Conceptual Site Model

Lee's Lane Landfill Site
Louisville, Kentucky

Report Prepared by Lee’s Lane Landfill Group and The Louisville and Jefferson County Metropolitan Sewer District

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1. Introduction

In 2013, the Environmental Protection Agency (EPA) completed a Five-Year Review at the Lee's Lane Landfill Superfund Site (the Site) located in Louisville, Kentucky, and identified eight items that required further evaluation (EPA, 2013b). The EPA and a group of Potentially Responsible Parties (PRPs) exchanged information in 2014/2015 and held discussions to address the items from the 2013 Five-Year Review. It was mutually agreed that much of the work already had been completed by various parties to address the eight items listed in the 2013 Five-Year Review. The Lee's Lane Landfill Group[1] and Louisville and Jefferson County Metropolitan Sewer District (MSD) (collectively, Respondents) offered to assemble the information into this Conceptual Site Model (CSM), which will be used to summarize the status of the 2013 Five-Year Review and provide recommendations of any follow-up work that may be needed at the Site.

1.1 Background

Table 1.1 provides a chronology of Site activities. The Site is located in the southwest part of Louisville along the Ohio River. The 112-acre former landfill received waste from the late 1940s until 1975. In 1975, flash fires were reported within a residential area known as Riverside Gardens located east of the Site. Studies completed in the 1970s identified off-site migration of methane in gas probes. EPA could not confirm that the flash fires in Riverside Gardens were the result of landfill gas. In 1980, Jefferson County government installed a landfill gas collection system (LFG system) at the Site.

In 1983, EPA listed the Site on the National Priorities List (NPL). A Remedial Investigation (RI) and Feasibility Study (FS) report was completed in April 1986 and a remedy selected under a 1986 Record of Decision (ROD). The 1986 ROD selected a remedy that included: (1) the installation of a rip rap embankment along the Ohio River; (2) localized placement of a soil cap over selected areas of exposed waste; (3) groundwater monitoring; and (4) continued operation of the LFG system that Jefferson County installed prior to the issuance of the ROD (EPA, 1986a and 1986b).

In 1991, a Consent Decree establishing certain Operation and Maintenance (O&M) activities at the Site was executed by EPA, Jefferson County government[2] and MSD (EPA, 1991). Pursuant to that Consent Decree, MSD has been conducting routine inspections and repairs as well as routine monitoring of landfill gas and groundwater at the Site.

In 1993, EPA published the first Five-Year Review. EPA concluded that the Site remedy remained protective of public health and the environment. EPA noted that the LFG system was in poor condition (EPA, 1993).

In 1998, EPA's second Five-Year Review reached similar conclusions as the 1993 report. EPA concluded that the Site remedy remained protective of public health and the environment. EPA

[1] American Synthetic Rubber Company, a Division of Michelin North America, Inc., Ashland, Inc., BP (for Atlantic Richfield Company), Celanese Corporation (for CNA Holding LLC), Chevron (for Kewanee Industries, Inc.), Clariant (for United Catalysts, Inc.), Dow Corning, Exxon (for Mobil Oil), Ford Motor Company, Goodrich Corporation, Industrial Disposal Co, Luvata (for Liberty Plastics), Owens-Illinois, Inc., Reynolds Metals Company, Rohm and Haas Company, Southern Gravure Systems, Inc., The Courier-Journal, Trimac Transportation Inc. f/k/a Liquid Transporters, Inc., and Waste Management of Kentucky, LLC. The Hofgesang Foundation elected not to participate. Additionally, the Lee's Lane Landfill Group believes the County is an independent PRP that should be included in all Site related activities and that there may be numerous additional Site PRPs.

[2] In 2003, Louisville and Jefferson County merged.

noted that the LFG system continued to be in poor condition, but EPA did not recommend any action items (EPA, 1998).

In 2003, EPA's third Five-Year Review concluded that the Site remedy was protective of human health and the environment, but raised concerns with Site security and trespassers. EPA also recommended that an evaluation be completed on the LFG system (EPA, 2003). MSD completed this evaluation and submitted to EPA for review in May 2004.

In 2008, EPA's fourth Five-Year Review concluded that the Site remedy remained protective of human health and the environment. However, EPA recommended that repairs to the LFG system be made to make the system function properly. In response, MSD completed repairs to the LFG system and installed three additional gas probes to augment the monitoring network. EPA noted additional concerns related to trespassers and the need to evaluate whether institutional controls are needed at the Site (EPA, 2008).

In 2011, in response to a routine Site inspection which identified exposed waste and a leachate seep, EPA collected four surface soil samples at the Site (EPA, 2011).

In 2013, EPA's fifth Five-Year Review identified the following items for further evaluation (EPA, 2013b, See Table 12: Recommendations to Address Current Site Issues, pg. 38-39), which are summarized below:

1. The 1986 ROD did not identify a ground water remedy. Review ground water data and determine if a ground water remedy needs to be established, along with Ground water Cleanup Goals, in a decision document.
2. The 1986 ROD did not identify RCRA capping requirements. Evaluate capping requirements and incorporate them into a decision document, if necessary.
3. The LFG system is currently not working as designed and may no longer be in an optimal location. Also the LFG system was not selected as part of the remedy in the 1986 ROD. Determine the need for LFG system as part of the remedy, and if needed, install updated LFG system.
4. The 1986 ROD did not include institutional controls. Evaluate the need for institutional controls in conjunction with current ground water sampling efforts. Consider institutional controls for the capped landfill area. Identify institutional control requirement in an enforceable document, if necessary.
5. Risk has not been identified at the Site. Conduct an updated data review and evaluation.
6. Groundwater is not adequately characterized and new wells are needed to obtain sufficient data. Install new ground water wells to appropriately characterize contamination and ground water flow. Address contamination as appropriate. Evaluate contaminant levels and ecological impacts at the discharge point to the Ohio River. Evaluate data to determine if additional sampling needs to be conducted for soil vapor intrusion.
7. Soil contamination is insufficiently characterized. Identify location of any remaining soil contamination through soil sampling, and address contamination, as appropriate.
8. Trespassing results in surface erosion and exposure. Identify whether additional measures are needed to discourage trespassers, and implement as appropriate.

In 2013, the Kentucky Department of Environmental Protection (KDEP) sampled surface soil within the Site area at 33 locations (KDEP, 2013). This task was undertaken to address the item that identified the need for additional surface soil characterization.

Also, in 2013, EPA began a Vapor Intrusion (VI) evaluation. EPA's 2013 work focused on soil gas in the area between the Site and Riverside Gardens housing development. EPA sampled 13 existing gas probes located at the Site perimeter and analyzed the samples for Volatile Organic Compounds (VOCs), methane, and other general gases. In addition, EPA installed and sampled five temporary gas probes located east of the Site between the Site and Riverside Gardens. EPA analyzed the soil gas for VOCs, methane and other general gases.

In 2014, the EPA issued a letter (EPA, 2014a) to the Settling Defendants (as defined in the Consent Decree) named in an August 4, 1993 Consent Decree in the matter of United States v. Ben Hardy, et al., Civil Action No. 90-0695 in the U.S. District Court for the Western District of Kentucky, which requested that the Settling Defendants take part in addressing the Site issues identified in the fifth Five Year Review Report.

In 2014, KDEP installed five new groundwater monitoring wells around the Site (KDEP, 2014).

In 2014, the EPA continued the VI evaluation by sampling select Riverside Garden residences in June, November, and December 2014. EPA sampled ambient air, sub-slab and crawl space locations at 33 residences in June 2014. Based on the June analytical results, EPA then sampled ambient air, soil vapor, crawl space locations and/or first-floor indoor air at eight residences in November 2014 and soil gas at eight locations in December 2014 (seven of the eight soil gas locations were the same as the November indoor locations).

In December, 2014, EPA issued a Special Notice Letter (SNL) to Settling Defendants to the 1993 Consent Decree, the Hofgesang Foundation, and MSD requesting that additional studies be completed at the Site.

In April 2015, a meeting was held between representatives of the Lee’s Lane Landfill Group, MSD, The Hofgesang Foundation, KDEP (via telephone) and EPA. During this meeting it was agreed that the SNL deadline of December 31, 2014 would be suspended. The Lee’s Lane Landfill Group, MSD, KDEP and EPA also agreed to have this CSM Report (Report) prepared in deferment to the SNL process.

In June 2015, EPA conducted another round of indoor air sampling as part of the VI evaluation at seven of the eight residences where indoor air sampling was conducted in November 2014. These seven residences were the same locations sampled in November 2014. Unit 003 was not resampled because access was respectfully declined by the property owner.

In July 2015, EPA conducted follow up soil gas sampling at three residences, and KDEP conducted a groundwater sampling event consisting of 5 existing monitoring wells (MW-101 through MW-105) for analysis of VOCs, SVOCs, pesticides/PCBs and metals.

In August 2015, a draft CSM report was provided to the EPA and KDEP. Comments were received in October 2015 from EPA/KDEP and have been incorporated into this Report.

2. Groundwater Characterization and Remedy Update

The 2013 Five-Year Review identified the following items:

Ground water is not adequately characterized and new wells are needed to obtain sufficient data. Install new ground water wells to appropriately characterize contamination and ground water flow. Address contamination as appropriate. Evaluate contaminant levels and ecological impacts at the discharge point to the Ohio River. Evaluate data to determine if additional sampling needs to be conducted for soil vapor intrusion (EPA, 2013b).

The 1986 ROD did not identify a ground water remedy. Review ground water data and determine if a ground water remedy needs to be established, along with ground water cleanup goals, in a decision document (EPA, 2013b).

2.1 Background

2.1.1 Overview of Hydrogeology

Figure 2.1 presents the monitoring well locations and groundwater contours for the Site and shows the location of Riverside Gardens east of the Site. As discussed in the 1986 Remedial Investigation (RI) Report, the Site is underlain by Ohio River Alluvium, which is 130 feet thick. The upper 5 to 40 feet consists of clay, silt and fine-grained sand overlying sand and gravel with clay lenses. Under normal conditions, the depth to groundwater ranges from approximately 35 to 40 feet below ground surface, with groundwater flow westward, toward the Ohio River. The depth of waste is 19 to 37 feet below ground and comes in contact with groundwater periodically during high water levels in the Ohio River (EPA, 1986).

Surficial soil conditions east of the Site and in the Riverside Gardens consist of approximately 10 feet of clay underlain by sand.

Appendix A provides boring and monitoring well logs for the Site as well as maps showing the locations. Appendix B presents a geologic cross section and location map from the 1986 RI (EPA, 1986a).

2.1.2 RI Monitoring Wells

During the RI, monitoring wells were installed to characterize groundwater. At that time, the critical groundwater contaminants were lead (ND to 150 μg/L), arsenic (ND to 87 μg/L), benzene (ND to 450 μg/L) and chromium (ND to 640 μg/L) (EPA, 2013b). Given that sampling confirmed that the presence of metals at the Site does not impact nearby water supply wells or the Ohio River, EPA selected continued groundwater monitoring as an approved remedy in the ROD (EPA, 1986a).

2.1.3 Monitoring Wells MW-A/MW-B/MW-2

Monitoring wells MWA, MWB and MW-2 were installed to monitor groundwater in the residential area of Riverside Gardens and confirmed that groundwater quality was not impacted in this area.

Monitoring Wells MWA, MWB and MW-2 were part of the groundwater monitoring program established by the ROD as part of the groundwater remedy, until their closure in 2010. The wells were closed because the residents of the Riverside Gardens neighborhood were connected to the municipal water supply and residential water supply wells were no longer used (EPA, 2003). The well abandonment logs are included in Appendix A.

2.1.4 Monitoring Wells MW-101 to MW-105

In response to the 2013 Five-Year Review, KDEP installed monitoring wells MW-101 through MW-105 in 2014. The results of three groundwater sampling rounds (June, 2014, March 2015 and July 2015), are provided in KDEP reports (KDEP, 2014, KDEP, 2015a and KDEP 2015b). As of August, 2015, KDEP has completed 3 of 4 quarterly rounds. It is expected that the fourth round was completed in October 2015 but the results were not reported as of date of this Report.

2.1.5 Monitoring Wells MW-04 and MW-05

Even though MW-04 and MW-05 are located alongside the more recently installed MW-104 and MW-105 monitoring wells, respectively, all four wells are utilized to obtain groundwater data. This is because the wells are actually nested, with MW-04 and MW-05 are screened in the lower part of the aquifer at depths between 79.5 and 84.5 feet and 51.5 to 86.5 feet, respectively, whereas MW-104 and MW-105 are screened in the upper part of the same aquifer at depths of between 45 and 65 feet and between 30 and 50 feet, respectively. Further, MSD has evaluated the condition of MW-04 and MW-05 based upon field inspection, purge tests, and sampling results to confirm that these wells remain in good condition.

2.2 Groundwater Levels and Flow Patterns

Under normal conditions, the groundwater depth is approximately 35 to 40 feet below ground surface at the Site and approximately 45 feet below ground in Riverside Gardens. Figure 2.1 presents the groundwater contours for the June 2014 event as measured by KDEP (KDEP, 2014), and shows that the groundwater flows towards the west.

For comparison purposes, figures depicting historical groundwater flow patterns reported over the years are included in Appendix C. As shown in these figures, typically the groundwater flow beneath the Site is toward the west and away from the residential area. During periods of high water levels in the Ohio River, the groundwater levels temporarily rise near the River. The RI/FS concluded that, even under flow reversal conditions, the groundwater does not migrate to Riverside Gardens (EPA, 1986a, page 4-31).

2.3 Groundwater Cleanup Goals

The ROD established a procedure to develop Alternate Concentration Limits (ACLs) for groundwater at monitoring wells at the Site (e.g., MW-4 and MW-5). Throughout the Site's monitoring history, ACLs were used to evaluate groundwater for all groundwater monitoring locations (ACLs were not applied to monitoring wells in Riverside Gardens.) ACLs were developed based on surface water and drinking water quality standards that were established for the protection of the Ohio River. Then an estimated factor of attenuation of groundwater discharge into the Ohio River during a period of low flow in the river was applied to these standards to derive the final ACL. For the 2008 ACLs, an attenuation factor of 1,100 was applied. The 2008 Five-Year Review identified the ACLs for the Site, which are listed on Table 2.1. In the 2013 Five-Year Review, the EPA noted that ACLs should no longer be used for the Site. EPA stated:

"At this point, ACLs are not an appropriate measure for the Site per the July 2005 EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-39. The EPA directive provides that site ground water concentration data will be compared to Safe Drinking Water Act MCLs, KDEP ground water standards, and Health Risk Based tap water concentrations (Regional Screening Levels (RSLs) and EPA Region 4 Site Specific Health Risk Based Levels) in order to determine the presence of site related ground water contamination. River water samples will be analyzed and compared to EPA and KDEP surface water concentration standards in order to determine the presence of surface water contamination related to the Site." (EPA, 2013b)

For Section 2.0 of this Report, the comparison to historical ACLs is provided and Section 7.4 provides an ecological risk evaluation.

For monitoring wells located in Riverside Gardens, MW-A, MW-B and MW-2, EPA typically used maximum contaminant levels (MCLs) to evaluate groundwater quality. EPA then developed Site-specific Groundwater Cleanup Goals in the 2013 Five-Year Review, which were based on MCLs and other health-based guidelines (2013 Groundwater Cleanup Goals). Table 2.1 provides the 2013 Groundwater Cleanup Goals.

Throughout the monitoring history of the Site, EPA has established that semi-volatiles, pesticides, PCBs and most VOCs are not compounds of concern (COCs) at the Site because these groups of compounds were below MCLs. EPA did establish 13 COCs, which included twelve metals and benzene. See Table 2.1 for the list of COCs (EPA, 1993; EPA, 1998; EPA, 2003; EPA, 2008; and EPA, 2013b).

This CSM compares groundwater data to both the applicable ROD-based ACLs and the 2013 Groundwater Cleanup Goals for the Site. For monitoring wells that were formerly located in Riverside Gardens, this Report compares the data only to the 2013 Groundwater Cleanup Goals for the Site.

From 1993 through 2008, EPA historically developed the ACLs in order to establish standards that would protect the Ohio River. These standards recognize that groundwater beneath the Site is not used for drinking water. The separate comparison to the 2013 Groundwater Cleanup Goals for monitoring wells at the Site is provided in order to comprehensively evaluate the data in the same manner EPA employed in 2013 even though these stringent goals do not represent the current exposure scenarios. This comparison also does not represent future conditions because water supply wells cannot be placed in a landfill or floodplain.

2.4 Groundwater Data Review

Routine monitoring at MW-A, MW-B, MW-2, MW-04 and MW-05 has been conducted over three decades. Each groundwater sample was analyzed for VOCs, semi-volatile organic compounds (SVOCs), pesticides/PCBs and metals. Because no comprehensive electronic database of sampling data was located, tables of groundwater data from various reports were compiled into Appendix D.

Table 2.2 provides a comparison of groundwater data to 2013 Groundwater Cleanup Goals for three monitoring wells that were formerly installed in the Riverside Gardens area (MW-A, MW-B and MW-2). As shown, none of the 13 COCs exceeded any of the 2013 Groundwater Cleanup Goals. As noted in Section 2.1.3, these three monitoring wells were abandoned after water service was provided to Riverside Gardens.

In 2014 and 2015, KDEP sampled MW-101, MW-102, MW-103, MW-104 and MW-105 for VOCs, SVOCs, Pesticides/PCBs and Metals.

Table 2.3 provides a comparison of groundwater data to historical ACLs and 2013 Groundwater Cleanup Goals for the 13 groundwater COCs for 2004 through 2015. As shown, all compounds are below the historical ACLs.

Groundwater results were also compared to the 2013 Groundwater Cleanup Goals. This comparison is presented on Table 2.3 and shows that only five COCs were observed to exceed the Groundwater Cleanup Goals based on recent data (2012 to 2015):

Arsenic: MW-04 (ND to 15 μg/L), MW-05 (23.4 to 45 μg/L), MW-102 (5.9J to 270 μg/L), MW-103 (9.2J to 29 μg/L) and MW-104 (250 μg/L to 300 μg/L) and MW-105 (2.7 to 16 μg/L) exceed the 2013 Groundwater Cleanup Goal of 10 μg/L for arsenic. Most monitoring wells are similar in concentration to the groundwater data monitored during the RI. Only MW-104 was identified as anomalous and this well represents an isolated location. MW-104 represents shallow groundwater at a screened depth of 45-65 feet which is close to the waste. The deeper well at the same location, (MW-04) has arsenic at concentrations similar to the Groundwater Cleanup Goal of 10 μg/L.

Manganese: MW-101 (270 μg/L to 1,600 μg/L), MW-103 (760 μg/L to 1,600 μg/L), MW-104 (1,000 μg/L to 1,100 μg/L) and MW-105 (4,200 μg/L to 7,300 μg/L) exceed the 2013 Groundwater Cleanup Goal of 900 μg/L. There is no MCL for manganese. The RI noted that manganese was elevated above secondary drinking water standards in many wells sampled during the RI regardless of location (EPA, 1986a). The recent results are consistent with the RI findings because MW-101 is upgradient of the Site and also exceeds the manganese goal.

Iron: MW-104 (21,000 to 29,000 μg/L) exceeds the 2013 Groundwater Cleanup Goal of 24,000 μg/L for iron which is similar to concentrations monitored during the RI. There is no MCL for iron.

Barium: MW-102 (160 to 2,200 μg/L) exceeded the 2013 Groundwater Cleanup Goal of 2,000 μg/L. However, this exceedance only occurred during the July, 2015 round and was inconsistent with previous data and inconsistent with the fact the MW-102 is an upgradient well.

Lead: MW-102 (ND to 41 μg/L), MW-103 (ND to 25 μg/L), MW-104 (ND to 130 μg/L) and MW-105 (ND to 17 μg/L) exceeded the 2013 Groundwater Cleanup Goal of 15 μg/L. However, all exceedances occurred in the July 2015 round are inconsistent with previous rounds.

Groundwater quality for arsenic, manganese, iron, barium, and lead has not significantly changed since the ROD. Current concentrations are similar in concentration and are in the same locations as monitored at the time of the ROD.

2.5 Groundwater Remedy Evaluation

As part of the 1986 ROD, EPA selected groundwater monitoring to address groundwater and concluded that the conditions in 1986 did not warrant active groundwater remediation (EPA, 1986b).

Local residents have been connected to the public water supplied by the Louisville Water Supply company since 1993 and water wells are no longer used (EPA, 2008). It is possible that some private wells may still exist, including hand-pumped wells, and may be used for non-potable purposes, such as lawn watering.

In addition, the first four Five-Year Reviews completed in 1993, 1998, 2003 and 2008 concluded that the remedy was protective of human health and the environment and recommended continued monitoring. The 2013 Five-Year Review concluded that the groundwater was inadequately characterized and recommended that the groundwater results be reviewed. In response, KDEP installed MW-101 through MW-105 and completed three groundwater monitoring rounds. The data collected from these new wells comprehensively address the groundwater action items (Items no.1 and 6) in EPA's 2013 Five-Year Review and allow a full evaluation of the condition of the groundwater at the Site.

2.6 Recommendations

An analysis of all of the groundwater analytical data collected to date confirms that there has not been a changed condition relative to groundwater since EPA issued the ROD. Rather, the groundwater quality has remained stable and the potential for groundwater exposure by any identifiable receptors has been eliminated. There is no evidence of a new release to groundwater, and the groundwater remedy remains protective of human health and the environment. Accordingly, the groundwater remedy selected by the ROD remains appropriate, and continued groundwater monitoring is recommended. The data confirm, however, that after KDEP completes four quarters of monitoring, that it is no longer necessary for KDEP to analyze for pesticides, PCBs or SVOCs as long as there continue to be no exceedances of the Groundwater Cleanup Goals for these compound groups. It is recommended that groundwater monitoring continue for the five metals COCs (i.e., arsenic, manganese, iron, barium and lead) at MW-04, MW-05, MW-101, MW-102, MW-103, MW-104, and MW-105, annually.

3. Landfill Soil Cover and Cap Update

The 2013 Five-Year Review identified the following item related to the cap.

The 1986 ROD did not identify RCRA capping requirements. Evaluate capping requirements and incorporate them into a decision document, if necessary (EPA, 2013b).

3.1 Background

3.1.1 Landfill Closure

In the mid-1970s, the Site was closed under the oversight of the Kentucky Department of Natural Resources and Environmental Protection (KDNREP). The Site had a disposal permit (Commonwealth of Kentucky, 1972) and correspondence between Hardy and the Kentucky Department of Natural Resources stated that the final soil cover was to be 2 feet thick (Hardy, 1974).

For the purposes of this Report, the term "cap area" consists of 7 acres in the western portion of the Central Tract. The term "soil cover area" refers to soil cover that was put in place at the time of landfill closure in the 1970s in the landfill tract areas, which has now become heavily wooded. Figure 3.1 shows both the cap area and soil cover area. As shown on Figure 3.1, there are buffer areas where there was no waste disposal around the perimeter of the Site within the Site boundary and the soil cover/cap boundary.

3.1.2 ROD Remedy Selection for Landfill Cap

The RI/FS specifically considered RCRA capping regulations as part of the remedy selection process (EPA, 1986a, See page 10-19), and the FS evaluation included the construction of a new cap on the Site. Specifically, EPA evaluated an alternative that involved the installation of a 7-foot thick cap (2 feet of sand for gas collection, 2 feet of clay and 3 feet of rooting zone soils). As noted in the RI/FS, the Site is located in the floodplain. When the Ohio River water level rises to flood stage, the groundwater also rises into the waste causing leachate generation. As such, no cap would eliminate leachate generation. The cost, in 1986 dollars, for a new cap and maintenance was estimated to be approximately $40 million. The ROD concluded that a new cap was not warranted (EPA, 1986a and 1986b). Instead, EPA selected a remedy that addressed the drums and exposed waste areas since "direct contact to hot spot areas and exposed drums would be remediated by capping "Hot Spot" areas and removing drums" (EPA, 1986b). As a result, both the cap area and the soil cover area received minor improvements with additional topsoil placement as part of the Remedial Action in the late 1980s.

3.1.3 Five – Year Review 1993

In March 1993, Resource Applications, Inc. submitted the first Five-Year Review Report for EPA. A site visit was completed, and no major areas of settlement or erosion of the topsoil were identified. The report states:

"The surface and cap conditions were observed in the site visit conducted in January 1992, and were checked for compliance with the guidelines set in the Operation and Maintenance (O&M) Plan. The general site conditions indicate no major settlement or erosion of the topsoil which would expose the waste, and that the response action implemented by EPA appears to still be protective of human health and the environment since there is no direct contact exposure pathway. Vegetation is well established on the cap and surrounding areas, and no evidence was found of any stressed vegetation. No leachate seeps were encountered during the site visit. The site access road did have several settled areas and one sunken area where the pavement has broken and subsided." (EPA, 1993, See Section 2.2.1).

3.1.4 Five – Year Review 1998

In June 1998, Roy F. Weston, Inc. (Weston) completed the second Five-Year Review Report for EPA. A site visit was completed in May 1997, and Weston noted that the capped area had a well-established vegetative cover, and there was no mention of exposed waste. The report states:

"During the site review, the capped area had a well-established, vegetative cover consisting predominantly of grasses ranging in height from about one foot to four feet tall. The height of vegetation is excessive and should be maintained at a height of 4 to 8 inches as specified in Section 4.6, Landfill, Surface and Cap Monitoring and Maintenance of the O & M Plan. As stated in this plan "Excessive grass height may reduce runoff away from the cover, may visually obstruct observations of the cover, and may damage the integrity of the cap." There were no depressions or tension cracks noted in the cap area. During the 1993 site review, a tension crack was noted east of the site access road. This crack could not be located during this review. No areas of erosion or active seeps or springs were seen in the capped area or at the eastern or western ends of the cap. During the 1993 site review, a small area of erosion was noted at the southwestern edge of the landfill. This area of erosion was not detected during this review and in fact, the area is heavily vegetated." (EPA, 1998, See Section 2.3).

3.1.5 Five – Year Review 2003

In June 2003, the U.S. Army Corps of Engineers (USACE) prepared the third Five-Year Review Report for EPA. The Site inspection for the third Five-Year Review Report was completed in February 2003 by representatives of EPA, Kentucky Natural Resources, MSD and the USACE. The Site inspection section of the report made note that there were no major surface depressions observed, but there was some severe rutting across the cap area with no reported evidence of waste exposure. The report states:

"The capped area immediately landward of the rip-rap appeared relatively flat with no major surface depressions observed. There was some severe rutting across the cap due to uncontrolled, trespasser, quad-runner ATV traffic." (EPA, 2003, See Site Inspection, page 16).

3.1.6 Five – Year Review 2008

In September 2008, the USACE prepared the fourth Five-Year Review Report for the EPA. The Site inspection was completed in February 2008 by representatives of MSD and the USACE. Similar to the 2003 Report, moderate to severe rutting across the cap area was noted, however, there was no mention of any exposed waste in these rutted areas. The report states:

"The capped area appeared relatively flat with no major surface depressions observed, Photographs 4 and 5. There was some moderate to severe rutting across the cap due to uncontrolled trespasser quad-runner ATV traffic" (EPA, 2008).

3.1.7 Five – Year Review 2013

In September 2013, Skeo Solutions completed the fifth Five-Year Review Report for the EPA. The Site inspection was completed in December 2012 by representatives of the EPA, KDEP, MSD, and Skeo Solutions. The report states:

"During the site inspection, participants toured the capped landfill area and rip-rap along the Ohio River, viewed the LFG collection system's wells and blower house, and drove throughout the Site to view ground water sampling wells and the status of site vegetation. The Site was in good condition." (EPA, 2013b, See Section 6.5).

3.1.8 Routine Site Inspections by MSD

MSD conducts quarterly inspections of the Site and documents the inspections. MSD evaluates signage, security measures, evidence of trespass, cap conditions and evidence of erosion at the 7 acre area in the Central Tract. Inspections at the site have identified evidence of trespassers and some impact from ATV use in the Southern and Central Tracts. ATV use is a major source of damage and maintenance expense at the Site. Improvements to signage and the installation of a fence were completed in 2011 (MSD, 2014).

3.2 Areas of Exposed Waste

Areas of exposed waste have been identified as part of MSD inspections and also as part of surface soil sampling completed by KDEP during the 2011 and 2013 sampling events. Exposed metal, plastic and rubber are the common types of waste exposed. It is possible that tree roots have extended through the soil cover area and into the waste and there is a potential for tree roots to lift waste to the surface. Another possible explanation for the exposed waste is stated in inspection reports which have noted that the Site has been used by ATVs and pickup trucks, which leave ruts in the cap that may expose waste (see Section 9.0 on security). Also trash has been observed to be brought on and dumped at various locations by ATVs and pickup trucks. Figure 3.2 presents the locations of exposed waste and shows the location of the Southern, Central and Northern Tracts. Exposed waste was mostly noted in the Southern Tract. The areas of exposed waste have not been delineated but are believed to represent a small portion of the overall landfill footprint based on limited Site inspections.

The trees within the soil cover area reduce infiltration to waste, and thus, reduce leachate generation. It is estimated that the 80 acre, mature forest at the Site reduces infiltration by approximately 12 inches per year (see Appendix E for tree transpiration estimate). EPA has a goal to evaluate sustainability as part of a remedy review. As such, a carbon footprint evaluation was completed to determine the benefits of the trees. Each wooded acre of forest absorbs 2,000 to 2,500 pounds of carbon per year, for a total of 160,000 to 200,000 pounds per year of carbon sequestration at the Site (American Forests has significant ecological benefits. 2015; Tree Search, 2015; US Department of Agriculture, 2015).

3.3 Review of Kentucky Landfill Regulations

As requested by EPA, this section evaluates the Kentucky regulations for landfill caps. Kentucky Administrative Regulations (KAR) 401 provides the requirements for landfill caps. The regulations do not apply to landfills closed prior to the mid-1990s (based on Kentucky Revised Statute 224 and Code of Federal Regulations 40 CFR 258.1). It is important to note that these regulations were established for new landfills and are not applicable to landfills, like the Site, that have been closed for over 40 years.

Kentucky regulations for new landfills call for a landfill gas collection layer and an active LFG system as part of the cap. However, the regulations do not apply to this pre-1990s site. In addition, there is no need for a LFG system at this Site because the landfill no longer has the potential to generate any significant quantity of landfill gas. This fact is demonstrated by the decline in methane levels at gas probes, and the fact that perimeter gas probes detections of methane are well below 5% of the lower explosive limit (LEL), which is the requirement in Kentucky for new landfills (see Section 5.0 of this Report which provides a more detailed evaluation of methane).

Kentucky regulations for new landfills also call for an 18-inch thick clay layer with a permeability of 1×10^{-7} cm/sec that acts as a barrier to infiltration, and thus, mitigates leachate generation to groundwater. In order to protect the integrity of the clay, the regulations call for a 36 inch protective layer over the clay. At the Site, impacts to groundwater by leachate were monitored over the past 30 years by the groundwater monitoring program. As discussed in Section 2.0, groundwater quality at the Site has remained stable over the years and already meets historical ACLs and most of EPA's 2013 Groundwater Cleanup Goals. Thus, there is no need to establish a cap that reduces infiltration to protect groundwater.

3.4 Applicable or Relevant and Appropriate Requirements (ARAR) Review

One of the Superfund evaluation criteria requires a review of the remedy against Applicable, or Relevant and Appropriate Requirements (ARARs). In this case, the applicable requirement is the Permit for the Site that was issued in the 1970s and had a closure requirement of 2 feet of soil cover. The Kentucky rules for new landfills are not relevant or appropriate for the Site because gas collection is not required to prevent methane migration and changes to the soil cover and cap is not needed to reduce infiltration to protect groundwater. See Section 3.3.

3.5 Recommendations

The soil cover and cap areas have remained stable since the time of the implementation of the Site remedy. The five Five-Year Reviews completed by EPA consistently confirm that the soil cover area and cap area are generally in good condition with minor or periodic maintenance needs consistent with landfills of this age and size. While these inspections did not cover the full aerial extent of the Site, these inspections confirm that there is no changed condition at the Site that would warrant an enhancement or modification to the soil cover or cap areas. It is recommended that inspections of the Site continue, but that the frequency be changed from quarterly to annually.

Inspections have noted that the soil cover (although not the cap area) has limited areas of exposed waste. It is recommended that a one-time, detailed inspection of the full Site be conducted to inventory and delineate locations of exposed waste, so that these areas can be addressed by "spot capping" consisting of cover soil, topsoil and seeding. Consideration should also be given to the possibility of no or reduced repair in remote areas with heavy brush or tree cover in recognition that these areas are not accessible for recreational use or trespassing.

See additional recommendations in Section 9 on trespassing and Site security. These measures will help maintain soil cover and cap integrity and will help prevent illegal dumping.

4. Surface Soil Update

The 2013 Five-Year Review identified the following item relative to surface soil:

Soil contamination is insufficiently characterized. Identify location of any remaining soil contamination through soil sampling, and address contamination, as appropriate (EPA, 2013b).

4.1 Background

During the RI/FS, EPA collected ten surface soil samples from potential “hot spots” based on visual observation, which were located throughout the Site. One surface soil sample was collected outside of the Site boundary for background comparison, which was located east of the Central Tract between Howard Avenue and Putman Avenue. Of the ten samples collected on the Site, three were collected from the Northern Tract, five samples from the Central Tract and two from the Southern Tract. The results showed detections of metals and organics.

4.2 Surface Soil Sampling 2011

In response to a routine inspection which found a leachate seep and exposed waste, EPA and MSD conducted sampling in 2011. Four areas were targeted based on the presence of surface accumulation of various types of debris, including crushed drums, wiring, insulators, plastic, different types of metal, and material from a fire at a local neoprene plant. The samples were analyzed for VOCs, SVOCs, pesticides, PCBs and metals. The results for both the EPA and the MSD sampling events are summarized on Table 4.1, and Figure 4.1 presents the sampling locations.

4.3 Surface Soil Sampling 2013

In April 2013, KDEP collected 33 surface soil samples from 28 discrete locations on the Site. Six soil samples were collected from the Northern Tract, 12 soil samples were collected from the Central Tract and 16 soil samples were collected from the Southern Tract. Table 4.2 and Figure 4.1 present the data from the 2013 sampling event (KDEP, 2013).

4.4 Evaluation of 2011 and 2013 Surface Soil Results

As requested by EPA, the surface soil results were compared to screening levels established based on recreational use and trespasser scenarios using a 1 x 10^{-6} risk-based screening level for carcinogens. Appendix F presents the risk-based screening levels developed for the trespasser/recreational use. For this Report, the lowest risk level for the two scenarios was used.

Arsenic exceeded the screening level, but KDEP noted that arsenic is naturally high in background. The 2013 KDEP report states that: "*Arsenic is naturally occurring in Kentucky soils at levels much higher than the RSL. All arsenic data were evaluated using Kentucky's Ambient Background Guidance Assessment document*"(KDEP, 2013). This is consistent with the RI sample, which reported background arsenic at 24 mg/kg in surface soil in Riverside Gardens (EPA, 1986a).

Of the 33 total locations sampled in 2011 and 2013, only 6 locations exceeded the risk-based recreational/trespasser screening levels:

LL03 (the Southern Tract) – this location was described as the area of a leachate seep. The only exceedance in this sample was benzo(a)pyrene (BaP) at a concentration of 0.48 mg/kg, which slightly exceeded the screening level of 0.12 mg/kg.

LL04 (Southern Tract) --this location was described in the field notes as a "trashy area". The only screening level exceedance was BaP at a concentration of 0.28 mg/kg, which has a screening level of 0.12 mg/kg.

C003 (Central Tract) -- this location was described in the field notes as “east side of open area”. The BaP concentration was 0.14 mg/kg which exceeded the screening level of 0.12 mg/kg. The dibenzo(a,h)anthracene concentration was 0.14 mg/kg which exceeded the screening level of 0.12 mg/kg.

S014 (and the duplicate sample, S012) (Southern Tract) – this location exceeded three individual risk based screening levels:

- Lead, at a concentration of 1,300 mg/kg, which is above its screening level of 400 mg/kg. However, the duplicate sample at the same location did not exceed the screening level for lead.
- BaP, at a concentration of 3.4 mg/kg and 5.1 mg/kg (in the duplicate sample), which is above the screening level of 0.12 mg/kg.
- Dibenzo(a,h)anthracene, at a concentration of 0.22 mg/kg, which was above the screening level of 0.12 mg/kg. However, the duplicate sample from the same location did not exceed the RSL for dibenzo(a,h)anthracene.

S005 (Southern Tract) – this location, noted to have stressed vegetation and tires, exceeded the screening level for PCBs and BaP:

- PCBs at a concentration of 28 mg/kg, which is above the screening level of 1.8 mg/kg; and
- BaP at a concentration of 4 mg/kg, which is above the screening level of 0.12 mg/kg.
- Bis(2-ethylhexyl) phthalate at a concentration of 350 mg/kg, which is above the screening level of 276 mg/kg.

C005 (Central Tract) – this location exceeded the screening level for BaP at a concentration of 0.31 mg/kg, which is above the screening level of 0.12 mg/kg.

In order to evaluate whether the sampling locations represented locations of potential exposure, the sampling locations were reviewed based on the description and location. Of the 33 locations sampled, 14 were sampled at locations of trespasser activity, such as trails, a deer stand and "hobo camp" (as identified in the field notes by KDEP). Of these 14 locations, only 2 locations (C005 and S0014 shown on Figure 4.1) exceeded the screening levels.

4.5 Recommendations

The 2011 and 2013 surface soil sampling results provide useful data of current surface soil conditions and identified six locations that contain soils with contaminants that exceed recreational/trespasser screening levels. The need for further sampling will be determined based on the findings of the detailed site inspection. As recommended in Section 3.0, areas of exposed waste need to be inventoried and evaluated to allow for potential "spot capping". The data confirm that there has not been a new release of contamination to surface soil, and that a maintained soil cover and cap remain protective of human health and the environment.

5. Landfill Gas Collection System Update for Methane Control

The 2013 Five-Year Review identified that the Landfill Gas Collection was not operating as designed and needed review.

The LFG collection system is currently not working as designed and may no longer be in an optimal location. Also it was not selected as the remedy in the 1986 ROD. Determine next steps for installing updated LFG collection system and install new system. Select the LFG collection system as the remedy if it was meant to be the remedy (EPA, 2013b).

5.1 Background on Landfill Gas

In 1975, flash fires were reported at residences in Riverside Gardens. A landfill gas investigation was conducted from 1975 to 1978 and gas probes were installed throughout the western part of Riverside Gardens at depths of 15 to 30 feet below ground. In 1978, EPA determined that there was not conclusive evidence that linked the 1975 flash fires to the Site because EPA noted that methane readings in gas probes at residences were more than 10 times below the LEL for methane (Jefferson County, 1978).

In 1979, Jefferson County took the responsibility to address the issue of potential landfill gas migration and engaged Stearns Conrad and Schmidt (SCS) to design a LFG system. In 1980, the active LFG system was installed, which included thirty landfill gas wells spaced 100 feet apart with each well connected to a header pipe that was then connected to a blower to vent any landfill gas.

Two engineering studies evaluated the system (SCS in 2004 and Smith Management Group (SMG) in 2010), and determined that the LFG system was inoperable and had exceeded its 25-year useful life (SMG, 2010, SCS, 2004 and EPA, 2013b). Data collected throughout the O&M period confirms that methane levels continued to decline with the exception of location G-1, which remained above 5% methane until 2007. After 2007, G-1 was consistently below 5% methane. In order to evaluate the G-1 area, MSD installed three gas monitoring wells (GMW-1,-2, and -3) in 2010. Installation logs for GMW-1, -2, and -3 are provided in Appendix A.

5.2 Evaluation of Subsurface Landfill Gas Migration 1993 to 2014

Figure 5.1 presents the location of the Site and the location of the LFG system and gas probes. Table 5.1 presents the methane data collected from 1993 through 2015.

This Report evaluates gas probe data from probes G-1 through G-5R collected over a 22 year period from 1993 until 2015. The data confirm that methane concentrations have declined even though the LFG system had operational issues. Kentucky regulation 401 KAR 48:090(4) for new landfills require that explosive gases not exceed the LEL of 5% for methane at the facility property boundary. This rule does not apply to the Site because it was not permitted under these regulations. However, the requirement is a good guideline to evaluate data for closed landfills.

As municipal solid waste ages within the landfill, the production of landfill gas diminishes and the potential for methane migration reduces over time. Methane concentrations have not exceeded the Kentucky Action level of 5% methane at any location since 2007. In 2010, three new gas probes (GMW-1, GMW-2 and GMW-3) were installed in the area of G-1 to evaluate residual levels of methane detected in this gas well. The results of soil gas testing are presented on Table 5.1 and show that methane levels are well below the LEL (5% methane).

Further, previous sampling indicated very low levels of methane present at the LFG system. During a 2004 investigation, SCS measured the methane levels in all 31 gas extraction wells (SCS, 2004). None of the 31 gas wells had methane above the LEL of 5%.

As part of EPA's 2013 soil gas study (i.e., study of potential methane migration), 13 permanent gas probes and 5 newly installed temporary gas probes were sampled between the Site and the Riverside Gardens. Analytical results from the 18 sample locations identified the highest reading as only 5.9 ppm (0.00059% methane) (EPA, 2013c).

As part of the vapor intrusion study in 2014 and 2015, temporary gas probes were installed at residences in Riverside Gardens. While the primary focus was VOCs, EPA also tested for methane. These results confirm that methane from the Site is not migrating to Riverside Gardens. Table 5.2 shows that methane levels are more than 100 times below the LEL for methane, with concentrations ranging from non-detect to 480 parts per million.

5.3 Evaluation of Landfill Gas Collection System/Remedy

The condition and performance of the LFG system is documented by SCS Engineers (SCS, 2004) and SMG (SMG, 2010).

Consistent with the SCS evaluation in 2004, SMG determined that the LFG system had exceeded its useful life. In addition, according to the LANDGEM Model completed by SMG, as of 2009, methane gas generation had been consistently decreasing. According to the 2009 model calculations, there had been an estimated 81.7% reduction of the annual amount of methane generated by the Site since 1976 (SMG, 2010).

5.4 Recommendations

A review of the methane data confirms that there has not been a new release of methane from the Site, and the remedy remains protective against off-Site migration of methane.

The extensive methane monitoring data collected over the past 22 years confirms that it is unnecessary to repair the LFG system because it is no longer needed to prevent methane migration. It is recommended that laboratory testing for methane be discontinued and that only field testing for methane and pressure be conducted at the permanent gas probes on a semi-annual basis. Methane measurements should continue to be compared to the LEL (5% for methane) and as long as the results continue to remain below the LEL, no additional action is required.

6. Vapor Intrusion Evaluation

The 2013 Five-Year Review identified the need for a vapor intrusion study, in part, as a follow up item to the inoperable landfill gas system.

6.1 Scope of VI Study

Following the 2013 Five Year Review, EPA initiated a VI evaluation. The scope of the VI evaluation for the Site and Riverside Gardens residential area included the following:

- Review of routine sampling for methane and VOCs at permanent gas probes (G series probes) at the Site perimeter from 1993 to 2015 (MSD, 1993 to 2015).
- In June 2013, EPA installed five temporary gas probes (LLL-1 through LLL-5) between the Site and Riverside Gardens. EPA sampled these temporary gas probes and the permanent gas probes from the G-series locations for parameters including VOCs and methane (EPA, 2013c).
- In June 2014, EPA completed ambient air, basement, sub-slab, crawl space and first floor sampling for various parameters, including VOCs and methane at 33 locations (Lockheed Martin, 2014a).
- In November 2014, EPA conducted follow-up sampling of crawl spaces, first floor indoor air and ambient locations at eight of the original 33 locations for various parameters, including VOCs and methane (Lockheed Martin, 2014b).
- In December 2014, EPA installed temporary gas probes and conducted soil gas sampling for parameters including VOCs and methane at eight residences (seven of which were the same locations sampled in November 2014). This sampling was completed based on results from the November sampling event (Lockheed Martin, 2015a).
- In June 2015, EPA repeated the soil gas and indoor air sampling at seven of the eight residences sampled in November/December 2014 (Lockheed Martin, 2015b).
- In July 2015, EPA collected additional soil gas samples to re-evaluate the qualified results from June 2015 from three locations (Lockheed Martin, 2015c) due to quality control issues with the June 2015 round. No additional indoor air sampling was conducted during this sampling event.

Figure 6.1 provides a schematic cross section showing the various sampling locations of the VI evaluation.

6.2 EPA Vapor Screening Levels

For the Site, EPA is using Region 4 established RSLs, which are listed on Table 6.1 (Lockheed Martin, 2014a). An exceedance of a screening level does not necessarily represent a health risk to residents from the VI pathway as it is essential to conduct a full evaluation of all sources of any exceedance. For example, with household residences, there are many potential sources of VOCs in common household products and from smokers in the home.

The approach EPA used compared the broad list of VOC detections to the RSLs in order to narrow both the list of potential COCs and the locations of potential concern. The next step was to collect additional data to confirm the presence or absence of any constituent and to further evaluate all potential sources and pathways.

6.3 Volatile Organic Compounds (VOC) at Landfill Gas Probes

Table 6.2 presents the VOC results for subsurface gas sampling completed between 2012 and 2015 from permanent landfill gas probes (G-1, G-2, G-3, G-4, G-5L, G-5R, GMW-1, GMW-2 and GMW-3) located at the perimeter of the Site. With respect to locations G-1 through G-5, there are two probes at each of these locations (one shallow at 15 feet and one deep at 40 feet). The monitoring involved field measurement of methane at both shallow and deep gas probes at each location for G-1 through G-4. The probe with the highest methane reading in each probe nest was selected for VOC analysis; in the event the results of the field measurements on both probes were equivalent or non-detect, the deeper probe was selected. Figure 6.2 shows the sampling locations. Table 6.2 presents the sampling results. Sampling results were reported in parts per billion by volume (ppbv) rather than $\mu g/m^3$. Hence, the screening levels are converted to ppbv for comparison in Table 6.2. As shown, PCE, carbon tetrachloride and chloroform exceeded EPA's soil gas screening levels in 4 of the permanent soil gas probe locations located next to the Site.

6.4 Ambient Air Monitoring Results

As part of the monitoring activities by MSD, ambient air was monitored for VOCs on a semi-annual basis. Figure 6.2 shows the ambient air monitoring locations, while Table 6.3 provides the results of ambient air monitoring from 2012 to 2015. As shown, there are VOCs detected in ambient air including the upwind, background samples. Similar to the subsurface gas sample results, the ambient air data are reported in ppbv rather than $\mu g/m^3$. Hence, the screening levels are converted to ppbv for Table 6.3. As shown, only chloroform exceeded its RSL at A1, A2, U1, U2 and R1 in September 2013. Figure 6.2 shows these locations. While most VOCs in ambient air were below RSLs, it is important to note that when VOCs are present in ambient air, these VOCs contribute to VOCs present in indoor air samples. There are many potential sources of VOCs in ambient air (e.g., industrial, vehicles, combustion), thus making source evaluation an essential component to every VI evaluation.

6.5 2013 Soil Gas Evaluation

In 2013, a soil gas study was completed using both permanent (G-series probes) and temporary gas probes (LLL-series probes) (EPA, 2013c). Figure 6.1 shows the soil gas probe locations on a typical cross section and Figure 6.2 shows the sampling locations. The G-series soil gas probes (except G-5) and the LLL-1 temporary soil gas probe represent soil gas concentrations at the Site perimeter, whereas LLL-2 through LLL-5 represent soil gas samples collected further away from the Site at locations between the Site and the residences in Riverside Gardens and G-5 represents the residential area.

VOC soil gas data collected from permanent gas probes (G-series probes) are provided in Table 6.4 and results from 2013 temporary gas probes (LLL-series probes) are presented in Table 6.5.

Of the 14 total locations sampled in 2013, eight locations exceeded the RSL screening levels for soil gas as follows:

- Location G-1L exceeded for chloroform
- Location G-4R exceeded for carbon tetrachloride and chloroform
- Location GMW-1 exceeded for tetrachloroethene (PCE)
- Location LLL-1 exceeded for carbon tetrachloride and chloroform
- Locations LLL-2, LLL-3, LLL-4, and LLL-5 exceeded for 1,3-butadiene

6.6 Evaluation of VOC Results in Soil Gas

Tables 6.2, 6.4 and 6.5 provide the VOC results from temporary and permanent gas probes (excluding temporary soil gas probes associated with the VI study). Each VOC that was detected above RSLs is discussed below:

- Chloroform exceeded the RSL at three perimeter Site locations (G-1, G-4R, and LLL-1) but was not detected above the RSL in the temporary soil gas probes located between the Site and the residential area in Riverside Gardens. Also, chloroform was detected above the RSL in ambient air in September 2013.
- Carbon tetrachloride exceeded the RSL at four soil gas locations (G-4L, G-4R, LLL-1 and Unit 015) but was not above the RSL at any other location.
- PCE exceeded the RSL at one perimeter Site location (GMW-1). PCE was not detected above the RSL at any other location.
- 1,3-butadiene did not exceed the RSL in any of the perimeter Site locations. However, 1,3-butadiene was detected above the RSL in four of the temporary soil gas probes (LLL-2, LLL-3, LLL-4 and LLL-5) located between the Site and the residential area in Riverside Gardens.

Site Perimeter: The soil gas sampling shows that there are isolated detections of select VOCs (carbon tetrachloride, PCE, and chloroform) above RSLs in soil gas at the Site perimeter.

Riverside Gardens: Carbon tetrachloride exceeded the RSL at a temporary gas probe at Unit 015 and 1,3-butadiene was detected in soil gas above its RSL at a number of temporary gas probes located in Riverside Gardens.

Given the above, further evaluation is required as it relates to both carbon tetrachloride and 1,3-butadiene. Additional discussion of each compound is below.

Elevated carbon tetrachloride levels above RSLs are present at G-4L and G-4R multiple times between 1997 and 2015 both in the shallow gas probe, G-4L (5 to 15 feet) and the deep gas probe, G-4R (30 to 40 feet). Carbon tetrachloride above RSLs was found at temporary gas probes at LLL-1

(6-24 feet) and Unit 015 (8 feet), G-4L and G-4R which are all located east of the Northern Tract of the Site. Figure 6.3 and Table 6.7 summarize the RSL exceedances for carbon tetrachloride. Figure 6.3 shows the highest value where multiple exceedances have occurred.

Carbon Tetrachloride was below the RSL at G-3 and LLL-2 to the south and the G-5R/G-5L soil gas probes to the east. Further investigation is needed to determine the source and extent of carbon tetrachloride above RSLs in soil gas.

Figure 6.4 and Table 6.8 summarize RSL exceedances of 1,3-butadiene, which includes results from temporary gas probes installed in residential areas which are discussed in Section 6.9. The RSL exceedances for 1,3-butadiene were noted to occur only at temporary soil gas probes and were not found in any of the permanent soil gas probes. Also, none of the permanent soil gas probes located at shallow and deep locations along the eastern perimeter of the Site exceeded the RSL. This suggests that the source of 1,3-butadiene in soil gas is not originating from the Site. As shown on Table 6.8, 1,3-butadiene was measured at shallow temporary gas probes at concentrations typically in the range of 7.6 to 56 $\mu g/m^3$ spread out over approximately 35 acres forming the western portion of Riverside Gardens.

6.7 June 2014 VI Sampling

In 2011, MSD prepared a map of residential locations that had basements and crawl spaces in Riverside Gardens. A copy of this map is reproduced as Appendix G. Due to the lack of basements in the majority of homes, the EPA sampling in June 2014 focused on crawl spaces. EPA sampling results from 33 residential locations in June 2014 were compared to indoor air RSLs even though the crawl spaces are not living spaces. Figure 6.5 shows the 33 sampling locations and Table 6.6 provides a summary of VOCs that exceeded RSLs. A total of seven residential locations were identified that exceeded one or more RSLs within crawl spaces (chloroform excluded). Since the RSLs for chloroform (based on 10^{-6} risk) were exceeded, EPA then used a modified screening level based on a non-carcinogenic hazard quotient of 1. This was based on the EPA Integrated Risk Information System (IRIS) toxicological assessment which clearly recommends that there is no carcinogenic risk until the oral dose or the air concentration exceeds the non-carcinogenic based value.

6.8 November/December 2014 VI Sampling

In November 2014, EPA collected sub-slab, crawl space, indoor air and ambient air samples at eight residential locations within Riverside Gardens.

In December 2014, EPA installed temporary gas probes at seven of the residences sampled in November and sampled the soil gas. Unit 003 did not have a soil gas sample.

6.9 June 2015 VI Sampling at 8 Residences

In June 2015, EPA continued the VI evaluation and sampled indoor air at seven of the eight residences that were sampled in November 2014. Unit 003 was not resampled because the property owner respectfully declined access.

6.10 VI Data Evaluation

Figure 6.1 shows a schematic cross section of sampling locations and Figure 6.6 shows the locations of the eight residences selected for the detailed VI evaluation and one location that was selected for soil gas only without indoor or crawl space sampling (Unit 034).

Tables 6.9a through 6.9i provide a comprehensive summary of the individual compounds that exceeded RSLs at the various sample locations (sub-slab, crawl space, first floor, etc.). As shown, six of the eight residential locations with indoor sampling identified RSL exceedances in the living space on the first floor. These exceedances include:

Unit 003 - Table 6.9a identifies a 1,2-dichloroethane (1,2-DCE) exceedance of 1.2 $\mu g/m^3$ in the first floor air sample in November 2014. The crawl space air result for 1,2-DCE- was over 10 times lower than the first floor result. There was no soil gas measurement at Unit 003. However, nearby soil gas samples at Unit 032 and Unit 033 did not detect 1,2-DCE. These results for Unit 003 do not show a completed VI pathway from soil gas to indoor air. EPA did not resample Unit 003 in June 2015 because the property owner respectfully declined access.

Unit 007: Table 6.9b identifies exceedances of 1,3-butadiene (6.7 $\mu g/m^3$), benzene (6.3 $\mu g/m^3$) and 1,2-DCE (1.6 $\mu g/m^3$) detections in the first floor air sample from November 2014. The corresponding crawl space air sample results for all three compounds were all more than 10 times lower than the first floor air results. EPA verbally noted to both GHD and SMG representatives during the June 2015 sampling round that there is a smoker in this residence, which is relevant because cigarette smoke can be a source of 1,3-butadiene and benzene in indoor air[3]. The data for Unit 007 do not demonstrate a completed VI pathway from soil gas to indoor air.

Unit 014: Table 6.9c identifies a 1,3-butadiene exceedance of 0.98 $\mu g/m^3$ in first floor air from November 2014. The crawl space and soil gas results for 1,3-butadiene were lower than the first floor result. EPA verbally noted to both GHD and SMG representatives during the June 2015 sampling round that there is a smoker in this residence. Cigarette smoke can be a source of 1,3-butadiene as noted previously. The results for Unit 014 do not show a completed VI pathway from soil gas to indoor air.

Unit 015: Table 6.9d identifies a 1,2-DCE exceedance of 1.1 $\mu g/m^3$ in the first floor air sample from November 2014. The corresponding crawl space air sample result was more than 10 times lower than the first floor air result. 1,2-DCE was not detected in the soil gas sample obtained from this Unit 015. The data for Unit 015 do not demonstrate a completed VI pathway from soil gas to indoor air.

Unit 023: Table 6.9e identifies exceedances of 1,4-dichlorobenzene (14 $\mu g/m^3$) and 1,2-DCE (1.2 $\mu g/m^3$) in the first floor air sample from November 2014. The corresponding crawl space air sample result is more than 10 times lower than the first floor result and neither compound was detected in the soil gas sample from this unit. The data for Unit 023 do not demonstrate a completed VI pathway from soil gas to indoor air.

Unit 030: Table 6.9f identifies an exceedance of 1,4-dichlorobenzene at 18 $\mu g/m^3$ in the first floor air sample from November 2014. The corresponding crawl space air sample result was more than 10 times lower than the first floor result and 1,4-dichlorobenzene was not detected in the soil gas

[3] EPA Technology Transfer Network - Air Toxics Web Site, http://epa.gov/ttnatw01/hlthef/butadiene.html and http://epa.gov/ttnatw01/hlthef/benzene.html

sample from this unit. The data for Unit 030 do not demonstrate a completed VI pathway from soil gas to indoor air.

Unit 032: Table 6.9g identifies no first floor exceedance of an RSL. The ambient air sample from June 2014 (13 $\mu g/m^3$) exceeded the RSL for 1,4-dichlorobenzene. The data for Unit 032 do not demonstrate a completed VI pathway from soil gas to indoor air.

Unit 033: Table 6.9h identifies no first floor exceedance of an RSL. The data for Unit 033 do not demonstrate a completed VI pathway from soil gas to indoor air.

Unit 034: Table 6.9i identifies that no first floor samples were collected. Only a soil gas sample was collected. This residence was found to be vacant in the June 2015 sampling round and was not re-sampled. The data for Unit 034 do not demonstrate a completed VI pathway from soil gas to indoor air.

6.11 Source Evaluation of VOCs in Soil Gas

This Section evaluates potential VOC sources in soil gas.

6.11.1 Lee's Lane Landfill

All landfills (including this Site) are a potential source of VOCs in soil gas. The potential for VOCs to migrate from landfills is related to landfill gas pressure caused by methane generation from waste decomposition. However, landfill gas generation dissipates and the potential for migration decreases over time.

While the source of the carbon tetrachloride is unknown, it is noted on Table 6.7 that carbon tetrachloride levels were low at soil gas probe location G-4 from 1997 until 2002 and then were frequently elevated thereafter. This suggests the arrival of a new source in 2003 that is inconsistent with landfill gas as a source. Further investigation is required to determine the source of carbon tetrachloride.

With respect to 1,3-butadiene, the lack of 1,3-butadiene exceedances at permanent soil gas probes at the Site perimeter confirm that the Site is not the source of 1,3-butadiene.

6.11.2 Residential Septic Systems

Residential septic systems can be a source of some VOCs. Carbon tetrachloride can be found in some household products. However, no reference was found for 1,3-butadiene as a component in household product causing contamination through septic systems (EPA, 2005). By design, septic tile beds leach wastewater into soils. VOCs in wastewater would have leached downward into subsurface soil. VOCs which adsorbed onto the soil could create soil gas vapors. The Riverside Gardens residential area had septic systems which could have received VOCs from household wastewater. Septic systems in Riverside Gardens were in place until 2004 when sewers were installed (FMSM, 2004). Even after the sanitary sewers were in place and waste water no longer drained to septic tile beds, the soil impacted from past septic releases could continue to be leaching to subsurface soils and groundwater.

During the June 2015 VI evaluation, former septic systems were noted to remain at several residences based on field inspections. The number of septic systems remaining is not known.

6.11.3 Groundwater

As discussed in Section 2.0, the groundwater at the Site and in Riverside Gardens does not contain VOCs above EPA's 2013 Groundwater Cleanup Goals confirming that groundwater is not a source to VOCs in soil gas. The proximity of elevated carbon tetrachloride at G-4L, G-4R, LLL-1, and Unit 015 to an industrial property located to the north which used carbon tetrachloride, raises the possibility that carbon tetrachloride could potentially be present in groundwater from off-site sources that used carbon tetrachloride.

6.12 Residential Sources of VOCs and Ambient Air

6.12.1 VOCs in Ambient Air

There were detections of VOCs above RSLs in ambient air samples. Chloroform exceeded the RSL at five locations in September 2013 and 1,4 dichlorobenzene exceeded the RSL at Unit 032 in June 2014. VOCs in ambient air are a source of low-level VOCs detected in residential indoor air samples.

6.12.2 Household Sources of VOCs

EPA Guidance recognizes the potential for VOC sources to originate from household sources and recommends that care be taken during any VI evaluation to remove household sources prior to sampling (EPA, 2015).

As of October, 2015, EPA has not provided documentation on household products present in residences prior to collecting indoor air samples, and there is no documentation that household sources were removed. Thus, it is not possible to rule out household products as a potential source of the indoor air detections. Typically, an inspection checklist, such as the checklist provided by EPA Guidance (EPA, 2015), is completed prior to conducting vapor sampling to document the presence of household products, storage areas, chemical usage and handling, recent ongoing activities (pest control, residential improvements, etc.), and whether the residents are smokers. Accordingly, any detections above the indoor air screening levels cannot necessarily be attributed to the Site, and in fact the absence of a soil gas pathway from the Site to Riverside Gardens confirms that the Site is most likely not the source of any indoor air detection of VOCs, which should be further confirmed by the June 2015 data.

All of the RSL exceedances from first floor sampled during November 2014 were higher, and often significantly higher (greater than 10 times), than the corresponding results from the crawlspace and soil gas samples. These data demonstrate that the sources of these vapors are likely the result of household products and materials and not the migration of constituents from the Site.

The VOCs that exceeded EPA screening levels include the following compounds which have common household uses

1,2-Dichloroethane (Ethylene Dichloride)

- It was formerly added to leaded gasoline as a lead scavenger.
- It is also used as a dispersant in rubber and plastics, as a wetting and penetrating agent.
- It was formerly used in the following products: ore flotation as a grain fumigant, as a metal degreaser, and in textile and PVC cleaning (www.epa.gov).

1,3-Butadiene

- It is found in automobile exhaust, cigarette smoke and wood fires and has been detected as a component of the side stream smoke from cigarettes. The average amount in side stream cigarette smoke is 205–361 µg/cigarette with an average airborne yield of 400 µg/cigarette (www.atsdr.cdc.gov).
- It has also been found in Liquid Nails Adhesive (www.householdproducts.nlm.nih.gov).

1,4-Dichlorobenzene

- It is one of two chemicals commonly used to make mothballs.
- It is used to make deodorant blocks used in garbage cans and restrooms, and to help control odors in animal-holding facilities.
- Toilet deodorizer is the most frequent means of exposure to this compound in the home (www.atsdr.cdc.gov).

Benzene

- The major sources of benzene exposure are tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions.
- Auto exhaust and industrial emissions account for about 20% of the total national exposure to benzene.
- About half of the exposure to benzene in the United States results from smoking tobacco or from exposure to tobacco smoke.
- The general population is exposed to benzene primarily by tobacco smoke (both active and passive smoking) and by inhaling contaminated air (particularly in areas with heavy motor vehicle traffic and around filling stations) (www.atsdr.cdc.gov).
- In homes, benzene may be found in glues, adhesives, cleaning products, paint strippers, tobacco smoke and gasoline. Most benzene in the environment comes from our use of petroleum products (www.dhs.wisconsin.gov).

6.13 Recommendations

With respect to soil gas, further evaluation is required to investigate the source of carbon tetrachloride observed at G-4L, G-4R, LLL-1 and Unit 015 area and of 1,3-butadiene observed in the residential area (but not adjacent to the landfill). It is recommended that 1,3-butadiene be added to the list of VOCs monitored during routine soil gas sampling at the G-series permanent gas probes. Additional investigation of 1,3- butadiene is recommend by evaluating the potential presence of 1,3-butadiene during the carbon tetrachloride investigation at three representative locations that previously had 1,3-butadiene exceedances with temporary gas probes.

With respect to the vapor intrusion study, the VI pathway between the Site and indoor air is incomplete. Thus, the VI data show that the remedy remains protective of human health and no further VI investigation is required.

With respect to current monitoring, it is recommended that ambient air monitoring be discontinued. Also, it is recommended that the frequency of VOC sampling at the G-series, permanent gas probes be changed from semi-annual to annual.

7. Health Risk Assessment Update

The 2013 Five-Year Review identified the following item related to the need for a risk update.

Risk has not been identified at the Site. Conduct an updated data review and evaluation (EPA, 2013b).

7.1 Human Health Update - Groundwater

7.1.1 Background on 1986 RI/FS Public Health Assessment of Groundwater

As part of the 1986 RI/FS, the EPA completed a Public Health Assessment that stated:

"Pollutant movement in the groundwater system is the major transport route to potential offsite receptors and will be examined more closely in this assessment. A small number of shallow, private drinking water wells are located in the Riverside Garden subdivision, east of the site. No elevated contaminant levels were found in these wells (see Tables 4-12 through 4-15). Two deep industrial process wells are also located north and south of the site and are operated by Borden and Louisville Gas and Electric. Analyses conducted during the remedial investigation did not reveal any elevated levels of hazardous contaminants in the wells (see Tables 4-10 and 4-11). Two public water supply wells withdrawing from the deeper portions of the aquifer are located on the Indiana side of the Ohio River. No contaminants typical of the site were found at elevated levels in these wells, although manganese was observed in excess of the secondary drinking water standard. As seen in Table 4-8, manganese, iron and chromium appear to be widespread in the deep portions of the aquifer. These substances were observed in upgradient monitor wells, onsite monitoring wells, and the Indiana public water supply wells. Although the site may contribute to the elevated levels, it does not appear to be the sole source." (EPA, 1986a page 8-12).

The only potential public health problem at the Lees Lane Landfill Site is related to the elevated chromium levels detected in the groundwater. Although the site is contributing to the elevated levels, it is not the only source since upgradient wells also contained elevated levels. Chromium was not detected in residential wells east of the site. Since groundwater flow is predominantly toward the Ohio River it is unlikely the residential wells will be affected in the future. Chromium was also not detected in the industrial process wells north and south of the site, however it was found at low levels in the Indiana public water supply wells across the Ohio River. It is not known if this chromium is related to elevated levels at the landfill Table 8-10 provides a summary of the potential public health concerns resulting from the public health and environmental assessment for the Lees lane landfill Site. As shown in the table, there is no current evidence of an off-site problem related to the landfill site." (EPA, 1986a page 8-37).

7.1.2 Drinking Water Receptor Update

There are no water supply wells on or near the Site on the Kentucky side of the Ohio River. Information on the Indiana side of the Ohio River was not updated because no adverse impacts to the Ohio River from the Site are occurring (see Section 7.1.4 below).

For the Kentucky side of the Ohio River, SMG contacted the Public Records Management-Open Records Section at KDEP and provided the Site co-ordinates (Latitude and Longitude: 38.193016°, -85.884075°) and requested a list of all surface water and groundwater withdrawal permits within a

1.5 mile radius. A response from Chris Yeary in the Watershed Management Branch of Kentucky Division of Water indicated that *"There are no permitted water withdrawals within the area of interest."* (SMG, 2015).

Also, residents in Riverside Gardens adjacent to the Site were connected to municipal water after the ROD (EPA, 2003). As such, there is no completed pathway between groundwater at the Site and potable water in Riverside Gardens. There are no records found as of October 2015 that document whether the private wells were sealed.

7.1.3 Comparison of Groundwater Data to Groundwater Cleanup Goals

The groundwater at the Site has been characterized through sampling of the monitoring well network. Section 2.0 of this Report presents the groundwater data base and provides a comparison to EPA's 2013 Groundwater Cleanup Goals. No VOC, pesticides, PCBs or SVOC contamination is present in groundwater, and the only metals present above these goals are arsenic, manganese, iron, barium, and lead which are not sources for Vapor Intrusion (VI).

7.2 Human Health Update - On Site Surface Soil

7.2.1 Comparison of Surface Soil Data to Screening Levels

Section 4.0 of this Report provides a comparison of surface soil data to screening levels. This comparison identified six locations where surface soil sampling results were above screening levels. The results identify that there are only a few locations where surface soil exceeds risk based screening levels based on cancer risk of 10^{-6} and hazard quotient of 1. Due to the risk based screening level exceedance, the cumulative carcinogenic risk and the non-carcinogenic hazard index associated with the trespasser and recreational user direct contact exposure to COPCs were calculated. The cumulative risks for the trespasser and recreational user direct contact exposure to COPCs in soil are within the EPA's defined target cancer risk range of 10^{-6} to 10^{-4}. The cumulative non-carcinogenic hazard index was also less than 1 for each of the receptors direct contact exposure to the COPCs in soil. This indicates that the COPC soil concentrations are not resulting in risks above acceptable levels.

7.3 Human Health - Vapor Intrusion

7.3.1 Evaluation of Potential Vapor Migration from Groundwater

As discussed in Section 2.0, groundwater flow beneath the Site is west towards the Ohio River and away from the residential area. During high water levels in the River, the groundwater levels temporarily rise near the River. The RI concluded that, even under flow reversal conditions, the groundwater does not migrate to the residential area located east of the Site (EPA, 1986a, See page 4-31).

As presented in Section 6.0, the VI pathway is being evaluated as part of the EPA's recent VI evaluation. Section 2.0 of this Report summarizes the groundwater quality and shows that VOC concentrations in the groundwater beneath the Site are below the Groundwater Cleanup Goals. As such, the VOCs not only meet drinking water criteria, they do not present any potential risk of vapor intrusion.

7.3.2 Evaluation of Potential Vapor Migration via Landfill Gas

Section 6.0 of this Report presents the results of the VI samples received to date. These studies show that the strongest marker of landfill gas, methane, does not migrate off-Site above Kentucky standards. In fact, methane levels in gas probes east of the Site and in gas probes next to residences in Riverside Gardens had minimal to no detectable levels of methane.

VOC data in gas probes located adjacent to the Site and Riverside Gardens show sporadic levels of VOCs that are likely attributed to the Site, but do not migrate to Riverside Gardens. The only VOCs detected in temporary soil gas probes located in Riverside Gardens were carbon tetrachloride and 1,3-butadiene.

Regardless of the source, the VI evaluation examined the relationship between soil gas, crawl space data and indoor air samples at residences in Riverside Gardens. As presented in Section 6.0, the VI data show that the pathway between the Site and indoor air is incomplete.

7.4 Ecological Risk Evaluation Update

7.4.1 Background – 1986 Ecological Assessment

As part of the RI/FS, an inventory of natural plant communities including grasses, trees, and wetland plant species at the Site was conducted. The RI/FS noted that the Site had a diversity of habitat to support a variety of small mammals, waterfowl and other birds. RI/FS (EPA, 1986a – See Sections 7.0 and 8.0). The ecological assessment included a qualitative evaluation of potential risk to wildlife based on concentrations of potential contaminants in surface soil and the potential of bioaccumulation. The ecological assessment concluded:

"In summary, the concentrations of the critical contaminants observed during the remedial investigation do not present a significant threat to the environmental receptors at the Lees Lane Landfill Site. Biota in continued direct contact with elevated contaminant levels in selected "hot spot" soil areas may experience symptoms of chronic toxicity; however, no acute toxicological effects would be expected at the current contaminant levels." (EPA, 1986a).

