West Lake Landfill Vicinity
Radiological Survey and Sampling
November 4-6, 2015
Final Report
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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>α</td>
<td>Alpha radiation</td>
</tr>
<tr>
<td>β</td>
<td>Beta radiation</td>
</tr>
<tr>
<td>γ</td>
<td>Gamma radiation</td>
</tr>
<tr>
<td>µR</td>
<td>MicroRoentgen</td>
</tr>
<tr>
<td>ASPECT</td>
<td>EPA’s Airborne Spectral Photometric Environmental Collection Technology</td>
</tr>
<tr>
<td>BMAC</td>
<td>Bridgeton Municipal Athletic Complex</td>
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<tr>
<td>cm</td>
<td>Centimeters</td>
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<tr>
<td>DHSS</td>
<td>Missouri Department of Health and Senior Services</td>
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<tr>
<td>DNR</td>
<td>Missouri Department of Natural Resources</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
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<tr>
<td>dpm</td>
<td>Disintegrations Per Minute</td>
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<td>DUP</td>
<td>Laboratory Duplicate Sample</td>
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<td>EMSI</td>
<td>Engineering Management Support, Inc.</td>
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<td>EPA</td>
<td>United States Environmental Protection Agency</td>
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<td>FD</td>
<td>Field Duplicate Sample</td>
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<td>FRC</td>
<td>U.S. Nuclear Regulatory Commission Free Release Criteria</td>
</tr>
<tr>
<td>FUSRAP</td>
<td>Formerly Utilized Sites Remedial Action Program</td>
</tr>
<tr>
<td>g</td>
<td>Grams</td>
</tr>
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<td>hr</td>
<td>Hour</td>
</tr>
<tr>
<td>ID</td>
<td>Identification</td>
</tr>
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<td>LANL</td>
<td>Los Alamos National Laboratory</td>
</tr>
<tr>
<td>L</td>
<td>Liter</td>
</tr>
<tr>
<td>LCS</td>
<td>Laboratory Control Sample</td>
</tr>
<tr>
<td>LEPS</td>
<td>Low Energy Photon Spectroscopy</td>
</tr>
<tr>
<td>MB</td>
<td>Method Blank</td>
</tr>
<tr>
<td>MDA</td>
<td>Minimum Detectable Activity</td>
</tr>
<tr>
<td>MSD</td>
<td>Metropolitan St. Louis Sewer District</td>
</tr>
<tr>
<td>NPL</td>
<td>National Priorities List</td>
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<td>NRC</td>
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<td>NUREG</td>
<td>Nuclear Regulatory Commission technical report designation</td>
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<tr>
<td>pCi</td>
<td>Pico Curies</td>
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<tr>
<td>PRP</td>
<td>Potentially Responsible Parties</td>
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<td>QA / QC</td>
<td>Quality Assurance and Quality Control</td>
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<td>QAPP</td>
<td>Quality Assurance Project Plan</td>
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<tr>
<td>RIM</td>
<td>Radiologically Impacted Material</td>
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<tr>
<td>ROD</td>
<td>Record of Decision</td>
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<td>Sampling and Analysis Plan</td>
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<tr>
<td>-------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile Organic Compounds</td>
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1.0 Introduction
On November 4 through November 6, 2015 the Missouri Department of Natural Resources (DNR) and Missouri Department of Health and Senior Services (DHSS) performed radiological surveys and sampling at locations in the vicinity of West Lake Landfill (site). The Environmental Protection Agency (EPA) also assisted in this event by providing additional equipment and staff. Sampling activities were conducted in publically accessible and private property areas near the perimeter of the site, as well as near residential areas, to determine if there is evidence of potential current exposures to the public. Where practical, the DNR performed gamma surveys to support selection of soil and sediment sampling at nine locations. Additionally, surface water sampling was performed at one location and settled dust swipe samples were collected at six locations. All dust wipe samples were analyzed using a bench top meter at the DNR’s Florissant Field Office. Two of these samples along with all soil, sediment, and water samples were sent to the Eberline Services laboratory for further analysis. An interim summary report of this sampling effort was produced on January 25, 2016 and detailed the field screening and instrumentation information.

This final report updates the previous interim information and identifies the selected sampling locations, details the radiological survey and testing methods, presents all field and laboratory results, and includes recommendations based on all results. In a joint effort, the Missouri Department of Health and Senior Services performed radiological air sampling and will present their results separately from this report. All results are being shared with EPA, which is the lead regulatory agency for the radiologically impacted areas of the site. Overall, laboratory results identified private property that has two sample locations above EPA criteria for unrestricted use, which will require additional investigation. This finding is consistent with conclusions identified in EPA’s 2008 OU-1 Record of Decision (EPA 2008.)

2.0 Site Description
The site is located on a parcel of approximately 200 acres within the city limits of Bridgeton, Missouri and was listed on the National Priorities List (NPL) in 1990 by EPA (Figure 1). The site consists of the Bridgeton Sanitary Landfill, which stopped receiving waste on December 31, 2004, and several old inactive areas with municipal solid waste and demolition debris. The site is divided into two Operable Units, or OUs. OU-1 consists of radiological areas (Area 1 and Area 2), and OU-2 consists of the other landfill areas, which are not known to be impacted by radionuclide contaminants.

The site is located approximately one mile north of the Interstate-70/270 interchange. The Missouri River lies approximately 2 miles north and west of the landfill and Lambert International Airport lies approximately 2 miles to the east-southeast. St. Charles Rock Road defines much of the eastern boundary of the site, with Boenker Lane/Old Saint Charles Road marking the southern and western boundaries.
3.0 Site Selection and Field Surveys

Preliminary sampling locations and areas of interest were selected during a field reconnaissance performed on October 20, 2015 and discussed in the November 2015 Radiological Survey and Sampling Plan (SAP). Selection was generally based on visual examination of the overall site’s geographic layout with consideration given to:

- Historic sampling efforts listed in Appendix G;
- Prevailing wind direction at the site;
- Water drainage patterns;
- Evidence of erosion or sediment deposition; and
- Proximity to residential communities

After the preliminary reconnaissance and site selection, the sampling team returned to the selected locations on November 4 and utilized field equipment to screen each site in order to determine the need for further investigation in addition to selecting soil and sediment sampling locations. The previously published interim report provided a brief discussion of the sampling procedures and field investigation results as well as field logs and field notes of each sample location. This final report incorporates the results of the interim report and provides a full discussion of all the sampling procedures and results obtained during the investigation including laboratory sample analyses. Chain of Custody sheets and standard Level IV Report of lab analyses are available in Appendix D & E of this report.

Sampling and surveying was performed by four DNR personnel in groups of two. Where practical, soil samples taken from the sampling locations identified in Figure 1 were collected based on notable fluctuations in the radiological surveying equipment. Specifically, each soil sample collected came from locations exhibiting the highest readings in any one area, and thus biased the sampling location based on the highest gamma readings measured in the field. Recorded weather data during the sampling event was either estimated based on hourly meteorological data provided by the DNR station located off of St. Charles Rock Road to the east of the site, or local data reported from a weather mobile phone application. Hourly meteorological data has been included in Appendix H.

Field and office equipment were used to survey sites for Alpha, Beta, and Gamma radiation. All types of radiation are present at low levels in the environment due to naturally occurring radionuclides. Therefore, radiation detection by the team’s field equipment was expected. None of the results presented an immediate concern for worker safety; however, some dust swipe results warranted further laboratory analysis due to equipment response that deviated from what was typically encountered during the investigation. Equipment used for field measurements are summarized in Section 3.1.

3.1 Field and Bench-top Equipment Description

The equipment used for field measurements during this event is summarized below. Each item has been given a letter identifier which is referenced for the remainder of this report.
Equipment operation checks were performed consistent with standard operating procedures and numerous response verification checks were made during the sampling effort. Sampling equipment and tools were decontaminated consistent with standard operating procedures. Additional information for each piece of equipment is provided in Appendix F.

**Equipment A:** Ludlum model 2221 with 43-5 ZnS Scintillator detector - For this event, the meter was read as an instantaneous rate to search for hotspots, scan dust swipe samples prior to bench testing, and scan personnel at the end of daily sampling activities. Cumulative counts for 1 minute were taken when instantaneous readings detected any activity.

**Equipment B:** Ludlum model 2221 with 44-10 NaI Gamma Scintillator detector - The meter was utilized to collect instantaneous gamma readings of larger areas (gamma surveys) where practical in order to identify locations with values in the higher range of each area. One-minute readings of each identified location were then collected in order to select each soil and sediment sample location.

**Equipment D:** The Ludlum model 19A µR meter probe was utilized for gamma surveys where soil and dust swipe samples were collected. The instrument was held horizontally near waist height. The instrument was preset to alarm at a reading of 50 µR/hr, which represents an approximate annual exposure rate of 0.438 REM.

**Equipment E:** Ludlum model 2929 with 43-10-1 swipe counter - This bench top meter was used to perform alpha counts and combined beta-gamma counts of dust swipe samples. A Thorium 230 check source was periodically used to confirm equipment response.

**EPA Equipment Y:** Ludlum model 2221 with 44-20 NaI Gamma Scintillator detector – This field equipment was brought by and periodically used by EPA personnel at some sampling locations (Photograph 1.)

**EPA Equipment Z:** Ludlum model 3030 with ZnS (Ag) Scintillator detector and shielded 2-inch sample tray – This bench top meter and probe is owned by EPA and was used for simultaneous alpha and beta sample counts of selected dust swipe samples. Readings are in CPM for alpha and combined beta gamma.
3.2 Radiological Field Surveys

Radiological field surveys or “gamma” surveys were conducted where practical in order to obtain instantaneous data for an overall assessment of gamma radiation activity in an area. For all practical survey locations, the field team predominately surveyed areas exhibiting erosional and depositional features in order to improve the likelihood of biased soil sampling locations. Due to the discriminate nature of the performed surveys, the results by themselves do not provide sufficient data to draw any conclusions regarding the absence or the extent of the presence of surficial radiologically impacted material. However, the data can be used to indicate a need for further investigation and attempt to bias soil sampling locations. For soil sample locations, gamma survey readings were the first step in identifying what location to obtain a surface soil sample. For dust sample locations, gamma surveys were utilized to complement dust sample results in order to determine if additional investigation within the area may be warranted.

Procedure: For all soil and dust sample locations, equipment B or D was utilized to obtain instantaneous gamma readings where practical at sample areas identified in Figures 1 through 6. Locations within each area identified for soil sampling that had comparatively higher instantaneous readings were flagged for longer scans using equipment B. Some areas were surveyed several times, as shown in Table 4, during this sampling event. Photograph 2 shows an instantaneous gamma survey being conducted at Spanish Village Park.

Results: Survey values revealed the vast majority of instantaneous readings in each area fell in the lower range of the detected values for gamma radiation, with brief fluctuations to comparatively higher values. Gamma surveys around soil sample locations S03 and S06 were not practical due to the dense vegetation present in those areas. Soil sample locations S02, located on or immediately adjacent to restricted private property to the north, and S10, located on or immediately adjacent to restricted private property northwest of Area 2, had some persistent readings approximately 20% to 30% higher than other readings within the same area. The areas around S02 and S10 were subsequently surveyed again during the following day with equipment B and EPA Equipment Y to verify previous observations. Additional procedures for obtaining soil samples in addition to soil sample results are discussed in Section 3.3. Gamma surveys conducted in areas near dust sampling locations did not reveal significant observations. Table 4 displays the range of instantaneous gamma readings for all surveyed locations.
3.3 Settled Dust

Dust swipe samples were used in conjunction with gamma surveys as an additional screening tool. The use of dust or “smear” sampling provides a quick, semi-quantitative result for removable contamination. Each swipe was bench-tested for gross alpha and gross beta-gamma to assist in determining if additional investigation for an area may be warranted. As with field gamma surveys, swipe sampling has limitations that significantly affect the usability of data results (EPA 2011, Frame and Abelquist.) The dust swipe results from this investigation cannot by themselves confirm that removable radioactivity is absent in an area, only that removable radioactivity is present. In addition, swipe sampling and testing methods have considerable inefficiencies that make it difficult to accurately identify and quantify the activity on a sample. EPA 600/R-11/122 (EPA 2011) provides a detailed summary of the state of practice and inherent limitations of swipe sampling and methods.

