Radiological Health, Safety and Environmental Services
A USA Environment, L.P. Company

AIR MONITORING, SAMPLING, AND QA/QC PLAN

WEST LAKE SUPERFUND SITE OPERABLE UNIT 1

October 2014

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AIR MONITORING, SAMPLING, AND QA/QC PLAN

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Signature **Date**

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A&A and EMSI are authorized to sign in lieu of Operable Unit 1 respondents.

WLLFOIA4312 - 001 - 0020615

CONTENTS

SECTION **PAGE**

1. INTRODUCTION 5
   1.1 Site Description 5
   1.2 Background 5
   1.3 Constituents of Concern 6
2. DATA USE OBJECTIVES 8
   2.1 Intended Use of Data 8
   2.2 Decisions to Be Made 8
   2.3 Questions to Be Addressed 8
3. QUALITY ASSURANCE OBJECTIVES 9
4. AIR MONITORING APPROACH AND SAMPLING METHODS 10
   4.1 Pre-construction Baseline Monitoring 10
      4.1.1 Compliance Evaluation 16
   4.2 Sample Collection and Analyses 16
      4.2.1 Accredited Laboratories and Contacts 17
      4.2.2 Data Management 18
      4.2.3 Data Verification, Validation, Quality Assessment, and Delivery 18
   4.3 Schedule of Work 18
   4.4 Project Organization and Responsibilities 18
5. QUALITY ASSURANCE REQUIREMENTS 20
   5.1 Sampling Identification, Handling, and Storage 20
   5.2 Air Sampling, Monitoring, and Analytical Equipment 22
      5.2.1 Precision 23
      5.2.2 Accuracy 23
      5.2.3 Representativeness 24
      5.2.4 Completeness 24
      5.2.5 Comparability 24
      5.2.6 Detection Limits 24
   5.3 Record Keeping 24
      5.3.1 Field Documentation 24
         5.3.1.1 Sampling Field Data Sheets 25
         5.3.1.2 Chain of Custody and Sample Labels 25
6. DELIVERABLES 26
   6.1 Document Revisions 26
   6.2 Reports 26
   6.3 Data Verification, Validation and Reports 26
   6.4 Corrective Actions 27
   6.5 Completion of Review 27
7. REFERENCES 28

FIGURES

Figure 1-1 West Lake Landfill Superfund Site 7
Figure 4-1 Predominant Wind Directions 12
Figure 4-2 Predominant Wind Directions 13
Figure 4-3 Air Monitoring Station Locations 14
Figure 5-1 Sample Chain of Custody 21
Figure 5-2 Sample Chain of Custody 22

TABLES

Table 4-1 List of Samplers for Perimeter Monitoring 15
Table 4-2 Numerical Air Monitoring Limits for Alpha and Beta Emitters 16
Table 4-3 Sample Analyses and Methods 17
Table 4-4 Field Sampling Summary 19

APPENDICIES

Appendix A Auxier and Associates Operating Procedures

Appendix B Eberline Analytical QA Manual

Appendix C Eurofins Air Toxics QA Manual

Appendix D Instrument Descriptions

Appendix E Radiello Reporting Limits

Appendix F Target Volatile Organic Compounds

WLLFOIA4312 - 001 - 0020617

1. INTRODUCTION

This Air Monitoring, Sampling, and Quality Assurance/Quality Control (QA/QC) Plan ("Plan") describes the environmental air sampling and monitoring activities which will be performed at the West Lake Landfill Superfund Site in Bridgeton, Missouri, as required by Paragraph 30d of the April 14, 2014 Administrative Settlement Agreement and Order on Consent for Removal Action – Preconstruction Work (Preconstruction ASAOC) entered into between the U.S. Environmental Protection Agency (EPA) and Respondents Bridgeton Landfill, LLC and Rock Road Industries, Inc. The activities implemented under this Plan are intended to obtain baseline air monitoring data prior to implementation of future remedial actions at West Lake Landfill Operable Unit 1 (OU-1) and installation of an isolation barrier between the Bridgeton Sanitary Landfill's North Quarry landfill unit and Area 1 of West Lake Landfill OU-1. This Plan also includes provisions to satisfy Paragraph 33a of the Preconstruction ASAOC regarding compliance with EPA's "Quality Assurance/Quality Control Guidance for Removal Activities" (EPA, 1990).

Respondents will install and commence operation of a permanent perimeter air monitoring system before any construction activities begin for the isolation barrier. The air monitoring activities will include sampling for airborne radioactive particulates, radon gas, volatile organic compounds (VOCs), and will measure gamma radiation. Sampling will be performed continuously at the perimeters of OU-1 Areas 1 and 2. Data collected from the monitoring activities will be used to assess and document the air quality along the boundaries of OU-1.

1.1 SITE DESCRIPTION

The West Lake Landfill Superfund Site is located at 13570 St. Charles Rock Road in Bridgeton, St. Louis County, Missouri, approximately one mile north of the intersection of Interstate 70 and Interstate 270. The site is divided into two Operable Units. Operable Unit-1 (OU-1) is comprised of the two disposal areas (Area 1 and Area 2) where radionuclides are mixed within landfilled soil and solid waste materials. Operable Unit-2 (OU-2) consists of the remainder of the site and includes several inactive landfilled areas containing sanitary waste or demolition debris, a solid waste transfer station, a concrete plant, an asphalt batch plant, and a permitted sanitary landfill (the Bridgeton Sanitary Landfill), which stopped receiving waste on Dec. 31, 2004. The Bridgeton Sanitary Landfill is a quarry-fill landfill containing municipal waste, and consists of the North Quarry and South Quarry landfill units. The southern border of OU-1 Area 1 is contiguous with the North Quarry cell of the Bridgeton Sanitary Landfill. OU-1's Area 2 is located along the northern portion of the overall site, approximately 1,000 feet (at the closest) from the outer boundary of the North Quarry landfill unit, and is separated from it by a road and by the closed demolition landfill (Figure 1-1).

Land use surrounding the site is primarily commercial and industrial, with residential uses to the south of the site (the Spanish Village subdivision) and to the east (the Terrisan Reste mobile home park).

1.2 BACKGROUND

According to the Nuclear Regulatory Commission (NRC), in 1973, approximately 8,700 tons of leached barium sulfate residues (a remnant from the Manhattan Engineer District/Atomic Energy Commission project) were reportedly mixed with approximately 39,000 tons of soil from the 9200

WLLFOIA4312 - 001 - 0020618

Latty Avenue Superfund site in Hazelwood, Missouri, transported to the West Lake Landfill, and used as daily or intermediate cover material. (NRC 1988, RMC 1982 and 1981).

EPA added the West Lake Landfill Superfund Site to its National Priorities List in 1990. In May 2008, EPA signed a Record of Decision (ROD) for OU-1, which selected a remedial action for the radiologically contaminated landfill areas and the area formerly described as the Ford Property, now called the Buffer Zone/Crossroad property. The 2008 ROD requires installation of a modified solid waste landfill cover over OU-1 Areas 1 and 2.

Since late 2010, the Bridgeton Sanitary Landfill South Quarry unit has experienced a subsurface smoldering event (SSE). In 2013, Respondents committed to construct a subsurface isolation barrier between the Bridgeton Sanitary Landfill's waste mass and radiologically-impacted material located in OU-1's Area 1.