The ecological evaluation also described the benthic communities and fish in the Ohio River. The benthic community was described as:

"The benthic invertebrate community of the Ohio River is limited in part by the lack of suitable substrate (USACE, 1982). . . .In summary, the characteristics of the invertebrate community as a whole in the river near the landfill is reported to be dominated by pollution-tolerant organisms (USACE, 1982)."

The fish community was described as follows:

"In general, the most commonly identified fish species were coarse fish and are considered tolerant of lower quality conditions found in the Ohio River."

7.4.2 Background – 1987 United States Department of Interior (DOI) Memorandum

In 1987, the DOI prepared a memo that summarizes the results of the Preliminary Natural Resources Survey. A copy of the survey is provided as Appendix G of this Report. The memo states:

"In response to Mr. Bruce Blanchard's request of August 18, 1986, we have conducted a preliminary survey of the subject site to determine whether or not natural resources under the trusteeship of the Department of Interior (DOI) are present in the vicinity of the site and, if present, whether or not damages have occurred or are likely to occur to these resources from pollutants on or derived from this sites. This survey was conducted in accordance with procedures outlined in PEP-Environmental Review Memorandum No.ER 83-2, and pursuant to the EPA/DOI Memorandum of Understanding on preliminary surveys of damages to natural resources (DOI, 1987)."

The survey was conducted prior to remediation at the Site and evaluated potential impacts to habitat related to exposed waste and ecological receptors exposed to potentially contaminated media at the Site. The conclusion of the survey was as follows:

"The natural resources survey indicates that adverse impacts to DOI trust resources resulting from the Lee's Lane Landfill Site probably are minor-to-nonexistent." (DOI, 1987).

Trust resources under the purview of DOI include species listed as federally threatened and endangered, waterfowl, and anadromous fish.

7.4.3 Ecological Receptor Update

Conditions at the Site have been evaluated and documented through routine inspections and five-year reviews. The conditions at the Site are not different than the conditions after the remedy was completed in the late 1980s. As such, the conclusions made during the RI/FS process and as part of the DOI survey in 1986 and 1987 remain valid. In the 2013 Five-Year Review, EPA stated that surface soil sampling conducted in 2011 addressed the ecological data gap. In addition to the 2011 surface soil sampling, KDEP conducted additional surface soil sampling in 2013.

7.5 Scope of Update on Ecological Risk Evaluation

The ecological evaluation conducted as part of the RI/FS focused on wildlife and DOI trust resources exposed to surface soil of the Site. As the RI/FS pre-dates EPA guidance for conducting ecological risk assessments, the ecological evaluation did not identify or quantitatively evaluate potentially complete migration and exposure pathways. The EPA and KDEP have identified the following potentially complete pathways as requiring evaluation in order to make risk management decisions for protection of ecological receptors on and immediately adjacent to the Site:

- Exposure of avian and mammalian wildlife to current concentrations of Site-related constituents in surface soil of the Site;
- Exposure of aquatic life in the surface water of the Ohio River due to runoff of surface water from the Site to the Ohio River;
- Exposure of aquatic life in the sediment of the Pond due to discharge and upwelling of groundwater;

- Exposure of aquatic life in the sediment of the Ohio River due to discharge and upwelling of groundwater; and
- Exposure of avian and mammalian wildlife to Site-related constituents below the soil cover and cap through food chain transfer.

Data for surface soil collected from the Site in 2011 and 2013 and groundwater collected from monitoring wells collected during 2011 through 2015 are used here to evaluate potential ecological pathways identified above. A Technical Memorandum, included as Appendix I, provides a detailed evaluation of each of the pathways. A summary of the evaluation of each pathway is presented below.

7.6 Evaluation of Potentially Complete Pathways

7.6.1 Exposure of Wildlife to Surface Soil

This Ecological Risk Assessment Update evaluates the potential for arsenic, chromium, copper, lead, nickel, mercury, zinc, Aroclor 1254, high molecular weight, polycyclic aromatic hydrocarbons (HMW PAHs), and bis(2-ethylhexyl)phthalate in surface soil to pose risk to avian and mammalian wildlife. The following assessment shows that there is no adverse ecological risk.

Arsenic

Arsenic was detected in 10 samples at concentrations ranging from 2.9 mg/kg to 8.41 mg/kg, with a 95% upper confidence limit (UCL) concentration of 7.0 mg/kg.

All concentrations are below the ecological soil screening levels (Eco-SSLs) for both avian wildlife (43 mg/kg) and mammalian wildlife (46 mg/kg). Consequently, it can be concluded that concentrations of arsenic in the surface soil do not pose risk to avian and mammalian wildlife.

Chromium

Chromium was detected in 10 samples at concentrations ranging from 14 mg/kg to 270 mg/kg, with a 95% UCL concentration of 157 mg/kg.

The Eco-SSLs for avian and mammalian wildlife are 26 mg/kg and 34 mg/kg, respectively. The potential for risk due to exposure to chromium was further evaluated using food chain models for American woodcock (avian insectivore) and short-tailed shrew (mammalian insectivore). Under current conditions, the 95% UCL exposure point concentration (EPC) for chromium potentially poses risk to avian insectivores. With spot capping of areas with highest concentrations of chromium, the potential for risk is below the threshold for concern.

The Technical Memorandum in Appendix I provides the input parameters and calculations for the food chain models.

Copper

Copper was detected in seven samples at concentrations ranging from 13 mg/kg to 240 mg/kg, with a 95% UCL concentration of 124 mg/kg.

The Eco-SSLs for avian and mammalian wildlife are 28 mg/kg and 49 mg/kg, respectively. The potential for risk due to exposure to copper was further evaluated using food chain models for

American woodcock and short-tailed shrew. Under current conditions, the 95% UCL EPC for copper potentially poses risk to avian insectivores. With spot capping of areas with highest concentrations of copper and assumptions for the food chain model that consider background, the potential for risk is below the threshold for concern.

The Technical Memorandum in Appendix I provides the input parameters and calculations for the food chain models.

Lead

Lead was detected in 10 samples at concentrations ranging from 14 mg/kg to 380 mg/kg, with a 95% UCL concentration of 262 mg/kg.

The Eco-SSLs for avian and mammalian wildlife are 11 mg/kg and 56 mg/kg, respectively. The potential for risk due to exposure to lead was further evaluated using food chain models for American woodcock and short-tailed shrew. Under current conditions, the 95% UCL EPC for lead potentially poses risk to both avian and mammalian insectivores. With spot capping of areas with highest concentrations of lead and assumptions for the food chain models that consider background, the potential for risk is below the threshold for concern for avian and mammalian insectivores.

The Technical Memorandum in Appendix I provides the input parameters and calculations for the food chain models.

Mercury

Mercury was detected in six samples at concentrations ranging from 0.1 mg/kg to 0.3 mg/kg, with a 95% UCL concentration of 0.24 mg/kg.

The EPA Region 5 ecological screening level (ESL) for mammalian wildlife is 0.00051 mg/kg. A screening value for avian wildlife is not available. The potential for risk due to exposure to mercury was further evaluated using food chain models for American woodcock and short-tailed shrew. Under current conditions, the 95% UCL EPC for mercury potentially poses risk to avian insectivores. With spot capping of areas with highest concentrations of mercury and assumptions for the food chain model that consider background, the potential for risk is below the threshold for concern.

The Technical Memorandum in Appendix I provides the input parameters and calculations for the food chain models.

Nickel

Nickel was detected in seven samples at concentrations ranging from 14 mg/kg to 230 mg/kg, with a 95% UCL concentration of 188 mg/kg.

The Eco-SSLs for avian and mammalian wildlife are 210 mg/kg and 130 mg/kg, respectively. The potential for risk due to exposure to nickel was further evaluated using food chain models for American woodcock and short-tailed shrew. Under current conditions, the 95% UCL EPC for nickel potentially poses risk to both avian and mammalian insectivores. With spot capping of areas with highest concentrations of nickel and assumptions for the food chain model that consider background, the potential for risk is below the threshold for concern.

The Technical Memorandum in Appendix I provides the input parameters and calculations for the food chain models.

Zinc

Zinc was detected in seven samples at concentrations ranging from 54 mg/kg to 530 mg/kg, with a 95% UCL concentration of 377 mg/kg.

The Eco-SSLs for avian and mammalian wildlife are 46 mg/kg and 79 mg/kg, respectively. The potential for risk due to exposure to zinc was further evaluated using food chain models American woodcock and short-tailed shrew. Under current conditions, the 95% UCL EPC for zinc is below the threshold for concern for both avian and mammalian insectivores.

The Technical Memorandum in Appendix I provides the input parameters and calculations for the food chain models.

Polychlorinated Biphenyls (PCBs)

Aroclor 1248 was detected in one of 37 samples and Aroclor 1254 was detected in eight of 37 samples. Based on a frequency of detection (FOD) less than 5% for 37 samples, it can be concluded that Aroclor 1248 does not pose a potential for risk to ecological receptors exposed to surface soil.

Aroclor 1254 was detected in eight of 37 samples at concentrations ranging from 0.025 mg/kg to 0.139 mg/kg with a 95% UCL concentration of 0.20 mg/kg.

The EPA Region 5 ESL for mammalian wildlife is 0.000332 mg/kg. A screening value for avian wildlife is not available. The potential for risk due to exposure to Aroclor 1254 was further evaluated using food chain models for American woodcock and short-tailed shrew. Under current conditions, the 95% UCL EPC for Aroclor 1254 is below the threshold for concern for both avian and mammalian insectivores.

The Technical Memorandum in Appendix I provides the input parameters and calculations for the food chain models.

Polycyclic Aromatic Hydrocarbons (PAHs)

Four HMW PAHs (benzo(a)pyrene [BaP], benzo(a)anthracene, benzo(k)fluoranthene, and dibenz(a,h)anthracene) were detected in surface soil. In the ecological risk assessment, HMW PAHs are evaluated as group due to similar mechanisms of ecotoxicity. One or more of the four HMW PAHs were detected in 25 of 37 samples. Concentrations range from 0.028 mg/kg to 8.22 mg/kg, with a 95% UCL concentration of 2.33 mg/kg.

An Eco-SSL of 1.1 mg/kg has been developed for HMW PAHs for mammalian receptors. A screening value for avian wildlife is not available. The potential for risk due to exposure to HMW PAHs was further evaluated using food chain models for American woodcock and short-tailed shrew. Under current conditions, the 95% UCL EPC for HMW PAHs is below the threshold for concern for both avian and mammalian insectivores.

The Technical Memorandum in Appendix I provides the input parameters and calculations for the food chain models.

Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was detected in 30 of 37 samples with concentrations ranging from 0.027 mg/kg to 350 mg/kg. The maximum concentration of 350 mg/kg is a statistical outlier at the 1% significance level (Dixon's outlier test in EPA 2013 Statistical Software ProUCL Version 5.0). With the outlier removed from the dataset, the maximum concentration is 9.9 mg/kg with a 95% UCL concentration of 1.20 mg/kg.

The EPA Region 5 ESL for mammalian wildlife is 0.925 mg/kg. A screening value for avian wildlife is not available. The potential for risk due to exposure to bis(2-ethylhexyl)phthalate was further evaluated using food chain models for American woodcock and short-tailed shrew. Under current conditions, the 95% UCL EPC for bis(2-ethylhexyl)phthalate is below the threshold for concern for both avian and mammalian insectivores. The Technical Memorandum in Appendix I provides the input parameters and calculations for the food chain models.

Dieldrin

Dieldrin was detected in one of 31 samples. Based on a FOD less than 5% for 31 samples, it can be concluded that dieldrin does not pose to ecological receptors exposed to surface soil.

Conclusion

Based on analysis presented above, the potential for risk to avian and mammalian insectivores is below the threshold for concern with use of LOAELs that are reflective of site-specific conditions and spot capping of areas with the highest concentrations of the COPECs.

7.6.2 Exposure of Aquatic Life to Surface Water of the Ohio River

Data for the Ohio River published by Youger and Mitsch (1989) was used to evaluate the sediment in the River collected for the reach between Pittsburgh and Louisville (general vicinity of the Landfill). The study concluded that concentrations of metals generally decrease from upstream to downstream. Reported concentrations of cadmium, chromium, copper, lead, nickel, and zinc near Louisville are all below the probable effect concentrations (PECs) identified by MacDonald et al. (2000). These data provide direct evidence that the landfill has not adversely impacted Ohio River sediments.

Further, the dense vegetation on the Site and forested area between the Site and the Ohio River filter the flow of surface runoff, allowing contaminants bound to particulate matter in runoff to drop out prior to the runoff discharging into the Ohio River. The use of vegetation for reduction of sediment runoff is widely recognized and is documented in River and Riparian Land Management Technical Guideline Number 1 May, 2001 ISSN 1445-3924 R.

It should also be recognized that the contributory drainage area of the Site relative to the Ohio River watershed is very small (112 acres) relative to the drainage basin of the Ohio River. Any potential contaminants transported in surface runoff will be significantly attenuated if they are discharged into the Ohio River.

Conclusion

Thus, the existing data and technical analysis combined with the Site conditions and size of the drainage area for the Site confirm that surface runoff from the Land does not pose any risk or adversely impact aquatic life in the Ohio River .

7.6.3 Exposure to Pond Sediment

Two sediment samples were collected from the Pond in 2011 – one sample by SMG and one sample by EPA. Arsenic, chromium, lead, and mercury were detected in both samples. Copper, nickel, zinc, Aroclor 1254, and four HMW PAHs were detected only in the sample collected by EPA.

The potential for risk to benthic invertebrates was evaluated by comparing arithmetic mean concentrations of arsenic, chromium, lead, and mercury and the detected concentrations of copper, nickel, zinc, Aroclor1254 and HMW PAHs to the so-called “consensus” probable effect concentrations (PECs). The mean concentrations of arsenic, chromium, and mercury and single sample concentrations of copper, nickel, zinc, Aroclor 1254 and HMW PAHs are below their PECs. These results suggest that arsenic, Aroclor 1254 and HMW PAHs do not pose a potential for risk to benthic invertebrates above the threshold for concern.

The mean concentration of lead (134 mg/kg) is slightly above its PEC (128 mg/kg). Comparison of the mean concentration of lead in bulk sediment to the PEC is conservative, as it does not consider factors that influence the bioavailability of lead in sediment. As a divalent metal, lead is likely bound to sulfides and organic carbon in sediment, which reduces its bioavailability to benthic invertebrates. Therefore, the potential for risk to benthic invertebrates exposed to lead in the sediment of the Pond is minimal.

Conclusion

Based on the above results, it is concluded that the potential for risk to benthic invertebrates in sediment of the Pond is below the threshold for concern.

7.6.4 Exposure to Ohio River Sediment

For this exposure pathway, the assumption is that aquatic life in the sediment of the Ohio River is potentially exposed to metals in groundwater flowing beneath the Site that migrates off-Site, discharges into the sediment, and flows upward through the sediment profile and into the biologically active zone. As groundwater mixes with overlying surface water in the biologically active zone, the EPC for sediment-dwelling organisms is the result of this mixing. Given the high flow of the Ohio River relative to the inflow of groundwater, the EPCs in the biologically active zone of the Ohio River are conservatively assumed to be 1% of the concentration in groundwater.

Calculated concentrations of potentially Site-related constituents in porewater in the biologically active zone are based on concentrations in MW-104 and MW-105, which are the monitoring wells closest to the Site. Arsenic, barium, cadmium, chromium iron, lead, manganese, mercury, selenium, and zinc were detected in MW-104 and/or MW-105. The potential for risk to benthic invertebrates was evaluated by comparing estimated EPCs in porewater to water quality benchmarks. If available, Kentucky water quality standards were used as benchmarks.

Arsenic

Concentrations of arsenic range from 2.7 µg/L to 300 µg/L, with an arithmetic mean concentration of 141 µg/L. The calculated EPC in porewater (1.41 µg/L) is below the Kentucky water quality standard of 150 µg/L. Consequently, arsenic does not pose a potential for risk to the aquatic life of the Ohio River above the threshold for concern.

Barium

Concentrations of barium range from 190 µg/L to 1,100 µg/L, with an arithmetic mean concentration of 567 µg/L. Adjusted for 100-fold dilution due to mixing, the arithmetic mean of 5.67 µg/L calculated for porewater is below the Dutch negligible concentration (NC) of 75 µg/L. Consequently, it can be concluded that barium does not pose a potential for risk to the aquatic life of the Ohio River above the threshold for concern.

Cadmium

Cadmium was detected in two samples at concentrations of 0.36 µg/L and 1.9 µg/L, with an arithmetic mean concentration of 1.13 µg/L. The calculated EPC for porewater (0.011 µg/L) is below the Kentucky water quality standard 0.152 µg/L. Consequently, cadmium does not pose a potential for risk to the aquatic life of the Ohio River above the threshold for concern.

Chromium

Chromium was detected in a single sample at a concentration of 32 µg/L. The calculated EPC for porewater (0.32 µg/L) is below the Kentucky water quality standard 11 µg/L. Consequently, chromium does not pose a potential for risk to the aquatic life of the Ohio River above the threshold for concern.

Iron

Concentrations of iron range from 6,300 µg/L to 29,000 µg/L, with an arithmetic mean concentration of 18,325 µg/L. The calculated EPC for porewater (183 µg/L) is below the Kentucky water quality standard of 1,000 µg/L. Consequently, it can be concluded that iron does not pose a potential for risk to the aquatic life of the Ohio River above the threshold for concern.

Lead

Lead was detected in two samples at concentrations of 17 µg/L and 130 µg/L, with an arithmetic mean concentration of 31.7 µg/L. The calculated EPC for porewater (0.317 µg/L) is below the Kentucky water quality standard of 1.2 µg/L. Consequently, it can be concluded that lead does not pose a potential for risk to the aquatic life of the Ohio River above the threshold for concern.

Manganese

Concentrations of manganese range from 1,000 µg/L to 7,300 µg/L, with an arithmetic mean concentration of 3,400 µg/L. The calculated EPC for porewater (34 µg/L) is below the lowest chronic value (LCV) for daphnids of 1,100 µg/L. Consequently, it can be concluded that manganese does not pose a potential for risk to the aquatic life of the Ohio River above the threshold for concern.

Mercury

Mercury was detected in one of two samples at a concentration of 1.6 µg/L. The calculated EPC for porewater (0.016 µg/L) is below the Kentucky water quality standard of 91 µg/L. Consequently, it can be concluded that mercury does not pose a potential for risk to the aquatic life of the Ohio River above the threshold for concern.

Selenium

Selenium was detected in two samples at concentrations of 0.95 µg/L and 1.9 µg/L, with an arithmetic mean concentration of 1.43 µg/L. The calculated EPC for porewater (0.014 µg/L) is below the Kentucky water quality standard of 5 µg/L. Consequently, it can be concluded that selenium does not pose a potential for risk to the aquatic life of the Ohio River above the threshold for concern.

Zinc

Zinc was detected in three samples at concentrations ranging from 13 µg/L to 20 µg/L, with an arithmetic mean concentration of 14.3 µg/L. The calculated EPC for porewater (0.143 µg/L) is below the Kentucky water quality standard of 64.5 µg/L. Consequently, it can be concluded that zinc does not pose a potential for risk to the aquatic life of the Ohio River above the threshold for concern.

Conclusion

Based on the above lines of evidence, including a conservative assumption of 100-fold dilution, it is concluded that concentrations of arsenic, barium, cadmium, chromium, iron, lead, manganese, mercury, selenium, and zinc in groundwater do not pose a potential for risk to benthic invertebrates in the sediment of the Ohio River above the threshold for concern.

7.6.5 Exposure of Wildlife Through Plant Uptake

The potential for risk to avian and mammalian wildlife through uptake of potential contaminants below the soil cover by deep rooted vegetation is negligible. Uptake of the constituents of concern by plants is low relative to the uptake by earthworms and other soil invertebrates. The food chain models for American woodcock and short-tailed shrew discussed in Section 7.6.1 assume that these two indicator species consume only earthworms. As risk to avian and mammalian insectivores was determined to be below the threshold for concern, the potential for risk to herbivores is also below the threshold. As an example, the Eco-SSLs for lead are 11 mg/kg for avian insectivores and 46 mg/kg for avian herbivores. Similarly, the Eco-SSLs for lead are 56 mg/kg for mammalian insectivores and 1,200 mg/kg for mammalian herbivores.

In addition to consumption of vegetation, wildlife could be exposed to potential contaminants that have bioaccumulated in leaves and other parts of above ground vegetation that have decomposed and become incorporated into surface soil. This potential source of contamination is accounted in the analysis of surface soil. As demonstrated in Section 7.6.1, the potential for risk to wildlife exposed to surface soil is below the threshold for concern.

Conclusion

Given the above, there is no adverse ecological risk associated with plant uptake.

7.6.6 Uncertainties in Toxicity Reference Values

An evaluation of the uncertainties in Toxicity Reference Values was completed and is presented in Appendix I. This evaluation identified that it is not meaningful to use the most conservative (i.e. lowest LOAELs because this produces Hazard Quotients that are greater than 1 for natural background concentrations for certain metals.

Conclusion

Alternative LOAELs for copper, lead, mercury, and nickel that are more appropriate for evaluating the potential for risk to terrestrial wildlife exposed to surface soil produce HQs that are below the threshold for concern.

7.6.7 Impact of Spot Capping in Ecological Risk Reduction

Appendix I presents an evaluation of the potential risk reduction by spot capping the three sample results with the highest metal concentrations. With spot capping, the HQs for American woodcock and short-tailed shrew for the metals move substantially below 1.

8. Institutional Controls (ICs) Update

The 2013 Five-Year Review identified the need for updating institutional controls and stated the following:

The 1986 ROD did not include institutional controls. Evaluate the need for institutional controls in conjunction with current ground water sampling efforts. Consider institutional controls for the capped landfill area. Identify institutional control requirement in an enforceable document, if necessary (EPA, 2013b).

8.1 Property Ownership

Figure 8.1 presents the current land ownership map for the Site. As shown, Hofgesang Foundation Inc. and Gernert CT, Inc.[4] own the majority of the Site.

8.2 Institutional Control Evaluation

The 2013 Five-Year review noted that there were no IC instruments in place to prevent groundwater use at the Site or disturbance of the soil cover and cap areas. The 1986 ROD did not require ICs. At a meeting held at EPA's office on April 28, 2015, the Hofgesang Foundation (who participated by telephone) stated that it is willing to work with the EPA to establish ICs for the Site.

As stated in the 2013 Five-Year Review, the EPA is considering three types of ICs: (1) restrictions on ground water precluding the drilling of wells or making use of ground water at the Site; (2) restrictions on activities that will prevent excavation, drilling or other actions that could impair the integrity of the soil cover and cap areas at the Site; and (3) use restrictions prohibiting non-industrial uses of the Site. All three types of ICs can be implemented through restrictive covenants under Kentucky law.

[4] Gernert CT shares the Lexington mailing address for the Treasurer of the Hofgesang Foundation

8.3 Recommendations

It is recommended that the EPA and the property owners evaluate the need for ICs for the Site consistent with appropriate future uses. Given that there are no exceedances of 10^{-4} risk or HI of 1, no IC prohibiting recreational use is needed. However, it is recommended that use restrictions prohibiting the development of the landfill for residential use be implemented.

9. Site Security Update

The 2013 Five-Year Review identified the need to address site security and stated the following:

Trespassing results in surface erosion and exposure. Identify whether additional measures are needed to discourage trespassers, and implement as appropriate (EPA, 2013b).

9.1 Site Security

Routine site inspections and the 2013 Five-Year Review have identified issues with Site security. There have been reports of ATVs causing damage to the soil cover and cap areas. There are also reports of people salvaging scrap metal from the Site. In response to security issues, MSD installed 1,040 feet of fence and four signs at the end of Elmwood Street adjacent to the Elmwood Salvage Yard. One sign and 100 feet of fence was installed at the end of Huff Lane. Four signs, a locking gate and 150 feet of fence were installed across an abandoned levee near the railroad track and Cane Run Road (MSD, 2012-2014). MSD has continued quarterly site inspections and has noted periodic evidence of trespassers with vehicles and ATVs.

9.2 Recommendations

It is recommended that ongoing Operations and Maintenance (O&M) activities required by the ROD, such as signage, road maintenance, fencing maintenance, and regular inspections continue.

10. Overall Conclusions and Recommendations

This CSM report summarizes the results of work completed during the post-ROD O&M period and the results of recent studies that address the items EPA raised in the 2013 Five-Year Review. There is no evidence of any changed condition compared to the ROD. In fact, studies show that Site conditions have significantly improved, and that there is no adverse human health or ecological risk present. The remedy remains protective of human health and the environment.

The CSM report recommends the following continuing activities at the Site:

(1) Annual inspections of the soil cover and cap areas should continue. A one-time, detailed inspection of the soil cover area is needed to identify areas of exposed waste;

(2) Semi-Annual field measurements for methane and pressure at soil gas probes;

(3) An evaluation is needed to determine the source of carbon tetrachloride and 1,3butadiene. The current soil gas probes will be sampled for both compounds. Annual sampling for VOCs (including 1,3-butadiene) at permanent gas probes should be conducted. Temporary gas probes will be used to further evaluate the source of carbon tetrachloride. As part of the carbon tetrachloride investigation, 1,3-butadiene will be sampled to see if past 1,3 butadiene

exceedances at locations Unit 015, Unit 023 and Unit 030 were false detections associated with sampling procedures.

(4) Groundwater monitoring annually for the five metal COCs (i.e., arsenic, manganese, iron, barium, and lead) at MW-4, MW-5, MW-101, MW-102, MW-103, MW-104, and MW-105; and

(5) Evaluate the need for Institutional Controls at the Site by the Site owners. Given that there are no exceedances of 10^{-4} or HI of 1, no IC prohibiting recreational use is needed but residential use should be prohibited.

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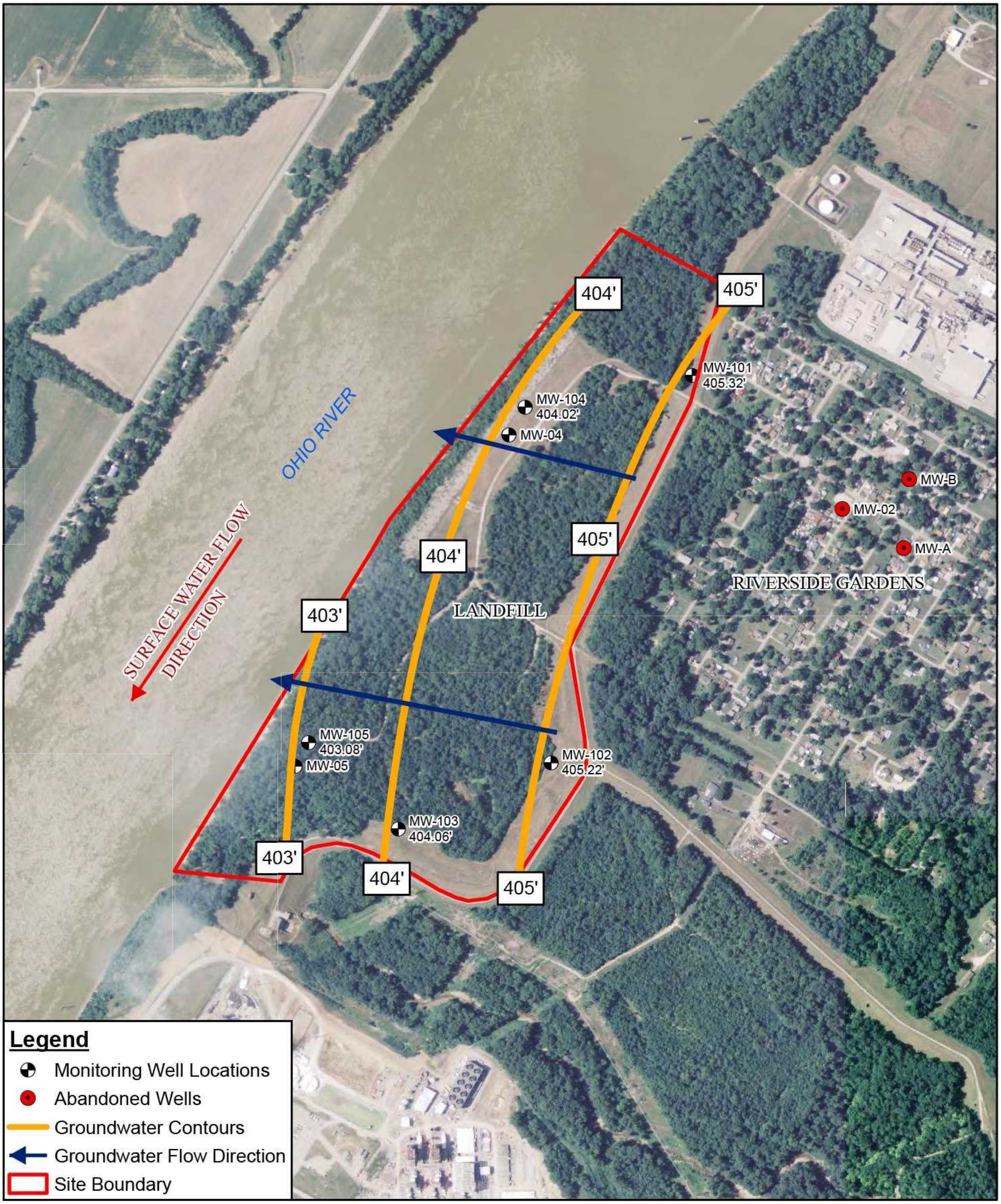
Figures



Aerial Image: NAIP Imagery of Kentucky, 2014 – U.S. Department of Agriculture (USDA) Farm Service Agency, Aerial Photography Field Office.

0 300 600 900
Feet

Coordinate System:
NAD 1983 StatePlane Kentucky
FIPS 1600 Feet

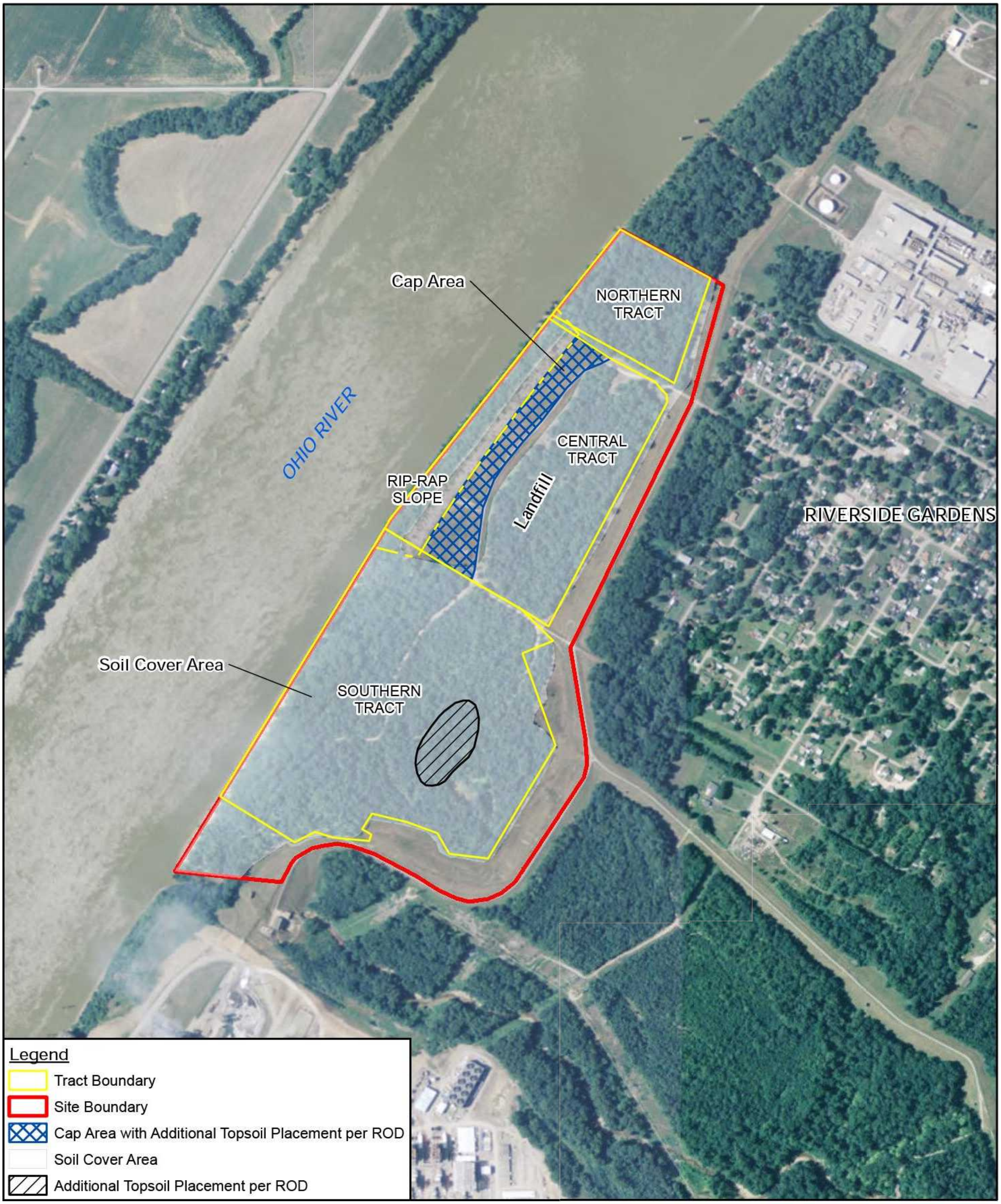
LEE'S LANE LANDFILL
LOUISVILLE, KY

089257
Dec 1, 2015

GROUNDWATER CONTOURS
5-28-14 DATA

FIGURE 2.1

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\002\089257-01(002)GIS-WA004.mxd



Aerial Image: NAIP Imagery of Kentucky, 2014 – U.S. Department of Agriculture (USDA) Farm Service Agency, Aerial Photography Field Office.

0 325 650 975

Feet

Coordinate System:
NAD 1983 StatePlane Kentucky
FIPS 1600 Feet

LEE'S LANE LANDFILL
LOUISVILLE, KY

089257
Dec 1, 2015

CAP AREA VS. SOIL COVER AREA

FIGURE 3.1

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\002\089257-01(002)GIS-WA011.mxd

Aerial Image: NAIP Imagery of Kentucky, 2014 – U.S. Department of Agriculture (USDA) Farm Service Agency, Aerial Photography Field Office.

0 300 600 900

Feet

Coordinate System:
NAD 1983 StatePlane Kentucky
FIPS 1600 Feet

LEE'S LANE LANDFILL
LOUISVILLE, KY

MAP OF SAMPLE LOCATIONS
NEAR EXPOSED WASTE BASED ON
2011 AND 2013 SAMPLE ROUNDS

089257
Dec 1, 2015

FIGURE 3.2

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\002\089257-01(002)GIS-WA008.mxd

Aerial Image: NAIP Imagery of Kentucky, 2014 – U.S. Department of Agriculture (USDA) Farm Service Agency, Aerial Photography Field Office.

0 325 650 975
Feet

Coordinate System:
NAD 1983 StatePlane Kentucky
FIPS 1600 Feet

N

LEE'S LANE LANDFILL
LOUISVILLE, KY

089257
Dec 1, 2015

2011 AND 2013 SOIL SAMPLE LOCATIONS

FIGURE 4.1

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\002\089257-01(002)GIS-WA002.mxd

Aerial Image: NAIP Imagery of Kentucky, 2014 – U.S. Department of Agriculture (USDA) Farm Service Agency, Aerial Photography Field Office.

0 300 600 900
Feet

Coordinate System:
NAD 1983 StatePlane Kentucky
FIPS 1600 Feet

N

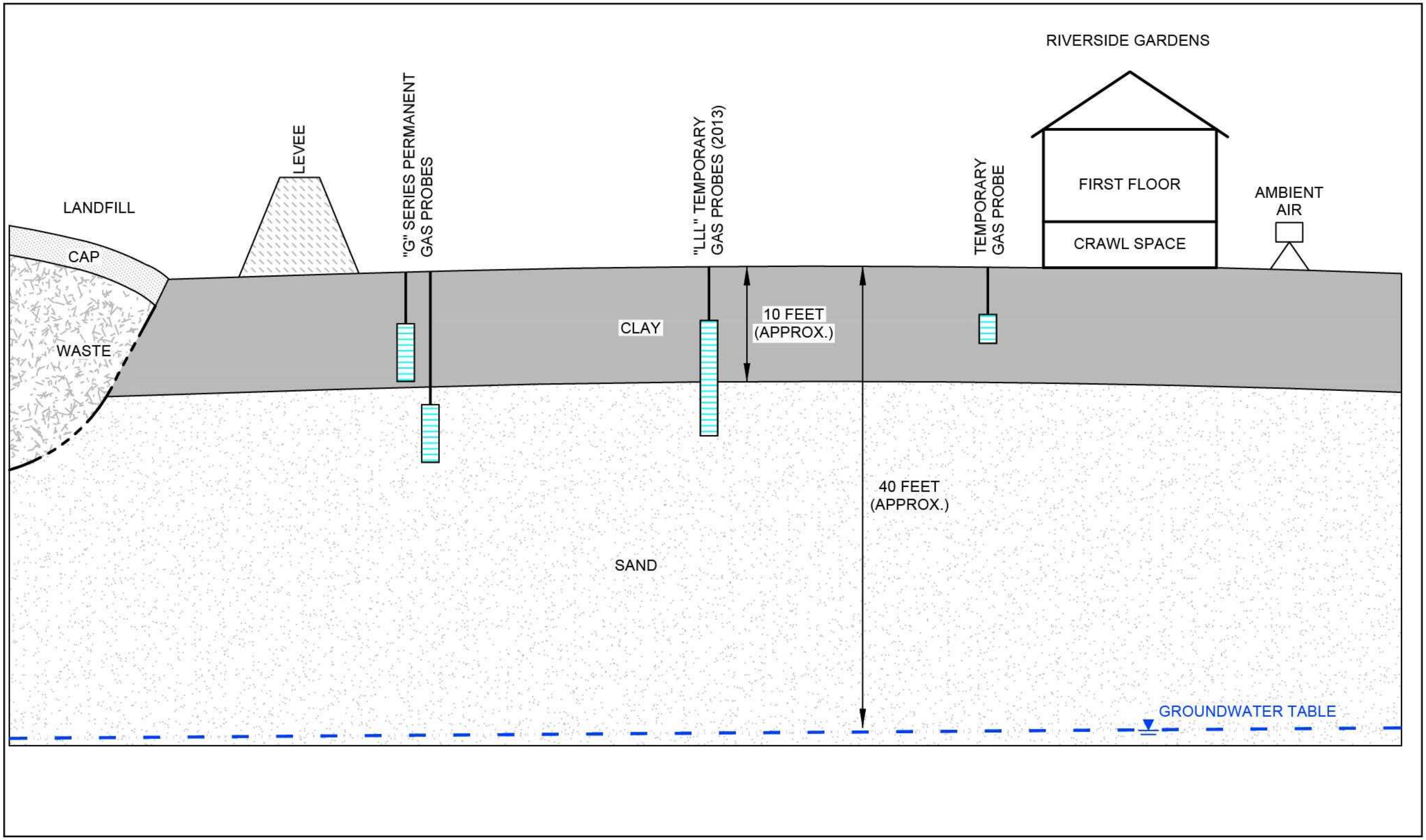
LEE'S LANE LANDFILL
LOUISVILLE, KY

089257
Dec 1, 2015

GAS PROBE LOCATIONS

FIGURE 5.1

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\002\089257-01(002)GIS-WA005.mxd



NOT TO SCALE

LEE'S LANE LANDFILL
LOUISVILLE, KY

SCHEMATIC CROSS-SECTION OF
SOIL GAS AND VI SAMPLING LOCATIONS

89257-00

Nov 20, 2015

FIGURE 6.1

CAD File: P:\drawings\89000s\89257\89257-REPORTS\89257-00(002)\89257-00(002)GN\89257-00(002)GN-WA001.dwg

Aerial Image: NAIP Imagery of Kentucky, 2014 – U.S. Department of Agriculture (USDA) Farm Service Agency, Aerial Photography Field Office.

0 300 600 900
Feet

Coordinate System:
NAD 1983 StatePlane Kentucky
FIPS 1600 Feet

N

LEE'S LANE LANDFILL
LOUISVILLE, KY

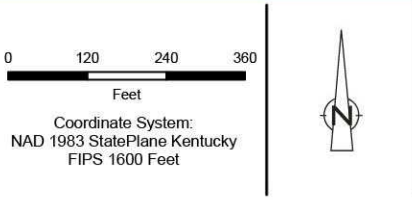
SOIL GAS AND
VI SAMPLING LOCATIONS
(PROBE AND AMBIENT)

089257
Dec 1, 2015

FIGURE 6.2

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\002\089257-01(002)GIS-WA006.mxd

Source: NAIP Imagery of Kentucky, 2014 – U.S. Department of Agriculture (USDA) Farm Service Agency, Aerial Photography Field Office.



Coordinate System:
NAD 1983 StatePlane Kentucky
FIPS 1600 Feet

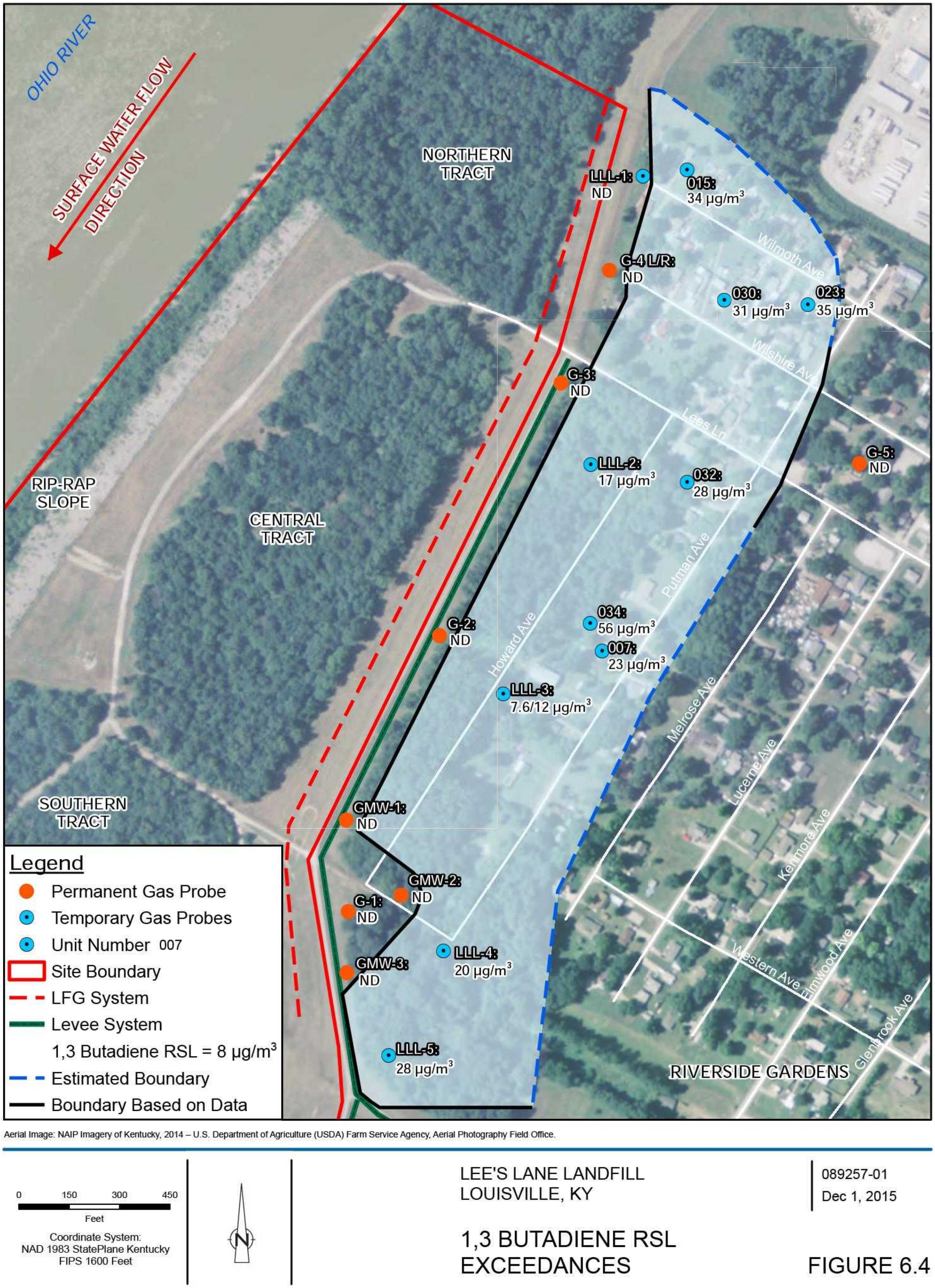
LEE'S LANE LANDFILL
LOUISVILLE, KY

089257-01
Feb 29, 2016

CARBON TETRACHLORIDE RSL MAXIMUM VALUES

FIGURE 6.3

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\003\089257-01(003)GIS-WA003.mxd



Aerial Image: NAIP Imagery of Kentucky, 2014 – U.S. Department of Agriculture (USDA) Farm Service Agency, Aerial Photography Field Office.

Coordinate System:
NAD 1983 StatePlane Kentucky
FIPS 1600 Feet

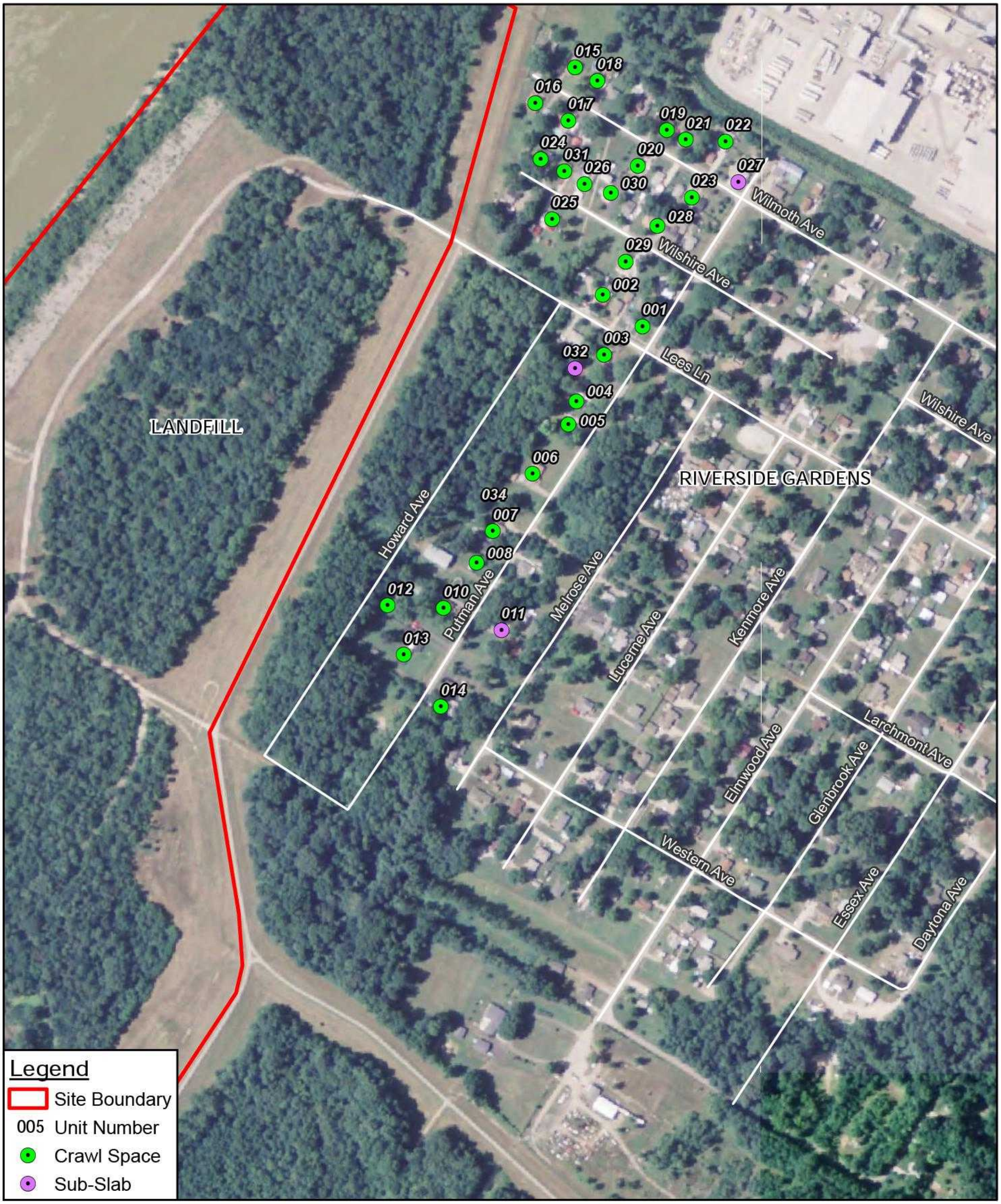
LEE'S LANE LANDFILL
LOUISVILLE, KY

089257-01
Dec 1, 2015

1,3 BUTADIENE RSL EXCEEDANCES

FIGURE 6.4

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\003\089257-01(003)GIS-WA002.mxd



Aerial Image: NAIP Imagery of Kentucky, 2014 – U.S. Department of Agriculture (USDA) Farm Service Agency, Aerial Photography Field Office.

0 150 300 450
Feet

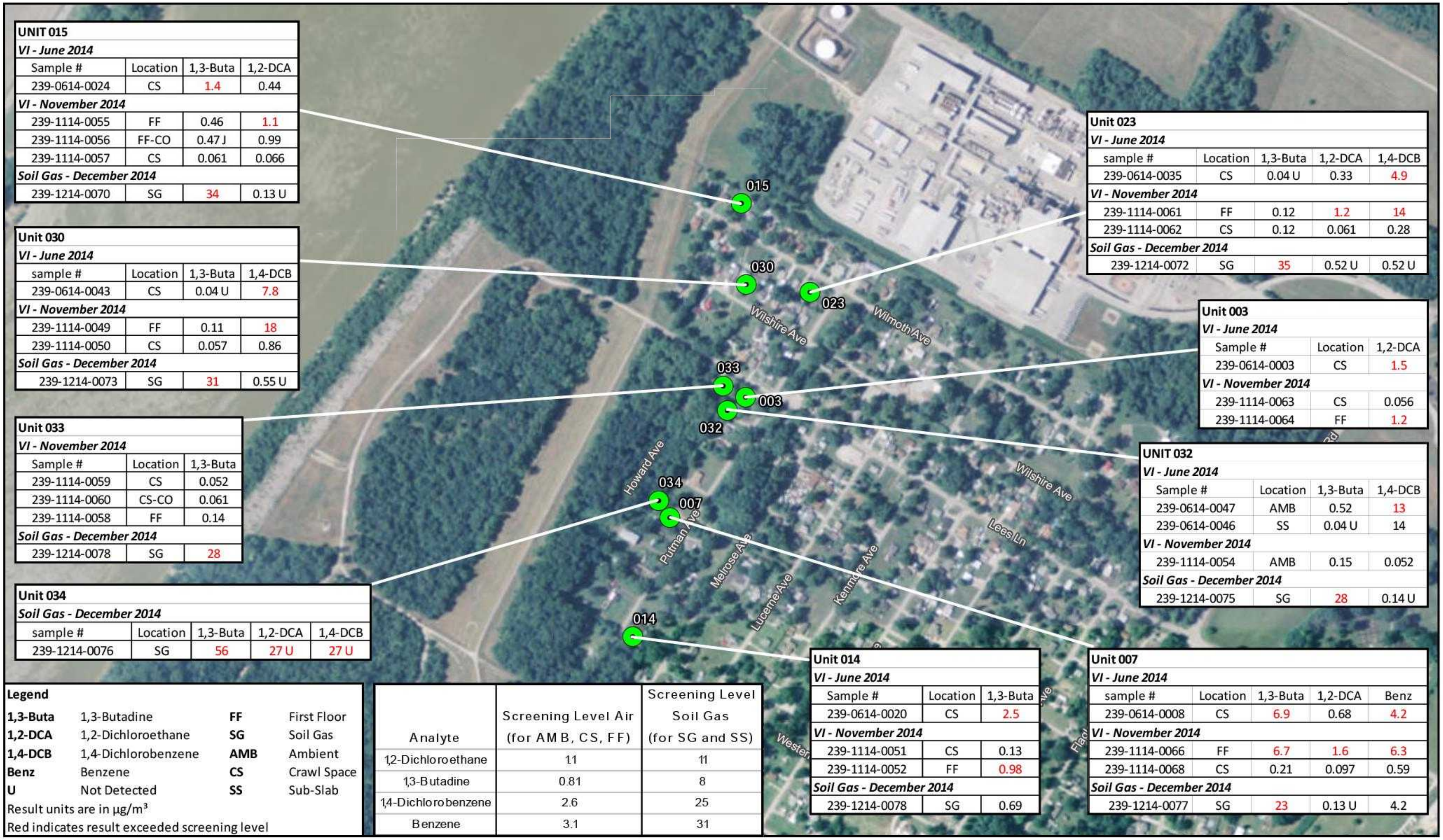
Coordinate System:
NAD 1983 StatePlane Kentucky
FIPS 1600 Feet

LEE'S LANE LANDFILL
LOUISVILLE, KY

089257
Dec 1, 2015

SUB-SLAB AND CRAWL SPACE
SAMPLE LOCATIONS - JUNE 2014 FIGURE 6.5

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\002\089257-01(002)GIS-WA007.mxd



UNIT 015

Sample #	Location	1,3-Buta	1,2-DCA
VI - June 2014			
239-0614-0024	CS	1.4	0.44
VI - November 2014			
239-1114-0055	FF	0.46	1.1
239-1114-0056	FF-CO	0.47 J	0.99
239-1114-0057	CS	0.061	0.066
Soil Gas - December 2014			
239-1214-0070	SG	34	0.13 U

Unit 030

sample #	Location	1,3-Buta	1,4-DCB
VI - June 2014			
239-0614-0043	CS	0.04 U	7.8
VI - November 2014			
239-1114-0049	FF	0.11	18
239-1114-0050	CS	0.057	0.86
Soil Gas - December 2014			
239-1214-0073	SG	31	0.55 U

Unit 033

Sample #	Location	1,3-Buta
VI - November 2014		
239-1114-0059	CS	0.052
239-1114-0060	CS-CO	0.061
239-1114-0058	FF	0.14
Soil Gas - December 2014		
239-1214-0078	SG	28

Unit 034

sample #	Location	1,3-Buta	1,2-DCA	1,4-DCB
Soil Gas - December 2014				
239-1214-0076	SG	56	27 U	27 U

Unit 023

sample #	Location	1,3-Buta	1,2-DCA	1,4-DCB
VI - June 2014				
239-0614-0035	CS	0.04 U	0.33	4.9
VI - November 2014				
239-1114-0061	FF	0.12	1.2	14
239-1114-0062	CS	0.12	0.061	0.28
Soil Gas - December 2014				
239-1214-0072	SG	35	0.52 U	0.52 U

Unit 003

Sample #	Location	1,2-DCA
VI - June 2014		
239-0614-0003	CS	1.5
VI - November 2014		
239-1114-0063	CS	0.056
239-1114-0064	FF	1.2

UNIT 032

Sample #	Location	1,3-Buta	1,4-DCB
VI - June 2014			
239-0614-0047	AMB	0.52	13
239-0614-0046	SS	0.04 U	14
VI - November 2014			
239-1114-0054	AMB	0.15	0.052
Soil Gas - December 2014			
239-1214-0075	SG	28	0.14 U

Unit 014

Sample #	Location	1,3-Buta
VI - June 2014		
239-0614-0020	CS	2.5
VI - November 2014		
239-1114-0051	CS	0.13
239-1114-0052	FF	0.98
Soil Gas - December 2014		
239-1214-0078	SG	0.69

Unit 007

sample #	Location	1,3-Buta	1,2-DCA	Benz
VI - June 2014				
239-0614-0008	CS	6.9	0.68	4.2
VI - November 2014				
239-1114-0066	FF	6.7	1.6	6.3
239-1114-0068	CS	0.21	0.097	0.59
Soil Gas - December 2014				
239-1214-0077	SG	23	0.13 U	4.2

Legend

1,3-Buta	1,3-Butadine	**FF**	First Floor
1,2-DCA	1,2-Dichloroethane	**SG**	Soil Gas
1,4-DCB	1,4-Dichlorobenzene	**AMB**	Ambient
Benz	Benzene	**CS**	Crawl Space
U	Not Detected	**SS**	Sub-Slab

Result units are in µg/m³

Red indicates result exceeded screening level

Analyte	Screening Level Air (for AMB, CS, FF)	Screening Level Soil Gas (for SG and SS)
1,2-Dichloroethane	1.1	11
1,3-Butadine	0.81	8
1,4-Dichlorobenzene	2.6	25
Benzene	3.1	31

Aerial Image: ESRI Basemap Imagery, Acquisition Date Unknown, Accessed 2015;

0 250 500 750

Feet

Coordinate System:
NAD 1983 StatePlane Kentucky
FIPS 1600 Feet

N

LEE'S LANE LANDFILL
LOUISVILLE, KY

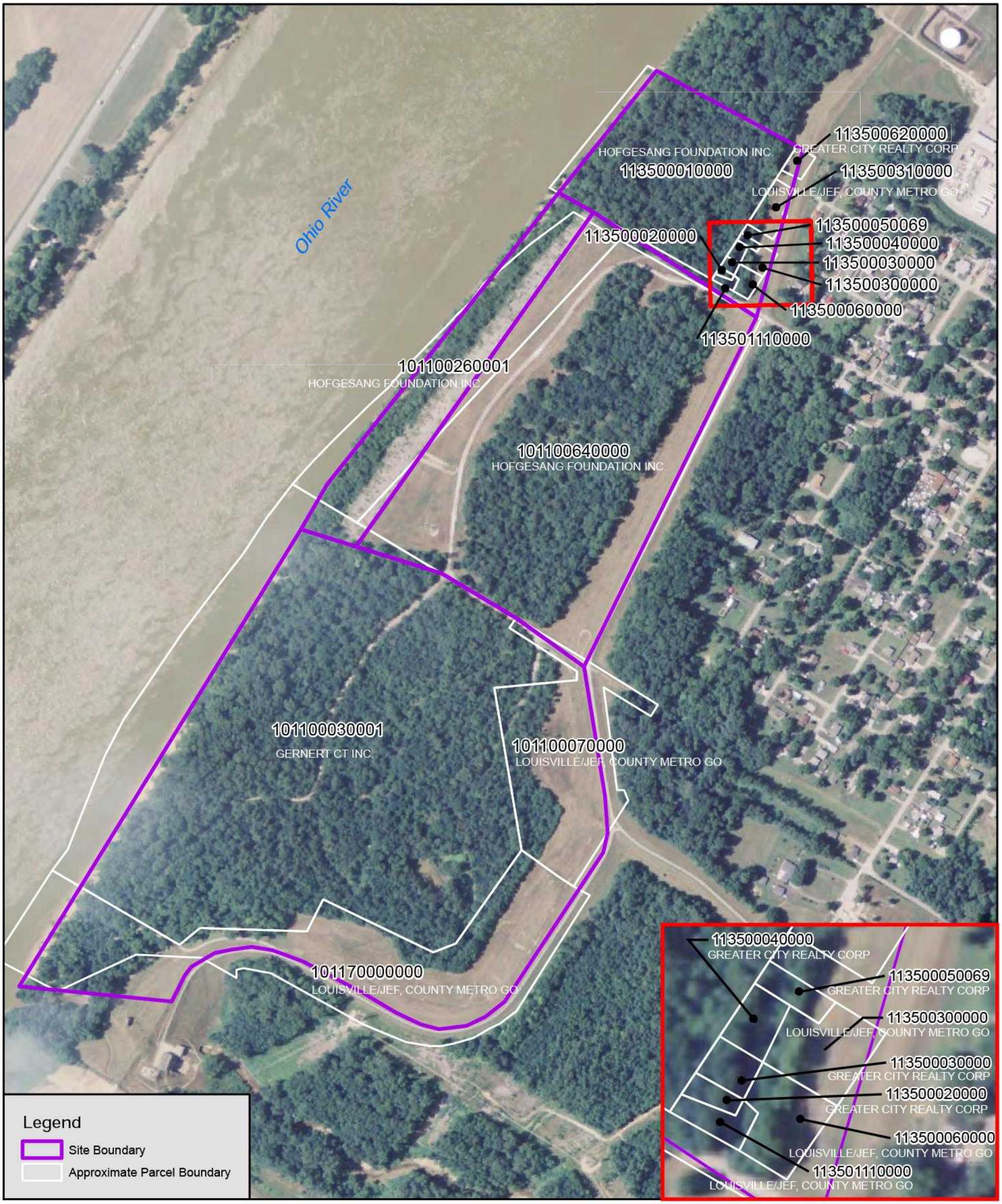
089257

Dec 1, 2015

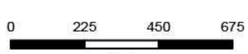
COPY SUMMARY OF EPA VI RESULTS - NOVEMBER 2014

FIGURE 6.6

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\002\089257-01(002)GIS-WA003.mxd



Aerial Image: NAIP Imagery of Kentucky, 2014 – U.S. Department of Agriculture (USDA) Farm Service Agency, Aerial Photography Field Office.



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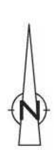


LEE'S LANE LANDFILL
LOUISVILLE, KY

089257
Dec 1, 2015

PROPERTY OWNERSHIP MAP

FIGURE 8.1

GIS File: Q:\GIS\PROJECTS\89000s\89257\Layouts\001\089257-00(001)GIS-WA001.mxd

Tables

Table 1.1

Chronology of Site Events
Lee's Lane Landfill Site
Louisville, Kentucky

Event	Date
Residents complained of flash fires around water heaters due to migration of methane gas from the landfill	1975
EPA conducted initial site inspection	November 1978
LFG collection system installed	October 1980
Site listed on NPL	September 1983
Remedial Investigation/Feasibility Study (RI/FS) begins	September 1983
State preliminary assessment	August 1984
EPA Health Assessment	November 1985
EPA completed combined RI/FS and EPA Record of Decision	September 1986
EPA began remedial action	March 1987
EPA began remedial design	March 1987
EPA completed remedial action	October 1987
EPA completed close-out report	March 1988
EPA completed remedial design	March 1988
EPA began second removal	September 1988
EPA completed second removal	September 1988
EPA signed an Administrative Order on Consent which transferred Operation & Maintenance (O&M) to the Metropolitan Sewer District (MSD)	July 1991
EPA First Five Year Report (FYR)	May 1993
Consent decrees entered by court	August 1993
Oversight of MSD's O&M transferred to Kentucky Environmental and Public Protection Cabinet (KEPPC)	April 1994
Site deleted from the NPL	April 1996
Consent Decree in the matter of United States v. Ben Hardy, et al.	January 1997
EPA Second FYR	July1998
Louisville and Jefferson County merged	January 2003
EPA Third FYR	July 2003
EPA Fourth FYR	September 2008
Surface Soil Sampling by EPA	April 2011
EPA Fifth FYR	September 2013
Surface Soil Sampling by KDEP	April 2013
Subsurface Gas Sampling by EPA	June 2013
EPA letter to PRPs requesting involvement at Site	January 2014
PRPs Meet to Discuss Site	March 2014
EPA issues Special Notice Letter	December 2014
Installation of MW101 through MW105 and Groundwater Sampling	2014-2015
Vapor Intrusion Sampling in Riverside Gardens	2014-2015
MSD Ground Water Samples	March 2015
PRPs, EPA, KDEP Meeting to Discuss Site	April 2015
Vapor Intrusion Sampling in Riverside Gardens	June 2015
Vapor Intrusion Sampling in Riverside Gardens	July 2015
KYDEP Ground Water Sampling	July 2015
MSD Ground Water Samples	September 2015

Table 2.1

Summary of Historical Alternate Concentration Limits (ACLs) and Groundwater Cleanup Goals
Lee's Lane Landfill Site
Louisville, Kentucky

Contaminant of Concern (COC)	Units	Alternate Concentration Limit (ACL) (EPA, 2008)	Groundwater Cleanup Goal (EPA, 2013b)
Arsenic	µg/L	11,000	10
Barium	µg/L	2,200,000	2,000
Beryllium	µg/L	4,400	4
Cadmium	µg/L	3,300	5
Chromium	µg/L	12,100	100
Copper	µg/L	13,200	1,300
Iron	µg/L	1,100,000	24,000
Lead	µg/L	3,960	15
Manganese	µg/L	55,000	900
Mercury	µg/L	1,000	2
Selenium	µg/L	5,500	50
Zinc	µg/L	174,900	10,000
Benzene	µg/L	2,420	5

Note:

EPA - Environmental Protection Agency
µg/L - micrograms per liter

Table 2.2

Comparison of Monitoring Well Results in Riverside Gardens to Groundwater Cleanup Goals
Lee's Lane Landfill Site
Louisville, Kentucky

Contaminant of Concern:		**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Total Chromium**	**Copper**	**Iron**	**Lead**	**Manganese**	**Mercury**	**Selenium**	**Zinc**	**Benzene**
Groundwater Cleanup Goal:		**10**	**2,000**	**4**	**5**	**100**	**1,300**	**24,000**	**15**	**900**	**2**	**50**	**10,000**	**5**
Units:		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-A	Sept. 2006	<5.0	23	<4.0	<5.0	<10.0	<10.0	<20.0	<5.0	<10.0	<0.20	<5.0	<20.0	<5.0
	Sept. 2005	<5.0	23	<4.0	<5.0	<10.0	<10.0	52	<5.0	17	<0.20	<5.0	<20.0	<5.0
	Sept. 2004	<5.0	20	<4.0	<5.0	<10.0	<10.0	49	<5.0	14	<0.20	<5.0	<20.0	<5.0
MW-B	Sept. 2006	<5.0/<5.0	23/21	<4.0/<4.0	<5.0/<5.0	<10.0/<10.0	<10.0/<10.0	120/140	<5.0/<5.0	480/480	<0.20/<0.20	<5.0/<5.0	<20.0/<20.0	<5.0/<5.0
	Sept. 2005	<5.0	17	<4.0	<5.0	63	<10.0	1,900	<5.0	320	<0.20	<5.0	<20.0	<5.0
	Sept. 2004	<5.0	19	<4.0	<5.0	32	<10.0	1,900	<5.0	560	<0.20	<5.0	<20.0	<5.0
MW-2	Sept. 2006	<5.0	220	<4.0	<5.0	<10.0	<10.0	5,400	<5.0	210	<0.20	<5.0	<20.0	<5.0
	Sept. 2005	<5.0	210	<4.0	<5.0	<10.0	<10.0	5,200	<5.0	220	<0.20	<5.0	<20.0	<5.0
	Sept. 2004	<5.0	200	<4.0	<5.0	<10.0	<10.0	4,700	<5.0	210	<0.20	<5.0	<20.0	<5.0

Notes:

µg/L - micrograms per liter
< - below detection limit

Table 2.3

Comparison of Results at Landfill Monitoring Wells to ACLs and Groundwater Cleanup Goals
Lee's Lane Landfill Site
Louisville, Kentucky

	Contaminant of Concern:	Arsenic	Barium	Beryllium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Selenium	Zinc	Benzene
	Historical Alternate Concentration Limit (ACL):	**11,000**	**2,200,000**	**4,400**	**3,300**	**12,100**	**13,200**	**1,100,000**	**3,960**	**55,000**	**1,000**	**5,500**	**174,900**	**2,420**
	2013 Groundwater Cleanup Goal:	**10**	**2,000**	**4**	**5**	**100**	**1,300**	**24,000**	**15**	**900**	**2**	**50**	**10,000**	**5**
	Units:	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
MW-4	November 2012	<5.0/<5.0	160/160	<4.0/<4.0	<5.0/<5.0	<10.0/<10.0	<10.0/<10.0	7,800/7,600	<5.0/7.5	210/190	<0.20<0.20	<5.0/<5.0	<20.0/<20.0	<1.0/<1.0
	September 2013	10/11	170/180	<4.0/<4.0	<5.0/<5.0	<10.0/<10.0	<10.0/<10.0	8,500/8,500	<5.0/<5.0	210/210	<0.20<0.20	<5.0/<5.0	<20.0/<20.0	<1.0/<1.0
	October 2014	5.9/15	180/170	<4.0/<4.0	<5.0/<5.0	<10.0/<10.0	<10.0/<10.0	8,900/8,500	<5.0/<5.0	230/220	<0.20<0.20	<5.0/<5.0	<20.0/<20.0	<1.0/<1.0
	September 2015	10.3/10.3	153/155	<5.0/<5.0	<5.0/<5.0	<10.0/<10.0	<20.0/<20.0	7,840/8,040	<5.0/<5.0	201/202	<10.0/<10.0	<5.0/<5.0	<20.0/<20.0	<1.0/<1.0
MW-5	November 2012	45	1,900	<4.0	<5.0	<10.0	<10.0	13,000	<5.0	400	<0.20	<5.0	<20.0	<1.0
	September 2013	42	1,300	<4.0	<5.0	<10.0	<10.0	8,900	<5.0	300	<0.20	<5.0	<20.0	<1.0
	October 2014	38	1,600	<4.0	<5.0	<10.0	<10.0	12,000	<5.0	340	<0.20	<5.0	<20.0	<1.0
	September 2015	23.4	384	<5.0	<5.0	<10.0	<20.0	5,380	<5.0	180	<10.0	<5.0	<20.0	<1.0
MW-101	June 2014	<1.9	110	<4.0	<5.0	<10.0	<20.0	910	<10.0	1,600	NA	<50.0	13	<0.50
	March 2015	1.2J/ND	80/81	<4.0/<4.0	<5.0/<5.0	<10.0/<10.0	<20.0/<20.0	180/170	<10.0/<10.0	270/370	NA	<50.0/<50.0	<10.0/<10.0	<0.5/<0.5
	July 2015	5.8 J/6.9J	140/170	NA	0.36 J/0.54 J	3.8/5.3	NA	NA	11	NA	<0.2/<0.2	2.1 J/1.9 J	NA	<0.5/<0.5
MW-102	June 2014	5.9J	160	<4.0	<5.0	<10.0	<20.0	2,900	<10.0	500	NA	<50.0	<10.0	<0.50
	March 2015	14	240	<4.0	<5.0	<10.0	<20.0	6300	<10.0	470	NA	<50.0	<10.0	<0.50
	July 2015	270	2200	NA	1.1	10	NA	NA	41	NA	NA	1	NA	<0.50
MW-103	June 2014	9.2J	550	<4.0	<5.0	<10.0	<20.0	8,400	<10.0	1,600	NA	<50.0	11	<0.50
	March 2015	19	1200	<4.0	<5.0	<10.0	<20.0	15000	<10.0	760	NA	<50.0	<10.0	<0.50
	July 2015	29	1100	NA	4	7.8	NA	NA	25	NA	NA	0.62	NA	<0.50
MW-104	June 2014	270/260	310/310	<4.0/<4.0	<5.0/<5.0	<10.0/<10.0	<20.0/<20.0	21,000/21,000	<10.0/<10.0	1,100/1,100	NA	<50.0/<50.0	20/20	<0.50/<0.50
	March 2015	250	480	<4.0	<5.0	<10.0	<20.0	29000	<10.0	1000	NA	<50.0	14	<5.0
	July 2015	300	740	NA	1.9	32	NA	NA	130	NA	1.6	1.9 J	NA	<0.50
MW-105	June 2014	8.2J	190	<4.0	<5.0	<10.0	<20.0	17,000	<10.0	7,300	NA	<50.0	13	<0.50
	March 2015	2.7	580	<4.0	<5.0	<10.0	<20.0	6,300	<10.0	4,200	NA	<50.0	<10.0	<0.50
	July 2015	16	1,100	NA	0.36 J	<0.60	NA	NA	17	NA	<0.2	0.95 J	NA	<0.50

Notes:

NA - Not Analyzed
J - Estimated values
µg/L - micrograms per liter
< - below detection limit

Table 4.1

Subsurface Soil Sampling Results - April 2011
Lee's Lane Landfill Site
Louisville, Kentucky

			April 2011 Soil Sampling Results (SMG Results)						April 2011 Soil Sampling Results (EPA Results)				
Station ID			**LL01**	**LL02**	**LL03**	**LL03**	**LL04**		**LL01**	**LL02**	**LL03**	**LL03**	**LL04**
Sample ID			LL01	LL02	LL03	LL03Dup	LL04		LL01	LL02	LL03	LL03Dup	LL04
Sample Depth Interval (ft bgs)													
Matrix		**Recreational/Trespasser**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**		**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
Sample Date		**Risk Screening Level**	4/6/2011	4/6/2011	4/6/2011	4/6/2011	4/6/2011		4/6/2011	4/6/2011	4/6/2011	4/6/2011	4/6/2011
Analyte	**Units**												
PCB-1248 (Aroclor 1248)	mg/kg	1.8	ND	ND	ND	ND	ND		ND	ND	ND	ND	ND
PCB-1254 (Aroclor 1254)	mg/kg	1.8	ND	ND	ND	ND	0.16		0.025 J	0.041 J	0.086 J	0.046 J	0.21 J
Benzo(a)pyrene	mg/kg	0.12	0.10	ND	ND	ND	0.11		0.11	ND	0.48	ND	0.28
Benzo(a)anthracene	mg/kg	1.2	0.09	ND	ND	ND	0.13		0.10	ND	0.37	ND	0.24
Benzo(k)fluoranthene	mg/kg	12	0.08	ND	ND	ND	0.10		0.11	ND	0.47	ND	0.25
Dibenzo(a,h)anthracene	mg/kg	0.12	ND	ND	ND	ND	ND		ND	ND	0.076	ND	0.053
Bis(2-ethylhexyl)phthalate	mg/kg	276	ND	0.76	ND	ND	0.42		0.54	ND	ND	ND	ND
Arsenic	mg/kg	3.7 - 16.0 (1)	8.13	8.41	6.44	6.33	6.88		3.6	3.1	3.1	4.5	2.9
Lead	mg/kg	400	88.3	63.9	57.9	24.6	263		84	57	210J	320	230
Thallium	mg/kg	5.5	--	--	--	--	--		ND	ND	ND	ND	ND
Chromium	mg/kg		17.9	21.3	13.9	12.5	49.0		18	19	16	16	21
Copper	mg/kg		--	--	--	--	--		32	32	36	23	43
Nickel	mg/kg		--	--	--	--	--		43	31	20	20	230
Mercury	mg/kg		--	--	--	--	--		0.14	0.30	2.3	0.15	0.23
Zinc	mg/kg		--	--	--	--	--		180	170	0.430	170	530

Notes:

Semi-volatiles, VOC and PCB/Pesticides were screened against residential criteria by KDEP and only parameters with residential exceedances are shown. EPA and KDEP did not provide an electronic data base, so a qualitative review of the lab sheets was conducted and it was determined that these parameter groups had very few detections and did not warrant further ecological review other than the parameters that exceeded residential criteria. A similar exercise was completed for metals. However, copper, chromium and nickel were added regardless of concentration at the request of EPA.

