

US EPA ARCHIVE DOCUMENT

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April 20, 2015  
REVISED May 1, 2015

VIA: Electronic Mail

U.S. Environmental Protection Agency  
Region VII SUPR/MOKS  
11201 Renner Boulevard  
Lenexa, KS 66219

**ATTENTION:** Mr. Bradley Vann

**SUBJECT: Phase 1D Investigation – Additional Characterization of Extent of Radiologically-Impacted Material in Area 1: Revised Addendum to Phase 1 Work Plans for Isolation Barrier Investigation, West Lake Landfill Operable Unit-1, Bridgeton, Missouri**

Dear Mr. Vann,

On behalf of Cotter Corporation (N.S.L.), Bridgeton Landfill, LLC., Rock Road Industries, Inc., and the United States Department of Energy (the “Respondents”), Engineering Management Support Inc. (EMSI) submits this revised Addendum to the Phase 1 Investigation Work Plans (the “Phase 1D Work Plan Addendum” or simply “the Addendum”). The purpose of the Addendum is to describe the scope and procedures to be used to conduct additional investigation of the extent of radiologically-impacted material (RIM) associated with Area 1 of Operable Unit-1 (OU-1) at the West Lake Landfill. This Addendum is considered to be Addendum No. 1 to the Gamma Cone Penetration Test (GCPT) Work Plan Revision 2 dated September 27, 2013 and Addendum No. 3 to the Core Sampling (Phase 1B, 1C and 2) Work Plan – Revision 1 dated January 8, 2014 and prior related Addendums No. 1 dated February 11, 2014 and No. 2 dated February 27, 2014, all of which were prepared by Feezor Engineering, Inc. and others and previously approved by the U.S. Environmental Protection Agency Region VII (EPA).<sup>1</sup> This Addendum is being submitted in response to the request made in EPA’s January 15, 2015 letter to the Respondents and in accordance with the West Lake Landfill Administrative Order on Consent, Docket No. VII-93-F-005. The Addendum includes changes made to address EPA’s April 3, 2015 comments on the March 20, 2015 draft addendum, and EPA’s April 24, 2015 comments on the April 20, 2015 draft addendum.

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<sup>1</sup> Cotter was not part of the initial Phase 1 work and did not review or comment on the prior Phase 1 report before it was submitted to EPA.

### Scope of Work and Objectives of the Investigation

The objective of the Phase 1D investigation is to broaden the scope of the originally designed Phase 1 investigation. Specifically, in addition to collection of data for purposes of identifying potential locations for an isolation barrier, the Phase 1D investigation also is intended to provide data necessary to identify the extent of RIM in the southwestern and western portions of Operable Unit-1 (OU-1) Area 1.

Based on discussions that occurred during a technical meeting at EPA's offices on January 23, 2015, fourteen (14) additional borings will be drilled along the western and southwestern margins of Area 1. The proposed boring locations are shown on Figure 1 attached to this letter; however, the locations are subject to adjustment in the field to account for physical access constraints, the presence of infrastructure and utilities, and any construction or maintenance activities associated with the Bridgeton Landfill that may occur contemporaneously with the drilling of these borings. The anticipated depths of the borings are provided on Table 1.

These borings are intended to augment the results obtained from the previously completed Phase 1 work (which included Phases 1A, 1B and 1C), the results of which were presented in the December 2014 report prepared by Feezor Engineering, Inc. and others (Feezor Engineering, Inc., et al., 2014a), and the results of earlier investigations of OU-1 (EMSI, 2000, McLaren Hart 1996a and 1996b, NRC, 1988 and RMC, 1982). The 14 additional borings and associated work are being termed "Phase 1D" to differentiate this work from the previously completed work.

The goal of the Phase 1D investigation is to complete the investigation of the extent of RIM along the southwestern and western boundaries of Area 1. To that end, results of the field investigations (e.g., GCPT field gamma readings, Sonic core samples, downhole gamma scans of the Sonic borings, etc.) will be reviewed in the field as they are developed to assess the potential for the occurrence of RIM (based on gamma emissions from radium) at each location to allow for field decisions, in consultation with EPA, regarding the possible need for additional borings or for deletion or relocation of one or more of the proposed borings. Final determination of the extent of RIM will be based on review and evaluation of the results of all of the Phase 1D field investigation activities and laboratory analyses to account for possible thorium occurrences which cannot be readily detected by the gamma scans, as well as for gamma emissions from potassium-40 which may be unrelated to possible RIM occurrences.

