists of PCE and reductive dechlorination products TCE and *cis*-1,2-DCE at concentrations that exceed screening levels. The source of Plume A is suspected to be the sewer system northeast of former Building 220. There is no historical record of a single large spill, but sporadic discharge of small quantities of spent product may have occurred. The depth of Plume A contamination is from just below ground to the weathered shale interface at approximately 26 to 28 ft bgs.

Plume B:
Plume B, northeast of former Building 220, consists of 1,2-DCA at concentrations that exceed screening levels. Plume B is largely commingled with Plume A. The source of Plume B is unknown, but may be associated with leaks in the former Building 220 sewer system. The depth of Plume B contamination is from just below ground to the weathered shale interface at approximately 24 to 30 ft bgs.

Plume C:
Plume C, southwest of former Building 220, consists of commingled CT, chloroform, and TCE at concentrations that exceed screening levels. Chloroform is likely present as a breakdown product of CT. The source of Plume C is unknown. The depth of Plume C contamination is from greater than 10 ft bgs (the depth of groundwater in that area) to the weathered shale interface at approximately 34 ft bgs.

1.2.4.5 **Groundwater Human Health Risk Assessment Results**

The human health risk assessment (HHRA) completed during the RI for the former Hanley Area estimated the risks posed by contamination to human health, and identified the contaminants and exposure pathways to be addressed by the remedial action. The HHRA included calculated risk estimates for residents, construction workers, and industrial workers exposed to on-site and off-site groundwater (CH2M HILL, 2009).

Hypothetical potable use of groundwater (all available depths) was evaluated in the HHRA at the request of MDNR and MDHSS, even though the current and future exposure pathways are incomplete for the following reasons:

- St. Louis City Ordinance 66777 prohibits use or attempted use of groundwater as a potable water supply and the drilling or installation of wells for a potable water supply within the corporate limits of the City of St. Louis.
- Insufficient yield in the contaminated zone (see Appendix A, CH2M HILL, 2011b).

The following groundwater COCs were identified:

- On-site Groundwater:

  - Tap water (Resident): Benzene, CT, chloroform, 1,2-DCA, *cis*-1,2-DCE, *trans*-1,2 DCE, manganese, naphthalene, 1,1,1,2-TeCA, 1,1,2,2-TeCA, 1,1,2-TCA, PCE, and TCE.
  - Groundwater in Excavation (Construction Worker): PCE (part of Plume A) and CT (part of Plume C).
- Off-site Groundwater:
  - Tap water (Resident): Chloroform, 1,2-DCA, manganese, PCE, and TCE. The risk estimates for this scenario are driven by the elevated concentrations detected in monitoring well MW-110, situated in the middle of Stratford Avenue.

The HHRA estimated risks to construction workers by assuming that that onsite and offsite groundwater lies within 10 ft below ground, the maximum depth at which the groundwater direct contact pathway for construction workers is considered complete. This assumption overestimates construction worker risk associated with CT in Plume C, where groundwater was estimated to be more than 10 ft bgs. The information was considered during the development of remedial alternatives for the FS prepared by CH2M HILL in 2010.

VOCs are present in site groundwater in an area downgradient of former Building 220. There is a potential pathway for vapor intrusion into current and future onsite residences from shallow groundwater. The vapor intrusion pathway is being addressed under OU-2.

1.3 PURPOSE

The selected remedy for the former Hanley Area consists of in situ treatment using chemical processes and soil mixing, with groundwater monitoring. During March 2012 ZVI was applied to soil and groundwater in place and mechanically mixed to distribute the chemical amendment throughout the soil column within the treatment zone. The purpose of the in situ treatment is to promote reduction of VOCs and to develop groundwater conditions conducive to the continued remediation of the COCs.

The OU-1 groundwater monitoring will support the remedial action objective of preventing unacceptable risk to onsite construction workers from dermal contact with groundwater containing CT and PCE, and will achieve the following objectives:

- Evaluate the performance of soil mixing in Plume A and monitor concentrations of PCE and degradation products within the treatment zone over time.
- Confirm that the exposure pathway between construction workers and contaminated groundwater in Plume C remains incomplete (based on the measured depth to groundwater) as long as CT concentrations remain above the remediation goal.
- Monitor trends in select VOC concentrations to assess stability of Plumes A, B, and C.

2.0 OCTOBER 2013 GROUNDWATER SAMPLING

The October 2013 groundwater sampling event is the fifth round of post-RA groundwater monitoring at the site and was conducted by HGL in accordance with the approved Site-Specific Work Plan (HGL, 2014).

2.1 FIELD ACTIVITIES

Field activities were conducted on October 28 and 29, 2013 and included the following:

- Synoptic water level measurements;
- Passive diffusion bag (PDB) sampling;
- Field operations documentation; and
- Decontamination.

Field operations were documented using the following data sheets and forms:

- Observed Water Level and Well Integrity Inspection Form (Appendix B);
- Passive Diffusion Bag Sampling and Deployment Form (Appendix C); and
- PDB Field Parameter Form (Appendix D).

2.1.1 Groundwater Elevation Survey

Water level measurements were collected from the monitoring wells listed in Section 3.1 and shown on Figure 3.1. All water level data were collected within 24 hours and recorded on the Observed Water Level and Well Integrity Inspection Form (Appendix B).

2.1.2 PDB Sampling

PDBs were used to collect groundwater samples from the wells listed in Section 3.1 and shown on Figure 3.1. Sampling information was recorded on the Passive Diffusion Bag Sampling and Deployment Form (Appendix C).

Field instrumental measurements of oxidation-reduction potential, dissolved oxygen, pH, specific conductance, and temperature were obtained using a downhole probe. Results were recorded on the PDB Field Parameter Forms (Appendix D).

2.2 FIELD VARIANCES

No field variances occurred.

2.3 SUMMARY OF SAMPLE ANALYSES

Sample identification and laboratory analysis for each well are summarized on Table 2.1.

3.0 PERFORMANCE MONITORING

Performance monitoring was conducted to characterize groundwater conditions and to assess the effectiveness of the active treatment, ZVI with soil mixing, in generating groundwater conditions conducive to reductive dechlorination of the COCs. Previous groundwater sampling events conducted to support RA performance monitoring are described in detail in the following reports:

- *Pre-Design Groundwater Investigation* (CH2M HILL, 2010a).
- Post-RA sampling:
  - *July 2012 Groundwater Monitoring Report – Operable Unit 1* (CH2M HILL, 2012a).
  - *November 2012 OU-1 Groundwater Long-Term Monitoring Report* (USACE, 2013a).
  - *March 2013 OU-1 Groundwater Long-Term Monitoring Report* (USACE, 2013b).
  - *Annual Groundwater Long-Term Monitoring Report, July 2012 through August 2013* (USACE, 2013c).

3.1 MONITORING LOCATIONS

The SLOP monitoring well network includes a total of 12 wells. Well construction details are provided on Table 3.1 and locations are shown on Figure 3.1:

- MW-106
- MW-107
- MW-108
- MW-109
- MW-110
- MW-119
- MW-112
- MW-113
- MW-114
- MW-115
- MW-116
- MW-118

Note that MW-119 is a replacement well for MW-111, which was abandoned prior to RA soil mixing activities. Additional wells to be installed as part of the OU-2 investigation may be added to the network at a later date.

3.2 VOC MONITORING PARAMETERS AND SCREENING LEVELS

VOC groundwater monitoring parameters and screening levels are as follows:

VOC	Screening Level (µg/L)	VOC	Screening Level (µg/L)
Benzene	5	Naphthalene	6.2
CT	5	1,1,1,2- TeCA	5.2
Chloroform	1.9	1,1,2,2-TeCA	0.67
1,2-DCA	5	1,1,2-TCA	5
cis-1,2-DCE	70	PCE	5
trans-1,2-DCE	100	TCE	5
Methylene chloride	5	Vinyl chloride	2

µg/L = micrograms per liter

Except for four chemicals, the screening levels correspond to maximum contaminant levels. For chloroform, naphthalene, 1,1,1,2-TeCA, and 1,1,2,2-TeCA, resident risk-based screening levels for potable groundwater use were developed by the Army during the FS (CH2M HILL, 2010b).

3.3 PERFORMANCE MONITORING DATA AND EVALUATION

3.3.1 Water Levels

During the October 2013 sampling event, the depth to groundwater ranged from 4.20 ft bgs at MW-110 to 22.84 ft bgs at MW-115. The highest groundwater level elevation was encountered in MW-118 at 536.83 ft amsl. Table 3.2 presents cumulative water level and groundwater elevation data.

Figure 3.1 shows the potentiometric surface for October 2013. The groundwater elevation data indicates that the groundwater flow direction is to the northeast away from the topographic high on the southwest corner of the site. During each of the post-RA sampling rounds, the same general trend of a groundwater high at MW-118 with groundwater flow to the northeast was observed.