NA - Not Analyzed
ND - Non Detect
(1) Arsenic data was evaluated using Kentucky's Ambient Background Guidance Assessment documents
(2) Duplicate Sample
[shaded] Exceedance of screening level

Table 4.2

Subsurface Soil Sampling Results - April 2013
Lee's Lane Landfill Site
Louisville, Kentucky

			April 2013 Soil Sampling Results																	
Station ID																				
Sample ID			N001	N001Dup	N001	N002	N003	N005	C001	C002	C003	C004	C005	C006	C006Dup	C006	C007	C008	C009	C010
Sample Depth Interval (ft bgs)			0-0.5	0-0.5	0.5-1.0	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0.5-2.0	0-0.5	0-0.5	0-0.5	0-0.5
Matrix			**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
Sample Date		**Recreational/Trespass**																		
Analyte	**Units**	**Risk Screening Level**																		
PCB-1248 (Aroclor 1248)	mg/kg	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1254 (Aroclor 1254)	mg/kg	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.30	ND	ND	0.21	ND	ND	ND	ND
Benzo(a)pyrene	mg/kg	0.12	0.043	0.035	0.028	ND	0.064	ND	0.060	ND	0.14	ND	0.31	0.068	0.085	0.048	0.084	0.075	ND	0.037
Benzo(a)anthracene	mg/kg	1.2	0.048	0.035	ND	0.031	0.064	ND	0.054	ND	0.14	ND	0.098	0.061	0.076	0.048	0.063	0.073	ND	0.047
Benzo(k)fluoranthene	mg/kg	12	0.77	ND	ND	ND	0.036	ND	0.034	ND	0.087	ND	0.087	0.045	0.044	ND	0.048	0.066	ND	ND
Dibenzo(a,h)anthracene	mg/kg	0.12	ND	ND	ND	ND	ND	ND	ND	ND	0.14	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate	mg/kg	276	0.38	0.2	ND	0.10	0.05	0.11	0.051	0.034	0.027	0.11	0.9	0.4	0.61	0.23	ND	0.96	0.21	ND
Dieldrin	mg/kg	0.24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	mg/kg	3.7 - 16.0 [1]	3.7	3.8	--	--	--	--	--	--	--	7.3	--	5.1	5.5	--	--	--	--	--
Lead	mg/kg	400	43	36	--	--	--	--	--	--	--	14	--	37	39	--	--	--	--	--
Thallium	mg/kg	5.5	ND	ND	--	--	--	--	--	--	--	<1.0	--	<0.99	1.1	--	--	--	--	--
Chromium	mg/kg		270	200	--	--	--	--	--	--	--	14	--	14	13	--	--	--	--	--
Copper	mg/kg		81	79	--	--	--	--	--	--	--	14	--	13	13	--	--	--	--	--
Nickel	mg/kg		53	63	--	--	--	--	--	--	--	17	--	14	15	--	--	--	--	--
Mercury	mg/kg		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/kg		180									54		65						

Table 4.2

Subsurface Soil Sampling Results - April 2013
Lee's Lane Landfill Site
Louisville, Kentucky

			April 2013 Soil Sampling Results															
	Station ID																	
	Sample ID		S001	S002	S003	S003	S004	S005	S006	S007	S008	S009	S010	S011	S014	S014Dup	S015	S016
	Sample Depth Interval (ft bgs)		0.0.5	0.0.5	0.0.5	0.5-2.0	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5
	Matrix		**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
	Sample Date	**Recreational/Trespass**																
Analyte	**Units**	**Risk Screening Level**																
PCB-1248 (Aroclor 1248)	mg/kg	1.8	ND	ND	ND	ND	ND	28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1254 (Aroclor 1254)	mg/kg	1.8	ND	ND	0.045	ND	ND	ND	ND	0.12	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	mg/kg	0.12	0.079	0.066	ND	ND	0.064	4	0.044	0.082	ND	ND	0.045	ND	3.4	5.1	ND	0.087
Benzo(a)anthracene	mg/kg	1.2	0.087	0.078	ND	ND	0.072	0.72	ND	0.068	ND	ND	0.044	ND	4.6	5.9	ND	0.091
Benzo(k)fluoranthene	mg/kg	12	0.049	0.035	ND	ND	0.04	ND	0.035	0.052	ND	ND	0.034	ND	ND	2.1	ND	0.053
Dibenzo(a,h)anthracene	mg/kg	0.12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.22	0.10	ND	ND
Bis(2-ethylhexyl)phthalate	mg/kg	276	0.17	0.27	0.11	0.11	0.12	350	1.3	9.9	0.54	0.11	0.23	0.054	ND	ND	0.13	0.55
Dieldrin	mg/kg	0.24	ND	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	mg/kg	3.7 - 16.0 (1)	--	--	--	--	--	--	--	--	--	--	--	--	7.9	16	--	--
Lead	mg/kg	400	--	--	--	--	--	--	--	--	--	--	--	--	380	1300	--	--
Thallium	mg/kg	5.5	--	--	--	--	--	--	--	--	--	--	--	--	ND	2.8	--	--
Chromium	mg/kg		--	--	--	--	--	--	--	--	--	--	--	--	36	43	--	--
Copper	mg/kg		--	--	--	--	--	--	--	--	--	--	--	--	240	260	--	--
Nickel	mg/kg		--	--	--	--	--	--	--	--	--	--	--	--	37	46	--	--
Mercury	mg/kg		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/kg														480			

Notes:
Semi-volatiles, VOC and PCB/Pesticides were screened against residential criteria by KDEP and only parameters with residential exceedances are shown. EPA and KDEP did not provide an electronic data base, so a qualititative review of the lab sheets was conducted and it was determined that these parameter groups had very few detections and did not warrant further ecological review other than the parameters that exceeded residential criteria. A similar exercise was completed for metals. However, copper, chromium and nickel were added regarless of concentration at the request of EPA.

NA - Not Analyzed
ND - Non Detect
(1) Arsenic data was evaluated using Kentucky's Ambient Background Guidance Assessment documents
[shaded] Exceedance of screening level

Table 5.1

Methane Concentrations at Gas Probes
Lee's Lane Landfill Site
Louisville, Kentucky

Kentucky Action Level is 5% of LEL which is 50,000 ppmV

Location: Date	G-1 Methane (ppmV)	G-2 Methane (ppmV)	G-3 Methane (ppmV)	G-4 Methane (ppmV)	G-5L Methane (ppmV)	G-5R Methane (ppmV)	GMW-1 Methane (ppmV)	GMW-2 Methane (ppmV)	GMW-3 Methane (ppmV)
4/23/2015	0.781	152	0.781	0.787	0.784	0.777	0.777	1.56	20,411
9/25/2014	ND	ND	ND	ND	ND	ND	0.813	1.52	ND
4/23/2014	ND	ND	ND	ND	ND	0.993	ND	1.24	2,376
9/26/2013	2.1	2.1	1.6	1.8	2.2	2.1	1.9	3.7	2.3
4/25/2013	1.27	1.47	1.65	2.24	1.71	2.38	1.54	1.86	2.31
9/28/2012	10.80	1.56	2.24	2.30	2.08	1.53	1.70	1.83	2.04
4/24/2012	8.93	12.70	3.43	2.25	2.02	1.77	1.24	1.60	11.80
9/27/2011	2.73	2.84	2.22	2.10	2.21	2.46	1.91	2.47	2.29
4/28/2011	9.28	105	4.07	2.47	4.67	3.17	2.76	3.12	296
9/25/2010	5.20	4.36	3.24	5.87	3.98	3.66			
4/30/2010	103	22.50	3.46	1.56	2.52	1.62			
9/25/2009	3.53	11.40	1.75	4.02	1.74	1.35			
4/22/2009	4.19	1.51	2.18	4.22	3.88	2.70			
9/24/2008	699	2.90	1.41	1.26	3.36	1.87			
4/17/2008	24.50	1.41	2.09	2.18	3.41	2.59			
11/5/2007	7,150	2.48	2.54	2.62	3.73	2.42			
4/27/2007	**86,900**	52.10	6.85	1.54	5.30	3.77			
9/15/2006	**64,400***	4.17	5.55	3.28	6.64	6.76			
4/25/2006	**13,700**	2.93	5.72	1.84	6.61	5.91			
9/30/2005	**57,900**	12.50	12.90	15.90	16.30	NA			
4/1/2005	**170,000**	5.10	7.50	1,130	5.80	5.40			
9/22/2004	161	12.40	13.50	13.80	12.30	11.80			
9/18/2003	65.50	13.20	12.80	12.00	11.20	1.00			
4/21/2003	156	15.60	9.38	20.80	10.90	11.40			
4/12/1999	NA	8.20	13.10	17.00	14.10	13.10			
9/17/1999	0.12	16.20	17.20	16.90	12.10	15.50			
3/12/1999	NA	8.20	13.10	17.00	14.10	13.10			
9/8/1998	2.08	7.27	7.46	5.70	7.32	4.61			
7/8/1998	**185,000**	3.51	5.54	2.86	NA	NA			
4/28/1998	0.21	1,200	1.23	1.72	0.16	0.58			
12/17/1997	**192,000**	5.71	3.32	2.98	ND	5.33			
9/24/1997	NA	NA	2.67	3.26	1.74	1.11			
6/25/1997	0.16	4.98	5.03	4.81	4.60	2.85			
5/14/1997	7,983	1,930	4.21	3.56	2.53	2.74			
12/12/1996	798	4.31	4.86	2.19	3.68	4.07			
9/24/1996	1.80	0.87	0.89	0.88	0.82	2.09			
5/22/1996	ND	5.56	4.24	3.08	3.36	10.97			
3/6/1996	51.84	2.62	1.94	1.92	1.89	2.77			
12/11/1995	4.05	1.73	2.37	4.25	1.87	6.10			
9/30/1995	2.72	ND	3.88	3.24	2.39	2.09			
6/28/1995	2.85	2.94	2.90	NA	3.99	3.01			
3/22/1995	2.82	1.11	2.49	2.82	2.46	2.46			
9/13/1994	3.11	3.63	3.73	3.39	1.29	2.87			
6/8/1994	1,052	0.89	0.86	2.52	2.10	1.87			
8/24/1993	1.70	0.05	1.40	0.57	0.92	2.30			
5/25/1993	2.08	2.06	0.84	1.98	1.24	1.97			
2/23/1993	4.80	3.60	4.30	7.40	5.00	3.30			

Notes:

NA - Not analyzed
ND - Non detect results
LEL - Lower explosive limit
ppmV - Parts per million by volume
* - Dilution Factor for G1 = 33.4346
Exceedances for Kentucky Action Level is 5% of LEL which is 50,000 pomp are shown in bold with shading

Table 5.2

Methane Results from Vapor Intrusion Studies
Lee's Lane Landfill Site
Louisville, Kentucky

Location	Date	Screen Interval (feet below ground)	Methane (ppmV)	Lower Explosive Limit for Methane (ppmv)
Temporary Gas Probes Between Landfill and Riverside Gardens				
LLL-1	June 2013	6 - 24	<4.2	50,000
LLL-2	June 2013	6 - 24	<4.2	50,000
LLL-3	June 2013	6 - 24	<4.2	50,000
LLL-4	June 2013	6 - 24	<4.2	50,000
LLL-5	June 2013	6 - 24	<4.2	50,000
Temporary Gas Probes Next to Residences*				
Unit 07	Jul. 2015	6 - 8	0.16 U	50,000
	Jun. 2015	6 - 8	7.9 U	50,000
	Dec. 2014	6 - 8	7.2	50,000
Unit 14	Jul. 2015	6 - 8	0.16 U	50,000
	Jun. 2015	6 - 8	8.5 U	50,000
	Dec. 2014	6 - 8	2	50,000
Unit 15	Jul. 2015	6 - 8	NS	50,000
	Jun. 2015	6 - 8	8.9	50,000
	Dec. 2014	6 - 8	9.4	50,000
Unit 23	Jul. 2015	6 - 8	NS	50,000
	Jun. 2015	6 - 8	3.7	50,000
	Dec. 2014	6 - 8	8.2	50,000
Unit 30	Jul. 2015	6 - 8	0.13 U	50,000
	Jun. 2015	6 - 8	6.4	50,000
	Dec. 2014	6 - 8	8.6	50,000
Unit 32	Jul. 2015	6 - 8	NS	50,000
	Jun. 2015	6 - 8	0.82 U	50,000
	Dec. 2014	6 - 8	12	50,000
Unit 33	Jul. 2015	6 - 8	NS	50,000
	Jun. 2015	6 - 8	5.9	50,000
	Dec. 2014	6 - 8	9	50,000
Unit 34	Jul. 2015	6 - 8	NS	50,000
	Jun. 2015	6 - 8	480	50,000
	Dec. 2014	6 - 8	21	50,000

Note:

*EPA reported to GHD that the December 2014 gas probes were placed 6 to 8 feet below ground surface (verbally)
June 2015 results are suspect due to QA/QC (helium) detection
ppmV - Parts per million by volume
< - below detection limit
U - non detect
NS - not sampled

Table 6.1

EPA Screening Levels for VI Study
Lee's Lane Landfill Site
Louisville, Kentucky

VOC	EPA Screening Level for Ambient Air, Crawl Space, First Floor (µg/m^3)	EPA Screening Level for Ambient Air, Crawl Space, First Floor (ppbV)	EPA Screening Level for Soil Gas (µg/m^3)	EPA Screening Level for Soil Gas (ppbV)
1,2-Dichloroethane	1.1		11	
1,3-Butadiene	0.81		8.0	
1,4-Dichlorobenzene	2.5	0.4	25	4.2
Benzene	3.1	1.0	31	9.7
Carbon Tetrachloride	4.1	0.7	41	6.5
Chloroform	1.1	0.2	11	2.3
Dibromochloromethane	1.04		10.4	
Ethylbenzene	11	2.5	110	25.4
Tetrachloroethylene	42	6.2	420	62.1
Trichloroethylene	2.1	0.4	21	3.9
Vinyl chloride	1.61	0.6	16.1	6.3
1,2,4-Trimethylbenzene	73		730	
1,1,1-Trichloroethane	52,000	9,512	520,000	95,116
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	310,000		3,100,000	
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	NS		NS	
1,3,5-Trimethylbenzene	NS		NS	
1,3-Dichlorobenzene	NS		NS	
2-Butanone (MEK)	52,000		520,000	
2-Hexanone (MBK)	310		3,100	
4-Ethyltoluene	NS		NS	
4-Methyl-2-pentanone (MIBK)	31,000		310,000	
Acetone	320,000		3,200,000	
Chlorobenzene	520		5,200	
Chloroethane	NS		NS	
Chloromethane	940	455	9,400	4,548
Cyclohexane	63,000		630,000	
Dichlorodifluoromethane (Freon 12)	1,000	203	10,000	2,027
Ethyl Acetate	730		7,300	
Heptane	NS		NS	
Hexane	7,300		73,000	
Isopropanol	73,000		730,000	
m&p-Xylene	1,000	230	10,000	2,299
Methyl tert-Butyl Ether (MTBE)	110		1,100	
Methylene Chloride	1,000	288	10,000	2,884
o-Xylene	1,000	231	10,000	2,309
Propene	31,000		310,000	
Styrene	10,000		100,000	
Tetrahydrofuran	NS		NS	
Toluene	52,000	13,804	520,000	138,041
Trichlorofluoromethane (Freon 11)	7,300	1,296	73,000	12,959

Notes:

EPA Screening levels for indoor air were provided by EPA Region 4 based on a
target cancer risk of 1 x 10-5 and a Hazard Quotient of 1.0 for non-carcinogens (Lockheed Martin, 2014).
Soil gas screening levels were 10x the indoor screening levels
NS - No Standard
VOCs without RSLs not included
ppbV - parts per billion by volume
µg/m^3 - micrograms per cubic meter of air

Table 6.2

VOC Results at Gas Probes
Lee's Lane Landfill Site
Louisville, Kentucky

Location	Compound	1,1,1-Trichloroethane	1,4-Dichlorobenzene	Benzene	Carbon tetrachloride	Chloroform	Chloromethane	Dichlorodifluoromethane	Ethylbenzene	Tetrachloroethene	Toluene	Trichloroethene	Trichlorofluoromethane	Vinyl chloride
	Screening Level (ppbV)	95,122	4.17	9.71	6.5	2.3	4,548	2,027	25.38	62.10	138,053	3.91	12,959	6.30
G-1	4/23/2015	0.191	NA	0.0846	ND	**3.52**	ND	1.27	ND	37.1	0.594	0.464	0.17	NA
	9/25/2014	0.202	ND	~~21~~	ND	**5.58**	0.561	0.693	~~0.539~~	36	~~3.58~~	0.543	0.234	0.199
	4/23/2014	ND	ND	0.331	ND	**9.23**	ND	0.924	ND	36.9	1.34	0.635	ND	ND
	9/26/2013	0.234	ND	0.0328	0.00798	**14.9**	0.602	0.77	ND	60.8	2.56	0.743	0.327	ND
	4/25/2013	0.195	ND	ND	ND	**21.1**	ND	0.813	0.0232	49.3	0.693	0.729	0.202	NA
	9/28/2012	0.125	0.237	0.96	0.0725	**17.4**	2.68	0.532	NA	35.2	2	1.07	0.283	4.9
G-2	4/23/2015	ND	NA	0.0958	ND	0.487	ND	0.546	ND	0.232	0.576	ND	0.0838	NA
	9/25/2014	1.26	ND	~~0.353~~	ND	ND	0.768	4.53	ND	36	~~0.316~~	ND	0.934	ND
	4/23/2014	0.698	ND	ND	ND	ND	ND	5.25	ND	4.15	0.329	ND	0.629	ND
	9/26/2013	0.907	ND	0.00893	0.0221	ND	0.134	3.82	ND	8.04	1.04	ND	0.743	ND
	4/25/2013	0.834	ND	ND	ND	0.0332	ND	6.83	ND	5.25	0.177	ND	0.83	NA
	9/28/2012	1.32	ND	ND	0.0239	0.0104	0.148	3.6	NA	11.6	0.0698	ND	0.82	ND
G-3	4/23/2015	0.92	NA	ND	ND	ND	ND	1.39	ND	1.42	0.203	ND	0.418	NA
	9/25/2014	2.5	ND	0.151	ND	ND	ND	1.21	ND	7.32	~~1.97~~	ND	0.681	ND
	4/23/2014	2.51	ND	ND	ND	ND	ND	1.19	ND	8.12	2.24	ND	0.514	ND
	9/26/2013	1.71	ND	ND	0.0639	ND	0.223	1.24	ND	2.65	0.678	ND	0.612	NA
	4/25/2013	3.08	ND	ND	0.041	ND	ND	1.62	ND	11.5	0.152	ND	0.675	NA
	9/28/2012	1.43	ND	ND	0.0273	ND	0.116	0.59	NA	2.26	0.135	ND	0.406	ND
G-4	4/23/2015	13.3	NA	ND	**772**	**10.5**	0.256	3.06	ND	17.2	1.14	ND	0.635	NA
	9/25/2014	26.4	ND	~~1.01~~	**1,019**	**21.4**	0.734	5.3	~~0.222~~	21.3	~~2.3~~	ND	1.22	ND
	4/23/2014	23.33	ND	ND	**1,268**	**20.6**	ND	5.12	ND	21.2	2.08	ND	0.866	ND
	9/26/2013	30.2	ND	ND	**2,500**	**27.7**	0.401	7.81	ND	31.9	3.27	0.0641	1.25	ND
	4/25/2013	16.3	0.00792	0.0528	**1,520**	**15.6**	0.272	4.83	ND	15.9	0.12	0.0585	0.694	NA
	9/28/2012	3.56	ND	ND	**262**	15.8	0.143	1.01	NA	2.23	0.0749	ND	0.469	ND
G-5L	4/23/2015	0.156	NA	ND	0.129	ND	ND	0.563	ND	0.386	0.114	ND	0.291	NA
	9/25/2014	0.142	ND	~~8.92~~	ND	ND	ND	0.528	~~0.783~~	0.135	~~1.67~~	0.248	0.357	ND
	4/23/2014	ND	ND	ND	ND	ND	ND	0.552	ND	ND	ND	ND	0.258	0.443
	9/26/2013	0.0644	ND	ND	0.0328	0.0951	0.154	0.541	ND	0.366	0.251	ND	0.328	ND
	4/25/2013	0.0602	ND	0.0476	0.141	0.0497	0.16	0.527	ND	0.0752	0.14	ND	0.275	NA
	9/28/2012	0.062	ND	ND	0.0973	ND	0.239	0.45	NA	0.0508	0.187	ND	0.299	0.0289
G-5R	4/23/2015	0.417	NA	0.0747	1.06	ND	ND	0.657	ND	0.169	1.27	ND	0.339	NA
	9/25/2014	0.527	ND	~~5.25~~	0.153	ND	0.17	0.637	~~0.152~~	0.818	~~2.02~~	ND	0.412	ND
	4/23/2014	0.298	ND	ND	ND	ND	0.432	0.548	ND	ND	1.45	ND	0.259	ND
	9/26/2013	0.399	ND	0.0262	0.107	ND	0.579	0.642	ND	0.542	2.43	ND	0.395	ND
	4/25/2013	0.299	ND	0.0311	0.106	ND	0.218	0.58	ND	0.227	0.18	ND	0.302	NA
	9/28/2012	0.538	ND	ND	0.0471	ND	0.183	0.485	NA	0.404	0.131	ND	0.389	0.0586
GMW-1	4/23/2015	0.216	NA	0.078	ND	0.358	0.426	1.54	ND	32.8	ND	0.402	0.244	NA
	9/25/2014	0.719	ND	~~16.6~~	ND	**3.56**	0.765	1.51	~~0.484~~	**99.6**	~~2.24~~	0.846	0.347	ND
	4/23/2014	ND	ND	0.412	ND	0.534	ND	1.67	ND	36	ND	ND	ND	ND
	9/26/2013	0.707	ND	0.132	ND	**2.8**	1.33	2.04	ND	**251**	0.456	1.19	0.372	ND
	4/25/2013	0.247	ND	0.0713	0.0107	1.12	0.568	1.87	ND	**66.5**	0.155	0.228	0.257	NA
	9/28/2012	0.526	ND	0.122	ND	26.5	1.65	0.951	NA	**177**	0.0692	0.914	0.318	ND
GMW-2	4/23/2015	ND	NA	0.1	0.0735	ND	0.307	0.499	ND	4.86	0.164	ND	0.242	NA
	9/25/2014	0.086	ND	~~4.5~~	0.089	0.363	0.661	0.548	~~0.288~~	13.4	~~0.729~~	ND	0.299	ND
	4/23/2014	ND	ND	0.395	ND	ND	ND	0.565	ND	14.2	0.372	ND	0.27	ND
	9/26/2013	0.0553	ND	0.0641	0.126	0.372	0.805	0.542	ND	19.1	1.26	ND	0.308	ND
	4/25/2013	0.166	ND	0.0401	0.0196	0.471	0.555	0.774	ND	25.8	0.259	ND	0.328	NA
	9/28/2012	0.409	ND	ND	0.0616	0.519	1.07	0.501	NA	**89.3**	0.0782	0.0992	0.359	ND
GMW-3	4/23/2015	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	9/25/2014	NA	ND	0.154	0.185	ND	1.22	1.16	ND	ND	0.276	ND	ND	ND
	4/23/2014	ND	ND	ND	ND	0.477	ND	1.56	ND	2.54	ND	ND	ND	ND
	9/26/2013	ND	ND	ND	0.0706	0.652	0.517	0.562	ND	7.47	0.272	0.0296	0.285	ND
	4/25/2013	ND	ND	0.0449	0.0292	0.365	0.53	1.2	ND	5.63	0.587	ND	0.178	NA
	9/28/2012	ND	ND	ND	0.0655	0.62	1.11	0.44	NA	13.5	0.376	0.212	0.277	ND

Notes:

ND - Non Detect
NA - Not analyzed
VOCs without RSLs not included
ppbV - parts per billion by volume
Soil Gas exceedances for EPA screening levels are shown in bold with shading.
~~value~~ = results identified as potentially anomalous by URS

Table 6.3

VOC Results in Ambient Air
Lee's Lane Landfill Site
Louisville, Kentucky

Location	Compound	Benzene	Carbon tetrachloride	Chloroform	Chloromethane	Dichlorodifluoromethane	Ethylbenzene	Methylene chloride	Toluene	Trichlorofluoromethane	o-Xylene	m-Xylene & p-Xylene
	Screening Level (ppbV)	1.0	0.7	0.2	455	203	2.5	288	13,804	1,296	231	230
A1	4/23/2015	ND	ND	NA	0.583	0.48	NA	0.135	ND	0.203	ND	ND
	9/25/2014	~~15.5~~	0.102	0.119	0.979	0.525	~~0.298~~	1.22	~~2.95~~	0.252	~~0.273~~	~~0.388~~
	4/23/2014	ND	ND	ND	ND	0.522	ND	1.04	0.36	ND	ND	ND
	9/26/2013	0.154	0.119	**0.279**	0.618	0.542	ND	0.226	1.16	0.288	0.0401	0.0836
	4/25/2013	0.109	0.131	ND	0.678	0.549	ND	0.168	0.227	0.252	ND	ND
	9/28/2012	0.14	0.125	0.026	0.632	0.526		0.096	0.631	0.267	0.0221	0.0613
A2	4/23/2015	ND	ND	NA	0.623	0.472	NA	0.152	ND	0.201	ND	ND
	9/25/2014	~~12.8~~	0.112	0.105	0.914	0.562	~~0.256~~	1.34	~~2.85~~	0.265	~~0.231~~	~~0.357~~
	4/23/2014	ND	ND	ND	ND	0.513	ND	1.3	0.459	ND	ND	ND
	9/26/2013	0.178	0.094	**0.306**	0.58	0.543	ND	0.21	2.96	0.279	0.0712	0.12
	4/25/2013	0.118	0.12	ND	0.651	0.56	ND	0.134	0.497	0.265	0.0172	0.0196
	9/28/2012	0.0983	0.124	ND	0.576	0.543	NA	0.072	0.407	0.272	ND	ND
U1	4/23/2015	0.186/0.0939	**0.905**/ND	NA	0.662/0.586	0.567/0.48	NA	0.476/0.2	0.981/0.114	0.243/0.209	0.0926/ND	0.216/ND
	12/29/2014	0.369/0.196	0.0905/0.0934	ND/ND	0.562/0.731	0.548/0.628	ND/ND	1.21/1.35	0.228/0.249	0.245/0.281	ND/ND	ND/0.154
	4/23/2014	ND	ND	ND	ND	0.552	ND	1.35	0.421	ND	ND	ND
	9/26/2013	0.151	0.119	**0.244**	0.575	0.557	0.0596	0.339	7.84	0.29	0.0827	0.173
	4/25/2013	0.107	0.11	ND	0.65	0.532	ND	0.128	0.551	0.259	ND	ND
	9/28/2012	ND	0.12	ND	0.588	0.535	NA	0.165	0.498	0.282	ND	ND
U2	4/23/2015	0.109	ND	NA	0.633	0.498	NA	0.158	2.63	0.216	ND	ND
	9/25/2014	~~39.5~~	0.0926	**0.895**	0.655	0.575	~~0.539~~	1.27	~~5.97~~	0.271	~~0.251~~	~~0.396~~
	4/23/2014	ND	ND	ND	ND	0.534	ND	1.01	0.398	ND	ND	ND
	9/26/2013	0.187	0.115	**0.614**	0.538	0.54	ND	0.098	1.33	0.28	ND	ND
	4/25/2013	0.109	0.132	ND	0.64	0.555	0.0244	0.121	1	0.252	0.0432	0.074
	9/28/2012	ND	0.132	ND	0.607	0.543	NA	0.051	0.358	0.293	ND	ND
R1	4/23/2015	0.0898	ND	NA	0.722	0.505	NA	0.125	ND	0.196	ND	ND
	9/25/2014	~~11.8~~	0.834	0.111	0.619	0.549	~~0.26~~	1.12	~~3.25~~	0.263	~~0.226~~	~~0.408~~
	4/23/2014	ND	ND	ND	ND	0.545	ND	1.03	ND	ND	ND	ND
	9/26/2013	0.176	0.13	**0.509**	0.556	0.533	ND	0.114	2.15	0.278	0.0633	0.129
	4/25/2013	0.118	0.151	ND	0.644	0.532	ND	0.13	0.737	0.244	0.032	0.0683
	9/28/2012	0.139	0.15	0.037	0.673	0.551	NA	0.093	0.519	0.275	0.0473	0.0314
R2	4/23/2015	0.0877/0.0828	ND/ND	NA	0.595/0.581	0.466/0.448	NA	0.172/0.128	ND/ND	0.194/0.2	ND/ND	ND/ND
	12/29/2014	0.201/0.226	0.103/0.116	ND/ND	0.579/0.533	0.573/0.562	ND/ND	1.41/1.45	0.186/0.161	0.268/0.312	ND/ND	ND/ND
	4/23/2014	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	9/26/2013	0.124	0.133	0.171	0.564	0.554	NS	0.147	2.53	0.298	NS	0.0589
	4/25/2013	0.104	0.135	ND	0.686	0.532	ND	0.0867	0.492	0.251	0.0317	0.0522
	9/28/2012	ND	0.135	ND	0.605	0.532	NA	0.075	0.379	0.278	ND	ND
R3	4/23/2015	0.0855/0.364	ND/ND	NA	0.548/0.578	0.448/0.465	NA	0.193/0.117	ND/ND	0.208/ND	ND/ND	ND/ND
	12/29/2014	0.207/0.184	0.0985/0.0973	ND/ND	0.537/0.620	0.575/0.542	ND/ND	1.34/1.33	0.227/0.258	0.260/0.259	ND/ND	ND/ND
	4/23/2014	ND	ND	ND	ND	0.522	ND	1.59	ND	ND	ND	ND
	9/26/2013	0.107	0.103	0.164	0.572	0.576	ND	0.184	2.53	0.277	0.0124	0.0488
	4/25/2013	0.0818	0.134	0.037	0.645	0.531	ND	0.143	0.646	0.255	ND	ND
	9/28/2012	ND	0.132	ND	0.757	0.527	NA	0.066	0.326	0.275	ND	ND

Notes:

ND - Non Detect
NA - Not Analyzed
NS - Not Sampled
Only detected VOCs shown and VOCs without RSLs not included
ppbV - parts per billion by volume
Ambient air exceedances for EPA screening levels are shown in bold with shading
~~value~~ = results identified as potentially anomalous by URS
Exceedances for EPA regional screening levels are shown in bold with shading

Table 6.4

VOC Results for Gas Probes 2013
Lee's Lane Landfill Site
Louisville, Kentucky

		Station ID	**G-1L**	**G-1R**	**G-2L**	**G-2R**	**G-3L**	**G-3R**	**G-4L**	**G-4R**	**G-5L**	**G-5R**	**GMW-1**	**GMW-2**	**GMW-2**	**GMW-3**
		Sample #	**G1LSG0613**	**G1RSG0613**	**G2LSG0613**	**G2RSG0613**	**G3LSG0613**	**G3RSG0613**	**G4LSG0613**	**G4RSG0613**	**G5LSG0613**	**G5RSG0613**	**GM W1SG0613**	**GMW2SG0613**	**W2SSG0613**	**GMW3SG0613**
		Sample Depth Interval (ft bgs)	**30 - 40**	**5 - 15**	**30 - 40**	**5 - 15**	**30 - 40**	**5 - 15**	**5 - 15**	**30 - 40**	**5 - 15**	**30 - 40**	**4.85 - 20.14**	**4.51 - 20.20**	**4.51 - 20.20**	**4.96 - 20.15**
		Matrix	**Soil Gas**	**Soil Gas**	**Soil Gas**	**Soil Gas**	**Soil Gas**	**Soil Gas**	**Soil Gas**	**Soil Gas**	**Soil Gas**	**Soil Gas**	**Soil Gas**	**Soil Gas**	**Soil Gas Split**	**Soil Gas**
		Sample Date	**6/5/2013**	**6/5/2013 15:18**	**6/5/2013 17:46**	**6/5/2013 17:30**	**6/6/2013 9:10**	**6/6/2013 9:06**	**6/6/2013 11:17**	**6/6/2013 12:15**	**6/6/2013 13:02**	**6/6/2013 12:56**	**6/5/2013 11:55**	**6/5/2013 12:34**	**6/5/2013 12:34**	**6/5/2013 14:50**
Analyte	**Units**	**Regional Screening Level**														
Methane	ppmV	**50,000**	5.9	< 4.4 U	< 4.5 U	< 4.5 U	< 4.2 U	< 4.4 U	< 4.3 U	< 4.3 U	< 4.3 U	< 4.2 U	< 4.2 U	< 4.2 U	< 4.2 U	< 4.3 U
(m- and/or p-)Xylene	$\mu g/m^3$	**10,000**	< 42 U	< 4.2 U	< 4.2 U	< 4.2 U	0.34 J,O	< 4.1 U	< 4.0 U	< 120 U	< 4.0 U	< 3.9 U	< 40 U	< 40 U	< 40 U	< 40 U
1,1,1-Trichloroethane	$\mu g/m^3$	**520,000**	< 26 U	< 2.6 U	1.6 J,O	6.4	0.97 J,O	7.6	0.28 J,O	170	0.84 J,O	1.4 J,O	1.7 J,O	< 25 U	< 25 U	< 25 U
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	$\mu g/m^3$	**3,100,000**	< 36 U	0.51 J,O	0.58 J,O	0.76 J,O	0.91 J,O	0.62 J,O	0.60 J,O	< 100 U	0.56 J,O	0.80 J,O	< 34 U	< 34 U	< 34 U	< 34 U
1,2,4-Trimethylbenzene	$\mu g/m^3$	**730**	< 23 U	< 2.3 U	< 2.3 U	< 2.3 U	< 2.2 U	< 2.3 U	0.34 J,O	< 66 U	< 2.2 U	< 2.2 U	< 22 U	< 22 U	< 22 U	< 22 U
1,3-Butadiene	$\mu g/m^3$	**8**	< 22 U	< 2.1 U	< 2.1 U	< 2.1 U	< 2.0 U	< 2.1 U	< 2.1 U	< 61 U	< 2.1 U	< 2.0 U	< 20 U	< 20 U	< 20 U	< 21 U
1,4-Dichlorobenzene	$\mu g/m^3$	**25**	< 29 U	< 2.9 U	< 2.9 U	< 2.9 U	< 2.7 U	< 2.8 U	0.24 J,O	< 82 U	< 2.8 U	0.44 J,O	< 27 U	< 27 U	< 27 U	< 28 U
Acetone	$\mu g/m^3$	**3,200,000**	< 19 U	8.9 J,O	9.4	18	18	4.7	35 J,O	< 33 U	< 4.7 U	3.1	< 11 U,O	18	13	15
Benzene	$\mu g/m^3$	**31**	< 15 U	< 1.5 U	< 1.5 U	< 1.5 U	0.40 J,O	< 1.5 U	0.28 J,O	< 43 U	< 1.5 U	0.27 J,O	< 14 U	< 14 U	< 14 U	< 15 U
Carbon Tetrachloride	$\mu g/m^3$	**41**	< 30 U	< 2.9 U	0.25 J,O	< 2.9 U	0.48 J,O	0.22 J,O	8.8	**20,000**	< 2.8 U	0.36 J,O	< 28 U	< 28 U	< 28 U	< 28 U
Chloroform	$\mu g/m^3$	**11**	**92**	0.87 J,O	6.9	< 2.3 U	0.34 J,O	< 2.2 U	0.54 J,O	**140**	0.77 J,O	< 2.1 U	9.5 J,O	1.3 J,O	1.5 J,O	3.9 J,O
Chloromethane	$\mu g/m^3$	**9,400**	< 9.7 U	< 0.96 U	< 0.96 U	< 0.96 U	2.8	< 0.94 U	1.8	< 27 U	< 0.92 U	0.57 J,O	< 9.1 U	< 9.1 U	< 9.1 U	< 9.2 U
Cyclohexane	$\mu g/m^3$	**630,000**	1.8 J,O	< 1.7 U	< 1.7 U	< 1.7 U	< 1.6 U	< 1.7 U	< 1.6 U	< 49 U	< 1.6 U	< 1.6 U	< 16 U	< 16 U	< 16 U	< 16 U
Dichlorodifluoromethane (Freon 12)	$\mu g/m^3$	**10,000**	4.5 J,O	4.0 J,O	16	42	3.2	6.5	2.9	45 J,O	3.1	3.2	11 J,O	3.6 J,O	3.0 J,O	8.6 J,O
Ethyl Benzene	$\mu g/m^3$	**110**	< 21 U	< 2.1 U	< 2.1 U	< 2.1 U	< 2.0 U	< 2.0 U	< 2.0 U	< 59 U	< 2.0 U	< 2.0 U	< 20 U	< 20 U	< 20 U	< 20 U
Hexane	$\mu g/m^3$	**73,000**	< 17 U	< 1.7 U	< 1.7 U	< 1.7 U	< 1.6 U	< 1.7 U	< 1.6 U	< 49 U	< 1.6 U	< 1.6 U	< 16 U	< 16 U	< 16 U	< 16 U
Isopropanol	$\mu g/m^3$	**730,000**	170 J,O	< 1.2 U,J,O	< 1.2 U,J,O	< 1.2 U,J,O	< 1.1 U,J,O	< 1.2 U,J,O	0.64 J,O	< 34 U,J,O	< 1.2 U,J,O	< 1.1 U,J,O	16 J,O	< 11 U,J,O	< 11 U,J,O	< 12 U,J,O
Methyl Butyl Ketone	$\mu g/m^3$	**3,100**	< 20 U	< 2.0 U	< 2.0 U	< 2.0 U	< 1.9 U	< 2.0 U	< 1.9 U	< 57 U	< 1.9 U	< 1.9 U	< 19 U	< 19 U	< 19 U	< 19 U
Methyl Ethyl Ketone	$\mu g/m^3$	**520,000**	< 15 U	2.8 J,O	1.5	3.2	2.5	0.48 J,O	4.4	< 41 U	0.71 J,O	0.97 J,O	< 14 U	< 14 U	< 14 U	< 14 U
Methyl Isobutyl Ketone	$\mu g/m^3$	**310,000**	< 20 U	< 2.0 U	< 2.0 U	< 2.0 U	< 1.9 U	< 2.0 U	< 1.9 U	< 57 U	< 1.9 U	< 1.9 U	< 19 U	< 19 U	< 19 U	< 19 U
Methylene Chloride	$\mu g/m^3$	**10,000**	< 16 U	< 1.6 U	< 1.6 U	< 1.6 U	< 1.5 U	< 1.6 U	0.41 J,O	< 47 U	< 1.6 U	< 1.5 U	< 15 U	< 15 U	< 15 U	< 16 U
Styrene	$\mu g/m^3$	**100,000**	< 20 U	< 2.0 U	< 2.0 U	< 2.0 U	< 1.9 U	< 2.0 U	< 1.9 U	< 57 U	< 1.9 U	< 1.9 U	< 19 U	< 19 U	< 19 U	< 19 U
Tetrachloroethene (Tetrachloroethylene)	$\mu g/m^3$	**420**	250	89 J,O	16	49	8.5	9.5	0.39 J,O	160	5.5	1.2 J,O	**560**	210	210	220
Toluene	$\mu g/m^3$	**520,000**	2.5 J,O	0.24 J,O	0.18 J,O	< 1.8 U	1.1 J,O	< 1.8 U	0.32 J,O	< 52 U	< 1.7 U	0.36 J,O	< 17 U	21	20	< 17 U
Trichloroethene (Trichloroethylene)	$\mu g/m^3$	**21**	5.6 J,O	< 2.6 U	< 2.6 U	< 2.6 U	< 2.4 U	< 2.5 U	< 2.5 U	< 74 U	< 2.5 U	< 2.4 U	< 25 U	< 25 U	< 25 U	4.1 J,O
Trichlorofluoromethane (Freon 11)	$\mu g/m^3$	**73,000**	< 27 U	1.5 J,O	2.7	5.5	1.9 J,O	2.7	1.5 J,O	7.0 J,O	1.6 J,O	1.6 J,O	1.5 J,O	1.7 J,O	1.9 J,O	< 25 U
Vinyl chloride	$\mu g/m^3$	**16**	12 J,O	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 1.2 U	< 35 U	< 1.2 U	1.7	< 12 U	< 12 U	< 12 U	< 12 U
o-Xylene	$\mu g/m^3$	**10,000**	< 21 U	< 2.1 U	< 2.1 U	< 2.1 U	< 2.0 U	< 2.1 U	< 2.0 U	< 60 U	< 2.0 U	< 2.0 U	< 20 U	< 20 U	< 20 U	< 20 U

Notes:

1. Exceedances for EPA regional screening levels are shown in bold with shading
2. EPA Screening levels for indoor air were provided by EPA
   Region 4 based on a target cancer risk of 1 x 10-5 and a Hazard
   Quotient of 1.0 for non-carcinogens (Lockheed Martin, 2014)
   Soil gas screening levels were 10x the indoor screening levels
3. Only detected VOCs shown and VOCs without RSLs not included

ppmV - parts per million by volume
$\mu g/m^3$ - micrograms per cubic meter of air
U - The analyte was not detected at or above the reporting limit.
J - estimated value
O - Other data qualifiers
ft bgs - feet below ground surface

Table 6.5

VOC Results for Temporary Gas Probes 2013
Lee's Lane Landfill Site
Louisville, Kentucky

		Station ID	LLL-1	LLL-2	LLL-3	LLL-3	LLL-4	LLL-5
		Sample #	LLL1SG0613	LLL2SG0613	LLL3SG0613	LLL3SSG0613	LLL4SG0613	LLL5SG0613
		Sample Depth Interval (ft bgs)	6 - 24	6 - 24	6 - 24	6 - 24	6 - 24	6 - 24
		Matrix	Soil Gas	Soil Gas	Soil Gas	Soil Gas Split	Soil Gas	Soil Gas
		Sample Date	6/4/2013 13:20	6/4/2013 14:44	6/4/2013 16:04	6/4/2013 16:04	6/4/2013 16:44	6/5/2013 10:23
Analyte	**Units**	**Regional Screening Level**						
Methane	ppmV	**50,000**	< 4.2 U	< 4.2 U	< 4.1 U	< 4.2 U	< 4.1 U	< 4.1 U
(m- and/or p-)Xylene	μg/m³	**10,000**	14 J,O	5.0	4.1 J,O	3.4 J,O	4.9	3.5 J,O
1,1,1-Trichloroethane	μg/m³	**520,000**	100	30	3.8	2.9	6.3	< 12 U
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	μg/m³	**3,100,000**	< 84 U	< 3.4 U	0.89 J,O	0.61 J,O	< 3.3 U	< 17 U
1,2,4-Trimethylbenzene	μg/m³	**730**	3.7 J,O	1.3 J,O	2.2 J,O	1.9 J,O	1.7 J,O	1.8 J,O
1,3-Butadiene	μg/m³	**8**	< 50 U	**17**	**12**	7.6	**20**	**28**
1,4-Dichlorobenzene	μg/m³	**25**	< 67 U	< 2.7 U	< 2.7 U,J,O	< 2.7 U	< 2.7 U	< 13 U,J,O
Acetone	μg/m³	**3,200,000**	120	86	200 J,O	280	140	200 J,O
Benzene	μg/m³	**31**	11 J,O	9.2	7.6	5.7	12	12
Carbon Tetrachloride	μg/m³	**41**	**2,700 J,O**	0.25 J,O	0.81 J,O	< 2.8 U	< 2.7 U	< 14 U
Chloroform	μg/m³	**11**	**160**	< 2.2 U	< 2.1 U	< 2.1 U	3.1	2.7 J,O
Chloromethane	μg/m³	**9,400**	< 22 U	< 0.91 U	0.77 J,O	< 0.90 U	< 0.89 U	< 4.4 U
Cyclohexane	μg/m³	**630,000**	13 J,O	< 1.6 U	7.3	5.9	7.4	4.8 J,O
Dichlorodifluoromethane (Freon 12)	μg/m³	**10,000**	48 J,O	7.0	8.9	6.4	5.1	4.0 J,O
Ethyl Benzene	μg/m³	**110**	6.8 J,O	3.0	2.4 J,O	1.9 J,O	3.0	2.3 J,O
Hexane	μg/m³	**73,000**	35 J,O	25	27	18	8.5	18
Isopropanol	μg/m³	**730,000**	< 28 U,J,O	4.1 J,O	3.2 J,O	2.8 J,O	2.0 J,O	< 5.6 U,J,O
Methyl Butyl Ketone	μg/m³	**3,100**	< 47 U	< 3.3 U,O	2.5	2.6	< 1.9 U	6.5 J,O
Methyl Ethyl Ketone	μg/m³	**520,000**	24 J,O	20	67	46 J,O	32	68
Methyl Isobutyl Ketone	μg/m³	**310,000**	< 47 U	0.57 J,O	1.6 J,O	2.1	0.74 J,O	1.5 J,O
Methylene Chloride	μg/m³	**10,000**	< 38 U	< 1.5 U	< 1.5 U	< 1.5 U	< 1.5 U	< 7.5 U
Styrene	μg/m³	**100,000**	< 47 U	1.7 J,O	1.4 J,O	1.2 J,O	1.8 J,O	1.9 J,O
Tetrachloroethene (PCE)	μg/m³	**420**	120	7.1	9.9	8.8	2.8 J,O	10 J,O
Toluene	μg/m³	**520,000**	19 J,O	14	11	9.2	15	12
Trichloroethene (TCE)	μg/m³	**21**	< 61 U	< 2.5 U	< 2.4 U	< 2.4 U	< 2.4 U	< 12 U
Trichlorofluoromethane (Freon 11)	μg/m³	**73,000**	< 62 U	2.6	1.2 J,O	1.7 J,O	3.0	1.5 J,O
Vinyl chloride	μg/m³	**16**	< 29 U	< 1.2 U	< 1.1 U	< 1.2 U	< 1.1 U	< 5.7 U
o-Xylene	μg/m³	**10,000**	4.2 J,O	2.2	1.7 J,O	1.3 J,O	2.4	1.6 J,O

Notes:

1. Exceedances for EPA screening levels are shown in bold with shading
2. EPA Screening levels for indoor air were provided by EPA
   Region 4 based on a target cancer risk of 1 x 10-5 and a
   Hazard Quotient of 1.0 for non-carcinogens (Lockheed Martin, 2014)
   Soil gas screening levels were 10x the indoor screening levels
3. Only detected VOCs shown and VOCs without RSLs not included

ft bgs - feet below ground surface
ppmv - parts per million by volume
μg/m³ - micrograms per cubic meter of air
U - The analyte was not detected at or above the reporting limit.
J - estimated values
O - Other data qualifiers

Table 6.6

Analytes that Exceeded RSLs - June 2014
Lee's Lane Landfill Site
Louisville, Kentucky

Location	Sub Location	Analyte[2]	Result ($\mu g/m^3$)	Screening Level [1] ($\mu g/m^3$)
Residential Unit 003	Crawl space	1,2-Dichloroethane	1.5	1.08
Residential Unit 007	Crawl space	1,3-Butadiene	6.9	0.811
Residential Unit 014	Crawl space	1,3-Butadiene	2.5	0.811
Residential Unit 015	Crawl space	1,3-Butadiene	1.4	0.811
Residential Unit 023	Crawl space	1,4-Dichlorobenzene	4.9	2.55
Residential Unit 030	Crawl space	1,4-Dichlorobenzene	7.8	2.55
Residential Unit 032	Ambient	1,4-Dichlorobenzene	13	2.55
Residential Unit 007	Crawl space	Benzene	4.2	3.12

Notes:

[1] Provided by EPA Region IV - Regional Screening Level based on Target cancer risk (TR) = IE-05 and target hazard quotient (THQ) = 1.0

[2] Chloroform excluded

$\mu g/m^3$ - micrograms per cubic meter

Table 6.7

Summary of Carbon Tetrachloride Results for Soil Gas Probes
Lee's Lane Landfill Site
Louisville, Kentucky

			G-4*	G-4R	G-4L	LLL-1	Unit 015
		Sample Depth Interval (ft bgs)	--	30-40	5-15	6-24	6-8
			Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
		Sample Date	Fall/Spring	Fall/Spring	Fall/Spring	Jun-13	Jun-15
			Units	Units	Units	Units	Units
Year	**Event**	**Regional Screening Level (µg/m³)**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**
2015	Fall	41					
	Spring	41		**4,856**			**1,800**
2014	Fall	41		**6,410**			
	Spring	41		**7,977**			
2013	Fall	41		**15,727**			
	Spring	41		**9,562**		**2,700 J,O/20,000**	
2012	Fall	41			**1,648**		
	Spring	41			**1,453**		
2011	Fall	41			**2,919**		
	Spring	41		**18,684**			
2010	Fall	41			**51.58**		
	Spring	41		**9,373**			
2009	Fall	41			**198**		
	Spring	41		**78.63**			
2008	Fall	41			**16,671**		
	Spring	41			**26,358**		
2007	Fall	41			**16,922**		
	Spring	41			**8,681**		
2006	Fall	41			**13,714**		
	Spring	41			**25,163**		
2005	Fall	41		5.03			
	Spring	41		**12,330**			
2004	Fall	41		0.94			
	Spring	41		11.95			
2003	Fall	41		**12,078**			
	Spring	41	**32,586**				
2002	Fall	41	**1,931**				
	Spring	41					
2001	Fall	41	2.46				
	Spring	41					
2000	Fall	41					
	Spring	41	**627**				
1999	Fall	41	1.70				
	Spring	41	12.58				
1998	Fall	41	0.88				
	Spring	41	2.96				
1997	Fall	41	1.13				

Notes:

µg/m³ - micrograms per cubic meter of air
J - estimated values
O - Other data qualifiers
* - No record of which probe was sampled (deep or shallow)
Exceedances for EPA regional screening levels are shown in bold with shading

Table 6.8

Summary of 1,3 Butadiene RSL Exceedances in Soil Gas
Lee's Lane Landfill Site
Louisville, Kentucky

		Station ID	LLL-2	LLL-3	LLL-4	LLL-5	Unit 007	Unit 015	Unit 023	Unit 030	Unit 032	Unit 033	Unit 034
		Sample Depth Interval (ft bgs)	30-40	5-15	6-24	6-8	6-8	6-8	6-8	6-8	6-8	6-8	6-8
		Matrix	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Event	**Units**	**Regional Screening Level**											
July 2015	µg/m³	8								16			
June 2015	µg/m³	8							15*	12*		11	
Nov/Dec 2014	µg/m³	8					23	34	35	31	28	28	56
June 2013	µg/m³	8	17	7.6/12	20	28							

Notes:

µg/m³ - micrograms per cubic meter of air
* QA/QC (Helium) showed up in results

Table 6.9a

Evaluation of VI Data - Unit 003
Lee's Lane Landfill Site
Louisville, Kentucky

Sample Location	Analyte	Screening Level[1] (μg/m^3)	Jun 2014 Results (μg/m^3)	Nov/Dec 2014 Results (μg/m^3)	Jun 2015 Results (μg/m^3)
Ambient	1,2-Dichloroethane	1.08	0.073 U	0.066	NS
First Floor	**1,2-Dichloroethane**	1.08	NS	**1.2**	NS
Crawl Space	**1,2-Dichloroethane**	1.08	**1.5**	0.056	NS
Soil Gas	1,2-Dichloroethane	11	NS	NS	NS

Notes:

1 - Provided by EPA Region IV- Regional Screening Level (RSL) based on Target cancer risk (TR) = 1E-05 and target hazard quotient (THQ) = 1.0

(μg/m^3) - micrograms per cubic meter

NS - not sampled

Exceedances for EPA screening levels are shown in bold with shading

Table 6.9b

Evaluation of VI Data - Unit 007
Lee's Lane Landfill Site
Louisville, Kentucky

Sample Location	Analyte	Screening Level[1] (µg/m^3)	Jun 2014 Results (µg/m^3)	Nov/Dec 2014 Results (µg/m^3)	Jun 2015 Results (µg/m^3)	Jul 2015 Results (µg/m^3)
Ambient	1,3-Butadiene	0.811	0.04 U	0.081	0.34 U	0.35 U/0.32
First Floor	**1,3-Butadiene**	0.811	NS	**6.7**	**4.3/4.7**	NS
Crawl Space	**1,3-Butadiene**	0.811	**6.9**	0.21	**2.8**	NS
Soil Gas	**1,3-Butadiene**	8.0	NS	**23**	5.9	0.32 U
Ambient	Benzene	3.12	0.22	0.61	0.57	0.45 U/ 0.46 U
First Floor	**Benzene**	3.12	NS	**6.3**	**5.6/6.4**	NS
Crawl Space	**Benzene**	3.12	**4.2**	0.59	**3.3**	NS
Soil Gas	Benzene	31.00	NS	4.2	11	0.51 U
Ambient	1,2-Dichloroethane	1.08	0.073 U	0.066	0.17 U	0.17 U/ 0.15 U
First Floor	**1,2-Dichloroethane**	1.08	NS	**1.6**	**1.8/2.1**	NS
Crawl Space	1,2-Dichloroethane	1.08	0.68	0.097	0.66	NS
Soil Gas	1,2-Dichloroethane	11	NS	0.13 U	0.16 U	0.16 U

Notes:

1 - Provided by EPA Region IV- Regional Screening Level (RSL) based on Target cancer risk (TR) = 1E-05 and target hazard quotient (THQ) = 1.0

(µg/m^3) - micrograms per cubic meter

NS - not sampled

Exceedances for EPA screening levels are shown in bold with shading

Table 6.9c

Evaluation of VI Data - Unit 014
Lee's Lane Landfill Site
Louisville, Kentucky

Sample Location	Analyte	Screening Level[1] (μg/m³)	Jun 2014 Results (μg/m³)	Nov/Dec 2014 Results (μg/m³)	Jun 2015 Results (μg/m³)	Jul 2015 Results (μg/m3)
Ambient	1,3-Butadiene	0.811	0.04 U	0.14/0.27 U	0.28 U	NS
First Floor	**1,3-Butadiene**	0.811	NS	**0.98**	**1.7**	NS
Crawl Space	**1,3-Butadiene**	0.811	**2.5**	0.13	0.40	NS
Soil Gas	1,3-Butadiene	8.0	NS	0.69	0.52	0.38

Notes:

1 - Provided by EPA Region IV- Regional Screening Level (RSL) based on Target cancer risk (TR) = 1E-05 and target hazard quotient (THQ) = 1.0

(μg/m³) - micrograms per cubic meter

NS - not sampled

Exceedances for EPA screening levels are shown in bold with shading

Table 6.9d

Evaluation of VI Data - Unit 015
Lee's Lane Landfill Site
Louisville, Kentucky

Sample Location	Analyte	Screening Level[1] (µg/m^3)	Jun 2014 Results (µg/m^3)	Nov/Dec 2014 Results (µg/m^3)	Jun 2015 Results (µg/m3)
Ambient	1,3-Butadiene	0.811	0.04 U	0.28 U	0.33 U
First Floor	**1,3-Butadiene**	0.811	NS	0.46/0.47 J	**1.0**
Crawl Space	**1,3-Butadiene**	0.811	**1.4**	0.061	0.51 U
Soil Gas	**1,3-Butadiene**	8.0	NS	**34**	**17**
Ambient	1,2-Dichloroethane	1.08	0.073 U	0.14 U	0.16 U
First Floor	**1,2-Dichloroethane**	1.08	NS	**1.1**/0.99	**1.2**
Crawl Space	1,2-Dichloroethane	1.08	0.44	0.066	0.69
Soil Gas	1,2-Dichloroethane	11	NS	0.13 U	0.17 U
Ambient	Carbon Tetrachloride	4.1	0.46	0.34	0.64
First Floor	Carbon Tetrachloride	4.1	NS	NA	0.83
Crawl Space	Carbon Tetrachloride	4.1	0.46	NA	0.6
Soil Gas	**Carbon Tetrachloride**	41	NS	2.4	**1,800**

Notes:

1 - Provided by EPA Region IV- Regional Screening Level (RSL) based on Target cancer risk (TR) = 1E-05 and target hazard quotient (THQ) = 1.0

(µg/m^3) - micrograms per cubic meter
NS - not sampled
NA - not analized
Exceedances for EPA screening levels are shown in bold with shading

Table 6.9e

Evaluation of VI Data - Unit 023
Lee's Lane Landfill Site
Louisville, Kentucky

Sample Location	Analyte	Screening Level[1] (µg/m³)	Jun 2014 Results (µg/m³)	Nov/Dec 2014 Results (µg/m³)	Jun 2015 Results (µg/m³)
Ambient	1,3-Butadiene	0.811	NS	NS	0.26 U
First Floor	1,3-Butadiene	0.811	NS	0.12	0.33 U
Crawl Space	1,3-Butadiene	0.811	0.04 U	0.12	0.76 U
Soil Gas	**1,3-Butadiene**	8.0	NS	**35**	**15**
Ambient	1,4-Dichlorobenzene	2.55	NS	NS	0.13 U
First Floor	**1,4-Dichlorobenzene**	2.55	NS	**14**	**310**
Crawl Space	**1,4-Dichlorobenzene**	2.55	**4.9**	0.28	**3.9**
Soil Gas	1,4-Dichlorobenzene	25	NS	0.52 U	0.54
Ambient	1,2-Dichloroethane	1.08	NS	NS	0.20
First Floor	**1,2-Dichloroethane**	1.08	NS	**1.2**	**1.6**
Crawl Space	1,2-Dichloroethane	1.08	0.33	0.061	1.0
Soil Gas	1,2-Dichloroethane	11	NS	0.52 U	0.19 U

Notes:

1 - Provided by EPA Region IV- Regional Screening Level (RSL) based on Target cancer risk (TR) = 1E-05 and target hazard quotient (THQ) = 1.0

(µg/m³) - micrograms per cubic meter

NS - not sampled

Exceedances for EPA screening levels are shown in bold with shading

Table 6.9f

Evaluation of VI Data - Unit 030
Lee's Lane Landfill Site
Louisville, Kentucky

Sample Location	Analyte	Screening Level[1] (µg/m³)	Jun 2014 Results (µg/m³)	Nov/Dec 2014 Results (µg/m³)	Jun 2015 Results (µg/m³)	Jul 2015 Results (µg/m³)
Ambient	1,3-Butadiene	0.811	NS	NS	0.36 U	NS
First Floor	1,3-Butadiene	0.811	NS	0.11	0.33 U	NS
Crawl Space	1,3-Butadiene	0.811	0.04 U	0.057	0.27 U	NS
Soil Gas	**1,3-Butadiene**	8.0	NS	**31**	**12**	**16**
Ambient	1,4-Dichlorobenzene	2.55	NS	NS	0.23	NS
First Floor	**1,4-Dichlorobenzene**	2.55	NS	**18**	**48**	NS
Crawl Space	**1,4-Dichlorobenzene**	2.55	**7.8**	0.86	**65**	NS
Soil Gas	1,4-Dichlorobenzene	25	NS	0.55 U	0.46	0.43
Ambient	1,2-Dichloroethane	1.10	NS	NS	0.18 U	NS
First Floor	**1,2-Dichloroethane**	1.10	NS	0.78	**5.5**	NS
Crawl Space	1,2-Dichloroethane	1.10	0.41	0.10	0.38	NS
Soil Gas	1,2-Dichloroethane	11	NS	0.55 U	0.16 U	0.13 U

Notes:

1 - Provided by EPA Region IV- Regional Screening Level (RSL) based on Target cancer risk (TR) = 1E-05 and target hazard quotient (THQ) = 1.0

(µg/m³) - micrograms per cubic meter

NS - not sampled

Exceedances for EPA screening levels are shown in bold with shading

Table 6.9g

Evaluation of VI Data - Unit 032
Lee's Lane Landfill Site
Louisville, Kentucky

Sample Location	Analyte	Screening Level[1] (µg/m³)	Jun 2014 Results (µg/m³)	Nov/Dec 2014 Results (µg/m³)	Jun 2015 Results (µg/m³)
Ambient	1,3-Butadiene	0.811	0.52	0.15	0.28 U
First Floor	**1,3-Butadiene**	0.811	NS	NS	**5.2**
Crawl Space	1,3-Butadiene	0.811	NS	NS	NS
Soil Gas	1,3-Butadiene	8.0	0.04 U	**28**	0.33 U
Ambient	**1,4-Dichlorobenzene**	2.55	**13**	0.052	0.14 U
First Floor	**1,4-Dichlorobenzene**	2.55	NS	NS	**3.9**
Crawl Space	1,4-Dichlorobenzene	2.55	NS	NS	NS
Soil Gas	1,4-Dichlorobenzene	25	14	0.14 U	0.65
Ambient	Benzene	3.10	0.41	0.15	0.41
First Floor	**Benzene**	3.10	NS	NS	**4.8**
Crawl Space	Benzene	3.10	NS	NS	NS
Soil Gas	Benzene	31	1.4	7.7	0.16 U

Notes:

1 - Provided by EPA Region IV- Regional Screening Level (RSL) based on Target cancer risk (TR) = 1E-05 and target hazard quotient (THQ) = 1.0

(µg/m³) - micrograms per cubic meter

NS - not sampled

Exceedances for EPA screening levels are shown in bold with shading

Table 6.9h

Evaluation of VI Data - Unit 033
Lee's Lane Landfill Site
Louisville, Kentucky

Sample Location	Analyte	Screening Level[1] (µg/m³)	Jun 2014 Results (µg/m³)	Nov/Dec 2014 Results (µg/m³)	Jun 2015 Results (µg/m³)
Ambient	1,3-Butadiene	0.811	NS	NS	0.33 U
First Floor	1,3-Butadiene	0.811	NS	0.14	0.29 U
Crawl Space	1,3-Butadiene	0.811	NS	0.052/0.061	0.33 U/0.30 U
Soil Gas	**1,3-Butadiene**	8.0	NS	**28**	**11**
Ambient	1,4-Dichlorobenzene	2.55	NS	NS	0.16 U
First Floor	**1,4-Dichlorobenzene**	2.55	NS	NS	**7.2**
Crawl Space	**1,4-Dichlorobenzene**	2.55	NS	0.43/0.39	**5.2/5.3**
Soil Gas	1,4-Dichlorobenzene	25	NS	0.54 U	0.35
Ambient	1,2-Dichloroethane	1.10	NS	NS	0.16 U
First Floor	**1,2-Dichloroethane**	1.10	NS	NS	**1.1**
Crawl Space	1,2-Dichloroethane	1.10	NS	0.057/0.058	0.68/0.68
Soil Gas	1,2-Dichloroethane	11	NS	0.54 U	0.14 U

Notes:

1 - Provided by EPA Region IV- Regional Screening Level (RSL) based on Target cancer risk (TR) = 1E-05 and target hazard quotient (THQ) = 1.0

(µg/m³) - micrograms per cubic meter

NS - not sampled

Exceedances for EPA screening levels are shown in bold with shading

Table 6.9i

Evaluation of VI Data - Unit 034
Lee's Lane Landfill Site
Louisville, Kentucky

Sample Location	Analyte	Screening Level[1] (μg/m³)	Jun 2014 Results (μg/m³)	Nov/Dec 2014 Results (μg/m³)	Jun 2015 Results (μg/m³)
Ambient	1,3-Butadiene	0.811	NS	NS	NS
First Floor	1,3-Butadiene	0.811	NS	NS	NS
Crawl Space	1,3-Butadiene	0.811	NS	NS	NS
Soil Gas	**1,3-Butadiene**	8.0	NS	**56**	0.34 U

Notes:

1 - Provided by EPA Region IV- Regional Screening Level (RSL) based on Target cancer risk (TR) = 1E-05 and target hazard quotient (THQ) = 1.0

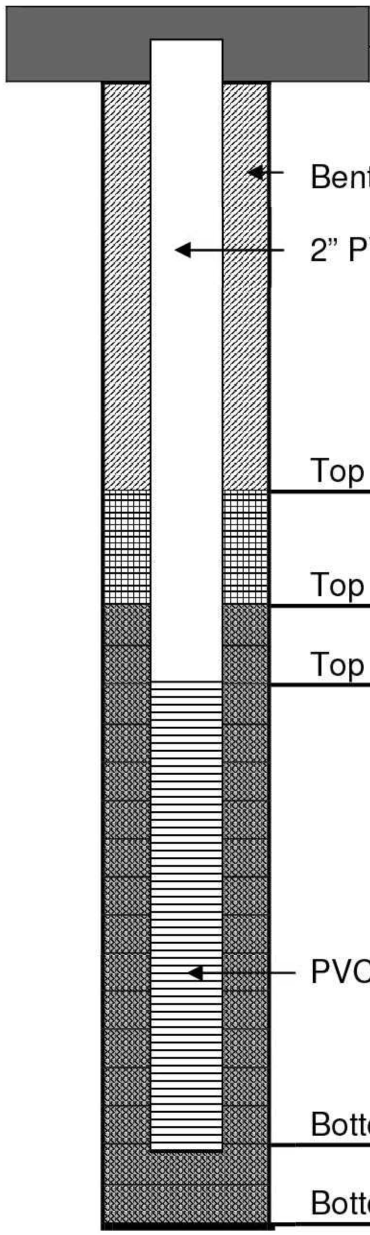
(μg/m³) - micrograms per cubic meter
NS - not sampled
Exceedances for EPA screening levels are shown in bold with shading

Appendices

Appendix A
Boring and Monitoring Well Logs

MONITORING WELL CONSTRUCTION LOG

Location Name:	Lee's Lane Landfill	State Assigned #	8006-8888
Address:	Lees Lane		
	Louisville, Kentucky	Facility Assigned #	MW-101



Above ground protective casing with Pad, Locking Plug, & Lock

Bentonite Grout

2" PVC Casing

Top of Bentonite Seal 47.5 b.g.s.