1.3 CONSTITUENTS OF CONCERN

West Lake Landfill contains both municipal solid waste and construction and demolition wastes. In a March 7, 2014 meeting, representatives from the EPA met with representatives from EMSI and requested that air monitoring be performed for airborne radiological contaminants and volatile organic compounds (VOCs). A Baseline Risk Assessment (BRA) was published in 2000 and identified the radionuclides of concern at the West Lake Landfill. These compounds, plus EPA's requested VOC sampling, will be the constituents of concern (COCs) to be monitored and sampled under this Plan.

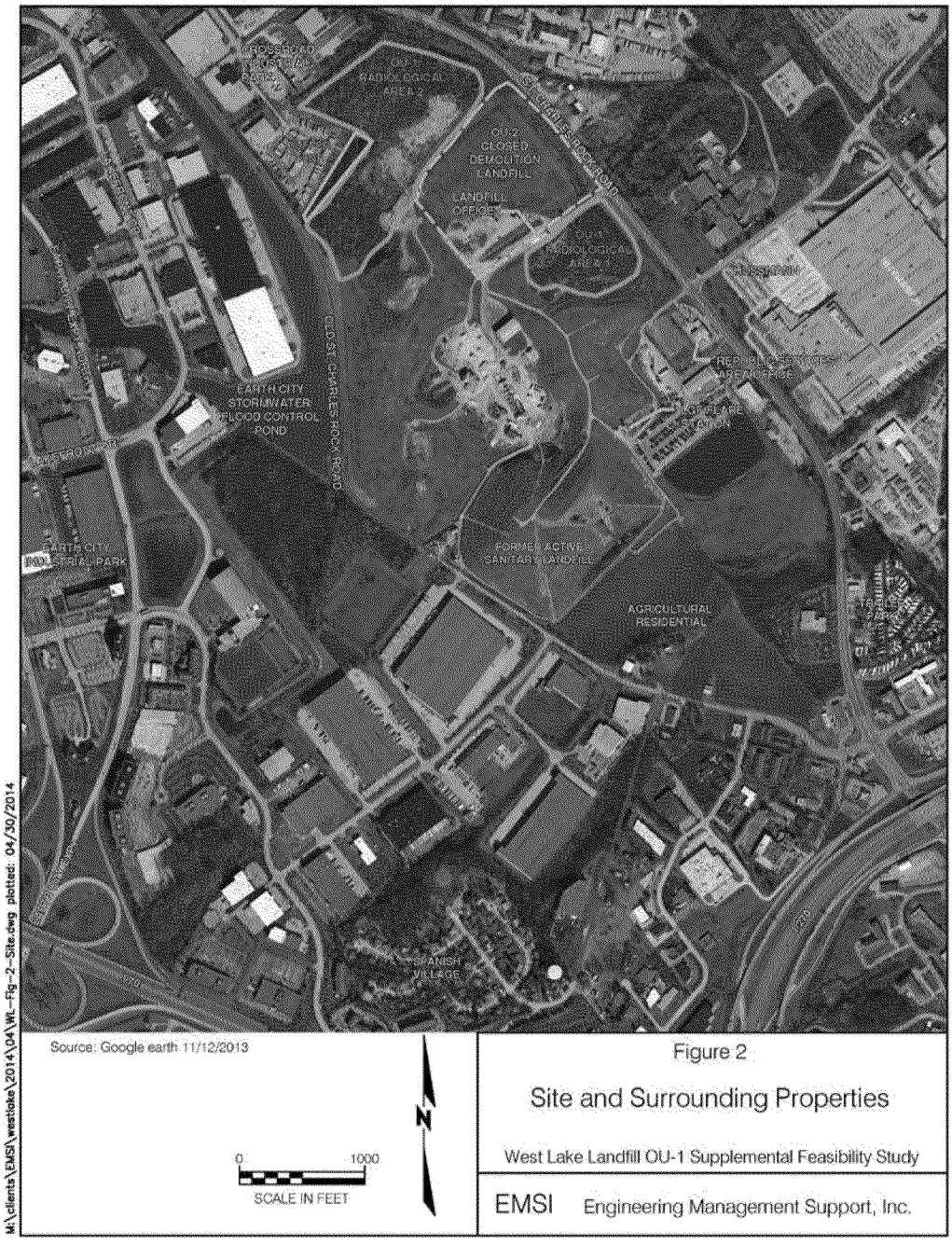

Figure 1-1 West Lake Landfill Superfund Site

WLLFOIA4312 - 001 - 0020620

2. DATA USE OBJECTIVES

This Plan provides for air quality monitoring in and around OU-1 beforeconstruction activities near or in OU-1.

2.1 INTENDED USE OF DATA

Air sampling and direct gamma radiation monitoring data collected by the air monitoring system will:

1) characterize the baseline conditions at the site;
2) assess the potential for releases of radioactive materials or chemical contaminants from the site; and
3) characterize trends, if any, in environmental radiation measurements, especially as they are affected by the site's construction events.

This data will be the basis for informed decisions regarding the health and safety of workers and the public, and will document compliance with regulatory standards. It will also provide a basis for qualitative dose reconstructions, if necessary.

2.2 DECISIONS TO BE MADE

Information gathered by the air monitoring and sampling activities will be used to decide if air quality at the perimeter of the site complies with the numerical limits identified in Section 4 of this Plan. If review of the data identifies a condition of non-compliance, the data will be used to determine the cause of the non-conformity, and to aid decision-makers in selecting a course of corrective action. The air monitoring and sampling system then will continue collecting data to document any corrective action's impact and provide quantitative metrics to decision-makers evaluating the effectiveness of a corrective action.

2.3 QUESTIONS TO BE ADDRESSED

Questions to be addressed include:

- What are the pre-construction, baseline airborne levels of COCs?
- What will be the level of exposure to potential receptors as measured by the air monitoring and sampling system, and do those levels exceed numerical limits which reflect dose-based or risk-based standards?

WLLFOIA4312 - 001 - 0020621

3. QUALITY ASSURANCE OBJECTIVES

The quality assurance objective for this monitoring and sampling program is designed to assess the quality of the data gathered at the perimeter of OU-1. Target analytes for sampling include airborne radioactive particulates (including alpha and beta emitters), radon gas, and VOCs. Ambient gamma radiation will be measured at the sampling locations as well. Quality assurance objectives for data are defined in compliance with EPA's "Quality Assurance/Quality Control Guidance for Removal Activities" (EPA 1990).

Samples collected for airborne radioactive particulates will be analyzed for gross alpha and gross beta activity. The analytical results will be compared to the appropriate perimeter investigative levels as specified in Table 4-3 for baseline activities. These "investigative levels" are administrative limits that are set below the NRC's "Standards for Protection Against Radiation" found at 10 CFR part 20, Appendix B, for occupational limits and effluent concentrations in air. Samples with results that exceed these investigative levels will undergo isotopic analysis to identify and quantify the specific radioisotopes present in the sampled material. All samples submitted for gross alpha/beta and isotopic analysis will be analyzed using EPA approved methods (see Section 4.4, below).

Gamma doses will be measured at the monitoring and sampling stations using thermoluminescent dosimeters. Alpha track etch detectors will be used to measure the levels of radon gas and radon daughters at the sampling locations as well. The results of these measurements, along with the airborne radioactive particulate results, will be incorporated into exposure calculations and compared to relevant criteria, and will determine baseline conditions for comparison during construction activities.