3.3.2 VOC Analytical Data

Groundwater samples were collected from PDB samplers installed in 12 monitoring wells at the site and analyzed for VOCs by USEPA Method 8260B. Results from the October 2013 sampling event indicate the presence of VOCs at concentrations exceeding screening levels in five of the 12 wells sampled: MW-106, MW-107, MW-110 MW-118, and MW-119. The COCs detected above screening levels are summarized in the following table and discussed in greater detail with respect to the plume in which they were detected:

COC	Screening Level (µg/L)	MW-106	MW-107	MW-110	MW-118	MW-119
1,2-DCA	5	74.8	34.1	27.3 J	-	-
CT	5	-	-	-	13,000	14.1 J
Chloroform	1.9	-	-	-	783	-
cis-1,2-DCE	70	-	-	176	-	1,820
PCE	5	-	-	4,170	-	-
TCE	5	-	-	-	4,170	14.6 J

- = not detected above screening level
µg/L = micrograms per liter
J = The analyte was detected at the reported concentration; the quantitation is an estimate.
All concentrations are in µg/L

Plume A – The highest concentrations of PCE, TCE, and *cis*-1,2-DCE were detected in MW-110, MW-118, and MW-119, respectively. The highest concentration of the PCE and TCE breakdown component *cis*-1,2-DCE is on site in MW-119, while the highest concentration of PCE was off site in MW-110 located on Stratford Avenue.

Plume B - The highest concentration of 1,2-DCA was detected in MW-106. Detections above screening levels were also reported for MW-107 and MW-110.

Plume C - The highest concentration of CT was detected in MW-118. Detection above the screening level was also reported for MW-119.

The extent of Plume A, Plume B, and Plume C are shown on Figure 3.2. Table 3.3 presents cumulative site groundwater monitoring data for the COCs, along with the screening levels and remediation goals. Figure 3.2 shows groundwater LTM data for August 2013 and October 2013. The annual report for 2014 will include discussion and trend graphs for the network monitoring wells for PCE and degradation products; CT and degradation products; and 1,1,1,2-TeCA and degradation products.

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TABLES

Table 2.1
Sampling Summary
October 2013 Sampling Event
The Former St. Louis Ordnance Plant, St. Louis, Missouri

Parameter	Measurement Type / By	Method	Preservation	Holding Time	Container
VOCs	Lab / Accutest	8260B	no headspace, HCl to pH < 2, 4 °C	14 days	3 - 40mL VOA vials
water level	Field / HGL	water level indicator	analyze immediately	field measurement	field measurement
DO, ORP, pH, temp, conductivity	Field / HGL	down hole probe	analyze immediately	field measurement	field measurement

Well	Field Sample ID	QC Sample ID	Sample Type
MW-106	MW-106		F
MW-107	MW-107		F
MW-108	MW-108		F
MW-109	MW-109		F
MW-110	MW-110		F
MW-112	MW-112	MW-112MS,MW-112MSD	F, MS, MSD
MW-113	MW-113		F
MW-114	MW-114		F
MW-115	MW-115		F
MW-116	MW-116		F
MW-118	MW-118	MW-518	F, D
MW-119	MW-119	MW-519	F, D
PDB blank	PDBB-102913		F
Trip blank	TB-102913		F

Notes:
< = less than
°C = degrees Celsius
D = quality control duplicate, collected from 2 locations with contamination.
DO = dissolved oxygen
F = field sample
HCl = hydrochloric acid
ID = identification
MS = matrix spike, collected from 1 location with low contamination.
MSD = matrix spike duplicate, collected from 1 location with low contamination.
ORP = oxidation reduction potential
QC = quality control
temp = temperature
VOA = volatile organic analysis
VOC = volatile organic compound

Table 3.1
Well Construction Information
October 2013 Sampling Event
The Former St. Louis Ordnance Plant, St. Louis, Missouri

Well ID	Date Installed	Total Depth (ft bgs)	Surface Elevation (ft amsl)	Riser Elevation (ft amsl)	Riser stick-up (ft bgs)	Screened Interval (ft bgs)	Filter Pack Interval (ft bgs)	Bentonite Interval (ft bgs)	Grout Interval[2] (ft bgs)	PDB midpoint depth[3] (ft bgs)	Top of PDB (ft bgs)	Top of PDB (ft btoc)
MW-101[1]	2001	35	563.16	562.65	-0.51	15.0-35.0	13.0-35.0	10.0-13.0	0.0-10.0	--	--	--
MW-102[1]	2001	35	558.86	558.58	-0.28	15.0-35.0	13.0-35.0	0.0-13.0	--	--	--	--
MW-103[1]	2001	35	555.49	555.25	-0.24	15.0-35.0	13.0-35.0	10.0-13.0	0.0-10.0	--	--	--
MW-104[1]	2001	35	557.56	557.06	-0.50	15.0-35.0	13.0-35.0	10.0-13.0	0.0-10.0	--	--	--
MW-105[1]	2001	35	553.66	556.58	2.92	15.0-35.0	13.0-35.0	10.0-13.0	0.0-10.0	--	--	--
MW-106	01/22/05	35	545.26	544.93	-0.33	15.0-35.0	12.0-35.0	7.0-12.0	3.0-7.0	25	24	23.67
MW-107[2]	01/25/07	27	532.11	531.76	-0.35	10.0-27.0	8.0-27.0	5.0-8.0	3.0-5.0	18.5	17.5	17.15
MW-108	01/25/07	27	534.48	534.17	-0.31	10.0-27.0	8.0-27.0	5.0-8.0	3.0-5.0	18.5	17.5	17.19
MW-109	01/26/07	28	536.65	536.35	-0.3	10.0-28.0	8.0-28.0	5.0-8.0	3.0-5.0	19	18	17.70
MW-110[2]	01/25/07	28	534.97	534.67	-0.3	10.0-28.0	8.0-28.0	5.0-8.0	3.0-5.0	19[4]	18	17.70
MW-111[1 2]	01/24/07	30	541.57	541.22	-0.35	10.0-30.0	7.0-30.0	2.0-7.0	--	--	--	--
MW-112[2]	01/25/07	28	534.22	533.49	-0.73	10.0-28.0	8.0-28.0	5.0-8.0	3.0-5.0	19	18	17.27
MW-113[2]	01/26/07	27	537.75	537.25	-0.5	10.0-27.0	8.0-27.0	5.0-8.0	3.0-5.0	18.5	17.5	17
MW-114[2]	03/20/07	29	543.75	543.41	-0.34	9.0-29.0	7.5-29.0	5.5-7.5	2.0-5.5	19	18	17.66
MW-115	05/19/08	43	557.64	560.66	3.02	33.0-43.0	31.0-43.0	29.0-31.0	0.0-29.0	37.98	36.98	40.00
MW-116	05/16/08	28	534.29	533.91	-0.38	18.0-28.0	16.0-28.0	14.0-16.0	0.0-14.0	23	22	21.62
MW-117[1]	06/05/08	54	541.44	541.18	-0.26	49.0-54.0	45.0-54.0	--	0.0-45.0	--	--	--
MW-118	08/11/10	36	553.55	553.31	-0.24	26.0-36.0	24.0-36.0	22.0-24.0	1.0-22.0	31	30	29.76
MW-119	05/09/12	30	542.15	541.63	-0.52	10.0-30.0	8.0-30.0	0.0-8.0	--	20	19	18.48

Notes:

[1] = Monitoring wells were abandoned in 2012. MW-119 replaces MW-111.

[2] = MW-106 completed with concrete from 0.0-3.0 feet bgs; MW-107 through MW-110, MW-112, and MW-113 completed with concrete from 0.0-2.5 feet bgs and fine sand from 2.5-3.0 feet bgs; MW-111 and MW-114 completed with concrete from 0.0-2.0 feet bgs.

[3] = PDB midpoints are based on a 24 in. PDB. The midpoint of the PDB was installed at the midpoint of the screened interval, except as follows:

MW-110: The midpoint of the PDB was installed at 12 ft bgs, approximately 7 feet above the midpoint of the screened interval, because of an apparent obstruction.

MW-115: The midpoint of the PDB was installed at 38 ft below the top of the polyvinyl chloride casing during the July 2012 LTM sampling event; MW-115 has 3. 02 ft of stick-up. A new cable was installed for the second round PDB sampling with the PDB midpoint at 41 ft btoc.

ft amsl = feet above mean sea level

ft bgs = feet below ground surface

ft btoc = feet below top of casing

ID = identification

PDB = passive diffusion bag

Table 3.2
Groundwater Elevation Data
October 2013 Sampling Event
The Former St. Louis Ordnance Plant, St. Louis, Missouri