Top of Sand Pack 49.5

Top of Screen 51.5 b.g.s.

PVC Screen

Bottom of Screen 71.5 b.g.s.

Bottom of Boring 73.5 b.g.s.

Depth to Groundwater		Total Depth of Boring (ft)	73.5	Total Depth of Well (ft)	71.5	Borehole Diameter	> 6"
Well Diameter	2 inch	Slot Size	.01	Drilling Unconsolidated	71.5	Drilling in Consolidated	0
Continuous Split Spoon Sampling (LF)	N/A	Random SS Samples	N/A	Split Spoon 5 ft Intervals (LF)	N/A	Drilling > 60 feet	
Date Installed:	4/21/2014	Completed By:	K. Crawford			Top of Casing	
			Comments: Drawing not to scale.				

UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

Use this form to report installation of monitoring or water wells.

Form must be completed and submitted to the Division of Water within 60 days of well completion.

See instructions below.

One copy to owner and one copy to drillerâ€™s files.

Owner Name(*)	Kentucky division of Environmental Protection
Owner First Name (*)	Dan
Owner Last Name(*)	Phelps
Owner Address(*)	200 Fair Oaks Lane
Owner City(*)	Frankfort
State(*)	Kentucky
Owner Zip(*)	40601
Owner Phone(*)	502-564-5716
Owner eMail	

Site Name(*)	Lee's Lane Landfill
Site Address(*)	4620 Lees Ln.
Site City(*)	louisville
State(*)	Kentucky
Site Zip(*)	40216
Site Phone	
Site eMail	
Well Latitude(*) DMS to DD Converter	38.194897
Well Longitude(*)	-85.878236
Method(*)	Paper or Internet Map Interpolation

Agency Interest (AI) Number	46333
Facility Type & ID	CERCLA

USGS Topo Map(*)	LOUISVILLE WEST	County(*)	Jefferson
Surface elevation (ft)	430	Elevation determined by	Topographic map interpolation - hardcopy
Physiographic Region(*)	Ohio River Alluvium	Well Use(*)	Monitoring well - ambient monitoring
Drilling Method(*)	Auger - hollow stem	Well Status(*)	active
Wellhead(*)	Locking Cap	Well Condition(*)	Functioning properly

Casing / Open Borehole

	From depth (ft)(*)	To depth (ft)(*)	Borehole diameter (in)(*)	Casing diameter (in)(*)	Casing type(*)
Delete	0	51.5	8.5	2	PVC
Add New					

Screen

	From depth (ft)(*)(*)	To depth (ft)(*)(*)	Borehole diameter (in) (*)(*)	Screen diameter (in)(*) (*)	Screen Type(*)(*)	Screen slot size(*)(*)
Delete	51.5	71.5	8.5	2	PVC	.01
Add New						

Annulus fill and seal

	Section(*)	From depth (ft)(*)	To depth (ft)(*)	Material(*)
Delete	Grout	0	47.5	Mixture - bentonite & cement
Delete	Seal	47.5	49.5	Bentonite
Delete	Filter Pack	49.5	71.5	Sand
Add New				

Lithologic log

	From depth (ft)(*)	To depth (ft)(*)	Description(*)
Delete	0	1	topsoil
Delete	1	15	silty clay
Delete	15	71.5	sand
Add New			

Site Map/Sketch Map(*)		Browse...
Well Diagram (monitoring well)		Browse...
Coliform analysis (if applicable)		Browse...
Signed variance (if applicable)		Browse...
Other laboratory analysis report (if applicable)		Browse...
Casing/Screen Supplemental Info		Browse...

Comments

Affimation: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. By submitting data, this transmission constitutes my signature and I am responsible for any and all content submitted either by me or by the people I represent.

Signature of certified driller & PIN(*)	zack bayne	Date Signed(*)	06/10/2014
Driller First Name(*)	zack	Driller Last Name(*)	bayne
Certification Number (*)	0370-0522-00	Certification Company(*)	Chase Environmental Group

Kentucky Well ID (AKGWA) Number (*)	8006-8888
Owner Well ID	MW-101
Work Start Date(*)	04/21/2014
Work End Date(*)	04/21/2014
Total depth (ft)(*)	71.5
Depth to bedrock (ft)	
Static water level (ft)	48
SWL method(*)	Measured
Casing height above surface (in)	42

WATER WELLS ONLY

Estimated well yield	
Well Yield Method	
Well service (# of people served)	
Disinfectant amount	
Disinfectant type	
Pitless adapter installed	
Pump installed	
Depth to intake (ft)	

Apparent quality and odor:

Appearance	
Odor Type	
Odor-Level	

Coliform Test

Coliform test type	
Coliform test results	or # colonies per 100 ml
Date Sampled	
Date Analyzed	

For Internal Staff Use Only

Date Received:	
Date Mapped:	
Mapped By:	

Save For Future Retrieval | Submit to DEP

UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

Use this form to report installation of monitoring or water wells.

Form must be completed and submitted to the Division of Water within 60 days of well completion.

See instructions below.

One copy to owner and one copy to drillerâ€™s files.

Owner Name(*)	Kentucky division of Environmental Protection
Owner First Name (*)	Dan
Owner Last Name(*)	Phelps
Owner Address(*)	200 Fair Oaks Lane
Owner City(*)	Frankfort
State(*)	Kentucky
Owner Zip(*)	40601
Owner Phone(*)	502-564-5716
Owner eMail	

Site Name(*)	Lee's Lane Landfill
Site Address(*)	4620 Lees Ln.
Site City(*)	louisville
State(*)	Kentucky
Site Zip(*)	40216
Site Phone	
Site eMail	
Well Latitude(*) DMS to DD Converter	38.188592
Well Longitude(*)	-85.881217
Method(*)	Paper or Internet Map Interpolation

Agency Interest (AI) Number	46333
Facility Type & ID	CERCLA
USGS Topo Map(*)	LOUISVILLE WEST
County(*)	Jefferson
Surface elevation (ft)	430
Elevation determined by	Topographic map interpolation - hardcopy
Physiographic Region(*)	Ohio River Alluvium
Well Use(*)	Monitoring well - ambient monitoring
Drilling Method(*)	Auger - hollow stem
Well Status(*)	active
Wellhead(*)	Locking Cap
Well Condition(*)	Functioning properly

Casing / Open Borehole

	From depth (ft)(*)	To depth (ft)(*)	Borehole diameter (in)(*)	Casing diameter (in)(*)	Casing type(*)
Delete	0	45	8.5	2	PVC
Add New					

Screen

	From depth (ft)(*)(*)	To depth (ft)(*)(*)	Borehole diameter (in) (*)(*)	Screen diameter (in)(*) (*)	Screen Type(*)(*)	Screen slot size(*)(*)
Delete	45	65	8.5	2	PVC	.01
Add New						

Annulus fill and seal

	Section(*)	From depth (ft)(*)	To depth (ft)(*)	Material(*)
Delete	Grout	0	41	Mixture - bentonite & cement
Delete	Seal	41	43	Bentonite
Delete	Filter Pack	43	65	Sand
Add New				

Lithologic log

	From depth (ft)(*)	To depth (ft)(*)	Description(*)
Delete	0	1	topsoil
Delete	1	20	silty clay
Delete	20	65	sand
Add New			

Site Map/Sketch Map(*)		Browse...
Well Diagram (monitoring well)		Browse...
Coliform analysis (if applicable)		Browse...
Signed variance (if applicable)		Browse...
Other laboratory analysis report (if applicable)		Browse...
Casing/Screen Supplemental Info		Browse...

Comments

Affirmation: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. By submitting data, this transmission constitutes my signature and I am responsible for any and all content submitted either by me or by the people I represent.

Signature of certified driller & PIN(*)	zack bayne
Date Signed(*)	06/10/2014
Driller First Name(*)	zack
Driller Last Name(*)	bayne
Certification Number (*)	0370-0522-00
Certification Company(*)	Chase Environmental Group

Kentucky Well ID (AKGWA) Number (*)	8006-8889
Owner Well ID	MW-102
Work Start Date(*)	04/23/2014
Work End Date(*)	04/23/2014
Total depth (ft)(*)	65
Depth to bedrock (ft)	
Static water level (ft)	44.7
SWL method(*)	Measured
Casing height above surface (in)	36

WATER WELLS ONLY

Estimated well yield	
Well Yield Method	
Well service (# of people served)	
Disinfectant amount	
Disinfectant type	
Pitless adapter installed	
Pump installed	
Depth to intake (ft)	

Apparent quality and odor:

Appearance	
Odor Type	
Odor-Level	

Coliform Test

Coliform test type	
Coliform test results	or # colonies per 100 ml
Date Sampled	
Date Analyzed	

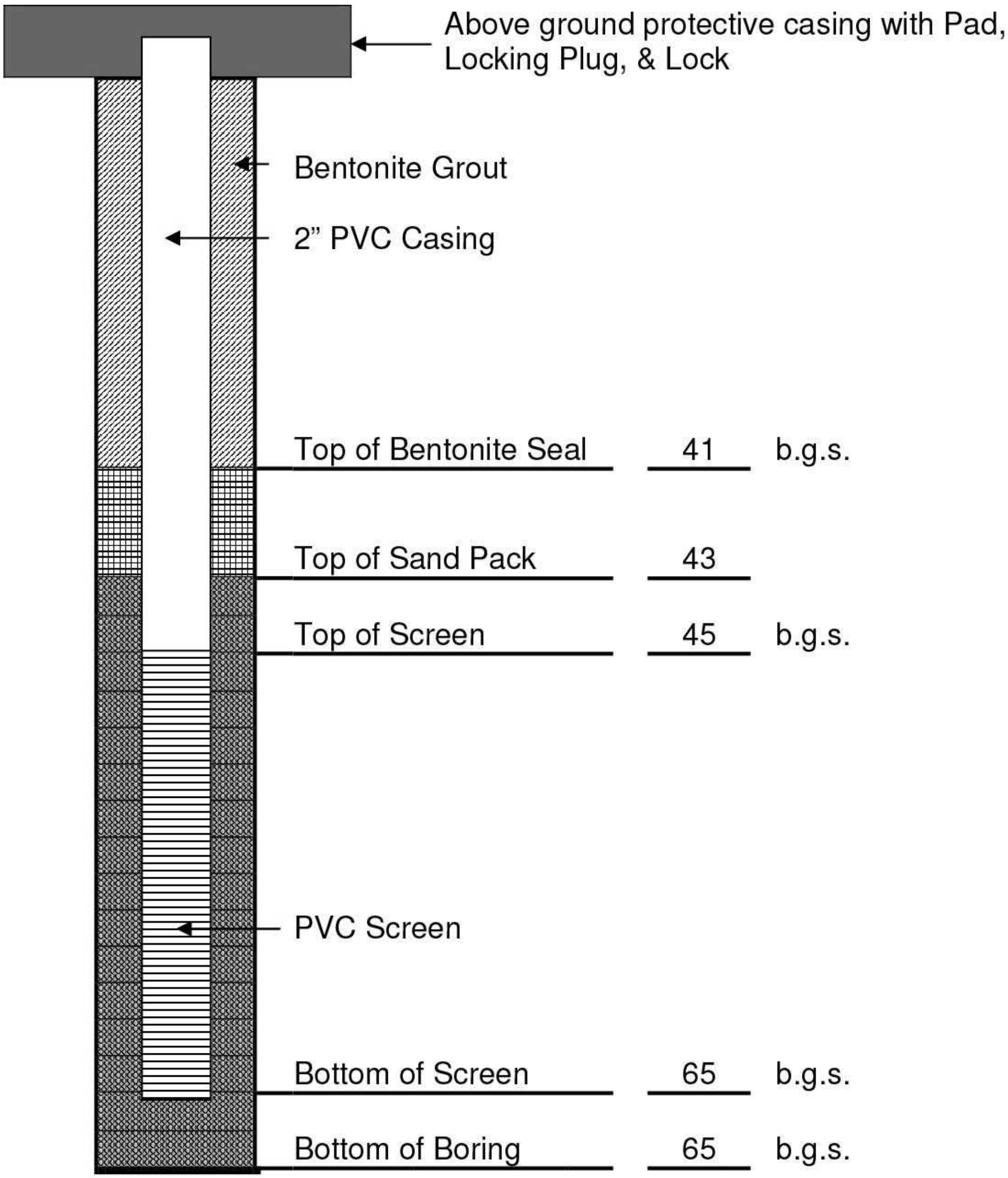
For Internal Staff Use Only

Date Received:	
Date Mapped:	
Mapped By:	

Save For Future Retrieval | Submit to DEP

MONITORING WELL CONSTRUCTION LOG

Location Name:	Lee's Lane Landfill	State Assigned #	8006-8890
Address:	Lees Lane		
	Louisville, Kentucky	Facility Assigned #	MW-103



Depth to Groundwater		Total Depth of Boring (ft)	65	Total Depth of Well (ft)	65	Borehole Diameter	> 6"
Well Diameter	2 inch	Slot Size	.01	Drilling Unconsolidated	65	Drilling in Consolidated	0
Continuous Split Spoon Sampling (LF)	N/A	Random SS Samples	N/A	Split Spoon 5 ft Intervals (LF)	N/A	Drilling > 60 feet	
Date Installed:	4/23/2014	Completed By:	K. Crawford			Top of Casing	
			Comments: Drawing not to scale.				

UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

Use this form to report installation of monitoring or water wells.

Form must be completed and submitted to the Division of Water within 60 days of well completion.

See instructions below.

One copy to owner and one copy to drillerâ€™s files.

Owner Name(*)	Kentucky division of Environmental Protection				
Owner First Name (*)	Dan	Owner Last Name(*)	Phelps		
Owner Address(*)	200 Fair Oaks Lane				
Owner City(*)	Frankfort	State(*)	Kentucky	Owner Zip(*)	40601
Owner Phone(*)	502-564-5716	Owner eMail			

Site Name(*)	Lee's Lane Landfill				
Site Address(*)	4620 Lees Ln.				
Site City(*)	louisville	State(*)	Kentucky	Site Zip(*)	40216
Site Phone		Site eMail			
Well Latitude(*) DMS to DD Converter	38.187343	Well Longitude(*)	-85.884413	Method(*)	Paper or Internet Map Interpolation

Agency Interest (AI) Number	46333	Facility Type & ID	CERCLA

USGS Topo Map(*)	LOUISVILLE WEST	County(*)	Jefferson
Surface elevation (ft)	430	Elevation determined by	Topographic map interpolation - hardcopy
Physiographic Region(*)	Ohio River Alluvium	Well Use(*)	Monitoring well - ambient monitoring
Drilling Method(*)	Auger - hollow stem	Well Status(*)	active
Wellhead(*)	Locking Cap	Well Condition(*)	Functioning properly

Casing / Open Borehole

	From depth (ft)(*)	To depth (ft)(*)	Borehole diameter (in)(*)	Casing diameter (in)(*)	Casing type(*)
Delete	0	45	8.5	2	PVC
Add New					

Screen

	From depth (ft)(*)(*)	To depth (ft)(*)(*)	Borehole diameter (in) (*)(*)	Screen diameter (in)(*) (*)	Screen Type(*)(*)	Screen slot size(*)(*)
Delete	45	65	8.5	2	PVC	.01
Add New						

Annulus fill and seal

	Section(*)	From depth (ft)(*)	To depth (ft)(*)	Material(*)
Delete	Grout	0	41	Mixture - bentonite & cement
Delete	Seal	41	43	Bentonite
Delete	Filter Pack	43	65	Sand
Add New				

Lithologic log

	From depth (ft)(*)	To depth (ft)(*)	Description(*)
Delete	0	1	topsoil
Delete	1	20	silty clay
Delete	20	40	gravel
Delete	40	65	sand, black gravel
Add New			

Site Map/Sketch Map(*)		Browse...
Well Diagram (monitoring well)		Browse...
Coliform analysis (if applicable)		Browse...
Signed variance (if applicable)		Browse...
Other laboratory analysis report (if applicable)		Browse...
Casing/Screen Supplemental Info		Browse...

Comments

Affirmation: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. By submitting data, this transmission constitutes my signature and I am responsible for any and all content submitted either by me or by the people I represent.

Signature of certified driller & PIN(*)	zack bayne	Date Signed(*)	06/10/2014
Driller First Name(*)	zack	Driller Last Name(*)	bayne
Certification Number (*)	0370-0522-00	Certification Company(*)	Chase Environmental Group

Kentucky Well ID (AKGWA) Number (*)	8006-8890
Owner Well ID	MW-103
Work Start Date(*)	04/23/2014
Work End Date(*)	04/23/2014
Total depth (ft)(*)	65
Depth to bedrock (ft)	
Static water level (ft)	41.6
SWL method(*)	Measured
Casing height above surface (in)	36

WATER WELLS ONLY

Estimated well yield	
Well Yield Method	
Well service (# of people served)	
Disinfectant amount	
Disinfectant type	
Pitless adapter installed	
Pump installed	
Depth to intake (ft)	

Apparent quality and odor:

Appearance	
Odor Type	
Odor-Level	

Coliform Test

Coliform test type	
Coliform test results	or # colonies per 100 ml
Date Sampled	
Date Analyzed	

For Internal Staff Use Only

Date Received:	
Date Mapped:	
Mapped By:	

Save For Future Retrieval | Submit to DEP

UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

Use this form to report installation of monitoring or water wells.

Form must be completed and submitted to the Division of Water within 60 days of well completion.

See instructions below.

One copy to owner and one copy to drillerâ€™s files.

Owner Name(*)	Kentucky division of Environmental Protection				
Owner First Name (*)	Dan	Owner Last Name(*)	Phelps		
Owner Address(*)	200 Fair Oaks Lane				
Owner City(*)	Frankfort	State(*)	Kentucky	Owner Zip(*)	40601
Owner Phone(*)	502-564-5716	Owner eMail			

Site Name(*)	Lee's Lane Landfill				
Site Address(*)	4620 Lees Ln.				
Site City(*)	louisville	State(*)	Kentucky	Site Zip(*)	40216
Site Phone		Site eMail			
Well Latitude(*) DMS to DD Converter	38.193994	Well Longitude(*)	-85.882186	Method(*)	Paper or Internet Map Interpolation

Agency Interest (AI) Number	46333	Facility Type & ID	CERCLA
USGS Topo Map(*)	LOUISVILLE WEST	County(*)	Jefferson
Surface elevation (ft)	430	Elevation determined by	Topographic map interpolation - hardcopy
Physiographic Region(*)	Ohio River Alluvium	Well Use(*)	Monitoring well - ambient monitoring
Drilling Method(*)	Auger - hollow stem	Well Status(*)	active
Wellhead(*)	Locking Cap	Well Condition(*)	Functioning properly

Casing / Open Borehole

	From depth (ft)(*)	To depth (ft)(*)	Borehole diameter (in)(*)	Casing diameter (in)(*)	Casing type(*)
Delete	0	45	8.5	2	PVC
Add New					

Screen

	From depth (ft)(*)(*)	To depth (ft)(*)(*)	Borehole diameter (in) (*)(*)	Screen diameter (in)(*) (*)	Screen Type(*)(*)	Screen slot size(*)(*)
Delete	45	65	8.5	2	PVC	.01
Add New						

Annulus fill and seal

	Section(*)	From depth (ft)(*)	To depth (ft)(*)	Material(*)
Delete	Grout	0	41	Mixture - bentonite & cement
Delete	Seal	41	43	Bentonite
Delete	Filter Pack	43	65	Sand
Add New				

Lithologic log

	From depth (ft)(*)	To depth (ft)(*)	Description(*)
Delete	0	1	topsoil
Delete	1	20	silty clay
Delete	20	35	saturated silty clay, odor
Delete	35	65.5	clayey sand
Add New			

Site Map/Sketch Map(*)		Browse...
Well Diagram (monitoring well)		Browse...
Coliform analysis (if applicable)		Browse...
Signed variance (if applicable)		Browse...
Other laboratory analysis report (if applicable)		Browse...
Casing/Screen Supplemental Info		Browse...
Comments		

Affirmation: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. By submitting data, this transmission constitutes my signature and I am responsible for any and all content submitted either by me or by the people I represent.

Signature of certified driller & PIN(*)	zack bayne	Date Signed(*)	06/10/2014
Driller First Name(*)	zack	Driller Last Name(*)	bayne
Certification Number (*)	0370-0522-00	Certification Company(*)	Chase Environmental Group

Kentucky Well ID (AKGWA) Number (*)	8006-8891
Owner Well ID	MW-104
Work Start Date(*)	04/22/2014
Work End Date(*)	04/22/2014
Total depth (ft)(*)	65.5
Depth to bedrock (ft)	
Static water level (ft)	44.7
SWL method(*)	Measured
Casing height above surface (in)	36

WATER WELLS ONLY

Estimated well yield	
Well Yield Method	
Well service (# of people served)	
Disinfectant amount	
Disinfectant type	
Pitless adapter installed	
Pump installed	
Depth to intake (ft)	

Apparent quality and odor:

Appearance	
Odor Type	
Odor-Level	

Coliform Test

Coliform test type	
Coliform test results	or # colonies per 100 ml
Date Sampled	
Date Analyzed	

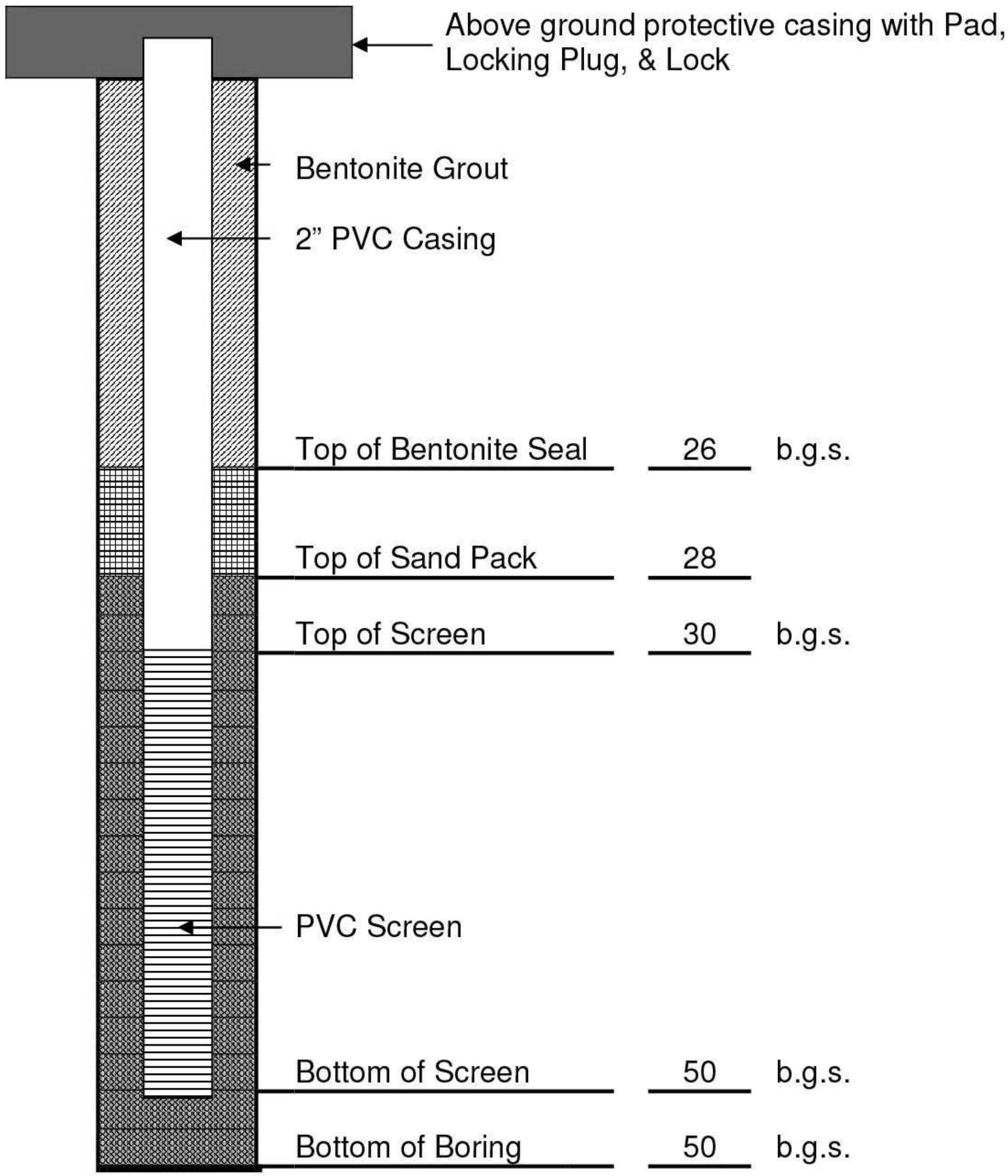
For Internal Staff Use Only

Date Received:	
Date Mapped:	
Mapped By:	

Save For Future Retrieval | Submit to DEP

MONITORING WELL CONSTRUCTION LOG

Location Name:	Lee's Lane Landfill	State Assigned #	8006-8894
Address:	Lees Lane		
	Louisville, Kentucky	Facility Assigned #	MW-105



Depth to Groundwater		Total Depth of Boring (ft)	50	Total Depth of Well (ft)	50	Borehole Diameter	> 6"
Well Diameter	2 inch	Slot Size	.01	Drilling Unconsolidated	50	Drilling in Consolidated	0
Continuous Split Spoon Sampling (LF)	N/A	Random SS Samples	N/A	Split Spoon 5 ft Intervals (LF)	N/A	Drilling > 60 feet	
Date Installed:	4/22/2014	Completed By:	K. Crawford			Top of Casing	
			Comments: Drawing not to scale.				

UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

Use this form to report installation of monitoring or water wells.

Form must be completed and submitted to the Division of Water within 60 days of well completion.

See instructions below.

One copy to owner and one copy to drillerâ€™s files.

Owner Name(*)	Kentucky division of Environmental Protection
Owner First Name (*)	Dan
Owner Last Name(*)	Phelps
Owner Address(*)	200 Fair Oaks Lane
Owner City(*)	Frankfort
State(*)	Kentucky
Owner Zip(*)	40601
Owner Phone(*)	502-564-5716
Owner eMail	

Site Name(*)	Lee's Lane Landfill
Site Address(*)	4620 Lees Ln.
Site City(*)	louisville
State(*)	Kentucky
Site Zip(*)	40216
Site Phone	
Site eMail	
Well Latitude(*) DMS to DD Converter	38.188429
Well Longitude(*)	-85.886852
Method(*)	Paper or Internet Map Interpolation

Agency Interest (AI) Number	46333
Facility Type & ID	CERCLA

USGS Topo Map(*)	LOUISVILLE WEST	County(*)	Jefferson
Surface elevation (ft)	430	Elevation determined by	Topographic map interpolation - hardcopy
Physiographic Region(*)	Ohio River Alluvium	Well Use(*)	Monitoring well - ambient monitoring
Drilling Method(*)	Auger - hollow stem	Well Status(*)	active
Wellhead(*)	Locking Cap	Well Condition(*)	Functioning properly

Casing / Open Borehole

	From depth (ft)(*)	To depth (ft)(*)	Borehole diameter (in)(*)	Casing diameter (in)(*)	Casing type(*)
Delete	0	30	8.5	2	PVC
Add New					

Screen

	From depth (ft)(*)(*)	To depth (ft)(*)(*)	Borehole diameter (in) (*)(*)	Screen diameter (in)(*) (*)	Screen Type(*)(*)	Screen slot size(*)(*)
Delete	30	50	8.5	2	PVC	.01
Add New						

Annulus fill and seal

	Section(*)	From depth (ft)(*)	To depth (ft)(*)	Material(*)
Delete	Grout	0	26	Mixture - bentonite & cement
Delete	Seal	26	28	Bentonite
Delete	Filter Pack	28	50	Sand
Add New				

Lithologic log

	From depth (ft)(*)	To depth (ft)(*)	Description(*)
Delete	0	1	topsoil
Delete	1	20	silty clay
Delete	20	50	clayey sand
Add New			

Site Map/Sketch Map(*)		Browse...
Well Diagram (monitoring well)		Browse...
Coliform analysis (if applicable)		Browse...
Signed variance (if applicable)		Browse...
Other laboratory analysis report (if applicable)		Browse...
Casing/Screen Supplemental Info		Browse...

Comments

Affirmation: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. By submitting data, this transmission constitutes my signature and I am responsible for any and all content submitted either by me or by the people I represent.

Signature of certified driller & PIN(*)	zack bayne	Date Signed(*)	06/10/2014
Driller First Name(*)	zack	Driller Last Name(*)	bayne
Certification Number (*)	0370-0522-00	Certification Company(*)	Chase Environmental Group

Kentucky Well ID (AKGWA) Number (*)	8006-8894
Owner Well ID	MW-105
Work Start Date(*)	04/22/2014
Work End Date(*)	04/22/2014
Total depth (ft)(*)	50
Depth to bedrock (ft)	
Static water level (ft)	27
SWL method(*)	Measured
Casing height above surface (in)	36

WATER WELLS ONLY

Estimated well yield	
Well Yield Method	
Well service (# of people served)	
Disinfectant amount	
Disinfectant type	
Pitless adapter installed	
Pump installed	
Depth to intake (ft)	

Apparent quality and odor:

Appearance	
Odor Type	
Odor-Level	

Coliform Test

Coliform test type	
Coliform test results	or # colonies per 100 ml
Date Sampled	
Date Analyzed	

For Internal Staff Use Only

Date Received:	
Date Mapped:	
Mapped By:	

Save For Future Retrieval | Submit to DEP

Geotechnical Engineering
Materials Testing/Inspection

TESTECH

Professional Surveying and
Environmental Services

Putting Our Experience to Work for You!

October 8, 2010

KENTUCKY DIVISION OF WATER
Watershed Management Branch
200 Fair Oaks Lane, 4th Floor
Frankfort, Kentucky 40601

Attn: Ms. Jo Blanset
GIS & Data Management Section

Re: **MONITORING WELL DECOMMISSIONING LOGS (8001-8971, 8001-8972 & 8001-8973) & SOIL GAS MONITORING WELL INSTALLATION LOGS (8005-5566, 8005-5567 & 8005-5568)**
U.S. Environmental Protection Agency, Region 4
Lee's Lane Landfill Superfund Site
Lee's Lane, Louisville, Jefferson Co., Kentucky
KYD #980557052
Tes Tech Project #26034

Ms. Blanset:

Attached are Uniform Kentucky Well Maintenance and Plugging Record forms for three (3) previously unregistered ground water monitoring wells (MW-02, MW-A and MW-B) and Uniform Kentucky Well Construction Record forms for three (3) newly installed soil gas monitoring wells (GMW-1, GMW-2 and GWM-3) that was installed by TesTech, Inc., Dayton, Ohio. Well decommissioning and installation work was performed under the supervision of Smith Management Group (SMG) on behalf of the Louisville and Jefferson County Metropolitan Sewer District (MSD). The Kentucky Division of Water had approved a well abandonment variance request for the abandonment of one (1) of the unregistered ground water monitoring wells (MW-B).

The three (3) ground water monitoring wells (MW-02, MW-A and MW-B) that were decommissioned were constructed of four (4) inch diameter stainless steel well casing and well screen. The well screens of these three (3) monitoring wells were wire wrapped with slot openings of 0.0060". Two (2) of the three (3) ground water monitoring wells (MW-02 and MW-A) that were decommissioned were over-drilled to below the original construction depth of the wells using 6.25" inside diameter (ID) hollow stem augers. The well materials were extracted from the ground and the resulting over-drilled bore holes were sealed to within one and five tenths (1.5) feet of grade with cement/bentonite grout that was placed using a one (1) inch diameter PVC tremie pipe. MW-B was abandoned by removal of the above surface riser pipe to a depth of approximately three (3) feet below ground surface followed by sealing of the remaining well in-place with cement/bentonite grout. The upper one and five tenths (1.5) feet of each well was completed to grade with top soil and grass seed.

Three (3) new soil gas monitoring wells (GMW-1, GMW-2 and GMW-3) were installed following the completion of the above discussed well decommissioning activities. The new soil gas monitor wells were installed in a grass surfaced areas. An approximate 2-foot square area was excavated around each monitoring well following installation and a four (4)-inch diameter protective well cover was placed central to the 2" PVC well pipe. Concrete pads were then poured around the protective well covers along with the installation of protective bumper posts. The concrete pads extend approximately four (4) inches below grade and the protective well cover is seated in the concrete pad. The wells were completed with a locking cap on the protective well covers and secured with padlocks.

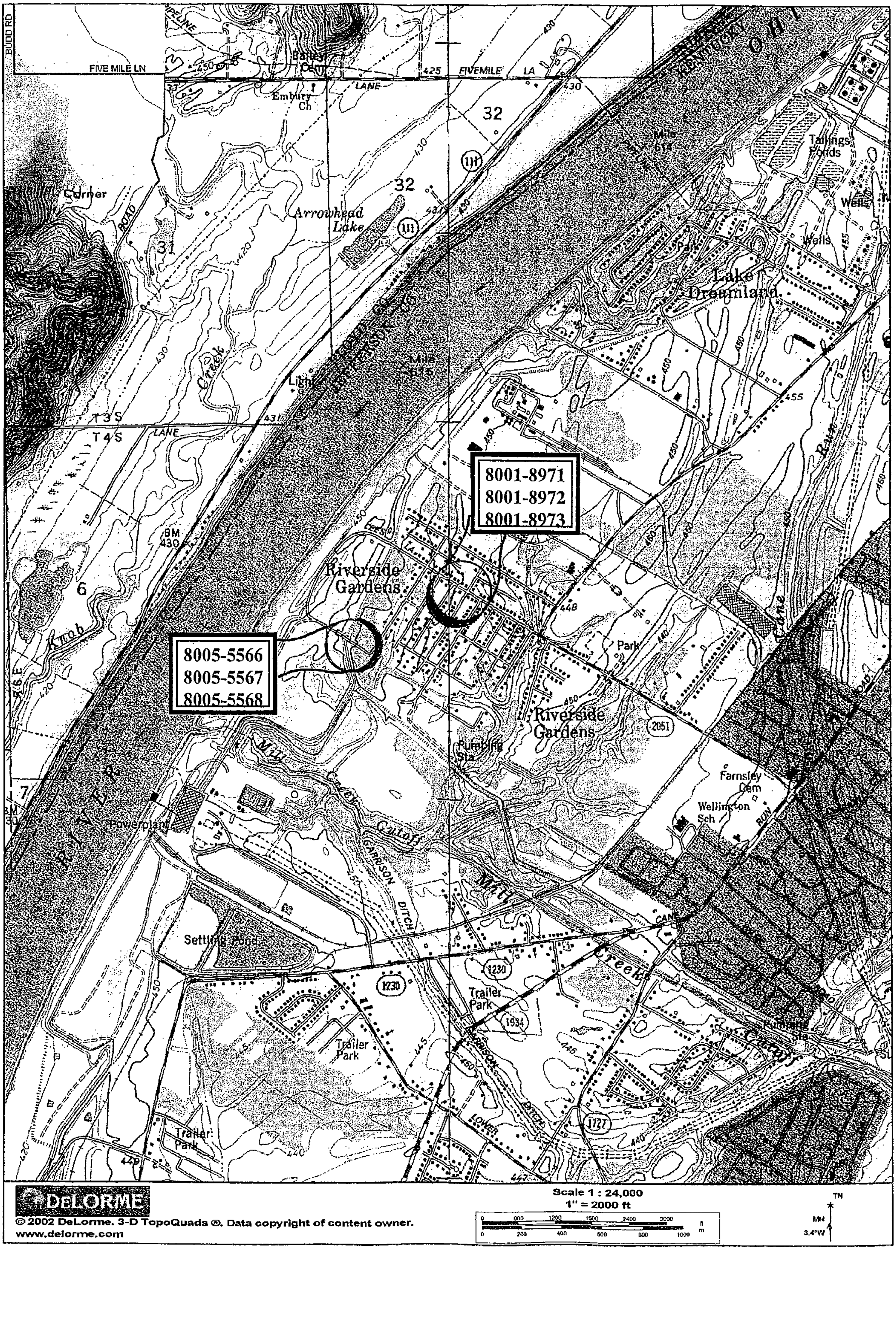
Should you have any questions and/or require any additional information regarding this project please contact TesTech's office at (937) 435-3200 or send e-mail to Mr. Gregory Reid at reid@testechinc.com.

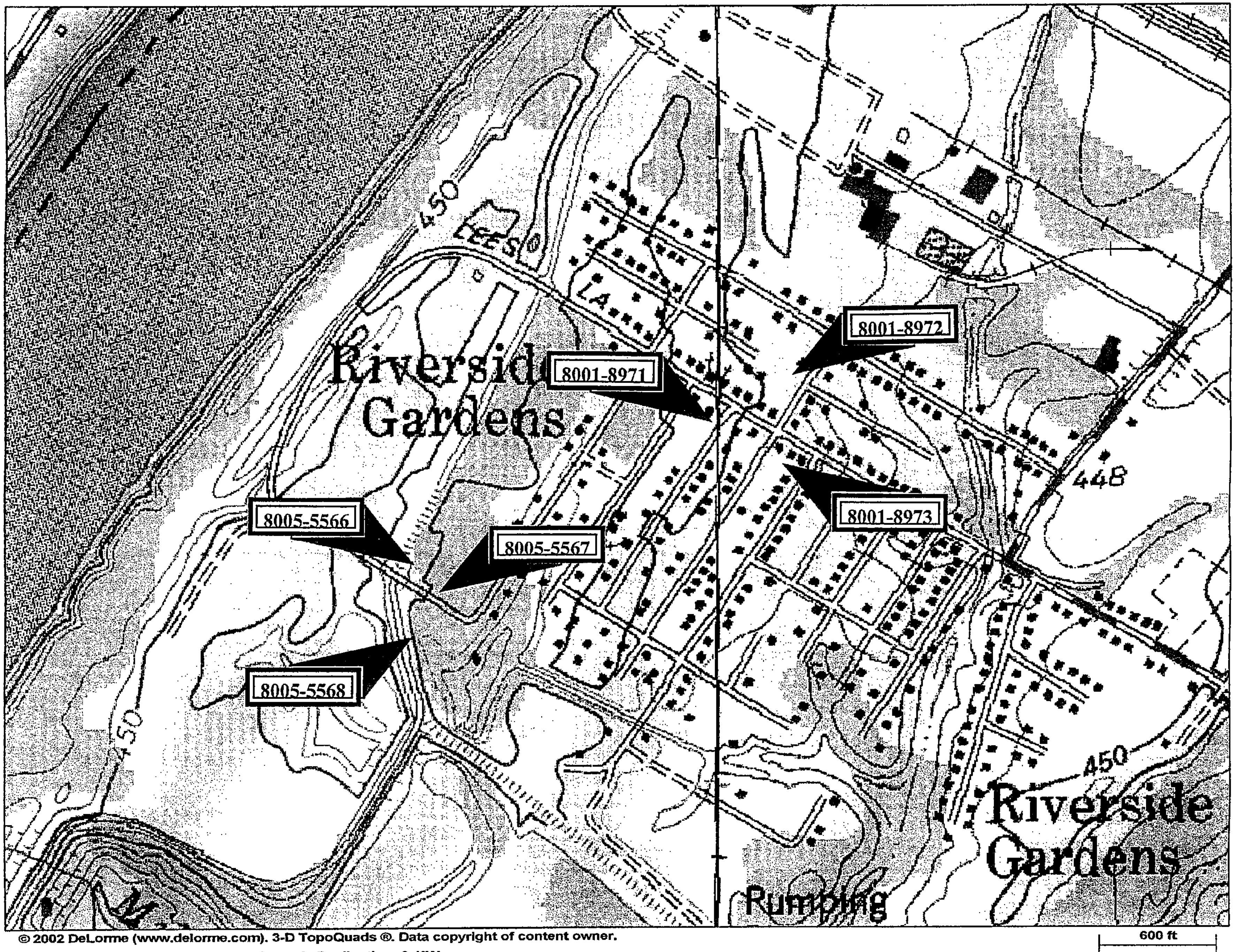
Sincerely,

TESTECH, INC.

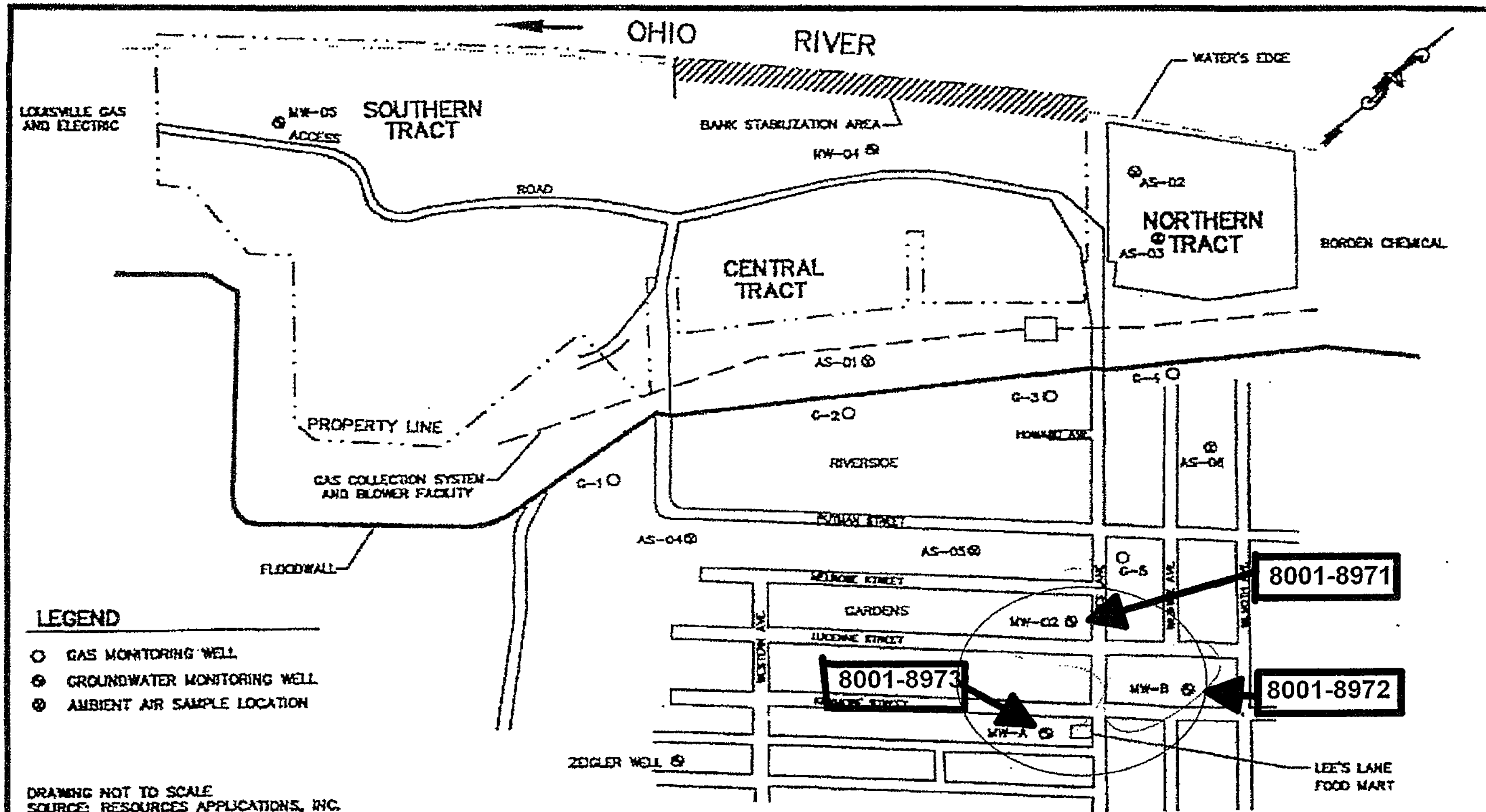
Gil W. Cumbee, PG, CMWD
Registered Professional Geologist
Certified Monitoring Well Driller

cc: Kyle R. Hagen, PE, Smith Management Group
Gregory Reid, TesTech, Inc.


8001-8971
8001-8972
8001-8973
8005-5566
8005-5567
8005-5568
Riverside Gardens
Riverside Gardens
Lake Dreamland
Arrowhead Lake
FIVE MILE LN
FIVEMILE LA
BUDD RD
Bailey Cem
Embury Ch
Corner
Tailings Ponds
Wells
Wells
Park
Park
Mile 614
Mile 615
Light
T 3 S
T 4 S
BM 430
Pumping Sta
Farnsley Cem
Wellington Sch
Powerplant
Settling Pond
Trailer Park
Trailer Park
Trailer Park
GARRISON DITCH
Mill Creek Cutoff
RIVER
Knob
Creek
DELORME
© 2002 DeLorme. 3-D TopoQuads ®. Data copyright of content owner.
www.delorme.com
Scale 1 : 24,000
1" = 2000 ft
TN
MN
3.4°W



Scale: 1 : 8,000 Map Rotation: 0° Magnetic Declination: 3.4°W



ARCS / LEE'S LANE LANDFILL
LOUISVILLE, KENTUCKY

SAMPLING LOCATIONS

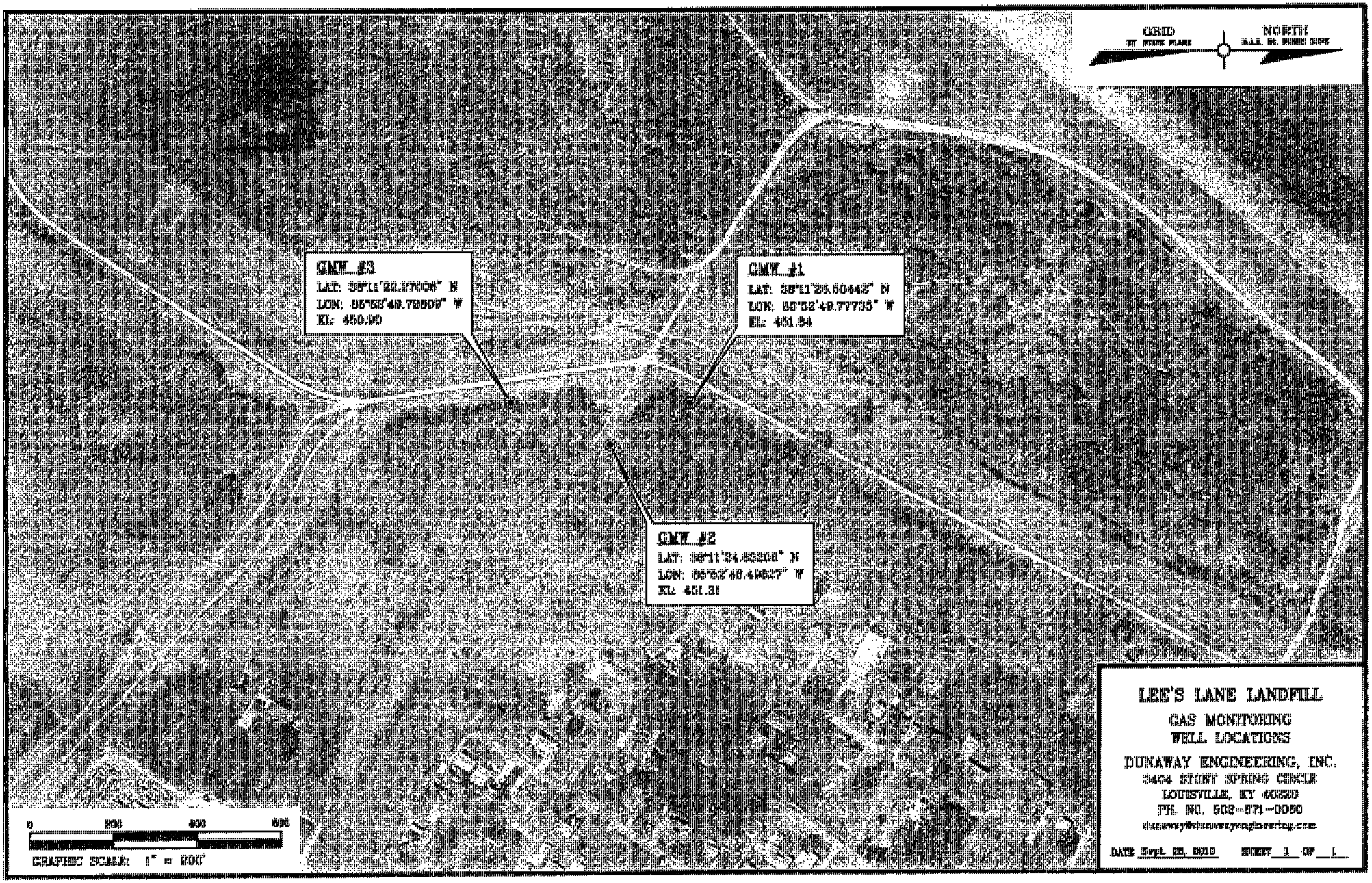
FIGURE 3-1

ROY F. WESTON, INC.

WESTON

MANAGERS DESIGNERS/CONSULTANTS

DRAWN	DATE	DES. ENG.	DATE	W. O. NO.
WRS	9/97			04400-083
CHECKED	DATE	APPROVED	DATE	DWG. NO.
				LEESL2-2


GRID
NORTH
GMW #3
GMW #1
GMW #2
LEE'S LANE LANDFILL
GAS MONITORING
WELL LOCATIONS
DUNAWAY ENGINEERING, INC.
LOUISVILLE, KY
SHEET 1 OF 1
0
200
400
600
GRAPHIC SCALE: 1" = 200'

UNIFORM KENTUCKY WELL MAINTENANCE AND PLUGGING RECORD

Use this form to report plugging and maintenance of wells. Do not write in shaded areas.
Original copy must be submitted to Division of Water within 30 days of completion.
Record must be typed or neatly printed or it will be returned to the driller as unacceptable.
Original to Division of Water, copy to owner, copy to driller's files.

1. Kentucky Well ID (AKGWA) Number: 8001 - 8971

2. Owner Well ID #: MW-02

4. Owner name: U.S. Environmental Protection Agency, Region 4

5. Owner address: 61 Forsyth SW Mail Code: 9T25

6. City: Atlanta **7. State:** GA **8. Zip:** 30303

3. Attachments

Required
1. Site plan or sketch map ☒
2. Well location
   - On topographic map, OR ☒
   - Obtained by GPS unit ☐

Conditionally Required
3. Well diagram (monitoring well) ☒
4. Coliform analysis (if applicable) ☐
5. Signed variance (if applicable) ☐

Optional
6. Other laboratory analysis report ☐

If site name and address differ from owner name and address:

9. Site name: Lee's Lane Landfill Superfund Site

10. Site address: Lee's Lane / Riverside Gardens Community

11. City: Louisville **12. State:** KY **13. Zip:** 40216

14. Agency Interest (AI) Number:

15. Facility type & ID Number: ☒ CERCLA ☐ Solid Waste ☐ Drinking Water ☐ RCRA ☐ UST
ID Number: KYD980557052

23. Work start date: Sep (Month) 07 (Day) 2010 (Year)

24. Work end date: Sep (Month) 10 (Day) 2010 (Year)

16. Owner phone:

17. Site phone:

25. Well status: ☐ Active ☐ Lost / destroyed ☐ Inactive ☐ Unsuitable for intended use ☒ Plugged

18. USGS topo map: Lanesville

19. County: Jefferson

20. Surface elevation (ft): 450.00

21. Elevation determined by: ☐ GPS ☒ Map ☐ Prior report ☐ Survey ☐ Prior well log

22. Physiographic Region: ☐ Bluegrass ☒ Ohio River Alluvium ☐ E. Coal Field ☐ W. Coal Field ☐ Miss. Plateau ☐ Jackson Purchase

26. Work type: ☐ Rework ☒ Plugged ☐ Deepen ☐ Excavated

27. Well Use: ☐ Agriculture ☐ Geothermal ☐ Commercial ☐ Heat pump ☐ Domestic ☐ HVAC ☐ Industrial ☐ Injection ☒ Monitoring / Remed Ambient Moi ☐ Mining ☐ Public ☐ Unused

28. Drilling method: ☒ Auger - HS ☐ Jet wash ☐ Auger - SS ☐ Push/probe ☐ Auger - bucket ☐ Rotary - air ☐ Auger - hand ☐ Rotary - mud ☐ Cable tool ☐ Rotary - reverse ☐ Core ☐ Sand point ☐ Driven casing ☐ Sonic ☐ Excavation ☐ Unknown ☐ Combined – HS auger & air rotary

29. Well specifications
- Total depth (ft): 98.00
- Casing diameter (in): 4.00
- Casing material: Stainless steel
- Screened interval: From depth, ft. 93.15 To depth, ft. 98.00

30. Replacement: ☐ Replace screen ☐ Replace improper seal ☐ Other:
Reason for replacement:

31. Repair: ☐ Repair concrete pad ☐ Repair steel protective casing ☐ Repair casing ☐ Extend casing above ground ☐ Install liner ☐ Install packer

32. Plugging sealing material

From depth, ft.	To depth, ft.	Material
0.0	1.5	Backfill - native
1.5	103	Bentonite grout

33. Plugging activity
- ☐ Well casing pulled, borehole grouted bottom to top
- ☒ Well overdrilled, casing-screen-grout-filter pack removed, borehole grouted bottom to top
- ☐ Casing cut-off (minimum 5 feet BGL), borehole grouted bottom to top
- ☐ Permanent bridge installed over void, borehole grouted bottom to top
- ☐ Well casing pulled, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Well overdrilled, casing-screen-grout-filter pack removed, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Casing cut-off (minimum 5 feet BGL), borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Permanent bridge installed over void, borehole filled with gravel/sand bottom to SWL and grouted SWL to top

34. Maintenance / cleaning
☐ Screen blocked by: ☐ sediment ☐ biological activity ☐ mineral deposition
☐ Well filled with sediment
☐ Corrosion ☐ Other
How cleaned? ☐ Mechanical removal ☐ Chemical treatment
Cleaning method:

Latitude: DMS ___° ___' ___" or Decimal ___°

Longitude: DMS ___° ___' ___" or Decimal ___°

Lat/Long method: ☐ INT ☐ GPS ☐ SUR ☐ REP

49. Comments
Overdrilled 4" stainless steel well casing w/ 6.25" ID HSA to 103'. Removed all well casing & screen materials

50. Affirmation: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge. Note: the driller is not responsible for natural groundwater quality or quantity encountered while drilling or completing this well.

Signature of certified driller: [signature]

Date signed: Oct (Month) 02 (Day) 2010 (Year)

Certification number: 0448-0455-00

Drilling company: TesTech, Inc.

Date Received:

Initials of record reviewer:

rev 04/11/2008

UNIFORM KENTUCKY WELL MAINTENANCE AND PLUGGING RECORD

Use this form to report plugging and maintenance of wells. Do not write in shaded areas.
Original copy must be submitted to Division of Water within 30 days of completion.
Record must be typed or neatly printed or it will be returned to the driller as unacceptable.
Original to Division of Water, copy to owner, copy to driller's files.

1. Kentucky Well ID (AKGWA) Number: 8001 - 8973

2. Owner Well ID #: MW-A

4. Owner name: U.S. Environmental Protection Agency, Region 4

5. Owner address: 61 Forsyth SW Mail Code: 9T25

6. City: Atlanta **7. State:** GA **8. Zip:** 30303

3. Attachments

Required
1. Site plan or sketch map ☒
2. Well location
   - On topographic map, OR ☒
   - Obtained by GPS unit ☐

Conditionally Required
3. Well diagram (monitoring well) ☒
4. Coliform analysis (if applicable) ☐
5. Signed variance (if applicable) ☐

Optional
6. Other laboratory analysis report ☐

If site name and address differ from owner name and address:

9. Site name: Lee's Lane Landfill Superfund Site

10. Site address: Lee's Lane / Riverside Gardens Community

11. City: Louisville **12. State:** KY **13. Zip:** 40216

14. Agency Interest (AI) Number:

15. Facility type & ID Number: ☒ CERCLA ☐ Solid Waste ☐ Drinking Water ☐ RCRA ☐ UST — KYD980557052

23. Work start date: Sep (Month) 07 (Day) 2010 (Year)

24. Work end date: Sep (Month) 13 (Day) 2010 (Year)

16. Owner phone: **17. Site phone:**

25. Well status: ☐ Active ☐ Lost / destroyed ☐ Inactive ☐ Unsuitable for intended use ☒ Plugged

18. USGS topo map: Louisville West

19. County: Jefferson

20. Surface elevation (ft): 450.00

21. Elevation determined by: ☐ GPS ☒ Map ☐ Prior report ☐ Survey ☐ Prior well log

22. Physiographic Region: ☐ Bluegrass ☒ Ohio River Alluvium ☐ E. Coal Field ☐ W. Coal Field ☐ Miss. Plateau ☐ Jackson Purchase

26. Work type: ☐ Rework ☒ Plugged ☐ Deepen ☐ Excavated

27. Well Use: ☐ Agriculture ☐ Geothermal ☐ Commercial ☐ Heat pump ☐ Domestic ☐ HVAC ☐ Industrial ☐ Injection ☒ Monitoring / Remed — Ambient Mo ☐ Mining ☐ Public ☐ Unused

28. Drilling method: ☒ Auger - HS ☐ Jet wash ☐ Auger - SS ☐ Push/probe ☐ Auger - bucket ☐ Rotary - air ☐ Auger - hand ☐ Rotary - mud ☐ Cable tool ☐ Rotary - reverse ☐ Core ☐ Sand point ☐ Driven casing ☐ Sonic ☐ Excavation ☐ Unknown ☐ Combined -- HS auger & air rotary

29. Well specifications
- Total depth (ft): 58.05
- Casing diameter (in): 4.00
- Casing material: Stainless steel
- Screened interval: From depth, ft. 48.05 — To depth, ft. 58.05

30. Replacement: ☐ Replace screen ☐ Replace improper seal ☐ Other:
Reason for replacement:

31. Repair: ☐ Repair concrete pad ☐ Repair steel protective casing ☐ Repair casing ☐ Extend casing above ground ☐ Install liner ☐ Install packer

32. Plugging sealing material

From depth, ft.	To depth, ft.	Material
0.0	1.5	Backfill - native
1.5	65.0	Bentonite grout

33. Plugging activity
- ☐ Well casing pulled, borehole grouted bottom to top
- ☒ Well overdrilled, casing-screen-grout-filter pack removed, borehole grouted bottom to top
- ☐ Casing cut-off (minimum 5 feet BGL), borehole grouted bottom to top
- ☐ Permanent bridge installed over void, borehole grouted bottom to top
- ☐ Well casing pulled, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Well overdrilled, casing-screen-grout-filter pack removed, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Casing cut-off (minimum 5 feet BGL), borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Permanent bridge installed over void, borehole filled with gravel/sand bottom to SWL and grouted SWL to top

34. Maintenance / cleaning: ☐ Screen blocked by: ☐ sediment ☐ biological activity ☐ mineral deposition ☐ Well filled with sediment ☐ Corrosion ☐ Other
How cleaned? ☐ Mechanical removal ☐ Chemical treatment
Cleaning method:

Latitude: DMS ___ ° ___ ' ___ " or Decimal ___ °

Longitude: DMS ___ ° ___ ' ___ " or Decimal ___ °

Lat/Long method: ☐ INT ☐ GPS ☐ SUR ☐ REP

49. Comments

Overdrilled 4" stainless steel well casing w/ 6.25" ID HSA to 65.0'. Removed all well casing & screen materials

50. Affirmation: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge. Note: the driller is not responsible for natural groundwater quality or quantity encountered while drilling or completing this well.

Signature of certified driller: [signature]

Date signed: Oct (Month) 02 (Day) 2010 (Year)

Date Received:

Certification number: 0448-0455-00

Drilling company: TesTech, Inc.

Initials of record reviewer:

rev 04/11/2008

UNIFORM KENTUCKY WELL MAINTENANCE AND PLUGGING RECORD

Use this form to report plugging and maintenance of wells. Do not write in shaded areas.
Original copy must be submitted to Division of Water within 30 days of completion.
Record must be typed or neatly printed or it will be returned to the driller as unacceptable.
Original to Division of Water, copy to owner, copy to driller's files.

4. Owner name: U.S. Environmental Protection Agency, Region 4

1. Kentucky Well ID (AKGWA) Number: 8001 - 8972

5. Owner address: 61 Forsyth SW Mail Code: 9T25

2. Owner Well ID #: MW-B

6. City: Atlanta **7. State:** GA **8. Zip:** 30303

3. Attachments

Required
1. Site plan or sketch map ☒
2. Well location
   - On topographic map, OR ☒
   - Obtained by GPS unit ☐

Conditionally Required
3. Well diagram (monitoring well) ☒
4. Coliform analysis (if applicable) ☐
5. Signed variance (if applicable) ☒

Optional
6. Other laboratory analysis report ☐

If site name and address differ from owner name and address:

9. Site name: Lee's Lane Landfill Superfund Site

10. Site address: Lee's Lane / Riverside Gardens Community

11. City: Louisville **12. State:** KY **13. Zip:** 40216

14. Agency Interest (AI) Number:

15. Facility type & ID Number: ☒ CERCLA ☐ Solid Waste ☐ Drinking Water ☐ RCRA ☐ UST — KYD980557052

23. Work start date: Sep (Month) 07 (Day) 2010 (Year)

24. Work end date: Sep (Month) 09 (Day) 2010 (Year)

16. Owner phone:

17. Site phone:

25. Well status: ☐ Active ☐ Inactive ☒ Plugged ☐ Lost / destroyed ☐ Unsuitable for intended use

18. USGS topo map: Louisville West

19. County: Jefferson

20. Surface elevation (ft): 450.00

21. Elevation determined by: ☐ GPS ☒ Map ☐ Prior report ☐ Survey ☐ Prior well log

22. Physiographic Region: ☐ Bluegrass ☒ Ohio River Alluvium ☐ E. Coal Field ☐ W. Coal Field ☐ Miss. Plateau ☐ Jackson Purchase

26. Work type: ☐ Rework ☒ Plugged ☐ Deepen ☐ Excavated

27. Well Use: ☐ Agriculture ☐ Geothermal ☐ Commercial ☐ Heat pump ☐ Domestic ☐ HVAC ☐ Industrial ☐ Injection ☒ Monitoring / Remed Ambient Mon ☐ Mining ☐ Public ☐ Unused

28. Drilling method: ☒ Auger - HS ☐ Auger - SS ☐ Auger - bucket ☐ Auger - hand ☐ Cable tool ☐ Core ☐ Driven casing ☐ Excavation ☐ Combined – HS auger & air rotary ☐ Jet wash ☐ Push/probe ☐ Rotary - air ☐ Rotary - mud ☐ Rotary - reverse ☐ Sand point ☐ Sonic ☐ Unknown

29. Well specifications
- Total depth (ft): 67.50
- Casing diameter (in): 4.00
- Casing material: Stainless steel
- Screened interval: From depth, ft. 57.5 To depth, ft. 67.5

30. Replacement: ☐ Replace screen ☐ Replace improper seal ☐ Other:
Reason for replacement:

31. Repair: ☐ Repair concrete pad ☐ Repair steel protective casing ☐ Repair casing ☐ Extend casing above ground ☐ Install liner ☐ Install packer

32. Plugging sealing material

From depth, ft.	To depth, ft.	Material
0.0	1.5	Backfill - native
1.5	67.5	Bentonite grout

33. Plugging activity
- ☐ Well casing pulled, borehole grouted bottom to top
- ☐ Well overdrilled, casing-screen-grout-filter pack removed, borehole grouted bottom to top
- ☒ Casing cut-off (minimum 5 feet BGL), borehole grouted bottom to top
- ☐ Permanent bridge installed over void, borehole grouted bottom to top
- ☐ Well casing pulled, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Well overdrilled, casing-screen-grout-filter pack removed, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Casing cut-off (minimum 5 feet BGL), borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Permanent bridge installed over void, borehole filled with gravel/sand bottom to SWL and grouted SWL to top

34. Maintenance / cleaning
☐ Screen blocked by: ☐ sediment ☐ biological activity ☐ mineral deposition
☐ Well filled with sediment
☐ Corrosion ☐ Other
How cleaned? ☐ Mechanical removal ☐ Chemical treatment
Cleaning method:

Latitude: DMS ° ' " or Decimal °

Longitude: DMS ° ' " or Decimal °

49. Comments
Cut off 4" stainless steel well casing below grade. Used tremie to place grout from bottom to near surface

50. Affirmation: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge. Note: the driller is not responsible for natural groundwater quality or quantity encountered while drilling or completing this well.

Lat/Long method: ☐ INT ☐ GPS ☐ SUR ☐ REP

Signature of certified driller: [signature]

Date signed: Oct (Month) 02 (Day) 2010 (Year)

Date Received:

Certification number: 0448-0455-00

Drilling company: TesTech, Inc.

Initials of record reviewer:

KENTUCKY MONITORING WELL VARIANCE REQUEST

Pursuant to 401 KAR 6:350

GENERAL INFORMATION

Requested by: [signature] Received by: JM

Certification Number: 098-0455-10 Date of Request: 10 (Month) 26 (Day) 2009 (Year)

Drilling Company: Testech Inc Time of Request: Hour Min am/pm

WELL LOCATION

Quadrangle: Willard

County: Jefferson

AKGWA Number: ____ - ____ NA

WELL OWNER IDENTIFICATION

Well Owner: USEPA Telephone: ______

Address: 61 Forsyth SW Mail Code: 9T25

City: Atlanta State: GA Zip Code: 30303-8960

Contact: Mr. Femi Akindele

EFFECTIVE DATES

Well Construction Date: ± 1986 Month Day Year

Well must be completed on or before: Month Day Year

REASON FOR VARIANCE

Location of wells will prevent the pulling of casing & overdrilling of wells

Applicable Regulation: 401 KAR 6:350 Section: 1(6)

WELL CHARACTERISTICS

Depth to: Estimated / Exact

Bedrock: unk ft ☐ ☐

Water Bearing Unit: 25-50 ft ☒ ☐

Type of Bedrock: ______

WELL CONSTRUCTION REQUIREMENTS

☐ The Kentucky Division of Water is issuing you a one time temporary water well variance as a certified monitoring well driller to plug a water well located at the following location: ______

Please include a copy of this variance request along with the plugging record that you submit.

☐ The Kentucky Division of Water is issuing you a one time temporary monitoring well construction variance due to the shallow water zone to be monitored at this site. This monitoring well construction variance is for the approval of the shorter intervals of the sand/filter packs and the Bentonite seals installed at ______

See attached DOW comments

Please include a copy of this variance request along with the monitoring well records that you submit.

☒ The Kentucky Division of Water is issuing you a one time temporary Abandonment variance due to Accessibility at this site. This variance is for the approval of Alternative plugging / Abandonment Procedure for wells installed at 38° 11' 34"/85° 52' 30" (MW-2), 38° 11' 37"/85° 52' 26" (MW-B) and 38° 11' 32"/85° 52' 26" (MW-A)

Please include a copy of this variance request along with the records that you submit.

SEALING MATERIALS REQUIRED FOR PLUGGING

Type: Concrete Grout

ADDITIONAL REQUIREMENTS

Sketch map must be provided.

THIS VARIANCE IS NOT VALID UNLESS SIGNED BY THE CERTIFIED WELL DRILLER AND THE WELL OWNER

DRILLER AFFIRMATION

I, the undersigned, agree to construct the above described well in accordance with all water well construction practices and standards established by the Kentucky Environmental and Public Protection Cabinet and in accordance with those conditions described in this variance request. I will be held financially responsible for remedial measures for this well if I fail to construct the well in compliance with the conditions established in this variance request.

Signature: [signature] Date: 10 (Month) 26 (Day) 2009 (Year)

DIVISION OF WATER AFFIRMATION

Signature: Joe Moffett Date: 11 (Month) 25 (Day) 09 (Year)

WELL OWNER AFFIRMATION

I, the undersigned, understand the above described well is not in compliance with the water well construction practices and standards established by the Kentucky Environmental and Public Protection Cabinet. I acknowledge that the driller has requested a variance to allow the well to be constructed according to the conditions described in this variance request. By signing below, I give my permission for the well to be constructed as described above. If this variance well is constructed to the specifications of this variance and results in degradation of groundwater quality, I will be financially responsible for remedial measures for this well, including plugging, if necessary.

Signature: ______ Date: Month Day Year

Division of Water – Watershed Management Branch, 200 Fair Oaks Lane, Frankfort, KY 40601 (502) 564-3410 rev 04/11/2008

Distribution: One copy to Division of Water, one copy to well owner, one copy to driller's files.

UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

Use this form to report installation of monitoring or water wells.
Original copy must be submitted to Division of Water within 30 days of completion.
See instructions on reverse of form. Do not write in shaded areas.
Record must be typed or neatly printed or it will be returned to the driller as unacceptable.
One copy to Division of Water, one copy to owner, one copy to driller's files.