Procedure: Dust swipe samples were obtained at each selected area using dry standard cloth swipes. A preliminary alpha scan of each swipe was performed using Equipment A prior to analyzing the swipe samples on Equipment E for 10-minute count duration alpha and beta-gamma counts. Photographs 7 and 8 show examples of dust sample collection and bench-top tests. Bench-top tests of dust swipe samples were performed first in order to obtain immediate and relatively inexpensive determination of potential presence and activity level of removable radioactive contamination. The results were compared to empty tray counts, and all samples that substantially deviated from empty tray values were flagged for additional analysis. As an additional quality control check, analysis using EPA equipment Z was performed on the flagged samples in addition to an equal number of samples exhibiting typical investigation results. The flagged samples were then sent to Eberline Laboratory for additional analyses. Laboratory results are discussed in Section 4.1.

Results: Eight locations were originally chosen for dust swipe samples, including two locations (D03 and D05) that had been previously tested by DNR on May 16, 2013. Of the eight planned locations, swipe samples were obtained for six locations, while two locations, D06 and D08 were not sampled due to site access or lack of adequate surface for sampling. A total of 18 swipe samples were collected from the six locations which are labelled first by the general location, then sequentially by letter for each separate object that was swiped. For example, all swipe samples collected at Spanish Village Park were identified as D04, and then each sample collected from separate locations at Spanish Village Park was labeled D04A, D04B, and D04C. DNR bench-top and quality control results are listed in Table 5 & 6.

Of the 18 samples analyzed, samples D05A and D07A were flagged for additional analysis. Sample D05A showed comparatively elevated alpha counts that incrementally decreased through each successive test down to values typically encountered during the
investigation. Sample D07A also showed comparatively elevated alpha count values that were sustained through each successive test. After being analyzed four times on Equipment E, these two samples, along with D04A and D01D for comparison purposes, were taken to EPA’s local office for additional bench-top testing on November 16 using EPA Equipment Z. EPA bench-top tests generally confirmed the results of Equipment E, and these results are presented in Table 7.

Based on screening results of D05A and the gamma survey, follow-up investigation for the immediate area was limited to laboratory analysis of D05A. Due to the proximity of sample locations S09 and S10 in addition to sampling in the immediate area by DHSS (MDHSS, 2016), follow-up investigation was limited to laboratory analysis of D07. Both samples D05A and D07A were sent to Eberline Services laboratory for additional analysis using non-destructive analytical techniques. The laboratory results are discussed in Section 4.3.

4.0 Laboratory Procedures and Results

Environmental media that were sampled and analyzed includes surface soil and sediment from zero to six inches below ground surface, surface water, and settled dust. Laboratory testing for soil and sediment include the following radionuclides of interest: Uranium-234 (U-234); U-235; U-238; Thorium-228 (Th-228); Th-230; Th-232; Radium-226 (Ra-226); Ra-228; and Lead-210 (Pb-210). Levels of Gross Alpha, Gross Beta and Gamma radiation were also examined. Laboratory testing for water samples includes total U, Ra-226, Ra-228, Gross Alpha, and Gross Beta. All radionuclides of interest are naturally occurring and will be present at low levels in the environment.

4.1 Laboratory Quality Assurance / Quality Control

Laboratory Quality Assurance and Quality Control (QA/QC) are necessary to enhance and document the quality and reliability of analytical data. While QA concentrates on the planning and implementation processes for establishing the reliability of laboratory data; QC procedures are the tools used to achieve data reliability. Accuracy and precision are important parameters for determining the quality and reliability of data provided by the lab.

Field QA/QC methods for sampling are detailed in DNR Federal Facility Section Quality Assurance Project Plan (QAPP) and Sampling Plan. A summary of, and rationale for field duplicate samples are summarized in this section.

Eberline Services laboratory performs a number of QA/QC checks that have been included in Eberline’s Level IV reporting packet available in Appendix E. The QA/QC procedures assist in determining the error, minimum detectable activity (MDA), and qualifiers that are reported in the summarized tables within the report. A brief description of some of the QA/QC protocol has been provided below to assist in distinguishing laboratory QA/QC data provided from Eberline’s data packet from results of field samples.
**Field Duplicate:** A field duplicate (FD) is a separate sample collected at the same time and sampling location under identical conditions and then treated exactly the same throughout the laboratory processes. The results obtained for field duplicates give a measure of the precision associated with sample collection, preservation, storage as well as the analytical test methods used. These samples were labeled in the field similar to other samples, but noted on the Chain of Custody only as FD. For this study, field staff collected one field duplicate sample for each matrix. A total of one soil/sediment duplicate sample and one surface water duplicate were collected.

**Laboratory Duplicate:** A laboratory duplicate (DUP) is prepared by taking two sample portions from the same sample container and then processing and analyzing as two separate samples. Analysis results are used to measure analytical precision from the sample digestion/extraction step through the analysis process. One laboratory duplicate was analyzed for water samples, and two for soil/sediment samples.

**Laboratory Method Blank:** A method blank (MB) is prepared to represent the matrix as closely as possible without analytes of interest, and is prepared/extracted/digested and analyzed exactly like the field samples. Its purpose is to assess any contamination potentially introduced during sample preparation activities.

**Laboratory Control Sample:** A laboratory control sample (LCS) is a controlled matrix, known to be free of analytes of interest. Known analytes are then added or “spiked” to the controlled matrix at verified concentrations, and then analyzed using the same laboratory procedures. The LCS spiked sample results are then compared to the known value of the spike to evaluate the accuracy and performance of the analytical procedure, including all preparation and analysis steps.

### 4.2 Data Quality Objectives

The purpose of this investigation, as stated in the SAP, is to determine if there is a current potential exposure to the public relative to the potential presence of radiologically impacted material at or near the ground surface. Our data quality objective is to provide sufficient sampling technique and analysis of sufficient quality, as outlined in DNR’s QAPP and SAP, to incorporate generated data into ongoing radiological characterization activities at the West Lake Landfill site.

Due to the discriminate and limited nature of investigation activities discussed in this report, it would be inappropriate to use the laboratory results by themselves to make a determination of the absence of contamination within a broader area based on negative laboratory results. Similarly, positive laboratory results by themselves do not definitively determine the extent of contamination, and therefore do not quantify any potential radiological health risk within the area in which a positive sample is obtained. Positive sample results may indicate the need for further characterization activity, or in other words, additional investigation.
regarding the presence and extent of contamination in the area in which the positive sample is found. Once an area is characterized, then a risk assessment can be made and health risks quantified. The results of this investigation can supplement on-going characterization activities currently being performed by the Potentially Responsible Parties (PRPs.)

4.3 Settled Dust

**Procedure:** As noted in Section 3.3, Samples D05A and D07A were sent to Eberline Services laboratory based on comparatively higher alpha counts. Eberline was initially requested to perform gross alpha and gross beta analysis on the samples in order to validate and quantify the results obtained during field testing. An informal gamma spectroscopy screening was requested for sample D07A in order to determine the source of beta activity detected from the initial analysis. Following the informal scan, a formal Low Energy Photon Spectroscopy (LEPS) analysis was requested.

The swipe sample laboratory results obtained during the investigation are compared to Nuclear Regulatory Commission (NRC) free release criteria for comparison (Table 1.) These criteria are used to assist in determining if NRC permitted facilities are sufficiently radiologically de-contaminated to be released for unrestricted use. The swiped surface area for each sample was variable and greater than 100 cm², but the resulting values have been compared to 100cm² surface area free release requirements as a conservative comparison.

**Results:** Samples D05A and D07A were tested by Eberline Services laboratory for Gross Alpha & Gross Beta using Method LANL MLR-100 Modified. A duplicate test on D05A was performed in addition to a laboratory control sample and method blank for quality assurance purposes. Quality assurance testing indicates acceptable results, and the results are summarized in Table 9. Overall, gross alpha and beta activity for all samples fall below NRC free release criteria (NRC, 1974). The Report of Analysis is available in Appendix E.

After reviewing the results of the gross alpha and beta analysis, an informal gamma spectroscopy screening for D07A was requested in order to determine if the detected beta activity was potentially associated with radionuclides of interest or from activity associated with Potassium 40(K-40), a naturally occurring isotope that is not known to be associated with radiologically impacted material (RIM) originating from OU-1. Gamma screening with Canberra Gamma Apex software was performed, and based on the results of this informal scan, K-40 was ruled out as a primary beta emitter. Since Pb-210 was identified as a radionuclide of potential concern, a formal scan using LEPS was requested and performed using Method LANL ER-130 Modified in order to determine if Pb-210 was the primary beta emitter. Laboratory results indicated potential Pb-210 concentration, but the value was below Minimum Detectable Activity, and therefore is considered non-detect. Overall, gross alpha and beta activity for all
samples fall below Nuclear Regulatory Commission free release criteria (NRC, 1974.) However, the results from sample D07A in combination with soil laboratory results and gamma surveys indicate a probable need for additional investigation in the area near dust sample location D07A.

Laboratory results of gross alpha and beta concentrations in Sample D05A, and the laboratory duplicate, were unremarkable so further isotopic analysis was not pursued. Bench-top results for Sample D05A and empty tray analysis during the second equipment check suggests that the activity may have been related to short-term changes in the testing environment. Rain occurring during this time may have affected the radon activity in the indoor environment where testing was performed.

Table 1: Laboratory Results of Selected Dust Swipe Samples Compared to Free Release Criteria

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Laboratory measured Alpha* (dpm/100cm²)</th>
<th>Laboratory measured Beta* (dpm/100cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D05A</td>
<td>1.35</td>
<td>2</td>
</tr>
<tr>
<td>D05A DUP</td>
<td>1.29</td>
<td>2.49</td>
</tr>
<tr>
<td>D07A</td>
<td>4.42</td>
<td>12.08</td>
</tr>
<tr>
<td><strong>FRC</strong></td>
<td><strong>20 dpm/ 100 cm²</strong></td>
<td><strong>1000 dpm/ 100cm²</strong></td>
</tr>
</tbody>
</table>

* Laboratory results were reported in pCi/sample, and D05 results are J-coded or estimated values. A conversion factor of 1pCi = 2.22 dpm was used for comparison purposes.

A Swipe area assumed to be equal to 100 cm². Actual swipe area was larger.

B FRC = NRC Free release criteria based on removable contamination (NRC, 1974)

4.4 Surface Soil and Sediment

Procedure: As noted in section 3.2, equipment B and D were utilized to take area-wide instantaneous gamma readings of each soil sample location where practical. Based on the results of the gamma surveys, flags were placed in locations that had comparatively higher instantaneous values in each area. One-minute duration gamma readings using Equipment B were then collected for each flagged location (Photograph 3). Generally, six 1-minute measurements were taken for each area and the location with the highest reading was selected to collect the soil sample. Table 8 shows the instantaneous gamma ranges for each soil sample location in addition to 1-minute duration gamma counts performed in order to bias each soil and sediment sample.

Surface soil and sediment samples were collected using a slide hammer and split spoon sampler fitted with a plastic sleeve. The resulting sample, encased in a 2-inch diameter
by 6-inch long plastic sleeve, was sealed on each end with a plastic cap then taped. (Photographs 4 - 5)

No difficulties were encountered with the field measuring or sampling tools. Some soil sampling locations were substantially moved from the original location selected during field reconnaissance due either to access issues or preferential selection based on surface erosional and depositional features. Sample location S02 located north of Area 2 appeared to contain crushed red brick debris which may have contributed to the comparatively elevated gamma readings, so an additional more segregated sample (S02B) was collected in an effort to potentially determine the source of the elevated gamma readings. An additional quality control field duplicate sample (S02C) was collected and sent for laboratory analysis.

Results: All samples including a quality control duplicate sample S02C were sent to Eberline Services for laboratory analysis. The following methods were used to analyze the soil and sediment samples:

- Isotopic Uranium (Uranium-234, 235, 238) – Method EML U-02 Modified;
- Isotopic Thorium (Thorium-228, 230, 232) – Method EML U-01 Modified;
- Radium – 226 – EPA Method 903.0 Modified;
- Radium – 228 – EPA Method 904.0 Modified;
- Lead – 210 – EML Pb-01 Modified; and
- Gross Alpha/Beta – LANL MLR-100 Modified

Quality control testing demonstrated acceptable precision and accuracy parameters. With some exceptions, Minimum Detectable Activities were generally low enough to quantify isotope concentrations. One notable exception was the U-235 Isotope. None of the results for U-235 were detected at concentrations higher than the detection limit and may be considered non-detect.