It is anticipated that drilling, logging, sampling and analytical testing of soil/waste samples from these borings will define the outer extent of RIM associated with Area 1. The additional soil boring locations have been selected to provide further definition of the distribution of RIM in the southwestern and western portions of Area 1. The results of the Phase 1D investigation will be incorporated with historical information regarding the extent of refuse in and around the solid waste management unit boundaries of Area 1 and their relationship to other site features (e.g., areas where no refuse exists, the boundaries of other solid waste management units at the Site, etc.).

It is expected that the results of the Phase 1D investigation, when combined with the results of the prior Phase 1 investigation, the earlier Remedial Investigation (RI) and the pre-RI investigations conducted by the Nuclear Regulatory Commission (NRC), will provide sufficient additional information to complete the assessment of the extent of RIM along the southwestern and western boundaries of Area 1. The results will also provide information needed to conduct additional evaluations of potential remedial alternatives for Area 1 as necessary, and to select a potential location(s) for a possible isolation barrier within the southern portion of Area 1 or along the southern boundary of Area 1.

In addition, the data collected from the Phase 1D investigation and the prior Phase 1, RI and NRC investigations will be also used, as necessary and appropriate, to calculate potential radionuclide concentrations for various potential exposure scenarios. Specifically, to the extent that a potential location for a possible isolation barrier is selected within the nominal extent of Area 1, the Phase 1D investigation results, combined with the results of the earlier studies, will provide sufficient data to allow for evaluation of potential short-term or long-term risks that may arise if a possible isolation barrier is located within, as opposed to completely outside, the extent of RIM. The data obtained from the various investigations may also be used to re-calculate potential baseline exposure levels and associated risks for Area 1 if such calculations are determined to be necessary. The data obtained from the Phase 1D and prior investigations are expected to provide sufficient information for calculation of statistically-based reasonable maximum exposure (RME) concentrations (i.e., 95% upper confidence limits) that may be used to evaluate potential exposures and risks from Area 1 overall and/or from any RIM that may be located outside of a potential thermal isolation barrier.

#### Field Investigation and Sample Collection and Analyses

The goal of the Phase 1D investigation is to complete the characterization of the extent of RIM in the southwestern and western portions of Area 1 by obtaining additional characterization data. Tasks associated with the additional investigation are anticipated to occur as follows:

1. The 14 boring locations will be surveyed and staked in the field, and on-site personnel familiar with the locations of any underground utilities or infrastructure will inspect the locations to verify the absence of utilities or infrastructure. The locations will also be inspected for possible impacts to or from ongoing operations, maintenance, or construction associated with the Bridgeton Landfill. The 14 proposed drilling locations will be relocated as necessary prior to the start of drilling activities.
2. At each of the proposed drilling locations, it is anticipated that a gamma cone penetrometer test (GCPT) rig will initially perform a direct push investigation utilizing a gamma detector to characterize the subsurface conditions to the limits of the depth of the GCPT equipment. It is expected that the equipment

and procedures used to perform this work will be the same as those used to perform the Phase 1 work described in the September 2013 Phase 1 Work Plan and the December 2014 Phase 1 report, with the possible exception that a truck-mounted rig may be used in place of the track-mounted GCPT utilized for the earlier Phase 1 work. The goal of each GCPT boring will be to push directly through the solid waste materials to a depth of approximately 5 – 10 feet into the underlying native materials to the extent that the equipment can do so as determined by the GCPT contractor's operator. Continuous gamma readings will be obtained down the length of each GCPT boring during direct push of the cone penetrometer. If refusal occurs at a depth above the planned total depth for a given GCPT boring, a second GCPT boring may be driven next to the first, depending upon the depth achieved by the first boring and the nature of the refusal. Gamma reading results will be reviewed as they become available to allow for an early determination of the presence or absence of RIM at each location so that field decisions can be made, in consultation with EPA, regarding the possible need for additional boring locations or potential deletion or relocation of some of the planned boring locations. All GCPT borings, including any abandoned GCPT borings that did not reach their planned depths, will be grouted according to the procedures described in the previously approved Phase 1 GCPT work plan (Feezor Engineering, Inc., et al., 2013). The final as-drilled locations of each of the GCPT borings, including any offset borings, will be surveyed for horizontal location and ground elevation.