8005- 5566

Field	Entry
1. Kentucky Well ID (AKGWA) Number	8005 - 5566
2. Owner Well ID #	GMW-1
4. Owner name	U. S. Environmental Protection Agency, Region 4
5. Owner address	61 Forsyth SW Mail Code: 9T25
6. City	Atlanta
7. State	GA
8. Zip	30303

If site name and address differ from owner name and address:

Field	Entry
9. Site name	Lee's Lane Landfill Superfund Site
10. Site address	Lee's Lane
11. City	Louisville
12. State	KY
13. Zip	40216

3. Attachments
Required
1. Site plan or sketch map [x]
2. Well location
   - On topographic map, OR [x]
   - Obtained by GPS unit [ ]

Conditionally Required
3. Well diagram (monitoring well) [x]
4. Coliform analysis (if applicable) [ ]
5. Signed variance (if applicable) [ ]

Optional
6. Other laboratory analysis report [ ]

14. Agency Interest (AI) Number:
15. Facility type & ID Number: [x] CERCLA [ ] Solid Waste [ ] Drinking Water [ ] RCRA [ ] UST — ID Number KYD980557052

31. Work start date: Sep 15 2010 (Month Day Year)
32. Work end date: Sep 16 2010 (Month Day Year)

16. Owner phone:
17. Site phone:

Please report depths in feet below surface, not as relative elevations

18. USGS topo map: Lanesville
19. County: Jefferson
20. Surface elevation (ft): 449.32
21. Elevation determined by: [ ] GPS [ ] Map [ ] Prior report [x] Survey [ ] Prior well log
22. Physiographic Region: [ ] Bluegrass [x] Ohio River Alluvium [ ] E. Coal Field [ ] W. Coal Field [ ] Miss. Plateau [ ] Jackson Purchase

33. Total depth (ft): 26.00
34. Depth to bedrock (ft): N/A
35. Static water level (ft): N/A
36. Casing height above surface (in): 30.24

23. Well Use: [ ] Agriculture [ ] Geothermal [ ] Commercial [ ] Heat pump [ ] Domestic [ ] HVAC [ ] Industrial [ ] Injection [x] Monitoring / Remed — Ambient Monitori [ ] Mining [ ] Public [ ] Unused

24. Drilling method: [x] Auger - HS [ ] Jet wash [ ] Auger - SS [ ] Push/probe [ ] Auger - bucket [ ] Rotary - air [ ] Auger - hand [ ] Rotary - mud [ ] Cable tool [ ] Rotary - reverse [ ] Core [ ] Sand point [ ] Driven casing [ ] Sonic [ ] Excavation [ ] Unknown [ ] Combined – HS auger & air rotary

25. Well status: [x] Active [ ] Inactive [ ] Unsuitable for intended use

26. Wellhead: [ ] Flush [ ] Locking [x] Well cap [ ] Sanitary seal

WATER WELLS ONLY

37. Estimated well yield ____ [ ] gpm [ ] gph [ ] gpd
38. Well service ____ # of people served
39. Disinfectant amount ____ [ ] oz [ ] qts [ ] cups [ ] lbs [ ] gal
40. Type [ ] Bleach [ ] Hypo-chlorite
41. Pitless adapter installed [ ] Yes [ ] No
42. Pump installed: [ ] Submersible [ ] Jet [ ] Turbine [ ] Bailer or bucket [ ] Hand [ ] No pump
43. Depth to intake (ft) ____
44. Apparent quality and odor:
APPEARANCE: [ ] Clear [ ] Cloudy [ ] Muddy [ ] Turbid
ODOR (none / slight / mod / high): Iron, Sulfur, Salt

27. Well completion: Casing and screens

From depth, ft.	To depth, ft.	Borehole diameter	Casing diameter	Casing type	Screen slot size
0.00	4.85	6.25	2"	PVC	
4.85	24.99	6.25	2"	PVC screen	0.25"

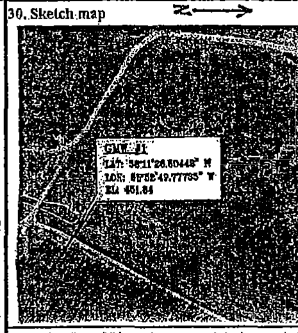
28. Annulus fill and seal

From depth, ft.	To depth, ft.	Material
0.00	1.20	Mixture - bentonite / cemen
1.20	4.50	Bentonite pellets
4.50	26.00	Gravel

29. Lithologic log (if more space is needed, continue on separate page)

From depth, ft.	To depth, ft.	Description (include any show of water and indicate apparent quality)
		See attached Soil Boring Log
		for GMW-1 by
		Smith Management Group

30. Sketch map



Show well location and distances from permanent structures, septic drain fields, major roads (include name or number) and intersections. INDICATE NORTH WITH AN ARROW.

COLIFORM TEST
45. Coliform test type [ ] fecal [ ] fecal and total
46. Coliform test results [ ] 0 or <1.0 [ ] TNTC [ ] Confluent or ____ # colonies per 100 ml
47. Date Sampled — Day Year
48. Date Analyzed — Month Day Year

Latitude: DMS ° ' " or Decimal °
Longitude: DMS ° ' " or Decimal °
Lat/Long method [ ] INT [ ] GPS [ ] SUR [ ] REP

49. Comments
Well Installed as Soil Gas Monitoring Well GMW-1.

50. Affirmation: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge. Note: the driller is not responsible for natural groundwater quality or quantity encountered while drilling or completing this well.

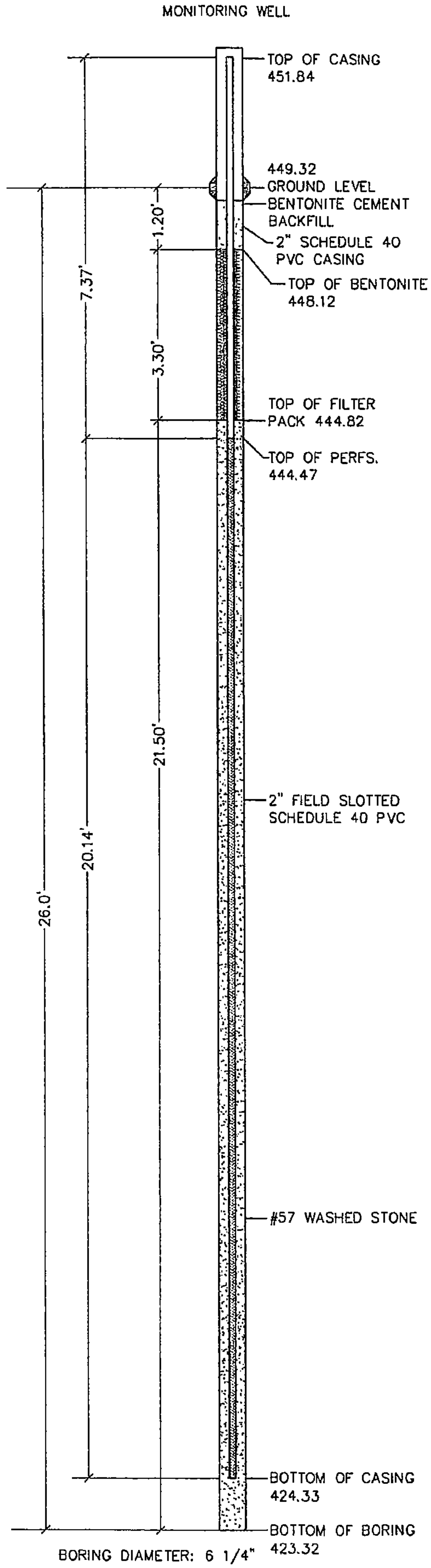
Signature of certified driller: [signature]
Date signed: Oct 08 2010 (Month Day Year)

Certification number: 0448-0455-00
Drilling company: Tes Tech, Inc.

Date Received
Initials of reviewer

rev 04/11/2008

GMW-1
8005-5566



METHOD OF INSTALLATION

6 1/4" OD HSA
CME 550X

SMITH MANAGMENT GROUP

LEE'S LANE LANDFILL

CITY OF LOUISVILLE — JEFFERSON COUNTY, KENTUCKY

SCALE: N/A		DATE: SEPTEMBER 15, 2010	
DESIGN WEH	TESTECH	8534 YANKEE STREET DAYTON, OHIO 45458-1833 OFFICE (937) 435-3200 FAX (937) 291-6549 email: testech@testechinc.com www.testechinc.com	PROJECT 26304
DRAWN CTT			BORING NO. GMW-1
CHKED WEH			AKGWA NO. 8005-5566

SOIL BORING LOG

Smith Management Group

BORE NUMBER:	GMW-1	LOCATION:	Lees Lane Landfill, Louisville, KY
DATE:	9/15/2010	WEATHER:	Clear 70° F
LOGGED BY:	Joe Sandman	DRILLED BY:	TesTech Inc.
DRILLING METHOD:	CME 55, 4.25 "Hollow Stem Augers	SAMPLING METHOD:	Split Spoon Samplers
TOTAL DEPTH:	26 Ft Below Grade	HOLE DIA:	7.5-inches

ELEVATION:

SAMPLE NO.	PID (ppm)	DEPTH	LITHOLOGY / REMARKS
		0	Sample 0-2', Recover 2.1'
		1	Gray & Brown Silty Mottled Clay, Stiff, Moist, No Odors
		2	Sample 2-4', Recover 1.9'
		3	Gray & Brown Silty Mottled Clay, Soft, Moist, No Odors
		4	Sample 4-6', Recover 2.0'
		5	Gray & Brown Silty Mottled Clay, Stiff, Moist, No Odors
		6	Sample 6-8', Recover 1.8'
		7	Gray & Brown Silty Mottled Clay, Medium Stiff, Moist, No Odors
		8	Sample 8-10', Recover 0.5'
		9	Brown Silty Clay and Very Fine Sand, Soft, Moist, No Odors
		10	Sample 10-12', Recover 1.5'
		11	Very Fine Silty Sand, Soft, Moist, No Odors
		12	Sample 12-14', Recover 1.2'
		13	Fine Brown Sand, Loose, Moist, No Odor
		14	Sample 14-16', Recover 1.7'
		15	Very Fine Brown Sand, Loose, Moist, No Odors
		16	Sample 16-18', Recover 1.65'
		17	Very Fine Brown Sand, Very Loose, Moist, No Odors
		18	Sample 18-20', Recover 1.72'
		19	Very Fine Brown Sand, Very Loose, Moist, No Odors
		20	Sample 20-22', Recover 1.5'
		21	Very Fine Brown Sand,Loose, Moist, No Odors
		22	Sample 22-24', Recover 1.68'
		23	Very Fine Brown Sand, Loose, Moist, No Odors
		24	Sample 24-26', Recover 1.4
		25	Fine Brown Sand, Loose, Moist, No Odor
		26	
		27	Total Depth Of Boring 26 Feet Below Surface Grade. No Water Was Encountered.
		28	Completed Boring As A Soil Gas Monitoring Well Labeled GMW-1.
		29	
		30	

UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

Use this form to report installation of monitoring or water wells.
Original copy must be submitted to Division of Water within 30 days of completion.
See instructions on reverse of form. Do not write in shaded areas.
Record must be typed or neatly printed or it will be returned to the driller as unacceptable.
One copy to Division of Water, one copy to owner, one copy to driller's files.

8005-5567

1. Kentucky Well ID (AKGWA) Number: 8005 - 5567

2. Owner Well ID #: GMW-2

4. Owner name: U. S. Environmental Protection Agency, Region 4

5. Owner address: 61 Forsyth SW Mail Code: 9T25

6. City: Atlanta | 7. State: GA | 8. Zip: 30303

3. Attachments
Required
1. Site plan or sketch map ☒
2. Well location
   - On topographic map, OR ☐
   - Obtained by GPS unit ☐

Conditionally Required
3. Well diagram (monitoring well) ☒
4. Coliform analysis (if applicable) ☐
5. Signed varience (if applicable) ☐

Optional
6. Other laboratory analysis report ☐

If site name and address differ from owner name and address:

9. Site name: Lee's Lane Landfill Superfund Site

10. Site address: Lee's Lane

11. City: Louisville | 12. State: KY | 13. Zip: 40216

14. Agency Interest (AI) Number:

15. Facility type & ID Number: ☒ CERCLA ☐ Solid Waste ☐ Drinking Water ☐ RCRA ☐ UST — KYD980557052

31. Work start date: Sep (Month) 14 (Day) 2010 (Year)

32. Work end date: Sep (Month) 16 (Day) 2010 (Year)

16. Owner phone: | 17. Site phone:

Please report depths in feet below surface, not as relative elevations

18. USGS topo map: Lanesville

19. County: Jefferson

20. Surface elevation (ft): 448.80

21. Elevation determined by: ☐ GPS ☐ Map ☐ Prior report ☒ Survey ☐ Prior well log

22. Physiographic Region: ☐ Bluegrass ☒ Ohio River Alluvium ☐ E. Coal Field ☐ W. Coal Field ☐ Miss. Plateau ☐ Jackson Purchase

33. Total depth (ft): 26.00

34. Depth to bedrock (ft): N/A

35. Static water level (ft): N/A

36. Casing height above surface (in): 30.12

23. Well Use: ☐ Agriculture ☐ Commercial ☐ Domestic ☐ Industrial ☒ Monitoring / Remed (Ambient Monitor) ☐ Public ☐ Geothermal ☐ Heat pump ☐ HVAC ☐ Injection ☐ Mining ☐ Unused

24. Drilling method: ☒ Auger - HS ☐ Auger - SS ☐ Auger - bucket ☐ Auger - hand ☐ Cable tool ☐ Core ☐ Driven casing ☐ Excavation ☐ Combined – HS auger & air rotary ☐ Jet wash ☐ Push/probe ☐ Rotary - air ☐ Rotary - mud ☐ Rotary - reverse ☐ Sand point ☐ Sonic ☐ Unknown

25. Well status: ☒ Active ☐ Inactive ☐ Unsuitable for intended use

26. Wellhead: ☐ Flush ☐ Locking ☒ Well cap ☐ Sanitary seal

WATER WELLS ONLY

37. Estimated well yield ____ ☐ gpm ☐ gph ☐ gpd

38. Well service ____ # of people served

39. Disinfectant amount ____ ☐ oz ☐ qts ☐ cups ☐ lbs ☐ gal

40. Type ☐ Bleach ☐ Hypo-chlorite

41. Pitless adapter installed ☐ Yes ☐ No

42. Pump installed: ☐ Submersible ☐ Jet ☐ Turbine ☐ Bailer or bucket ☐ Hand ☐ No pump

43. Depth to intake (ft) ____

44. Apparent quality and odor:
APPEARANCE: ☐ Clear ☐ Cloudy ☐ Muddy ☐ Turbid
ODOR (none / slight / mod / high): ☐ ☐ ☐ ☐ Iron; ☐ ☐ ☐ ☐ Sulfur; ☐ ☐ ☐ ☐ Salt

27. Well completion: Casing and screens

From depth, ft.	To depth, ft.	Borehole diameter	Casing diameter	Casing type	Screen slot size
0.00	4.51	6.25	2"	PVC	
4.51	24.71	6.25	2"	PVC screen	0.25"

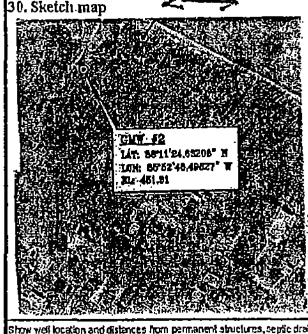
28. Annulus fill and seal

From depth, ft.	To depth, ft.	Material
0.00	2.30	Mixture - bentonite / cemen
2.30	4.20	Bentonite pellets
4.20	26.00	Gravel

29. Lithologic log (if more space is needed, continue on separate page)

From depth, ft.	To depth, ft.	Description (include any show of water and indicate apparent quality)
		See attached Soil Boring Log
		for GMW-2 by
		Smith Management Group

30. Sketch map (N →)



Show well location and distances from permanent structures, septic drain fields, major roads (include name or number) and intersections. *INDICATE NORTH WITH AN ARROW.*

COLIFORM TEST

45. Coliform test type ☐ fecal ☐ fecal and total

46. Coliform test results ☐ 0 or <1.0 ☐ TNTC ☐ Confluent or ____ # colonies per 100 ml

47. Date Sampled: Day Year

48. Date Analyzed: Month Day Year

Latitude: DMS ° ' " or Decimal °

Longitude: DMS ° ' " or Decimal °

Lat/Long method ☐ INT ☐ GPS ☐ SUR ☐ REP

49. Comments

Well Installed as Soil Gas Monitoring Well GMW-2.

50. Affirmation: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge. Note: the driller is not responsible for harmful groundwater quality or quantity encountered while drilling or completing this well.

Signature of certified driller: [signature]

Date signed: Oct (Month) 08 (Day) 2010 (Year)

Date Received

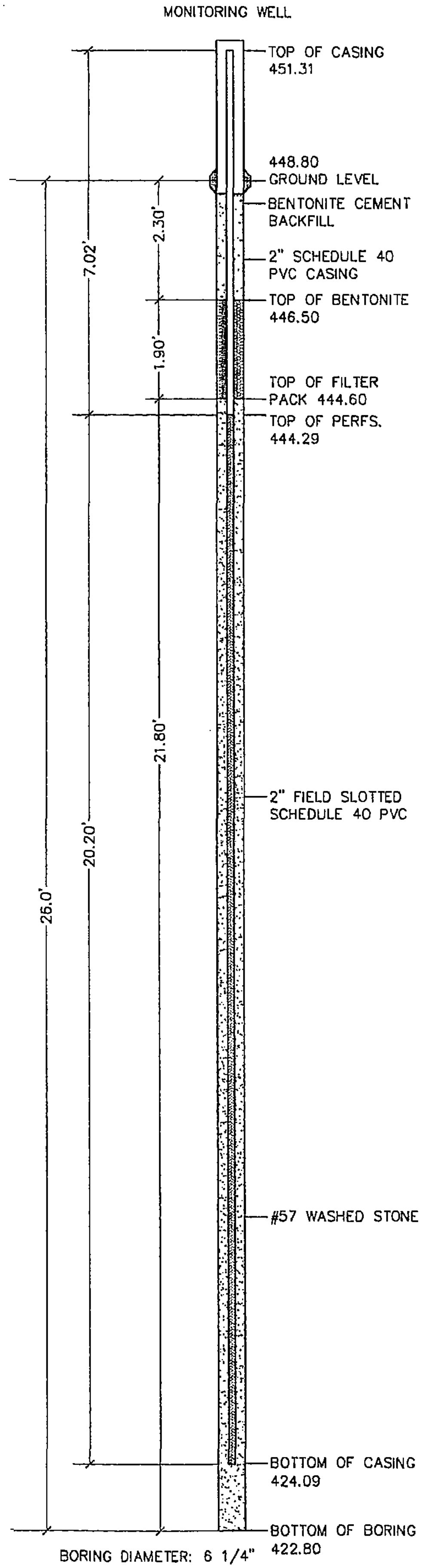
Certification number: 0448-0455-00

Drilling company: Tes Tech, Inc.

Initials of reviewer

rev 04/11/2008

GMW-2
8005-5567



METHOD OF
INSTALLATION

6 1/4" OD HSA
CME 550X

SMITH MANAGMENT GROUP

LEE'S LANE LANDFILL

CITY OF LOUISVILLE — JEFFERSON COUNTY, KENTUCKY

SCALE: N/A		DATE: SEPTEMBER 15, 2010	
DESIGN WEH	TESTECH	8534 YANKEE STREET DAYTON, OHIO 45458-1833 OFFICE (937) 435-3200 FAX (937) 291-6549 email: testech@testechinc.com www.testechinc.com	PROJECT 26304
DRAWN CTT			BORING NO. GMW-2
CHKED WEH			AKGWA NO. 8005-5567

SMG
Smith Management Group

SOIL BORING LOG

BORE NUMBER:	GMW-2	LOCATION:	Lees Lane Landfill, Louisville, KY
DATE:	9/14/2010	WEATHER:	Clear 68° F
LOGGED BY:	Joe Sandman	DRILLED BY:	TesTech Inc.
DRILLING METHOD:	CME 55, 4.25 "Hollow Stem Augers	SAMPLING METHOD:	Split Spoon Samplers
TOTAL DEPTH:	26 Ft Below Grade	HOLE DIA:	7.5-inches

ELEVATION:

SAMPLE NO.	PID (ppm)	DEPTH	LITHOLOGY / REMARKS
		0	Sample 0-2', Recover 2.1' Gray Silt, Very Stiff, Dry, Roots In Top 0.5', No Odors
		2	Sample 2-4', Recover 1.4' Brown Silty Clay, Stiff, Dry, No Odors
		4	Sample 4-6', Recover 1.8' Gray And Brown Silty Clay, Mottled, Stiff, Dry, No Odors
		6	Sample 6-8', Recover 1.8' Gray And Brown Silty Clay, Soft, No odors Very Fine Brown Sand, Loose, Moist, No Odors
		8	Sample 8-10', Recover 1.8' Gray Silt, Soft, Moist, No Odors Very Fine Sand, Loose, Moist, No Odors
		10	Sample 10-12', Recover 1.9' Fine Brown Sand, Loose, Moist, No Odors
		12	Sample 12-14', Recover 0.8' Fine Brown Sand, Loose, Moist, No Odor
		14	Sample 14-16', Recover 1.7' Fine Brown Sand, Loose, Moist, No Odors
		16	Sample 16-18', Recover 1.2' Fine Brown Sand, Very Loose, Moist, No Odors
		18	Sample 18-20', Recover 1.5' Fine Brown Sand, Very Loose, Moist, No Odors
		20	Sample 20-22', Recover 1.1' Fine Brown Sand,Loose, Moist, No Odors
		22	Sample 22-24', Recover 1.9' Fine Brown Sand, Loose, Moist, No Odors
		24	Sample 24-26', Recover 1.7' Medium Sand, Slightly Moist, Loose, No Odors
		26	
		27	Total Depth Of Boring 26 Feet Below Surface Grade. No Water Was Encountered. Completed Boring As A Soil Gas Monitoring Well Labeled GMW-2
		29	
		30	

UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

Use this form to report installation of monitoring or water wells.
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See instructions on reverse of form. Do not write in shaded areas.
Record must be typed or neatly printed or it will be returned to the driller as unacceptable.
One copy to Division of Water, one copy to owner, one copy to driller's files.

8005-5568

1. Kentucky Well ID (AKGWA) Number: 8005 - 5568

2. Owner Well ID #: GMW-3

3. Attachments

Required
- 1. Site plan or sketch map ☒
- 2. Well location
  - On topographic map, OR ☐
  - Obtained by GPS unit ☐

Conditionally Required
- 3. Well diagram (monitoring well) ☒
- 4. Coliform analysis (if applicable) ☐
- 5. Signed variance (if applicable) ☐

Optional
- 6. Other laboratory analysis report ☐

4. Owner name: U. S. Environmental Protection Agency, Region 4

5. Owner address: 61 Forsyth SW Mail Code: 9T25

6. City: Atlanta **7. State:** GA **8. Zip:** 30303

If site name and address differ from owner name and address:

9. Site name: Lee's Lane Landfill Superfund Site

10. Site address: Lee's Lane

11. City: Louisville **12. State:** KY **13. Zip:** 40216

14. Agency Interest (AI) Number:

15. Facility type & ID Number: ☒ CERCLA ☐ Solid Waste ☐ Drinking Water ☐ RCRA ☐ UST — KYD980557052

31. Work start date: Sep (Month) 15 (Day) 2010 (Year)

32. Work end date: Sep (Month) 16 (Day) 2010 (Year)

16. Owner phone:

17. Site phone:

18. USGS topo map: Lanesville

19. County: Jefferson

20. Surface elevation (ft): 448.50

21. Elevation determined by: ☐ GPS ☐ Map ☐ Prior report ☒ Survey ☐ Prior well log

22. Physiographic Region: ☐ Bluegrass ☒ Ohio River Alluvium ☐ E. Coal Field ☐ W. Coal Field ☐ Miss. Plateau ☐ Jackson Purchase

Please report depths in feet below surface, not as relative elevations

33. Total depth (ft): 26.00

34. Depth to bedrock (ft): N/A

35. Static water level (ft): N/A

36. Casing height above surface (in): 28.80

23. Well Use: ☐ Agriculture ☐ Commercial ☐ Domestic ☐ Industrial ☒ Monitoring / Remed: Ambient Monitori ☐ Public ☐ Geothermal ☐ Heat pump ☐ HVAC ☐ Injection ☐ Mining ☐ Unused

24. Drilling method: ☒ Auger - HS ☐ Auger - SS ☐ Auger - bucket ☐ Auger - hand ☐ Cable tool ☐ Core ☐ Driven casing ☐ Excavation ☐ Combined – HS auger & air rotary ☐ Jet wash ☐ Push/probe ☐ Rotary - air ☐ Rotary - mud ☐ Rotary - reverse ☐ Sand point ☐ Sonic ☐ Unknown

25. Well status: ☒ Active ☐ Inactive ☐ Unsuitable for intended use

26. Wellhead: ☐ Flush ☐ Locking ☒ Well cap ☐ Sanitary seal

WATER WELLS ONLY

37. Estimated well yield ____ ☐ gpm ☐ gph ☐ gpd

38. Well service ____ # of people served

39. Disinfectant amount ____ ☐ oz ☐ qts ☐ cups ☐ lbs ☐ gal

40. Type ☐ Bleach ☐ Hypo-chlorite

41. Pitless adapter installed ☐ Yes ☐ No

42. Pump installed: ☐ Submersible ☐ Jet ☐ Turbine ☐ Bailer or bucket ☐ Hand ☐ No pump

43. Depth to intake (ft) ____

44. Apparent quality and odor:

APPEARANCE: ☐ Clear ☐ Cloudy ☐ Muddy ☐ Turbid

ODOR (none / slight / mod / high): Iron ☐ ☐ ☐ ☐; Sulfur ☐ ☐ ☐ ☐; Salt ☐ ☐ ☐ ☐

27. Well completion: Casing and screens

From depth, ft.	To depth, ft.	Borehole diameter	Casing diameter	Casing type	Screen slot size
0.00	4.96	6.25	2"	PVC	
4.96	25.01	6.25	2"	PVC screen	0.25"

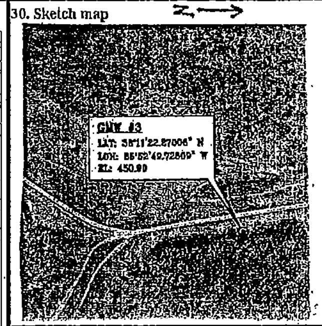
28. Annulus fill and seal

From depth, ft.	To depth, ft.	Material
0.00	0.55	Mixture - bentonite / cemen
0.55	4.20	Bentonite pellets
4.20	26.00	Gravel

29. Lithologic log (if more space is needed, continue on separate page)

From depth, ft.	To depth, ft.	Description (include any show of water and indicate apparent quality)
		See attached Soil Boring Log
		for GMW-3 by
		Smith Management Group

30. Sketch map N ⟶



Show well location and distances from permanent structures, septic drain fields, major roads (include name or number) and intersections. *INDICATE NORTH WITH AN ARROW.*

COLIFORM TEST

45. Coliform test type ☐ fecal ☐ fecal and total

46. Coliform test results ☐ 0 or <1.0 ☐ TNTC ☐ Confluent or ____ # colonies per 100 ml

47. Date Sampled Month Day Year

48. Date Analyzed Month Day Year

Latitude DMS ° ' " or Decimal °

Longitude DMS ° ' " or Decimal °

Lat/Long method ☐ INT ☐ GPS ☐ SUR ☐ REP

49. Comments

Well installed as Soil Gas Monitoring Well GMW-3.

50. Affirmation: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge. Note: the driller is not responsible for natural groundwater quality or quantity encountered while drilling or completing this well.

Signature of certified driller: [signature]

Date signed: Oct (Month) 08 (Day) 2010 (Year)

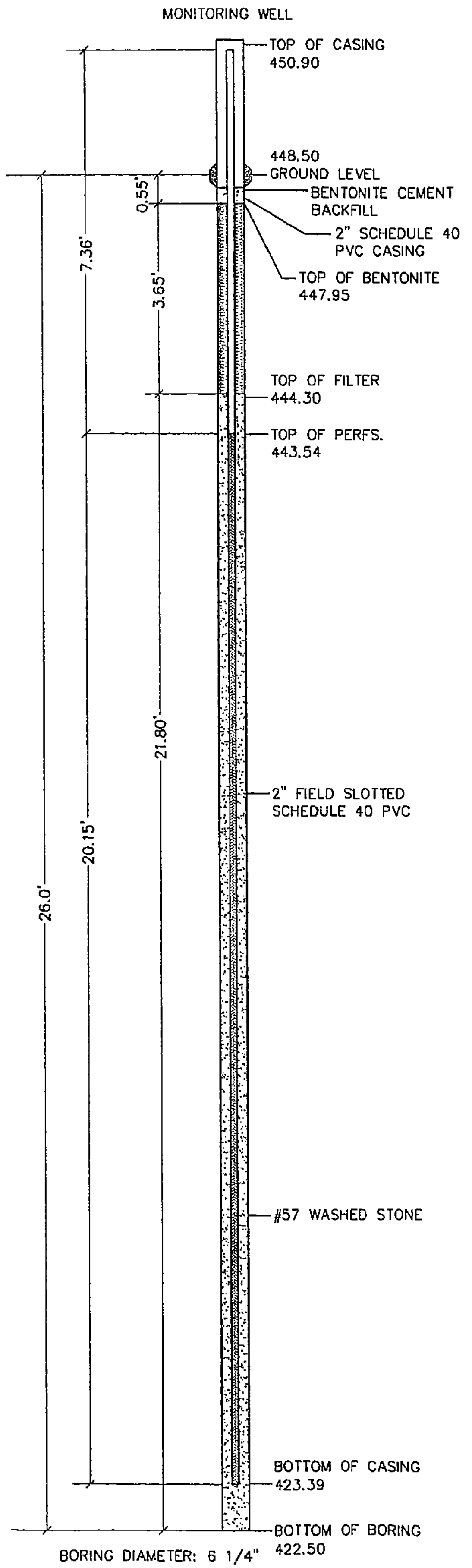
Date Received

Certification number: 0448-0455-00

Drilling company: Tes Tech, Inc.

Initials of reviewer

GMW-3
8005-5568



METHOD OF INSTALLATION

6 1/4" OD HSA
CME 550X

SMITH MANAGMENT GROUP

LEE'S LANE LANDFILL

CITY OF LOUISVILLE — JEFFERSON COUNTY, KENTUCKY

SCALE: N/A — DATE: SEPTEMBER 15, 2010

DESIGN WEH	TESTECH	8534 YANKEE STREET DAYTON, OHIO 45458-1833 OFFICE (937) 435-3200 FAX (937) 291-6549 email: testech@testechinc.com www.testechinc.com	PROJECT 26304
DRAWN CTT			BORING NO. GMW-3
CHKED WEH			AKGWA NO. 8005-5568

SOIL BORING LOG

Smith Management Group

BORE NUMBER:	GMW-3	LOCATION:	Lees Lane Landfill, Louisville, KY
DATE:	9/15/2010	WEATHER:	Clear 68° F
LOGGED BY:	Joe Sandman	DRILLED BY:	TesTech Inc.
DRILLING METHOD:	CME 55, 4.25 "Hollow Stem Augers	SAMPLING METHOD:	Split Spoon Samplers
ELEVATION:			
TOTAL DEPTH:	26 Ft Below Grade	HOLE DIA:	7.5-inches

SAMPLE NO.	PID (ppm)	DEPTH	LITHOLOGY / REMARKS
		0	Sample 0-2', Recover 2.0'
		1	Gray Silty Clay, Very Stiff, Dry, No Odors
		2	Sample 2-4', Recover 1.6'
		3	Brown And Gray Silty Clay, Very Stiff, Dry, No Odors
		4	Sample 4-6', Recover 1.71'
		5	Gray Silty Clay, Very Stiff, Dry, No Odors Gray And Brown Mottled Silty Clay, Very Stiff, Dry
		6	Sample 6-8', Recover 0.0'
		7	
		8	Sample 8-10', Recover 0.98'
		9	Very Fine Silty Brown Sand, Loose, moist, No Odors
		10	Sample 10-12', Recover 1.89'
		11	Very Fine Brown Silty Sand, Loose, Moist, No Odors
		12	Sample 12-14', Recover 0.0'
		13	
		14	Sample 14-16', Recover 1.86'
		15	Very Fine Brown Silty Sand, Loose, Moist, No Odors
		16	Sample 16-18', Recover 1.2'
		17	Very Fine Brown Silty Sand, Very Loose, Moist, No Odors
		18	Sample 18-20', Recover 0.0'
		19	
		20	Sample 20-22', Recover 1.18'
		21	Fine Brown Sand,Loose, Moist, No Odors
		22	Sample 22-24', Recover 1.21'
		23	Fine Brown Sand, Loose, Moist, No Odors
		24	Sample 24-26', Recover 1.2'
		25	Fine Brown Sand, Moist, Loose, No Odors
		26	
		27	Total Depth Of Boring 26 Feet Below Surface Grade. No Water Was Encountered.
		28	Completed Boring As A Soil Gas Monitoring Well Labeled GMW-3
		29	
		30	

LEE 001

001257

WELL MW-01 CONSTRUCTION INFORMATION
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

Driller:	Hardin/Huber Associates
Date of Completion:	November 3, 1984
Drilling Method:	Oversized augers

WATER LEVEL INFORMATION

*Elevation (top of pipe):	452.03'
*Elevation ('and surface):	449.30'
*Elevation (water table):	399.93' on 2/8/85

BOREHOLE DATA

Borehole Diameter:	8"
Thickness of Overburden:	53'
Depth Drilled in Rock:	0
Total Depth of Hole:	53'

CASING

Type:	Stainless steel, schedule 5
Diameter:	4"
Length:	45.73'
Type of Joint:	Threaded/flush
Screen Slot:	0.010
Screen Length:	10'
Screen Setting:	43' - 53'

GRAVEL/SAND PACK

Type:	Washed sand/cave-in
Size:	Coarse sand
Depth:	21' - 53'

	SEAL	GROUT
Type:	NA**	Cement - bentonite grout
Method:	NA**	Tremie pipe
Depth:	NA**	0' - 21'

DEVELOPMENT

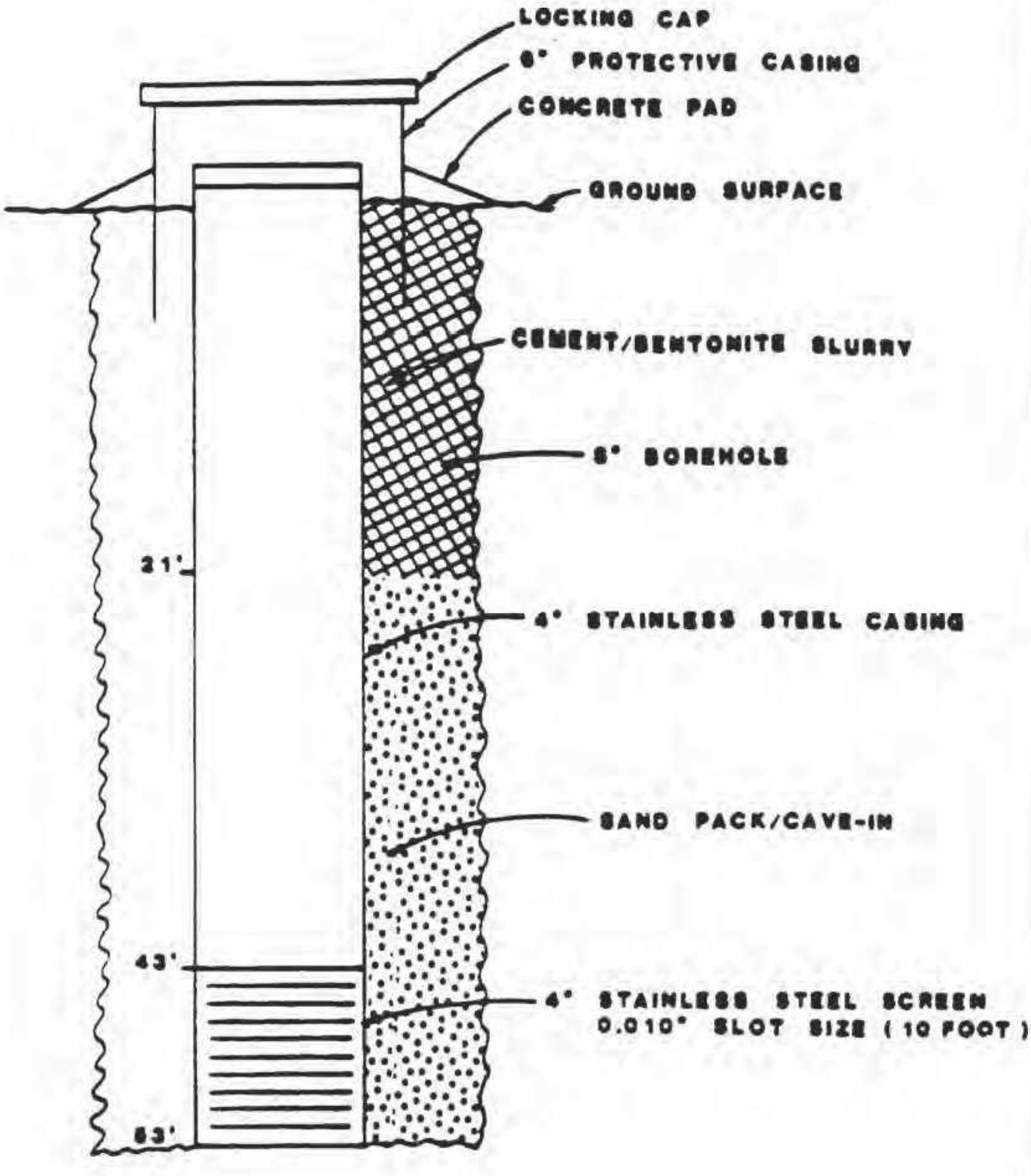
Method:	Bailer
Rate of Flow:	NA**
Length of Time:	1 hour

COMMENTS

*All elevations are recorded adjusted mean sea level (AMSL).
**NA - not applicable

LEE 001

001253



WELL CONSTRUCTION MW-01
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

NUS CORPORATION
A Halliburton Company

LEE 001

001259

WELL MW-02 CONSTRUCTION INFORMATION
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

Driller:	Hardin/Huber Associates
Date of Completion:	November 8, 1984
Drilling Method:	Regular augers/mud rotary

WATER LEVEL INFORMATION

*Elevation (top of pipe):	452.37'
*Elevation (land surface):	449.68'
*Elevation (water table):	400.99' on 2/8/85

BOREHOLE DATA

Borehole Diameter:	8"
Thickness of Overburden:	113'
Depth Drilled in Rock:	5'
Total Depth of Hole:	118'

CASING

Type:	Stainless steel, schedule 5
Diameter:	4"
Length:	96'
Type of Joint:	Threaded/flush
Screen Slot:	0.010
Screen Length:	5'
Screen Setting:	93.5' - 98.5'

GRAVEL/SAND PACK

Type:	Washed sand/cave-in
Size:	Coarse sand
Depth:	89' - 98.5'

	SEAL	GROUT
Type:	Bentonite seal	Cement - bentonite
Method:	Dropped	Tremie pipe
Depth:	85' - 89'	0' - 85'

DEVELOPMENT

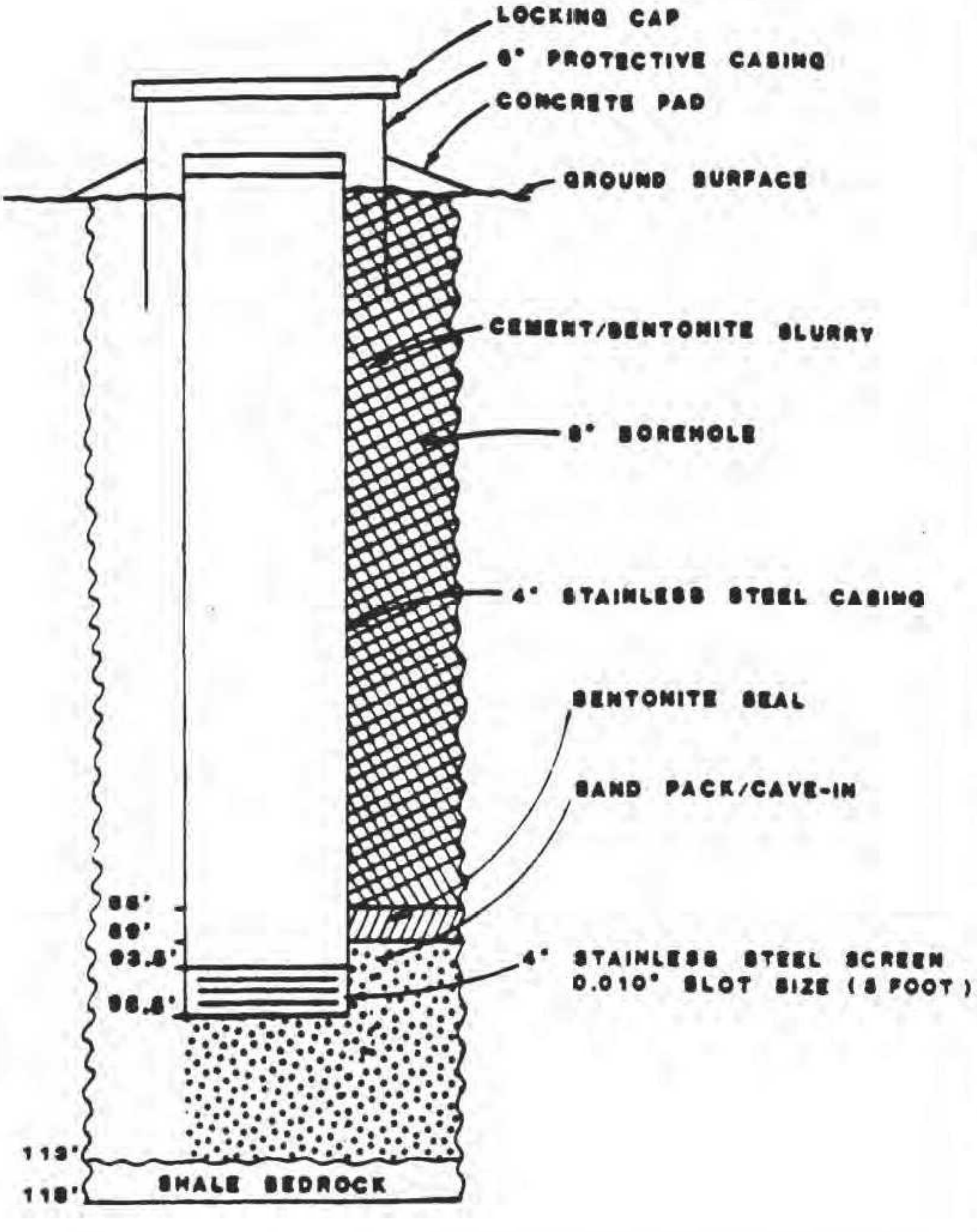
Method:	Submersible pump
Rate of Flow:	9 gallons per minute
Length of Time:	2 hours

COMMENTS

*All elevations are recorded adjusted mean sea level (AMSL).

LEE 001

001260



WELL CONSTRUCTION MW-02
LEES LANES LANDFILL SITE
JEFFERSON COUNTY , KENTUCKY

NUS CORPORATION
A Halliburton Company

001261

LEE 001

Boring No.: MW-02
Lees Lane Landfill
Project No.: TDD F4-8403-17
Date: October 31, 1984
Field Geologist: G. Schank
Subcontractor: Hardin/Huber Associates

Depth (ft)	Blow Count	Grain Size	Sorting	H_2O Content	Lithologic Description
0-1.5	3 2 4	coarse	poor	dry	Gravel, silty, clayey, brown, poorly sorted
5-6.5	4 5 8	clay	good	dry	Clay, trace silt, brown, iron stains, black organic spots, medium dense
10-11.5	3 5 7	silt	fair	damp to moist	Silt, sandy, trace clay, brown
15-16.5	4 5 6	fine	good	moist	Sand, fine, well sorted, brown, moist, silica, micaceous
20-21.5	3 4 5	fine	fair to good	damp	Same as above - drier
25-26.5	4 6 7	fine	fair	damp	Sand, fine, silty, brown, black stringers, damp, micaceous
30-31.5	4 7 9	fine to coarse	poor	moist to wet	Sand, fine to coarse, brown, trace silt, micaceous

Boring No.: MW-02
Lees Lane Landfill
Page Two

Depth (ft)	Blow Count	Grain Size	Sorting	H_2O Content	Lithologic Description
35-36.5	4 8 12	medium to coarse	fair	moist to wet	Sand, medium to coarse, brown with some orange, 2" clay lens, black stringers, trace gravel
40-41.5	6 10 14	coarse	poor	moist	Sand and gravel, poorly sorted, orange and brown, iron stains, clay lens, moist
45-46.5	5 12 17	medium	good	dry	Sand, medium light brown, dry, silica, beach type sand
50-51.5	8 18 26	coarse	poor	wet	Sand, gravel and cobbles, poorly sorted, some black spots, wet, WATER
55-56.5	3 7 8	coarse	poor	wet	Same as above
60-61.5	14 14 22	coarse	poor	wet	Same as above
65-66.5	12 16 24	fine to coarse	poor	wet	Sand, fine to coarse, brown, poorly sorted, wet
70-71.5	12 14 16	fine to coarse	poor	wet	Same as above - trace gravel

Boring No.: MW-02
Lees Lane Landfill
Page Three

Depth (ft)	Blow Count	Grain Size	Sorting	H_2O Content	Lithologic Description
75-76.5	8 10 12	coarse	poor	wet	Sand and gravel, gray, poorly sorted river gravel
80-81.5	10 11 12	coarse	poor	wet	Same as above
85-86.5	3 6 10	medium to coarse	fair	wet	Sand, medium, trace coarse and fine, gray
90-91.5	22 26 28	coarse	poor	wet	Sand and gravel, poorly sorted, gray and brown, 3" stiff silt lens
95-96.5	35 44 58	coarse	poor	wet	Sand, gravel and cobbles, some large gravel
100-101.5	14 21 22	coarse	poor	wet	Same as above
103-104.5	32 24 26	coarse	poor	wet	Same as above
108-109.5	19 25 26	coarse	poor	wet	Sand and gravel, mostly sand, gray and brown
113-114.5	100/1.5	shale			Shale, black, fractured

Cored bedrock to 118 feet. Black shale, friable
Monitor Well set at 98.5 feet
Ground Elevation: 449.68 feet (msl)
MW-01 installed at same location.

LEE 001

001264

WELL MW-03 CONSTRUCTION INFORMATION
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

Driller:	Hardin/Huber Associates
Date of Completion:	November 15, 1984
Drilling Method:	Regular augers/mud rotary

WATER LEVEL INFORMATION

*Elevation (top of pipe):	453.70'
*Elevation (land surface):	451.61'
*Elevation (water table):	399.31' on 2/8/85

BOREHOLE DATA

Borehole Diameter:	8"
Thickness of Overburden:	116'
Depth Drilled in Rock:	3'
Total Depth of Hole:	119'

CASING

Type:	Stainless steel, schedule 5
Diameter:	4"
Length:	73.10'
Type of Joint:	Threaded/flush
Screen Slot:	0.010
Screen Length:	35'
Screen Setting:	71' - 106'

GRAVEL/SAND PACK

Type:	Washed sand/cave-in
Size:	Coarse sand
Depth:	65' - 106'

	SEAL	GROUT
Type:	Bentonite seal	Cement - bentonite
Method:	Dropped	Tremie pipe
Depth:	63' - 65'	0' - 63'

DEVELOPMENT

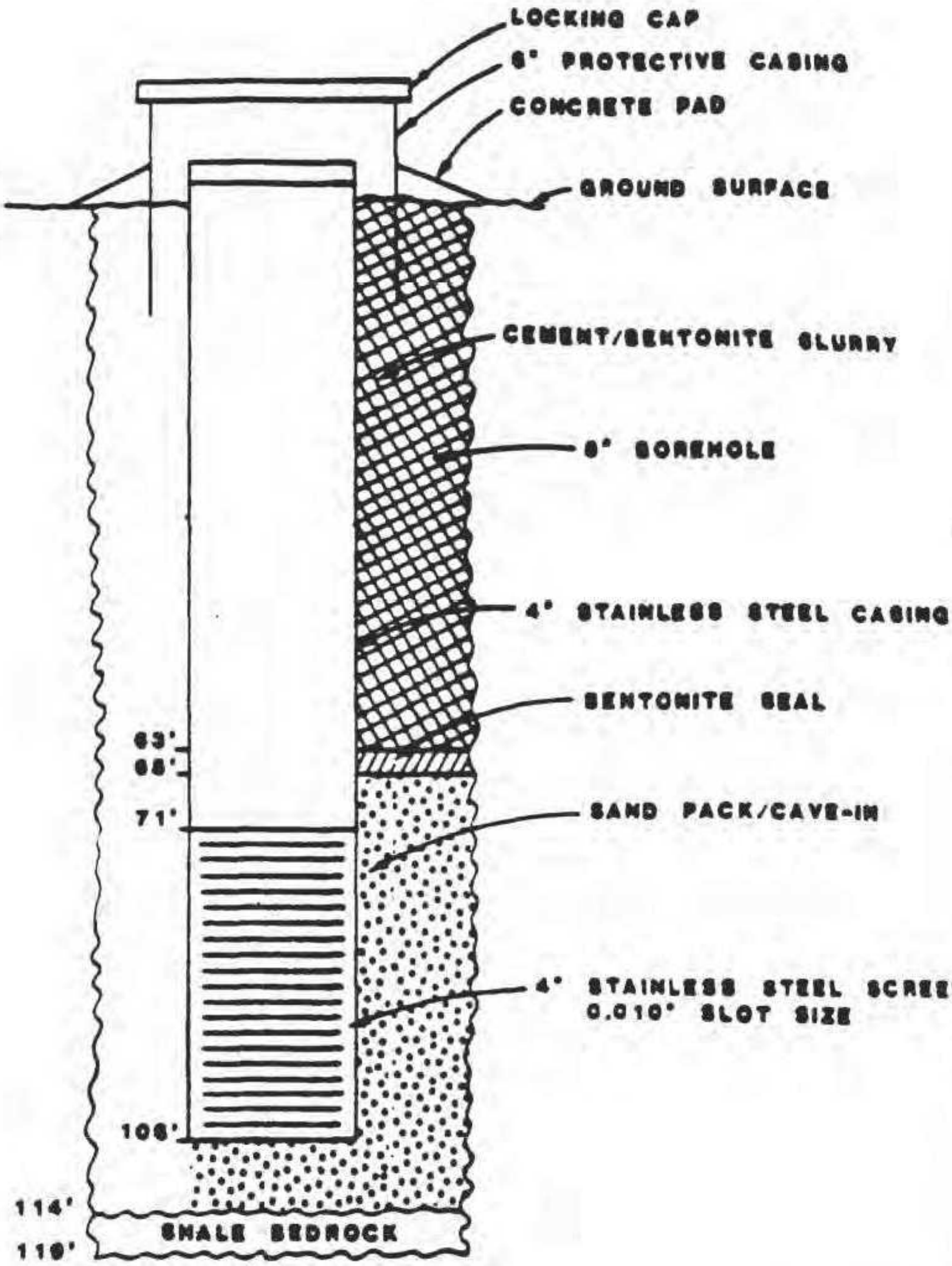
Method:	Submersible pump
Rate of Flow:	9 gallons per minute
Length of Time:	2 hours

COMMENTS

*All elevations are recorded adjusted mean sea level (AMSL).

LEE 001

001265



WELL CONSTRUCTION MW-03
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

D-9

NUS CORPORATION
A Halliburton Company

0012660

LEE 001

Boring No.: MW-03
Lees Lane Landfill
Project No.: TDD F4-8403-17
Date: November 12, 13, 14, 15, 1984
Driller: Jeff Corron
Field Geologist: K. Perry
Subcontractor: Hardin/Huber Associates

Depth (ft)	Blow Count	Grain Size	Sorting	H_2O Content	Lithologic Description
0.0'-1.5'	1 3 8	silt	fair	dry	Topsoil, silty, medium, brown and black organic spots
5.0-6.5	6 12 14	silt	fair	dry	Silt, clayey, light and dark brown, black organic spots
10.0-11.5	6 7 6	fine	fair	damp	Sand and clay, silty, sand is fine, brown, some black organic spots
15.0-16.5	3 6 14	fine	fair	damp to moist	Sand, fine, silty, brown
20.0-21.5	6 8 8	fine	fair	damp	Same as above
25.0-26.5	3 6 7	fine to coarse	poor	damp	Sand and gravel, sand is fine, gravel is medium
30.0-31.5	11 15 23	fine to coarse	very poor	moist	Same as above
35.0-36.5	24 23 25	fine to coarse	very poor	damp	Same as above

Boring MW-03
Lee's Lane Landfill
Page Two

001267

LEE 001

Depth (ft)	Blow Count	Grain Size	Sorting	H_2O Content	Lithologic Description
40.5-41.5	11 27 32	fine to coarse	very poor	damp	Sand and gravel, sand is fine, gravel is larger
45.0-46.5	22 39 43	fine to coarse	very poor	damp (dryer)	Same as above
50.0-51.5	12 30 41	medium to coarse	poor	dry to damp	Sand, medium, some gravel, light brown to orange brown, dark laminations
55.0-56.5	14 17 16	fine to medium	well	dry to damp	Sand, fine to medium, well sorted, brown
60.0-61.5	6 7 14	medium to coarse	very poor	wet	Sand, medium, silty, clayey, some gravel, shale fragments, wet, WATER
65.0-66.5	30 42 48	medium to coarse	very poor	wet	Same as above
70.0-71.5	24 26 40	medium to coarse	very poor	wet	Same as above, gravel and shale fragments
75.0-76.5	20 28 38	medium to coarse	very poor	wet	Same as above

Boring No.: MW-03
Lees Lane Landfill
Page Three

Depth (ft)	Blow Count	Grain Size	Sorting	H2O Content	Lithologic Description
78.0-79.5	20 24 26	medium to coarse	poor	wet	Sand, medium, gravelly, dark brown, poorly sorted, wet
83.0-84.5	24 30 27	coarse	poor	wet	Same as above
88.0-89.5	25 32 40	coarse	poor	wet	Same as above, coarser
93.0-94.5	38 41 37	coarse	very poor	wet	Same as above, coarser
98.0-99.5	30 23 34	coarse	very poor	wet	Same as above
103.0-104.5	36 20 14	coarse	very poor	wet	Same as above, less coarse
108.0-109.5	11 15 16	fine to medium	fair	wet	Sand, fine to medium, silty, some gravel, dark brown

Boring No.: MW-03
Lees Lane Landfill
Page Four

Depth (ft)	Blow Count	Grain Size	Sorting	H_2O Content	Lithologic Description
113	52 69 55		—NO RECOVERY—		Gravel in tip of sampler
116	refusal	bedrock			Black shale

Cored bedrock to 119 feet. Black shale, friable.
Monitor well set at 106 feet
Ground elevation: 451.61 feet (msl)

D 15

001269

LEE 001

LEE 001

001270

WELL MW-04 CONSTRUCTION INFORMATION
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

Driller:	Hardin/Huber Associates
Date of Completion:	December 4, 1984
Drilling Method:	Regular augers/mud rotary

WATER LEVEL INFORMATION

*Elevation (top of pipe):	448.58'
*Elevation (land surface):	445.48'
*Elevation (water table):	395.63' on 2/8/85

BOREHOLE DATA

	Monitor Well	Surface Casing
Borehole Diameter:	8"	12"
Thickness of Overburden:	91'	40'
Depth Drilled in Rock:	0'	0'
Total Depth of Hole:	91'	40'

CASING

	Monitor Well	Surface Casing
Type:	Stainless steel, schedule 5	Black steel
Diameter:	4"	10"
Length:	87.60'	40'
Type of Joint:	Threaded/flush	Welded
Screen Slot:	0.010	
Screen Length:	5'	
Screen Setting:	84.5' - 89.5'	

GRAVEL/SAND PACK

Type:	Washed sand
Size:	Coarse sand
Depth:	80' - 89.5'

	SEAL	GROUT
Type:	Bentonite seal	Cement - bentonite
Method:	Dropped	Tremie pipe
Depth:	78' - 80'	0' - 78'

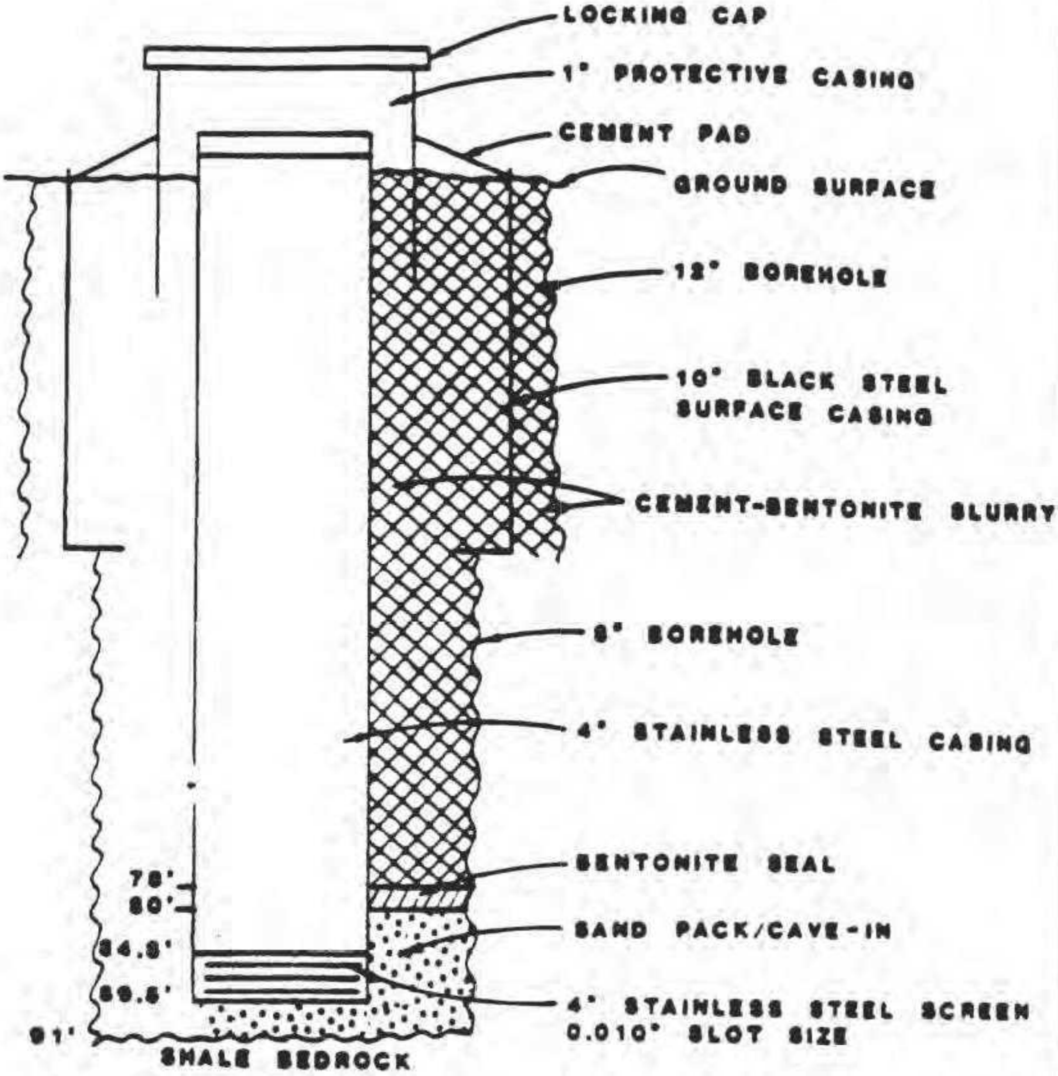
DEVELOPMENT

Method:	Submersible pump
Rate of Flow:	1 gallon per minute
Length of Time:	3 hours

COMMENTS

*All elevations are recorded adjusted mean sea level (AMSL).

001271



WELL CONSTRUCTION MW-04
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

NUS CORPORATION
A Halliburton Company

Boring No.: MW-04
Lees Lane Landfill
Project No.: TDD F4-8403-17
Date: December 1, 2, 3, 4, 1984
Field Geologist: John Anderson
Subcontractor: Hardin/Huber Associates

Depth (ft)	Lithologic Description*
0.0-13.0	Brick fragments, concrete, wood blocks, construction type rubble.
13.0-30.0	Clay, fine grain sand, greenish-gray, very wet, runny.
30.0-53.0	Sand, gravel, silt, drilling easy to this point.
53.0-91.0	Gravel, sand, some very large gravel, drilling difficult. Bedrock at 91 feet.

* Samples taken from drill cuttings
Monitor well set at 89.5 feet
Ground Elevation: 445.48 feet (msl)

WELL MW-05 CONSTRUCTION INFORMATION
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

Driller:	Hardin/Huber Associates
Date of Completion:	November 29, 1984
Drilling Method:	Regular augers/mud rotary

WATER LEVEL INFORMATION

*Elevation (top of pipe):	429.78'
*Elevation (land surface):	426.89'
*Elevation (water table):	395.55' on 2/8/85

BOREHOLE DATA

Borehole Diameter:	8"
Thickness of Overburden:	94'
Depth Drilled in Rock:	5'
Total Depth of Hole:	99'

CASING

Type:	Stainless steel, schedule 5
Diameter:	4"
Length:	54.4'
Type of Joint:	Threaded/flush
Screen Slot:	0.010
Screen Length:	35'
Screen Setting:	51.5' - 86.5'

GRAVEL/SAND PACK

Type:	Washed sand
Size:	Coarse sand
Depth:	46' - 86.5'

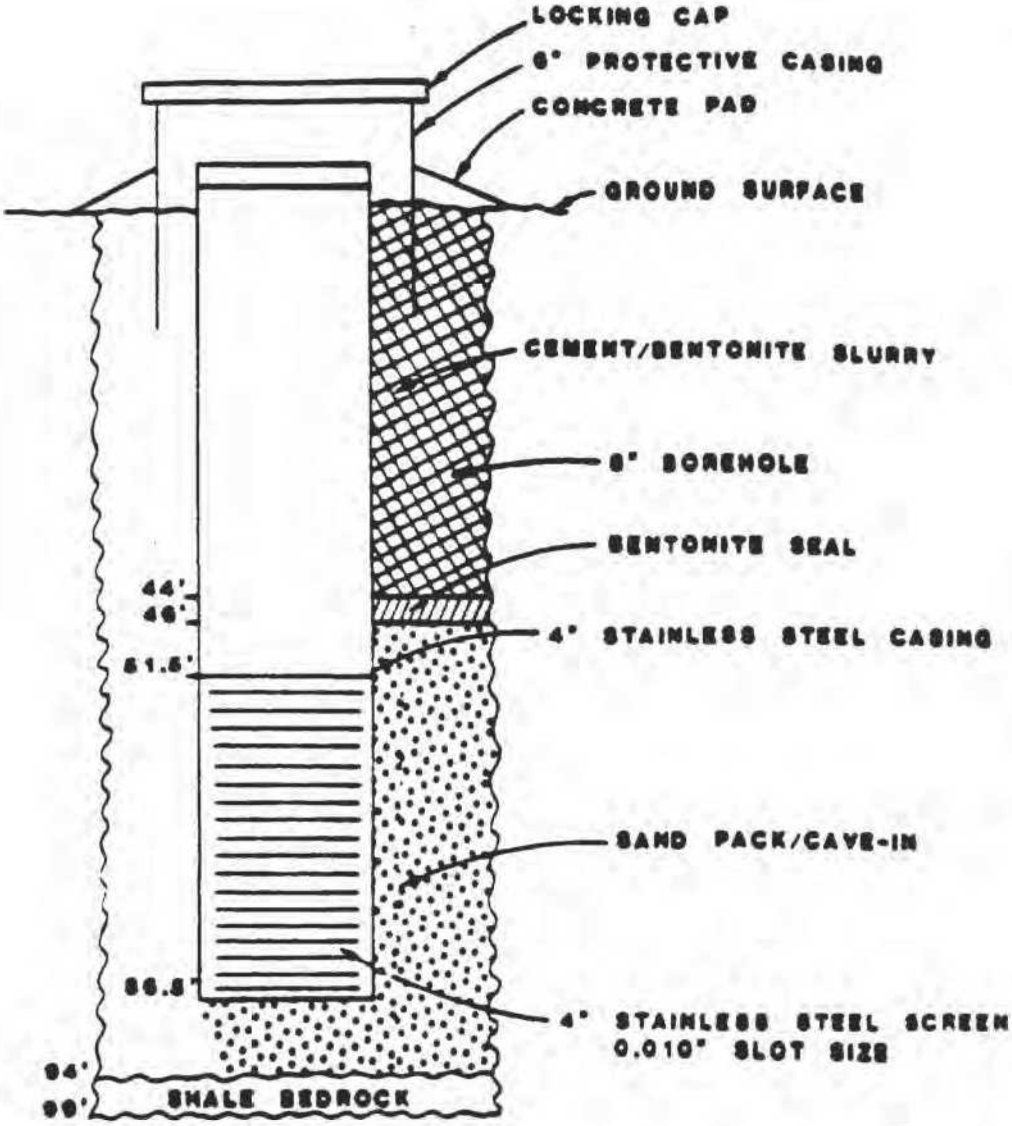
	SEAL	GROUT
Type:	Bentonite seal	Cement - bentonite
Method:	Dropped	Tremie pipe
Depth:	44' - 46'	0' - 44'

DEVELOPMENT

Method:	Submersible pump
Rate of Flow:	9 gallons per minute
Length of Time:	2 hours

COMMENTS

*All elevations are recorded adjusted mean sea level (AMSL).



WELL CONSTRUCTION MW-05
LESS LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

NUS CORPORATION
A Halliburton Company

Boring No.: MW-05
Lees Lane Landfill
Project No.: TDD F4-8403-17
Date: October 31, 1984
Field Geologist: J. Anderson
Subcontractor: Hardin/Huber Associates

Depth (ft)	Blow Count	Grain Size	Sorting	H_2O Content	Lithologic Description
0.0'-1.5'	2 4 6	clay	good	damp	Clay, silty, sandy, brown, organic material, damp
5.0-6.5	3 4 5	clay	good	damp	Same as above
10.0-11.5	3 5 5	clay	good	damp	Same as above, no organics
15.0-16.5	2 2 3	clay	good	damp to moist	Same as above
20.0-21.5	2 2 2	clay	good	wet	Same as above, moist to wet
25.0-26.5	1 2 2	clay	good	wet	Same as above
30.0-31.5	1 2 2	clay	good	wet	Clay, silty, sandy, greenish grey, wet
35.0-36.5	3 6 8	clay	good	wet	Same as above

Boring MW-05
Lees Lane Landfill
Page Two

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LEE 001

Depth (ft)	Blow Count	Grain Size	Sorting	H_2O Content	Lithologic Description
40.5-41.5	3 3 5	clay	good	wet	Clay, silty, sandy, greenish gray, wet
45.0-46.5	2 4 6	fine to coarse	fair	wet	Sand, fine to coarse, silty, clayey, poorly sorted, brown, wet
50.0-51.5	7 12 15	fine to coarse	poor	wet	Sand, silty, gravel, poorly sorted, greenish gray, wet
55.0-56.5 D-20	8 10 15	fine to coarse	fair	wet	Sand and gravel, poorly sorted, brownish gray, wet
60.0-61.5	12 18 19	fine to coarse	poor	wet	Same as above
63.0-64.5	4 3 2	---- NO RECOVERY ----			
68.0-69.5	10 14 26	fine	good	wet	Same as above
73.0-74.5	16 15 13	fine to coarse	poor	wet	Same as above, grayish green and brown

Depth (ft)	Blow Count	Grain Size	Sorting	H_2O Content	Lithologic Description
78.0-79.5	32 33 18	fine to coarse	poor	wet	Sand and gravel, poorly sorted, grayish green and brown, wet
83.0-84.5	24 12 17	fine to coarse	poor	wet	Same as above
88.0-89.5	12 8 6	coarse	fair	wet	Same as above, grayish brown
93.0-94.5	50 100+ Refusal	coarse	poor	wet	Same as above, shale fragments, greenish gray

Cored bedrock to 99 feet. Black shale, friable.
Monitor Well set at 86.5 feet
Ground Elevation: 426.89 feet (msl)

(24)

UNIFORM KENTUCKY WELL MAINTENANCE AND PLUGGING RECORD

Use this form to report plugging and maintenance of wells. Do not write in shaded areas.
Original copy must be submitted to Division of Water within 30 days of completion.
Record must be typed or neatly printed or it will be returned to the driller as unacceptable.
Original to Division of Water, copy to owner, copy to driller's files.