Table 2 provides a comparison of calculated results to EPA Unrestricted Use Criteria in addition to Pb-210 results. Overall, radioactivity of Pb-210 was consistent with Radium-226 activity. Complete isotopic results are available in Table 10.
Table 2: Comparison of Soil Sample Results to Site-Specific Preliminary Remedial Goals

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Thorium 230 + 232</th>
<th>Radium 226 + 228</th>
<th>Total Uranium</th>
<th>Lead-210</th>
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<tr>
<td>EPA Unrestricted Use value</td>
<td>7.9</td>
<td>7.9</td>
<td>54.5</td>
<td>No value established</td>
</tr>
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<td>WLL20151104-S01</td>
<td>3.1</td>
<td>2.3</td>
<td>1.8*</td>
<td>1.07</td>
</tr>
<tr>
<td>WLL20151104-S02</td>
<td>5.8</td>
<td>6.0</td>
<td>5.7*</td>
<td>3.28</td>
</tr>
<tr>
<td>WLL20151104-S02B</td>
<td>2.6</td>
<td>3.2</td>
<td>1.7*</td>
<td>1.59</td>
</tr>
<tr>
<td>WLL20151104-S02C (FD)</td>
<td>2.9</td>
<td>3.4</td>
<td>1.6*</td>
<td>1.48</td>
</tr>
<tr>
<td>WLL20151105-S03</td>
<td>3.8</td>
<td>3.4</td>
<td>1.8*</td>
<td>1.60</td>
</tr>
<tr>
<td>WLL20151105-S04</td>
<td>4.3</td>
<td>1.7*</td>
<td>1.6*</td>
<td>1.23</td>
</tr>
<tr>
<td>WLL20151104-S05</td>
<td>2.7</td>
<td>3.3</td>
<td>2.0*</td>
<td>1.12</td>
</tr>
<tr>
<td>WLL20151105-S06</td>
<td>1.7</td>
<td>2.4</td>
<td>1.6*</td>
<td>ND</td>
</tr>
<tr>
<td>WLL20151106-S08</td>
<td>3.7</td>
<td>3.7</td>
<td>1.8*</td>
<td>ND</td>
</tr>
<tr>
<td>WLL20151105-S09</td>
<td>9.2</td>
<td>3.6</td>
<td>1.9*</td>
<td>1.46</td>
</tr>
<tr>
<td>WLL20151104-S10</td>
<td>24.6</td>
<td>3.8*</td>
<td>2.0*</td>
<td>2.47</td>
</tr>
</tbody>
</table>

* Indicates one result was non-detect
A Reference value based on EPA Unrestricted Use Criteria
ND = Non-detect

Total radionuclide activity in soil sample S10 was notably more elevated compared to all other soil samples analyzed during the investigation. In addition to exceeding EPA unrestricted use level for Th-230 + 232, over 65% of the total activity in the sample is associated with the Th-230 Isotope. Data suggest radiologically impacted material (RIM) is present in sample S10, and additional investigation in the area surrounding this sample location is warranted.

Total radionuclide activity in soil sample S09 were comparatively higher than total activity found in most other samples, and also exceeded EPA unrestricted use level for Th-230+232. Nearly half of the laboratory detected activity is associated with the Th-230 isotope. Soil sample S09 is located in proximity to soil sample S10 and dust sample D07, with all samples being on private property. Data suggest that RIM is present in sample S09, and further investigation in the area surrounding sample location S09 is warranted.

Total radionuclide activity in soil sample S02 was also higher compared to typical activity found in other sample results for this investigation. It is noted that instead of having activity dominated by Th-230, the activity distribution of this sample was relatively even for thorium, radium and uranium isotopes. Sample S02 was observed to
contain red brick material at the time of collection. Since brick material has been shown to be a potential source of radioactivity (Eichholz, et al, NUREG 1501), an additional sample (S02B) was collected in an attempt to isolate any potential source of activity. Laboratory results for sample S02B, without brick material observed in the sample, showed decreased activity similar to typical soil sample results found in the investigation. A comparison of these two results in addition to the field duplicate suggests that the brick material may be the source of radiological activity. However, red brick may be part of demolition debris originally located within West Lake Landfill, so RIM related activity cannot be conclusively ruled out. Since the laboratory results of a sample show activity of both Thorium and Radium near EPA unrestricted use levels, and the 1-minute gamma results of this area have readings that are higher than all other areas surveyed, additional investigation may be warranted.

Total radionuclide activity in soil sample S04 was roughly mid-range in comparison to other sample results from this investigation, and was below EPA unrestricted use levels for the WLL site. However, Th-230 activity accounted for a notable portion of the total activity, and may indicate some influence from a non-natural source. Additional confirmatory investigation or further fate and transport study may be warranted to characterize the presence of site related contaminants. This recommendation is due to only a single sample being collected, and that sample laboratory results indicate there is comparatively higher Thorium concentration in the sample than other soil sample results. This investigation may need to extend toward the area surrounding sample location S03, also referred as the North Surface Water or North Surface Water Body (McLaren/Hart 1996, EMSI 2000), which also showed slightly higher Th-230 activity compared to overall activity in the sample.

4.5 Surface Water

Procedure: One surface water sample and one field duplicate quality control sample was collected into 4-liter cubitainers for laboratory analysis. The water samples were obtained in the wooded area southwest of the site where water had collected during the November 5 rain event (Figure 6). Photograph 6 shows the samples being prepared for delivery. No problems were encountered during sampling.

Results: The following methods were used to analyze the water samples:

- Total Uranium – Method ASTM D5174 Modified
- Radium – 226 – EPA 903.0 Modified
- Radium – 228 – EPA 904.0
- Gross Alpha/Beta – EPA 900.0 Modified

Quality control testing demonstrated acceptable precision and accuracy parameters.
Overall, sample results for radiological contaminants of interest were below laboratory detection limits or below regulatory action and screening levels. Due to the stringent standards for drinking water, water sample results were compared to state drinking water standards, and provided in Table 3.

### Table 3: Comparison of Water Sample Results to Drinking Water Regulations

<table>
<thead>
<tr>
<th>Comparison of Water Sample Results to Drinking Water Regulatory Action Levels&lt;sup&gt;C&lt;/sup&gt;</th>
<th>Combined Radium&lt;sup&gt;A&lt;/sup&gt; (pCi/L)</th>
<th>Total Uranium&lt;sup&gt;B&lt;/sup&gt; (µg/L)</th>
<th>Gross Alpha&lt;sup&gt;B&lt;/sup&gt; (pCi/L)</th>
<th>Gross Beta&lt;sup&gt;D&lt;/sup&gt; pCi/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory Action Level&lt;sup&gt;C&lt;/sup&gt;</td>
<td>5</td>
<td>30</td>
<td>15</td>
<td>50&lt;sup&gt;D&lt;/sup&gt;</td>
</tr>
<tr>
<td>WLL20151105-W01</td>
<td>ND&lt;sup&gt;A&lt;/sup&gt;</td>
<td>1.49</td>
<td>2.2</td>
<td>8.85</td>
</tr>
<tr>
<td>WLL20151105-W01 DUP</td>
<td>ND&lt;sup&gt;A&lt;/sup&gt;</td>
<td>1.15</td>
<td>1.9</td>
<td>10.24</td>
</tr>
<tr>
<td>WLL20151105-W02 FD</td>
<td>ND&lt;sup&gt;A&lt;/sup&gt;</td>
<td>ND&lt;sup&gt;A&lt;/sup&gt;</td>
<td>ND&lt;sup&gt;A&lt;/sup&gt;</td>
<td>10.10</td>
</tr>
</tbody>
</table>

<sup>A</sup> Radionuclide activity was not detected above Minimum Detectable Activity, and is indicated as non-detect (ND)

<sup>B</sup> Drinking water regulations assess Uranium limits separately from other Alpha emitters. Total Uranium activity was subtracted from Gross Alpha results in order to make an appropriate comparison.

<sup>C</sup> 10 CSR 60-4.060

<sup>D</sup> Screening value for drinking water testing for beta activity minus K-40

### 5.0 Conclusion

On November 4 through November 6, 2015 DNR and DHSS, with support from EPA, performed radiological surveys and sampling at locations in the vicinity of West Lake Landfill. Two dust swipe samples along with all soil, sediment, and water samples were sent to Eberline Services laboratory for further analysis. This final report updates the previous interim information and identifies the selected sampling locations, details the radiological survey and testing methods, presents all field and laboratory results, and includes recommendations based on all results.

Overall, all samples fell below site-specific action levels, with the exception of two soil samples that indicated the presence of site-related contaminants above EPA’s unrestricted use level. However, due to the discriminate and limited nature of investigation activities associated with this report, it would be inappropriate to use these results by themselves to make definitive conclusions regarding the absence, extent of presence, or potential health risk of radioactive contamination found at investigated sites.

Listed below are the recommendations of this effort as based on the results of this investigation.
1. Recommendation Requiring Additional Site Characterization; Soil Sample locations S09 & S10: Survey and sample data suggests that the area located immediately northwest of, and adjacent to OU-1 Area 2 requires additional characterization. The supporting data includes persistent comparatively higher values from gamma surveys, comparatively higher alpha and beta activity on dust swipe sample D07A, and soil sample results from S10, and S09 that exceed EPA’s unrestricted use levels. These sample results can supplement on-going characterization activities by incorporation into any additional investigation conducted by EPA and the PRPs. This conclusion is consistent with the need for additional investigation identified in EPA’s 2008 OU-1 Record of Decision (EPA 2008.)

2. Results Suggesting Additional Evaluation; Soil Sample Location S02: Soil sampling results at location S02, while below site-specific action levels, did show comparatively higher activity levels. Laboratory results for sample S02B suggests the activity levels present in sample S02 may be attributable to brick material observed in the sample. However, given the limited number of samples collected from this area, and the unknown origin of the brick material, more evaluation may be needed to confirm the cause and extent of activity in this area.

3. Results Suggesting Additional Evaluation; Soil Sample Location S04: Although Sample S04 is below site specific action levels, additional evaluation of this area is recommended based on comparatively higher concentration of Th-230 activity, and the limited number of samples collected in proximity.

In conclusion, DNR has communicated all information and findings to EPA and any affected private property owners. This report will be posted to the Department’s Westlake Landfill website. The DHSS radiological air sampling results will be presented in a separate report.
6.0 References


EMSI, 2000, Remedial Investigation Report, West Lake Landfill Operable Unit 1, April 10.


EPA, 2008, Record of Decision – West Lake Landfill Site, Bridgeton, Missouri, Operable Unit 1, May.

EPA 2011, Performance-based Approach To The Use of Swipe Samples in a Radiological or Nuclear Incident, EPA 600/R-11/122, October.


MDHSS, 2016, Missouri Department of Health and Senior Services, Bridgeton/West Lake Landfill Radiological Sampling Interim Report, January

MDNR, 2015, Federal Facilities Section West Lake Landfill Vicinity Radiological Survey and Sampling Plan, November 3.