Well ID	June 2008		August 2008		August 2010		December 2011		June 2012	
	depth to water (ft btoc)	static water elevation (ft amsl)	depth to water (ft btoc)	static water elevation (ft amsl)	depth to water (ft btoc)	static water elevation (ft amsl)	depth to water (ft btoc)	static water elevation (ft amsl)	depth to water (ft btoc)	static water elevation (ft amsl)
MW-101[1]	2.90	559.75	4.29	558.36	--	--	--	--	--	--
MW-102[1]	16.95	541.63	20.25	538.33	--	--	--	--	--	--
MW-103[1]	21.48	533.77	20.68	534.57	--	--	--	--	--	--
MW-104[1]	13.96	543.10	15.12	541.94	--	--	--	--	--	--
MW-105[1]	20.52	536.06	22.53	534.05	--	--	22.99	533.59	--	--
MW-106	8.59	536.34	10.31	534.62	9.45	535.48	10.14	534.79	--	--
MW-107	3.10	528.66	3.72	528.04	2.89	528.87	3.40	528.36	3.74	528.02
MW-108	1.01	533.16	3.39	530.78	2.18	531.99	2.29	531.88	3.73	530.44
MW-109	2.18	534.17	4.76	531.59	3.50	532.85	2.95	533.40	4.12	532.23
MW-110	0.20	534.47	2.21	532.46	1.24	533.43	1.23	533.44	1.02	533.65
MW-111[1]	3.79	537.43	5.42	535.80	4.49	536.73	5.27	535.95	--	--
MW-112	0.40	533.09	2.57	530.92	1.29	532.20	2.11	531.38	3.03	530.46
MW-113	1.39	535.86	2.50	534.75	1.52	535.73	1.79	535.46	3.50	533.75
MW-114	2.93	540.48	4.61	538.80	4.00	539.41	5.64	537.77	5.72	537.69
MW-115	24.24	536.42	24.57	536.09	24.13	536.53	24.14	536.52	25.26	535.40
MW-116	3.81	530.10	4.50	529.41	3.87	530.04	3.99	529.92	4.75	529.16
MW-117[1]	12.28	528.90	11.69	529.49	10.21	530.97	9.67	531.51	--	--
MW-118	--	--	--	--	26.25	527.06	13.19	540.12	14.75	538.56
MW-119	--	--	--	--	--	--	--	--	18.36	523.27

Table 3.2
Groundwater Elevation Data
October 2013 Sampling Event
The Former St. Louis Ordnance Plant, St. Louis, Missouri

Well ID	July 2012		November 2012		March 2013		August 2013		October 2013	
	depth to water (ft btoc)	static water elevation (ft amsl)	depth to water (ft btoc)	static water elevation (ft amsl)	depth to water [2] (ft btoc)	static water elevation (ft amsl)	depth to water (ft btoc)	static water elevation (ft amsl)	depth to water (ft btoc)	static water elevation (ft amsl)
MW-101[1]	--	--	--	--	--	--	--	--	--	--
MW-102[1]	--	--	--	--	--	--	--	--	--	--
MW-103[1]	--	--	--	--	--	--	--	--	--	--
MW-104[1]	--	--	--	--	--	--	--	--	--	--
MW-105[1]	--	--	--	--	--	--	--	--	--	--
MW-106	12.14	532.79	10.59	534.34	5.30	539.63	10.16	534.77	12.58	532.35
MW-107	4.74	527.02	4.13	527.63	3.27	528.49	4.20	527.56	4.08	527.68
MW-108	4.72	529.45	4.59	529.58	0.76	533.41	3.20	530.97	3.91	530.26
MW-109	4.77	531.58	5.00	531.35	1.45	534.90	3.14	533.21	4.98	531.37
MW-110	4.57	530.10	2.61	532.06	0.40	534.27	1.76	532.91	3.90	530.77
MW-111[1]	--	--	--	--	--	--	--	--	--	--
MW-112	5.71	527.78	3.13	530.36	0.00	533.49	2.47	531.02	4.18	529.31
MW-113	4.79	532.46	2.92	534.33	0.10	537.15	2.52	534.73	4.04	533.21
MW-114	7.85	535.56	6.09	537.32	2.55	540.86	5.52	537.89	8.36	535.05
MW-115	26.11	534.55	24.89	535.77	23.76	536.90	24.78	535.88	25.86	534.80
MW-116	5.42	528.49	4.82	529.09	4.00	529.91	4.20	529.71	4.75	529.16
MW-117[1]	--	--	--	--	--	--	--	--	--	--
MW-118	17.63	535.68	10.78	542.53	12.39	540.92	13.61	539.70	16.48	536.83
MW-119	13.75	527.88	9.93	531.70	2.56	539.07	6.46	535.17	8.55	533.08

Notes:
[1] = Monitoring wells were abandoned in 2012. MW-119 replaces MW-111.
[2] = Depth to water may not be accurate for MW-110, MW-112, MW-113 due to snowmelt runoff entering the well.
ft amsl = feet above mean sea level
ft bgs = feet below ground surface
ft btoc = feet below top of casing
ID = identification

Table 3.3
Groundwater VOC Analytical Results
The Former St. Louis Ordnance Plant, St. Louis, Missouri

VOCs (SW8260B)	Remediation Goal / Risk-Based Threshold	Screening Level	MW-106	MW-106	MW-106	MW-106	MW-106	MW-106[1]	MW-106[2]	MW-106	MW-106	MW-106	MW-106	MW-106	MW-106
		Sample Date	2/1/05	2/6/06	4/21/07	6/3/08	8/13/10	7/24/12	7/24/12	7/23/12	11/28/12	3/26/13	3/26/13	8/7/13	10/29/13
		Sampling method	UNK	UNK	LF	LF	LF	LF	LF	PDB	PDB	LF	PDB	PDB	PDB
1,1,1,2-Tetrachloroethane	NC	5.2	0.22 U	5 U	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
1,1,2,2-Tetrachloroethane	NC	0.67	0.1 U	*5 U*	*5 U*	*1 U*	*1 U*	*1 U*	*1 U*	*1 U*	0.29 U	0.29 U	0.29 U	0.29 U	0.50 U
1,1,2-Trichloroethane	NC	5	0.14 U	5 U	5 U	1 U	1.1 U	1 U	1 U	1 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U
1,2-Dichloroethane	NC	5	**62.2**	**4.3 J**	**4.4 J**	**3.3**	**54.9**	0.5 U	**48.7**	**55.6**	**58**	**1.2**	**0.72 J**	**34**	**74.8**
Benzene	NC	5	0.14 U	5 U	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	0.50 U
Carbon tetrachloride	3,200[3]	5	0.14 U	5 U	5 U	1 U	1 U	0.5 U	0.5 U	0.5 U	0.36 U	0.36 U	0.36 U	0.36 U	0.50 U
Chloroform	90,900[4]	1.9	0.21 U	*5 U*	*5 U*	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
cis- 1,2-Dichloroethene	24,900[4]	70	0.15 U	5 U	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.17 U	0.17 U	0.17 U	0.17 U	0.50 U
Methylene chloride	1,070,000[4]	5	0.40 U	5 U	5 U	0.54 U	5 U	5 U	5 U	5 U	0.2 U	0.2 U	0.2 U	0.2 U	4.0 U
Naphthalene	NC	6.2	0.14 U	5 U	5 U	1 U	5 R	5 U	5 U	5 UJ	0.24 U	0.24 U	0.24 U	0.24 U	2.0 U
Tetrachloroethene	21,000[3]	5	**0.34 J**	**0.44 J**	5 U	1 U	**0.32 J**	**0.27 J**	0.5 U	**0.21 J**	**0.3 J**	0.26 U	0.26 U	0.26 U	0.50 U
trans- 1,2-Dichloroethene	NC	100	0.15 U	5 U	5 U	1 U	0.5 U	0.66 U	0.66 U	0.66 U	0.18 U	0.18 U	0.18 U	0.18 U	0.50 U
Trichloroethene	2,320[4]	5	**0.28 J**	5 U	5 U	1 U	**0.21 J**	0.5 U	0.5 U	**0.22 J**	**0.32 J**	0.27 U	0.27 U	0.27 U	0.50 U
Vinyl chloride	47,500[4]	2	0.24 U	*5 U*	*5 U*	1 U	1 U	1 U	1 U	1 U	0.24 U	0.24 U	0.24 U	0.24 U	0.50 U

VOCs (SW8260B)	Remediation Goal / Risk-Based Threshold	Screening Level	MW-107[5]	MW-107[5]	MW-107[5]	MW-107[5]	MW-107[5]	MW-107[5]	MW-107[5]	MW-107[5]	MW-107[5]	MW-107[5]	MW-107[5]	MW-107[5]	MW-107[5]
		Sample Date	4/20/07	6/5/08	8/11/10	5/23/11	12/19/11	6/6/12	7/25/12	7/23/12	11/27/12	3/27/13	3/27/13	8/7/13	10/29/13
		Sampling method	LF	LF	LF	LF	LF	LF	LF	PDB	PDB	LF	PDB	PDB	PDB
1,1,1,2-Tetrachloroethane	NC	5.2	5 U	1 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
1,1,2,2-Tetrachloroethane	NC	0.67	*5 U*	*1 U*	*1 U*	*1 UJ*	1 U	*1 U*	*1 U*	*1 U*	0.29 U	0.29 U	0.29 U	0.29 U	*0.50 U*
1,1,2-Trichloroethane	NC	5	5 U	1 UJ	1.1 U	1.1 U	1.1 U	1 U	1 U	1 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U
1,2-Dichloroethane	NC	5	**3 J**	1 UJ	**22.7**	**13.9**	**9.8**	0.5 U	**19.3**	**21.9**	**28**	**9.9**	**9.1**	**23**	**34.1**
Benzene	NC	5	5 U	1 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	0.50 U
Carbon tetrachloride	3,200[3]	5	5 U	1 UJ	1 U	1 U	*1 U*	0.5 U	0.5 U	0.5 U	0.36 U	0.36 U	0.36 U	0.36 U	0.50 U
Chloroform	90,900[4]	1.9	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
cis- 1,2-Dichloroethene	24,900[4]	70	5 U	1 UJ	**0.57**	**0.68**	**0.71**	**0.74**	**0.73**	**0.74**	**0.94 J**	**0.91 J**	**0.96 J**	**0.94 J**	**1.1**
Methylene chloride	1,070,000[4]	5	5 U	1 UJ	5 U	5 U	5 U	5 U	5 U	5 U	0.2 U	0.2 U	0.2 U	0.2 U	4.0 U
Naphthalene	NC	6.2	5 U	1 UJ	5 U	5 U	5 U	5 UJ	5 UJ	5 UJ	0.24 U	0.24 U	0.24 U	0.24 U	2.0 U
Tetrachloroethene	21,000[3]	5	5 U	1 U	1.1 U	1.1 U	*1.1 U*	0.5 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
trans- 1,2-Dichloroethene	NC	100	5 U	1 U	0.5 U	0.5 U	0.5 U	0.66 U	0.66 U	0.66 U	0.18 U	0.18 U	0.18 U	0.18 U	0.50 U
Trichloroethene	2,320[4]	5	5 U	1 U	**0.39 J**	**0.4 J**	**0.58**	**0.6**	0.5 U	**0.71**	**1.1**	**0.91 J**	**0.99 J**	**0.79 J**	**1.2**
Vinyl chloride	47,500[4]	2	*5 U*	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.24 U	0.24 U	0.24 U	0.24 U	0.50 U