1. Kentucky Well ID (AKGWA) Number: 8001 - 8971

2. Owner Well ID #: MW-02

4. Owner name: U.S. Environmental Protection Agency, Region 4

5. Owner address: 61 Forsyth SW Mail Code: 9T25

6. City: Atlanta **7. State:** GA **8. Zip:** 30303

3. Attachments
Required
1. Site plan or sketch map ☒
2. Well location
   On topographic map, OR ☒
   Obtained by GPS unit ☐

Conditionally Required
3. Well diagram (monitoring well) ☒
4. Coliform analysis (if applicable) ☐
5. Signed variance (if applicable) ☐

Optional
6. Other laboratory analysis report ☐

If site name and address differ from owner name and address:

9. Site name: Lee's Lane Landfill Superfund Site

10. Site address: Lee's Lane / Riverside Gardens Community

11. City: Louisville **12. State:** KY **13. Zip:** 40216

14. Agency Interest (AI) Number: 46333

15. Facility type & ID Number: ☒ CERCLA ☐ Solid Waste ☐ Drinking Water ☐ RCRA ☐ UST — KYD980557052

23. Work start date: Sep 07 2010 (Month Day Year)

24. Work end date: Sep 10 2010 (Month Day Year)

16. Owner phone:

17. Site phone:

25. Well status: ☐ Active ☐ Lost / destroyed ☐ Inactive ☐ Unsuitable for intended use ☒ Plugged

✓ **18. USGS topo map:** Lanesville

19. County: Jefferson

20. Surface elevation (ft): 450.00

21. Elevation determined by: ☐ GPS ☒ Map ☐ Prior report ☐ Survey ☐ Prior well log

22. Physiographic Region: ☐ Bluegrass ☒ Ohio River Alluvium ☐ E. Coal Field ☐ W. Coal Field ☐ Miss. Plateau ☐ Jackson Purchase

26. Work type: ☐ Rework ☒ Plugged ☐ Deepen ☐ Excavated

27. Well Use: ☐ Agriculture ☐ Geothermal ☐ Commercial ☐ Heat pump ☐ Domestic ☐ HVAC ☐ Industrial ☐ Injection ☒ Monitoring / Remed (Ambient Mon) ☐ Mining ☐ Public ☐ Unused

28. Drilling method: ☒ Auger - HS ☐ Jet wash ☐ Auger - SS ☐ Push/probe ☐ Auger - bucket ☐ Rotary - air ☐ Auger - hand ☐ Rotary - mud ☐ Cable tool ☐ Rotary - reverse ☐ Core ☐ Sand point ☐ Driven casing ☐ Sonic ☐ Excavation ☐ Unknown ☐ Combined – HS auger & air rotary

29. Well specifications
Total depth (ft): 98.00
Casing diameter (in): 4.00
Casing material: Stainless steel
Screened interval: From depth, ft. 93.15 To depth, ft. 98.00

30. Replacement: ☐ Replace screen ☐ Replace improper seal ☐ Other:
Reason for replacement:

31. Repair: ☐ Repair concrete pad ☐ Repair steel protective casing ☐ Repair casing ☐ Extend casing above ground ☐ Install liner ☐ Install packer

32. Plugging sealing material

From depth, ft.	To depth, ft.	Material
0.0	1.5	Backfill - native
1.5	103	Bentonite grout

33. Plugging activity
- ☐ Well casing pulled, borehole grouted bottom to top
- ☒ Well overdrilled, casing-screen-grout-filter pack removed, borehole grouted bottom to top
- ☐ Casing cut-off (minimum 5 feet BGL), borehole grouted bottom to top
- ☐ Permanent bridge installed over void, borehole grouted bottom to top
- ☐ Well casing pulled, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Well overdrilled, casing-screen-grout-filter pack removed, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Casing cut-off (minimum 5 feet BGL), borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Permanent bridge installed over void, borehole filled with gravel/sand bottom to SWL and grouted SWL to top

34. Maintenance / cleaning
☐ Screen blocked by: ☐ sediment ☐ biological activity ☐ mineral deposition
☐ Well filled with sediment
☐ Corrosion ☐ Other
How cleaned? ☐ Mechanical removal ☐ Chemical treatment
Cleaning method:

Latitude: DMS ___° ___' ___" or Decimal 38.192839°

Longitude: DMS ___° ___' ___" or Decimal -85.875134

49. Comments
Overdrilled 4" stainless steel well casing w/ 6.25" ID HSA to 103'. Removed all well casing & screen materials

Lat/Long method: ☐ INT ☐ GPS ☐ SUR ☐ REP

50. Affirmation: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge. Note: the driller is not responsible for natural groundwater quality or quantity encountered while drilling or completing this well.

Signature of certified driller: [signature]

Date signed: Oct 02 2010 (Month Day Year)

Date Received: OCT 11 2010

Certification number: 0448-0455-00

Drilling company: TesTech, Inc.

Initials of record reviewer:

CL 6/17/13

rev 04/11/2008

(24)

UNIFORM KENTUCKY WELL MAINTENANCE AND PLUGGING RECORD

Use this form to report plugging and maintenance of wells. Do not write in shaded areas.
Original copy must be submitted to Division of Water within 30 days of completion.
Record must be typed or neatly printed or it will be returned to the driller as unacceptable.
Original to Division of Water, copy to owner, copy to driller's files.

1. Kentucky Well ID (AKGWA) Number: 8001 - 8973

2. Owner Well ID #: MW-A

4. Owner name: U.S. Environmental Protection Agency, Region 4

5. Owner address: 61 Forsyth SW Mail Code: 9T25

6. City: Atlanta **7. State:** GA **8. Zip:** 30303

3. Attachments
Required
1. Site plan or sketch map ☒
2. Well location
   On topographic map, OR ☒
   Obtained by GPS unit ☐
Conditionally Required
3. Well diagram (monitoring well) ☒
4. Coliform analysis (if applicable) ☐
5. Signed variance (if applicable) ☐
Optional
6. Other laboratory analysis report ☐

If site name and address differ from owner name and address:

9. Site name: Lee's Lane Landfill Superfund Site

10. Site address: Lee's Lane / Riverside Gardens Community

11. City: Louisville **12. State:** KY **13. Zip:** 40216

14. Agency Interest (AI) Number: 46333

15. Facility type & ID Number: ☒ CERCLA ☐ Solid Waste ☐ Drinking Water ☐ RCRA ☐ UST — ID Number: KYD980557052

23. Work start date: Sep (Month) 07 (Day) 2010 (Year)

24. Work end date: Sep (Month) 13 (Day) 2010 (Year)

16. Owner phone:

17. Site phone:

25. Well status: ☐ Active ☐ Lost / destroyed ☐ Inactive ☐ Unsuitable for intended use ☒ Plugged

18. USGS topo map: Louisville West

19. County: Jefferson

20. Surface elevation (ft): 450.00

21. Elevation determined by: ☐ GPS ☒ Map ☐ Prior report ☐ Survey ☐ Prior well log

22. Physiographic Region: ☐ Bluegrass ☒ Ohio River Alluvium ☐ E. Coal Field ☐ W. Coal Field ☐ Miss. Plateau ☐ Jackson Purchase

26. Work type: ☐ Rework ☒ Plugged ☐ Deepen ☐ Excavated

27. Well Use: ☐ Agriculture ☐ Geothermal ☐ Commercial ☐ Heat pump ☐ Domestic ☐ HVAC ☐ Industrial ☐ Injection ☒ Monitoring / Remed (Ambient Mon) ☐ Mining ☐ Public ☐ Unused

28. Drilling method: ☒ Auger - HS ☐ Jet wash ☐ Auger - SS ☐ Push/probe ☐ Auger - bucket ☐ Rotary - air ☐ Auger - hand ☐ Rotary - mud ☐ Cable tool ☐ Rotary - reverse ☐ Core ☐ Sand point ☐ Driven casing ☐ Sonic ☐ Excavation ☐ Unknown ☐ Combined – HS auger & air rotary

29. Well specifications
Total depth (ft): 58.05
Casing diameter (in): 4.00
Casing material: Stainless steel
Screened interval: From depth, ft. 48.05 To depth, ft. 58.05

30. Replacement: ☐ Replace screen ☐ Replace improper seal ☐ Other:
Reason for replacement:

31. Repair: ☐ Repair concrete pad ☐ Repair steel protective casing ☐ Repair casing ☐ Extend casing above ground ☐ Install liner ☐ Install packer

32. Plugging sealing material

From depth, ft.	To depth, ft.	Material
0.0	1.5	Backfill - native
1.5	65.0	Bentonite grout

33. Plugging activity
☐ Well casing pulled, borehole grouted bottom to top
☒ Well overdrilled, casing-screen-grout-filter pack removed, borehole grouted bottom to top
☐ Casing cut-off (minimum 5 feet BGL), borehole grouted bottom to top
☐ Permanent bridge installed over void, borehole grouted bottom to top
☐ Well casing pulled, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
☐ Well overdrilled, casing-screen-grout-filter pack removed, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
☐ Casing cut-off (minimum 5 feet BGL), borehole filled with gravel/sand bottom to SWL and grouted SWL to top
☐ Permanent bridge installed over void, borehole filled with gravel/sand bottom to SWL and grouted SWL to top

34. Maintenance / cleaning
☐ Screen blocked by: ☐ sediment ☐ biological activity ☐ mineral deposition
☐ Well filled with sediment
☐ Corrosion ☐ Other
How cleaned? ☐ Mechanical removal ☐ Chemical treatment
Cleaning method:

Latitude: DMS ___° ___' ___" or Decimal 37.192199

Longitude: DMS ___° ___' ___" or Decimal -85.873846

ce 6/20/13

49. Comments
Overdrilled 4" stainless steel well casing w/ 6.25" ID HSA to 65.0'. Removed all well casing & screen materials

50. Affirmation: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge. Note: the driller is not responsible for natural groundwater quality or quantity encountered while drilling or completing this well.

Lat/Long method: ☐ INT ☐ GPS ☐ SUR ☐ REP

Signature of certified driller: [signature]

Date signed: Oct (Month) 02 (Day) 2010 (Year)

Date Received: OCT 11 2010

Certification number: 0448-0455-00

Drilling company: TesTech, Inc.

Initials of record reviewer:

rev 04/11/2008

(24)

UNIFORM KENTUCKY WELL MAINTENANCE AND PLUGGING RECORD

Use this form to report plugging and maintenance of wells. Do not write in shaded areas.
Original copy must be submitted to Division of Water within 30 days of completion.
Record must be typed or neatly printed or it will be returned to the driller as unacceptable.
Original to Division of Water, copy to owner, copy to driller's files.

1. Kentucky Well ID (AKGWA) Number: 8001 - 8972
2. Owner Well ID #: MW-B
3. Attachments
   - Required
     1. Site plan or sketch map ☒
     2. Well location: On topographic map, OR ☒; Obtained by GPS unit ☐
   - Conditionally Required
     3. Well diagram (monitoring well) ☒
     4. Coliform analysis (if applicable) ☐
     5. Signed variance (if applicable) ☒
   - Optional
     6. Other laboratory analysis report ☐

4. Owner name: U.S. Environmental Protection Agency, Region 4
5. Owner address: 61 Forsyth SW Mail Code: 9T25
6. City: Atlanta 7. State: GA 8. Zip: 30303

If site name and address differ from owner name and address:

9. Site name: Lee's Lane Landfill Superfund Site
10. Site address: Lee's Lane / Riverside Gardens Community
11. City: Louisville 12. State: KY 13. Zip: 40216
14. Agency Interest (AI) Number: 46333
15. Facility type & ID Number: ☒ CERCLA ☐ Solid Waste ☐ Drinking Water ☐ RCRA ☐ UST — ID Number: KYD980557052
16. Owner phone:
17. Site phone:
18. USGS topo map: Louisville West
19. County: Jefferson
20. Surface elevation (ft): 450.00
21. Elevation determined by: ☐ GPS ☒ Map ☐ Prior report ☐ Survey ☐ Prior well log
22. Physiographic Region: ☐ Bluegrass ☒ Ohio River Alluvium ☐ E. Coal Field ☐ W. Coal Field ☐ Miss. Plateau ☐ Jackson Purchase
23. Work start date: Sep 07 2010 (Month Day Year)
24. Work end date: Sep 09 2010 (Month Day Year)
25. Well status: ☐ Active ☐ Lost / destroyed ☐ Inactive ☐ Unsuitable for intended use ☒ Plugged
26. Work type: ☐ Rework ☒ Plugged ☐ Deepen ☐ Excavated

27. Well Use: ☐ Agriculture ☐ Geothermal ☐ Commercial ☐ Heat pump ☐ Domestic ☐ HVAC ☐ Industrial ☐ Injection ☒ Monitoring / Remed (Ambient Mon) ☐ Mining ☐ Public ☐ Unused

28. Drilling method: ☒ Auger - HS ☐ Jet wash ☐ Auger - SS ☐ Push/probe ☐ Auger - bucket ☐ Rotary - air ☐ Auger - hand ☐ Rotary - mud ☐ Cable tool ☐ Rotary - reverse ☐ Core ☐ Sand point ☐ Driven casing ☐ Sonic ☐ Excavation ☐ Unknown ☐ Combined – HS auger & air rotary

29. Well specifications
- Total depth (ft): 67.50
- Casing diameter (in): 4.00
- Casing material: Stainless steel
- Screened interval: From depth, ft. 57.5 To depth, ft. 67.5

30. Replacement: ☐ Replace screen ☐ Replace improper seal ☐ Other:
Reason for replacement:

31. Repair: ☐ Repair concrete pad ☐ Repair steel protective casing ☐ Repair casing ☐ Extend casing above ground ☐ Install liner ☐ Install packer

32. Plugging sealing material

From depth, ft.	To depth, ft.	Material
0.0	1.5	Backfill - native
1.5	67.5	Bentonite grout

33. Plugging activity
- ☐ Well casing pulled, borehole grouted bottom to top
- ☐ Well overdrilled, casing-screen-grout-filter pack removed, borehole grouted bottom to top
- ☒ Casing cut-off (minimum 5 feet BGL), borehole grouted bottom to top
- ☐ Permanent bridge installed over void, borehole grouted bottom to top
- ☐ Well casing pulled, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Well overdrilled, casing-screen-grout-filter pack removed, borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Casing cut-off (minimum 5 feet BGL), borehole filled with gravel/sand bottom to SWL and grouted SWL to top
- ☐ Permanent bridge installed over void, borehole filled with gravel/sand bottom to SWL and grouted SWL to top

34. Maintenance / cleaning: ☐ Screen blocked by: ☐ sediment ☐ biological activity ☐ mineral deposition ☐ Well filled with sediment ☐ Corrosion ☐ Other
How cleaned? ☐ Mechanical removal ☐ Chemical treatment
Cleaning method:

Latitude: DMS ___ ° ___ ' ___ " or Decimal 38.206793 °
Longitude: DMS ___ ° ___ ' ___ " or Decimal -85.851600
Lat/Long method: ☐ INT ☐ GPS ☐ SUR ☐ REP

49. Comments
Cut off 4" stainless steel well casing below grade. Used tremie to place grout from bottom to near surface.

50. Affirmation: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge. Note: the driller is not responsible for natural groundwater quality or quantity encountered while drilling or completing this well.

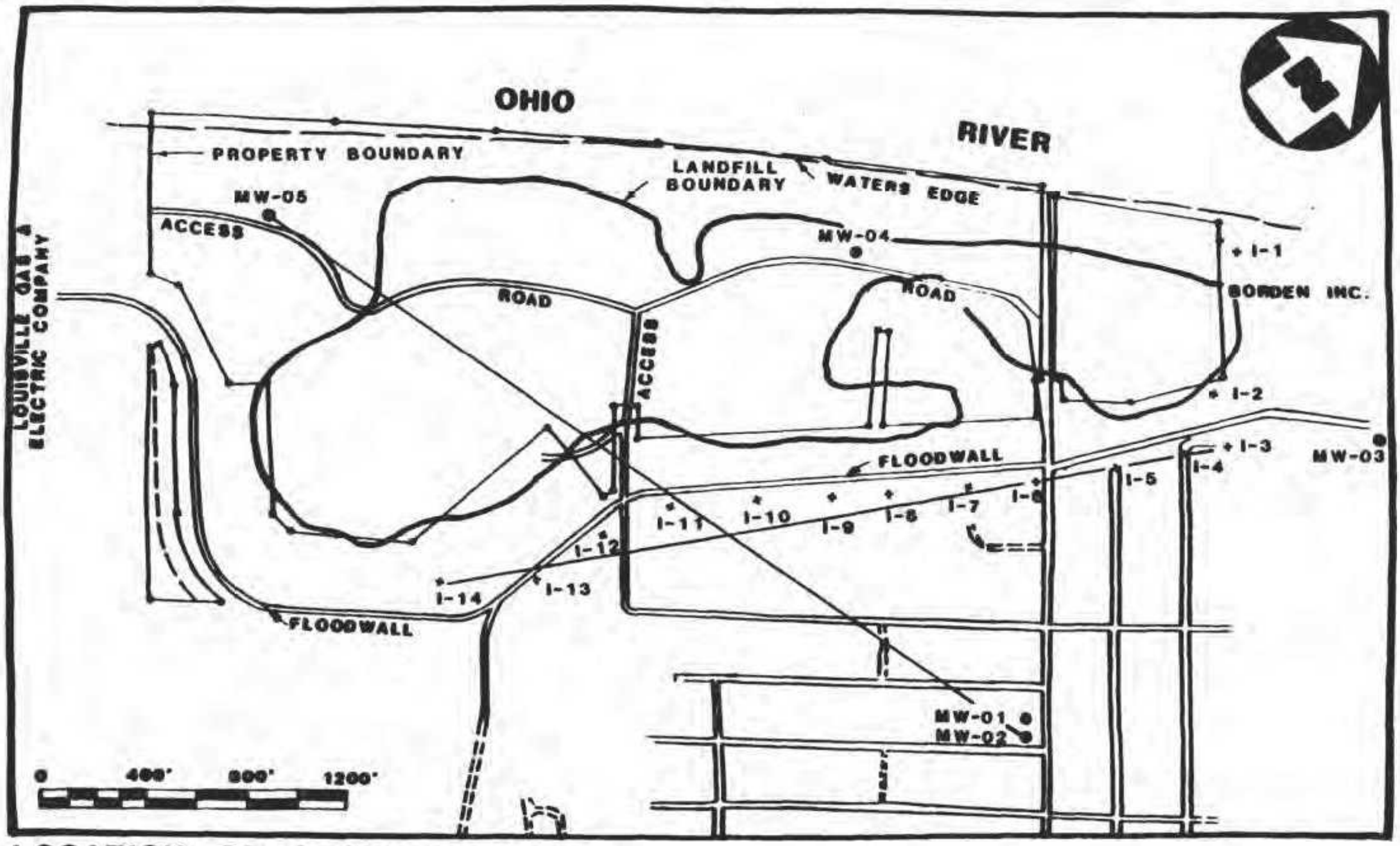
Signature of certified driller: [signature]
Date signed: Oct 02 2010 (Month Day Year)
Certification number: 0448-0455-00
Drilling company: TesTech, Inc.
Date Received: OCT 11 2010
Initials of record reviewer:

rev 04/11/2008

Appendix B

Geologic Cross-Section and Location Map

Reference: 1986.04.00 NUS RIFS x Sections



LOCATION OF CROSS-SECTIONS
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

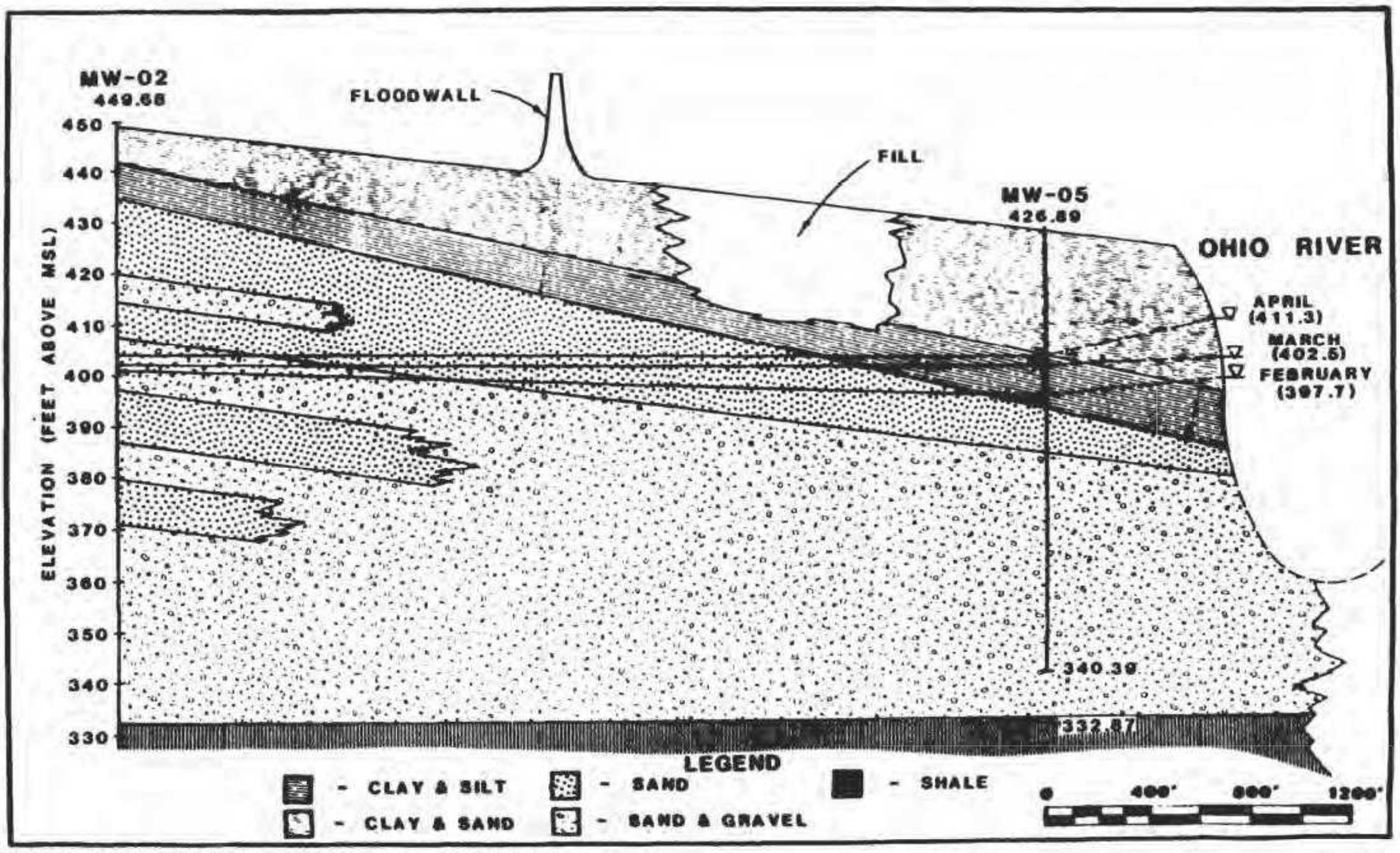
LEGEND

● - GROUNDWATER MONITOR WELLS

+ - GAS MONITOR WELLS

FIGURE 4-2

NUS CORPORATION
A Halliburton Company



CROSS-SECTION MW-02 - MW-05
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

FIGURE 4-4

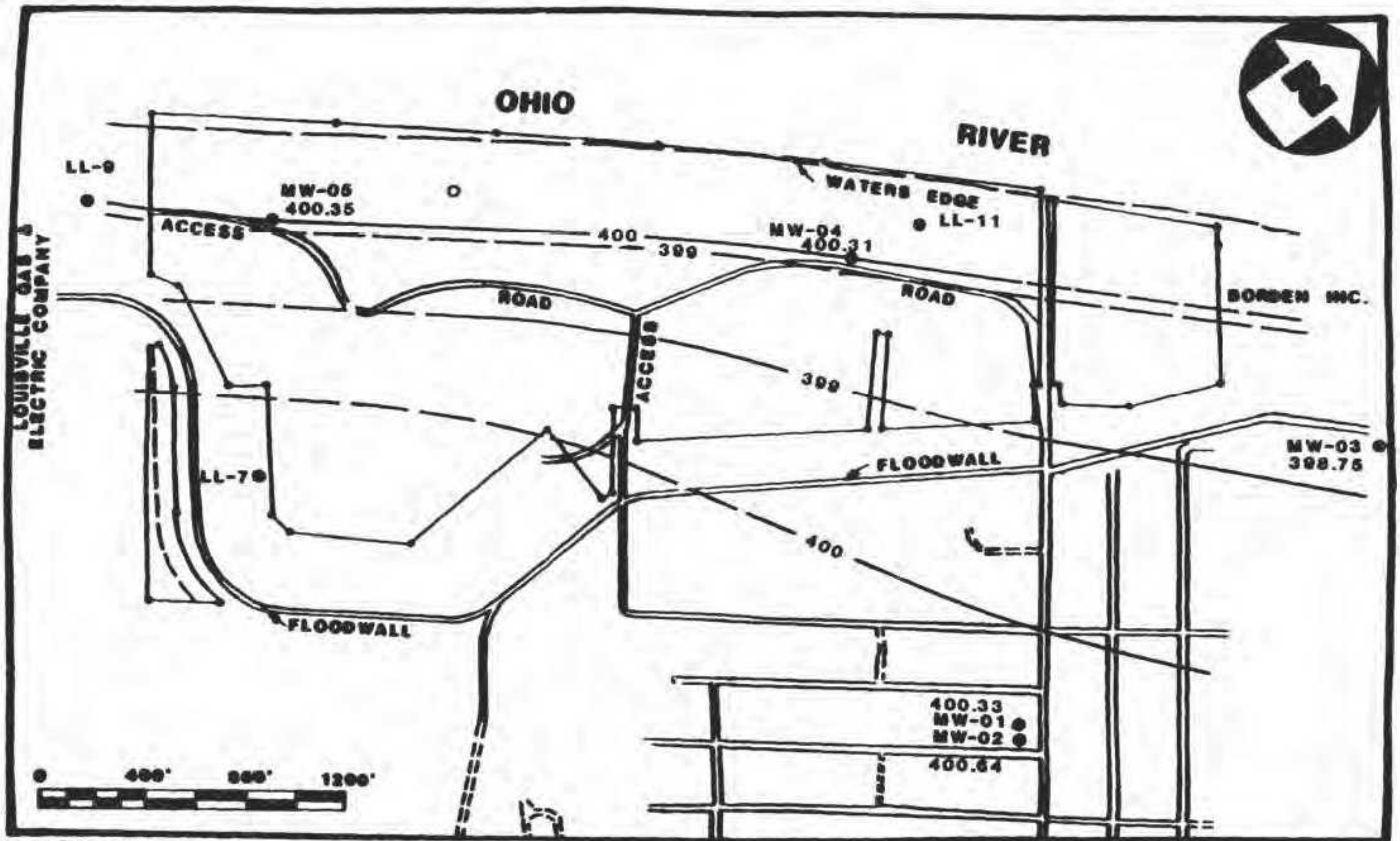
NUS CORPORATION
A Halliburton Company

Appendix C
Historical Groundwater Flow Patterns
Reference: 1986.04.00 NUS RIFS and Contours

TABLE 4-3
GROUNDWATER ELEVATIONS
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

Well #	11/27/84	12/4-8/84	1/8-9/85	2/8/85	3/11/85	4/11/85	5/13/85
LL-7	396.82	397.47		402.47	402.59	403.92	398.98
LL-9	393.37	394.15		395.15	400.80	402.59	394.66
LL-11	396.03	395.17		401.62	407.90	410.07	404.19
MW-01		400.57	400.33	399.93	401.83	403.21	402.81
MW-02		401.04	400.64	400.99	402.02	403.47	403.13
MW-03		396.54	398.75	397.31	400.02	401.89	399.34
MW-04		396.79	400.31	396.63	401.02	402.31	395.64
MW-05		395.90	400.35	395.55	401.28	402.70	395.10
Ohio River				397.7	402.55	411.3	

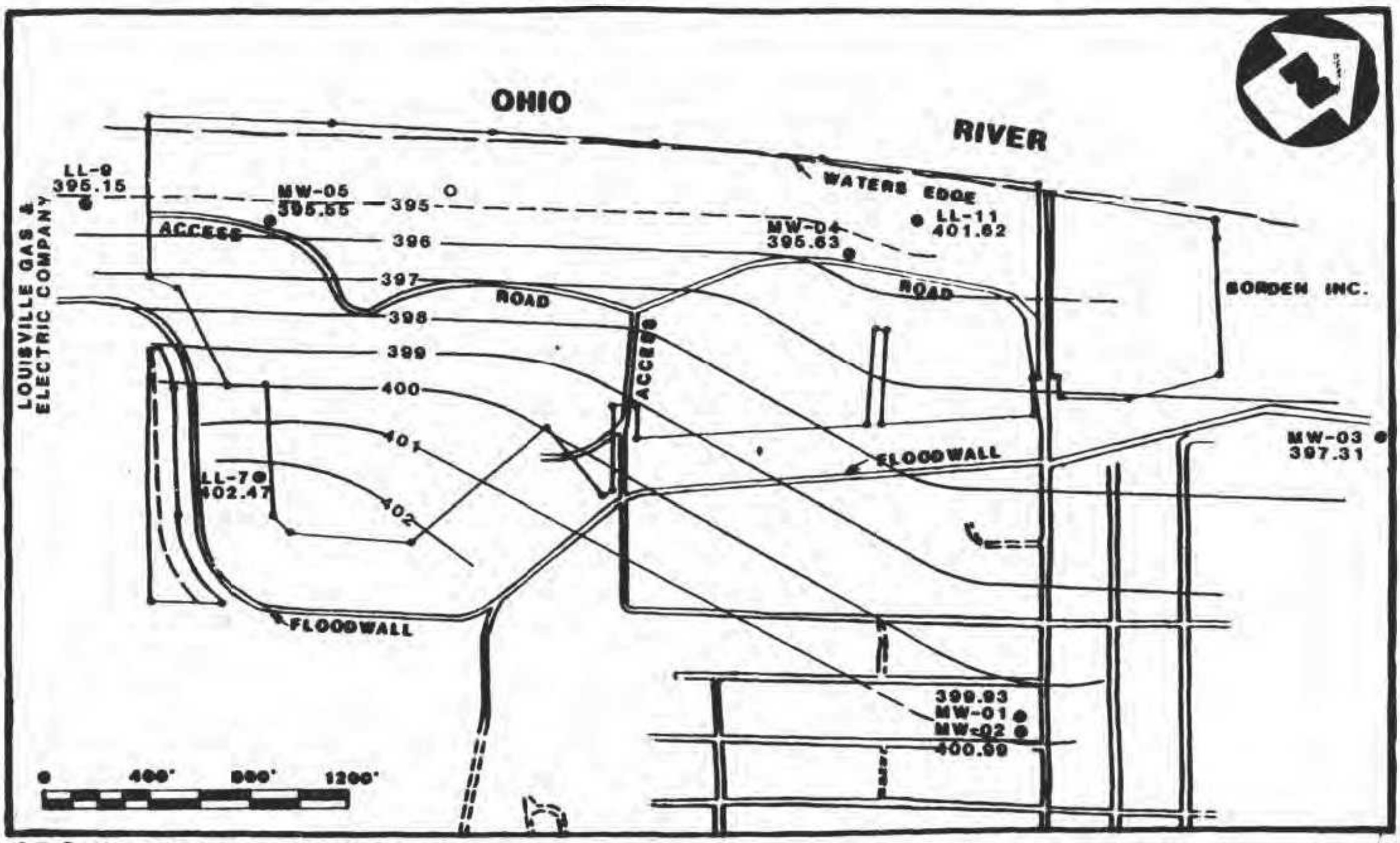
Note: All readings are in feet and referenced to mean sea level (msl)



GROUNDWATER CONTOURS
JANUARY 8 & 9, 1985
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

FIGURE 4-12

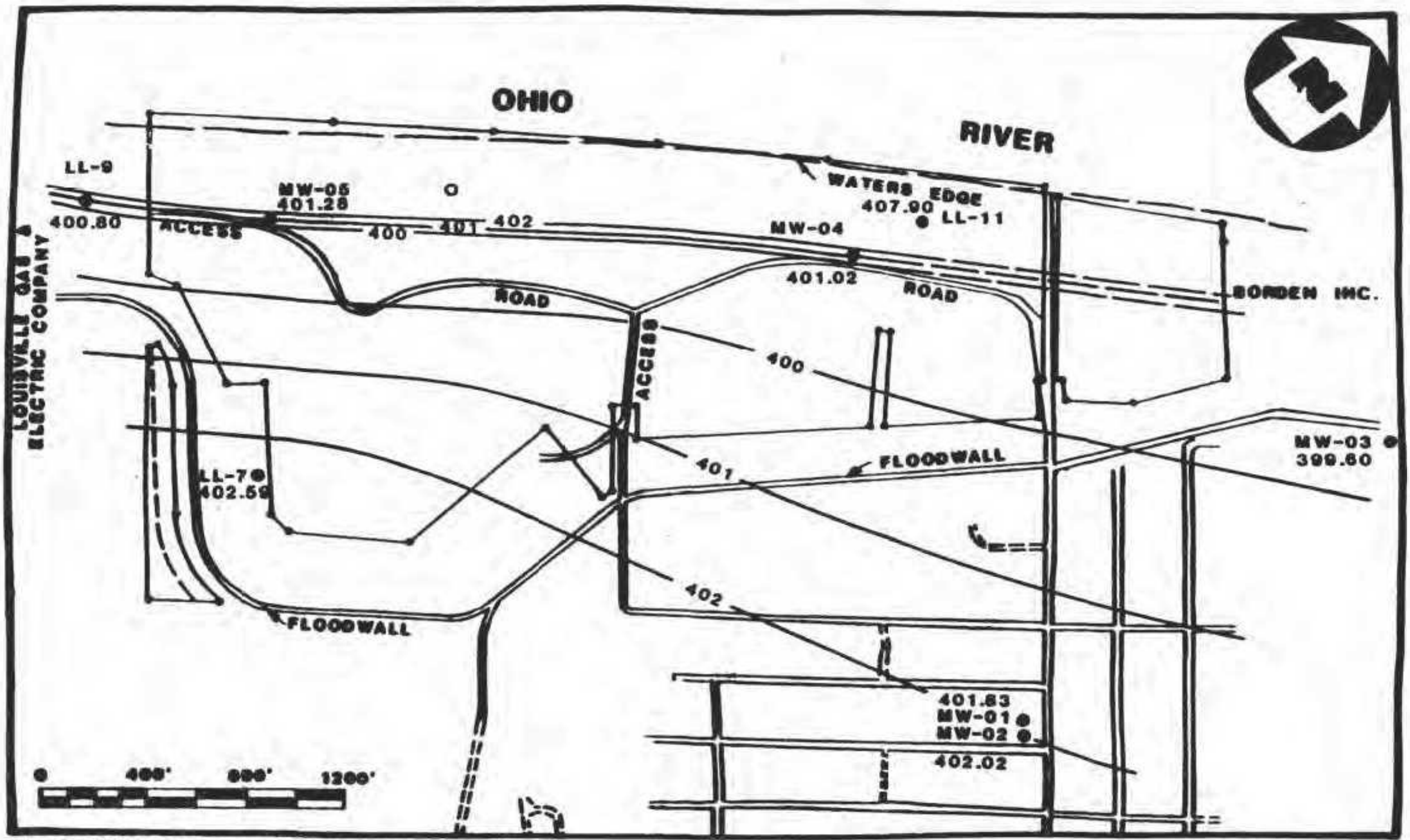
NUS CORPORATION
A Halliburton Company



GROUNDWATER CONTOURS
FEBURARY 8, 1985
LEES LANE LANDFILL SITE
JEFFERSON COUNTY, KENTUCKY

FIGURE 4-13

NUS CORPORATION
A Halliburton Company



GROUNDWATER CONTOURS

MARCH 11, 1985

LEES LANE LANDFILL SITE

JEFFERSON COUNTY, KENTUCKY

FIGURE 4-14

NUS CORPORATION

A Halliburton Company

Appendix D
Historical Groundwater Data

Ground Water Data from 1988 to 1989

Reference: 1993.03.11 EPA Reviewed of Response Actions

TABLE A.1 CONTAMINANTS DETECTED IN GROUNDWATER MONITORING WELL MW-A LEES LANE LANDFILL, LOUISVILLE, KY					
	ARAR	1ST July 88	2ND Oct. 88	3RD March 89	4TH June 89
INORGANICS					
ALUMINUM	n/a	12,000	--	940	--
ARSENIC	[0.018]	3	--	--	--
BARIUM	$(1,000)^{DWS}$	180	23	31	42
CADMIUM	5	15	--	--	--
CALCIUM	n/a	200,000	110,000	110,000	95,000
CHROMIUM	$(50)^{DWS}$	29	--	13	--
COBALT	n/a	100JN	--	--	--
COPPER	[1,000]	100J	--	--	--
IRON	$(1,000)^{WAH}$	51,000	1,300J	3,000	310
LEAD	15*	45	--	--	--
MAGNESIUM	n/a	76,000	31,000	38,000	32,000
MANGANESE	$(50)^{DWS}$	4,100	120	270	71
NICKEL	100	140	--	--	48
POTASSIUM	n/a	1,900	--	1,900	9,800
SODIUM	n/a	27,000	24,000	27,000	21,000
VANADIUM	n/a	38	--	--	--
ZINC	[5,000]	160J	--	--	--
ORGANICS					
AMINOHEXANOIC ACID	n/a	10JN	--	--	--
BENZOTHIAZOLE	n/a	--	--	--	2JN
BUTYL BENZYL PHTHALATE	100	--	3J	--	--
UNIDENTIFIED COMPOUNDS	n/a	60J	--	--	20JN

Notes:

ARAR = Applicable or Relevant and Appropriate Requirements
ARAR = Drinking Water Standards Maximum Contaminant Level (MCL), November, 1991, except for values in [ ] or ( ).
[ ] = ARAR is the Clean Water Act Ambient Water Quality Criteria (AWQC), October 1991.
( ) = ARAR is the Kentucky Administrative Regulations (KAR), January, 1992.
DWS = KAR Domestic Water Supply Source Criteria
WAH = KAR Warm water Aquatic Habitat Criteria
All values in µg/l
n/a = ARAR not available
Shaded values exceeded the ARAR
J = Estimated value

N = Presumptive evidence of presence of material
-- = Not detected
* = MCL Action Level

TABLE A.2 CONTAMINANTS DETECTED IN GROUNDWATER MONITORING WELL MW-B
LEES LANE LANDFILL, LOUISVILLE, KY

	ARAR	1ST July 88	2ND Oct. 88	3RD March 89	4TH June 89
INORGANICS					
ALUMINUM	n/a	2,400	--	300	--
BARIUM	(1,000)^{DWS}	56	--	21	17
CALCIUM	n/a	110,000	110,000	110,000	100,000
CHROMIUM	(50)^{DWS}	23	--	--	--
COBALT	n/a	12	--	--	--
COPPER	[1,000]	--	13	--	--
IRON	(1,000)^{WAH}	10,000	500J	920	300
LEAD	15*	18	--	--	--
MAGNESIUM	n/a	40,000	29,000	37,000	36,000
MANGANESE	(50)^{DWS}	1,000	300	630	220
POTASSIUM	n/a	--	--	1,600	--
SODIUM	n/a	23,000	25,000	23,000	18,000
VANADIUM	n/a	6	--	--	--
ZINC	[5,000]	100J	--	--	--
ORGANICS					
UNIDENTIFIED COMPOUNDS	n/a	60J	--	--	--

Notes:

ARAR = Applicable or Relevant and Appropriate Requirements
ARAR = Drinking Water Standards Maximum Contaminant Level (MCL), November, 1991, except for values in [ ] or ( ).
[ ] = ARAR is the Clean Water Act Ambient Water Quality Criteria (AWQC), October 1991.
( ) = ARAR is the Kentucky Administrative Regulations (KAR), January, 1992.
DWS = KAR Domestic Water Supply Source Criteria
WAH = KAR Warm water Aquatic Habitat Criteria
All values in µg/l
n/a = ARAR not available
Shaded values exceeded the ARAR
J = Estimated value

N = Presumptive evidence of presence of material
-- = Not detected
* = MCL Action Level

TABLE A.3 CONTAMINANTS DETECTED IN ZEIGLER WELL PW-01
LEES LANE LANDFILL, LOUISVILLE, KY

	ARAR	1ST July 88	2ND Oct. 88	3RD March 89	4TH June 89
INORGANICS					
ALUMINUM	n/a	NA	--	--	--
BARIUM	$(1{,}000)^{DWS}$	NA	--	--	15
CALCIUM	n/a	NA	89,000	91,000	93,000
COPPER	[1,000]	NA	130	--	--
MAGNESIUM	n/a	NA	29,000	30,000	32,000
MANGANESE	$(50)^{DWS}$	NA	11	11	20
NICKEL	100	NA	25J	--	--
POTASSIUM	n/a	NA	--	2,100	--
SODIUM	n/a	NA	22,000	25,000	28,000
ZINC	[5,000]	NA	1,600	2,300J	2,300
ORGANICS					
2,4-DIMETHYLPHENOL	[400]	NA	--	--	1J
ETHYLBENZENE	700	NA	2J	--	--
FLUORANTHENE	$(42)^{DWS}$	NA	--	--	0.7J
2-METHYLNAPTHALENE	n/a	NA	--	--	0.6J
PHENANTHRENE	n/a	NA	--	--	0.7J

Notes:

ARAR = Applicable or Relevant and Appropriate Requirements
ARAR = Drinking Water Standards Maximum Contaminant Level (MCL), November, 1991, except for values in [ ] or ( ).
[ ] = ARAR is the Clean Water Act Ambient Water Quality Criteria (AWQC), October 1991.
( ) = ARAR is the Kentucky Administrative Regulations (KAR), January, 1992.
DWS = KAR Domestic Water Supply Source Criteria
All values in µg/l
n/a = ARAR not available
* = MCL Action Level

NA = Not Analyzed
-- = Not detected
J = Estimated value

TABLE A.4 CONTAMINANTS DETECTED IN GROUNDWATER MONITORING WELL MW-02 LEES LANE LANDFILL, LOUISVILLE, KY					
	ARAR	1ST July,88	2ND Oct.,88	3RD March,89	4TH June,89
INORGANICS					
ALUMINUM	n/a	63	--	110	--
BARIUM	$(1,000)^{DWS}$	90	83	87	88
CALCIUM	n/a	59,000	58,000	61,000	65,000
CHROMIUM	$(50)^{DWS}$	--	89J	26	--
COPPER	[1,000]	33J	130	--	--
IRON	$(1,000)^{WAH}$	950	1,100J	2,300	320
LEAD	15*	15	12	--	--
MAGNESIUM	n/a	19,000	16,000	18,000	20,000
MANGANESE	$(50)^{DWS}$	150	67	160	110
NICKEL	100	--	71J	--	--
POTASSIUM	n/a	1,400	--	1,000	--
SODIUM	n/a	7,400	5,400	7,300	7,500
ZINC	[5,000]	190J	--	--	--
ORGANICS					
BENZOTHIAZOLE	n/a	--	--	--	2JN
BUTYL BENZYL PHTHALATE	100	--	37	--	--
DIELDRIN	$(7.1x10^{-5})^{DWS}$	0.02JN	--	--	--
TOLUENE	1,000	--	--	24	--
UNIDENTIFIED COMPOUNDS	n/a	--	20J	--	20J

Notes:

ARAR = Applicable or Relevant and Appropriate Requirements
ARAR = Drinking Water Standards Maximum Contaminant Level (MCL), November, 1991, except for values in [ ] or ( ).
[ ] = ARAR is the Clean Water Act Ambient Water Quality Criteria (AWQC), October 1991.
( ) = ARAR is the Kentucky Administrative Regulations (KAR), January, 1992.
DWS = KAR Domestic Water Supply Source Criteria
WAH = KAR Warm water Aquatic Habitat Criteria
All values in µg/l
n/a = ARAR not available
Shaded values exceeded the ARAR
J = Estimated value

N = Presumptive evidence of presence of material
-- = Not detected
* = MCL Action Level

TABLE A.5 CONTAMINANTS DETECTED IN GROUNDWATER MONITORING WELL MW-04 LEES LANE LANDFILL, LOUISVILLE, KY					
	ARAR	1ST July 88	2ND Oct. 88	3RD March 89	4TH June 89
INORGANICS					
ALUMINUM	n/a	--	--	91	--
ARSENIC	{65,000}	--	--	--	5
BARIUM	{1,300,000}	120	120	95	100
CALCIUM	n/a	90,000	83,000	90,000	87,000
CHROMIUM	{65,000}	9	--	--	--
COPPER	{28,600}	7J	16	--	--
IRON	{1,300,000}	610	3,700J	9,300	8,700
LEAD	{65,000}	29	23	--	7
MAGNESIUM	n/a	7,400	24,000	29,000	30,000
MANGANESE	{65,000}	--	150	330	270
POTASSIUM	n/a	5,300	--	2,400	--
SODIUM	n/a	20,000	23,000	26,000	2,300
ORGANICS					
ACENAPTHENE	[20]	--	--	--	0.4J
BENZENE	{1,560}	10	2J	--	--
BENZENEACETIC ACID	n/a	10J	--	--	--

Notes:

ARAR = Applicable or Relevant and Appropriate Requirements
ARAR = Drinking Water Standards Maximum Contaminant Level (MCL), November, 1991, except for values in [ ] or ( ) or { }.
[ ] = ARAR is the Clean Water Act Ambient Water Quality Criteria (AWQC), October 1991.
( ) = ARAR is the Kentucky Administrative Regulations (KAR), January, 1992.
{ } = ARAR is the Alternate Concentration Limit (ACL) for Ohio River side wells.
All values in µg/l
n/a = ARAR not available
-- = Not detected
J = Estimated value

TABLE A.5 (cont'd) CONTAMINANTS DETECTED IN GROUNDWATER MONITORING WELL MW-04 LEES LANE LANDFILL, LOUISVILLE, KY					
	ARAR	1ST July 88	2ND Oct. 88	3RD March 89	4TH June 89
ORGANICS					
BIS(2-ETHYLHEXYL) PHTHALATE	[1.76]	--	--	--	56
BUTANOIC ACID	n/a	10JN	--	--	--
CHLOROBENZENE	[20]	7	--	--	--
4-CHLORO 3-METHYL PHENOL	[3,000]	--	--	--	0.8J
2-CHLOROPHENOL	[0.1]	--	--	--	1J
DECONIC ACID	n/a	20JN	--	--	--
DI-N BUTYLPHTHLATE	[2,715]	--	--	--	0.6J
DI-N OCTYLPHTHALATE	n/a	--	--	--	0.5J
DODECANOIC ACID	n/a	80JN	--	--	9JN
ETHYL BENZENE	700	44	11	--	--
ETHYLHEXANOL	n/a	10JN	--	--	--
ETHYLMETHYLBENZENE SULFONAMIDE	n/a	--	--	--	6JN
HEXADECANOIC ACID	n/a	--	--	--	5JN
METHYLBUTANOIC ACID	n/a	20JN	--	--	--
PENTANOL	n/a	--	700JN	--	--
PHENOL	$(3{,}500)^{DWS}$	140	--	--	--
PYRENE	[956.7]	--	--	--	0.4J
TETRACOSENOIC ACID-METHYLESTER	n/a	--	--	--	2JN
TETRADECONIC ACID	n/a	20JN	--	--	3JN
TOLUENE	1,000	--	2J	--	--
TRIMETHYLBENZENE SULFONAMIDE	n/a	--	--	--	6JN
UNIDENTIFIED COMPOUNDS	n/a	70JN	--	--	50JN

Notes:

ARAR = Applicable or Relevant and Appropriate Requirements
ARAR = Drinking Water Standards Maximum Contaminant Level (MCL), November, 1991, except for values in [ ] or ( ) or { }.
[ ] = ARAR is the Clean Water Act Ambient Water Quality Criteria (AWQC), October 1991.
( ) = ARAR is the Kentucky Administrative Regulations (KAR), January, 1992.
{ } = ARAR is the Alternate Concentration Limit (ACL) for Ohio River side wells.
All values in µg/l
n/a = ARAR not available
Shaded values exceeded the ARAR
J = Estimated value
N = Presumptive evidence of presence of material
-- = Not detected
* = MCL Action Level

TABLE A.6 CONTAMINANTS DETECTED IN GROUNDWATER MONITORING WELL MW-05 LEES LANE LANDFILL, LOUISVILLE, KY					
	ARAR	1ST July 88	2ND Oct. 88	3RD March 89	4TH June 89
INORGANICS					
ALUMINUM	n/a	NA	--	75	80
ANTIMONY	5-10	NA	--	580	62
ARSENIC	{65,000}	NA	--	17J	10J
BARIUM	{1,300,000}	NA	350	560	200
CALCIUM	n/a	NA	47,000	74,000	67,000
CHROMIUM	{65,000}	NA	83J	8	--
COPPER	{28,600}	NA	14	170	--
IRON	{1,300,000}	NA	17,000J	7,700	12,000
LEAD	{65,000}	NA	--	25,000	3,700
MAGNESIUM	n/a	NA	13,000	28,000	14,000
MANGANESE	{65,000}	NA	2,300	1,400	750
NICKEL	100	NA	49J	--	--
POTASSIUM	n/a	NA	--	9,900	--
SODIUM	n/a	NA	15,000	33,000	13,000
ZINC	{91,000}	NA	--	96J	--

Notes:

ARAR = Applicable or Relevant and Appropriate Requirements
ARAR = Drinking Water Standards Maximum Contaminant Level (MCL), November, 1991, except for values in [ ] or ( ) or { }.
[ ] = ARAR is the Clean Water Act Ambient Water Quality Criteria (AWQC), October 1991.
( ) = ARAR is the Kentucky Administrative Regulations (KAR), January, 1992.
{ } = ARAR is the Alternate Concentration Limit (ACL) for Ohio River side wells.
<u>All values in µg/l</u>
-- = Not detected
Shaded values exceeded the ARAR
n/a = ARAR not available
J = Estimated value
NA = Not Analyzed

TABLE A.6 (cont'd) CONTAMINANTS DETECTED IN GROUNDWATER MONITORING WELL MW-05 LEES LANE LANDFILL, LOUISVILLE, KY					
	ARAR	1ST July 88	2ND Oct. 88	3RD March 89	4TH June 89
ORGANICS					
BIS(2-ETHYLHEXYL) PHTHALATE	[1.76]	--	--	--	46
BUTYLIDENEBIS-METHYLPHENOL	n/a	--	--	50JN	--
DECONIC ACID	n/a	--	--	--	4JN
DODECANOIC ACID	n/a	40JN	--	--	30JN
ETHYLMETHYLBENZENE SULFONAMIDE	n/a	--	--	--	10JN
HEXADECANOIC ACID	n/a	10JN	--	--	20JN
METHYLBUTANOIC ACID	n/a	10JN	--	--	--
METHYLDIOXOLANE	n/a	6JN	--	--	--
OCTANOIC ACID	n/a	--	--	--	4JN
PENTANOL	n/a	--	10JN	--	--
TETRACOSENOIC ACID-METHYLESTER	n/a	--	--	--	1JN
TETRADECONIC ACID	n/a	--	--	--	10JN
TRIMETHYLBENZENE SULFONAMIDE	n/a	--	--	--	10JN
UNIDENTIFIED COMPOUNDS	n/a	100J	--	--	90J

Notes:

ARAR = Applicable or Relevant and Appropriate Requirements
ARAR = Drinking Water Standards Maximum Contaminant Level (MCL), November, 1991, except for values in [ ] or ( ) or { }
[ ] = ARAR is the Clean Water Act Ambient Water Quality Criteria (AWQC), October 1991.
( ) = ARAR is the Kentucky Administrative Regulations (KAR), January, 1992.
{ } = ARAR is the Alternate Concentration Limit (ACL) for Ohio River side wells.

<u>All values in µg/l</u>
-- = Not detected
N = Presumptive evidence of presence of material

n/a = ARAR not available
J = Estimated value
Shaded values exceeded the ARAR

Ground Water Data from 2002

Reference: 2009.08.28 MSD Request to Close 3 GW Wells

Table 1: September 2002 Analytical Results (1)

Contaminants	MCLs (mg/L)	2008 Proposed ACLs (mg/L)	MW-A (mg/L)	MW-B (mg/L)	MW-02 (mg/L)
Arsenic	0.05	11	<0.05	<0.05	<0.05
Antimony	0.006	6.6	<0.01	<0.01	<0.01
Cadmium	0.005	3.3	<0.05	<0.05	<0.05
Chromium (VI)	0.1	12.1	0.064	0.21	<0.03
Iron	0.3[SMCL]	1100	0.66	3.9	4.6
Lead	0.015	3.96	<0.05	<0.05	<0.05
Manganese	0.05[SMCL]	55	0.025	0.33	0.21
1,2-Dichloroethane	0.005	5.5	<0.05	<0.05	<0.05
Trichloroethane	0.005	5.5	<0.01	<0.05	<0.01
Bis(2-ethylhexyl) phthalate	0.006	5.5	<0.05	<0.01	<0.05

Note: 1) As reported in the Fourth Five-Year Review Report for Lee's Lane Landfill dated September 2008.
2) SMCL – Secondary Maximum Contaminant Level

The samples listed above show that for lead, antimony, cadmium, arsenic, 1,2-Dichloroethane, Trichloroethane, and Bis(2-ethylhexyl)phthalate, all analytical results were below the detection limits. The table above demonstrates that all of the contaminants identified in the 2002 groundwater samples are lower than the 2008 Proposed Alternative Concentration Limits. Therefore, MSD requests permission to plug and abandon the three groundwater wells. .

No groundwater well installation records could be located for the three groundwater wells., Observations by SMG and MSD personnel indicate each well was constructed as follows:

Table 2: Monitoring Well Construction Information

Well #	Depth (1) (ft.)	Depth to Water (1) (ft.)	Casing size (in.)	Casing MOC	Grout Type	Cap type
MW-A	64	47.2	4	Stainless steel	Assumed concrete grout	Steel riser with locking cap set in concrete
MW-B	70	45.2	4	Stainless steel	Assumed concrete grout	Steel riser with locking cap set in concrete
MW-02	101	50.2	4	Stainless steel	Assumed concrete grout	Steel riser with locking cap set in concrete

Notes: 1) Depths recorded from the top of the well casing.

Groundwater Monitoring Data 2003-2007

Reference: Fourth Five Year Review Report

Table 6: Groundwater Monitoring Data 2003 - 2007

Parameters Detected	Current Laboratory Detection Limits mg/L	Alternate Concentration Limit (mg/l) proposed 2008*	Sample Date			
			9/18/2003	9/22/2004	9/15/2005	12/4/2007
Well MW-04						
Beryllium	0.004	4.40	<0.004	<0.004	<0.004	<0.004
Chromium	0.01	12.1	<0.001	<0.001	<0.001	<0.001
Copper	0.01	13.2	<0.01	<0.01	<0.01	<0.01
Iron	0.02	1100	6	6.2	7.2	7.4
Manganese	0.01	55	0.14	0.14	0.15	0.15
Lead	0.005	3.96	0.0082	<0.005	<0.005	<0.005
Antimony	0.01	6.60	0.01	<0.01	<0.01	<0.01
Cadmium	0.005	3.30	<0.005	<0.005	<0.005	<0.005
Arsenic	0.005	11.0	0.01	0.011	0.012	0.011
1,2-Dichloroethane	0.01	5.50	<0.005	<0.005	<0.005	<0.005
Trichloroethane	0.005	5.50	<0.005	<0.005	<0.005	<0.005
Bis (2-ethylhexylphthalate	0.01	5.50	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium	0.01					<0.01
Well MW-05						
Beryllium	0.004	4.40	<0.004	<0.004	<0.004	<0.004
Chromium	0.01	12.1	<0.001	<0.001	<0.001	<0.001
Copper	0.01	13.2	<0.01	<0.01	<0.01	<0.01
Iron	0.02	1100	17	14	12	15
Manganese	0.01	55	0.86	0.7	0.54	0.68
Lead	0.005	3.96	<0.005	<0.005	<0.005	<0.005
Antimony	0.01	6.60	<0.01	<0.01	<0.01	<0.01
Cadmium	0.005	3.30	<0.005	<0.005	<0.005	<0.005
Arsenic	0.005	11.0	0.051	0.033	0.054	0.033
1,2-Dichloroethane	0.01	5.50	<0.005	<0.005	<0.005	<0.005
Trichloroethane	0.005	5.50	<0.005	<0.005	<0.005	<0.005
Bis (2-ethylhexylphthalate	0.01	5.50	<0.001	<0.001	<0.001	<0.001
Hexavalent Chromium	0.01					<0.01

* Based on 11,000cfs Ohio River flow

2006 – Laboratory lost samples, no data available

The Operations and Maintenance Manual indicates that the full Target Compound List will be used for reporting at the Site. Data associated with groundwater indicates that the method detection limit (0.01 mg/L) is not appropriate for reporting Antimony (MCL=0.006 mg/L) because the ACL is lower than the detection limit. Additionally, a method reportable limits should be established for the laboratory, where reporting at 3 times the detection limit should be required to reduce uncertainty in the measurement. This may be significant when evaluating cadmium or TCE, where reporting limits were 0.05 mg/L and the MCL is 0.005 mg/L. This 5-year review recommends reporting limits be established based on the action levels, or approved ACLs, data uncertainty and bias, and tolerable decision errors, where the established reportable limits must be 5 to10 times the action levels (e.g. it is noted that cadmium was reported at ten times less prior to 2000. Data Quality Objectives should be reviewed and the Operations and Maintenance Manual should be updated to include the new DQOs prior to the next review.

GW Well Monitoring Data

Reference: Fourth Five Year Review Report

Form C-3 Groundwater Monitoring Data

GW MW-A

Parameter Detected	Maximum Contaminant Level (mg/L)	07/88	10/88	02/89	06/89	10/92	02/93	05/93	08/93	11/93	06/94	09/94	11/94	03/95	09/95	12/95	05/96	12/96	11/99	09/00	09/01	09/02
	Units:	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Chromium	0.1	0.029	ND	0.013	ND	0.12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.01	< 0.01	0.032	0.064
Iron	0.3^{SMCL}	51	13 J	3	0.31	3.9	0.45	0.5	0.42	0.7	0.49	0.53	0.57	0.66	1.3	0.44	0.57	0.52	0.32	0.066	1.4	0.66
Manganese	0.05^{SMCL}	4.1	0.12	0.27	0.071	0.38	0.052	ND	ND	0.075	ND	ND	0.032	ND	0.059	ND	ND	ND	0.026	< 0.01	0.089	0.025
Lead	0.015	0.045	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.005	< 0.05	< 0.05	< 0.05
Antimony	0.006	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.03	< 0.01	< 0.01	< 0.01
Cadmium	0.005	0.015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	100	< 0.05	< 0.05	< 0.05
Arsenic	0.05	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05	< 0.05
1,2-Dichloroethane	0.005	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		< 0.05	< 0.05	< 0.05
Trichloroethane	0.005	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		< 0.05	< 0.05	< 0.05
Bis(2-ethylhexyl)phthalate	0.006	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		< 0.01	< 0.01	< 0.01

SMCL = Secondary Maximum Contaminant Level
NA = Not Analyzed
ND = Compound Not Detected

GW MW-B

Parameter Detected	Maximum Contaminant Level (mg/L)	07/88	10/88	03/89	06/89	10/92	02/93	05/93	08/93	11/93	03/94	06/94	09/94	11/94	03/95	06/95	09/95	12/95	05/96	03/96	12/96	09/00	09/01	09/02
	Units:	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Chromium	0.1	0.023	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.01	0.014	0.21
Iron	0.3^{SMCL}	10	0.5 J	0.9	0.3	3.9	0.55	0.6	0.34	0.6	4.5	1	1	0.54	0.81	1.4	0.7	0.35	0.94	0.39	0.4	0.23	2.2	3.9
Manganese	0.05^{SMCL}	1	0.3	0.63	0.22	0.38	0.49	ND	0.37	0.41	1.2	0.52	0.45	0.31	0.3	0.5	0.38	0.27	0.16	0.18	0.21	0.3	0.25	0.33
Lead	0.015	0.018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.038	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05
Antimony	0.006	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.01	< 0.01	< 0.01
Cadmium	0.005	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05
Arsenic	0.05	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05
1,2-Dichloroethane	0.005	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05
Trichloroethane	0.005	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05
Bis(2-ethylhexyl)phthalate	0.006	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND					< 0.01	< 0.01	< 0.01

SMCL = Secondary Maximum Contaminant Level
NA = Not Analyzed
ND = Compound Not Detected

GW MW-02

Parameter Detected	Maximum Contaminant Level (mg/L)	07/88	10/88	03/89	06/89	10/92	02/93	05/93	08/93	11/93	03/94	06/94	09/94	11/94	03/95	06/95	12/95	05/96	03/96	12/96	09/00	09/01	09/02
	Units:	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Chromium	0.1	ND	0.089 J	0.026	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.01	< 0.02	< 0.03
Iron	0.3^{SMCL}	0.95	1.1 J	2.3	0.32	2.8	3	2.9	3	2.8	3.2	2.9	3.1	3.4	3.5	3	2.8	3.6	3.5	4.2	4.1	4.3	4.6
Manganese	0.05^{SMCL}	0.15	0.087	0.16	0.11	0.11	0.12	0.11	0.13	0.11	0.1	0.12	0.11	0.13	0.13	0.11	0.12	0.13	0.15	ND	0.19	0.19	0.21
Lead	0.015	0.015	0.012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.015	ND	ND	< 0.05	< 0.05	< 0.05
Antimony	0.006	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.01	< 0.01	< 0.01
Cadmium	0.005	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05
Arsenic	0.05	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05
1,2-Dichloroethane	0.005	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05
Trichloroethane	0.005	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05
Bis(2-ethylhexyl)phthalate	0.006	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND					< 0.01	< 0.01	< 0.01

SMCL = Secondary Maximum Contaminant Level
NA = Not Analyzed
ND = Compound Not Detected

GW MW-04

Parameter Detected	Alternate Concentration Limit (mg/L) revised 2003*	07/88	10/88	03/89	06/89	10/92	02/93	05/93	08/93	11/93	03/94	06/94	09/94	11/94	03/95	06/95	09/95	12/95	05/96	03/96	12/96	09/00	09/01	09/02	9/18/2003	9/22/2004	9/15/2005	12/4/2007
	Units:	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Chromium	55	0.009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	1100	0.61	3.7 J	9.3	8.7	5.9	7.2	8.3	6	5.8	7	6.4	6.5	6.2	8.3	5.9	6	5.7	7.2	8.6	8.3	5.5	6.2	6.4	6	6.2	7.2	7.4
Manganese	55	ND	0.15	0.33	0.27	0.16	0.17	ND	0.16	0.15	0.16	0.16	0.15	0.16	0.15	0.14	0.15	0.13	0.16	0.2	0.16	0.14	0.14	0.15	0.14	0.14	0.15	0.15
Lead	55	0.029	0.023	ND	0.007	ND	0.028	ND	ND	ND	0.12	ND	0.035	0.021	ND	ND	0.016	ND	0.019	0.039	ND	0.0068	0.0068	< 0.05	0.0082	< 0.005	< 0.005	< 0.005
Antimony	(0.006)	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01
Cadmium	13.2	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05	< 0.005	< 0.005	< 0.005	< 0.005
Arsenic	55	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.012	0.11	0.0061	0.01	0.011	0.012	0.011
1,2-Dichloroethane	(0.005)	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05	< 0.005	< 0.005	< 0.005	< 0.001
Trichloroethane	(0.005)	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05	< 0.005	< 0.005	< 0.005	< 0.001
Bis(2-ethylhexyl)phthalate	(0.006)	ND	ND	ND	0.056	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND					< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

NA = Not Analyzed
ND = Compound Not Detected
() = Maximum Contaminant Level (MCL)
*Based on 11,000 cfs Ohio River flow

GW MW-05

Parameter Detected	Alternate Concentration Limit (mg/L) revised 2003*	07/88	10/88	03/89	06/89	10/92	02/93	05/93	08/93	11/93	03/94	06/94	09/94	11/94	03/95	06/95	09/95	12/95	05/96	03/96	12/96	09/00	09/01	09/02	9/18/2003	9/22/2004	9/15/2005	12/4/2007
	Units:	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Chromium	55	NA	083 J	0.008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND	< 0.01	0.026	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Iron	1100	NA	17 J	7.7	12	110	41	130	ND	55	21	110	140	120	14	110	70	240	48	48	17	14	ND	26	17	14	12	15
Manganese	55	NA	2.3	1.4	0.75	0.98	0.72	1.1	ND	0.82	0.58	1.1	1	1.2	1.1	1.2	0.97	1.3	0.76	0.71	ND	0.9	ND	0.92	0.86	0.7	0.54	0.68
Lead	55	NA	ND	25	3.7	1.3	0.43	0.72	0.99	0.39	0.09	0.62	0.24	0.3	0.06	0.21	0.23	0.32	0.06	0.52	0.14	< 0.05	< 0.05	0.068	< 0.005	< 0.005	< 0.005	< 0.005
Antimony	(0.006)	NA	ND	0.58	0.062	0.036	ND	ND *	ND	0.043	ND	ND	0.042	0.043	ND	ND	ND	ND	ND	ND	ND	< 0.03	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cadmium	13.2	NA	NA	NA	NA	0.0092	0.0053	ND	ND	ND	ND	ND	0.0053	0.005	ND	ND	0.0054	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05	< 0.005	< 0.005	< 0.005	< 0.005
Arsenic	55	NA	ND	0.017 J	0.01 J	0.8	0.3	ND	2.6	0.36	0.12	0.38	0.72	0.85	ND	0.55	0.53	1.6	0.3	0.26	0.07	0.029	< 0.05	0.1	0.051	0.033	0.054	0.033
1,2-Dichloroethane	(0.005)	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05	< 0.005	< 0.005	< 0.005	< 0.001
Trichloroethane	(0.005)	NA	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.05	< 0.05	< 0.05	< 0.005	< 0.005	< 0.005	< 0.001
Bis(2-ethylhexyl)phthalate	(0.006)	ND	ND	ND	0.046	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

J = Estimated
NA = Not Analyzed
ND = Compound Not Detected
() = Maximum Contaminant Level (MCL)
*Based on 11,000 cfs Ohio River flow
2006 - lab lost samples

Metals Analyzed by SW846-6010B
Volatile Organics Analyzed by SW846-8240B
Semi-Volatile Organics Analyzed by SW846-8270C
No quantitation limits are available
Values of non detect (ND) are not available prior to 2000

Appendix E
Estimated Transpiration Benefit

Appendix E Estimated Transpiration Benefit

1. Objective

Document the basis for estimate of transpiration at the Lee's Lane Landfill (the Site) providing capture of approximately 12 inches of water per year.

2. Site Background Data

- The Site spans 112 acres
- Approximately 80 acres vegetated with mature trees
- Tree species are primarily silver maple (Acer saccharinum), red mulberry (Morus rubra), slippery elm (Ulmus rubra), and American elm (Ulmus americana).

3. Assumptions

- A silver maple or red maple have similar transpiration rates to the cited mature maple rate
- The average of the transpiration range for a gallons per day (gpd) estimate is conservative for year round in the warm site climate (Kentucky)
- An American elm and slippery elm have similar transpiration rates
- An equal distribution of these four tree species populate the 80 acres
- An average of 100 mature trees per vegetated acre
- The lower bound estimate of transpiration for a "summer day" is conservative for year round in the warm site climate

4. Calculations

To estimate the water capture provided by the forested areas of the Site transpiration rates for each species were researched. A mature maple can transpire 65-140 liters (17-37 gallons) per summer day (Cotrone, 2013). A mature red mulberry transpires an estimated 14-24 gpd per tree (ITRC, 2009). Transpiration for a red maple ranges from 5-17 acre-inches and transpiration for an American elm ranges from 1.5-7 acre-inches (Horton, 1973).

Since consistent units were not available for all species, assumptions and conversion ratios were used to determine a conservative estimate in gpd per tree. To estimate the transpiration in gpd per tree a ratio was computed for the red maple and American elm transpiration values provided.

For the lower estimate the ratio is:

$$\frac{1.5}{5} = 0.30 \text{ } or \text{ } 30\%$$

For the higher estimate the ratio is:

$$\frac{7}{17} = 0.41\ or\ 41\%$$

Using these estimates the extrapolated transpiration for the American elm in gallons per summer day would be:

$$0.30 \times\ 17\ \frac{gpd}{tree} = 5.1\frac{gpd}{tree}$$

and

$$0.41 \times\ 37\ \frac{gpd}{tree} = 14.8\frac{gpd}{tree}$$

For the purposes of estimating the annual water uptake the following transpiration values were used:

- Silver maple: 17 gpd per tree
- Red mulberry: 19 gpd per tree
- American elm: 5.1 gpd per tree
- Slippery elm: 5.1 gpd per tree

Acre Estimate:

$$\left(25\ trees \times 17\frac{gpd}{tree}\right) + \left(25\ trees \times 19\frac{gpd}{tree}\right) + \left(25\ trees \times 5.1\frac{gpd}{tree}\right) + \left(25\ trees \times 5.1\frac{gpd}{tree}\right) = 1{,}155\ \frac{gpd}{acre}$$

$$1{,}155\ \frac{gpd}{acre} \times \frac{1\ ft^3}{7.481\ gallons} \times \frac{1\ acre}{43{,}560\ ft^2} \times \frac{12\ in}{1\ ft} \times \frac{365\ days}{1\ year} = 15.5\ \frac{inches}{year}$$

Total Annual Transpiration Volume:

$$1{,}155\ \frac{gpd}{acre} \times 80\ acres \times \frac{274\ days}{1\ year} = 25{,}318{,}000\frac{gallons}{year}$$

5. References

Cotrone, Vincent. 2013. "Trees: A Green, Cost Effective Stormwater Management Practice." Pennsylvania State Extension. http://www1.villanova.edu/content/dam/villanova/engineering/vcase/sym-presentations/1a3_Role%20of%20Urban_Vincent%20Cotrone.pdf

Horton, Jerome S. 1973. *Evapotranspiration and Water Research as Related to Riparian and Phreatophyte Management*. Tempe, AZ: Forest Service – U.S. Department of Agriculture.

ITRC (Interstate Technology & Regulatory Council). 2009. *Phytotechnology Technical and Regulatory Guidance and Decision Trees, Revised*. PHYTO-3. Washington, D.C.: The Interstate Technology & Regulatory Council, Phytotechnologies Team, Tech Reg Update. www.itrcweb.org

Appendix F
Technical Memorandum - Derivation of Site-Specific Clean-up Levels of Soil

Appendix F Technical Memorandum - Derivation of Site-Specific Clean-up Levels of Soil

1. Introduction

This memorandum presents the calculation of the Site-Specific Cleanup Levels (SSCLs) for soil the Chemicals of Potential Concern (COPCs) at Lee's Land Landfill (Site), Louisville, Kentucky. The equations and exposure assumption used to calculate soil SSCLs for the trespasser and recreational user scenarios are presented below. GHD has developed the SSCLs for the trespasser and recreational user exposure to soils in response to the United States Environmental Protection Agency (EPA) and Kentucky Department of Environmental Protection (KDEP) comments on the draft Conceptual Site Model (CSM) dated August 17, 2015.