Even though the BRA did not identify VOCs as chemicals of concern at the site, EPA has requested that VOCs also be monitored. Monitoring of VOCs will be performed using Radiello Code 130 chemical adsorbing cartridge diffusion samplers to obtain integrated measurements of VOC concentrations in air for 14 day periods. The subset of stations at which VOCs will be measured was mandated by the EPA and can be found in the EPA's comments on the Work plan, comment number 5.

If the analytical results for radon gas indicate levels greater than 4 pCi/l, radon-220 detectors will be added to all monitoring stations.

Only equipment, supplies, and consumables with acceptable quality characteristics and from qualified vendors will be accepted for this project. Receipt and initial verification of all materials and equipment received, either purchased or contract (client) supplied, is the responsibility of designated A&A personnel.

Data used for preparing this Plan are listed in the references section. The data was accepted for use in preparing this Plan through peer review. There are no known limitations on the use of the data.

All of the analyses described above are characterized as QA3 (definitive quantification and identification), and are subject to the quality requirements detailed in Section 5 of this Plan.

4. AIR MONITORING APPROACH AND SAMPLING METHODS

Auxier and Associates, Inc. (A&A) personnel will be responsible for implementing this Plan, including: air sample collection; analysis and summary of laboratory data; and preparation and submittal of reports to Engineering Management Support, Inc. (EMSI). As Project Coordinator for the Respondents under the Preconstruction ASAOC, EMSI will, in turn, submit the information to EPA. Subcontractors will assist A&A in the analysis of samples and installation of a meteorological station to document wind speeds and directions. Environmental monitoring stations will be maintained by a qualified technician during the baseline monitoring phase of the work.. Buried or overhead electrical power service will be provided to all environmental monitoring station locations.

Monitoring activities will measure gamma activity using direct-reading instruments and will filter ambient air to collect samples of dust and vapors. Air sampling activities will use the equipment and methods described in this Plan, while analysis of those samples will be performed by accredited laboratories. The monitoring and sampling frequency is discussed later in this Plan. This project should not require expedited turn-around times for analytical results. Occupational health and safety monitoring during construction will be described in a separate Site-Specific Health and Safety and Radiation Safety Plan.

Monitoring and sampling activities covered under this plan include pre-construction baseline monitoring. Monitoring and sampling activities during construction and post construction will be covered in work plans specific to those phases of the project. The sampling approach for the pre-construction monitoring phase is presented in the following subsection.

4.1 PRE-CONSTRUCTION BASELINE MONITORING

An integrated system of 13 static environmental monitoring stations will be established around the perimeters of OU-1 Areas 1 and 2, with two located close to the nearest on-site buildings. These locations were selected to ensure that the sampling campaign encompassed Areas 1 and 2, including the entry road and the road through the center of the site.

An on-site meteorological station will be installed to measure wind speed and wind direction. The station will be mounted on top of the landfill office building (13570 St. Charles Rock Road). RM Young Company's Model 05305 Wind Monitor-AQ (see Appendix D), or an equivalent model will measure wind speed and direction at a minimum, and be installed on the landfill office building in such a way as to minimize or negate building-wake effects. The equipment will meet the requirements of EPA's "Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)" (May, 1987).

As evidenced by the Illinois State Climatologist Office and University of Missouri wind rose graphs included as Figure 4-1 and 4-2, predominant wind directions are from the south-east and north-west as measured at Lambert-St. Louis International Airport, which is located just north and west of the site.

The air monitoring and sampling locations are arranged in a broad line running roughly south-east to north-west, with stations strategically located in the non-predominant south-west and north-east wind directions as well. The resulting placements, shown in Figure 4-3, are sufficient to provide a representative sampling of Areas 1 and 2 in all wind direction conditions. While these locations

will likely need to be adjusted for access to electrical service, topographical considerations, and in response to current or anticipated construction activities, the integrity of the monitoring design will be maintained.

These samplers will have access to 110-120v line power, be secured from tampering, and be weatherproof.

Table 4-1 lists the types and quantities of environmental monitoring equipment for the different monitoring stations depicted in Figure 4-3. The table also lists the COCs measured by the equipment housed at each station. This inventory of equipment or COCs may change if new information becomes available during design or implementation of the isolation barrier or other response actions at the site.

The sampling and sensor equipment in each standard monitoring station enclosure will operate continuously. The equipment in these stations will consist of a high volume air sampler for airborne particulates, a continuous radon monitor (alpha track etch), and an environmental radiation detector called a thermoluminescent dosimeter (TLD). Alpha track etch monitors will provide a cumulative measure of radon gas present and will allow determination of average radon levels for the sampling period. TLDs will measure ambient gamma radiation levels.

Particulates gathered on air sample filters will be collected on a monthly basis and analyzed for alpha and beta emitters. Radiation dosimeters and alpha track etch detectors will be exchanged and sent for analysis every calendar quarter.

Five of the monitoring stations will house continuous passive samplers to monitor for VOCs. Monitoring of VOCs will be performed using the Radiello Code 130 chemical adsorbing cartridge diffusion samplers that will be left in place for periods of 14 days. The Radiello Code 130 cartridges consist of a stainless steel net cylinder with 100 mesh grid opening and 5.8 mm diameter, packed with approximately 530 milligrams of activated charcoal. VOCs are trapped by adsorption and recovered by carbon disulfide displacement.

VOC analysis is performed by gas chromatography/mass spectrometry. Passive/diffusive samplers rely on unassisted molecular diffusion of the gaseous agent to migrate from the air onto the sorbent material. The advantages of the Radiello technology include: continuous sampling for up to a 30 day period; higher capacity and sampling rates; greater selectivity and sensitivity; and consistent sampling rates (Sigma Aldrich 2014). A description of the Radiello equipment is presented in Appendix D.

In addition to the monitoring and sampling outlined in this plan, personnel involved with monitoring station installation, sample collection and monitoring station maintenance will wear 4-gas meters and use handheld meters to check for hydrogen sulfide.