Table 3.3
Groundwater VOC Analytical Results
The Former St. Louis Ordnance Plant, St. Louis, Missouri

VOCs (SW8260B)	Remediation Goal / Risk-Based Threshold	Screening Level	MW-108	MW-108	MW-108	MW-108	MW-108	MW-108	MW-108	MW-108	MW-108	MW-108	MW-108
		Sample Date	4/20/07	6/4/08	8/11/10	2/14/12	7/26/12	7/23/12	11/28/12	3/27/13	3/27/13	8/7/13	10/29/13
		Sampling method	LF	LF	LF	LF	LF	PDB	PDB	LF	PDB	PDB	PDB
1,1,1,2-Tetrachloroethane	NC	5.2	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
1,1,2,2-Tetrachloroethane	NC	0.67	*5 U*	*1 U*	*1 U*	*1 U*	*1 U*	*1 U*	0.29 U	0.29 U	0.29 U	0.29 U	0.50 U
1,1,2-Trichloroethane	NC	5	5 U	1 U	1.1 U	1.1 U	1 U	1 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U
1,2-Dichloroethane	NC	5	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
Benzene	NC	5	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	0.50 U
Carbon tetrachloride	3,200[3]	5	5 U	1 U	1 U	1 U	0.5 U	0.5 U	0.36 U	0.36 U	0.36 U	0.36 U	0.50 U
Chloroform	90,900[4]	1.9	*5 U*	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
cis- 1,2-Dichloroethene	24,900[4]	70	**10**	**9.4**	**6.6**	**1.2**	**2.7**	**1.6**	**1.2**	**0.57 J**	**0.45 J**	**0.60 J**	**1.7**
Methylene chloride	1,070,000[4]	5	5 U	0.53 U	5 U	5 U	5 U	5 U	0.2 U	0.2 U	0.2 U	0.2 U	4.0 U
Naphthalene	NC	6.2	5 U	1 U	5 U	5 U	5 UJ	5 UJ	0.24 U	0.24 U	0.24 U	0.24 U	2.0 U
Tetrachloroethene	21,000[3]	5	5 U	1 U	1.1 U	1.1 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
trans- 1,2-Dichloroethene	NC	100	**0.54 J**	**0.6 J**	**0.35 J**	0.5 U	0.66 U	0.66 U	0.18 U	0.18 U	0.18 U	0.18 U	0.50 U
Trichloroethene	2,320[4]	5	**18**	**16.8**	**4.6**	**0.55**	**0.79**	**0.68**	**0.54 J**	0.27 U	0.27 U	0.27 U	**0.34 J**
Vinyl chloride	47,500[4]	2	*5 U*	1 U	**0.19 J**	1 U	1 U	1 U	0.24 U	0.24 U	0.24 U	0.24 U	0.50 U

VOCs (SW8260B)	Remediation Goal / Risk-Based Threshold	Screening Level	MW-109	MW-109	MW-109	MW-109	MW-109	MW-109	MW-109	MW-109	MW-109	MW-109	MW-109
		Sample Date	4/22/07	6/4/08	8/11/10	12/19/11	7/26/12	7/23/12	11/28/12	3/27/13	3/27/13	8/7/13	10/29/13
		Sampling method	LF	LF	LF	LF	LF	PDB	PDB	LF	PDB	PDB	PDB
1,1,1,2-Tetrachloroethane	NC	5.2	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
1,1,2,2-Tetrachloroethane	NC	0.67	*5 U*	*1 U*	*1 U*	*1 U*	*1 U*	*1 U*	0.29 U	0.29 U	0.29 U	0.29 U	0.50 U
1,1,2-Trichloroethane	NC	5	5 U	1 U	1.1 U	1.1 U	1 U	1 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U
1,2-Dichloroethane	NC	5	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
Benzene	NC	5	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	0.50 U
Carbon tetrachloride	3,200[3]	5	5 U	1 U	1 U	1 U	0.5 U	0.5 U	0.36 U	0.36 U	0.36 U	0.36 U	0.50 U
Chloroform	90,900[4]	1.9	*5 U*	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
cis- 1,2-Dichloroethene	24,900[4]	70	**1.7 J**	**1.5**	**1.3**	**0.56**	**0.7**	**0.5**	**0.56 J**	**0.34 J**	**0.31 J**	**0.32 J**	**0.36 J**
Methylene chloride	1,070,000[4]	5	5 U	1 U	5 U	5 U	5 U	5 U	0.2 U	0.2 U	0.2 U	0.2 U	4.0 U
Naphthalene	NC	6.2	5 U	1 U	5 U	5 U	5 UJ	5 UJ	0.24 U	0.24 U	0.24 U	0.24 U	2.0 U
Tetrachloroethene	21,000[3]	5	**3.9 J**	**2.9**	**1 J**	**0.31 J**	0.5 U	**0.28 J**	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
trans- 1,2-Dichloroethene	NC	100	5 U	1 U	0.5 U	0.5 U	0.66 U	0.66 U	0.18 U	0.18 U	0.18 U	0.18 U	0.50 U
Trichloroethene	2,320[4]	5	**5.8**	**5.1**	**2.5**	**1.2**	**1**	**0.83**	**0.72 J**	**1.1**	**0.89 J**	**0.73 J**	**0.84 J**
Vinyl chloride	47,500[4]	2	*5 U*	1 U	1 U	1 U	1 U	1 U	0.24 U	0.24 U	0.24 U	0.24 U	0.50 U

Table 3.3
Groundwater VOC Analytical Results
The Former St. Louis Ordnance Plant, St. Louis, Missouri

		Well Location	**MW-110**	**MW-110**	**MW-110**	**MW-110**	**MW-110**	**MW-110**	**MW-110**	**MW-110**	**MW-110**	**MW-110**	**MW-110**
		Sample Date	4/22/07	6/5/08	8/11/10	12/19/11	7/26/12	7/23/12	11/28/12	3/27/13	3/27/13	8/7/13	10/29/13
		Sampling method	LF	LF	LF	LF	LF	PDB	PDB	LF	PDB	PDB	PDB
VOCs (SW8260B)	**Remediation Goal / Risk-Based Threshold**	**Screening Level**				MW-110							
1,1,1,2-Tetrachloroethane	NC	5.2	5 U	*20 UJ*	*25 U*	*25 U*	*10 U*	*10 U*	0.26 U	0.26 U	0.26 U	*13 U*	*25 U*
1,1,2,2-Tetrachloroethane	NC	0.67	*5 U*	*20 U*	*50 U*	*50 U*	*20 U*	*20 U*	0.29 U	0.29 U	0.29 U	*14 U*	*25 U*
1,1,2-Trichloroethane	NC	5	5 U	*20 UJ*	*57 U*	*57 U*	*20 U*	*20 U*	0.27 U	0.27 U	0.27 U	*13 U*	*25 U*
1,2-Dichloroethane	NC	5	**150**	**100 J**	**68.2**	*25 U*	**25.7**	**31.6**	**23**	**51**	**21**	*9.4 U*	**27.3 J**
Benzene	NC	5	5 U	*20 UJ*	*25 U*	*25 U*	*10 U*	*10 U*	0.2 U	0.2 U	0.2 U	*9.8 U*	*25 U*
Carbon tetrachloride	3,200[3]	5	5 U	*20 UJ*	*51 U*	*51 U*	*10 U*	*10 U*	**0.46 J**	**1.3**	**3.1**	*18 U*	*25 U*
Chloroform	90,900[4]	1.9	**0.35 J**	*20 U*	*25 U*	*25 U*	*10 U*	*10 U*	0.19 U	**0.43 J**	**0.61 J**	*9.4 U*	*25 U*
cis- 1,2-Dichloroethene	24,900[4]	70	**46**	**82.2 J**	**143**	**156**	**164**	**203**	**190**	**140**	**160**	**150 D**	**176**
Methylene chloride	1,070,000[4]	5	5 U	*20 UJ*	*250 U*	*250 U*	*100 U*	*100 U*	0.2 U	0.2 U	0.2 U	*10 U*	*200 U*
Naphthalene	NC	6.2	5 U	*20 UJ*	*250 U*	*250 U*	*100 UJ*	*100 UJ*	0.24 U	0.24 U	0.24 U	*12 U*	*100 U*
Tetrachloroethene	21,000[3]	5	**7,700 D**	**9,440**	**13,400**	**9,380**	**3,930**	**5,770**	**5,300 D**	**7,900 D**	**6,700 D**	**5,700 D**	**4,170**
trans- 1,2-Dichloroethene	NC	100	**0.93 J**	20 UJ	25 U	25 U	13.2 U	13.2 U	**2.5**	**2.9**	**3**	*9.2 U*	25 U
Trichloroethene	2,320[4]	5	**82**	**129**	**203**	**208**	**141**	**228**	**220 JD**	**200 D**	**200 D**	**190 D**	**174**
Vinyl chloride	47,500[4]	2	*5 U*	*20 U*	*50 U U*	*50 U*	*20 U*	*20 U*	0.24 U	0.24 U	0.24 U	*12 U*	*25 U*