3. Upon completion of the GCPT borings, the results of the GCPT logs will be reviewed to identify any intervals with elevated gamma readings that may be indicative of the presence of RIM at each location and to identify target depths for collection of biased depth interval samples from those intervals with elevated gamma readings during the next step in the investigation.
4. Upon completion of the GCPT borings and review of the results, a Sonic drilling rig will be brought on site to drill soil borings and collect soil core samples from near each GCPT location. It is anticipated that the Sonic drill rig will set up within 5 to 10 feet of each GCPT location. This offset is considered necessary to avoid possible radionuclide occurrences or other effects associated with the bentonite grout used to abandon the GCPT borings. The Sonic rig will drill down through the solid waste materials and through approximately 5 to 10 feet of the underlying native materials, collecting continuous soil/waste samples (to the extent possible given actual core recoveries). It is anticipated that the equipment and procedures used to perform this work will be generally the same as those used to perform the Phase 1 work described in the January 2014 Phase 1B, 1C and 2 Work Plan (Feezor Engineering, Inc., et al., 2014b), the related Addendum No. 1 dated February 11, 2014 (Feezor Engineering, Inc., et al., 2014c) and the December 2014 Phase 1 report (Feezor Engineering, Inc., et al., 2014a).

5. Upon completion of each Sonic borehole, a PVC pipe will be installed to maintain the borehole opening and the borehole will be downhole logged for gamma radiation. The collected core samples will be visually inspected (with color and appearance noted), geologically logged, and scanned for gamma radiation. The PVC pipe will be removed from the boring and each boring will be grouted using a tremie pipe from the bottom of the hole up to the ground surface. The final, as-drilled locations for each Sonic boring will be surveyed.
6. Based on the results of the GCPT gamma logs, the downhole logging of the Sonic boreholes, and the visual and geologic logging and gamma scans of the core samples, grab samples will be collected from each Sonic core sample for submittal to offsite analytical laboratories for radiological analyses and Target Analyte List (TAL) trace metals, plus Sulfate, Carbonate and Fluoride analyses that will be used to evaluate whether the radionuclide occurrences are associated with Leached Barium Sulfate Residue (LBSR) and related soil disposed at the site in 1973 or are associated with natural occurrences or other possible source materials that may be present at the landfill.

Samples will be collected from the intervals with the highest gamma readings and/or at the discretion of the site health physicist/engineer/geologist from any intervals where visual inspection identifies potentially anomalous materials. For planning purposes, it is anticipated that two sample intervals will be selected from each Sonic boring for laboratory analyses. For Sonic cores exhibiting only one small interval (e.g., a foot or less) with elevated gamma readings, the second sample will be collected randomly; however, in these cases preference will be given, to the extent practical, to obtaining samples from intervals bounded by the 1971 and 1975 topographic surfaces (see Table 1) so as to maximize the potential for obtaining materials representative of wastes disposed contemporaneously with the placement of soil mixed with LBSR that occurred during the latter part of 1973. For any location at which the gamma scans obtained from the GCPT or Sonic borings do not provide clear and sufficient data to define the lower boundary of potential RIM occurrence (e.g., where refusal was encountered at a depth where the gamma readings may potentially still be elevated), one or more samples will be obtained from the lower portion of the core material for laboratory analyses to provide data for defining the lower extent of RIM occurrence at that location. For Sonic borings that are drilled outside of the extent of the 1971-1975 waste deposits, and whose core samples do not display any identifiable elevated gamma levels, laboratory samples will be collected from two random depth intervals.

EPA will be provided an opportunity to collect split samples for performance of duplicate sample analyses, toxicity leaching characteristic procedure (TCLP) testing, pyrolysis testing or such other additional testing that EPA desires to conduct, subject to the availability of sufficient material from the



interval(s) of interest. Priority will be given to obtaining sufficient sample volumes for the samples to be sent to the offsite laboratories for the additional characterization of Area 1.