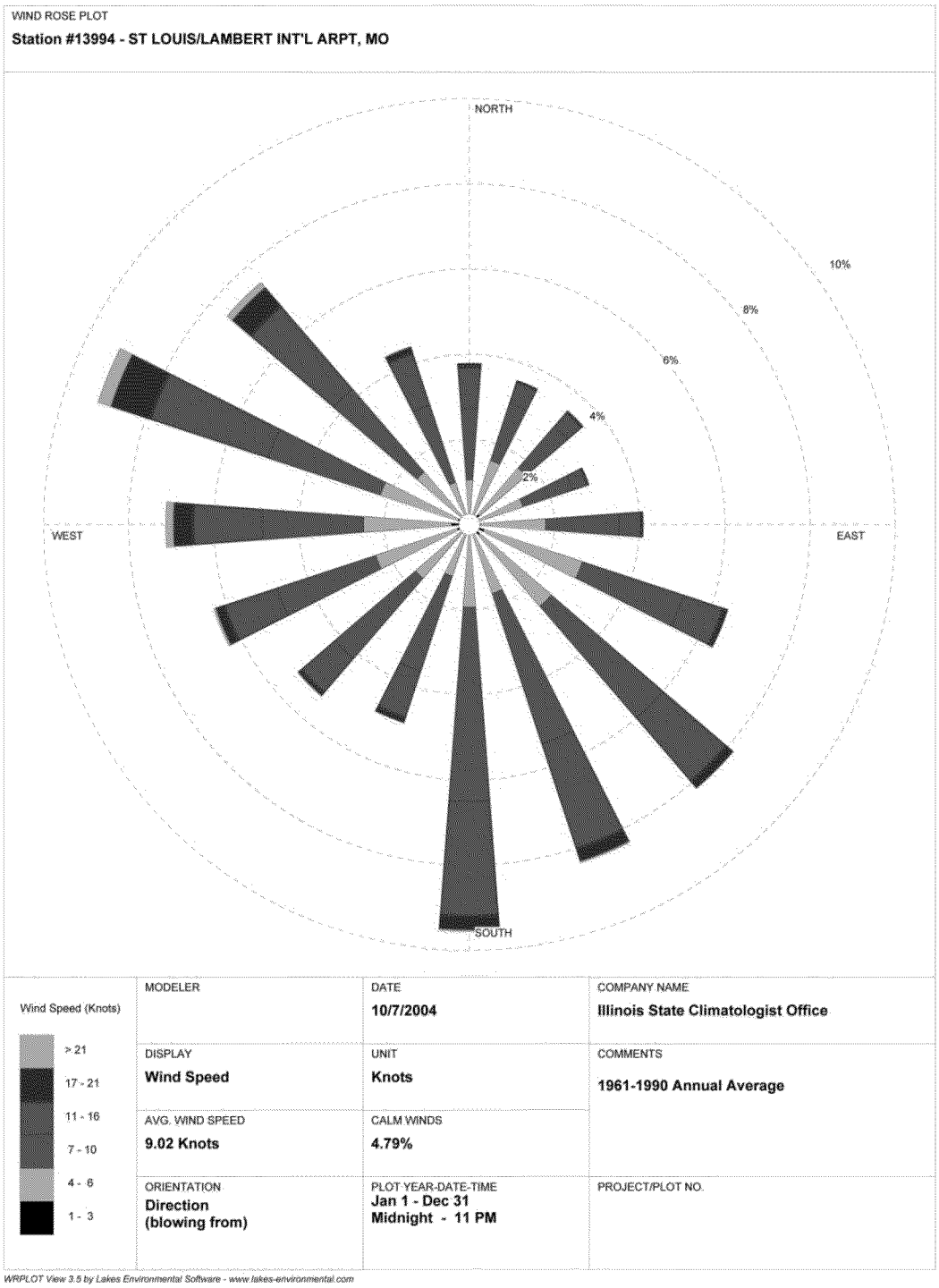

Figure 4-1 Predominant Wind Directions

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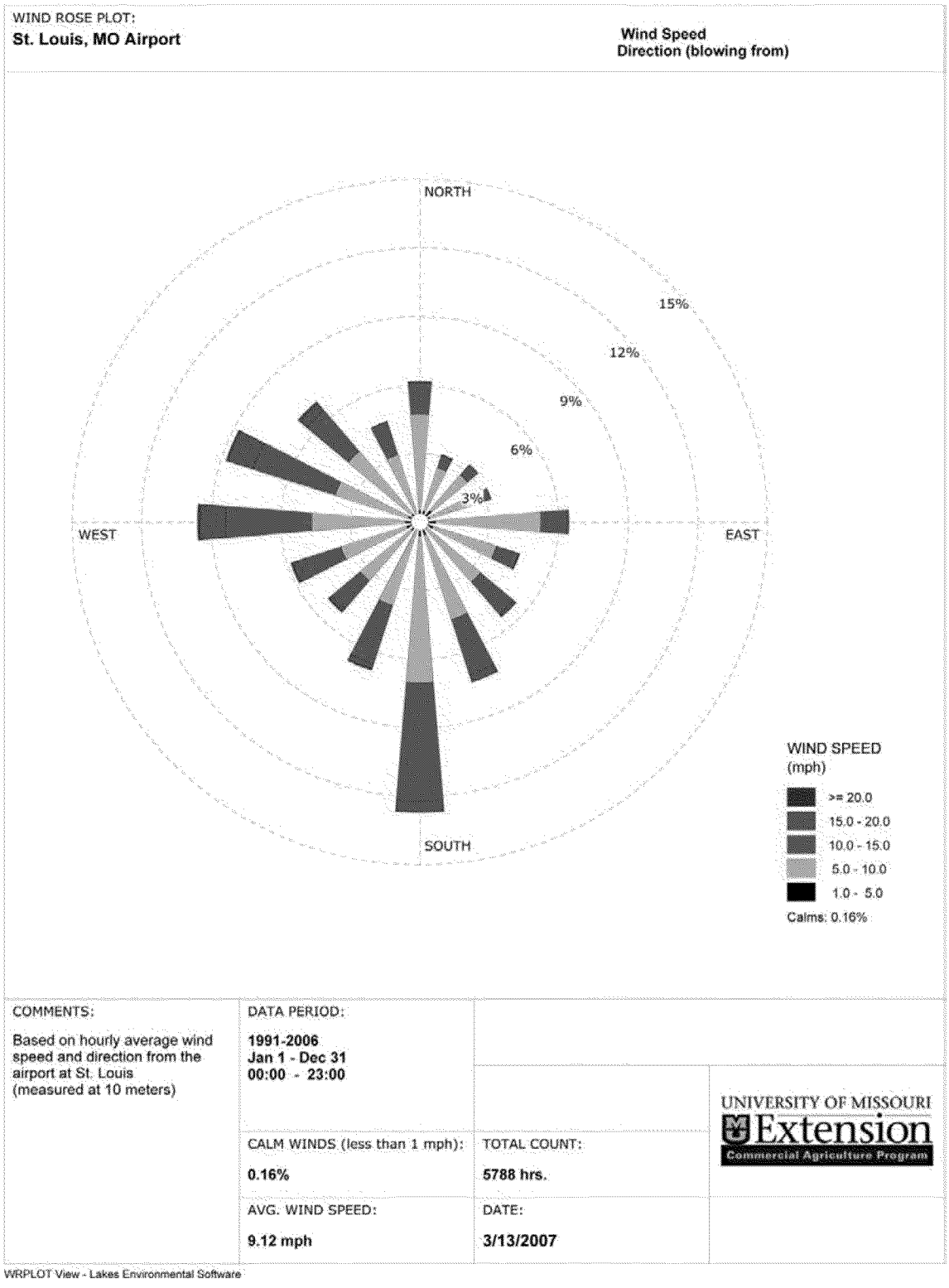