		Well Location	**MW-111[5]**	**MW-111[5]**	**MW-111[5]**	**MW-111[5]**	**MW-119**	**MW-119**	**MW-119**	**MW-519**	**MW-119**	**MW-519**	**MW-119**	**MW-519**	**MW-119**	**MW-519**	**MW-119**	**MW-519**
		Sample Date	4/21/07	6/6/08	8/13/10	12/19/11	7/25/12	7/23/12	11/28/12	11/28/12	3/28/13	3/28/13	3/28/13	3/28/13	8/7/13	8/7/13	10/28/13	10/28/13
		Sampling method	LF	LF	LF	LF	LF	PDB	PDB	PDB	LF	LF	PDB	PDB	PDB	PDB	PDB	PDB
VOCs (SW8260B)	**Remediation Goal / Risk-Based Threshold**	**Screening Level**																
1,1,1,2-Tetrachloroethane	NC	5.2	**16**	*50 U*	**17.4 J**	**17.1 J**	*10 U*	*50 U*	**3.3**	**2.3**	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	*10 U*	*10 U*
1,1,2,2-Tetrachloroethane	NC	0.67	**0.58 J**	*50 U*	*100 U*	*100 U*	*20 U*	*100 U*	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	*10 U*	*10 U*
1,1,2-Trichloroethane	NC	5	5 U	*50 U*	*114 U*	*114 U*	*20 U*	*100 U*	**4.8**	**5.2**	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U	*10 U*	*10 U*
1,2-Dichloroethane	NC	5	5 U	*50 U*	*50 U*	*50 U*	*10 U*	*50 U*	**0.47 J**	**0.5 J**	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	*10 U*	*10 U*
Benzene	NC	5	**0.22 J**	*50 U*	*50 U*	*50 U*	*10 U*	*50 U*	**1.3**	**1.6**	**2.3**	**3.4**	**1.6**	**1.4**	**4.8**	**4.9**	*10 U*	*10 U*
Carbon tetrachloride	3,200[3]	5	**2.7 J**	*50 U*	*102 U*	*102 U*	*10 U*	*50 U*	*180 UD*	*180 UD*	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	**14.1 J**	*10 U*
Chloroform	90,900[4]	1.9	**20**	**23.8 J**	**21.7 J**	**24.3 J**	*10 U*	*50 U*	*94 UD*	*94 UD*	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	*10 U*	*10 U*
cis- 1,2-Dichloroethene	24,900[4]	70	**250 JD**	**281**	**330**	**324**	**1,070**	**2,320**	**4,500 D**	**4,800 D**	**88**	**140**	**210 D**	**200**	**480 D**	**470 D**	**1,660**	**1,820**
Methylene chloride	1,070,000[4]	5	5 U	*50 U*	**139 J**	*500 U*	*100 U*	*500 U*	0.2 U	0.2 U	1.2 u	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	*80 U*	*80 U*
Naphthalene	NC	6.2	5 U	*50 U*	*500 R*	*500 U*	*100 UJ*	*500 UJ*	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	*40 U*	*40 U*
Tetrachloroethene	21,000[3]	5	**29,000 D**	**34,900**	**43,300**	**36,100**	**4,520**	**17,100**	**11,000 D**	**8,600 D**	**5.8**	**15**	**9.2**	**5.5**	**0.35 J**	**0.36 J**	*10 U*	*10 U*
trans- 1,2-Dichloroethene	NC	100	**12**	50 U	50 U	50 U	13.2 U	66 U	**17**	**25**	0.18 U	0.18 U	0.18 U	0.18 U	**0.24 J**	0.18 U	10 U	10 U
Trichloroethene	2,320[4]	5	**1,400 D**	**1,620**	**1,610**	**1,720**	**493**	**1,330**	**2,600 D**	**2,400 D**	**6.6**	**14**	**2.4**	**1.9**	**0.31 J**	**0.29 J**	**14.6 J**	**6.9 J**
Vinyl chloride	47,500[4]	2	**0.32 J**	*50 U*	*100 U*	*100 U*	*20 U*	*100 U*	**22**	**20**	0.24 U	0.24 U	**1.2**	0.24 U	**2.2**	**2.3**	*10 U*	*10 U*

Table 3.3
Groundwater VOC Analytical Results
The Former St. Louis Ordnance Plant, St. Louis, Missouri

		Well Location	MW-112	MW-112	MW-112	MW-112	MW-112	MW-112	MW-112	MW-112	MW-112	MW-112
		Sample Date	4/22/07	6/5/08	8/13/10	7/25/12	7/23/12	11/28/12	3/27/13	3/27/13	8/7/13	10/29/13
		Sampling method	LF	LF	LF	LF	PDB	PDB	LF	PDB	PDB	PDB
VOCs (SW8260B)	**Remediation Goal / Risk-Based Threshold**	**Screening Level**							NS - snow melt runoff affecting well			
1,1,1,2-Tetrachloroethane	NC	5.2	5 U	1 *UJ*	0.5 U	0.5 U	0.5 U	0.26 U		0.26 U	0.26 U	0.50 U
1,1,2,2-Tetrachloroethane	NC	0.67	*5 U*	*1* U	*1* U	*1* U	*1* U	0.29 U		0.29 U	0.29 U	0.50 U
1,1,2-Trichloroethane	NC	5	5 U	1 UJ	1.1 U	1 U	1 U	0.27 U		0.27 U	0.27 U	0.50 U
1,2-Dichloroethane	NC	5	5 U	1 UJ	**0.21 J**	0.5 U	0.5 U	0.19 U		0.19 U	0.19 U	0.50 U
Benzene	NC	5	5 U	1 UJ	0.5 U	0.5 U	0.5 U	0.2 U		0.2 U	0.2 U	0.50 U
Carbon tetrachloride	3,200[3]	5	5 U	1 UJ	1 U	0.5 U	0.5 U	0.36 U		0.36 U	0.36 U	0.50 U
Chloroform	90,900[4]	1.9	*5 U*	1 U	0.5 U	0.5 U	0.5 U	0.19 U		0.19 U	0.19 U	0.50 U
cis- 1,2-Dichloroethene	24,900[4]	70	5 U	1 UJ	0.5 U	0.5 U	0.5 U	0.17 U		0.17 U	0.17 U	0.50 U
Methylene chloride	1,070,000[4]	5	5 U	1 UJ	5 U	5 U	5 U	0.2 U		0.2 U	0.27 U	4.0 U
Naphthalene	NC	6.2	5 U	1 UJ	5 R	5 UJ	5 UJ	0.24 U		0.24 U	0.24 U	2.0 U
Tetrachloroethene	21,000[3]	5	5 U	1 U	1.1 U	0.5 U	0.5 U	0.26 U		0.26 U	0.26 U	0.50 U
trans- 1,2-Dichloroethene	NC	100	5 U	1 UJ	0.5 U	0.66 U	0.66 U	0.18 U		0.18 U	0.18 U	0.50 U
Trichloroethene	2,320[4]	5	5 U	1 U	0.5 U	0.5 U	0.5 U	0.27 U		0.27 U	0.27 U	0.50 U
Vinyl chloride	47,500[4]	2	*5 U*	1 U	1 U	1 U	1 U	0.24 U		0.24 U	0.24 U	0.50 U