7. Upon completion of the core logging and gamma scan of the core material, samples for laboratory analyses will be identified, collected and shipped or otherwise delivered in batches to the analytical laboratories (as opposed to shipping all of the samples at the end of the field investigation). Upon arrival at the radiological laboratory, the samples will be dried and ground to promote homogeneity and analyzed for Radium-226,; Radium-228; Thorium-230 and Thorium-232; Uranium-234, Uranium-235 and Uranium-238; Actinium-227; Potassium-40; Protactinium-231; Scandium; and Lead-210. The samples will also be analyzed for TAL trace metals, plus Sulfate, Carbonate, and Fluoride. The purpose for collection of TAL metals and Sulfate, Carbonate and Fluoride is to provide multiple lines of evidence to delineate and differentiate radiological constituents associated with LBSR disposed of at the site from radiological constituents associated with other solid waste and/or naturally occurring radionuclides. The Respondents also understand that EPA may collect split samples for TCLP analyses. Therefore, the Respondents wish to collect TAL metals to evaluate total metals contents of the samples for comparison purposes.
8. Upon receipt of the laboratory analytical reports and electronic data deliverables, the data will be subjected to data validation in general accordance with the procedures set forth in the Multi-Agency Radiation Laboratory Analytical Protocol (MARLAP) or EPA functional guidelines for validation of inorganic data (EPA, 2008) and entered into an electronic database with the appropriate data validation qualifiers.

Other than the changes described above, it is anticipated that all of the work will be performed in general accordance with the procedures set forth in the Phase 1 Work Plans (Feezor Engineering, Inc., 2014a, b, and c and 2013) and associated documents (e.g., Health and Safety Plans) used for the prior Phase 1 investigations.

In order to provide preliminary data regarding the potential extent of RIM as early as possible during performance of the field investigation, priority will be given to drilling and sampling the southernmost borings (e.g., 1D-5, 1D-7, 1D-9 and 1D-14) during the initial portion of the field investigation. Such a priority will, however, be subject to other constraints – including but not limited to possible interference with ongoing Bridgeton Landfill activities or the need for road or drill pad construction, which may dictate performance of work at other locations prior to completion of one or more of the above listed borings.

Although the proposed additional soil borings and the overall design of the proposed Phase 1D investigation is expected to provide sufficient data to complete the delineation of the extent of RIM in Area 1, it is possible that an additional boring or borings may be

needed to achieve this objective. Specifically, field review of the results of the field investigations (core logging) and field measurements (e.g., GCPT, downhole gamma scans of the boreholes or gamma scans of the recovered core samples) may indicate that one or more additional borings may be necessary to complete the delineation of the extent of RIM. If so, the Phase 1D investigation will be expanded to include any additional borings considered necessary to complete the delineation of the extent of RIM. The necessity of and proposed locations for any additional borings that may be considered necessary to complete the delineation of the extent of RIM will be discussed with EPA's on-site representative and, subject to availability and timing, EPA's Remedial Project Manager (RPM). Any decisions reached during these discussions will be documented within 24 hours by email to the RPM and again in the monthly project status reports. EPA approval for any additional boring locations or other possible additional work will be obtained prior to performance of any additional work.

### Reporting

The progress of the field work and laboratory analyses will be reported to EPA on a weekly basis and as part of the monthly progress reports for OU-1. The as-received, un-validated results of the laboratory analyses of the samples will be included in the monthly progress reports.

Upon receipt of all of the laboratory analytical results, the results will be subjected to data validation. A report of the results of the Phase 1D investigation will be prepared documenting the results of the field investigations and the laboratory analyses.

In addition to a narrative description of the field investigation, a summary of the field investigation results and laboratory analyses, and an updated evaluation of the extent of RIM, the Phase 1D investigation report is anticipated to also include the following information:

- Copies of the daily field logs,
- GCPT cone penetrometer and gamma logs,
- Downhole gamma scans of the Sonic boreholes,
- Final soil core geologic logs,
- Gamma scans of the soil cores,
- Photographs of the core samples,
- Chain-of-custody records,
- Analytical laboratory reports,
- Data validation reports,
- Records of radiation exit scans for workers exiting Area 1,
- External exposure monitoring (TLD) results,
- Worker and work area related health and safety air monitoring results,
- Equipment release survey results,
- Investigative derived waste volumes and test results,
- Copies of pages from any field notebooks (to the extent they are used), and



- General photographs of the field investigation activities (if any are obtained).