Figure 4-2 Predominant Wind Directions

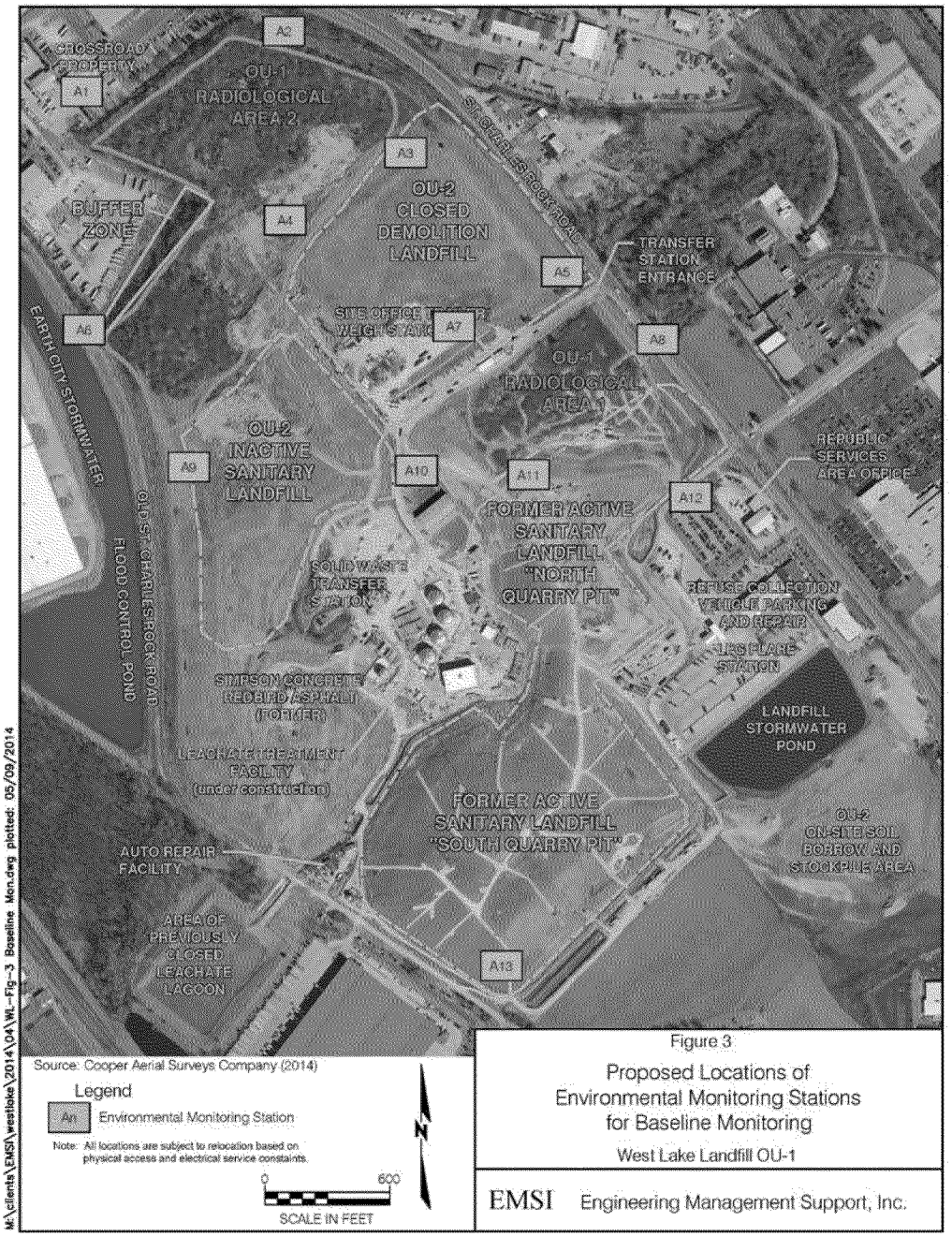

Figure 4-3 Air Monitoring Station Locations

WLLFOIA4312 - 001 - 0020627

Table 4-1 List of Samplers for Perimeter Monitoring

Perimeter Monitor Inventory per Location	Sampling Mode and Collection Frequency	Contaminants Measured
Proposed list of samplers at A01, A05, A07, A08, A11		
Metered air pump with dual chamber sampler for particulate fiber filter	Continuous / Every 28 days	Total alpha and beta activity
Alpha Track Etch Detector for radon gas	Continuous / Quarterly	Radon-222 and radon daughters
Radiello RAD130 Canister	Continuous / Every 14 days	Volatile Organic Compounds[1]
Radiation dosimeter (TLD)	Continuous / Quarterly	Gamma radiation levels
Proposed list of samplers at remaining on-site and perimeter locations (x8)		
Metered air pump with filter to collect particulates	Continuous / Monthly	Total alpha and beta activity
Alpha Track Etch Detector for radon gas	Continuous / Quarterly	Radon-222 and radon daughters
Radiation dosimeter (TLD)	Continuous / Quarterly	Gamma radiation levels
Meteorological monitoring station		
High resolution wind sensor	Continuous	Wind speed and direction

[1] No guidance has been provided by stakeholders regarding a target analyte list for VOCs. The Radiello 130 media will be analyzed for the list of analytes included in Appendix F. This list was provided by the laboratory and reflects common analytes for which sampling rates have been calculated.

WLLFOIA4312 - 001 - 0020628

4.1.1 Compliance Evaluation

Table 4-2 lists airborne activity limits that will be used to evaluate operations that involve the potential exposure of workers or the public to radioactive materials during all phases of the monitoring program. . The entire table is presented below, but only the row titled "Fence line/Perimeter" applies to the tasks outlined in this plan. Because multiple radionuclides are involved, site-specific limits were calculated based on the mixture of radionuclides identified in Area 1, as established in the BRA. Administrative limits (called "investigative levels") are set below their calculated allowable limits. These investigative levels are expressed as the gross alpha and gross beta air concentrations, and are shown in the last two columns of Table 4-2. Samples with analytical results that exceed the investigative levels will undergo isotopic analysis to identify and quantify the specific radioisotopes present in the sampled material. All samples for gross alpha/beta and isotopic analysis will be analyzed using EPA approved methods (see Section 4.4, below).

Table 4-2 Numerical Air Monitoring Limits for Alpha and Beta Emitters

Activity	Maximum Allowable Time-weighted Air Concentration (µCi/mL)	Gross Alpha Investigative Levels		Gross Beta Investigative Levels	
		µCi/mL	dpm/m^3	µCi/mL	dpm/m^3
Inside Work Area	7.7×10^{-12} [a]	1.62E-12[b]	3.6[b]	3.15E-13 [c]	0.7[c]
Work Area Boundary	3.5×10^{-14} [d]	2.93E-14[e]	0.065[e]	5.86E-15[f]	0.013[f]
Fence line/Perimeter	7.0×10^{-15} [g]	5.86E-15[h]	0.013[h]	1.35E-15[i]	0.003[i]

[a] Calculated from 10 CFR part 20, Appendix B, Table 1 Derived Air Concentrations (DACs), and the expected mixture of isotopes (Auxier, 2014).
[b] Airborne activity of alpha emitters in the mixture that are present at 25% of the DAC.
[c] Airborne activity of beta emitters in the mixture that are present at 25% of the DAC.
[d] Calculated from 10 CFR part 20, Appendix B, Table 2 Effluent Concentrations (Air) and expected mixture of isotopes.
[e] Airborne activity of alpha emitters in the mixture that are present at the effluent limit of 50 mrem/y assuming 8760 hours of discharge a year.
[f] Airborne activity of beta emitters in the mixture that are present at the effluent limit of 50 mrem/y assuming 8760 hours of discharge a year.
[g] Calculated using 20% of the 10 CFR part 20, Appendix B, Table 2 Effluent Concentrations (Air) and expected mixture of isotopes.
[h] Airborne activity of alpha emitters in the mixture that are present at the NESHAPS limit of 10 mrem/y assuming 8760 hours of discharge a year.
[i] Airborne activity of beta emitters in the mixture that are present at the NESHAPS limit of 10 mrem/y assuming 8760 hours of discharge a year.

VOC results obtained from ambient upwind and downwind monitoring stations will be compared against applicable criteria and/or risk based screening levels.