		Well Location	MW-113	MW-113	MW-113	MW-113	MW-113	MW-113	MW-113	MW-113	MW-113	MW-113	MW-113
		Sample Date	4/21/07	6/4/08	8/12/10	12/19/11	7/25/12	7/23/12	11/28/12	3/28/13	3/28/13	8/7/13	10/28/13
		Sampling method	LF	LF	LF	LF	LF	PDB	PDB	LF	PDB	PDB	PDB
VOCs (SW8260B)	**Remediation Goal / Risk-Based Threshold**	**Screening Level**											
1,1,1,2-Tetrachloroethane	NC	5.2	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
1,1,2,2-Tetrachloroethane	NC	0.67	*5 U*	*1 U*	*1 U*	*1 U*	*1 U*	*1 U*	0.29 U	0.29 U	0.29 U	0.29 U	0.50 U
1,1,2-Trichloroethane	NC	5	5 U	1 U	1.1 U	1.1 U	1 U	1 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U
1,2-Dichloroethane	NC	5	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
Benzene	NC	5	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	0.50 U
Carbon tetrachloride	3,200[3]	5	5 U	1 U	1 U	1 U	0.5 U	0.5 U	0.36 U	0.36 U	0.36 U	0.36 U	0.50 U
Chloroform	90,900[4]	1.9	*5 U*	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
cis- 1,2-Dichloroethene	24,900[4]	70	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.17 U	0.17 U	0.17 U	0.17 U	0.50 U
Methylene chloride	1,070,000[4]	5	5 U	1 R	5 U	5 U	5 U	5 U	0.2 U	0.2 U	0.2 U	0.2 U	4.0 U
Naphthalene	NC	6.2	5 U	1 U	5 R	5 U	5 UJ	5 UJ	0.24 U	0.24 U	0.24 U	0.24 U	2.0 U
Tetrachloroethene	21,000[3]	5	5 U	**0.88 J**	1.1 U	**0.33 J**	0.5 U	0.5 U	**1.4**	0.26 U	0.26 U	0.26 U	**1.0**
trans- 1,2-Dichloroethene	NC	100	5 U	1 U	0.5 U	0.5 U	0.66 U	0.66 U	0.18 U	0.18 U	0.18 U	0.18 U	0.50 U
Trichloroethene	2,320[4]	5	5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U
Vinyl chloride	47,500[4]	2	*5 U*	1 U	1 U	1 U	1 U	1 U	0.24 U	0.24 U	0.24 U	0.24 U	0.50 U

Table 3.3
Groundwater VOC Analytical Results
The Former St. Louis Ordnance Plant, St. Louis, Missouri

		Well Location	**MW-114**	**MW-114**	**MW-114**	**MW-114**	**MW-114**	**MW-114**	**MW-114**	**MW-114**	**MW-114**	**MW-114**
		Sample Date	4/22/07	6/3/08	8/11/10	7/24/12	7/23/12	11/28/12	3/27/13	3/27/13	8/7/13	10/28/13
		Sampling method	LF	LF	LF	LF	PDB	PDB	LF	PDB	PDB	PDB
VOCs (SW8260B)	**Remediation Goal / Risk-Based Threshold**	**Screening Level**										
1,1,1,2-Tetrachloroethane	NC	5.2	5 U	1 U	0.5 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
1,1,2,2-Tetrachloroethane	NC	0.67	*5 U*	*1 U*	*1 U*	*1 U*	*1 U*	0.29 U	0.29 U	0.29 U	0.29 U	0.50 U
1,1,2-Trichloroethane	NC	5	5 U	1 U	1.1 U	1 U	1 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U
1,2-Dichloroethane	NC	5	**3.3 J**	1 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
Benzene	NC	5	5 U	1 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	0.50 U
Carbon tetrachloride	3,200[3]	5	5 U	1 U	1 U	0.5 U	0.5 U	0.36 U	0.36 U	0.36 U	0.36 U	0.50 U
Chloroform	90,900[4]	1.9	*5* U	1 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
cis- 1,2-Dichloroethene	24,900[4]	70	5 U	1 U	**0.26 J**	0.5 U	0.5 U	0.17 U	0.17 U	0.17 U	0.17 U	0.50 U
Methylene chloride	1,070,000[4]	5	5 U	1 R	5 U	5 U	5 U	0.2 U	0.2 U	0.2 U	0.23 U	4.0 U
Naphthalene	NC	6.2	5 U	1 U	5 U	5 U	5 UJ	0.24 U	0.24 U	0.24 U	0.24 U	2.0 U
Tetrachloroethene	21,000[3]	5	5 U	**0.64 J**	**0.58 J**	0.5 U	0.5 U	**0.32 J**	0.26 U	0.26 U	0.26 U	0.50 U
trans- 1,2-Dichloroethene	NC	100	5 U	1 U	0.5 U	0.66 U	0.66 U	0.18 U	0.18 U	0.18 U	0.18 U	0.50 U
Trichloroethene	2,320[4]	5	5 U	**0.54 J**	**0.62**	**0.44 J**	**0.34 J**	**0.28 J**	0.27 U	0.27 U	0.27 U	0.50 U
Vinyl chloride	47,500[4]	2	*5 U*	1 U	1 U	1 U	1 U	0.24 U	0.24 U	0.24 U	0.24 U	0.50 U

		Well Location	**MW-115**	**MW-115**	**MW-115**	**MW-115**	**MW-115**	**MW-115**	**MW-115**	**MW-115**	**MW-115**
		Sample Date	6/5/08	8/13/10	7/24/12	7/23/12	11/28/12	3/28/13	3/28/13	8/7/13	10/28/13
		Sampling method	LF	LF	LF	PDB	PDB	LF	PDB	PDB	PDB
VOCs (SW8260B)	**Remediation Goal / Risk-Based Threshold**	**Screening Level**									
1,1,1,2-Tetrachloroethane	NC	5.2	1 UJ	0.5 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
1,1,2,2-Tetrachloroethane	NC	0.67	*1 U*	*1 U*	*1 U*	*1 U*	0.29 U	0.29 U	0.29 U	0.29 U	0.50 U
1,1,2-Trichloroethane	NC	5	1 UJ	1.1 U	1 U	1 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U
1,2-Dichloroethane	NC	5	1 UJ	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
Benzene	NC	5	1 UJ	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	0.50 U
Carbon tetrachloride	3,200[3]	5	**0.38 J**	1 U	**0.32 J**	0.5 U	**0.52 J**	**0.48 J**	**0.57 J**	**0.61 J**	**0.92 J**
Chloroform	90,900[4]	1.9	1 U	0.5 U	**0.16 J**	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U
cis- 1,2-Dichloroethene	24,900[4]	70	1 UJ	0.5 U	0.5 U	0.5 U	0.17 U	0.17 U	0.17 U	0.17 U	0.50 U
Methylene chloride	1,070,000[4]	5	1 UJ	5 U	5 U	5 U	0.2 U	0.2 U	0.2 U	0.2 U	4.0 U
Naphthalene	NC	6.2	1 UJ	5 R	5 U	5 UJ	0.24 U	0.24 U	0.24 U	0.24 U	2.0 U
Tetrachloroethene	21,000[3]	5	1 U	1.1 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U
trans- 1,2-Dichloroethene	NC	100	1 UJ	0.5 U	0.66 U	0.66 U	0.18 U	0.18 U	0.18 U	0.18 U	0.50 U
Trichloroethene	2,320[4]	5	1 U	0.5 U	0.5 U	0.5 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U
Vinyl chloride	47,500[4]	2	1 U	1 U	1 U	1 U	0.24 U	0.24 U	0.24 U	0.24 U	0.50 U

Table 3.3
Groundwater VOC Analytical Results
The Former St. Louis Ordnance Plant, St. Louis, Missouri

VOCs (SW8260B)	Remediation Goal / Risk-Based Threshold	Screening Level	MW-116	MW-116	MW-116	MW-116	MW-116	MW-116	MW-116	MW-116	MW-116	MW-116	MW-117[5]
		Sample Date	6/4/08	8/11/10	2/14/12	7/25/12	7/23/12	11/27/12	3/27/13	3/27/13	8/7/13	10/29/13	6/12/08
		Sampling method	LF	LF	LF	LF	PDB	PDB	LF	PDB	PDB	PDB	LF
1,1,1,2-Tetrachloroethane	NC	5.2	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U	1 U
1,1,2,2-Tetrachloroethane	NC	0.67	*1 U*	*1 U*	*1 U*	*1 U*	*1 U*	0.29 U	0.29 U	0.29 U	0.29 U	0.50 U	*1 U*
1,1,2-Trichloroethane	NC	5	1 U	1.1 U	1.1 U	1 U	1 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U	1 U
1,2-Dichloroethane	NC	5	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U	1 U
Benzene	NC	5	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	0.50 U	1 U
Carbon tetrachloride	3,200[3]	5	1 UJ	1 U	1 U	0.5 U	0.5 U	0.36 U	0.36 U	0.36 U	0.36 U	0.50 U	1 U
Chloroform	90,900[4]	1.9	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.19 U	0.19 U	0.19 U	0.19 U	0.50 U	1 U
cis- 1,2-Dichloroethene	24,900[4]	70	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.17 U	0.17 U	0.17 U	0.17 U	0.50 U	1 U
Methylene chloride	1,070,000[4]	5	1 U	5 U	5 U	5 U	5 U	0.2 U	0.2 U	0.2 U	0.2 U	4.0 U	1 U
Naphthalene	NC	6.2	1 U	5 U	5 U	5 UJ	5 UJ	0.24 U	0.24 U	0.24 U	0.24 U	2.0 U	1 UJ
Tetrachloroethene	21,000[3]	5	1 U	1.1 U	1.1 U	0.5 U	0.5 U	0.26 U	0.26 U	0.26 U	0.26 U	0.50 U	1 U
trans- 1,2-Dichloroethene	NC	100	1 U	0.5 U	0.5 U	0.66 U	0.66 U	0.18 U	0.18 U	0.18 U	0.18 U	0.50 U	1 U
Trichloroethene	2,320[4]	5	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.27 U	0.27 U	0.27 U	0.27 U	0.50 U	1 U
Vinyl chloride	47,500[4]	2	1 UJ	1 U	1 U	1 U	1 U	0.24 U	0.24 U	0.24 U	0.24 U	0.50 U	1 U