The content of the Phase 1D report may be modified to include the results of any other investigations that may be undertaken in the same time frame as the Phase 1D investigation (such as additional characterization of the Areas 1 and 2 requested by EPA).

Upon completion and distribution of the Phase 1D report, a comprehensive report of the results of the various Phase 1 investigations and other investigations undertaken beyond that associated with the Phase 1D work, such as additional characterization of Areas 1 and 2, will be prepared. This report will present the field investigation and laboratory testing data obtained from all of the investigations. The comprehensive report will include geotechnical interpretation of the all of the cone penetrometer (CPT) data for determination of pore pressures and lithologic properties based on the CPT data. This report will also include revisions to the previous Bridgeton Landfill Thermal Isolation Barrier Investigation Phase 1 Report, Bridgeton, St. Louis County, Missouri (Feezor Engineering, Inc., et al., 2014a) and address comments provided by EPA, MDNR and MDHS as necessary and appropriate. (Note: Responses to these comments will also be prepared to document what, if any, revisions were necessary to the Phase 1 report to address the comments.)

The comprehensive report will also include a preliminary assessment of the extent of RIM in Area 1 of the West Lake Landfill and the relationship between such RIM and adjacent solid waste units (e.g., the North Quarry portion of the Bridgeton Landfill) at the site. Differentiation of RIM from other possible occurrences of radionuclides in municipal solid waste (MSW) is expected to be made based on the following:

1. Evaluation of the radionuclide results obtained from the laboratory testing, including the Potassium-40 results relative to the GCPT, downhole and core sample gamma logs;
2. Locations and depths in which RIM is interpreted to occur relative to the 1971 and 1975 topographic elevations;
3. The ratios of the activity levels of the radium (Ra-226/Ra-228) and thorium (Th-230/Th-232) isotopes;
4. Evaluation of the equilibrium/disequilibrium between parent (e.g., thorium) and daughter (e.g., radium) radionuclides;
5. Review of the trace metal and anion analytical data; and
6. Review of available aerial photography.

Based on these evaluations, conclusions regarding the extent of RIM in Area 1 will be developed and presented in the comprehensive report. A figure displaying the extent of RIM in Area 1, based on results of the Phase 1D investigation, any other investigations that may be performed (e.g., additional characterization of Areas 1 and 2) and prior investigations (Phase 1A, 1B, and 1C, RI, McLaren Hart, and NRC investigations) will be prepared and included in the comprehensive report. A final evaluation of the extent of RIM will be performed using the procedures that were used in the Supplemental Feasibility Study (SFS) (see Appendix B of the SFS report) and all of the additional data

and information collected since the 2011 SFS as part of preparation of the Supplemental SFS report.

Schedule

It is anticipated that the Phase 1D investigation will require approximately six months to complete from the date of EPA approval of this Work Plan Addendum. EPA requested that the Addendum include a calendar date schedule in addition to an estimated duration schedule. For purposes of preparing such a schedule, Respondents have assumed that EPA approval of the Work Plan Addendum for Phase 1D will be received on May 4, 2015 and that the work will begin one week later (on or about May 11, 2015). The schedule for the primary activities associated with the Phase 1D work based on an assumed May 4, 2015 date of receipt of EPA approval to proceed is as follows:

<u>Activity</u>	<u>Duration (weeks)</u>	<u>Estimated Completion</u>
Mobilization	1	May 18
Construction of access paths/drilling pads	2	June 1
GCPT borings	2	June 15
Sonic drilling, geologic logging and core scanning	4	July 13
Laboratory Analyses	6	August 24
Data validation/data management	3	September 14
Data evaluation/preparation of boring logs, summary tables and figures	4	October 12
Preparation and internal review of Phase 1D investigation report and submittal to EPA	4	November 9, 2015
Preparation of comprehensive interpretative report and submittal to EPA	8.5	January 8, 2016*
Total Duration	35	

\*Actual submittal date may be revised based on the schedule developed for any additional site characterization work (e.g., additional characterization of Area 1 and 2) that may be performed that would also be included in the comprehensive report.