4.2 SAMPLE COLLECTION AND ANALYSES

Samples will be collected in accordance with A&A Air Sampling Procedure 3.9 (see Appendix A).

Air particulate samples will be analyzed by EPA approved methods/procedures. There are no regulatory methods for the preparation and analysis of the Radiello 130 samplers. The procedures published by Radiello serve as the basis for Eurofin Air Toxic's Standard Operation Procedure with QC elements outlined in EPA SW-846 8260 and 8270 incorporated as applicable. Laboratories with quality systems in place such as those identified in Section 4.4.1 will perform the analyses required to implement this Plan. Table 4-3 details the analytical methods required for each contaminant of concern.

Table 4-3 Sample Analyses and Methods

Analyte (COC)	Collection Method	Test	Sensitivity Level	Test Facility	Facility Location
Thorium Uranium Radium-226	Particulate Air Sample (4 in)	EPA Method 900.0 Gross Alpha/ Beta (GAGB)	1 dpm/sample	Eberline Analytical	Oak Ridge, TN
Rn-222	Track Etch	Alpha Track Etch	0.5 pCi/L	Inspect USA	Marshall, NC
Radiation Dose	TLD	TLD	<1 mRem	Mirion Tech	Irvine, CA
VOC	Radiello Code 130 Passive sorbent diffusion sampler	carbon disulfide desorption followed GC/MS analysis	See Appendix E	Eurofins Air Toxics	Folsom, CA

4.2.1 Accredited Laboratories and Contacts

Eberline Analytical
Mike McDougall
601 Scarboro Road
Oak Ridge, TN 37830
Tel 865.481.0683

Eurofins Air Toxics
Kelly Buettner
180 Blue Ravine Road, Suite B
Folsom, CA 95630

Inspect USA
100 S Main Street, Ste 609
Marshall, NC 28753

Mirion Technologies, Inc
17192 Murphy Avenue
Irvine, CA 92614
800-251-3331

WLLFOIA4312 - 001 - 0020630

4.2.2 Data Management

The laboratories will supply Level IV CLP-like data reports with all analytical results to A&A and EMSI. The laboratories will also supply analytical results in electronic spreadsheet format to the A&A Project Manager and EMSI.

4.2.3 Data Verification, Validation, Quality Assessment, and Delivery

The primary goal of data verification and validation (V&V) is to ensure that decisions are supported by data of the type and quality needed and expected for the intended use. Data verification is the process of evaluating the completeness, correctness, and consistency of a laboratory package or final data to assure that laboratory conditions and operations are compliant with project plan documents (see Section 5). Data validation addresses the reliability of the data. Results are evaluated to determine the presence or absence of an analyte and the uncertainty of the measurement process for contaminants of concern (see Section 6). Finally, scientific and statistical evaluation of the data may be required to determine if the quality of the data can support its intended use (MARLAP 2004). V&V and summary reports will be generated and submitted to EMSI. The A&A Project Manager will coordinate with EMSI to determine the formats and schedules desired for transmittal of the laboratory results, validation and summary reports.

4.3 SCHEDULE OF WORK

Work is tentatively scheduled to begin in 2014. .

4.4 PROJECT ORGANIZATION AND RESPONSIBILITIES

A&A personnel will be responsible for the air monitoring and sampling plan, air sample collection using A&A air sampling procedure 3.9, analysis and summary of laboratory data, and preparation and submittal of reports to EMSI. Michael Bollenbacher will function as the A&A Project Manager and the Certified Health Physicist for this project. Cecilia Greene and Lyn Brill will perform data validation. Environmental monitoring stations will be maintained by a qualified technician during the baseline monitoring phase and by the on-site radiological protection group (health physics personnel) during the construction phase. Subcontractors such as the laboratories listed below and EMSI and Bridgeton Landfill LLC personnel will assist A&A in the analysis of samples and the operation of the monitoring stations.

Eberline Analytical
Mike McDougall
601 Scarboro Road
Oak Ridge, TN 37830
Tel 865.481.0683

Eurofins Air Toxics
Kelly Buettner
180 Blue Ravine Road, Suite B
Folsom, CA 95630

Inspect USA
100 S Main Street, Ste 609
Marshall, NC 28753

Mirion Technologies, Inc
17192 Murphy Avenue
Irvine, CA 92614
800-251-3331

WLLFOIA4312 - 001 - 0020631

Table 4-4 Field Sampling Summary

Analytical Parameter	Level of Sensitivity	Matrix	Sample Frequency	Container Type	Preservatives & Holding Times	Subtotal Target Field Samples	Field QC Extras			Total Field Samples
							Rinsate Blanks & Matrix Spikes	Filter Blanks	Field Duplicates	
Gross Alpha/Beta	1 dpm/ sample	Air Filter	13 x Continuous Air Samplers /Monthly	Glassine Envelope	NA	156	NA	12	12	180
Radon	0.5 pCi/l	Track Etch Detector	13 x Continuous Samplers /Quarter	Track Etch Detector	NA	56	NA	NA	NA	56
Gamma Dose	1 mrem	TLD	13 x Stations/ Quarter	TLD	NA	56	NA	NA	NA	56
VOC	See Appendix B for MDL and RL	Radiello Canister	5 Continuous Every 14 Days	Radiello Canister	NA	130	NA	NA	1 Every 14 Days	156

WLLFOIA4312 - 001 - 0020632

5. QUALITY ASSURANCE REQUIREMENTS

The A&A Project Manager (PM) will manage quality assurance for the sample collection and field activities associated with this project. All field activities will be performed by trained personnel according to established A&A procedures. Field records will be reviewed and approved by the A&A Project Manager or his/her representative.

Only laboratories with established QA/QC systems will be retained for analytical services. The laboratory will perform QA/QC procedures to ensure routine laboratory accuracy and precision objectives in accordance with their standard operating procedures and the requirements of the specific methods used for testing. Laboratory QC samples include laboratory control standards, blanks, duplicates and other performance samples, the results of which are included in each data package.

Level IV data packages will be supplied by the laboratories to support analytical findings. Electronic data deliverables are submitted by the laboratory to assist A&A in verifying and validating the data. Records will be reviewed for completeness and maintained in the project files.

The quality of the air sampling and monitoring campaign is assessed in all phases of the program including:

1. Sample identification, handling and storage;
2. The function of air sampling and monitoring equipment;
3. The accuracy and reliability of analytical procedures; and
4. Recordkeeping.

5.1 SAMPLING IDENTIFICATION, HANDLING, AND STORAGE

Samples will be identified according to approved A&A procedures. All samples will be uniquely identified. Sample designators will be placed on all collection envelopes or containers. Sample information at a minimum shall include: the sample date, sampler's name, time period when the sample was collected, the sample flow rates at start and end of the sample, sample location, and any other information required by the respective analytical laboratories. Sample labels will be filled out using indelible ink and affixed to appropriate containers immediately prior to sample collection.

Samples will be handled carefully to prevent cross-contamination and will be placed in appropriately labeled containers. Chains of Custody forms (Figures 5-1 & 5-2) will be filled out by sampling personnel at the time the sample is obtained. It is the responsibility of the PM to arrange sample collection and delivery to the analytical laboratories. The Chain of Custody accompanies the sample through all transportation functions until the sample is received at the laboratory. The Chain of Custody is signed by the receiving laboratory. The Chain of Custody includes the following information: site name, sample identification number (assigned by the sampler in the field), sample date, sample location (using the established Site Coordinate System), and type of analysis required. Whenever the sample is transferred from one party to another, both parties sign the Chain of Custody and record the date and time of the transfer.