Appendix A: Tables
<table>
<thead>
<tr>
<th>Location Description</th>
<th>Associated Sample IDs</th>
<th>Surface Type</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>D (µR/hr)</td>
</tr>
<tr>
<td>AAA Trailer Back Fence Line</td>
<td>D07A; S10</td>
<td>Grass; Gravel</td>
<td>8 – 15</td>
</tr>
<tr>
<td>AAA Trailer Back Fence Line</td>
<td>S10</td>
<td>Grass; Gravel</td>
<td>*</td>
</tr>
<tr>
<td>AAA Trailer SW Corner</td>
<td>S09</td>
<td>Grass</td>
<td>*</td>
</tr>
<tr>
<td>Virbec</td>
<td>S04</td>
<td>Grass</td>
<td>5 – 10&lt;sup&gt;C&lt;/sup&gt;</td>
</tr>
<tr>
<td>Artur Trucking Back Lot</td>
<td>S01</td>
<td>Grass</td>
<td>*</td>
</tr>
<tr>
<td>Artur Trucking Back Lot</td>
<td>S02; S02B; S02C</td>
<td>Grass</td>
<td>*</td>
</tr>
<tr>
<td>Drainage Area – Woods south of landfill</td>
<td>S06; W01; W02</td>
<td>Grass</td>
<td>*</td>
</tr>
<tr>
<td>MSD Lift Station and Levee Gate</td>
<td>D05A; D05B; D05C; D05D</td>
<td>Grass; Gravel; Concrete</td>
<td>5 - 10</td>
</tr>
<tr>
<td>House on Hill</td>
<td>D03A; D03B</td>
<td>Grass; Concrete</td>
<td>7 – 13</td>
</tr>
<tr>
<td>Abandoned Gas Station</td>
<td>D02A-1; D02A-2; D02B</td>
<td>Grass; Concrete</td>
<td>7 – 15</td>
</tr>
<tr>
<td>13374 Lakefront Drive</td>
<td>None</td>
<td>Grass</td>
<td>8 – 13</td>
</tr>
<tr>
<td>Spanish Village Park</td>
<td>D04A; D04B; D04C</td>
<td>Grass; Concrete; Playground fill</td>
<td>8 – 10</td>
</tr>
<tr>
<td>Spanish Village Park</td>
<td>S05; D04A; D04B; D04C</td>
<td>Grass</td>
<td>10 – 15&lt;sup&gt;A&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ditch adjacent to St. Charles Rock Road and OU1 Area 2</td>
<td>S03</td>
<td>Grass</td>
<td>*</td>
</tr>
</tbody>
</table>

*not surveyed

<sup>A</sup> Upper range of readings obtained near brick-walled restroom
<sup>B</sup> Point reading
<sup>C</sup> Light rain reported during survey
<sup>D</sup> Directional shield installed
Table 5: Screening Values for all Dust Swipe Sample Analyses Using Equipment E

<table>
<thead>
<tr>
<th>Sample Location Description</th>
<th>Sample ID</th>
<th>Preliminary Alpha Result (CPM)</th>
<th>10-Minute Alpha Result (Total Count)</th>
<th>10-Minute Beta + Gamma Result (Total Count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First equipment check was performed (see Table 6) prior to the following samples</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spanish Village Park: Pavilion Rafter</td>
<td>D04A</td>
<td>0</td>
<td>4</td>
<td>431</td>
</tr>
<tr>
<td>Spanish Village Park: Upper Jungle Gym Slide Bay Floor</td>
<td>D04B</td>
<td>0</td>
<td>2</td>
<td>445</td>
</tr>
<tr>
<td>Spanish Village Park: Bathroom Air Inlet</td>
<td>D04C</td>
<td>0</td>
<td>4</td>
<td>432</td>
</tr>
<tr>
<td>Home on hill: Picnic Bench</td>
<td>D03A</td>
<td>0</td>
<td>2</td>
<td>443</td>
</tr>
<tr>
<td>Home on hill: Piano</td>
<td>D03B</td>
<td>0</td>
<td>2</td>
<td>400</td>
</tr>
<tr>
<td>MSD Lift Station: Top of Control Panel (tested three times)</td>
<td>D05A</td>
<td>0, 0, 0</td>
<td>12, 7, 6</td>
<td>431, 417, 437</td>
</tr>
<tr>
<td>Second equipment check was performed (see Table 6) prior to the following samples</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DNR EER Response Trailer (EER): Roof under AC Canopy</td>
<td>D01E</td>
<td>0</td>
<td>5</td>
<td>423</td>
</tr>
<tr>
<td>MSD Lift Station: Air Monitoring Station</td>
<td>D05B</td>
<td>0</td>
<td>4</td>
<td>421</td>
</tr>
<tr>
<td>MSD Lift Station: Road surface near entrance</td>
<td>D05C</td>
<td>0</td>
<td>3</td>
<td>428</td>
</tr>
<tr>
<td>MSD Lift Station: Levy Gate</td>
<td>D05D</td>
<td>0</td>
<td>3</td>
<td>430</td>
</tr>
<tr>
<td>DNR EER Trailer: Floor</td>
<td>D01C</td>
<td>0</td>
<td>4</td>
<td>416</td>
</tr>
<tr>
<td>DNR EER Trailer: Oven exhaust hood</td>
<td>D01A</td>
<td>0</td>
<td>4</td>
<td>436</td>
</tr>
<tr>
<td>DNR EER Trailer: Printer shelf</td>
<td>D01B</td>
<td>0</td>
<td>2</td>
<td>433</td>
</tr>
<tr>
<td>AAA Trailer: Radiation Warning Sign on fence (tested three times)</td>
<td>D07A</td>
<td>0, 0, 0</td>
<td>13, 18, 16</td>
<td>473, 439, 423</td>
</tr>
<tr>
<td>Third equipment check was performed (see Table 6) prior to the following samples</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DNR EER Trailer: Furnace Air Intake</td>
<td>D01D</td>
<td>0</td>
<td>6</td>
<td>438</td>
</tr>
<tr>
<td>Abandoned Gas Station Canopy Downspout: Sample 1 of 2</td>
<td>D02A-1</td>
<td>0</td>
<td>4</td>
<td>456</td>
</tr>
<tr>
<td>Abandoned Gas Station Canopy Downspout: Sample 2 of 2</td>
<td>D02A-2</td>
<td>0</td>
<td>3</td>
<td>394</td>
</tr>
<tr>
<td>Abandoned Gas Station: Trash can</td>
<td>D02B</td>
<td>0</td>
<td>3</td>
<td>419</td>
</tr>
<tr>
<td>MSD Lift Station: Top of Control Panel (4)</td>
<td>D05A</td>
<td>0</td>
<td>5</td>
<td>452</td>
</tr>
<tr>
<td>AAA Trailer: Radiation Warning Sign on fence (4)</td>
<td>D07A</td>
<td>0</td>
<td>17</td>
<td>474</td>
</tr>
<tr>
<td>Final equipment check was performed (see Table 6) to confirm equipment response</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Total counts may be converted to CPM by dividing the total count value by 10
Testing performed on November 5, 2015
### Table 6: Equipment E Response Checks Using 1) An Empty Tray and 2) Th-230 Check Source

<table>
<thead>
<tr>
<th>Equipment Check Description and Time</th>
<th>10-Minute Alpha Result (Total Count)</th>
<th>10-Minute Beta + Gamma Result (Total Count)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Equipment Check</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06:47 Empty Tray</td>
<td>2</td>
<td>416</td>
</tr>
<tr>
<td>07:00 Th-230 Check Source</td>
<td>9414</td>
<td>1764</td>
</tr>
<tr>
<td><strong>Second Equipment Check</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09:28 Empty Tray(1)</td>
<td>3</td>
<td>394</td>
</tr>
<tr>
<td>09:49 Empty Tray(2)</td>
<td>5</td>
<td>411</td>
</tr>
<tr>
<td>10:00 Empty Tray(3)</td>
<td>0</td>
<td>417</td>
</tr>
<tr>
<td>10:13 Th-230 Check Source</td>
<td>9414</td>
<td>1783</td>
</tr>
<tr>
<td><strong>Third Equipment Check</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:09 Empty Tray(1)</td>
<td>2</td>
<td>423</td>
</tr>
<tr>
<td>14:25 Empty Tray(2)</td>
<td>2</td>
<td>407</td>
</tr>
<tr>
<td>14:36 Empty Tray(3)</td>
<td>3</td>
<td>413</td>
</tr>
<tr>
<td>14:47 Th-230 Check Source</td>
<td>9393</td>
<td>1741</td>
</tr>
<tr>
<td><strong>Final Equipment Check</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19:04 Th-230 Check Source(1)</td>
<td>9601</td>
<td>1729</td>
</tr>
<tr>
<td>19:43 Th-230 Check Source(2)</td>
<td>9476</td>
<td>1715</td>
</tr>
<tr>
<td>19:56 Th-230 Check Source(3)</td>
<td>9402</td>
<td>1856</td>
</tr>
<tr>
<td>20:09 Empty Tray</td>
<td>3</td>
<td>427</td>
</tr>
</tbody>
</table>

Total counts may be converted to CPM by dividing the total count value by 10.

Testing performed on November 5, 2015.

### Table 7: Dust Sample Screening Values using EPA Equipment Z

<table>
<thead>
<tr>
<th>Equipment Check</th>
<th>10 Minute Alpha Result (average CPM)</th>
<th>10 Minute Beta + Gamma Result (average CPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Check using Th230 (α) Check Source</td>
<td>3291(^A)</td>
<td>*</td>
</tr>
<tr>
<td>Equipment Check using Sr90 (β) Check Source</td>
<td>*</td>
<td>1198(^A)</td>
</tr>
<tr>
<td>Equipment Check with an Empty Tray</td>
<td>0</td>
<td>42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>10 Minute Alpha Result (average CPM)</th>
<th>10 Minute Beta + Gamma Result (average CPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D04A</td>
<td>0</td>
<td>45</td>
</tr>
<tr>
<td>D01D</td>
<td>0</td>
<td>43</td>
</tr>
<tr>
<td>D05A</td>
<td>0</td>
<td>43</td>
</tr>
<tr>
<td>D07A</td>
<td>1</td>
<td>48</td>
</tr>
</tbody>
</table>

\(^A\) One minute counts

Equipment Checks and Testing completed between 12:30 and 14:15 on November 16, 2015.
<table>
<thead>
<tr>
<th>Location Description</th>
<th>Sample ID</th>
<th>1-minute Gamma Counts for soil sample location on Equipment B (CPM)</th>
<th>1-minute Gamma Counts for soil sample location on Equipment D (CPM)</th>
<th>Equipment D (µR/hr)</th>
<th>Equipment B (1000 CPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S03</td>
<td></td>
<td>9.4 A</td>
<td>9.4 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S06</td>
<td></td>
<td>9.8 A</td>
<td>9.8 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S02</td>
<td></td>
<td>7-14 B</td>
<td>7-14 B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S01</td>
<td></td>
<td>8-11</td>
<td>8-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S04</td>
<td></td>
<td>8-11</td>
<td>8-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S09</td>
<td></td>
<td>10-12</td>
<td>10-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S10</td>
<td></td>
<td>7-15</td>
<td>7-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S05</td>
<td></td>
<td>8-11</td>
<td>8-11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 9: Summary of Laboratory Results for Dust Swipe Samples

Laboratory Analysis of Swipe Samples D05A and D07A
Gross Alpha & Gross Beta
Collection Date: November 4, 2015
Results in pCi/sample

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Sample Location</th>
<th>Gross Alpha</th>
<th></th>
<th>Gross Beta</th>
<th></th>
</tr>
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<td>Error</td>
<td>MDA</td>
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MDA = Minimum Detectable Activity
J = Laboratory Data Qualifier: Value is estimated
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Res = Results
Err = Error
MDA = Minimum Detectable Activity
Q = Laboratory Data Qualifier
U = Radionuclide was detected, but not detected above the MDA
J = Value is estimated
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<tr>
<td></td>
<td>Q J U</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
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</tbody>
</table>

Res = Results  
Err = Error  
MDA = Minimum Detectable Activity  
Q = Laboratory Data Qualifier  
U = Radionuclide was detected, but not detected above the MDA  
J = Value is estimated
Table 12: Summary of Laboratory Results for Surface Water Samples

Radionuclide Results for Surface Water Samples
Collection Date: November 5, 2015
Results are in (pCi/L)

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<th>Parameter</th>
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<td>Error</td>
<td>MDA</td>
<td>Result</td>
<td>Error</td>
<td>MDA</td>
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<tr>
<td>Gross Alpha</td>
<td>3.65 J</td>
<td>2.03</td>
<td>3.48</td>
<td>3.04</td>
<td>1.38</td>
<td>1.53</td>
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<tr>
<td>Gross Beta</td>
<td>8.85</td>
<td>2.69</td>
<td>4.86</td>
<td>10.24</td>
<td>2.44</td>
<td>4.08</td>
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<td>Radium-226</td>
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<td>0.13</td>
<td>0.44</td>
<td>0.34 U</td>
<td>0.36</td>
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<td>Radium-228</td>
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<td>0.50</td>
<td>0.95</td>
<td>0.29 U</td>
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<tr>
<td>Total Uranium$^\wedge$</td>
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<td>0.04</td>
<td>1.00</td>
<td>1.15</td>
<td>0.03</td>
<td>1.00</td>
</tr>
</tbody>
</table>

$^\wedge$ Results are in µg/l

MDA = Minimum Detectable Activity
U = Laboratory Qualified Data: Radionuclide was detected, but not detected above the MDA
J = Laboratory Qualified Data: Value is estimated
Appendix B: Figures
Figure 1: Map of Sampling Locations
Figure 2: Sampling Locations North of Area 2
Figure 3: Sampling Locations Southeast of Area 1

Legend:
- OIT - Coastal Saltmarsh
- OIT - Freshwater Saltmarsh
- OIT - Intermixed Saltmarsh
- OIT - Coastal Debris Halftidal
- OIT - Estuarine Freshwater
- WATER
- SOIL
- SAND
- DIRT
- DIRT
- NEIGHBORS
- SUBURBS
- LEGEND

Sampling Locations YEOV 2015

Victoria

West Lake Lagoon
Figure 4: Sampling locations at Spanish Village Park south of WLL.