The above schedule is estimated and subject to change based on the actual levels of effort required for each task, the availability of the drilling subcontractors and their equipment, and potential impacts from adverse weather conditions (e.g., temperatures , thunderstorms, high winds, or other violent weather conditions, etc. that would necessitate work stoppages or delays). Any potential change to the above schedule will be identified and discussed with EPA and followed up with a written request to modify the schedule. In the event that it is determined that a percussion drilling rig is required to

obtain samples and/or complete the borings (as was necessary for some of the Phase 1C borings) additional time will be required to complete the work.

It is anticipated that preparation of the comprehensive investigation report will be submitted to EPA no later than 60 days after submission of the Phase 1D investigation and other additional investigation (e.g., additional Area 1 and 2 characterization) data summary report(s). Including preparation of the comprehensive investigation report, the total duration of the project is estimated to be eight months (not including any additional time that may be necessary to incorporate the results of other additional investigations, such as the additional Area 1 and 2 characterization, the results of which may also be integrated into the comprehensive investigation report.

### Project Team

EMSI will provide overall management and direction of the field investigation, data validation and management, data evaluation, and reporting. Feezor Engineering, Inc. will be responsible for the field investigations, including all drilling, geologic logging of boreholes and core samples, and job site health and safety. Auxier & Associates will be responsible for (1) conducting downhole logging of the Sonic boreholes; (2) performing the gamma logging of the core samples; (3) in conjunction with Feezor Engineering's geologist/engineer, selecting/collecting/submitting sample intervals for laboratory analyses, (4) monitoring and documentation of radiological conditions in and around the work area; and (5) providing assistance to Feezor Engineering with implementation and monitoring of health and safety practices and radiation scanning for equipment release.

The GCPT logs will be provided to P.J. Carey & Associates for interpretation of geotechnical properties relative to possible future construction of an isolation barrier in the areas of the new boring locations. Note that interpretation of the cone penetrometer data will not be included in the report of the Phase 1D investigation, which instead will rely on the geologic logging of the boreholes and core samples but will be included in the comprehensive Phase 1 report.

Radiological analyses of the samples will be performed by Eberline Analytical in Oak Ridge, Tennessee. Trace metal/anion analyses will be performed by Test America, St. Louis, Missouri. Surveying will be performed by Weaver Consulting Group. Construction of paths and drill pads will be performed by Sharp STL Service, Inc. under supervision by Feezor Engineering, Inc. GCPT drilling and logging will be performed by ConeTec and Sonic drilling will be conducted by Frontz Drilling, both of which were the same drilling contractors used for the prior Phase 1 work.

### References

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Landfill, St. Louis County, Missouri, NUREG/CR-2722, May.

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(EMSI) from Brad Vann (EPA Region VII) dated April 3, 2015 (Comments on the Phase  
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dated March 5, 2015 (Comments on the Bridgeton Landfill Thermal Isolation Barrier  
Investigation Phase 1 Report),

EPA, 2010, USEPA Contract Laboratory Program National Functional Guidelines for  
Inorganic Superfund Data Review, USEPA-540-R-10-11, February.

EPA, 2004, Multi-Agency Radiological Laboratory Analytical Protocols Manual  
(MARLAP), USEPA-402-B-04-001A, July.

If you have any questions or desire additional information related to this Work Plan Addendum or any other aspect of the project, please do not hesitate to contact me.

Sincerely,  
ENGINEERING MANAGEMENT SUPPORT, Inc.



Paul V. Rosasco, P.E.

Attachments:

Table 1: Summary of Elevation Data and Anticipated Depth of the Proposed Phase 1D Borings  
Figure 1: Proposed Phase 1D Borings in Area 1

Distribution:

Shawn Muenks - Missouri Dept of Natural Resources  
Victoria Warren – Republic Services, Inc.  
Joe Benco – Republic Services, Inc.  
Brian Power – Bridgeton Landfill, LLC  
Russ Eggert – Lathrop & Gage  
William Beck – Lathrop & Gage  
Nicholas Johnson – Lathrop & Gage  
Dale Guariglia – Bryan Cave HRO  
John McGahren – Morgan Lewis  
Steven Miller - U. S. Department of Energy  
Philip Dupre – U.S. Department of Justice  
Dan Feezor – Feezor Engineering  
Mike Bollenbacher – Auxier & Associates  
Peter Carey – Peter J. Carey & Associates