Auxier & Associates, Inc.
Radiological Health, Safety and Environmental Consulting
A USA Environment, L.P. Company

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9821 Cogdill Road
Suite I
Knoxville, TN 37932
(865) 675-3669

CHAIN OF CUSTODY FORM

Project Name:		Project Manager:	
Location:		Telephone No.:	
Sample Custodian:		Fax No.:	

SAMPLE IDENTIFICATION	DATE OF COLLECTION	SAMPLE DESCRIPTION	SAMPLE IDENTIFICATION	DATE OF COLLECTION	SAMPLE DESCRIPTION

Relinquished By:	Received In Good Condition By:	Time:	Date:
Method Of Shipment:			
Relinquished By:	Received In Good Condition By:	Time:	Date:
Method Of Shipment:			

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Figure 5-1 Sample Chain of Custody Form 1

PASSIVE SAMPLE COLLECTION

Air Toxics LTD.

CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice
Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action, of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922.

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630
(916) 985-1000 FAX (916) 985-1020

Page _____ of _____

Project Manager _____
Collected by: (Print and Sign) _____
Company _____ Email _____
Address _____ City _____ State ____ Zip _____
Phone _____ Fax _____

Project Info:
P.O. # _____
Project # _____
Project Name _____

Turn Around Time:
❑ Normal
❑ Rush
_____ specify

Reporting Units:
❑ ppmv
❑ ppbv
❑ µg/m3
❑ mg/m3

Lab I.D.	Field Sample I.D. (Location)	Sampler #	Date of Deployment (mm/dd/yy)	Time of Deployment (hr : min)	Date of Retrieval (mm/dd/yy)	Time of Retrieval (hr : min)	Analysis Requested	Indoor Air	Outdoor Air	Workplace Monitoring	Other ( )
								❑	❑	❑	❑
								❑	❑	❑	❑
								❑	❑	❑	❑
								❑	❑	❑	❑
								❑	❑	❑	❑
								❑	❑	❑	❑
								❑	❑	❑	❑
								❑	❑	❑	❑
								❑	❑	❑	❑
								❑	❑	❑	❑

Relinquished by: (signature) Date/Time	Received by: (signature) Date/Time	Sample Site Air Temperature:
Relinquished by: (signature) Date/Time	Received by: (signature) Date/Time	Notes:
Relinquished by: (signature) Date/Time	Received by: (signature) Date/Time	

Lab Use Only	Shipper Name	Air Bill #	Temp (°C)	Condition	Custody Seals Intact?	Work Order #
					Yes No None	

Figure 5-2 Sample Chain of Custody Form 2

Samples will be stored in a designated location prior to counting and between counts if multiple counts are required. All samples will be held under internal Chain of Custody at the laboratory using the appropriate storage technique. The analytical laboratory project manager assigned by each laboratory to this project will be responsible for tracking the status of the samples throughout the laboratory.

5.2 AIR SAMPLING, MONITORING, AND ANALYTICAL EQUIPMENT

Air sampling equipment will be calibrated, and the functionality of the equipment checked according to manufacturer specifications and A&A procedures. The minimum requirements necessary to ensure accurate measurements are described in this section.

Air flow meters, differential pressure indicators, and other devices used to determine volumetric flow rates of air samplers will be calibrated annually. Copies of the calibration records will be maintained on-site as well as in A&A's corporate offices.

The operability of air sampling equipment will be verified at the time of sample collection to include positive air flow indication and adequate supply of strip chart paper.

WLLFOIA4312 - 001 - 0020635

Laboratory Quality Assurance Program Manuals that include instrument calibration and control requirements are included in appendices B and C and are incorporated by reference. Laboratory Procedures

The quality of the laboratory data is assessed by precision, accuracy, representativeness, completeness, and comparability (the "PARCC" parameters), and detection limits. Definitions of these parameters and the applicable quality control procedures are described below. Laboratory Quality Assurance Program Manuals are included in appendices B and C and are incorporated by reference.

5.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability (precision) of two or more measurements compared to their average values. Precision is calculated from results of duplicate sample analyses. The duplicate samples will consist of one or more of the following: co-located samples, field replicates, analytical laboratory replicate, and/or laboratory instrument replicate. Laboratory replicate samples will be analyzed at a minimum frequency of one per twenty samples (five percent) per matrix analyzed. Laboratory replicate precision for radionuclides is quantitatively expressed as the absolute or relative percent difference (RPD). These measures are then compared to control limits based on the required or relative method uncertainties.

The variability in the sampling technique will be evaluated by analyzing 1 field duplicate for each monthly sampling event. The laboratory will be instructed to analyze two 47 mm samples from each of the identified filters, for a total of 12 duplicate samples. These duplicate samples will be used to qualitatively assess the precision of the sampling mechanism, but will not be used to qualify or reject data.

Since no standards have been set for VOCs in non-industrial settings, replicates and duplicates as described in OSWER Section 2.8 for compliance with QA3 objectives will not be collected. One field duplicate will be collected per sampling event for a total of 12 duplicate samples.

5.2.2 Accuracy

Accuracy is a measure of the closeness (bias) of the measured value to the true value. The accuracy of laboratory test results can be assessed by analyzing a reference material, third party performance evaluation samples, or "spiking" samples in the laboratory with known standards (surrogates or matrix spikes) and determining the percent recovery.

Laboratory control samples (spikes) for both chemical and radiological analyses will be carried out in accordance with SW846 requirements for organic analyses (EPA, 1986) at a minimum frequency of one in 20 samples (five percent) per matrix analyzed. A surrogate spike will be added to each sample for VOC analysis to evaluate analytical efficiency by measuring recovery.

The accuracy of sample results can also be affected by sample contamination. Sample contamination can occur because of improperly cleaned sampling equipment, or because of high radiation levels in the laboratory. To ascertain that the samples are not contaminated by laboratory activities, blank samples will be analyzed at a minimum frequency of one in 20 samples (five percent) per matrix analyzed.

In the special case of glass fiber air filters, the filters naturally contain 1-2 pCi/g of alpha emitting radionuclides. One clean, unused filter from each lot will be submitted for gross alpha/gross beta analysis. The level of activity measured on the field blank may be considered when evaluating the analytical results of the remaining samples.

5.2.3 Representativeness

Representativeness is a qualitative measure of how closely the measured results reflect the actual concentration or distribution of the constituent concentrations in the matrix sampled. The sampling plan design, sampling collection techniques, sample handling protocols, sample analysis methods, and data review procedures have been developed to assure the results obtained are representative of on-site conditions.

5.2.4 Completeness

Completeness is defined as the percentage of measurements judged to be valid. Results will be considered valid if they are not rejected during data validation. The target completeness goal for this work will be 90 percent.

5.2.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The use of standard methods and procedures for both sample collection and laboratory analysis ensure comparability of data.

5.2.6 Detection Limits

Each laboratory will be requested to provide full documentation of the analysis performed which will include detection limits for the procedure followed. These documents will be reviewed for completeness and maintained in the project files.