Legends:
- Water
- Soil
- Solid Waste
- Metal Fixtures
- Dewatered
- MI DIA
- Samples
- Legend

Sampling Locations Nov. 2015.

Vicinity:
- West Lake Landfill
- North Boundary
- South Boundary
- East Boundary
- Sampling Area
- Property Lines

Legend:
- DT 2.0
- DT 1.0
- DT 0.5
- DT 0.2
- DT 0.1
- DT 0.05
- DT 0.01
- DT 0.005
- DT 0.001
- DT 0.0005
- DT 0.0001
Figure 5: Additional Sampling Locations South of West Lake Landfill

Legend:
- O2: - Oxygen Active Sampling Location
- O2: - Oxygen Inactive Sampling Location
- O1: - Methane Active Sampling Location
- O1: - Methane Inactive Sampling Location
- VAP: - Vapors Emitted from Gas
- WATER
- SOIL
- SEDIMENT
- DIST
- MEDIA
- SNAiRES
- Legend

Sampling Locations: Nov 2015

Vicinity:
West Lake Landfill
Figure 6: Sampling Location in Wooded Area South of West Lake Landfill
Appendix C: Photograph Log

Photograph 1: EPA Ludlum 2221 with NaI 44-20 detector and directional shield attachment (EPA Equipment Y)

Photograph 2: Gamma walkover survey conducted at Spanish Village Park
Photograph 3: One minute count being conducted on equipment B following gamma survey of immediate area. These locations are flagged in preparation of final soil sample location S09

Photograph 4: Soil sampling with Split Spoon sampler
Photograph 5: Soil and sediment samples collected on November 4, 2015 being prepared for shipment

Photograph 6: Surface water samples being prepared for shipment
Photograph 7: Collection of dust swipe sample D02A

Photograph 8: Testing of Dust Swipe Sample D04B with Equipment E
Appendix D: Chain of Custody

<table>
<thead>
<tr>
<th>Sample Description</th>
<th>Sample Number</th>
<th>Sample Type</th>
<th>Sample Date</th>
<th>Sample Location</th>
<th>Test Results</th>
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<tbody>
<tr>
<td>Sample ID 1</td>
<td>001</td>
<td>Grass Blade</td>
<td>05/01/2019</td>
<td>Site A</td>
<td>Result A</td>
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<td>Sample ID 2</td>
<td>002</td>
<td>Grass Stalk</td>
<td>05/02/2019</td>
<td>Site B</td>
<td>Result B</td>
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<tr>
<td>Sample ID 3</td>
<td>003</td>
<td>Wheat</td>
<td>05/03/2019</td>
<td>Site C</td>
<td>Result C</td>
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</table>

Notes:
- All tests were conducted in accordance with standard procedures.
- Sample ID numbers and locations are accurate.
- Test results are representative of the sample.

Sample Collection:
- Samples were collected by trained personnel.
- Samples were kept in airtight containers to prevent contamination.

Sample Storage:
- Samples were stored at -20°C until analysis.
- Samples were not exposed to light or direct heat.

Sample Analysis:
- Results were obtained using standard instrumental methods.
- All analyses were performed by certified personnel.

Chain of Custody:
- Sample collection, storage, and analysis were tracked throughout.
- All personnel involved in the process were identified.
- Records were maintained for future reference.

Missouri Department of Natural Resources

Sincerely,
[Signature]
<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/28/2015</td>
<td>L10R</td>
<td>123 lb</td>
</tr>
<tr>
<td>12/15/2015</td>
<td>L20L</td>
<td>456 lb</td>
</tr>
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</table>

**Sample Preparation and Storage:**
- Store at room temperature.
- Protect from light.

**Notes:**
- All samples to be submitted within 24 hours of collection.
- Include chain of custody with all samples.
Appendix E: Level IV Data Packets

Level IV data packets are available upon request
Appendix F:  Radiological Field Equipment

*Equipment A:* Ludlum model 2221 with 43-5 ZnS Scintillator detector - The meter has both digital and analog scales, is able to provide both instantaneous rates and accumulative counts over a user set time, and has field adjustable voltage settings to give the user some flexibility in selection of probes and focusing on feedback at different energy levels to help evaluate readings. The 43-5 ZnS detector is an alpha radiation detector that requires very close proximity to the surface of the object being surveyed.

*Equipment B:* Ludlum model 2221 with 44-10 NaI Gamma Scintillator detector - The meter has both digital and analog scales, and is able to provide both instantaneous rates and cumulative counts over a user set time. The meter also has field adjustable voltage settings to give the user some flexibility in selection of probes and focusing on feedback at different energy levels to help evaluate readings. The 44-10 detector is a Sodium Iodide (NaI) gamma radiation detector that combines high sensitivity and fast response.

*Equipment D:* Ludlum model 19A µR meter - This meter with built-in detector has a fixed logarithmic analog scale and can merely give feedback as a rate in units of micro-roentgen per hour (µR/hr). It is meant to give fast and easy dose estimates in areas of low activity levels and to provide an alarm as activity begins to approach a preset action level. The instrument needle is constantly moving in response to activity such that visual precision is several µR/hr. Results are most easily presented as a range.

*Equipment E:* Ludlum model 2929 with 43-10-1 swipe counter - This is a bench top meter and probe designed for counting swipe samples. These samples are small cloth patches used to retrieve dust. Readings are in total counts for alpha and combined beta gamma so readings need to be divided by the duration of the count in minutes for a CPM value.

*EPA Equipment Y:* Ludlum model 2221 with 44-20 NaI Gamma Scintillator detector – The 44-20 detector has higher detection sensitivity than Equipment B, making it well suited for survey applications (Photograph 1.)

*EPA Equipment Z:* Ludlum model 3030 with ZnS (Ag) Scintillator detector and shielded 2-inch sample tray – This was utilized as a bench top meter and probe used for simultaneous alpha and beta sample counting. Readings are in CPM for alpha and combined beta gamma.
Appendix G: Previous Investigations

Historic sampling and surveying efforts identified in the SAP that were considered for the current investigation:

- Late 1980’s Department of Energy (DOE) Haul Road Sampling, 28 intersections (1994 DOE Remedial Investigation)
- 2005 DNR Formerly Utilized Sites Remedial Action Program (FUSRAP) haul road sampling St. Charles Rock Road, Taussig, Boenker
- March 2013 EPA ASPECT Gamma and Infrared Survey
- May 2013 DNR Radiological Survey, Alpha, Beta, Gamma survey/screening
- June 2013 DHSS Air Sampling, Alpha/Beta particulates, Ambient Gamma
- May 2014 EPA BMAC radiation survey and sampling
- 2014 EPA Community Air Monitoring, Gamma, Alpha/Beta Particulates, Radon
- April 2015 MO University of Science and Technology Phyto forensics
- May 2015 Respondents Air Monitoring, VOCs, Gamma, Alpha/Beta Particulates, Radon
Appendix H: Field Data Logs

Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015
Arrival Time: 9:50
Departure Time: 11:30

Team members/responsibilities:
Ryan Seabaugh + Eric Gilstrap

Weather (Description) Temperature: 67°F
Partly Cloudy Humidity: 77%
Wind: (Direction and Speed)
8 @ 3 mph

Radiation detection equipment used: model/serial number/calibration:

☐ Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
  Time: 
  Reading: 

☒ Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015
  Time: 11/4/15 11:00
  Reading: 0 CPM. S. CLUM. OCCURRENCES OF SINGLE 16CPH. SET( SLIDE) 1.0CPM. ANE PTES

☒ Ludlum Model 19A/201916/June 25, 2015
  Time: 
  Reading: 
  Range of Readings: 8 - 10 mR/hr

Sample Collection Log Information

Sample location description:
SPANISH VILLAGE PARK

Odors Present: Yes ☒ No ☐ If Yes Please Describe:

Collection equipment:
DUST SWIPE, EXTENSION POLE

Sampler’s name(s):
See Team Members

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Descript.</th>
<th>UTM (m) GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
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<td>JUNGLE GYM</td>
<td>0721502 4292866</td>
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<td>RR AIR INTAKE</td>
<td>0721891 4292819</td>
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43
Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015  Arrival Time: 12:50  Departure Time: 13:48

Team members/responsibilities:
Ryan Seabaugh  Eric Gilstrap

Weather (Description)  Temperature: 70°F  Humidity: 66%  Wind: (Direction and Speed)

Radiation detection equipment used: model/serial number/calibration:

☐ Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
  Time:
  Reading:

☐ Ludlum Model 2221 & 43-5 Detector/156999 & PR155892/August 8, 2015
  Time: 11/5/15
  Reading: (C) CPM SWIPES

☐ Ludlum Model 19A/201916/June 25, 2015
  Range of Readings: 5 - 10 μR/hr

Sample Collection Log Information

Sample location description:
MSD Lift Station → Levee Gate

Odors Present: Yes or No  If Yes Please Describe: MODERATE

Collection equipment:
Dust Swipe, Extension Pole

Sampler's name(s):
See Team Members

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Description</th>
<th>UTM (m)</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
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</thead>
<tbody>
<tr>
<td>WLL20151104D05A</td>
<td>11/4/15 13:00</td>
<td>GRAB</td>
<td>DUST</td>
<td>MSD-Pump PANEL</td>
<td>0721820</td>
<td>4293609</td>
<td>4Y, 3Y, 2Y, 2B</td>
</tr>
<tr>
<td>WLL20151104D05B</td>
<td>11/4/15 13:15</td>
<td>DUST</td>
<td>EER Air SAMPLER</td>
<td>0721854</td>
<td>4293600</td>
<td>2Y, 3Y, 4Y, 4B</td>
<td></td>
</tr>
</tbody>
</table>
Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015   Arrival Time: 13:28  Departure Time: 13:45

Team members/responsibilities:
Ryan Seabaugh, Eric Gilstrap

Weather (Description)    Temperature: 71 F    Humidity: 64 %    Wind: (Direction and Speed)
Partly Cloudy             S @ 3 mph

Radiation detection equipment used: model/serial number/calibration:

☐ Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
  Time:  
  Reading: 

☐ Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015 (SWIPE5)
  Time: 1/5/15
  Reading: 0 CPM each

☐ Ludlum Model 19A/201916/June 25, 2015
  Range of Readings: 7 - 13 M R/ha

Sample Collection Log Information

Sample location description:
☒ HOUSE ON THE HILL

Odors Present: Yes  No
If Yes Please Describe:

Collection equipment:
DUST SWIPE

Sampler's name(s):
See Team Members

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Descript.</th>
<th>UTM (m)</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLL20151104D03A</td>
<td>11/4/15 13:30</td>
<td>GRAB</td>
<td>DUST PICNIC BENCH</td>
<td>0722364</td>
<td>4293420</td>
<td>W 2925</td>
<td>COUNT X, B R</td>
</tr>
<tr>
<td>WLL20151104D03B</td>
<td>11/4/15 13:42</td>
<td>↓</td>
<td>PANO TOP</td>
<td>0722333</td>
<td>4293407</td>
<td>↓</td>
<td></td>
</tr>
</tbody>
</table>
**Sample Event Log Information**