2. Derivation of Site-Specific Cleanup Levels (SSCLs)

GHD has derived the SSCLs in accordance with EPA guidance documents. The following EPA guidance documents were used to derive the SSCLs:

- EPA Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part) A, EPA/540/1-89/002, December 1989
- EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER Directive 9355.4-24, December 2002
- Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004
- Guidelines for Carcinogenic Risk Assessment and Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, March 2005
- Exposure Factors Handbook 2011 Edition (Final). Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F, September 2011
- Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil, OSWER 9200.1-113, December 2012
- Region 4 Human Health Risk Assessment Bulletins Supplemental Guidance, Section 4.2.2 Trespasser Scenario, January 2014 Final Draft
- Regional Screening Level (RSL) Summary Table, June 2015. Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
- Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 2014

The equations used to develop the SSCLs for soil (direct contact) are presented in Section 2.1. For each COPC, two risk-based concentrations were initially developed if toxicity data was available: one protective of carcinogenic health impacts and a second protective of non-carcinogenic health impacts. The SSCL for each particular exposure pathway was determined to be the lower value between carcinogenic and non-carcinogenic health impacts. The SSCLs were developed using a target cancer risk of 1.0×10^{-6} and target non-cancer hazard quotient (HQ) of 1.0. Section 2.2 presents the receptor-specific exposure assumptions applied in the development of the pathway-specific SSCLs, Section 2.3 presents the human health toxicity values applied for each identified chemical parameter, and Section 2.4 presents a summary of the SSCLs calculated for each COPC and exposure pathway.

2.1 Soil Exposure Equations

Trespasser and Recreational User

The SSCLs developed for the trespasser and recreational user incidental ingestion, dermal contact, and inhalation exposure to soil were derived based on the following equations:

Carcinogenic Endpoint:

$$SSCL_{soil} = \frac{TR \times ATc}{EF \times ED[((CSF_o \times IR \times CF \times RAF_o)/BW) + (CSF_d \times SA \times AF \times CF \times RAF_d)/BW) + (URF_i \times FT \times (1/PEF \text{ or } VF)))]}$$

Non-Carcinogenic Endpoint:

$$SSCL_{soil} = \frac{THQ \times ATnc}{EFa \times EFb \times ED[((1/RfD_o \times IR \times CF \times RAF_o)/BW) + (1/RfD_d \times SA \times AF \times CF \times RAF_d)/BW) + (1/RfC_i \times FT \times (1/PEF \text{ or } VF)))]}$$

Where:

$SSCL_{soil}$	=	Site-Specific Cleanup Level in soil based on oral, dermal, and inhalation exposure (mg/kg)
TR	=	Target Cancer Risk
THQ	=	Target Hazard Quotient
CSF_o	=	Cancer Slope Factor – oral – chemical-specific $(mg/kg/day)^{-1}$
CSF_d	=	Cancer Slope Factor - dermal - chemical-specific $(mg/kg/day)^{-1}$
URF_i	=	Inhalation Unit Risk Factor – chemical-specific $(mg/m^3)^{-1}$
RfD_o	=	Reference Dose – oral – chemical-specific (mg/kg/day)
RfD_d	=	Reference Dose - dermal - chemical-specific (mg/kg/day)
RfC_i	=	Reference Concentration – inhalation – chemical-specific (mg/m^3)
IR	=	Ingestion Rate (mg/day)
RAF_o	=	Relative Absorption Factor – oral – chemical-specific (percent/100)
RAF_d	=	Relative Absorption Factor – dermal – chemical-specific (percent/100)
CF	=	Conversion Factor (kg/mg)
SA	=	Surface Area of skin exposed (cm^2)
AF	=	Soil to Skin Adherence Factor (mg/cm^2)
PEF	=	Particulate Emission Factor (m^3/kg)
VF	=	Volatilization Factor – inhalation - chemical-specific (L/m^3)
FT	=	Fraction of Time Exposed – inhalation (hours/24 hours) (accounts for the portion of the day that the receptor would inhale dust emitted from soil to ambient air)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)

ATc	=	Averaging Time – carcinogen (days)
ATnc	=	Averaging Time – non-carcinogen (days)

The inhalation of COPCs within vapor originating from soil is modeled through the use of a volatilization factor (VF) to estimate ambient air concentrations based on the soil concentration. The VF is chemical specific and was calculated using the approach presented in EPA (2002).

2.2 Receptor Exposure Assumptions

Trespasser

The exposure assumptions that were applied in the derivation of the $SSCL_{soil}$ for the trespasser are summarized below:

Exposure Factor	Units	Trespasser	
		Value	Reference
Ingestion Rate of Soil – IR	mg soil/day	100	EPA, 2002
Exposure Frequency – EF	days/year	58	EPA, 2011 (1)
Exposure Duration – ED	Years	10	EPA, 2014a
Body Weight – BW	Kg	45	EPA, 2014a
Skin Surface Area Available for Contact – SA	cm^2	5,537	EPA, 2011 (2)
Skin Adherence Factor – AF	mg/cm^2	0.07	EPA, 2004
Absorption Factor – ABS - oral	%/100	chemical specific	EPA, 2012 (3)
Absorption Factor – ABS - dermal	%/100	chemical specific	EPA, 2004
Fraction Time Exposed -Inhalation – FT	Unitless	3.9/24	EPA, 2011 (4)
Particulate Emission Factor - PEF	m^3/kg	1.36E+09	EPA, 2002
Volatilization Factor – VF	m^3/kg	chemical specific	EPA, 2002
Averaging Time (cancer) - AT-C	Days	25,550	EPA, 1989
Averaging Time (non-cancer) - AT-N	Days	3,650	EPA, 1989
Mutagenic Factor - MF	Unitless	3	EPA, 2005 (5)

Notes:

(1) The basis for the EF is the average of the mean time spent outdoors for the age groups 6-11 and 11-16 from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total) (EPA, 2011). For 6-11 years old, the time spent outdoors of 132 min/day equals an exposure frequency of 33 days/year [(132 min/d /1440 total min/d)*365]. For 11-16 years old, the time spent outdoors of 100 min/day equals an exposure frequency of 25 days/year [(100 min/d /1440 total min/d)*365]. The average of the 6-11 and 11-16 ages groups of 29 days/year is a central tendency value that was doubled to 58 days/year to derive the EF value.

(2) The basis for SA is the average value for age groups 6 to 11 and 11 to 16 and calculated by summing the mean surface area by body part for face, lower arms, lower legs, feet, and hands from Table 7-2, Recommended Values for Surface Area of Body Parts, Males and Female Children Combined (EPA, 2011). The surface area of the face was assumed to be one-third the surface area of the head, the surface area of the lower legs was assumed to be 40 percent of the surface area of the legs, and the surface area of the lower arms was assumed to be 45 percent of the surface area of the arms, consistent with EPA (2004).

(3) The default assumption of 100% is applied for all parameters with the exception of arsenic at 60% (EPA, 2012).

(4) The basis for the FT is the average of the mean time spent outdoors for the age groups 6-11 and 11-16 from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (EPA, 2011). For 6-11 years old, the time spent outdoors of 132 min/day equates to 2.2 hrs [132/60]. The average of the 6-11 and 11-16 ages groups of 1.95 hours is a central tendency value that was doubled to 3.9 hours to derive the FT value.

(5) Mutagenic ingestion, dermal contact, and inhalation intakes calculated using default age-dependent adjustment factor of 3 for ages >2 to 16 years as applied for carcinogens that act via a mutagenic mode of action.

All exposure assumptions and equations utilized in the derivation of the $SSCL_{soil}$ for the trespasser are also summarized in Table 1.

To determine the potential inhalation exposure to the volatile COPCs in soil volatilizing to ambient air, a VF was used to estimate the ambient air concentration based on the soil concentration of the COPC. The VF is chemical-specific and was calculated using the approach presented in EPA (2002). Default EPA soil and chemical-specific properties were used in calculating the VF. The equations and inputs for the calculated VF values for the trespasser are presented in Table 2.

Recreational User

The exposure assumptions that were applied in the derivation of $SSCL_{soil}$ for the recreational user are summarized below:

Exposure Factor	Units	Recreational User				
		Young Child (0-2 yrs)	Child (2-6 yrs)	Young Adult (6-16 yrs)	Adult (16-26 yrs)	Reference
Ingestion Rate of Soil – IR	mg soil/day	200	200	100	100	EPA, 2002
Exposure Frequency – EF	days/year	50				EPA, 2011 (1)
Exposure Duration – ED	years	2	4	10	10	EPA, 2014b
Body Weight – BW	kg	15	15	80	80	EPA, 2014b
Skin Surface Area Available for Contact – SA	cm^2	1,475	2,514	5,537	6,032	EPA, 2011 (2)
Skin Adherence Factor – AF	mg/cm^2	0.2	0.2	0.07	0.07	EPA, 2002
Absorption Factor – ABS - oral	%/100	chemical specific				EPA, 2012 (3)
Absorption Factor – ABS - dermal	%/100	chemical specific				EPA, 2004
Fraction Time Exposed -Inhalation – FT	unitless	3.4/24				EPA, 2011 (4)
Particulate Emission Factor - PEF	m^3/kg	1.36E+09				EPA, 2002
Volatilization Factor – VF	m^3/kg	chemical specific				EPA, 2002
Averaging Time (cancer) - AT-C	days	25,550				EPA, 1989
Averaging Time (non-cancer) - AT-N	days	730	1,460	3,650	3,650	EPA, 1989
Mutagenic Factor - MF	unitless	10	3	3	1	EPA, 2005 (5)

Notes:

(1) The basis for the EF is the average of the mean time spent outdoors for all of the age groups (not including > 65 yrs) from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total) (EPA, 2011). For 1-3 months old, the time spent outdoors of 8 min/day equals an exposure frequency of 2 days/year [(8 min/d /1440 min/d)*365]. For 3-6 months old, the time spent outdoors of 26 min/day equals an exposure frequency of 7 days/year [(26 min/d /1440 min/d)*365]. For 6-12 months old, the time spent outdoors of 139 min/day equals an exposure frequency of 35 days/year [(139 min/d /1440 min/d)*365]. For 1-2 years old, the time spent outdoors of 36 min/day equals an exposure frequency of 9 days/year [(36 min/d /1440 min/d)*365]. For 2-3 years old, the time spent outdoors of 76 min/day equals an exposure frequency of 19 days/year [(76 min/d /1440 min/d)*365]. For 3-6 years old, the time spent outdoors of 107 min/day equals an exposure frequency of 27 days/year [(107 min/d /1440 min/d)*365]. For 6-11 years old, the time spent outdoors of 132 min/day equals an exposure frequency of 33 days/year [(132 min/d /1440 total min/d)*365]. For 11-16 years old, the time spent outdoors of 100 min/day equals an exposure frequency of 25 days/year [(100 min/d /1440 total min/d)*365]. For 16-21 years old, the time spent outdoors of 102 min/day equals an exposure frequency of 26 days/year [(102 min/d /1440 total min/d)*365]. For 18-65 years old, the time spent outdoors of 281 min/day equals an exposure frequency of 71 days/year [(281 min/d /1440 total min/d)*365]. The average of all of the ages groups of 25 days/year is a central tendency value that was doubled to 50 days/year to derive the EF value.

(2) The basis for SA is the average value for each age groups of 0-2 yrs, 2-6 yrs, and 6-16 yrs, and calculated by summing the mean surface area by body part for face, lower arms, lower legs, feet, and hands from Table 7-2, Recommended Values for Surface Area of Body Parts, Males and Female Children Combined (EPA, 2011). The surface area of the face was assumed to

Exposure Factor	Units	Recreational User				
		Young Child (0-2 yrs)	Child (2-6 yrs)	Young Adult (6-16 yrs)	Adult (16-26 yrs)	Reference

be one-third the surface area of the head, the surface area of the lower legs was assumed to be 40 percent of the surface area of the legs, and the surface area of the lower arms was assumed to be 45 percent of the surface area of the arms, consistent with EPA (2004). The adult SA was taken from EPA, 2014b.

(3) The default assumption of 100% is applied for all parameters with the exception of arsenic at 60% (EPA, 2012).

(4) The basis for the FT is the average of the mean time spent outdoors for all of the age groups (not including > 65 yrs) from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (EPA, 2011). For 1-3 months old, the time spent outdoors of 8 min/day equates to 0.13 hrs [8/60]. For 3-6 months old, the time spent outdoors of 26 min/day equates to 0.43 hrs [26/60]. For 6-12 months old, the time spent outdoors of 139 min/day equates to 2.3 hrs [139/60]. For 1-2 years old, the time spent outdoors of 36 min/day equates to 0.6 hrs [36/60]. For 2-3 years old, the time spent outdoors of 76 min/day equates to 1.3 hrs [76/60]. For 3-6 years old, the time spent outdoors of 107 min/day equates to 1.8 hrs [107/60]. For 6-11 years old, the time spent outdoors of 132 min/day equates to 2.2 hrs [132/60]. For 11-16 years old, the time spent outdoors of 100 min/day equates to 1.7 hrs [100/60]. For 16-21 years old, the time spent outdoors of 102 min/day equates to 1.7 hrs [102/60]. For 18-65 years old, the time spent outdoors of 281 min/day equates to 4.7 hrs [281/60]. The average of all ages groups of 1.7 hours is a central tendency value that was doubled to 3.4 hours to derive the FT value.

(5) Mutagenic ingestion, dermal contact, and inhalation intakes calculated using default age-dependent adjustment factor of 3 for ages >2 to 16 years as applied for carcinogens that act via a mutagenic mode of action.

All exposure assumptions and equations utilized in the derivation of the $SSCL_{soil}$ for the recreational user are also summarized in Table 3.

To determine the potential inhalation exposure to the volatile COPCs in soil volatilizing to ambient air, a VF was used to estimate the ambient air concentration based on the soil concentration of the COPC. The VF is chemical-specific and was calculated using the approach presented in EPA (2002). Site-specific soil and chemical-specific properties were used in calculating the VF. The equations and inputs for the calculated VF values for the recreational user are presented in Table 4.

2.3 Human Health Toxicity Values

The toxicity values used in the calculation of the soil SSCLs included ingestion and dermal cancer slope factors (CSFs) and inhalation unit risk factors (URFs) for carcinogenic effects, and chronic ingestion and dermal reference doses (RfDs) and inhalation reference concentrations (RfCs) for non-carcinogenic effects. The toxicity values were obtained from EPA's Regional Screening Level (RSL) Table (last updated June 2015).

2.4 Summary of Site-Specific Cleanup Levels (SSCLs)

The equations, exposure assumptions, and toxicity values used in the development of the SSCLs are presented in the following tables for the various exposure pathways:

- Trespasser Direct Contact with Soil SSCLs - Table 1
- Recreational User Direct Contact with Soil SSCLs - Table 3

Tables 1 and 3 also present a comparison of the SSCLs to the maximum soil concentrations. As shown in Table 1, the maximum soil concentration for lead, benzo(a)pyrene, and aroclor-1248 exceeded the trespasser SSCLs. The maximum soil concentration for arsenic, lead, benzo(a)pyrene, benzo(a)anthracene, dibenzo(a,h)anthracene, bis(2-ethylhexyl)phthalate, and aroclor-1248 exceeded the recreational user SSCLs, as presented in Table 3.

2.5 Risk Quantification Summary

As there were exceedances of the SSCLs based on the lower of 1 x 10^{-6} cancer risk and hazard quotient of 1, the sum of the risks and hazards from the COPCs were calculated to determine if the cumulative cancer risk was above 1 x 10^{-4}, or if any target organ hazard quotient exceeds 1, for either trespasser or recreational user.

The cumulative cancer risk and hazard index for the trespasser and recreational user were calculated using the exposure assumptions utilized in the derivation of the $SSCL_{soil}$ for each receptor as summarized in Section 2.2.

An Exposure Point Concentration (EPC) is a conservative estimate of the contaminant concentration at an exposure point or in an exposure area. The EPCs for these calculations were conservatively set to the maximum concentration of the COPCs in soil. Typically, the EPCs would be the 95 percent upper confidence limit (UCL) of the mean of the COPCs concentrations in soil.

The risk/hazard calculations for the trespasser and recreational user direct contact exposure to COPCs in soil are presented in Tables 5 and 6, respectively. It should be noted that the hazard calculations for the recreational user are based on the most conservative life stage of the recreational user which is the young child/child.

As presented in Tables 5 and 6, the cumulative carcinogenic risk and the non-carcinogenic hazard associated with the trespasser and recreational user direct contact exposure to COPCs in soil are within the EPA Superfund regulations (National Contingency Plan {NCP]) target cancer risk range of 1 x 10^{-6} to 1 x 10^{-4} and less than the target hazard index of 1.0, respectively. As the cumulative non-carcinogenic hazard index is less than 1, there is no target organ hazard quotient above 1. This indicates that the COPC soil concentrations are not resulting in risks and hazards above acceptable levels.

3. References

EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.

EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.

EPA, 2005: Guidelines for Carcinogenic Risk Assessment and Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, March 2005.

EPA, 2011: Exposure Factors Handbook 2011 Edition (Final). Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F, September 2011.

EPA, 2012: Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil, OSWER 9200.1-113, December 2012.

EPA, 2014a: Region 4 Human Health Risk Assessment Bulletins Supplemental Guidance, Section 4.2.2 Trespasser Scenario, January 2014 Final Draft.

EPA, 2014b: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120, February 2014.

EPA, 2015: Regional Screening Level (RSL) Summary Table, June 2015. Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.

Table F.1

Derivation of Site-Specific Cleanup Levels for Soil - Trespasser Oral, Dermal, and Inhalation Exposure
Lee's Land Landfill Site
Louisville, Kentucky

Chemicals of Potential Concern (COPC)	Mutagenic Compound Yes or No	Volatile Compound Yes or No	Cancer Toxicity Data: CSF Oral 1/(mg/kg-d)	Cancer Toxicity Data: CSF Dermal 1/(mg/kg-d)	Cancer Toxicity Data: URF Inhalation 1/(mg/m^3)	Non-Cancer Toxicity Data: RfD Oral (mg/kg-d)	Non-Cancer Toxicity Data: RfD Dermal (mg/kg-d)	Non-Cancer Toxicity Data: RfC Inhalation (mg/m^3)	Absorption Factor: ABSo Oral (%/100)	Absorption Factor: ABSd Dermal (%/100)	VF or PEF (m^3/kg)	Trespasser: TR Adolescent (6-16 yrs) (mg/kg)	Trespasser: THQ Adolescent (6-16 yrs) (mg/kg)	Site-Specific Cleanup Level for Soil (1) ($SSCL_{soil}$) (mg/kg)	Maximum Soil Concentration (mg/kg)
Metals															
Arsenic	No	No	1.50E+00	1.50E+00	4.30E+00	3.00E-04	3.00E-04	1.50E-05	6.00E-01	3.00E-02	1.36E+09	1.84E+01	1.18E+03	18	16
Lead	--	--	--	--	--	--	--	--	--	--	--	NC	NC	400 (2)	**1300**
Thallium	No	No	--	--	--	1.00E-05	1.00E-05	--	1.00E+00	0.00E+00	1.36E+09	NC	2.83E+01	28	2.8
SVOCs															
Benzo(a)pyrene	Yes	No	7.30E+00	7.30E+00	1.10E+00	--	--	--	1.00E+00	1.30E-01	1.36E+09	6.02E-01	NC	0.6	**5.1**
Benzo(a)anthracene	Yes	Yes	7.30E-01	7.30E-01	1.10E-01	--	--	--	1.00E+00	1.30E-01	2.77E+06	6.00E+00	NC	6.0	5.9
Benzo(k)fluoranthene	Yes	No	7.30E-02	7.30E-02	1.10E-01	--	--	--	1.00E+00	1.30E-01	1.36E+09	6.02E+01	NC	60	2.1
Dibenzo(a,h)anthracene	Yes	No	7.30E+00	7.30E+00	1.20E+00	--	--	--	1.00E+00	1.30E-01	1.36E+09	6.02E-01	NC	0.6	0.22
Bis(2-ethylhexyl)phthalate	No	No	1.40E-02	1.40E-02	2.40E-03	2.00E-02	2.00E-02	--	1.00E+00	1.00E-01	1.36E+09	1.02E+03	4.08E+04	1020	350
Pesticides															
Dieldrin	No	No	1.60E+01	1.60E+01	4.60E+00	5.00E-05	5.00E-05	--	1.00E+00	1.00E-01	1.36E+09	8.93E-01	1.02E+02	0.9	0.04
PCBs															
Aroclor 1248	No	Yes	2.00E+00	2.00E+00	5.70E-01	--	--	--	1.00E+00	1.40E-01	3.20E+05	6.17E+00	NC	6.2	**28**
Aroclor 1254	No	Yes	2.00E+00	2.00E+00	5.70E-01	2.00E-05	2.00E-05	--	1.00E+00	1.40E-01	5.09E+05	6.26E+00	3.67E+01	6.3	0.3

Notes:

-- Not Available
NC Not Calculated
BOLD Maximum soil concentration exceeds $SSCL_{soil}$.
(1) Final SSCL is the lower of the calculated carcinogenic and noncarcinogenic concentrations.
(2) Lead concentration is based on the residential RSL value (EPA, 2015).
(3) The default assumption of 100% is applied for all parameters with the exception of arsenic at 60% (EPA, 2012).
(4) The basis for SA is the average value for age groups 6 to 11 and 11 to 16 and calculated by summing the mean surface area by body part for face, lower arms, lower legs, feet, and hands from Table 7-2, Recommended Values for Surface Area of Body Parts, Males and Female Children Combined (EPA, 2011). The surface area of the face was assumed to be one-third the surface area of the head, the surface area of the lower legs was assumed to be 40 percent of the surface area of the legs, and the surface area of the lower arms was assumed to be 45 percent of the surface area of the arms, consistent with EPA (2004).
(5) The basis for the FT is the average of the mean time spent outdoors for the age groups 6-11 and 11-16 from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (EPA, 2011).
For 6-11 years old, the time spent outdoors of 132 min/day equates to 2.2 hrs [132/60].
For 11-16 years old, the time spent outdoors of 100 min/day equates to 1.7 hrs [100/60].
The average of the 6-11 and 11-16 ages groups of 1.95 hours is a central tendency value that was doubled to 3.9 hours to derive the FT value.
(6) The basis for the EF is the average of the mean time spent outdoors for the age groups 6-11 and 11-16 from Table 16-1, Recommended Values for Activity Factors - Time Outdoors (total) (EPA, 2011).
For 6-11 years old, the time spent outdoors of 132 min/day equals an exposure frequency of 33 days/year [(132 min/d /1440 total min/d)*365].
For 11-16 years old, the time spent outdoors of 100 min/day equals an exposure frequency of 25 days/year [(100 min/d /1440 total min/d)*365].
The average of the 6-11 and 11-16 ages groups of 29 days/year is a central tendency value that was doubled to 58 days/year to derive the EF value.

Table F.1

Derivation of Site-Specific Cleanup Levels for Soil - Trespasser Oral, Dermal, and Inhalation Exposure
Lee's Land Landfill Site
Louisville, Kentucky

References:

EPA, 1989: Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.
EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.
EPA, 2004: Risk Assessment Guidance for Superfund (RAGS):Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005, July 2004.
EPA, 2005: Guidelines for Carcinogenic Risk Assessment and Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, March 2005.
EPA, 2011: Exposure Factors Handbook 2011 Edition (Final). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/052F, September 2011.
EPA, 2012: Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil, OSWER 9200.1-113, December 2012.
EPA, 2014: Region 4 Human Health Risk Assessment Bulletins Supplemental Guidance, Section 4.2.2 Trespasser Scenario, January 2014 Final Draft.
EPA, 2015: Regional Screening Level (RSL) Summary Table, June 2015. Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.

Trespasser Exposure Assumptions	Abbreviation	Value	Source
Site-Specific Cleanup Level for Soil (mg/kg)	SSCL$_{soil}$	calculated	
Target Risk Level (unitless)	TR	1.0E-06	
Target Hazard Level (unitless)	THQ	1	
Cancer Slope Factor (1/[mg/kg-day])	CSF	chemical-specific	EPA, 2015
Reference Dose (mg/kg-day)	RfD	chemical-specific	EPA, 2015
Unit Risk Factor (1/[mg/m^3])	URF	chemical-specific	EPA, 2015
Reference Concentration (mg/m^3)	RfC	chemical-specific	EPA, 2015
Ingestion Rate (mg/day)	IR	100	EPA, 2002
Absorption Factor - Oral (%/100)	ABSo	chemical-specific	EPA, 2012 (3)
Surface Area Exposed (cm^2/day)	SA	5,537	EPA, 2011 (4)
Adherence Factor (mg/cm^2)	AF	0.07	EPA, 2004
Absorption Factor - Dermal (%/100)	ABSd	chemical-specific	EPA, 2004
Fraction Time Exposed (unitless)	FT	3.9/24	EPA, 2011 (5)
Exposure Frequency (days/year)	EF	58	EPA, 2011 (6)
Exposure Duration (years)	ED	10	EPA, 2014
Body Weight (kg)	BW	45	EPA, 2014
Conversion Factor (kg/mg)	CF	1.0E-06	--
Averaging Time - carc. (days)	AT-C	25,550	EPA, 1989
Averaging Time - noncarc. (days)	AT-NC	3,650	EPA, 1989
Particulate Emission Factor (m^3/kg)	PEF	1.36E+09	EPA, 2002
Volatilization Factor (m^3/kg)	VF	chemical-specific	Refer to Table 2
Mutagenic Factor (unitless)	MF	3	EPA, 2005

Exposure Equations

Carcinogenic Endpoints:

$$SSCL_{soil} = \frac{TR \times AT\text{-}C}{EF \times ED \times [(CSF \times IR \times CF \times ABSo)/BW + (CSF \times SA \times AF \times CF \times ABSd)/BW + (URF \times FT \times (1/VF \text{ or } PEF))]}$$

Carcinogenic Endpoints: Mutagenic Compounds

$$SSCL_{soil} = \frac{TR \times AT\text{-}C}{EF \times ED \times MF \times [(CSF \times IR \times CF \times ABSo)/BW + (CSF \times SA \times AF \times CF \times ABSd)/BW + (URF \times FT \times (1/VF \text{ or } PEF))]}$$

Non-Carcinogenic Endpoints:

$$SSCL_{soil} = \frac{THQ \times AT\text{-}NC}{EF \times ED \times MF \times [((1/RfD) \times IR \times CF \times ABSo)/BW + ((1/RfD) \times SA \times AF \times CF \times ABSd)/BW + ((1/RfC) \times FT \times (1/VF \text{ or } PEF))]}$$

Table F.2

Derivation of Volatilization Factor (VF) for Soil - Trespasser Inhalation Exposure
Lee's Land Landfill Site
Louisville, Kentucky

			Reference	Units	Chemicals of Potential Concern (COPCs)		
					Benzo(a)anthracene	**Aroclor 1248**	**Aroclor 1254**
VF: Soil-to-Air Volatilization Factor							
$VF = Q/C \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times 10^{-4}(m^2/cm^2)$							
Where:	**VF**	**= soil-to-air volatilization factor**	Equation 4-8, EPA, 2002	m^3/kg	**2.77E+06**	**3.20E+05**	**5.09E+05**
	Q/C_{vol}	= inverse of mean conc - centre of square source	Equation D-3, EPA, 2002	$(g/m^2\text{-sec})/(kg/m^3)$	6.82E+01	6.82E+01	6.82E+01
	D_A	= apparent diffusivity	Equation 4-8, EPA, 2002	cm^2/s	6.68E-10	4.99E-08	1.97E-08
	T	= exposure interval	EPA, 2002	s	3.15E+08	3.15E+08	3.15E+08
	ρ_b	= soil dry bulk density	EPA, 2002	g/cm^3	1.5	1.5	1.5
Q/C_{vol}: Inverse of Mean Conc - Centre of Square Source							
$Q/C_{vol} = A \times \exp\frac{(\ln Area - B)^2}{C}$							
Where:	"A"	= constant	EPA, 2002	unitless	1.19E+01	1.19E+01	1.19E+01
	Area	= areal extent of the site or contamination	EPA, 2002	acres	0.5	0.5	0.5
	"B"	= constant	EPA, 2002	unitless	1.84E+01	1.84E+01	1.84E+01
	"C"	= constant	EPA, 2002	unitless	2.10E+02	2.10E+02	2.10E+02
D_A: Apparent Diffusivity							
$D_A = \frac{[(\theta_a^{10/3} D_i H' + \theta_w^{10/3} D_w)/n^2]}{\rho_b K_d + \theta_w + \theta_a H'}$							
Where:	D_A	= apparent diffusivity	Equation 4-8, EPA, 2002	cm^2/s	6.68E-10	4.99E-08	1.97E-08
	θ_a	= air-filled porosity	EPA, 2002	unitless	2.84E-01	2.84E-01	2.84E-01
	θ_w	= water-filled porosity	EPA, 2002	unitless	0.15	0.15	0.15
	n	= total soil porosity	EPA, 2002	unitless	4.34E-01	4.34E-01	4.34E-01
	ρ_b	= soil dry bulk density	EPA, 2002	g/cm^3	1.5	1.5	1.5
	H'	= dimensionless Henry's Law Constant	EPA, 2015	unitless	4.90E-04	1.80E-02	1.20E-02
	D_i	= diffusivity of chemical x in air	EPA, 2015	cm^2/s	2.60E-02	2.40E-02	2.40E-02
	D_w	= diffusivity of chemical x in water	EPA, 2015	cm^2/s	6.70E-06	6.20E-06	6.10E-06
	K_d	= soil-water partition coefficient	EPA, 2002	cm^3/g	1.08E+03	4.62E+02	7.80E+02
Kd: Soil-Water Partition Coefficient							
$K_d = K_{oc} \times f_{oc}$							
Where:	K_d	= soil-water partition coefficient	EPA, 2002	cm^3/g	1080	462	780
	K_{oc}	= soil organic carbon-water partition coefficient	EPA, 2015	cm^3/g	1.80E+05	7.70E+04	1.30E+05
	f_{oc}	= organic content of soil	EPA, 2002	g/g	0.006	0.006	0.006

Reference:

EPA, 2015: Regional Screening Level (RSL) Chemical-specific Parameters Supporting Table, June 2015.
Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.

EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

Table F.3

Derivation of Site-Specific Cleanup Levels for Soil - Recreational User Oral, Dermal, and Inhalation Exposure
Lee's Land Landfill Site
Louisville, Kentucky

Chemicals of Potential Concern (COPC)	Mutagenic Compound Yes or No	Volatile Compound Yes or No	Cancer Toxicity Data: CSF Oral 1/(mg/kg-d)	CSF Dermal 1/(mg/kg-d)	URF Inhalation 1/(mg/m3)	Non-Cancer Toxicity Data: RfD Oral (mg/kg-d)	RfD Dermal (mg/kg-d)	RfC Inhalation (mg/m3)	Absorption Factor: ABSo Oral (%/100)	ABSd Dermal (%/100)	VF or PEF (m3/kg)	Recreational User: TR Lifetime (mg/kg)	THQ Young Child (0-2 yrs) (mg/kg)	THQ Child (2-6 yrs) (mg/kg)	THQ Adolescent (6-16 yrs) (mg/kg)	THQ Adult (16-26 yrs) (mg/kg)	Site-Specific Cleanup Level for Soil (1) (SSCL) (mg/kg)	Maximum Soil Concentration (mg/kg)
Metals																		
Arsenic	No	No	1.50E+00	1.50E+00	4.30E+00	3.00E-04	3.00E-04	1.50E-05	6.00E-01	3.00E-02	1.36E+09	4.78E+00	2.55E+02	2.43E+02	2.44E+03	2.41E+03	4.8	**<u>16</u>**
Lead	--	--	--	--	--	--	--	--	--	--	--	NC	NC	NC	NC	NC	400 (2)	**<u>1300</u>**
Thallium	No	No	--	--	--	1.00E-05	1.00E-05	--	1.00E+00	0.00E+00	1.36E+09	NC	5.48E+00	5.48E+00	5.84E+01	5.84E+01	5.5	2.8
SVOCs																		
Benzo(a)pyrene	Yes	No	7.30E+00	7.30E+00	1.10E+00	--	--	--	1.00E+00	1.30E-01	1.36E+09	1.16E-01	NC	NC	NC	NC	0.12	**<u>5.1</u>**
Benzo(a)anthracene	Yes	Yes	7.30E-01	7.30E-01	1.10E-01	--	--	--	1.00E+00	1.30E-01	4.46E+06	1.15E+00	NC	NC	NC	NC	1.2	**<u>5.9</u>**
Benzo(k)fluoranthene	Yes	No	7.30E-02	7.30E-02	1.10E-01	--	--	--	1.00E+00	1.30E-01	1.36E+09	1.16E+01	NC	NC	NC	NC	12	2.1
Dibenzo(a,h)anthracene	Yes	No	7.30E+00	7.30E+00	1.20E+00	--	--	--	1.00E+00	1.30E-01	1.36E+09	1.16E-01	NC	NC	NC	NC	0.12	**<u>0.22</u>**
Bis(2-ethylhexyl)phthalate	No	No	1.40E-02	1.40E-02	2.40E-03	2.00E-02	2.00E-02	--	1.00E+00	1.00E-01	1.36E+09	2.76E+02	9.54E+03	8.75E+03	8.42E+04	8.21E+04	276	**<u>350</u>**
Pesticides																		
Dieldrin	No	No	1.60E+01	1.60E+01	4.60E+00	5.00E-05	5.00E-05	--	1.00E+00	1.00E-01	1.36E+09	2.41E-01	2.39E+01	2.19E+01	2.10E+02	2.05E+02	0.24	0.04
PCBs																		
Aroclor 1248	No	Yes	2.00E+00	2.00E+00	5.70E-01	--	--	--	1.00E+00	1.40E-01	5.16E+05	1.76E+00	NC	NC	NC	NC	1.8	**<u>28</u>**
Aroclor 1254	No	Yes	2.00E+00	2.00E+00	5.70E-01	2.00E-05	2.00E-05	--	1.00E+00	1.40E-01	8.21E+05	1.77E+00	9.08E+00	8.10E+00	7.57E+01	7.34E+01	1.8	0.3

Notes:

-- Not Available
NC Not Calculated
<u>BOLD</u> Maximum soil concentration exceeds SSCL
(1) Final SSCL is the lower of the calculated carcinogenic and noncarcinogenic concentration.
(2) Lead concentration is based on the residential RSL value (EPA, 2015).
(3) The default assumption of 100% is applied for all parameters with the exception of arsenic at 60% (EPA, 2012).
(4) The basis for SA is the average values for each age group of 0-2 yrs, 2-6 yrs, and 6-16 yrs, and calculated by summing the mean surface area by body part for face, lower arms, lower legs, feet, and hands from Table 7-2 Recommended Values for Surface Area of Body Parts, Male and Female Children Combined (EPA, 2011). The surface area of the face was assumed to be one-third the surface area of the head; the surface area of the lower legs was assumed to be 40 percent of the surface area of the legs, and the surface area of the lower arms was assumed to be 45 percent of the surface area of the arms, consistent with EPA (2004).
(5) The basis for the ET is the average of the mean time spent outdoors for all of the age groups (not including 65 yrs) from Table 16-1 Recommended Values for Activity Factors - Time Outdoors (EPA, 2011).
For 1-3 months old, the time spent outdoors of 8 min/day equates to 0.13 hr [8/60]
For 3-6 months old, the time spent outdoors of 26 min/day equates to 0.43 hr [26/60]
For 6-12 months old, the time spent outdoors of 139 min/day equates to 2.3 hr [139/60]
For 1-2 years old, the time spent outdoors of 36 min/day equates to 0.6 hr [36/60]
For 2-3 years old, the time spent outdoors of 76 min/day equates to 1.3 hr [76/60]
For 3-6 years old, the time spent outdoors of 107 min/day equates to 1.8 hr [107/60]
For 6-11 years old, the time spent outdoors of 132 min/day equates to 2.2 hr [132/60]
For 11-16 years old, the time spent outdoors of 100 min/day equates to 1.7 hr [100/60]
For 16-21 years old, the time spent outdoors of 102 min/day equates to 1.7 hr [102/60]
For 18-65 years old, the time spent outdoors of 281 min/day equates to 4.7 hr [281/60]
The average of all age groups of 1.7 hours is a central tendency value that was doubled to 3.4 hours to derive the ET value.
(6) The basis for the EF is the average of the mean time spent outdoors for all of the age groups (not including 65 yrs) from Table 16-1 Recommended Values for Activity Factors - Time Outdoors (total) (EPA, 2011).
For 1-3 months old, the time spent outdoors of 8 min/day equals an exposure frequency of 2 days/year [(8 min/d / 1440 min/d)*365]
For 3-6 months old, the time spent outdoors of 26 min/day equals an exposure frequency of 7 days/year [(26 min/d / 1440 min/d)*365]
For 6-12 months old, the time spent outdoors of 139 min/day equals an exposure frequency of 35 days/year [(139 min/d / 1440 min/d)*365]
For 1-2 years old, the time spent outdoors of 36 min/day equals an exposure frequency of 9 days/year [(36 min/d / 1440 min/d)*365]
For 2-3 years old, the time spent outdoors of 76 min/day equals an exposure frequency of 19 days/year [(76 min/d / 1440 min/d)*365]
For 3-6 years old, the time spent outdoors of 107 min/day equals an exposure frequency of 27 days/year [(107 min/d / 1440 min/d)*365]
For 6-11 years old, the time spent outdoors of 132 min/day equals an exposure frequency of 33 days/year [(132 min/d / 1440 total min/d)*365]
For 11-16 years old, the time spent outdoors of 100 min/day equals an exposure frequency of 25 days/year [(100 min/d / 1440 total min/d)*365]
For 16-21 years old, the time spent outdoors of 102 min/day equals an exposure frequency of 26 days/year [(102 min/d / 1440 total min/d)*365]
For 18-65 years old, the time spent outdoors of 281 min/day equals an exposure frequency of 71 days/year [(281 min/d / 1440 total min/d)*365]
The average of all of the age groups of 25 days/year is a central tendency value that was doubled to 50 days/year to derive the EF value.

Table F.3

Derivation of Site-Specific Cleanup Levels for Soil - Recreational User Oral, Dermal, and Inhalation Exposure
Lee's Land Landfill Site
Louisville, Kentucky

References

EPA 1989. Risk Assessment Guidance for Superfund (RAGS) Volume 1 – Human Health Evaluation Manual (Part A), Interim Final. EPA/540/1-89/002. December 1989.
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EPA 2012. Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil. OSWER 9200.1-113. December 2012.
EPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 2014.
EPA 2015. Regional Screening Levels (RSLs) Summary Table. June 2015. Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

Recreational User Exposure Assumptions	Abbreviation	Value	Source
Cleanup Level for Soil (mg/kg)	$SSCL_{s,r}$	calculated	
Target Risk Level (unitless)	TR	1.0E-06	
Target Hazard Level (unitless)	THQ	1	
Cancer Slope Factor (1/[mg/kg-day])	CSF	chemical-specific	EPA 2015
Reference Dose (mg/kg-day)	RfD	chemical-specific	EPA 2015
Unit Risk Factor (1/[mg/m³])	URF	chemical-specific	EPA 2015
Reference Concentration (mg/m³)	RfC	chemical-specific	EPA 2015
Ingestion Rate (mg/day) - Young Child (Age 0-2)	IRyc	200	EPA 2002
Ingestion Rate (mg/day) - Child (Age 2-6)	IRc	200	EPA 2002
Ingestion Rate (mg/day) - Young Adult (Age 6-16)	IRya	100	EPA 2002
Ingestion Rate (mg/day) - Adult (Age 16-26)	IRa	100	EPA 2002
Absorption Factor - Oral (% / 100)	ABSo	chemical-specific	EPA 2012 (3)
Surface Area (cm²/day) - Young Child (Age 0-2)	SAyc	1,475	EPA 2011 (4)
Surface Area (cm²/day) - Child (Age 2-6)	SAc	2,514	EPA 2011 (4)
Surface Area (cm²/day) - Young Adult (Age 6-16)	SAya	5,507	EPA 2011 (4)
Surface Area (cm²/day) - Adult (Age 16-26)	SAa	6,032	EPA 2014
Adherence Factor (mg/cm²) - Young Child (Age 0-2)	AFyc	0.2	EPA 2002
Adherence Factor (mg/cm²) - Child (Age 2-6)	AFc	0.2	EPA 2002
Adherence Factor (mg/cm²) - Young Adult (Age 6-16)	AFya	0.07	EPA 2002
Adherence Factor (mg/cm²) - Adult (Age 16-26)	AFa	0.07	EPA 2002
Absorption Factor - Dermal (% / 100)	ABSd	chemical-specific	EPA 2004
Fraction Time Exposed (unitless)	FT	3.4/24	EPA 2011 (5)
Exposure Frequency (days/year)	EF	50	EPA 2011 (6)
Exposure Duration (years) - Young Child (Age 0-2)	EDyc	2	EPA 2014
Exposure Duration (years) - Child (Age 2-6)	EDc	4	EPA 2014
Exposure Duration (years) - Young Adult (Age 6-16)	EDya	10	EPA 2014
Exposure Duration (years) - Adult (Age 16-26)	EDa	10	EPA 2014
Body Weight (kg) - Young Child (Age 0-2)	BWyc	15	EPA 2014
Body Weight (kg) - Child (Age 2-6)	BWc	15	EPA 2014
Body Weight (kg) - Young Adult (Age 6-16)	BWya	80	EPA 2014
Body Weight (kg) - Adult (Age 16-26)	BWa	80	EPA 2014
Conversion Factor (kg/mg)	CF	1.0E-06	
Averaging Time - cancer (days)	AT-C	25,550	EPA 1989
Averaging Time - noncancer (days) - Young Child (Age 0-2)	AT-NCyc	730	EPA 1989
Averaging Time - noncancer (days) - Child (Age 2-6)	AT-NCc	1,460	EPA 1989
Averaging Time - noncancer (days) - Young Adult (Age 6-16)	AT-NCya	3,650	EPA 1989
Averaging Time - noncancer (days) - Adult (Age 16-26)	AT-NCa	3,650	EPA 1989
Particulate Emission Factor (m³/kg)	PEF	1.[illegible]E+09	
Volatilization Factor (m³/kg)	VF	chemical-specific	Refer to Table 4
Mutagenic Factor (unitless) - Young Child (Age 0-2)	MF1	10	EPA 2005
Mutagenic Factor (unitless) - Child (Age 2-6)	MF2	3	EPA 2005
Mutagenic Factor (unitless) - Young Adult (Age 6-16)	MF3	3	EPA 2005
Mutagenic Factor (unitless) - Adult (Age 16-26)	MF4	1	EPA 2005

Table F.3

Derivation of Site-Specific Cleanup Levels for Soil - Recreational User Oral, Dermal, and Inhalation Exposure
Lee's Land Landfill Site
Louisville, Kentucky

Exposure Equations

Carcinogenic Constituent

$$SSCL_{soil} = \frac{TR \times AT\text{-}C}{\begin{array}{c} EF \times [((CSF \times IR_{a} \times ED_{a} \times CF \times ABSgi / BW_{a}) + (CSF \times SA_{a} \times AF_{a} \times ED_{a} \times CF \times ABSd / BW_{a}) + (IUR \times ET \times ED_{a} \times (1/VF \text{ or } PEF))) + \\ ((CSF \times IR_{c} \times ED_{c} \times CF \times ABSgi / BW_{c}) + (CSF \times SA_{c} \times AF_{c} \times ED_{c} \times CF \times ABSd / BW_{c}) + (IUR \times ET \times ED_{c} \times (1/VF \text{ or } PEF))) + \\ ((CSF \times IR_{y3} \times ED_{y3} \times CF \times ABSgi / BW_{y3}) + (CSF \times SA_{y3} \times AF_{y3} \times ED_{y3} \times CF \times ABSd / BW_{y3}) + (IUR \times ET \times ED_{y3} \times (1/VF \text{ or } PEF))) + \\ ((CSF \times IR_{3} \times ED_{3} \times CF \times ABSgi / BW_{3}) + (CSF \times SA_{3} \times AF_{3} \times ED_{3} \times CF \times ABSd / BW_{3}) + (IUR \times ET \times ED_{3} \times (1/VF \text{ or } PEF)))] \end{array}}$$

Carcinogenic Constituent — Mutagenic Compound

$$SSCL_{soil} = \frac{TR \times AT\text{-}C}{\begin{array}{c} EF \times [((CSF \times IR_{a} \times ED_{a} \times MF1 \times CF \times ABSgi / BW_{a}) + (CSF \times SA_{a} \times AF_{a} \times ED_{a} \times CF \times MF1 \times ABSd / BW_{a}) + (IUR \times ET \times ED_{a} \times MF1 \times (1/VF \text{ or } PEF))) + \\ ((CSF \times IR_{c} \times ED_{c} \times MF2 \times CF \times ABSgi / BW_{c}) + (CSF \times SA_{c} \times AF_{c} \times ED_{c} \times MF2 \times CF \times ABSd / BW_{c}) + (IUR \times ET \times ED_{c} \times MF2 \times (1/VF \text{ or } PEF))) + \\ ((CSF \times IR_{y3} \times ED_{y3} \times MF3 \times CF \times ABSgi / BW_{y3}) + (CSF \times SA_{y3} \times AF_{y3} \times ED_{y3} \times MF3 \times CF \times ABSd / BW_{y3}) + (IUR \times ET \times ED_{y3} \times MF3 \times (1/VF \text{ or } PEF))) + \\ ((CSF \times IR_{3} \times ED_{3} \times MF4 \times CF \times ABSgi / BW_{3}) + (CSF \times SA_{3} \times AF_{3} \times ED_{3} \times MF4 \times CF \times ABSd / BW_{3}) + (IUR \times ET \times ED_{3} \times MF4 \times (1/VF \text{ or } PEF)))] \end{array}}$$

Non-Carcinogenic Constituent

$$SSCL_{soil} = \frac{THQ \times AT\text{-}NC}{EF \times ED \times [(1/RfD_{o} \times IR \times CF \times ABSgi/BW) + (1/RfD_{d} \times SA \times AF \times CF \times ABSd/BW) + (1/RfC_{i} \times ET \times (1/VF \text{ or } PEF))]}$$

Table F.4

Derivation of Volatilization Factor (VF) for Soil - Recreational User Inhalation Exposure
Lee's Land Landfill Site
Louisville, Kentucky

			Reference	Units	Chemicals of Potential Concern (COPCs)		
					Benzo(a)anthracene	**Aroclor 1248**	**Aroclor 1254**
VF: Soil-to-Air Volatilization Factor							

$$VF = Q/C \times \frac{(3.14 \times D_A \times T)^{1/2}}{(2 \times \rho_b \times D_A)} \times (10^{-4}\, m^2/cm^2)$$

			Reference	Units	Benzo(a)anthracene	Aroclor 1248	Aroclor 1254
Where:	**VF**	= **soil-to-air volatilization factor**	Equation 4-8, EPA, 2002	m^3/kg	**4.46E+06**	**5.16E+05**	**8.21E+05**
	Q/C_{vol}	= inverse of mean conc - centre of square source	Equation D-3, EPA, 2002	$(g/m^2\text{-sec})/(kg/m^3)$	6.82E+01	6.82E+01	6.82E+01
	D_A	= apparent diffusivity	Equation 4-8, EPA, 2002	cm^2/s	6.68E-10	4.99E-08	1.97E-08
	T	= exposure interval	EPA, 2002	s	8.20E+08	8.20E+08	8.20E+08
	r_b	= soil dry bulk density	EPA, 2002	g/cm^3	1.5	1.5	1.5

Q/C_{vol}: Inverse of Mean Conc - Centre of Square Source

$$Q/C_{vol} = A \times \exp\frac{(\ln Area - B)^2}{C}$$

			Reference	Units	Benzo(a)anthracene	Aroclor 1248	Aroclor 1254
Where:	"A"	= constant	EPA, 2002	unitless	1.19E+01	1.19E+01	1.19E+01
	Area	= areal extent of the site or contamination	EPA, 2002	acres	0.5	0.5	0.5
	"B"	= constant	EPA, 2002	unitless	1.84E+01	1.84E+01	1.84E+01
	"C"	= constant	EPA, 2002	unitless	2.10E+02	2.10E+02	2.10E+02

D_A: Apparent Diffusivity

$$D_A = \frac{\left[\left(\theta_a^{10/3} D_i H' + \theta_w^{10/3} D_w\right)/n^2\right]}{\rho_b K_d + \theta_w + \theta_a H'}$$

			Reference	Units	Benzo(a)anthracene	Aroclor 1248	Aroclor 1254
Where:	D_A	= apparent diffusivity	Equation 4-8, EPA, 2002	cm^2/s	6.68E-10	4.99E-08	1.97E-08
	Q_a	= air-filled porosity	EPA, 2002	unitless	2.84E-01	2.84E-01	2.84E-01
	Q_w	= water-filled porosity	EPA, 2002	unitless	0.15	0.15	0.15
	n	= total soil porosity	EPA, 2002	unitless	4.34E-01	4.34E-01	4.34E-01
	r_b	= soil dry bulk density	EPA, 2002	g/cm^3	1.5	1.5	1.5
	H'	= dimensionless Henry's Law Constant	EPA, 2015	unitless	4.90E-04	1.80E-02	1.20E-02
	D_i	= diffusivity of chemical x in air	EPA, 2015	cm^2/s	2.60E-02	2.40E-02	2.40E-02
	D_w	= diffusivity of chemical x in water	EPA, 2015	cm^2/s	6.70E-06	6.20E-06	6.10E-06
	K_d	= soil-water partition coefficient	EPA, 2002	cm^3/g	1.08E+03	4.62E+02	7.80E+02

Kd: Soil-Water Partition Coefficient

$$K_d = K_{oc} \cdot f_{oc}$$

			Reference	Units	Benzo(a)anthracene	Aroclor 1248	Aroclor 1254
Where:	K_d	= soil-water partition coefficient	EPA, 2002	cm^3/g	1080	462	780
	K_{oc}	= soil organic carbon-water partition coefficient	EPA, 2015	cm^3/g	1.80E+05	7.70E+04	1.30E+05
	f_{oc}	= organic content of soil	EPA, 2002	g/g	0.006	0.006	0.006

Reference:

EPA, 2015: Regional Screening Level (RSL) Chemical-specific Parameters Supporting Table, June 2015.
Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.
EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December 2002.

Table F.5

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for Trespasser

Lee's Land Landfill Site

Louisville, Kentucky

Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemicals of Potential Concern	Maximum Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations (1)				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	On-Site	Ingestion	Arsenic	1.60E+01	mg/kg	4.84E-07	mg/kg-d	1.50E+00	(mg/kg-d)$^{-1}$	7.3E-07	3.39E-06	mg/kg-d	3.00E-04	mg/kg-d	1.1E-02
				Lead	1.30E+03	mg/kg	6.56E-05	mg/kg-d	--	(mg/kg-d)$^{-1}$	NC	4.59E-04	mg/kg-d	--	mg/kg-d	NC
				Thallium	2.80E+00	mg/kg	1.41E-07	mg/kg-d	--	(mg/kg-d)$^{-1}$	NC	9.89E-07	mg/kg-d	1.00E-05	mg/kg-d	9.9E-02
				Benzo(a)pyrene	5.10E+00	mg/kg	7.72E-07	mg/kg-d	7.30E+00	(mg/kg-d)$^{-1}$	5.6E-06	1.80E-06	mg/kg-d	--	mg/kg-d	NC
				Benzo(a)anthracene	5.90E+00	mg/kg	8.93E-07	mg/kg-d	7.30E-01	(mg/kg-d)$^{-1}$	6.5E-07	2.08E-06	mg/kg-d	--	mg/kg-d	NC
				Benzo(k)fluoranthene	2.10E+00	mg/kg	3.18E-07	mg/kg-d	7.30E-02	(mg/kg-d)$^{-1}$	2.3E-08	7.42E-07	mg/kg-d	--	mg/kg-d	NC
				Dibenzo(a,h)anthracene	2.20E-01	mg/kg	3.33E-08	mg/kg-d	7.30E+00	(mg/kg-d)$^{-1}$	2.4E-07	7.77E-08	mg/kg-d	--	mg/kg-d	NC
				Bis(2-ethylhexyl)phthalate	3.50E+02	mg/kg	1.77E-05	mg/kg-d	1.40E-02	(mg/kg-d)$^{-1}$	2.5E-07	1.24E-04	mg/kg-d	2.00E-02	mg/kg-d	6.2E-03
				Dieldrin	4.00E-02	mg/kg	2.02E-09	mg/kg-d	1.60E+01	(mg/kg-d)$^{-1}$	3.2E-08	1.41E-08	mg/kg-d	5.00E-05	mg/kg-d	2.8E-04
				Aroclor 1248	2.80E+01	mg/kg	1.41E-06	mg/kg-d	2.00E+00	(mg/kg-d)$^{-1}$	2.8E-06	9.89E-06	mg/kg-d	--	mg/kg-d	NC
				Aroclor 1254	3.00E-01	mg/kg	1.51E-08	mg/kg-d	2.00E+00	(mg/kg-d)$^{-1}$	3.0E-08	1.06E-07	mg/kg-d	2.00E-05	mg/kg-d	5.3E-03
			Exposure Route Total								1.0E-05					1.2E-01
			Dermal	Arsenic	1.60E+01	mg/kg	9.39E-08	mg/kg-d	1.50E+00	(mg/kg-d)$^{-1}$	1.4E-07	6.57E-07	mg/kg-d	3.00E-04	mg/kg-d	2.2E-03
				Lead	1.30E+03	mg/kg	0.00E+00	mg/kg-d	--	(mg/kg-d)$^{-1}$	NC	0.00E+00	mg/kg-d	--	mg/kg-d	NC
				Thallium	2.80E+00	mg/kg	0.00E+00	mg/kg-d	--	(mg/kg-d)$^{-1}$	NC	0.00E+00	mg/kg-d	1.00E-05	mg/kg-d	NC
				Benzo(a)pyrene	5.10E+00	mg/kg	3.89E-07	mg/kg-d	7.30E+00	(mg/kg-d)$^{-1}$	2.8E-06	9.07E-07	mg/kg-d	--	mg/kg-d	NC
				Benzo(a)anthracene	5.90E+00	mg/kg	4.50E-07	mg/kg-d	7.30E-01	(mg/kg-d)$^{-1}$	3.3E-07	1.05E-06	mg/kg-d	--	mg/kg-d	NC
				Benzo(k)fluoranthene	2.10E+00	mg/kg	1.60E-07	mg/kg-d	7.30E-02	(mg/kg-d)$^{-1}$	1.2E-08	3.74E-07	mg/kg-d	--	mg/kg-d	NC
				Dibenzo(a,h)anthracene	2.20E-01	mg/kg	1.68E-08	mg/kg-d	7.30E+00	(mg/kg-d)$^{-1}$	1.2E-07	3.91E-08	mg/kg-d	--	mg/kg-d	NC
				Bis(2-ethylhexyl)phthalate	3.50E+02	mg/kg	6.84E-06	mg/kg-d	1.40E-02	(mg/kg-d)$^{-1}$	9.6E-08	4.79E-05	mg/kg-d	2.00E-02	mg/kg-d	2.4E-03
				Dieldrin	4.00E-02	mg/kg	7.82E-10	mg/kg-d	1.60E+01	(mg/kg-d)$^{-1}$	1.3E-08	5.47E-09	mg/kg-d	5.00E-05	mg/kg-d	1.1E-04
				Aroclor 1248	2.80E+01	mg/kg	7.66E-07	mg/kg-d	2.00E+00	(mg/kg-d)$^{-1}$	1.5E-06	5.37E-06	mg/kg-d	--	mg/kg-d	NC
				Aroclor 1254	3.00E-01	mg/kg	8.21E-09	mg/kg-d	2.00E+00	(mg/kg-d)$^{-1}$	1.6E-08	5.75E-08	mg/kg-d	2.00E-05	mg/kg-d	2.9E-03
			Exposure Route Total								5.1E-06					7.6E-03
		Exposure Point Total									1.6E-05					1.3E-01
	Exposure Medium Total										1.6E-05					1.3E-01

Table F.5

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for Trespasser

Lee's Land Landfill Site

Louisville, Kentucky

Receptor Population: Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemicals of Potential Concern	Maximum Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations (1)				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Ambient Air	On-Site	Inhalation	Arsenic	1.60E+01	mg/kg	4.34E-11	mg/m	4.30E+00	(mg/m)^{1}	1.9E-10	3.04E-10	mg/m	1.50E-05	mg/m	2.0E-05
				Lead	1.30E+03	mg/kg	3.53E-09	mg/m	--	(mg/m)^{1}	NC	2.47E-08	mg/m	--	mg/m	NC
				Thallium	2.80E+00	mg/kg	7.59E-12	mg/m	--	(mg/m)^{1}	NC	5.32E-11	mg/m	--	mg/m	NC
				Benzo(a)pyrene	5.10E+00	mg/kg	4.15E-11	mg/m	1.10E+00	(mg/m)^{1}	4.6E-11	9.68E-11	mg/m	--	mg/m	NC
				Benzo(a)anthracene	5.90E+00	mg/kg	2.36E-08	mg/m	1.10E-01	(mg/m)^{1}	2.6E-09	5.50E-08	mg/m	--	mg/m	NC
				Benzo(k)fluoranthene	2.10E+00	mg/kg	1.71E-11	mg/m	1.10E-01	(mg/m)^{1}	1.9E-12	3.99E-11	mg/m	--	mg/m	NC
				Dibenzo(a,h)anthracene	2.20E-01	mg/kg	1.79E-12	mg/m	1.20E+00	(mg/m)^{1}	2.1E-12	4.18E-12	mg/m	--	mg/m	NC
				Bis(2-ethylhexyl)phthalate	3.50E+02	mg/kg	9.49E-10	mg/m	2.40E-03	(mg/m)^{1}	2.3E-12	6.65E-09	mg/m	--	mg/m	NC
				Dieldrin	4.00E-02	mg/kg	1.08E-13	mg/m	4.60E+00	(mg/m)^{1}	5.0E-13	7.59E-13	mg/m	--	mg/m	NC
				Aroclor 1248	2.80E+01	mg/kg	3.23E-07	mg/m	5.70E-01	(mg/m)^{1}	1.8E-07	2.26E-06	mg/m	--	mg/m	NC
				Aroclor 1254	3.00E-01	mg/kg	2.17E-09	mg/m	5.70E-01	(mg/m)^{1}	1.2E-09	1.52E-08	mg/m	--	mg/m	NC
			Exposure Route Total								1.9E-07					2.0E-05
		Exposure Point Total									1.9E-07					2.0E-05
	Exposure Medium Total										1.9E-07					2.0E-05
Medium Total											1.6E-05					1.3E-01
							Total of Receptor Risk Across All Media				**1.6E-05**	**Total of Receptor Hazard Across All Media**				**1.3E-01**

Note:

NC = Not Calculated

(1) Non-cancer hazard calculations based on the most conservative receptor, that being the young child and child.

Table F.6

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for Recreational User

Lee's Land Landfill Site

Louisville, Kentucky

Receptor Population: Recreational User
Receptor Age: Young Child, Child, Adolescent, and Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemicals of Potential Concern	Maximum Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations (1)				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	On-Site	Ingestion	Arsenic	1.60E+01	mg/kg	1.69E-06	mg/kg-d	1.50E+00	(mg/kg-d)$^{-1}$	2.5E-06	1.75E-05	mg/kg-d	3.00E-04	mg/kg-d	5.8E-02
				Lead	1.30E+03	mg/kg	2.29E-04	mg/kg-d	--	(mg/kg-d)$^{-1}$	NC	2.37E-03	mg/kg-d	--	mg/kg-d	NC
				Thallium	2.80E+00	mg/kg	4.93E-07	mg/kg-d	--	(mg/kg-d)$^{-1}$	NC	5.11E-06	mg/kg-d	1.00E-05	mg/kg-d	5.1E-01
				Benzo(a)pyrene	5.10E+00	mg/kg	3.13E-06	mg/kg-d	7.30E+00	(mg/kg-d)$^{-1}$	2.3E-05	9.32E-06	mg/kg-d	--	mg/kg-d	NC
				Benzo(a)anthracene	5.90E+00	mg/kg	3.62E-06	mg/kg-d	7.30E-01	(mg/kg-d)$^{-1}$	2.6E-06	1.08E-05	mg/kg-d	--	mg/kg-d	NC
				Benzo(k)fluoranthene	2.10E+00	mg/kg	1.29E-06	mg/kg-d	7.30E-02	(mg/kg-d)$^{-1}$	9.4E-08	3.84E-06	mg/kg-d	--	mg/kg-d	NC
				Dibenzo(a,h)anthracene	2.20E-01	mg/kg	1.35E-07	mg/kg-d	7.30E+00	(mg/kg-d)$^{-1}$	9.8E-07	4.02E-07	mg/kg-d	--	mg/kg-d	NC
				Bis(2-ethylhexyl)phthalate	3.50E+02	mg/kg	6.16E-05	mg/kg-d	1.40E-02	(mg/kg-d)$^{-1}$	8.6E-07	6.39E-04	mg/kg-d	2.00E-02	mg/kg-d	3.2E-02
				Dieldrin	4.00E-02	mg/kg	7.05E-09	mg/kg-d	1.60E+01	(mg/kg-d)$^{-1}$	1.1E-07	7.31E-08	mg/kg-d	5.00E-05	mg/kg-d	1.5E-03
				Aroclor 1248	2.80E+01	mg/kg	4.93E-06	mg/kg-d	2.00E+00	(mg/kg-d)$^{-1}$	9.9E-06	5.11E-05	mg/kg-d	--	mg/kg-d	NC
				Aroclor 1254	3.00E-01	mg/kg	5.28E-08	mg/kg-d	2.00E+00	(mg/kg-d)$^{-1}$	1.1E-07	5.48E-07	mg/kg-d	2.00E-05	mg/kg-d	2.7E-02
			Exposure Route Total								4.0E-05					6.3E-01
			Dermal	Arsenic	1.60E+01	mg/kg	2.58E-07	mg/kg-d	1.50E+00	(mg/kg-d)$^{-1}$	3.9E-07	3.50E-06	mg/kg-d	3.00E-04	mg/kg-d	1.2E-02
				Lead	1.30E+03	mg/kg	0.00E+00	mg/kg-d	--	(mg/kg-d)$^{-1}$	NC	0.00E+00	mg/kg-d	--	mg/kg-d	NC
				Thallium	2.80E+00	mg/kg	0.00E+00	mg/kg-d	--	(mg/kg-d)$^{-1}$	NC	0.00E+00	mg/kg-d	1.00E-05	mg/kg-d	NC
				Benzo(a)pyrene	5.10E+00	mg/kg	1.29E-06	mg/kg-d	7.30E+00	(mg/kg-d)$^{-1}$	9.4E-06	4.83E-06	mg/kg-d	--	mg/kg-d	NC
				Benzo(a)anthracene	5.90E+00	mg/kg	1.49E-06	mg/kg-d	7.30E-01	(mg/kg-d)$^{-1}$	1.1E-06	5.59E-06	mg/kg-d	--	mg/kg-d	NC
				Benzo(k)fluoranthene	2.10E+00	mg/kg	5.31E-07	mg/kg-d	7.30E-02	(mg/kg-d)$^{-1}$	3.9E-08	1.99E-06	mg/kg-d	--	mg/kg-d	NC
				Dibenzo(a,h)anthracene	2.20E-01	mg/kg	5.56E-08	mg/kg-d	7.30E+00	(mg/kg-d)$^{-1}$	4.1E-07	2.08E-07	mg/kg-d	--	mg/kg-d	NC
				Bis(2-ethylhexyl)phthalate	3.50E+02	mg/kg	1.88E-05	mg/kg-d	1.40E-02	(mg/kg-d)$^{-1}$	2.6E-07	2.55E-04	mg/kg-d	2.00E-02	mg/kg-d	1.3E-02
				Dieldrin	4.00E-02	mg/kg	2.15E-09	mg/kg-d	1.60E+01	(mg/kg-d)$^{-1}$	3.4E-08	2.91E-08	mg/kg-d	5.00E-05	mg/kg-d	5.8E-04
				Aroclor 1248	2.80E+01	mg/kg	2.11E-06	mg/kg-d	2.00E+00	(mg/kg-d)$^{-1}$	4.2E-06	2.86E-05	mg/kg-d	--	mg/kg-d	NC
				Aroclor 1254	3.00E-01	mg/kg	2.26E-08	mg/kg-d	2.00E+00	(mg/kg-d)$^{-1}$	4.5E-08	3.06E-07	mg/kg-d	2.00E-05	mg/kg-d	1.5E-02
			Exposure Route Total								1.6E-05					4.0E-02
		Exposure Point Total									5.6E-05					6.7E-01
	Exposure Medium Total										5.6E-05					6.7E-01

Table F.6

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for Recreational User

Lee's Land Landfill Site

Louisville, Kentucky

Receptor Population: Recreational User
Receptor Age: Young Child, Child, Adolescent, and Adult

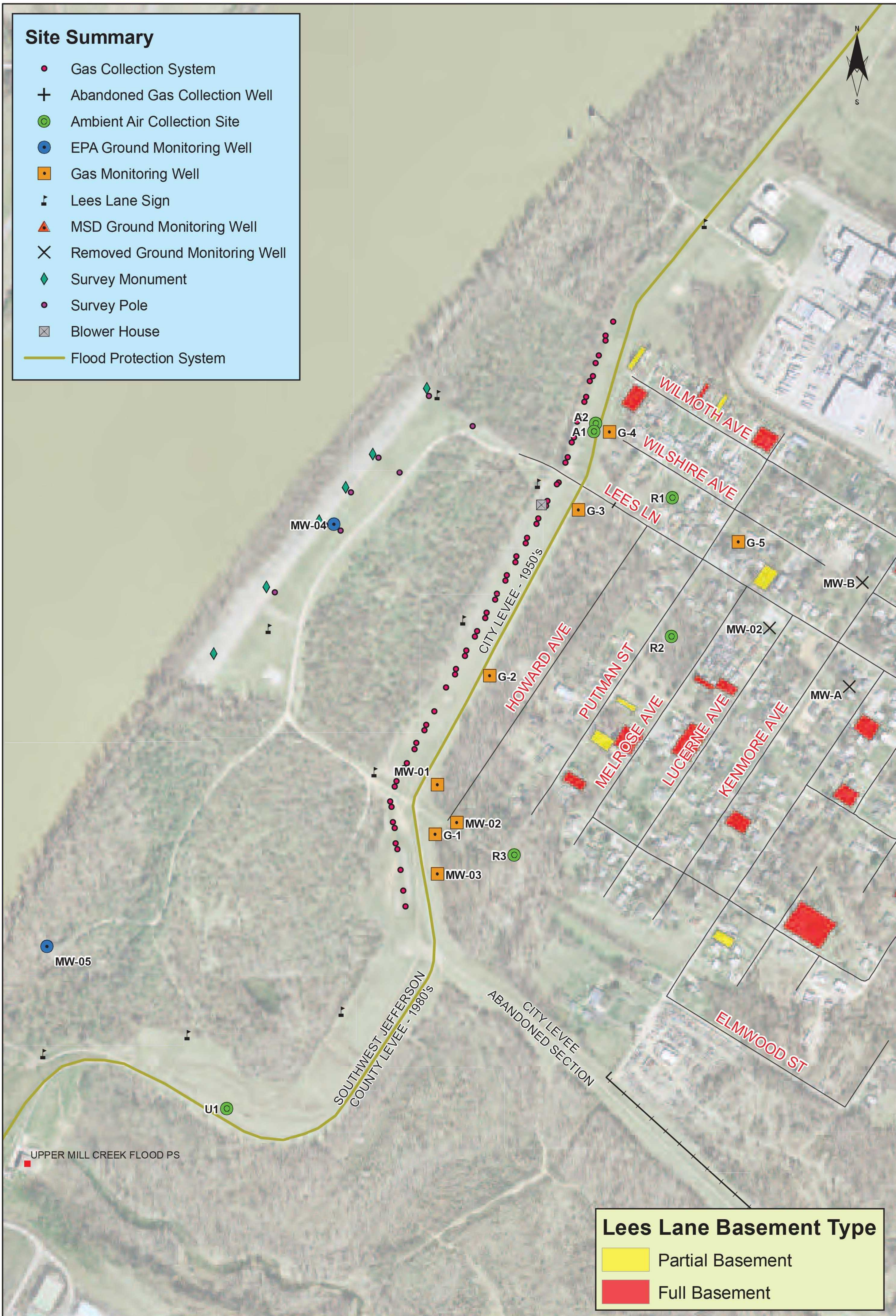
Medium	Exposure Medium	Exposure Point	Exposure Route	Chemicals of Potential Concern	Maximum Concentration		Cancer Risk Calculations					Non-Cancer Hazard Calculations (1)				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Ambient Air	On-Site	Inhalation	Arsenic	1.60E+01	mg/kg	9.73E-11	mg/m	4.30E+00	(mg/m)^{1}	4.2E-10	5.24E-10	mg/m	1.50E-05	mg/m	3.5E-05
				Lead	1.30E+03	mg/kg	7.90E-09	mg/m	--	(mg/m)^{1}	NC	4.26E-08	mg/m	--	mg/m	NC
				Thallium	2.80E+00	mg/kg	1.70E-11	mg/m	--	(mg/m)^{1}	NC	9.17E-11	mg/m	--	mg/m	NC
				Benzo(a)pyrene	5.10E+00	mg/kg	8.59E-11	mg/m	1.10E+00	(mg/m)^{1}	9.4E-11	1.67E-10	mg/m	--	mg/m	NC
				Benzo(a)anthracene	5.90E+00	mg/kg	4.88E-08	mg/m	1.10E-01	(mg/m)^{1}	5.4E-09	9.49E-08	mg/m	--	mg/m	NC
				Benzo(k)fluoranthene	2.10E+00	mg/kg	3.54E-11	mg/m	1.10E-01	(mg/m)^{1}	3.9E-12	6.87E-11	mg/m	--	mg/m	NC
				Dibenzo(a,h)anthracene	2.20E-01	mg/kg	3.70E-12	mg/m	1.20E+00	(mg/m)^{1}	4.4E-12	7.20E-12	mg/m	--	mg/m	NC
				Bis(2-ethylhexyl)phthalate	3.50E+02	mg/kg	2.13E-09	mg/m	2.40E-03	(mg/m)^{1}	5.1E-12	1.15E-08	mg/m	--	mg/m	NC
				Dieldrin	4.00E-02	mg/kg	2.43E-13	mg/m	4.60E+00	(mg/m)^{1}	1.1E-12	1.31E-12	mg/m	--	mg/m	NC
				Aroclor 1248	2.80E+01	mg/kg	7.23E-07	mg/m	5.70E-01	(mg/m)^{1}	4.1E-07	3.89E-06	mg/m	--	mg/m	NC
				Aroclor 1254	3.00E-01	mg/kg	4.87E-09	mg/m	5.70E-01	(mg/m)^{1}	2.8E-09	2.62E-08	mg/m	--	mg/m	NC
			Exposure Route Total								4.2E-07					3.5E-05
		Exposure Point Total									4.2E-07					3.5E-05
	Exposure Medium Total										4.2E-07					3.5E-05
Medium Total											5.6E-05					6.7E-01
							Total of Receptor Risk Across All Media				**5.6E-05**	**Total of Receptor Hazard Across All Media**				**6.7E-01**

Note:

NC = Not Calculated

(1) Non-cancer hazard calculations based on the most conservative receptor, that being the young child and child.