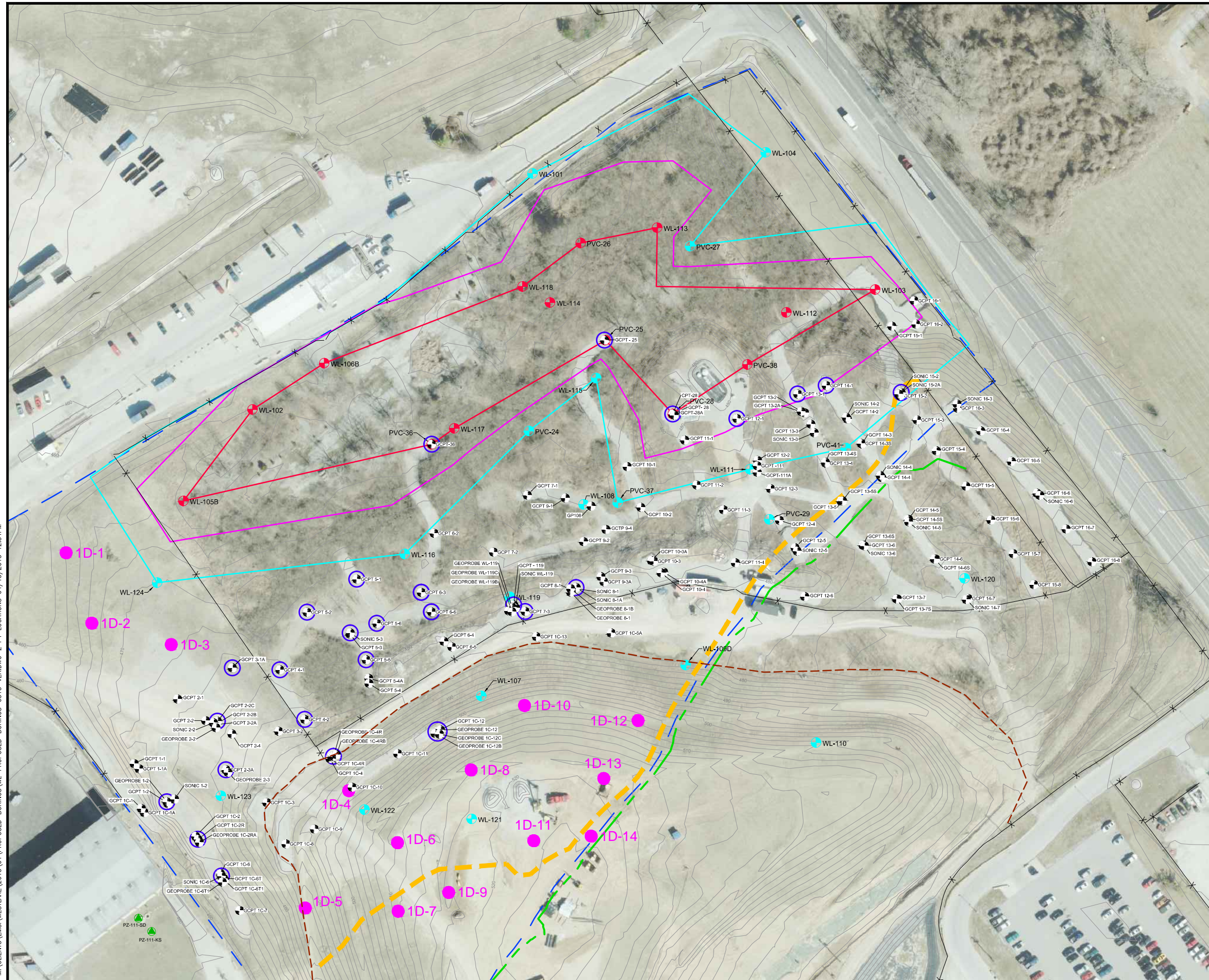
Table 1: Summary of Elevation Data and Anticipated Depth of the Proposed Phase 1D Borings