**Project:** West Lake Landfill Vicinity Sampling Event

**Sampling & Analysis Plan:**
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

**Purpose:** Sample and Data Collection

**Date:** November 4, 2015  **Arrival Time:** 13:50  **Departure Time:** 14:30

**Team members/responsibilities:**
Ryan Seabaugh & Eric Gilstrap

**Weather (Description):** Partly Cloudy

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Humidity</th>
<th>Wind (Direction and Speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72°F</td>
<td>65%</td>
<td>S @ 3.7 mph</td>
</tr>
</tbody>
</table>

**Radiation detection equipment used:**
- Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
- Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015
- Ludlum Model 19A/201916/June 25, 2015

**Time:**
- Reading:
  - 11/5/15
  - 11/4/15

**Reading:**
- 0CPM SWIPES
- 0CPM W/SHORABLE SINGLE COUNTS 1CPM (TRASH BARREL)

**Range of Readings:** 7 - 15 M R/h

---

**Sample Collection Log Information**

**Sample location description:** St. Charles Rock Road Abandoned Gas Station

**Odors Present:** Yes

**If Yes Please Describe:** MILD

**Collection equipment:** DUST SWIPE EXTENSION POLE

**Sampler's name(s):** See Team Members

---

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Descript.</th>
<th>LTRN (m)</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLL20151104D02A-1</td>
<td>11/4/15 14:05</td>
<td>GRABS</td>
<td>DUST</td>
<td>DOWN-SPOUT</td>
<td>0722830</td>
<td>42.935944, Count O1, B+8 x 12.5</td>
</tr>
<tr>
<td>WLL20151104D02A-2</td>
<td>11/4/15 14:15</td>
<td></td>
<td>DOWM-SPOUT</td>
<td>SAME</td>
<td>0722832</td>
<td>42.93564 M</td>
</tr>
<tr>
<td>WLL20151104D02B</td>
<td>11/4/15 14:25</td>
<td></td>
<td>TRASH BARREL</td>
<td></td>
<td>0722854</td>
<td>42.9359 M</td>
</tr>
</tbody>
</table>
### Sample Event Log Information

**Project:** West Lake Landfill Vicinity Sampling Event

**Sampling & Analysis Plan:**
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

**Purpose:** Sample and Data Collection

**Date:** November 4, 2015  **Arrival Time:** 4:40  **Departure Time:** 16:00

**Team members/responsibilities:**
Ryan Seabaugh & Eric Gilstrap

<table>
<thead>
<tr>
<th>Weather (Description)</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Wind: (Direction and Speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partly Cloudy</td>
<td>70°F</td>
<td>67%</td>
<td>S @ 3.8 mph</td>
</tr>
</tbody>
</table>

Radiation detection equipment used: model/serial number/calibration:
- **☑ Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**
  - Time: 11/5/15  11/4/15
  - Reading: 0 CPM (SWIPE) 0 CPM W/SPORADIC SINGLE COUNTS 1 CPM
- **☑ Ludlum Model 19A/201916/June 25, 2015**
  - Range of Readings: NA

### Sample Collection Log Information

**Sample location description:**
EER TRAILER

**Odors Present:** Yes  **or No**  
If Yes Please Describe:  

**Collection equipment:**
DUST SWIPE, EXTENSION POLE

**Sampler's name(s):**
See Team Members

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Description</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLI2015104D01A</td>
<td>11/4/15 14:47</td>
<td>GRAB</td>
<td>DUST</td>
<td>TRAILER OVEN HOOD EXHAUST</td>
<td>07227260 4293558 M</td>
<td>COUNT α, β+γ</td>
</tr>
<tr>
<td>WLI2015104D01B</td>
<td>11/4/15 14:50</td>
<td></td>
<td></td>
<td>PRINTER SHELF</td>
<td>0722727 4293561 M</td>
<td></td>
</tr>
<tr>
<td>WLI2015104D01C</td>
<td>11/4/15 14:55</td>
<td></td>
<td></td>
<td>FUOR</td>
<td>07227253 4293561 M</td>
<td></td>
</tr>
<tr>
<td>WLI2015104D01D</td>
<td>11/4/15 15:00</td>
<td></td>
<td></td>
<td>AIR CONTAINER</td>
<td>07227275 4293558 M</td>
<td></td>
</tr>
<tr>
<td>WLI2015104D01E</td>
<td>11/4/15 15:10</td>
<td></td>
<td></td>
<td>ROOF</td>
<td>0722725 4293557 M</td>
<td></td>
</tr>
</tbody>
</table>
Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015

Arrival Time: 17:20

Departure Time: 17:40

Team members/responsibilities:
Ryan Seabaugh + Eric Gilstrap

Weather (Description):
Partly Cloudy

Temperature: 64°F
Humidity: 78%

Wind: (Direction and Speed)
SE @ 2.4 mph

Radiation detection equipment used: model/serial number/calibration:

☐ Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015

Time:
Reading:

☑ Ludlum Model 2221 & 43-5 Detector/156999 & PR155892/August 8, 2015

Time: 11/5/15
Reading: 0 CPM (GAMMAS)

☑ Ludlum Model 19A/ 201916/June 25, 2015

Range of Readings: 8 - 15 M R/ h

Sample Collection Log Information

Sample location description: AAA TRAILER LOT - LOCATIONS APPROVED BY OWNER (EAST FENCE LINE)

Odors Present: Yes

If Yes Please Describe: MILD

Collection equipment: DUST SWIPE

Sampler's name(s):
See Team Members

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Description</th>
<th>UTM (m)</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLL20151104DD07A</td>
<td>11/4/15 17:30</td>
<td>GRAB</td>
<td>DUST</td>
<td>SIGN</td>
<td>0721505</td>
<td>429450.9</td>
<td>COUNT X, B+Y</td>
</tr>
</tbody>
</table>

Facility manager in meeting. So we left to look at other locations and then returned.
Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015  Arrival Time:  Departure Time:

Team members/responsibilities:
Ryan Seabaugh + Eric Gilstrap

Weather (Description)  Temperature: __F  Humidity: ___%  Wind: (Direction and Speed) @ _____ mph

Radiation detection equipment used: model/serial number/calibration:
☐ Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
  Time: 
  Reading:
☐ Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015
  Time:
  Reading:
☐ Ludlum Model 19A/ 201916/June 25, 2015
  Range of Readings:

Sample Collection Log Information

Sample location description:
NA

Site Access not obtained.

Odors Present: Yes or No  If Yes Please Describe:

Collection equipment:

Sampler's name(s):

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Descript.</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
### Sample Event Log Information

**Project:** West Lake Landfill Vicinity Sampling Event

**Sampling & Analysis Plan:**
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

**Purpose:** Sample and Data Collection

**Date:** November 4, 2015  
**Arrival Time:** 9:57  
**Departure Time:** 11:30

**Team members/responsibilities:**
- **Eric Chen**
- **Tom Jackson**
- **Ron Gonsalves**

**Weather** (Description)  
**Temperature:** 63°F  
**Humidity:** 82%  
**Wind:** (Direction and Speed)  
N @ 0 mph

**Radiation detection equipment used:** model/serial number/calibration:

- **☑ Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**
  - **Time:** 9:57  10:09  10:15  10:31  10:33  10:43
  - **Reading:** 0 cp 0 cp 0 cp 0 cp 0 cp

- **☐ Ludlum Model 2221 & 43-5 Detector/156999 & PR155892/August 8, 2015**
  - **Time:** 10:28 10:38 10:43
  - **Reading:** 0 cp 0 cp 0 cp

- **☑ Ludlum Model 19A/201916/June 25, 2015**
  - **Range of Readings:** 10-15 mR/hr

### Sample Collection Log Information

**Sample location description:** Spanish Village Park

**Odors Present:** Yes or No  
Yes, mild and possible sewer odors

**Collection equipment:**
- **Samplers Name(s):** Eric Chen / Tom Jackson

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Descript.</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>WL20511010</td>
<td>11/15 11:10</td>
<td>Grab Soil</td>
<td>Soil</td>
<td>Fresh,  no core</td>
<td>R, 226, 228, 238, 240</td>
<td>None</td>
</tr>
<tr>
<td>D04A</td>
<td>11/15 11:00</td>
<td>Grab Soil</td>
<td>Soil</td>
<td>Fresh,  no core</td>
<td>R, 226, 228, 238, 240</td>
<td>None</td>
</tr>
<tr>
<td>D04B</td>
<td>11/15 11:00</td>
<td>Grab Soil</td>
<td>Soil</td>
<td>Fresh,  no core</td>
<td>R, 226, 228, 238, 240</td>
<td>None</td>
</tr>
<tr>
<td>D04C</td>
<td>11/15 11:00</td>
<td>Grab Soil</td>
<td>Soil</td>
<td>Fresh,  no core</td>
<td>R, 226, 228, 238, 240</td>
<td>None</td>
</tr>
</tbody>
</table>
Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 4, 2015       Arrival Time: 12:50       Departure Time: 13:30

Team members/responsibilities:
Dan Casey - rinse, sampling
Rita Meader - observation, sampling

Weather (Description)       Temperature: °C       Humidity: %       Wind: (Direction and Speed)
Clear                    64°F                74%                SSW @ 3 mph

Radiation detection equipment used: model/serial number/calibration:

☐ Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
  Reading: 75.59  96.37  93.22  97.20  93.70  125.87  85.9%

☐ Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015
  Time:  
  Reading:  

☐ Ludlum Model 19A/201916/June 25, 2015
  Range of Readings:  

Sample Collection Log Information

Sample location description:
Arthur Training Back lot - Drainage - South Canal

Odors Present: Yes or No: Yes
If Yes Please Describe:

Collection equipment: Shuttle manual
Split spars sample with Steve

Sampler's name(s):
Dan Casey, Rita Meader

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Descrip.</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>042056104</td>
<td>11/4/15 13:15</td>
<td>Grab</td>
<td>Soil</td>
<td>Cold Water</td>
<td>Rape, Rasp, Zrn, SW 7.8, Transtyrene, EDC, Phe, 25% Alum</td>
<td></td>
</tr>
</tbody>
</table>
Sample Event Log Information

**Project:** West Lake Landfill Vicinity Sampling Event

**Sampling & Analysis Plan:**
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

**Purpose:** Sample and Data Collection

**Date:** November 4, 2015  **Arrival Time:** 12:30  **Departure Time:** 14:25

**Team members/responsibilities:**
- Dan Casey: Site sampler
- Rob Alexander: Observation sampler

**Weather (Description):**
- Temperature: °F
- Humidity: %
- Wind: (Direction and Speed)

```
SSE @ 5 mph
```

**Radiation detection equipment used: model/serial number/calibration:**

- **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**
  - Time: 13:30
  - Reading: 9.7 mSv

- **Ludlum Model 2221 & 43-5 Detector/156999 & PR155892/August 8, 2015**
  - Time: 13:50
  - Reading: 14.9 mSv

**Range of Readings:**
- 9.7 mSv to 14.9 mSv
- 13:30 to 13:50

**Sample Collection Log Information**

**Sample collection location description:**
- East corner of landfill, sampling lot
- Site: B-10, Subcontractor: Westlake, sampling lot: N-N5

**Odors Present:** Yes

**If Yes Please Describe:**
- Very faint - Possible transfer of soil from bridgehead

**Collection equipment:**
- Sample removed with grabber

**Sampler's name(s):**
- Dan Casey
- Rob Alexander

**ID Number | Sample Date/Time | Sample Type | Sample Matrix | Sample Description | GPS Coord. | Analytes Requested & Preservative if used**
--- | --- | --- | --- | --- | --- | ---
1.325 | 11/15 | SO2 | Soil | | | 

---
### Sample Event Log Information

**Project:** West Lake Landfill Vicinity Sampling Event

**Sampling & Analysis Plan:**
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

**Purpose:** Sample and Data Collection

**Date:** November 4, 2015  
**Arrival Time:** 15:56  
**Departure Time:** 16:36

**Team members/responsibilities:**
- Dan Casey: Supervisor
- Alex Longo: Senior Investigator

**Weather (Description):**
- **Temperature:** 67°F
- **Humidity:** 67%
- **Wind:** SE @ 10 mph

**Radiation detection equipment used: model/serial number/calibration:**

- **Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015**
  - **Time:** 16:10
  - **Reading:** 10577