VOCs (SW8260B)	Remediation Goal / Risk-Based Threshold	Screening Level	MW-118	MW-118	MW-118	MW-118	MW-518	MW-118	MW-118	MW-518	MW-518	MW-118	MW-518	MW-118	MW-518
		Sample Date	8/13/10	7/24/12	7/23/12	11/28/12	11/28/12	3/28/13	3/28/13	3/28/13	3/28/13	8/7/13	8/7/13	10/28/13	10/28/13
		Sampling method	LF	LF	PDB	PDB	PDB	LF	PDB	LF	PDB	PDB	PDB	PDB	PDB
1,1,1,2-Tetrachloroethane	NC	5.2	2.5 U	*25 U*	*25 U*	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	*26 U*	*26 U*	*25 U*	*25 U*
1,1,2,2-Tetrachloroethane	NC	0.67	*5 U*	*50 U*	*50 U*	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	*29 U*	*29 U*	*25 U*	*25 U*
1,1,2-Trichloroethane	NC	5	**1.4 J**	*50 U*	*50 U*	**5**	**4.7**	**4.2**	**4.6**	**4.1**	**4.5**	*27 U*	*27 U*	*25 U*	*25 U*
1,2-Dichloroethane	NC	5	2.5 U	*25 U*	*25 U*	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	*19 U*	*19 U*	*25 U*	*25 U*
Benzene	NC	5	**1.8 J**	*25 U*	*25 U*	**8.2**	**7.9**	**5.4**	**6.6**	**5.2**	**6.2**	*20 U*	*20 U*	*25 U*	*25 U*
Carbon tetrachloride	3,200[3]	5	**1,480**	**10,200**	**15,100**	**13,000 D**	**12,000 D**	**9,400 D**	**11,000 D**	**9,100 D**	**12,000 D**	**12,000 D**	**12,000 D**	**11,900**	**13,000**
Chloroform	90,900[4]	1.9	**165**	**734**	**864**	**800 D**	**760 D**	**650 D**	**710 D**	**640 D**	**760 D**	**680 D**	**670 D**	**778**	**783**
cis- 1,2-Dichloroethene	24,900[4]	70	2.5 U	25 U	25 U	**0.23 J**	**0.23 J**	0.17 U	**0.46 J**	0.17 U	**0.22 J**	*17 U*	*17 U*	25 U	25 U
Methylene chloride	1,070,000[4]	5	**5.9 J**	*250 U*	*250 U*	0.2 U	0.2 U	0.28 u	0.30 u	0.2 U	0.28 U	*32 U*	*35 U*	*200 U*	*200 U*
Naphthalene	NC	6.2	25 R	*250 U*	*250 UJ*	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	*24 U*	*24 U*	*100 U*	*100 U*
Tetrachloroethene	21,000[3]	5	*5.7 U*	*25 U*	*25 U*	**0.76 J**	**0.51 J**	**0.49 J**	**0.60 J**	**0.47 J**	**0.45 J**	*26 U*	*26 U*	*25 U*	*25 U*
trans- 1,2-Dichloroethene	NC	100	2.5 U	33 U	33 U	0.18 U	0.18 U	0.18 U	0.18 U	0.18 U	0.18 U	*18 U*	*18 U*	25 U	25 U
Trichloroethene	2,320[4]	5	**809**	**3,140**	**4,210**	**4,100 D**	**3,800 D**	**3,200 D**	**3,800 D**	**3,100 D**	**3,900 D**	**3,400 D**	**3,600 D**	**4,040**	**4,170**
Vinyl chloride	47,500[4]	2	*5 U*	*50 U*	*50 U*	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	*24 U*	*24 U*	*25 U*	*25 U*

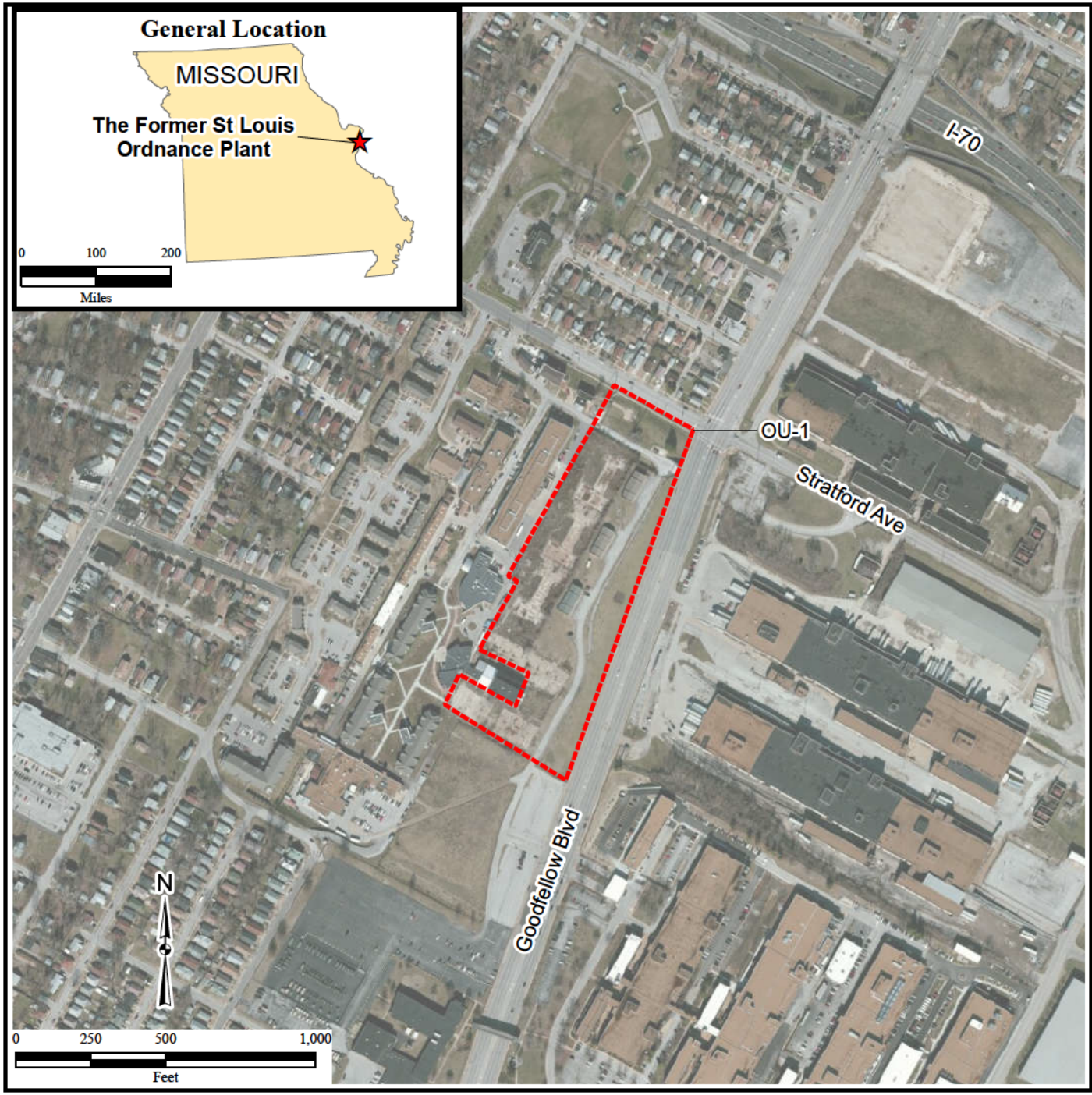
Notes:
Screening levels for the vapor intrusion pathway and assessing plume stability are U.S. Environmental Protection Agency Maximum Contamiant Levels (MCLs) or resident risk-base screening levels for potable use for chemicals without MCLs.
Italics = reporting limit for nondetects exceeds screening level
bold = laboratory analytical positive detection
Shaded = result exceeds screening level

* = QC duplicate sample
D = quantified at dilution
J = the analyte was detected at the reported concentration; the quantitation is an estimate.
LF = low-flow sampling
NC = not calculated
NS = not sampled. Well affected by snowmelt runoff.
PDB = passive diffusion bag sampling
R = the result is rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria.
U = not detected. The associated number indicates the analyte limit of detection.
UJ = not detected. The associated number indicates the analyte limit of detection, which may be inaccurate.
UNK = unknown

[1] = The sample was re-analyzed because the results were not comparable with previous sample results.
[2] = Results represent the re-analyzed sample.
[3] = Remediation goal to prevent unacceptable risk to construction workers from dermal contact with groundwater containing carbon tetrachloride and tetrachloroethene.
[4] = Risk-based thresholds protective of construction workers calculated for carbon tetrachloride and tetrachloroethene degradation products.
[5] = Monitoring wells were abandoned in 2012. MW-119 replaces MW-111.