Boring	Northing	Easting	1971 Elevation	1975 Elevation	1979 Design Elevation	2014 Elevation	Minimum of 1971, 1975, 1979 Elevations	Anticipated Depth of Boring
1D-1	1,069,084.94	515,745.70	457.5	454.9		462.2	454.9	7.3
1D-2	1,068,998.58	515,777.22	462.1	445.3		466.6	445.3	21.3
1D-3	1,068,972.45	515,874.51	444.2	463.9		471.5	444.2	27.3
1D-4	1,068,793.50	516,091.90	434.0	449.0	467.2	496.3	434.0	62.2
1D-5	1,068,649.79	516,038.76	431.6	438.9	457.7	486.1	431.6	54.5
1D-6	1,068,729.80	516,151.73	431.6	447.8	458.6	510.9	431.6	79.3
1D-7	1,068,645.80	516,152.49	441.3	437.5	451.4	511.3	437.5	73.8
1D-8	1,068,818.90	516,241.96	431.6	456.2	460.7	516.4	431.6	84.7
1D-9	1,068,668.89	516,214.42	440.2	438.7	450.1	519.1	438.7	80.4
1D-10	1,068,897.82	516,307.30	431.6	464.9	463.7	503.4	431.6	71.8
1D-11	1,068,732.16	516,318.69	431.6	439.1	449.7	521.7	431.6	90.1
1D-12	1,068,879.49	516,446.50	431.6	444.1	445.8	505.5	431.6	73.9
1D-13	1,068,808.45	516,404.51	431.6	443.6	450.4	519.5	431.6	87.9
1D-14	1,068,737.78	516,389.12	440.5	439.3	447.0	521.6	439.3	82.3

Notes:

- 1) The 1971 Elevation was determined from a March 12, 1971 topography developed by Surdex Corporation from historical aerial photogrammetry.
- 2) The 1975 Elevation was determined from an April 6, 1975 topography developed by Surdex Corporation from historical aerial photogrammetry.
- 3) The 1979 Elevation was determined by a surface provided by Aquaterra to represent the bottom of the fill - its methodology of determination is unknown.
- 4) The 2014 Topography was determined from an aerial topography from Cooper Aerial. Date of flyover March 12, 2014.
- 5) Elevations are for the ground surface in units of feet above mean sea level (amsl).
- 6) Boring depths are in feet below ground surface (bgs)

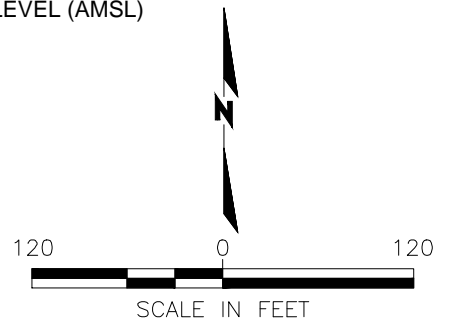




**LEGEND**

- PROPOSED PHASE 1D BORING LOCATION
- PHASE 1 BORING LOCATION
- LOCATIONS WITH ELEVATED PHASE I GAMMA READINGS AND/OR RADIUM OR THORIUM ABOVE UNRESTRICTED USE LEVELS
- RI BORING WITH ELEVATED DOWNHOLE GAMMA READING
- RI BORING WITH NON-ELEVATED DOWNHOLE GAMMA READING
- BEDROCK GROUNDWATER WELL
- SFS ESTIMATED MINIMUM EXTENT OF RIM
- SFS ESTIMATED EXTENT OF RIM
- SFS ESTIMATED POTENTIAL OUTER EXTENT OF RIM
- FENCE
- 480 03-20-14 TOPOGRAPHIC CONTOUR
- APPROXIMATE INTERSECTION OF 1971 AND 1975 TOPOGRAPHY
- EDGE OF NORTH QUARRY HIGH WALL
- APPROXIMATE AREA 1 BOUNDARY
- NORTH TOE OF ABOVE GRADE PORTION OF NORTH QUARRY LANDFILL UNIT

- NOTES:**
- AERIAL TOPOGRAPHY PROVIDED BY COOPER AERIAL SURVEYS CO. AND IS DATED MARCH 20, 2014
  - ALL ELEVATIONS ARE ABOVE MEAN SEA LEVEL (AMSL)



**Figure 1**  
**PROPOSED PHASE 1D BORINGS**  
**IN AREA 1**  
 West Lake Landfill OU-1  
**EMSI Engineering Management Support, Inc.**