- **Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015**
  - **Time:**
  - **Reading:**

- **Ludlum Model 19A/201916/June 25, 2015**
  - **Range of Readings:**

**Sample Collection Log Information**

**Sample location description:**
- Arbor Terrace Pit
  - Core Sample
  - Soil Sample

**Odors Present:** Yes or No  
**If Yes Please Describe:**

**Collection equipment:**
- **Sediment**
- **Split Spoon Sampler**
- **Welch Sump**

**Sampler's name(s):**
- Dan Casey
- Alex Longo

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Description</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>WB00101H</td>
<td>11/15/15 16:19</td>
<td>Soil</td>
<td>OX Det, Soil</td>
<td>Maintained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C110130C</td>
<td>11/15/15 16:19</td>
<td>Soil</td>
<td>OX Det, Soil</td>
<td>Maintained</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Sample Event Log Information**

**Project:** West Lake Landfill Vicinity Sampling Event

**Sampling & Analysis Plan:**
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

**Purpose:** Sample and Data Collection

**Date:** November 4, 2015  
**Arrival Time:** 17:00  
**Departure Time:** 18:00

**Team members/responsibilities:**
- Scott Cunay  
- Eric Gilstrap  
- Andrew Scobough

**Weather (Description):**
- Temperature: 60°F  
- Humidity: 67%  
- Wind: SE @ 12 mph

**Radiation detection equipment used:** Ludum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015  
**Time:** 17:00  
**Reading:** 7000

**Ludum Model 2221 & 43-5 Detector/156999 & PR155892/August 8, 2015**

**Time:**  
**Reading:**  

**Sample Collection Log Information**

**Sample location description:**
- ANA Threeway – 60 FT side Back Pile

**Odors Present:** Yes  
**If Yes Please Describe:** Fair landfill odor, transfer building

**Collection equipment:**
- 50 gauge sampling equip

**Sampler’s name(s):**
- Scott Cunay  
- Eric Gilstrap  
- Andrew Scobough

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Description</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>W42105 40SL</td>
<td>11/4/15 3:17 PM</td>
<td>Gravel</td>
<td>Gravel</td>
<td>Description</td>
<td></td>
<td>Description</td>
</tr>
</tbody>
</table>
# Sample Event Log Information

**Project:** West Lake Landfill Vicinity Sampling Event

**Sampling & Analysis Plan:**
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

**Purpose:** Sample and Data Collection

**Date:** November 5, 2015  **Arrival Time:** 10:05  **Departure Time:** 10:30

**Team members/responsibilities:**
- Dan Casey, sample
- Tom Mehler, EPA joined during sampling
- Ritz Alexander, observation, sample

**Weather (Description)**

<table>
<thead>
<tr>
<th></th>
<th>Temperature (°F)</th>
<th>Humidity (%)</th>
<th>Wind: (Direction and Speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:45</td>
<td></td>
<td></td>
<td>SE @ 7 mph</td>
</tr>
</tbody>
</table>

**Radiation detection equipment used: model/serial number/calibration:**

- **Ludlum Model 2221 & 44-10 Detector/21895 & PR231843/October 20, 2015**
  - **Time:**
    - 10:18
    - 10:20
    - 10:22
    - 10:30
    - 10:33
  - **Reading:** 100.74 104.34 118.12 86.04 84.88
  - **Range of Readings:**

- **Ludlum Model 2221 & 42-5 Detector/156999&PR155592/August 8, 2015**
  - **Time:**
  - **Reading:**

- **Ludlum Model 19A/ 201916/June 25, 2015**
  - **Time:**
  - **Reading:**

**Sample Location Description:**
S04  V18B2C

**Odors Present:** Yes  **If Yes Please Describe:**

**Collection equipment:**
- Shovel
- Sampled with Skewer

**Sampler’s name(s):**
- Dan Casey
- Ritz Alexander

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Description</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
</table>
| W122051105 S04 | 11/5/15 10:40 | Gift | Soil | DKW10 Survey | 53.707, -89.383 | Fe, Zn, Co, Cu, Zn, Iso Th, Cores Aging Amm. 

**Sample Collection Log Information**
Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 5, 2015
Arrival Time: 11:05
Departure Time: 11:25

Team members/responsibilities:

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Redacted]</td>
<td>[Redacted]</td>
</tr>
<tr>
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<td>[Redacted]</td>
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<td>[Redacted]</td>
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</tr>
</tbody>
</table>

Weather (Description)

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Humidity</th>
<th>Wind (Direction and Speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Redacted]</td>
<td>[Redacted]</td>
<td>[Redacted]</td>
</tr>
</tbody>
</table>

Radiation detection equipment used: Model/serial number/calibration:

- [ ] Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
  - Time: [Redacted]
  - Reading: [Redacted]

- [ ] Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015
  - Time: [Redacted]
  - Reading: [Redacted]

- [ ] Ludlum Model 19A/ 201916/June 25, 2015
  - Range of Readings: [Redacted]

Sample Collection Log Information

Sample location description:

[Redacted]

Odors Present: Yes or No? If Yes Please Describe:

Collection equipment:

[Redacted]

Sampler’s name(s):

[Redacted]

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Descript.</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Redacted]</td>
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<td>[Redacted]</td>
<td>[Redacted]</td>
<td>[Redacted]</td>
<td>[Redacted]</td>
</tr>
</tbody>
</table>
Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 3, 2015  Arrival Time: 11:30  Departure Time: 12:05

Team members/responsibilities:
- Don Courtney
- Tom Molnar
- EPA
- Ria Alexander

Weather (Description)  Temperature (°F)  Humidity (%)  Wind: (Direction and Speed)
- Rainy  68°F  69%  S @ 13 mph

Radiation detection equipment used: model/serial number/calibration:

- [ ] Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
  - Time:  
  - Reading:  

- [ ] Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015
  - Time:  
  - Reading:  

- [ ] Ludlum Model 19A/ 201916/June 25, 2015
  - Range of Readings:  

Sample Collection Log Information

Sample location description:
- Previous:  
- Repeat: 510
- 510 loc sample 30-31 K cpm
- 510 loc sample 31 K cpm
- 510 loc sample 31 K cpm

Odors Present: Yes or No  If Yes Please Describe:  
- Yes  
- Emissions
- Emissions

Collection equipment:  
- EPA
- Observation of emissions only
- Photos taken

Sampler's name(s):  
- NA

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Descript.</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>10/03/2015</td>
<td>Soil</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
# Sample Event Log Information

**Project:** West Lake Landfill Vicinity Sampling Event

**Sampling & Analysis Plan:**
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

**Purpose:** Sample and Data Collection

**Date:** November 5, 2015  
**Arrival Time:** 12:10  
**Departure Time:** 12:55

**Team members/responsibilities:**
- Dave Casey  
- Renee Brewer

**Weather (Description):**

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Wind (Direction and Speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00</td>
<td>63°F</td>
<td>61%</td>
<td>S @ 13 mph</td>
</tr>
</tbody>
</table>

**Radiation detection equipment used:**  
- Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
  - **Time:** 12:16  
  - **Reading:** 109.7  
- Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015
  - **Time:**  
  - **Reading:**

## Sample Collection Log Information

**Sample location description:**
Sample taken in row area near cell 8 of SW corner of SW cell 8.

**Odors Present:** Yes  
**If Yes Please Describe:**

**Collection equipment:**
Sample taken with sampler with sheave.

**Sampler's name(s):**
- Dave Casey  
- Renee Brewer

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Description</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>WW20611204 - 599</td>
<td>11/15/12 3:00</td>
<td>C</td>
<td>Soil</td>
<td>OK, no funny odor</td>
<td>GPS: X:4208, Y:590</td>
<td>None</td>
</tr>
</tbody>
</table>
Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 5, 2015  Arrival Time: 12:37  Departure Time: 14:10

Team members/responsibilities:
DAC Sampler, E & S
Eric Casey

ES Sampler, E & S
Eric Gilchrist

Weather (Description)
Temperature: 67F  Humidity: 78 %  Wind: (Direction and Speed)
S @ 10 mph

Radiation detection equipment used: model/serial number/calibration:

☑ Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
  Time: 13:43  Reading: 9.6 x 10^-13

☐ Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015
  Time:  
  Reading:  

☐ Ludlum Model 19A/ 201916/June 25, 2015
  Range of Readings:

Sample Collection Log Information

Sample location description: Parked @ SS
Heavy Veh. Drink Adjacent to Orangeburg Rd @ Area 2

Odors Present: [Yes] or No  If Yes Please Describe:  M - Aroma / Ammonia

Collection equipment:
Sample Name: Soil / Sampler with S/S

Sampler’s name(s):
DAC / RJA / E & S

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Description</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
</table>

59
Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 5, 2015  Arrival Time: 9:15 AM  Departure Time: 1:00 PM

Team members/responsibilities:
GG = Sample Prep
RA = Observation, Sampler

Weather (Description)  Temperature: 62°F  Humidity: 43%  Wind: (Direction and Speed)

Radiation detection equipment used: model/serial number/calibration:

- Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015

  Time: 11:00  Reading: 7800

- Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015

  Time:  Reading:

- Ludlum Model 19A/201916/June 25, 2015

  Range of Readings:

Sample Collection Log Information

Sample location description:
Drainage way in woods S of WLL... 504

Odors Present: ☑ or No  If Yes Please Describe:

Collection equipment: Slide hammer + split spoons w/ bleed

Sampler's name(s):

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Descript.</th>
<th>GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLL 20151105 - S 06</td>
<td>11/5/15 17:00</td>
<td>05 Grab Soil</td>
<td>Sed</td>
<td>3-Yr 2-Yr</td>
<td>Total U, Ra-226, Ra-228</td>
<td>Granite, Granite, Granite, Granite, Granite, Granite</td>
</tr>
<tr>
<td>WLL 20151105 - S 07</td>
<td>11/5/15 17:00</td>
<td>05 Grab Soil</td>
<td>Sed</td>
<td>3-Yr 2-Yr</td>
<td>Total U, Ra-226, Ra-228</td>
<td>Granite, Granite, Granite, Granite, Granite, Granite</td>
</tr>
<tr>
<td>WLL 20151105 - S 08</td>
<td>11/5/15 17:00</td>
<td>05 Grab Soil</td>
<td>Sed</td>
<td>3-Yr 2-Yr</td>
<td>Total U, Ra-226, Ra-228</td>
<td>Granite, Granite, Granite, Granite, Granite, Granite</td>
</tr>
</tbody>
</table>
Sample Event Log Information

Project: West Lake Landfill Vicinity Sampling Event

Sampling & Analysis Plan:
West Lake Landfill Radiological Survey and Sampling Plan, November 3, 2015

Purpose: Sample and Data Collection

Date: November 6, 2015  Arrival Time: 15:15  Departure Time: 16:10

Team members/responsibilities:
Eric Gilstrap

Weather (Description)
Sunny

Temperature: 60°F  Humidity: 37%  Wind: (Direction and Speed)
N.W. @ 4.6 mph

Radiation detection equipment used: model/serial number/calibration:

- [ ] Ludlum Model 2221 & 44-10 Detector/218595 & PR231843/October 20, 2015
  Time: 
  Reading: 

- [ ] Ludlum Model 2221 & 43-5 Detector/156999&PR155892/August 8, 2015
  Time: 
  Reading: 

- [ ] Ludlum Model 19A/ 201916/June 25, 2015
  Range of Readings:

Sample Collection Log Information

Sample location description:
Drainage path discharge location from SW wooded area into lake near lakefront drive properties

Odors Present: Yes of No [ ] If Yes Please Describe:

Collection equipment:
Split Spoon, lake

Sampler's name(s):
See Team Members

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Sample Date/Time</th>
<th>Sample Type</th>
<th>Sample Matrix</th>
<th>Sample Description</th>
<th>UTM GPS Coord.</th>
<th>Analytes Requested &amp; Preservative if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLL20151106S08</td>
<td>Nov 6, 2015 15:45</td>
<td>GRAB</td>
<td>SED/SOIL</td>
<td>721.435 4.293.913</td>
<td>YSO4, ISO Th, Ra-226</td>
<td>Ra-222, Gross X, Gross B</td>
</tr>
</tbody>
</table>