Appendix G
Riverside Gardens - Location of Crawl Spaces and Basements



Nov 2011

H:\Lee's Lane

Map prepared by MSD Infrastructure & Flood Protection
scraig

Lees Lane
EPA SUPERFUND SITE

0 100 200 400 600 800 1,000
Feet

Appendix H
1987 Natural Resources Survey

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Post Office Box 845
Cookeville, TN 38501

January 16, 1987

MEMORANDUM

TO: AFWE, USFWS, Atlanta, GA. (Attn: RCA)

FROM: Field Supervisor, ES, Cookeville, TN.

SUBJECT: Preliminary Natural Resources Survey, Lee's Lane Landfill Site, Louisville, Jefferson County, Kentucky (ER 86/1028)

In response to Mr. Bruce Blanchard's request of August 18, 1986, we have conducted a preliminary survey of the subject site to determine whether or not natural resources under the trusteeship of the Department of the Interior (DOI) are present in the vicinity of the site and, if present, whether or not damages have occurred or are likely to occur to these resources from pollutants on or derived from this site. This survey was conducted in accordance with procedures outlined in PEP-Environmental Review Memorandum No. ER 83-2, and pursuant to the EPA/DOI Memorandum of Understanding on preliminary surveys of damages to natural resources. If you have questions or comments, please contact RCA Specialist Lee Barclay of my staff.

Site Description and Background

The Lee's Lane Landfill Site is located adjacent to the Ohio River in Jefferson County, approximately 4.4 miles southwest of Louisville, Kentucky. The site, consisting of 112 acres, is composed of three tracts and measures approximately 5,000 feet in length and 1,500 feet in width. The Northern and Central Tracts of the landfill consist of level to gently sloping land while the Southern Tract contains two depressions with steep slopes. Three terraces, each approximately 20 feet wide, form the slope on the river side of the landfill. Much of the landfill surface is covered with well-established vegetation ranging from grasses and shrubs to woodlands. Elevations range from 383 feet above mean sea level (amsl) along the Ohio River to 461 feet amsl along the levee.

The site is bordered on the east and south by a flood protection levee (designed on the 500-year flood). To the northeast is Borden, Incorporated (a chemical manufacturer), to the south is Louisville Gas and Electric, Cane Run Plant (a coal-burning generating station), and to the east is Riverside Gardens (a residential development of about 330 homes and 1,100 people). Beyond these areas the surrounding land use is predominantly woodlands and agricultural land.

Lee's Lane Landfill is bordered on the west by the Ohio River. The site, located at River Mile 616, is on the riverside of the earthen levee and is subject to flooding during high water periods. Flood conditions occur every 1.2 years and have an average duration of 12 days. Based on the designated 100-year flood level of 447.6 feet amsl, which occurred in 1945, some 25 to 50 percent of the landfill would be inundated with floodwaters during this event.

Two ponds, a swamp, and intermittent streams are located on the site. These waterbodies apparently result from surface runoff and possibly from groundwater exposure. The swamp and ponds are located in the southern portion of the site. Seeps can also be found during low river levels along the river bank where groundwater breaks out of the ground and enters the river.

The geology of the site area consists of approximately 110 feet of Ohio River alluvium and glacial outwash underlain by New Albany shale, reported to be 100 feet thick. The alluvial aquifer is unconfined, with the shale forming an aquitard between the alluvial aquifer and the deeper limestone aquifers. The water table is approximately 50 feet below land surface and flow in the aquifer is predominantly toward the Ohio River. Water levels in the aquifer vary with fluctuations of the Ohio River.

The terrestrial flora on and near Lee's Lane Landfill has been subjected to societal disturbances. The landfill surface supports typical field grasses. The grass cover is successfully established over most of the landfill, with the exception of some erosional areas near the river and in the Army Corps of Engineers' levee construction area on the southern side of the landfill. North of the landfill there is an industrial park. The east side of the landfill is bordered by the levee, which serves as a managed buffer zone between the landfill and the adjacent residential development. The west side of the site has a relatively undisturbed area which serves as a buffer zone between the landfill and the Ohio River. This strip of land supports a more dense growth of grasses, shrubs, and trees typical of bottomland riparian woodlands. This strip of riparian habitat is subject to periodic inundation by the Ohio River.

Site access is presently unrestricted and the site is occasionally used for recreational purposes such as hunting and target practice. Scattered piles of domestic debris observed during the Natural Resources Survey suggest that indiscriminant dumping may still be occurring.

Domestic, commercial, and industrial wastes were disposed of in the landfill from the late 1940's to 1975. Prior to and during its use as a landfill, sand and gravel were quarried at the site by the Hofgesang Company. In 1971, the State permitted the Southern Tract of the landfill under its Solid Waste Program. In 1974, the Lee's Lane

Landfill permit expired and, due to repeated compliance violations, was not renewed.

In March 1975, the Jefferson County Department of Public Health was notified of the presence of methane gas in Riverside Gardens. As a result of explosive levels of methane gas, seven families were evacuated by the Jefferson County Housing Authority. The homes were purchased and the families were relocated. In April 1975, the Kentucky Natural Resources and Environmental Protection Cabinet (NREPC) filed a lawsuit that resulted in landfill closure. All construction requiring excavation was prohibited within 860 feet of the landfill and any construction proposed within 1,500 feet of the landfill required a gas test.

Between 1975 and 1979, 44 gas observation wells were installed in and around the landfill and in Riverside Gardens to monitor the concentration, pressure and lateral extent of methane migration. Samples collected from these wells indicated that the source of the methane and associated toxic gases was the decomposition of landfill wastes. In October 1980, a gas collection system was installed on the site between the fill and Riverside Gardens.

In February 1980, the Kentucky Department of Hazardous Materials and Waste Management (HMWM) discovered approximately 400 drums about 100 feet from the Ohio River bank on a 10-foot vertical rise above the river. Over 50 chemicals were identified, including phenolic resins, benzene, and relatively high concentrations of copper, cadmium, nickel, lead, chromium, and arsenic. In October of 1981, the drums were removed by the owners under Court Order. The wastes were removed from the drums and transported to an approved hazardous waste disposal facility. The remaining nonhazardous drummed materials and the empty drums were buried onsite.

A Remedial Investigation was initiated at the Lee's Lane Landfill Site in 1983 by the NUS Corporation under contract from the EPA. Major findings from this investigation are summarized as follows: (1) Primary contaminant migration pathways consist of surface water infiltration to groundwater and surface runoff to the large onsite pond, except during major storms and floods. (2) Onsite surface water contains low, but elevated, levels of contaminants. (3) Contaminant "hot spots" occur onsite, with soil samples containing estimated concentrations of lead and chromium of 2,000 mg/kg (ppm) each, for example. (4) The major migration pathway for groundwater is direct discharge to the Ohio River. (5) Onsite groundwater contains low, but elevated, levels of organic compounds and some inorganic contaminants. The primary organic contaminants are phenolic resins and benzene, while the major inorganic contaminants include arsenic, barium, cadmium, chromium, lead, manganese, and iron. (6) Offsite groundwater concentrations of these contaminants are currently below the maximum allowable levels for drinking water. (7) The public health assessment concluded that the primary public health concern at the site was the elevated levels of chromium found in onsite groundwater, and that there was no evidence of offsite public health problems related to the site at that time. (8) The public health assessment also noted that, in the absence of controlled access to the site, the surface wastes should be removed and the soils containing elevated levels of chromium and lead should be covered.

Interior's Trusteeship

Our investigation reveals that there are no known anadromous fishes or critical habitats for endangered or threatened species that occur in the vicinity of the Lee's Lane Landfill. However, Indiana bats occur in the area and an occasional bald eagle is observed feeding or resting along the Ohio River. Several species of migratory birds occasionally can be found near the project site, including the red-tailed hawk, red-shouldered hawk, mourning dove, eastern bluebird, cardinal, eastern meadowlark, mockingbird, American robin, and several species of sparrows and warblers. No National Parks, National Wildlife Refuges, National Fish Hatcheries, or Indian Reservations occur in the general vicinity of the site.

National Resources Survey

Survey investigations of this site included examination of topographic maps of the site; coordination with the Kentucky Department of Environmental Protection, the Kentucky Department of Fish and Wildlife Resources, and the Kentucky Nature Preserves Commission; and consultation with the Service's Asheville, North Carolina, Endangered Species Field Station.

An onsite inspection of the Lee's Lane Landfill site and adjacent habitats was conducted on December 13, 1983, by Dr. Lee A. Barclay, Ecological Services, U.S. Fish and Wildlife Service, Cookeville, Tennessee, and Mr. Jim Lee, Regional Environmental Officer, Department of the Interior, Atlanta, Georgia. They were accompanied by representatives of the U.S. Geological Survey, the U.S. Environmental Protection Agency, and the Kentucky Department of Environmental Protection who provided technical assistance and background information on the site and its operations. Follow-up inspections were conducted by Dr. Barclay in June 1984 and May 1986.

The 112-acre site is primarily level to gently sloping land that is fairly well stabilized with grasses and shrubs. The southern portion of the site contains two shallow ponds and is fairly steep-sloped. A 20-to-50-foot strip of riparian vegetation occurs along the terraced banks of the Ohio River on the western border of the site.

Fish and wildlife habitats on the vast majority of the site have been severely degraded due to prior landfill and more recent remedial actions. Very little habitat or food materials are present on the site to attract wildlife, with the exception of the two ponds and the strip of riparian vegetation that borders the Ohio River. Higher quality fish and wildlife habitat is relatively abundant in the general project area , so there is little about the site that would attract fish and wildlife species to it.

Conclusions and Recommendations

The natural resources survey indicates that adverse impacts to DOI trust resources resulting from the Lee's Lane Landfill Site probably are minor-to-nonexistent. The major reasons for this conclusion are the current lack of suitable habitat on the site to attract or support fish and wildlife populations, and the relative abundance of more suitable habitat in the project vicinity. Furthermore, offsite migration of contaminants from this site has not been demonstrated, although it probably has occurred to some unknown degree during storm events and flooding.

From a fish and wildlife standpoint, expeditious cleanup of the site - including treatment or removal of contaminated soils, sediments, and surface waters, and paving or capping to prevent downward movement of water through contaminated zones - would be in the best interest of DOI trust resources.

Because of the lack of suitable habitat at Lee's Lane Landfill to support significant numbers of wildlife or fish species, and the absence of other DOI trust resources in the site vicinity, we recommend that the DOI waive its right to bring claims against responsible parties and/or the Superfund for any damages to these resources caused by the release of hazardous substances, provided that the contaminated soils, sediments, and surface waters are removed from the site or properly treated and, further, that the site be capped or otherwise treated so as to retard or eliminate downward movement of water through contaminated zones and, hence, offsite migration of contaminated groundwater. This action will allow EPA to consummate settlement of enforcement proceedings and get the site cleaned up as expeditiously as possible.

Thomas S. Talley

Thomas S. Talley
Field Supervisor

TST/LAB/bb

xc: Mr. Jim Lee, REO, DOI, Atlanta, GA.

Appendix I
Technical Memorandum - Evaluation of Ecological

APPENDIX I –
Technical Memorandum – Evaluation of Ecological Risk

1. Introduction

This Technical Memorandum provides an evaluation of the potential for risk to ecological receptors for the following potentially complete migration and exposure pathways for Lee's Lane Landfill (Landfill):

1. Exposure of avian and mammalian wildlife to surface soil of the Landfill,
2. Exposure of aquatic life in the Ohio River due to surface runoff from the Landfill,
3. Exposure of benthic invertebrates to sediment of the Pond,
4. Exposure of benthic invertebrates in the Ohio River to groundwater migrating from the beneath the Landfill to sediment of the Ohio River, and
5. Exposure of wildlife to site-related constituents below the Landfill cap through food chain transfer.

Each of the pathways is evaluated below.

2. Avian and Mammalian Wildlife Exposed to Soil

2.1 Data Evaluated

The dataset for the evaluation of risk to avian and mammalian wildlife consisted of samples of surface soil collected in 2011 from the Landfill by SMG and the United States Environmental Protection Agency (EPA) and in 2013 by Kentucky Department for Environmental Quality (KDEP). Surface soil data for the 2011 and 2013 sampling events are presented in Table I.1 and Table I.2, respectively. The constituents evaluated are those screened by KDEP and identified as exceeding residential criteria for the protection of human health and those identified by GHD as qualitatively elevated above site-specific background (e.g., Table 5.4 on page 5-23 of the Remedial Investigation/Feasibility Study (NUS, 1986)).

Table I.3 presents the summary statistics for the dataset. Information presented in Table I.3 includes number of samples, number samples with detected concentrations, frequency of detection (FOD), minimum and maximum detected concentrations, arithmetic mean concentrations, and 95% upper confidence limit (UCL) concentrations calculated using ProUCL, Version 5 (EPA, 2013a). For locations where duplicate samples were collected, the primary sample was included in the dataset whereas the duplicate sample was used for quality assurance/quality control (QA/QC).

Constituents detected in surface soil are seven metals (arsenic, chromium, copper, lead, mercury, nickel, and zinc), two polychlorinated biphenyls (PCBs – Aroclor 1248 and Aroclor 1254), four polycyclic aromatic hydrocarbons (PAHs – benzo(a)pyrene, benzo(a)anthracene, benzo(k)fluoranthene, and dibenz(a,h)anthracene), one semi-volatile organic compound (SVOC – bis(2-ethylhexyl)phthalate), and one pesticide (dieldrin).

Thallium was detected in two duplicate samples, but not in either primary sample. Because thallium was not detected in primary samples, it is eliminated from evaluation. Aroclor 1248 was detected in one of 37 samples (2.7%) and dieldrin in one of 31 samples (3.2%). Based on FODs less than 5% for a minimum of 20 samples, Aroclor 1248 and dieldrin are also eliminated from evaluation.

Benchmarks for PAHs have been developed for low molecular weight (LMW) and high molecular weight (HMW) PAHs based on similar ecotoxicological effects. Accordingly, benzo(a)pyrene, benzo(a)anthracene, benzo(k)fluoranthene, and dibenz(a,h)anthracene are evaluated collectively as HWM PAHs. The concentration of HMW PAHs in a sample is as the sum of the concentrations of benzo(a)pyrene, benzo(a)anthracene, benzo(k)fluoranthene, and dibenz(a,h)anthracene.

The dataset for bis(2-ethylhexyl)phthalate, a common laboratory contaminant, contains a sample with a concentration (320 mg/kg) that is over an order of magnitude greater than the sample with next highest concentration (9.9 mg/kg). Dixon's outlier test, available in ProUCL, identified 320 mg/kg as a statistically significant outlier at the 99% confidence level. Summary statistics for bis(2-ethylhexyl)phthalate presented in Table I.3 are presented for the datasets with and without the outlier.

2.2 Methods

Evaluation of risk to avian and mammalian wildlife was conducting using a 2-step process. In the first step, exposure point concentrations (EPCs) were compared to generic ecological screening values (ESVs) specific to avian and/or mammalian wildlife. ESVs for arsenic, chromium, copper, lead, nickel, zinc, and HMW PAHs are ecological soil screening levels (Eco-SSLs) identified by EPA (2005a, 2005b, 2007a, 2007b, 2007c, 2007d, 2008). The ESV for mercury is the preliminary remediation goal (PRG) for American woodcock identified by Efroymson et al. (1997). ESVs for Aroclor 1254 and bis(2-ethylhexyl)phthalate are ecological screening levels (ESLs), based on masked shrew, identified by EPA, Region 5 (EPA, 2003). For Eco-SSLs, the lower of the benchmarks for avian and mammalian wildlife was conservatively selected as the ESV. EPCs are 95% UCL concentrations. Constituents with EPCs below their ESVs were identified as not posing risk to wildlife above the potential for concern. Constituents with EPC greater than their ESVs were carried forward for further evaluation using chain models.

The evaluation of risk proceeded to the second step only if the EPC of a constituent exceeded its ESV. In this step, simple food chain models were used to evaluate the potential for risk to avian and mammalian insectivores. The food chains focused on insectivores because the potential for risk is typically higher to insectivores than other trophic guilds due to a relatively higher potential for bioaccumulation, higher food ingestion rates, and smaller foraging ranges.

Exposure of wildlife to potential contaminants was calculated as:

$$IR_{total} = (IR_{food} * C_{food}) + (IR_{soil} * C_{soil}) + (IR_{water} * C_{water}) \qquad \text{Equation 1}$$

where,

IR_{total} = Total ingestion rate of a constituent (mg/kg day),
IR_{food} = Food ingestion rate (kg dry weight/kg body weight/day),
IR_{soil} = Incidental ingestion rate of soil (kg dry weight/kg body weight/day),
IR_{water} = Ingestion rate of drinking water (L/kg body weight/day),
C_{food} = Concentration of a constituent in food (mg/kg dry weight),
C_{soil} = Concentration of a constituent in soil (mg/kg dry weight), and
C_{water} = Concentration of a constituent in surface water (mg/L).

Ingestion of a constituent (IR_{total}), or dose, was divided by a toxicity reference value (TRV) to produce a hazard quotient (HQ):

$$HQ = IR_{total}/TRV \qquad \text{Equation 2}$$

A HQ greater than 1 (i.e., the dose exceeds the TRV) identifies a potential for risk to wildlife.

Concentrations of each constituent in soil invertebrates (C_{food}) were calculated using the equations identified in Table I.4.

2.3 Results

Table I.5 summarizes the results of the first step of the evaluation of risk to wildlife. Information presented in Table I.5 includes ESVs, receptors upon which the ESVs are based, source of the ESVs, EPCs, and identification of constituents with EPCs greater than their ESVs.

The EPC for arsenic is below its ESV. Therefore, it can be concluded that concentrations of arsenic in surface soil do not pose a potential for risk to avian and mammalian wildlife above the potential for concern.

The EPCs for chromium, copper, lead, mercury, nickel, zinc, Aroclor 1254, HMW PAHs, and bis(2-ethylhexyl)phthalate exceed their ESVs. Consequently, these nine constituents were further evaluated using food chain models.

Table I.4 summarizes the food chain model for American woodcock, an indicator species for avian insectivores. Table I.5 summarizes the food chain model for short-tailed shrew, an indicator species for mammalian insectivores. Information presented in Table I.4 and Table I.5 includes EPCs and ingestion of each constituent in soil invertebrates, surface water, and soil; total ingestion; TRVs; and HQs.

The exposure parameters for body weight, food ingestion rate, water ingestion rate, and soil ingestion rate are from EPA, Region 4 (EPA, 2013b). The TRVs for chromium, copper, lead, mercury, nickel, zinc, Aroclor 1254, and HMW PAHs are the lowest observed adverse effect levels (LOAELs) identified by Region 4. For bis(2-ethylhexyl)phthalate, the TRV for American woodcock is the no observed adverse effect level (NOAEL) identified by Sample et al. (1996) and the TRV for short-tailed shrew is the LOAEL, also identified by Sample et al. (1996).

The EPCs for soil are the 95% UCL concentrations identified in Table I.3. The EPCs for soil were used to calculate concentrations in soil invertebrates consumed by American woodcock and short-tailed shrew based on the equations identified in Table I.4. The EPCs for metals in surface water are the Kentucky water quality standards for Kentucky (KDEP, 2003), assuming a hardness of 50 mg/L calcium carbonate. The EPCs for Aroclor 1254, HMW PAHs, and bis(2-ethylhexyl)phthalate in surface water are assumed to be 0 mg/L.

For American woodcock, the HQs for zinc (0.7), Aroclor 1254 (0.1), and bis(2-ethylhexyl)phthalate (1) are equal to or below 1 (Table I.6). Therefore, it can be concluded that concentrations of zinc, Aroclor 1254, and bis(2-ethylhexyl)phthalate in the surface soil of the Landfill do not pose a potential for risk to avian wildlife above the threshold for concern.

The HQs for chromium (2), copper (3), lead (10), mercury (2), and nickel (2) are greater than 1 (Table I.6), indicating a potential for risk to avian insectivores. The HQs for copper, lead, and mercury are based on conservative LOAELs that produce HQs greater than 1 for natural background concentrations. Use of alternative LOAELs that consider background produce HQs of 0.4 for copper and lead and 0.1 for mercury. Section 7 discusses the conservatism of the LOAELs identified by EPA Region 4 and selection of alternative LOAELs. As discussed in Section 8, spot capping of surface soil will reduce HQs for chromium (0.3) and nickel (0.4) to values below 1.

For short-tailed shrew, the HQs for chromium (0.1), copper (1), mercury (0.4), zinc (0.8), Aroclor 1254 (0.6), HMW PAHs (0.3), and bis(2-ethylhexyl)phthalate (0.005) are equal to or below 1 (Table I.7). Therefore, it can be concluded that concentrations of chromium, copper, mercury, zinc, Aroclor 1254, HMW PAHs, and bis(2-ethylhexyl)phthalate in the surface soil of the Landfill do not pose a potential for risk to mammalian wildlife above the threshold for concern.

The HQs for lead (2) and nickel (7) are greater than 1 (Table I.5), indicating a potential for risk to mammalian insectivores. The HQ for nickel is based on a conservative LOAEL that produces a HQ greater than 1 for natural background concentrations, whereas the LOAEL for lead is based a study that is not representative of exposure for terrestrial receptors. Use of LOAELs that consider background and more appropriate exposure conditions produce HQs of 0.07 and 0.6 for lead and nickel, respectively. Section 7 discusses the conservatism of the LOAELs identified by EPA Region 4 and selection of alternative LOAELs.

2.4 Conclusion

Based on analysis presented above, the potential for risk to avian and mammalian insectivores is below the threshold for concern with use of LOAELs that are reflective of site-specific conditions and with spot capping of areas with the highest concentrations of the COPECs.

3. Aquatic Life in the Ohio River

3.1 Evaluation

Data for the Ohio River published by Youger and Mitsch (1989) was used to evaluate sediment data in the river collected for the reach between Pittsburgh and Louisville (general vicinity of the Landfill). The study concluded that concentrations of metals generally decrease from upstream to downstream. Reported concentrations of cadmium, chromium, copper, lead, nickel, and zinc near Louisville are all below the probable effect concentrations (PECs) identified by MacDonald et al. (2000). These data provide direct evidence from sampling data that the landfill has not adversely impacted Ohio River sediments.

The dense vegetation on the Site and forested area between the Site and the Ohio River filter the flow of surface runoff, allowing contaminants bound to particulate matter in runoff to drop out prior to the runoff discharging into the Ohio River. The use of vegetation for reduction of sediment runoff is widely recognized and is documented in the technical document (NRCS, 2010)

It should also be recognized that the contributory drainage area of the Site relative to the Ohio River watershed is very small (112 acres) relative to the drainage basin of the Ohio River. Any potential contaminants transported in surface runoff will be significantly attenuated once discharged into the Ohio River.

3.2 Conclusion

Based on the above lines of evidence, it is concluded that surface runoff from the Land does not pose risk or adversely impact aquatic life in the Ohio River.

4. Benthic Invertebrates in the Pond

4.1 Data Evaluated

The dataset for evaluation of risk to benthic invertebrates in the Pond consists of two sediment samples collected in 2011 by SMG and EPA. The bottom elevation of the Pond is well above the water table. Consequently, upwelling of groundwater and discharge into the sediment profile of Pond is not a complete migration pathway.

Table I.8 presents the summary statistics for the dataset. Arsenic and lead were detected in both samples. Table I.8 identifies the detected concentrations arithmetic mean of the two samples. Aroclor 1254, benzo(a)pyrene, benzo(a)anthracene, benzo(k)anthracene, and dibenz(a,h)anthracene were detected in one of the two samples. Table I.8 identifies the concentrations for the SMG and EPA samples. For PAHs, the concentration total PAHs, calculated as the sum of the four detected PAHs, is also identified in Table I.8. Duplicate samples were collected by both SMG and EPA. The primary sample was included in the dataset whereas the duplicate was used for QA/QC.

4.2 Methods

The potential for risk to benthic invertebrates in the Pond was evaluated by comparing EPCs to sediment quality benchmarks (SQBs). For arsenic and lead, which were detected in both sediments, the EPCs are the arithmetic mean concentrations of the two samples. The rationale for using the arithmetic mean as the EPC is that the samples collected by SMG and EPA are in the same general area of the Pond. For Aroclor 1254 the EPC is the detected concentration. For PAHs, the EPC is the concentration of total PAHs in the EPA sample. The SQBs for arsenic, chromium, copper, lead, mercury, nickel, zinc, Aroclor 1254 and total PAHs are probable effect concentrations (PECs) identified by MacDonald et al. (2000). The SQB for thallium is the maximum permissible concentration (MPC) identified by Crommentuijn et al. (1997).

Constituents with EPCs below their SQBs were identified as not posing a potential for risk to benthic invertebrates above the potential for concern.

4.3 Results

Table I.9 summarizes the evaluation of risk to benthic invertebrates in the Pond. The EPCs for arsenic, chromium, copper, mercury, nickel, thallium, zinc, Aroclor 1254 and total PAHs are below their SQBs.

For lead, the EPC (134 mg/kg) is slightly greater than its SQB (128 mg/kg). Although the EPC exceeds the SQB, other lines of evidence suggest exposure to lead does not adversely affect the benthic community. For one, the highest concentration of 210 mg/kg of lead for the EPA sample is an estimated concentration (J qualified). Second, the concentration of the closely located sample collected by SMG (57.9 mg/kg) is substantially below the SQB. Third, comparison of concentrations of lead in bulk sediment to a SQB is conservative, as it does not consider factors that influence the bioavailability of lead in sediment. As a divalent metal, lead is likely bound to sulfides and organic carbon in sediment, which reduces its bioavailability to benthic invertebrates (EPA, 2005c). Fourth, the bottom elevation of the Pond with sits well above the water table. As such, the potential for groundwater to upwell into the biologically active zone of the sediment profile is minimal.

4.4 Conclusion

Based on the above results, it is concluded that the potential for risk to benthic invertebrates in sediment of the Pond is below the threshold for concern.

5. Benthic Invertebrates in the Ohio River

5.1 Data Evaluated

The dataset for evaluation of risk to benthic invertebrates in the sediment of the Ohio River consists for samples collected from monitoring wells MW-104 and MW-105, which are shallow wells closest to the Ohio River. Samples for the dataset were collected in June 2014, March 2015, and June 2015.

Constituents detected in MW-104 and MW-105 consist of ten metals (arsenic, barium, cadmium, chromium, iron, lead, manganese, mercury, selenium, and zinc). Beryllium and copper were analyzed for, but were not detected. Benzene was also analyzed for, but was not detected. For samples with duplicates, the primary sample was included in the dataset whereas the duplicate was used for QA/QC.

Table I.10 presents the summary statistics for the pooled data for MW-104 and MW-105. Information presented in Table I.10 includes number of samples, number of samples with detected concentrations, FOD, minimum and maximum concentrations, and arithmetic means.

5.2 Methods

Aquatic life in the sediment of the Ohio River is potentially exposed to metals in groundwater that flows beneath the landfill and migrates off-Site, discharges into sediment, and flows upward through the sediment profile and into the biologically active zone. The biologically active zone is typically restricted to the top 2-3 inches of the sediment profile (Chaloner and Wotton, 1996; Davis, 1974). As groundwater mixes with overlying surface water in the biologically active zone, the EPC for sediment-dwelling organisms is the result of this mixing. Given the high flow of the Ohio River relative to the inflow of groundwater, the EPCs in the biologically active zone are assumed to be 1% of the concentration in groundwater in MW-104 and MW-105. The EPCs are arithmetic means multiplied by 0.01. This assumed mixing is very conservative as the RI calculated a dilution factor of 67,456 for groundwater discharging to the Ohio River (see Section 4.3.4.5 of the RI (NUS, 1986)). The assumed mixing of groundwater and surface water in the biologically active zone is 0.15% of calculated dilution by surface water. Table I.10 identifies the EPCs for the metals detected in MW-104 and MW-105, with and without mixing in the biologically active zone.

The potential for risk to benthic invertebrates was evaluated by comparing EPCs to ESVs for surface water. ESVs for surface water are more appropriate for evaluation of risk to benthic invertebrates than benchmarks for bulk sediment as potential toxicity is through exposure to porewater in the interstitial spaces of the sediment (EPA, 2005c). The ESVs for arsenic, cadmium, chromium, iron, lead, mercury, selenium, and zinc are Kentucky water quality standards (KDEP, 2003). The ESVs for cadmium, lead, and zinc are hardness-dependent. In the absence of site-specific data on hardness, a hardness of 50 mg/L calcium carbonate was conservatively assumed. The ESV for manganese is the lowest chronic value (LCV) for daphnids identified by Suter and Tsao (1996).

The ESV for barium is the negligible concentration (NC) of 75 µg/L identified by Crommentuijn et al. (1997). The NC is calculated as the sum of the background concentration and negligible addition (NA), which is 1% of the maximum permissible addition (MPA), which is a no effect concentration based on toxicity tests. Several other sources of screening benchmarks identify values of 39-40 µg/L for barium. (Suter and Tsao, 1996). These values are Tier II benchmarks, which, because of the absence of sufficient database, include a number of conservative assumptions.

Constituents with EPCs below their ESVs were identified as not posing a potential for risk to benthic invertebrates above the potential for concern.

5.3 Results

Table I.11 summarizes the evaluation of risk to benthic invertebrates in the sediment of the Ohio River. Information presented in Table I.11 includes ESVs, basis and sources of the ESVs, EPCs with and without mixing, and identification of constituents with EPCs greater than their ESVs.

Conservatively assuming no attenuation during migration from the monitoring wells to the Ohio River and no mixing in the biologically active zone, the EPCs for arsenic, selenium, and zinc are below their ESVs. For this conservative exposure scenario, the EPCs for barium, cadmium, chromium, iron, lead, manganese, and mercury exceed their ESVs.

Based on a conservative assumption of 100-fold dilution due to mixing, the EPCs for all ten constituents evaluated are below their ESVs. As discussed above, the RI calculated a dilution factor of 67,456.

The data presented by Youger and Mitsch (1989) provide an additional line of evidence. As discussed in Section 4, concentrations of metals in bulk sediment, which are used to evaluate the potential for risk to benthic invertebrates, are below PECs identified by MacDonald et al. (2000).

5.4 Conclusion

Based on the above lines of evidence, including a conservative assumption of 100-fold dilution, it is concluded that concentrations of arsenic, barium, cadmium, chromium, iron, lead, manganese, mercury, selenium, and zinc in groundwater do not pose a potential for risk to benthic invertebrates in the sediment of the Ohio River above the threshold for concern.

6. Exposure Through Plant Uptake

6.1 Evaluation

The potential for risk to avian and mammalian wildlife through uptake of potential contamination below the Landfill cap by deep rooted vegetation is negligible. Uptake of the constituents of concern by plants is low relative the uptake by earthworms and other soil invertebrates (EPA, 2010). The food chain models for American woodcock and short-tailed shrew discussed in Section 2.3 assumed that these two indicator species consume only earthworms. As risk to avian and mammalian insectivores was determined to be below the threshold for concern, the potential for risk to herbivores is also below the threshold. For example, the Eco-SSLs for lead are 11 mg/kg for avian insectivores and 46 mg/kg for avian herbivores (EPA, 2005b). Similarly, the Eco-SSLs for lead are 56 mg/kg for mammalian insectivores and 1,200 mg/kg for mammalian herbivores.

In addition to consumption of vegetation, wildlife could be exposed to potential contaminants that have bioaccumulated in leaves and other parts of above ground vegetation that have decomposed and become incorporated into surface soil. This potential source of contamination in surface soil is accounted for in the analysis of surface soil. As demonstrated in Section 2.3, the potential for risk of wildlife exposure to surface soil is below the potential for concern.

6.2 Conclusion

Given the above, there is no adverse ecological risk associated with plant uptake.

7. Uncertainties in Toxicity Reference Values

7.1 Evaluation

The food chain models identified a potential for risk to avian and mammalian insectivores exposed to lead and nickel and avian insectivores exposed to chromium, copper, and mercury. The TRVs for the food chain models are LOAELs identified by EPA, Region 4 (2013b). The LOAELs are generally the lowest LOAELs identified in various guidance sources and, as such, may not be applicable to site-specific conditions in northern Kentucky. To assess the applicability of the LOAELs to terrestrial wildlife exposed to surface soil of the Landfill, protective concentration levels (PCLs) were calculated using the exposure parameters for American woodcock and short-tailed shrew and LOAELs identified EPA Region 4.

Table I.12 identifies PCLs for chromium, copper, lead, mercury, and nickel and compares them to the 95% UCL and 95th percentile ambient background concentrations for Kentucky (Kentucky Natural Resources Protection Cabinet, 2004). For avian wildlife, the PCLs for lead and mercury are below the 95% UCL and 95th percentile concentrations whereas the PCL for copper is below the 95th percentile. For mammalian wildlife, the PCL for nickel is below the 95th percentile concentration. These results suggest the Region 4 LOAELs for copper, lead, mercury, and zinc are overly conservative as TRVs for Kentucky. A discussion of the technical basis of the Region 4 TRVs is provided below.

For copper, the Region 4 LOAEL of 4.68 mg/kg-day for avian wildlife is the lowest bounded LOAEL (i.e., the study from which the LOAEL is reported also reports a NOAEL) of 61 LOAELs for growth and reproduction identified in the Eco-SSL source document for copper (EPA, 2007a). The geometric mean of the 61 bounded LOAELs is 35.2 mg/kg-day. Using the geometric mean as an alternative to the lowest LOAEL, the HQ for American woodcock is 0.4, indicating a potential for risk below the threshold for concern (Table I.13).

For lead, the Region 4 LOAEL of 1.94 mg/kg-day for avian wildlife is the lowest bounded LOAEL of 15 bounded LOAELs for growth and reproduction identified in the Eco-SSL source document (EPA, 2005b). The geometric mean of the 15 bounded LOAELs is 42.7 mg/kg-day. Using the geometric mean as an alternative LOAEL, the HQ of American woodcock is 0.4, indicating a potential for risk below the threshold for concern (Table I.13).

For mercury, the Region 4 LOAEL of 0.078 mg/kg-day for avian wildlife is from the Great Lakes Water Quality Initiative (GLWGI) and is based on exposure to methyl mercury. As factors that facilitate methylation of mercury are not expected to be present in surface soil, a LOAEL for inorganic mercury is more appropriate to evaluate the potential for risk to terrestrial receptors. Using the LOAEL of 0.9 mg/kg-day based on mercuric chloride identified by Sample et al. (1996), the HQ for American woodcock is 0.1 (Table I.13), indicating a potential for risk below the threshold for concern.

For nickel, the Region 4 LOAEL of 2.71 mg/kg-day for mammalian wildlife is the lowest of 16 bounded LOAELs for growth and reproduction identified in the Eco-SSL source document (EPA, 2007b). The geometric mean of the 16 bounded LOAELs is 33.2 mg/kg-day. Using the geometric mean as an alternative LOAEL, the HQ for short-tailed shrew is 0.6 (Table I.13), indicating a potential for risk below the threshold for concern.

Although the PCL for lead for mammalian receptors is above ambient background for Kentucky, the Region 4 LOAEL for lead is the lowest of 38 bounded LOAELs for growth and reproduction identified in the Eco-SSL source document (EPA, 2005b). Moreover, it is from a study in which rats were exposed to a highly soluble form of lead (lead acetate) in drinking water, test conditions that are not applicable terrestrial exposure scenarios. The geometric mean of the 38 bounded LOAELs is 157 mg/kg-day. Using the geometric mean as an alternative LOAEL, the HQ for short-tailed shrew is 0.07 (Table I.13), indicating a potential for risk below the threshold for concern.

7.2 Conclusion

In summary, alternative LOAELs for copper, lead, mercury, and nickel that are more appropriate for evaluating the potential for risk to terrestrial wildlife exposed to surface soil produce HQs that are below the threshold for concern.

8. Spot Capping of Surface Soil

8.1 Evaluation

To facilitate risk management decisions for the Lee's Lane Landfill, EPCs were calculated using existing data assuming spot capping in the areas of sample locations N001, LL04, and S014. Samples from these locations have the highest concentrations of chromium, copper, lead, mercury, and nickel. Table I.14 identifies the EPCs assuming spot capping at sample locations N001, LL04, and S014.

Table I.15 identifies the HQs for American woodcock and short-tailed shrew with no remedial actions and with spot remediation in the areas of sample locations N001, LL04, and S014. The HQs are based on the alternative LOAELs identified in Table I.13.

8.2 Conclusion

With no remedial actions, the HQs for American woodcock exposed to chromium and nickel exceed 1 and the HQ for short-tailed shrew is equal to 1.

With spot capping, the HQs for American woodcock and short-tailed shrew for all five metals (chromium, copper, lead, mercury and nickel) are substantially below 1.

9. References

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Table I.1

Soil Data for 2011 Sampling Event
Ecological Risk Evaluation
Lee's Lane Landfill

			April 2011 Soil Sampling Results (SMG Results)					April 2011 Soil Sampling Results (EPA Results)				
Station ID			**LL01**	**LL02**	**LL03**	**LL03**	**LL04**	**LL01**	**LL02**	**LL03**	**LL03**	**LL04**
Sample ID			LL01	LL02	LL03	LL03Dup	LL04	LL01	LL02	LL03	LL03Dup	LL04
Sample Depth Interval (ft bgs)												
Matrix			**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
Sample Date		**Background**	4/6/2011	4/6/2011	4/6/2011	4/6/2011	4/6/2011	4/6/2011	4/6/2011	4/6/2011	4/6/2011	4/6/2011
Constituent	**Units**											
Metals												
Arsenic	mg/kg	0.059 - 55.5 (1)	8.13	8.41	6.44	6.33	6.88	3.6	3.1	3.1	4.5	2.9
Chromium	mg/kg	2.83 - 168 (1)	17.9	21.3	13.9	12.5	49.0	18	19	16	16	21
Copper	mg/kg	0.49 - 636 (1)	NA	NA	NA	NA	NA	32	32	36	23	43
Lead	mg/kg	0.03 - 284 (1)	88.3	63.9	57.9	24.6	263	84	57	210J	320	230
Nickel	mg/kg	0.39 - 83.7 (1)	NA	NA	NA	NA	NA	43	31	20	20	230
Mercury	mg/kg	0.007 - 0.721 (1)	NA	NA	NA	NA	NA	0.14	0.30	2.3	0.15	0.23
Thallium	mg/kg	0.13 - 28 (1)	NA	NA	NA	NA	NA	ND	ND	ND	ND	ND
Zinc	mg/kg	6 - 470 (1)	NA	NA	NA	NA	NA	180	170	0.430	170	530
Polychlorinated Biphenyls (PCBs)												
PCB-1248 (Aroclor 1248)	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1254 (Aroclor 1254)	mg/kg		ND	ND	ND	ND	0.16	0.025 J	0.041 J	0.086 J	0.046 J	0.21 J
Polycyclic Aromatic Hydrocarbons (PAHs)												
Benzo(a)pyrene	mg/kg		0.10	ND	ND	ND	0.11	0.11	ND	0.48	ND	0.28
Benzo(a)anthracene	mg/kg		0.09	ND	ND	ND	0.13	0.10	ND	0.37	ND	0.24
Benzo(k)fluoranthene	mg/kg		0.08	ND	ND	ND	0.10	0.11	ND	0.47	ND	0.25
Dibenzo(a,h)anthracene	mg/kg		ND	ND	ND	ND	ND	ND	ND	0.076	ND	0.053
Semi-Volatile Organic Compounds (SVOCs)												
Bis(2-ethylhexyl)phthalate	mg/kg		ND	0.76	ND	ND	0.42	0.54	ND	ND	ND	ND

Notes:

Semi-volatiles, VOC and PCB/Pesticides were screened against residential criteria by KDEP and only parameters with residential exceedances are shown. Given that there is no electronic data base, a qualititative review of the lab sheets was conducted and it was determined that these parameter groups had very few detections and did not warrant further ecological review other than the parameters that exceeded residential criteria. A similar exercise was completed for metals. However, copper, chromium, nickel, mercury and zinc were added regardless of concentration at the request of EPA that additional metals be evaluated.

NA - Not Analyzed
ND - Non Detect
(1) Arsenic data was evaluated using Kentucky's Ambient Background Guidance Assessment documents

Table I.2

Soil Data for 2013 Sampling Event
Ecological Risk Evaluation
Lee's Lane Landfill

			April 2013 Soil Sampling Results														
Station ID																	
Sample ID			N001	N001Dup	N001	N002	N003	N005	C001	C002	C003	C004	C005	C006	C006Dup	C006	C007
Sample Depth Interval (ft bgs)			0-0.5	0-0.5	0.5-1.0	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0.5-2.0	0-0.5
Matrix			**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
Sample Date																	
Constituents	**Units**	**Background**															
Metals																	
Arsenic	mg/kg	0.059 - 55.5 [1]	3.7	3.8	NA	NA	NA	NA	NA	NA	NA	7.3	NA	5.1	5.5	NA	NA
Chromium	mg/kg	2.83 - 168 [1]	270	200	NA	NA	NA	NA	NA	NA	NA	14	NA	14	13	NA	NA
Copper	mg/kg	0.49 - 636 [1]	81	79	NA	NA	NA	NA	NA	NA	NA	14	NA	13	13	NA	NA
Lead	mg/kg	0.03 - 284 [1]	43	36	NA	NA	NA	NA	NA	NA	NA	14	NA	37	39	NA	NA
Mercury	mg/kg	0.39 - 83.7 [1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	NA	--	--	NA	NA
Nickel	mg/kg	0.007 - 0.721 [1]	53	63	NA	NA	NA	NA	NA	NA	NA	17	NA	14	15	NA	NA
Thallium	mg/kg	0.13 - 28 [1]	ND	ND	NA	NA	NA	NA	NA	NA	NA	<1.0	NA	<0.99	1.1	NA	NA
Zinc	mg/kg	6 - 470 [1]	180	170	NA	NA	NA	NA	NA	NA	NA	54	NA	65	66	NA	NA
Polychlorinated Biphenyls (PCBs)																	
PCB-1248 (Aroclor 1248)	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1254 (Aroclor 1254)	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.30	ND	ND	0.21	ND
Polycyclic Aromatic Hydrocarbons (PAHs)																	
Benzo(a)pyrene	mg/kg		0.043	0.035	0.028	ND	0.064	ND	0.060	ND	0.14	ND	0.31	0.068	0.085	0.048	0.084
Benzo(a)anthracene	mg/kg		0.048	0.035	ND	0.031	0.064	ND	0.054	ND	0.14	ND	0.098	0.061	0.076	0.048	0.063
Benzo(k)fluoranthene	mg/kg		0.77	ND	ND	ND	0.036	ND	0.034	ND	0.087	ND	0.087	0.045	0.044	ND	0.048
Dibenzo(a,h)anthracene	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	0.14	ND	ND	ND	ND	ND	ND
Semi-Volatile Organic Compounds (SVOCs)																	
Bis(2-ethylhexyl)phthalate	mg/kg		0.38	0.2	ND	0.10	0.05	0.11	0.051	0.034	0.027	0.11	0.9	0.4	0.61	0.23	ND
Pesticides																	
Dieldrin	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table I.2

Soil Data for 2013 Sampling Event
Ecological Risk Evaluation
Lee's Lane Landfill

			April 2013 Soil Sampling Results															
Station ID																		
Sample ID			C008	C009	C010	S001	S002	S003	S003	S004	S005	S006	S007	S008	S009	S010	S011	S014
Sample Depth Interval (ft bgs)			0-0.5	0-0.5	0-0.5	0.0.5	0.0.5	0.0.5	0.5-2.0	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5	0.0.5
Matrix			**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
Sample Date																		
Constituents	**Units**	**Background**																
Metals																		
Arsenic	mg/kg	0.059 - 55.5 [1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.9
Chromium	mg/kg	2.83 - 168 [1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	36
Copper	mg/kg	0.49 - 636 [1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	240
Lead	mg/kg	0.03 - 284 [1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	380
Mercury	mg/kg	0.39 - 83.7 [1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	--
Nickel	mg/kg	0.007 - 0.721 [1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	37
Thallium	mg/kg	0.13 - 28 [1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND
Zinc	mg/kg	6 - 470 [1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	480
Polychlorinated Biphenyls (PCBs)																		
PCB-1248 (Aroclor 1248)	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	28	ND	ND	ND	ND	ND	ND	ND
PCB-1254 (Aroclor 1254)	mg/kg		ND	ND	ND	ND	ND	0.045	ND	ND	ND	ND	0.12	ND	ND	ND	ND	ND
Polycyclic Aromatic Hydrocarbons (PAHs)																		
Benzo(a)pyrene	mg/kg		0.075	ND	0.037	0.079	0.066	ND	ND	0.064	4	0.044	0.082	ND	ND	0.045	ND	3.4
Benzo(a)anthracene	mg/kg		0.073	ND	0.047	0.087	0.078	ND	ND	0.072	0.72	ND	0.068	ND	ND	0.044	ND	4.6
Benzo(k)fluoranthene	mg/kg		0.066	ND	ND	0.049	0.035	ND	ND	0.04	ND	0.035	0.052	ND	ND	0.034	ND	ND
Dibenzo(a,h)anthracene	mg/kg		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.22
Semi-Volatile Organic Compounds (SVOCs)																		
Bis(2-ethylhexyl)phthalate	mg/kg		0.96	0.21	ND	0.17	0.27	0.11	0.11	0.12	350	1.3	9.9	0.54	0.11	0.23	0.054	ND
Pesticides																		
Dieldrin	mg/kg		ND	ND	ND	ND	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND

Table I.2

Soil Data for 2013 Sampling Event
Ecological Risk Evaluation
Lee's Lane Landfill

			April 2013 Soil Sampling Results		
Station ID					
Sample ID			S014Dup	S015	S016
Sample Depth Interval (ft bgs)			0.0.5	0.0.5	0.0.5
Matrix			**Soil**	**Soil**	**Soil**
Sample Date					
Constituents	**Units**	**Background**			
Metals					
Arsenic	mg/kg	0.059 - 55.5 (1)	16	NA	NA
Chromium	mg/kg	2.83 - 168 (1)	43	NA	NA
Copper	mg/kg	0.49 - 636 (1)	260	NA	NA
Lead	mg/kg	0.03 - 284 (1)	1300	NA	NA
Mercury	mg/kg	0.39 - 83.7 (1)	--	NA	NA
Nickel	mg/kg	0.007 - 0.721 (1)	46	NA	NA
Thallium	mg/kg	0.13 - 28 (1)	2.8	NA	NA
Zinc	mg/kg	6 - 470 (1)	740	NA	NA
Polychlorinated Biphenyls (PCBs)					
PCB-1248 (Aroclor 1248)	mg/kg		ND	ND	ND
PCB-1254 (Aroclor 1254)	mg/kg		ND	ND	ND
Polycyclic Aromatic Hydrocarbons (PAHs)					
Benzo(a)pyrene	mg/kg		5.1	ND	0.087
Benzo(a)anthracene	mg/kg		5.9	ND	0.091
Benzo(k)fluoranthene	mg/kg		2.1	ND	0.053
Dibenzo(a,h)anthracene	mg/kg		0.10	ND	ND
Semi-Volatile Organic Compounds (SVOCs)					
Bis(2-ethylhexyl)phthalate	mg/kg		ND	0.13	0.55
Pesticides					
Dieldrin	mg/kg		ND	ND	ND

Notes:

Semi-volatiles, VOC and PCB/Pesticides were screened against residential criteria by KDEP and only parameters with residential exceedances are shown.
Given that there is no electronic data base, a qualitative review of the lab sheets was conducted and it was determined that these parameter groups had very few detections and did not warrant further ecological review other than the parameters that exceeded residential criteria. A similar exercise was completed for metals.
However, copper, chromium, nickel, mercury and zinc were added regardless of concentration at the request of EPA that additional metals be evaluated.

NA - Not Analyzed
ND - Non Detect
(1) Arsenic data was evaluated using Kentucky's Ambient Background Guidance Assessment documents
N001Dup is labeled as S013 on lab sheet
C006Dup is labeled as N004 on lab sheet
S014Dup is labeled as S012 on lab sheet

Table I.3

Summary Statistics for Surface Soil
Ecological Risk Evaluation
Lee's Lane Landfill

Constituent	***No. Samples***	***No. Detects***	***FOD***	***Minimum Detect (mg/kg)***	***Maximum Detect (mg/kg)***	***Arithmetic Mean (mg/kg)***	***UCL (mg/kg)***	***UCL Method***
Metals								
Arsenic	10	10	100%	2.9	8.41	5.70	7.00	Student's-t UCL
Chromium	10	10	100%	14	270	48.0	157	95% Chebyshev (Mean, Sd) UCL
Copper	7	7	100%	13	240	65.0	124	Student's-t UCL
Lead	10	10	100%	14	380	126	262	95% Adjusted Gamma UCL
Mercury	6	6	100%	0.1	0.3	0.172	0.24	Student's-t UCL
Nickel	7	7	100%	14	230	60.7	188	95% Adjusted Gamma UCL
Thallium	7	0	0%	---	---	---	---	---
Zinc	7	7	100%	54	530	237	377	Student's-t UCL
Polychlorinated Biphenyls (PCBs)								
Aroclor 1248	37	1	2.7%	28	28	n/c	n/c	---
Aroclor 1254	37	8	22%	0.025	0.3	0.139	0.200	Student's-t UCL
Polycyclic Aromatic Hydrocarbons (PAHs)								
Benzo(a)pyrene	37	24	65%	0.028	4	0.647	n/c	---
Benzo(a)anthracene	37	23	62%	0.031	4.6	0.600	n/c	---
Benzo(k)fluoranthene	37	19	51%	0.034	0.77	0.199	n/c	---
Dibenz(a,h)anthracene	37	3	8.1%	0.053	0.22	0.118	n/c	---
HMW PAHs (Detects) [1]	37	25	68%	0.028	8.22	0.756	2.33	95% Chebyshev (Mean, Sd) UCL
Semi-Volatile Organic Compounds								
Bis(2-ethylhexyl)phthalate								
All Data (Detects) [1]	37	30	81%	0.027	350	12.3	63.07	95% Chebyshev (Mean, Sd) UCL
Less Outlier (Detects) [1]	36	29	81%	0.027	9.9	0.651	1.20	95% Standard Bootstrap UCL
Pesticides								
Dieldrin	31	1	3.2%	0.04	0.04	n/c	n/c	---

Notes:

[1] - Summary statistics calculated for detected concentrations. Detection limits not reported for non-detects.
n/c - not calculated
FOD - Frequency of Detection
HMW - High Molecular Weight
Sd - Standard Deviation
UCL - Upper Confidence Limit

Table I.4

Soil to Soil Invertebrate Uptake Equations
Ecological Risk Evaluation
Lees Lane Landfill

Constiutent	***Soil to Soil Invertebrate Uptake Equation***	***Source***
Metals		
Chromium	$C_{invertebrate} = 0.306 * C_{soil} * 0.16$	USEPA (2008)
Copper	$C_{Invertebrate} = 0.515 * C_{soil} * 0.16$	USEPA (2007a)
Lead	$C_{Invertebrate} = exp((0.807 * (ln(C_{soil})) - 0.218)) * 0.16$	USEPA (2005b)
Mercury	$C_{Invertebrate} = exp((0.3369 * (ln(C_{soil})) + 0.0781)) * 0.16$	Sample et al. (1998)
Nickel	$C_{Invertebrate} = 0.7778 * C_{soil} * 0.16$	Sample et al. (1998)
Zinc	$C_{Invertebrate} = exp((0.328 * (ln(C_{soil})) + 4.449)) * 0.16$	
Polychlorinated Biphenyls (PCBs)		
Aroclor 1254	$C_{Invertebrate} = 0.66 * C_{soil}$	Blankenship et al. (2005)
Polycyclic Aromatic Hydrocarbons (PAHs)		
HMW PAHs	$C_{Invertebrate} = 2.6 * C_{soil} * 0.16$	USEPA (2007c)
Semi-Volatile Organic Compounds (SVOCs)		
bis(2-ethylhexyl)phthalate	$C_{Invertebrate} = 1 * C_{soil}$	Uptake Factor of 1.0 Assumed

Notes:

$C_{invertebrate}$ - Concentration in soil invertebrates (mg/kg wet weight)
C_{soil} - Concentration in soil (mg/kg dry weight)
exp - Exponential
ln - Natural Logarithm

Table I.5

Comparison of Exposure Point Concentrations for Soil to Ecological Screening Values
Ecological Risk Evaluation
Lee's Lane Landfill

Constituent	*Ecological Screening Value*			*Exposure Point Concentration (mg/kg)*	*Exposure Point Concentration > Ecological Screening Value*	*Advance to Food Chain Model*
	Value (mg/kg)	*Receptor*	*Source*			
Metals						
Arsenic	43	Eco-SSL$_{Plant}$	EPA (2005a)	7.0	No	No
Chromium	26	Eco-SSL$_{Plant}$	EPA (2005b)	**157**	Yes	Yes
Copper	28	Eco-SSL$_{Plant}$	EPA (2006)	**124**	Yes	Yes
Lead	11	Eco-SSL$_{Plant}$	EPA (2005c)	**262**	Yes	Yes
Mercury	0.00051	Woodcock	Efroymson et al. (1997)	**0.24**	Yes	Yes
Nickel	130	Eco-SSL$_{Mammals}$	EPA (2007a)	**188**	Yes	Yes
Zinc	46	Eco-SSL$_{Plant}$	EPA (2007b)	**377**	Yes	Yes
Polychlorinated Biphenyls (PCBs)						
Aroclor 1254	0.000332	ESL$_{Shrew}$	EPA (2003)	**0.200**	Yes	Yes
Polycyclic Aromaic Hydrocarbons (PAHs)						
HMW PAHs	1.1	Eco-SSL$_{Mammal}$	EPA (2007)	**2.33**	Yes	Yes
Semi-Volatile Organic Compounds (SVOCs)						
Bis(2-ethylhexyl)phthalate	0.925	ESL$_{Shrew}$	EPA (2003)	**1.20**	Yes	Yes

Notes:

Bold Font identifies Exposure Point Concentration > Ecological Screening Value
Eco-SSL - Ecological Soil Screening Level
EPA - U.S. Environmental Protection Agency
ESL - Ecological Screening Level

Table I.6

Food Chain Model - American Woodcock
Ecological Risk Evaluation
Lee's Lane Landfill

AMERICAN WOODCOCK

Exposure Parameters		
Body Weight	0.170	kg
Food Ingestion		
Wet Weight	1.16	kg WW/kg BW-day
Dry Weight	0.186	kg DW/kg BW-day
Water Ingestion	0.100	L/kg BW-day
Soil Ingestion	0.104	unitless

Constituent	*MEDIA CONCENTRATIONS*			*INGESTION*				*TRV*	*HQ*
	Soil Invertebrates	*Surface Water*	*Soil*	*Soil Invertebrates*	*Surface Water*	*Soil*	*Total*		
	mg/kg WW	*mg/L*	*mg/kg DW*	*mg/kg-day*	*mg/kg-day*	*mg/kg-day*	*mg/kg-day*	*mg/kg-day*	*unitless*
Metals									
Chromium	7.69E+00	4.20E-02	1.57E+02	8.92E+00	4.20E-03	3.03E+00	1.20E+01	5.00E+00	**2.E+00**
Copper	1.02E+01	5.00E-03	1.24E+02	1.19E+01	5.00E-04	2.39E+00	1.43E+01	4.68E+00	**3.E+00**
Lead	1.15E+01	1.20E-03	2.62E+02	1.34E+01	1.20E-04	5.06E+00	1.84E+01	1.94E+00	**1.E+01**
Mercury	1.10E-01	7.70E-04	2.36E-01	1.23E-01	8.00E-05	4.60E-03	1.30E-01	7.80E-02	**2.E+00**
Nickel	2.34E+01	2.90E-02	1.88E+02	2.71E+01	2.90E-03	3.63E+00	3.08E+01	1.86E+01	**2.E+00**
Zinc	9.58E+01	6.40E-02	3.77E+02	1.11E+02	6.40E-03	7.28E+00	1.18E+02	1.70E+02	7.E-01
Polychlorinated Biphenyls (PCBs)									
Aroclor 1254	1.32E-01	0.00E+00	2.00E-01	1.53E-01	0.00E+00	3.86E-03	1.57E-01	1.20E+00	1E-01
Polycyclic Aromatic Hydrocarbons (PAHs)									
HMW PAHs	9.69E-01	0.00E+00	2.33E+00	1.12E+00	0.00E+00	4.50E-02	1.17E+00	1.43E+00	8E-01
Semi-Volatile Organic Compounds (SVOCs)									
Bis(2-ethylhexyl)phthalat	1.02E+00	0.00E+00	1.02E+00	1.18E+00	1.97E-02	1.20E+00	1.20E+00	1.10E+00	1E+00

Notes:

Bold Font identifies Hazard Quotient > 1
DW - Dry Weight
HMW - High Molecular Weight
HQ - Hazard Quotient
TRV - Toxicity Reference Value
WW - Wet Weight

Table I.7

Food Chain Model - Short-Tailed Shrew
Ecological Risk Evaluation
Lee's Lane Landfill

SHORT-TAILED SHREW

Exposure Parameters		
Body Weight	0.017	kg
Food Ingestion		
Wet Weight	0.81	kg WW/kg BW-day
Dry Weight	0.130	kg DW/kg BW-day
Water Ingestion	0.290	L/kg BW-day
Soil Ingestion	0.037	unitless

	MEDIA CONCENTRATIONS			*INGESTION*				*TRV*	*HQ*
	Soil Invertebrates	*Surface Water*	*Soil*	*Soil Invertebrates*	*Surface Water*	*Soil*	*Total*		
	mg/kg WW	*mg/L*	*mg/kg DW*	*mg/kg-day*	*mg/kg-day*	*mg/kg-day*	*mg/kg-day*	*mg/kg-day*	*unitless*
Metals									
Chromium	7.69E+00	4.20E-02	1.57E+02	6.23E+00	1.22E-02	7.50E-01	6.99E+00	5.82E+01	1E-01
Copper	1.02E+01	5.00E-03	1.24E+02	8.28E+00	1.45E-03	5.90E-01	8.87E+00	6.79E+00	1E+00
Lead	1.15E+01	1.20E-03	2.62E+02	9.32E+00	3.50E-04	1.26E+00	1.06E+01	5.00E+00	**2E+00**
Mercury	1.10E-01	7.70E-04	2.36E-01	8.60E-02	2.20E-04	1.10E-03	9.00E-02	2.50E-01	4E-01
Nickel	2.34E+01	2.90E-02	1.88E+02	1.90E+01	8.41E-03	9.00E-01	1.99E+01	2.71E+00	**7E+00**
Zinc	9.58E+01	6.40E-02	3.77E+02	7.76E+01	1.86E-02	1.81E+00	7.94E+01	1.04E+02	8E-01
Polychlorinated Biphenyls (PCBs)									
Aroclor 1254	1.32E-01	0.00E+00	2.00E-01	1.07E-01	0.00E+00	9.60E-04	1.08E-01	6.00E-01	6E-01
Polycyclic Aromatic Hydrocarbons (PAHs)									
HMW PAHs	9.69E-01	0.00E+00	2.33E+00	7.85E-01	0.00E+00	1.10E-02	7.96E-01	3.07E+00	3E-01
Semi-Volatile Organic Compounds(SVOCs)									
Bis(2-ethylhexyl)phthalate	1.02E+00	0.00E+00	1.02E+00	8.26E-01	0.00E+00	4.89E-03	8.31E-01	1.83E+02	5E-03

Notes:

Bold Font identifies Hazard Quotient > 1
DW - Dry Weight
HMW - High Molecular Weight
HQ - Hazard Quotient
TRV - Toxicity Reference Value
WW - Wet Weight

Table I.8

Summary Statistics for Pond Sediment
Ecological Risk Evaluation
Lee's Lane Landfill

Constituent	*No. Samples*	*No. Detects*	*FOD*	*SMG Sample LL03 (mg/kg)*	*EPA Sample LL03 (mg/kg)*	*Arithmetic Mean (mg/kg)*	*EPC (mg/kg)*
Metals							
Arsenic	2	2	100%	6.44	3.1	4.77	4.77
Chromium	2	2	100%	13.9	16	15.0	15.0
Copper	1	1	100%	NA	36	36.0	36.0
Lead	2	2	100%	57.9	210 J	134	134
Mercury	2	2	100%	0.82	0.15	0.49	0.49
Nickel	1	1	100%	NA	20	20.0	20.0
Thallium	0	0	n/c	NA	NA	---	---
Zinc	1	1	100%	NA	430	430	430
Polychlorinated Biphenyls (PCBs)							
Aroclor 1254	2	1	50%	ND	0.086 J	n/c	0.086
Polycyclic Aromatic Hydrocarbons (PAHs)							
Benzo(a)pyrene	2	1	50%	ND	0.48	n/c	---
Benzo(a)anthracene	2	1	50%	ND	0.37	n/c	---
Benzo(k)anthracene	2	1	50%	ND	0.47	n/c	---
Dibenz(a,h)anthracene	2	1	50%	ND	0.076	n/c	---
Total PAHs	2	1	50%	ND	1.396	n/c	1.40

Notes:

J - Estimated concentration
EPA - U.S. Environmental Protection Agency
EPC - Exposure Point Concentration
FOD -Frequency of Detection
SMG - Smith Management Group

Table I.9

Comparison of Exposure Point Concentrations for Pond Sediment to Sediment Quality Benchmarks
Ecological Risk Evaluation
Lee's Lane Landfill

Constituent	***Sediment Quality Benchmark***			***Exposure Point Concentration (mg/kg)***	***Exposure Point Concentration > Sediment Quality Benchmark***	***Potential for Risk to Benthic Invertebrates***
	Value (mg/kg)	***Benchmark***	***Source***			
Metals						
Arsenic	33.0	PEC	MacDonald et al. (2000)	4.77	No	No
Chromium	111	PEC	MacDonald et al. (2000)	15.0	No	No
Copper	149.0	PEC	MacDonald et al. (2000)	36.0	No	No
Lead	**128**	**PEC**	**MacDonald et al. (2000)**	**134**	**Yes**	Marginal
Mercury	1.06	PEC	MacDonald et al. (2000)	0.49	No	No
Nickel	48.6	PEC	MacDonald et al. (2000)	20.0	No	No
Thallium	2.6	MPC	Crommentuijn et al. (1997)	ND	---	No
Zinc	459	PEC	MacDonald et al. (2000)	430	No	No
Polychlorinated Biphenyls (PCBs)						
Aroclor 1254	0.676	PEC	MacDonald et al. (2000)	0.086	No	No
Polycyclic Aromatic Hydrocarbons PAHs)						
Total PAHs	22.8	PEC	MacDonald et al. (2000)	1.396	No	No

Notes:

Bold Font identifies Exposure Point Concentration > Sediment Quality Benchmark
MPC - Maximum Permissible Concnetration
ND - Not Detected
PEC - Probable Effect Concentration

Table I.10

Summary Statistics of MW-104 and MW-105
Lee's Lane Landfill
Ecological Risk Evaluation

Constituent	*No. Samples*	*No. Detects*	*FOD*	*Minimum Detect (µg/L)*	*Maximum Detect (µg/L)*	*Arithmetic Mean (µg/L)*	*EPC (µg/L)*	
							No Mixing	*100-Fold Mixing*
Metals								
Arsenic	6	6	100%	2.7	300	141	141	1.41
Barium	6	6	100%	190	1,100	567	567	5.67
Beryllium	4	0	0%	---	---	---	---	
Cadmium	6	2	33%	0.36	1.9	1.13	1.13	0.011
Chromium	6	1	17%	32	32	n/c	32.0	0.320
Copper	4	0	0%	---	---	---	---	
Iron	4	4	100%	6,300	29,000	18,325	18,325	183
Lead	6	2	33%	17	130	31.7	31.7	0.317
Manganese	4	4	100%	1,000	7,300	3,400	3,400	34.0
Mercury	2	1	50%	1.6	1.6	n/c	1.6	0.016
Selenium	6	2	33%	0.95	1.9	1.43	1.43	0.014
Zinc	4	3	75%	13	20	14.3	14.3	0.14
Volatile Organic Compounds (VOCs)								
Benzene	4	0	0%	---	---	---	---	---

Notes:

EPC - Exposure Point Concentration
FOD - Frequency of Detection

Table I.11

Comparison of Estimated Exposure Point Concentrations in Porewater in the Ohio River to Ecological Screening Values
Ecological Risk Evaluation
Lee's Lane Landfill

Constituent	***Ecological Screening Value***			***Exposure Point Concentration (µg/L)***		***Exposure Point Concentration > Ecological Screening Value***		***Potential for Risk to Benthic Invertebrates***
	Value (µg/L)	***Benchmark***	***Source***	***No Mixing***	***100-Fold Mixing***	***No Mixing***	***100-Fold Mixing***	
Metals								
Arsenic	150	WQS	KDEP (2003)	141	141.20	No	No	No
Barium	75	NC	Crommentuijn et al. (1997)	567	0.567	**Yes**	No	No
Cadmium	0.152	WQS	KDEP (2003)	1.13	0.011	**Yes**	No	No
Chromium	11	WQS	KDEP (2003)	32.0	0.32	**Yes**	No	No
Iron	1,000	WQS	KDEP (2003)	18,325	183	**Yes**	No	No
Lead	1.2	WQS	KDEP (2003)	31.7	0.317	**Yes**	No	No
Manganese	1,100	LCV	Suter and Tsao (1996)	3,400	34.0	**Yes**	No	No
Mercury	0.91	WQS	KDEP (2003)	1.60	0.016	**Yes**	No	No
Selenium	5.0	WQS	KDEP (2003)	1.90	0.019	No	No	No
Zinc	64.5	WQS	KDEP (2003)	14.3	0.143	No	No	No

Notes:

Bold Font identifies Exposure Point Concentration > Ecological Screening Value
KDEP - Kentucky Department for Environmental Protection
LCV - Lowest Chronic Value
NC - Negligible Concentration
WQS - Water Quality Standard

Table I.12

Comparison of Protective Concentration Levels to Kentucky Ambient Background
Ecological Risk Evaluation
Lee's Land Landfill

Constiutent	***Units***	***PCL***		***Kentucky Ambient Background***	
		Avian	***Mammalian***	***95% UCL***	***95^{th} Percentile***
Chromium	mg/kg	65.7	---	21.3	40.0
Copper	mg/kg	**40.7**	---	21.3	41.7
Lead	mg/kg	**18.6**	106	33.0	84.6
Mercury	mg/kg	**0.058**	---	0.07	0.14
Nickel	mg/kg	113	**25.6**	21.7	46.8

Notes:

Bold Font identifies PCL below 95% UCL and/or 95th Percentile for Ambient Background
PCL - Protective Concentration Level
UCL - Upper Confidence Limit

Table I.13

Comparison of Hazard Quotients of Region 4 and Alternative LOAELs
Ecological Risk Evaluation
Lee's Land Landfill

Constiutent	***Avian***				***Mammalian***			
	Region 4		***Alternative***		***Region 4 LOAEL***		***Alternative***	
	LOAEL (mg/kg-day)	***HQ (unitless)***	***LOAEL (mg/kg-day)***	***HQ (unitless)***	***LOAEL (mg/kg-day)***	***HQ (unitless)***	***LOAEL (mg/kg-day)***	***HQ (unitless)***
Copper	4.68	**3**	35.2	0.4	---	---	---	---
Lead	1.94	**10**	42.7	0.4	5.0	**2**	157	0.07
Mercury	0.078	**2**	0.90	0.1	---	---	---	---
Nickel	---	---	---	---	2.71	**7**	33.2	0.6

Notes:

Bold Font identifies HQ > 1
HQ - Hazard Quotient
LOAEL - Lowest Observed Adverse Effect Level

Table I.14

Exposure Point Concenrations With Spot Capping
Ecological Risk Evaluation
Lee's Land Landfill

Exposure Point Concentration	***Units***	***EPC with N001, LL04, and S014 data removed***
Chromium	mg/kg	19.7
Copper	mg/kg	35.3
Lead	mg/kg	80.7
Mercury	mg/kg	0.276
Nickel	mg/kg	42

Notes:

Exposure Concentrations and 95% Upper Confidence Limits (UCLs), unless otherwise noted
[a] - Exposure Point Concentration is 90th Percentile

Table I.15

Hazard Quotients with Spot Capping
Ecological Risk Evaluation
Lee's Land Landfill

Remediation Scenario	***Chromium***	***Copper***	***Lead***	***Mercury***	***Nickel***
No Remediation					
American Woodcock	**2**	0.4	0.4	0.1	**2**
Short-Tailed Shrew	0.1	1	0.07	0.4	0.6
Spot Capping at Sample Locations N001, LL04, and S014					
American Woodcock	0.3	0.1	0.2	0.2	0.4
Short-Tailed Shrew	0.02	0.4	0.03	0.4	0.1

Notes:

Bold Font identifies HQ > 1