5.3 RECORD KEEPING

Each sample is tracked from the time of collection by extensive paper work which is completed during sampling and includes the following, as appropriate: 1) field documentation, 2) sampling field data sheet, 3) chain of custody, and 4) sample labels.

Original copies of field records and analytical data will be placed in the project file and retained for seven years. These records will be initially maintained in the by Auxier and Associates, Inc. but may be transferred to the client for long-term storage.

5.3.1 Field Documentation

The field data recorded at the time of sample collection provides an unambiguous identification of each sample. These field data include the following, as appropriate:

- Date of entry;
- Purpose of sampling;
- Description of sample;
- Number and size of sample taken;
- Description of sampling point;

- Date and time of collection of sample;
- Field sample identification number(s);
- References, such as maps or photographs, of the sampling site;
- Field observations;
- All field measurements, sample #, calibration dates, operators and techniques;
- Coordinate location of each sample using the Site x, y, z coordinate system, if applicable; and
- Any other information required by the respective analytical laboratories.

Because sampling situations vary widely, field notes will be as descriptive and inclusive as possible; anyone reading the entries should be able to reconstruct the sampling situation from the recorded information. Language within field notes will be objective, factual, and free of inappropriate or ambiguous terminology. All field personnel are required to date and sign any data entries. All field documentation will be retained.

Appendix A contains A&A procedures that are applicable to this project.

5.3.1.1 Sampling Field Data Sheets

Sampling field data sheets include information on specific activities related to collection of a single sample. The sampling personnel will complete the sampling field data sheets in the field at the time of the sample collection.

5.3.1.2 Chain of Custody and Sample Labels

See Section 5.1.

WLLFOIA4312 - 001 - 0020638

6. DELIVERABLES

6.1 DOCUMENT REVISIONS

This document and any subsequent revisions will be supplied to the project coordinator for distribution to stakeholders.

6.2 REPORTS

Laboratory certification and accreditation is achieved through successful completion of independent performance evaluations and external audits and is available for review in the laboratory's quality assurance plan (see Attachment B). State certification provides initial confidence in the laboratory's ability to successfully apply the requested analytical methods. Quality assurance reports from the laboratory to Michael Bollenbacher, the Project PM/CHP, are made in conjunction with audits by external entities. These reports may include the results of data validation, performance audits, an assessment of the precision, accuracy and completeness of the data, and a summary of quality assurance problems and proposed solutions.

A&A will prepare a validation report after all data packages are received from the laboratories for a particular sampling event and data validation has been completed. The data validation report will summarize the overall quality of the analytical results, identify any corrective measures, and will identify qualifiers applied to the results. The data validation reports will be included in the quarterly status reports or as appropriate.

6.3 DATA VERIFICATION, VALIDATION AND REPORTS

Data validators for A&A and EMSI, Cecilia Greene and Lynn Brill, will review all radiological and chemical data for completeness and accuracy and to determine if the project QA/QC goals have been achieved. Field operations will be fully documented, reviewed, and audited on an annual basis by the Auxier and Associates Quality Assurance Officer, Marsha Joseph. Ms. Joseph will report her findings and observations to Paul Rocasco and Mike Bollenbacher for assessment and corrective action, if applicable. The quality of field and laboratory data will be evaluated based on precision, accuracy, representativeness, completeness, and comparability of the data generated by each type of analysis.

The validators will review all laboratory submittals to verify that the data package is complete, including checks to verify:

- Sample numbers and analyses match the Chain of Custody;
- All analyses requested were performed;
- Package contains Chain of Custody;
- Laboratory applied data qualifiers (if applicable);
- Case narrative identifies problems (if applicable), including explanation of data qualifiers;
- Sample hold times are met;
- Instrument performance checks performed and acceptable;
- QA/QC samples present at proper frequency; and
- Reports for QA/QC samples
- Describe in detail any off-normal conditions or difficulties

WLLFOIA4312 - 001 - 0020639

The completeness, correctness, and conformance/compliance of the data will be verified and validated against the method, procedural, and contractual requirements. Guidance for data verification/validation is provided in the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) for radiological constituents, and guidance contained in Quality Assurance/Quality Control Guidance for Removal Activities (EPA, 1990) for chemical constituents. Qualifiers will be applied to the analytical data according to the guidance contained in these documents. One hundred percent of the laboratory data will be verified and validated. Reports must be reviewed and approved by the Project CHP prior to transmission to a regulatory agency or inclusion in draft reports.

6.4 CORRECTIVE ACTIONS

Corrective actions are developed on a case-by-case basis and are initiated whenever control limits are exceeded, or when results of other system audits or inter-laboratory results indicate an analysis is outside of control limits. Corrective action is taken to determine the cause, and a decision is made on the acceptability of the data collected for that lot of samples. Laboratory Quality Assurance Program Manuals are included in Appendices B and C.

Situations that may result in corrective action in the analytical laboratory or the field laboratory when include:

- Hold times are exceeded;
- A blank has exceeded the limit of quantitation;
- An instrument has failed a calibration check;
- A performance or check sample result is outside control limits; and
- A laboratory control sample result has exceeded the control limits.

6.5 COMPLETION OF REVIEW

Once all data within the data set are determined to be acceptable, the Project CHP will approve the data set. If not, the Project CHP will determine what further action is necessary. Further action could include re-sampling, reanalyzing archived samples, or eliminating the questionable data from consideration.

WLLFOIA4312 - 001 - 0020640

7. REFERENCES

EPA 2014	"Administrative Settlement Agreement and Order on Consent for Removal Action – Preconstruction Work, in the matter of West Lake Landfill Superfund Site," United States Environmental Protection Agency (EPA), EPA Docket No. CERCLA-07-2014-0002, 2014.
EPA 1990	"Quality Assurance/Quality Control Guidance for Removal Activities – Sampling QA/QC Plan and Data Validation Procedures," EPA, Interim Final, EPA/540/G-90/004, April 1990.
NRC 1988	"Radioactive Material in the West Lake Landfill – Summary Report," U.S. Nuclear Regulatory Commission (NRC), NUREG 1308 – Rev. 1, June 1988
RMC 1982	"Radiological Survey of the West Lake Landfill, St. Louis County, Missouri," Radiation Management Corporation (RMC), NUREG/CR-2722, May 1982.
RMC 1981	"Report on Site Visit – West Lake Landfill, St. Louis County, Missouri," RMC, 1981.
Auxier 2000	"Baseline Risk Assessment, West Lake Landfill, Operable Unit 1," Auxier & Associates, Inc., April 24, 2000.
Auxier 2011	"Evaluation of Potential Risks Associated with the Proposed Remedial Alternatives," Auxier & Associates, Inc., Appendix H to the Supplemental Feasibility Study Radiological-Impacted Material Excavation Alternatives Analysis, West Lake Landfill Operable Unit-1, EMSI, December, 2011.
Sigma-Aldrich 2014	"Radiello Diffusive Sampling System," Supelco, Sigma Aldrich, 2014.
EPA 1987	"Ambient Monitoring Guidelines for Prevention of Significant Deterioration," EPA-450/4-87-007, May 1987
MARLAP 2004	"Multi-Agency Radiological Laboratory Analytical Protocols Manual" (MARLAP), Part I, July 2004.
Auxier 2014	"Radiation Safety Plan for Site Preparation and Subsurface Investigation Activities, West Lake Landfill's Operable Unit 1 Preconstruction Activities," Auxier and Associates, Inc., April 30, 2014.