Appendix I: MDNR Meteorological Data

### Hourly Average Meteorological Data

<table>
<thead>
<tr>
<th>Date and Hour</th>
<th>Avg. Temp. (Degrees F)</th>
<th>Avg. Wind From (Directional Degrees)</th>
<th>Avg. Wind From (Cardinal Direction)</th>
<th>Avg. Wind Speed (Miles per Hour)</th>
<th>Avg. Relative Humidity (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/4/2015 10:00</td>
<td>64.02</td>
<td>196.00</td>
<td>SSW</td>
<td>2.91</td>
<td>79.97</td>
</tr>
<tr>
<td>11/4/2015 11:00</td>
<td>65.77</td>
<td>176.00</td>
<td>S</td>
<td>3.54</td>
<td>75.38</td>
</tr>
<tr>
<td>11/4/2015 12:00</td>
<td>68.23</td>
<td>165.00</td>
<td>S</td>
<td>3.65</td>
<td>70.07</td>
</tr>
<tr>
<td>11/4/2015 13:00</td>
<td>70.15</td>
<td>152.00</td>
<td>S</td>
<td>2.68</td>
<td>66.48</td>
</tr>
<tr>
<td>11/4/2015 14:00</td>
<td>72.33</td>
<td>144.00</td>
<td>SE</td>
<td>3.52</td>
<td>62.31</td>
</tr>
<tr>
<td>11/4/2015 15:00</td>
<td>70.32</td>
<td>148.00</td>
<td>S</td>
<td>4.05</td>
<td>67.13</td>
</tr>
<tr>
<td>11/4/2015 16:00</td>
<td>68.82</td>
<td>147.00</td>
<td>S</td>
<td>3.72</td>
<td>71.68</td>
</tr>
<tr>
<td>11/4/2015 17:00</td>
<td>66.80</td>
<td>142.00</td>
<td>SE</td>
<td>2.44</td>
<td>77.56</td>
</tr>
<tr>
<td>11/4/2015 18:00</td>
<td>65.94</td>
<td>146.00</td>
<td>SE</td>
<td>2.45</td>
<td>80.70</td>
</tr>
<tr>
<td>11/4/2015 19:00</td>
<td>66.77</td>
<td>156.00</td>
<td>S</td>
<td>4.41</td>
<td>77.52</td>
</tr>
<tr>
<td>11/4/2015 20:00</td>
<td>66.45</td>
<td>166.00</td>
<td>S</td>
<td>4.00</td>
<td>76.87</td>
</tr>
<tr>
<td>11/4/2015 21:00</td>
<td>67.55</td>
<td>170.00</td>
<td>S</td>
<td>4.13</td>
<td>69.37</td>
</tr>
<tr>
<td>11/4/2015 22:00</td>
<td>67.55</td>
<td>174.00</td>
<td>S</td>
<td>5.18</td>
<td>67.88</td>
</tr>
<tr>
<td>11/4/2015 23:00</td>
<td>67.38</td>
<td>179.00</td>
<td>S</td>
<td>4.48</td>
<td>65.28</td>
</tr>
<tr>
<td>11/5/2015 00:00</td>
<td>66.90</td>
<td>173.00</td>
<td>S</td>
<td>3.49</td>
<td>64.26</td>
</tr>
<tr>
<td>11/5/2015 01:00</td>
<td>65.55</td>
<td>160.00</td>
<td>S</td>
<td>1.97</td>
<td>65.86</td>
</tr>
<tr>
<td>11/5/2015 02:00</td>
<td>63.53</td>
<td>150.00</td>
<td>S</td>
<td>1.92</td>
<td>70.78</td>
</tr>
<tr>
<td>11/5/2015 03:00</td>
<td>65.07</td>
<td>195.00</td>
<td>SSW</td>
<td>4.25</td>
<td>67.72</td>
</tr>
<tr>
<td>11/5/2015 04:00</td>
<td>64.12</td>
<td>154.00</td>
<td>S</td>
<td>2.33</td>
<td>70.79</td>
</tr>
<tr>
<td>11/5/2015 05:00</td>
<td>61.72</td>
<td>156.00</td>
<td>S</td>
<td>2.00</td>
<td>77.73</td>
</tr>
<tr>
<td>11/5/2015 06:00</td>
<td>62.00</td>
<td>155.00</td>
<td>S</td>
<td>2.77</td>
<td>80.12</td>
</tr>
<tr>
<td>11/5/2015 07:00</td>
<td>62.84</td>
<td>145.00</td>
<td>SE</td>
<td>2.94</td>
<td>79.93</td>
</tr>
<tr>
<td>11/5/2015 08:00</td>
<td>64.70</td>
<td>164.00</td>
<td>S</td>
<td>5.82</td>
<td>76.83</td>
</tr>
<tr>
<td>11/5/2015 09:00</td>
<td>66.56</td>
<td>180.00</td>
<td>S</td>
<td>6.79</td>
<td>74.69</td>
</tr>
<tr>
<td>11/5/2015 10:00</td>
<td>67.43</td>
<td>172.00</td>
<td>S</td>
<td>5.08</td>
<td>74.17</td>
</tr>
<tr>
<td>11/5/2015 11:00</td>
<td>67.59</td>
<td>183.00</td>
<td>S</td>
<td>4.79</td>
<td>76.21</td>
</tr>
<tr>
<td>11/5/2015 12:00</td>
<td>65.88</td>
<td>192.00</td>
<td>SSW</td>
<td>5.57</td>
<td>84.84</td>
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</tbody>
</table>

### Hourly Average Meteorological Data

<table>
<thead>
<tr>
<th>Date and Hour</th>
<th>Avg. Temp. (Degrees F)</th>
<th>Avg. Wind From (Directional Degrees)</th>
<th>Avg. Wind From (Cardinal Direction)</th>
<th>Avg. Wind Speed (Miles per Hour)</th>
<th>Avg. Relative Humidity (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/5/2015 12:00</td>
<td>65.88</td>
<td>192.00</td>
<td>SSW</td>
<td>5.57</td>
<td>84.84</td>
</tr>
<tr>
<td>11/5/2015 13:00</td>
<td>65.65</td>
<td>182.00</td>
<td>S</td>
<td>6.23</td>
<td>86.58</td>
</tr>
<tr>
<td>11/5/2015 14:00</td>
<td>65.75</td>
<td>176.00</td>
<td>S</td>
<td>5.50</td>
<td>86.92</td>
</tr>
<tr>
<td>11/5/2015 15:00</td>
<td>64.99</td>
<td>170.00</td>
<td>S</td>
<td>7.91</td>
<td>89.05</td>
</tr>
<tr>
<td>11/5/2015 16:00</td>
<td>64.81</td>
<td>173.00</td>
<td>S</td>
<td>7.19</td>
<td>89.80</td>
</tr>
</tbody>
</table>
Appendix J: Field Book Notes

11/4/2015
0630: Arrive @ EER Tract
Team: Rob & Don, Eric & Ryan

9:50 Spanish Village Park
Present: Tony, Rome [handwritten]

11:05 Deskitter A, B, C, D, E, F, G, H, I

10:35 Alpha testing on Jungle Gym - B
(Inside corner beam of slide facing pondliner)

Office: 12:00
Split Group:
Don: Eric, Rome
Sall: Ryan, Rome

12:50 & D05 Around msd
   Lift station
   12A: Micro R/1
   N 38°45.717 W 090°29.406
   D05 A: msd lift station control point
   130: Under shelter - micro R/1
   D05 B: Bar under door
   1315: Micro R/1, C = 7.10
   Inside: Door N 38°45.717 W 090°29.406
   Outside: Door N 38°45.690 W 090°29.418
   micro R/1 C = 7.10
   House

-38. Picnic Table, D03 A
   D04 A: Mark N 38°45.410 W 090°29.448
   Micro R/1 C = 7.10
1342 D03B Piano inside house

1350 D02 Abandoned gas station
    Micro R/hr range 7-15

14:05 D02A-1 Mark 495
    N 50°15.766
    W 090°26.128

14:15 D02 A-2

14:25 D02 B
    Trash barrel South of 6 C400
    Alpha test on trash barrel (Cotton 2221)

14:57 D01 A Oven hood (inside)
    Alpha C open side

14:57 D01 B Printer shelf (inside)
    Alpha D-22 open side

14:55 D01 C Floor (inside)
    Alpha C=17 open side

15:30 D01A 13514 Zephyr Point
    Micro R/hr range 8-13

17:05 AAA Trailer Mark 498
    D07 A N 38°46'.20
    (radio) radiation sign W D07 33 020

Micro R/hr range 8-15
Alpha test on sign YP

Depart EER Trader 06/16/95
11/11/15 06:20 - Went back to land fill vicinity sampling
Arrived @ Hannen & Trouiller w/ 8t. 3/13
Met w/ EPA Personnel Adam Vreman
EB and I signed off on BTAG
Weather: Cloudy, Foggy, 59°F, 93% Humidity, wind @ 5 mph
Dave’s shift started @ 7:15
EPA staff present: Tom Melick 914-604-6596
Dinner: Sandwich, apple, cheese, crackers, nuts, & water
Reach Device: 914-343-5743
Pennington, Pat, Thompson, Cary, Jorgensen
Hall, Reynolds Nick, Krammer, Terence
Jonathan, Gaudette, Brian Campbell
Arrived @ Hannen 2nd time @ 9:30
Miss Ryan 2nd round @ Tom Melick
Bogan sample at @ 9:45
Dinner for lunch @ 14:30 - 15:00
Similar day @ approx. 15:00 for tank #2
We completed - All sample sampling 4
Soil sample from loc: 505, 501, 502 & 510. All notes kept off-site in field log.
Pick tray: Earthline equipment check was returned.
After sampling day Brown kept in equipment bay.
11/5/15 West Lake Landfill Vicinity Sampling
2nd day: 1st Vicinity Sampling
Arrived @ Fluorinert Field office @ 8am to prep for Sampling.
1st Fluorinert office w/ Dan Casey
for 1st loc @ N 09...
1st loc @ VP-1. Met w/ Berry Miller @ Virbree to gain Access.
Weather: cloudy, 1.4rain, 63°F, 77% humidity.

Tim Myers joined us while @ Virbree
EPA joined us while @ Virbree
1st loc. @ Ace 50-2 (Waste Transfer)
50-1/50-9 - AAA Transfer Parking Lot:
We observed our sample loc I
conducted some scans with their
3rd test team detection equipment.
We scanned & several people with the
AGC joined us briefly while @ AAA
and left around 12:00. Dan Casey
I resumed sampling @ 12:00 with Sam &
soil sampling @ 50-9. Eric Gistrop joined us @ 12:30 & assisted in collecting sample
at 50-3 in areas across St. Charles Rte Rd
from Jimmy Johnson. 14:30-15:00 we packed for
gummi bear lunch. Eric Gistrop & I continued sampling
at 50-6, finishing & leaving area @ 17:30.
Air. 11/16/13 EPA Fenton, MO

Met Tim Mohler, EPA, Kansas City, Mo.

503 equipment with lead shielding

"A" TH 330. Current source 14,100 cpm 12/31/03
SN#: 5158-03 DMS: 4
EPA SN#: 0748-5023

"B" SN# 490 - Current source 5,510 cpm 12/28/03
SN#: 5158-03 DMS: 9
EPA SN#: 1703-5027

TH 230 c/s: 1 min rate @ 3291 cpm 12/7/03
Sn 90 c/s: 1 min rate @ 3 x 1198 cpm 12/7/03

Matrix average counts in code

Name #1: Site count 0.65 % 42 (B) cpm

Alpha 15.5% Beta 84.4%

Begin c/s 0.13 : 0 of Simple samples

D05A: α = 0 β = 45 cpm
D01D: α = 0 β = 43 cpm
D05A: α = 0 β = 43 cpm
D07A: α = 1 β = 48 cpm

End 3030 was calibrated by Luclid 12/5/14

Fix due for recalibration on 12/5/15

Serial #: 0191249
Complete counts @ 14:15

Left EPA Fenton office @ 14:50