FIGURES

Figure 1.1
Site Location
The Former
St. Louis Ordnance Plant



Legend

Site Location

\\Gst-srv-01\hglgis\Army_GW\St_Louis_Ordnance_Plant\OU1_GW_Report_Oct013
(1-01)St_Louis_Ord_Loc.mxd
5/6/2014 JG
Source: HGL, ArcGIS Online Imagery

[redacted]

HGL HydroGeoLogic, Inc

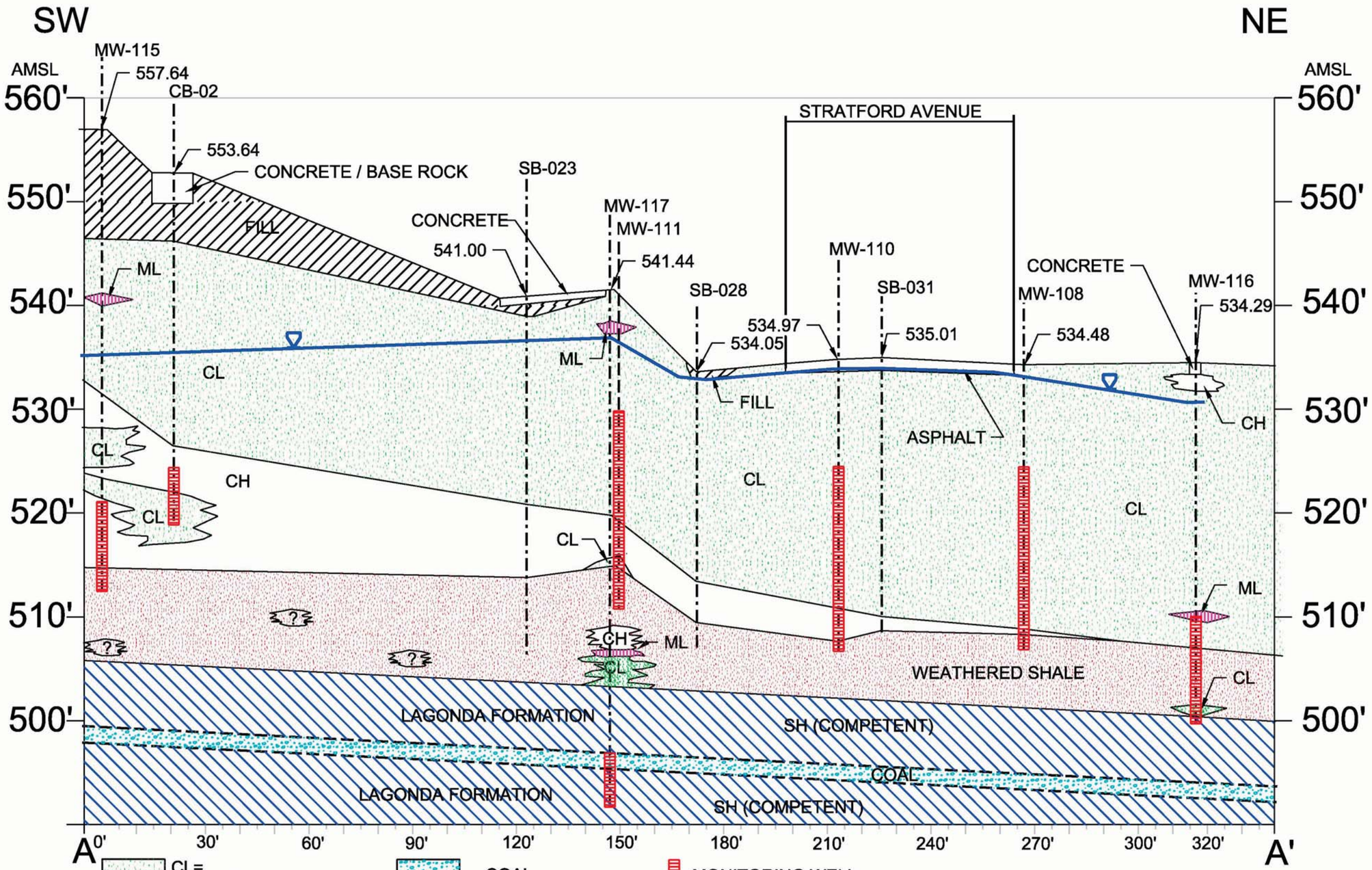
[redacted]

APPENDIX A

HISTORICAL FIGURES

- **Figure 1-2: Current Site Features**
- **Figure 1-3: Location of Cross-Section A-A'**
- **Figure 1-4: Geologic Cross-Section A-A'**

[redacted]



CL= LEAN CLAY

FILL

ML= SILT

CH= FAT CLAY

COAL

WEATHERED SHALE

SH (COMPETENT)

MONITORING WELL SCREEN

POTENTIOMETRIC SURFACE

AMSL ABOVE MEAN SEA LEVEL

POSSIBLE LENSES

INFERRED

0 30 60 90

Scale In Feet

NOTES:

1. NOT ALL SOIL LENSES ARE DEPICTED.
2. WATER LEVEL AT MW-111 WAS USED TO CREATE POTENTIOMETRIC SURFACE NEAR MW-117

US Army Corps of Engineers
Kansas City District

FIGURE 1-4
GEOLOGIC CROSS - SECTION A-A'

St. Louis Ordnance Plant
Former Hanley Area
St. Louis, Missouri

01nf002d_364298.dgn

APPENDIX B

OBSERVED WATER LEVEL AND WELL INTEGRITY INSPECTION FORM

OBSERVED WATER LEVEL AND WELL INTEGRITY INSPECTION FORM

Project: St. Louis Ordnance Plant, Former Hanley Area, St. Louis, Missouri

Project no:

Personnel: J. Dowling, K. Dresden

Well No.	date	time	static water level (0.01 ft. btoc)	total depth of well (0.01 ft. btoc)	Well Cap	Well Casing	Pad	Lock	Protect. Casing	Comments
MW-118 ✓	10/28/15	1130	16.48	—	✓	✓	✓	✓	—	
114 ✓		1150	8.36	—	✓	✓	✓	✓	—	
113 ✓		1200	4.04	—	✓	✓	✓	✓	—	
119 ✓		1205	8.55	—	✓	✓	✓	✓	—	
106 ✓		1208	12.58	—	✓	✓	✓	✓	—	Bolt Missing in Lower
112		1220	4.18	—	✓	✓	✓	✓	—	
115		1230	25.86	—	✓	✓	✓	✓	✓	Stick up
108		1340	3.98	—	✓	✓	✓	✓	—	
116		1345	4.75	—	✓	✓	✓	✓	—	
107		1350	4.08	—	✓	✓	✓	✓	—	
110		1355	3.90	—	✓	✓	✓	✓	—	Flange broken Missing bolt
109		1400	4.98	—	✓	✓	✓	✓	—	Bolt broken off in flange

√ = Good Condition

* = See Comments

APPENDIX C

PASSIVE DIFFUSION BAG SAMPLING AND DEPLOYMENT FORM

Passive Diffusion Bag Sampling and Deployment Form

Project: SLOP

Samplers: J. Dowling / K. Deeds

Well ID	Date Sampled	Time Sampled	Date Deployed	Time Deployed	Static Water Level (ft btoc)	Depth to top of PDB (ft btoc)	Water Column Over PDB (ft)	Observations
MW-115	10-28-13	1520	10-28-13	1525	25.86	40.00	14.14	
MW-118		1555		1605	16.48	29.76	13.28	
MW-518		1600						
MW-113		1630		1635	4.04	17.00	12.96	
MW-114		1645		1650	8.36	17.66	9.30	
MW-119		1700		1707	8.55	18.48	9.93	
MW-519		1705						
MW-112	10-29-13	0840	10-29-13	0845	4.18	17.27	13.09	
MW-112MS								
MW-112MSD								
MW-107		0910		0912	4.08	17.15	13.07	
MW-116		0925		0928	4.75	21.62	16.87	
MW-108		0940		0942	3.98	17.19	13.21	
MW-109		0952		0955	4.98	17.70	12.72	
MW-110		1005		1007	3.90	17.70	13.80	
MW-106		1022		1024	12.58	23.67	11.09	
PDBB-102913		1029	—	—	—	—	—	PDB Blank

Analysis: VOCs 8260B

PDB Source: FON

PDB Lot: 7308006

Water Source: —

Water Lot: —

Pre-filled

Unfilled

APPENDIX D

PDB FIELD PARAMETER FORM

PDB Field Parameter Form

Project: SLOP

Samplers: J. Demmy / K. Dooden

Instrument Used: YSI 556

Well ID	Date	Time	Water Quality Parameters					
			Temperature (°C)	Specific Conductivity (µmhos/cm)	Dissolved Oxygen (mg/L)	pH su	ORP (mV)	Turbidity (NTU)
MW-115	10-28-13	1517	15.92	.566	2.37	6.83	177.2	—
MW-118		1550	15.74	.584	0.75	5.75	186.2	—
MW-518		~~1600~~						
MW-113		1620	17.39	.610	0.49	5.90	139.0	—
MW-114		1638	16.50	.910	0.83	6.32	76.0	—
MW-119		1657	17.83	0.501	0.57	7.95	-126.7	—
MW-519								
MW-112	10-29-13	0835	16.85	0.480	0.25	6.20	67.5	—
MW-112MS								
MW-112MSD								
MW-107		0905	19.36	0.882	0.35	6.19	99.9	—
MW-116		0920	18.43	0.864	0.24	6.45	98.5	—
MW-108		0933	19.59	0.923	0.21	6.49	132.0	—
MW-109		0946	19.58	0.660	0.21	6.26	138.3	—
MW-110		1000	19.28	0.535	0.19	6.55	100.3	—
MW-106		1017	15.06	0.643	0.31	6.29	129.7	—

Observations (weather conditions, well deterioration/damage, evidence of tampering, odor, exemption (if any) and reason, etc.):