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ENVIRONMENT

VIA EMAIL

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B0033701.0000.00001

Subject:
Work Plan for Further Characterization of Extent of Radiologically Impacted Material in Areas 1 and 2, West Lake Landfill Operable Unit-1, Bridgeton, Missouri

Dear Messrs. Vann and Beck:

On behalf of Respondent Cotter Corporation (N.S.L.) (Cotter), ARCADIS US, Inc. (ARCADIS) submits this Work Plan in Support of Further Characterization of the Extent of Radiologically Impacted Material in Areas 1 and 2 of Operable Unit 1 of the West Lake Landfill.

The purpose of this Work Plan is to describe the scope and procedures to be used to conduct additional investigation as to the composition, distribution, and extent of radiologically-impacted material (RIM) associated with Areas 1 and 2 of Operable Unit-1 (OU-1) at the West Lake Landfill, in accordance with the requirements of Paragraph 49 of the 1993 Administrative Order of Consent (AOC) for Remedial Investigation/Feasibility Study for the West Lake Landfill NPL Site located in Bridgeton, Missouri ("West Lake" or the "Site"), as amended. This Work Plan supplements previous and ongoing activities to further characterize the nature and extent of RIM in Areas 1 and 2 and is consistent with Cotter's previous recommendations for additional sampling work at the Site, which were approved by EPA via Alyse Stoy's email of June 12, 2015 to John McGahren. This Work Plan incorporates by reference and generally adopts (to the extent applicable to the work

described herein) the protocols and procedures set forth in the 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 approved by EPA on May 5, 2015 (as amended to address EPA's comments on May 23, 2015) and associated documents (e.g., Health and Safety Plans) used for the prior Phase 1 investigations, which should serve to facilitate EPA's review of this submittal.

Through this testing, Cotter intends to increase EPA's, the Respondents', and the public's understanding about the nature and location of RIM at the Site, as well as its mobility/immobility and its potential to impact the groundwater at the Site. Cotter also believes that this testing will help EPA and the Respondents evaluate the proper remedy for the Landfill protective of human health and the environment, and support the ongoing supplemental feasibility study efforts.

Although counsel for Respondents Bridgeton Landfill LLC (Bridgeton) and Rock Road Industries (Rock Road) has advised us that Bridgeton does not join this submission, Bridgeton has agreed to permit Cotter to conduct the requested work, subject to certain conditions, including, among other things, that the work be done by Paul Rosasco of Engineering Management Support, Inc. (EMSI), who currently serves as the Project Coordinator for the Respondents under the AOC, and EMSI's subcontractors. Copies of this work plan and the ensuing sampling results will also be provided to Bridgeton.

Since drilling equipment is currently mobilized at the Site, Cotter believes that this additional sampling should add no more than two weeks to the existing drilling schedule set forth in the recently submitted Work Plans for Areas 1 and 2.

Scope of Work and Objectives of the Investigation

As noted in Paragraph 49 of the AOC, Respondents shall have the right to gather any additional data not specified or required under that Consent Order. Because Respondent Cotter anticipates that the gathering of this additional data to complete the work identified in the Phase I Work Plans referenced above will likely require a slight modification or extension of the schedule, Cotter submitted a Technical Memorandum to EPA on May 18, 2015, in accordance with the requirements of Paragraph 49 of the AOC, to explain the basis for the need for the requested additional data described herein and the nature of the requested modification. Following EPA's June 12, 2015 approval of the work proposed by Cotter in its May

18 submission, and the recent agreement by Bridgeton as noted above, Cotter respectfully submits this Work Plan to the EPA Project Coordinator for EPA's review and approval, in conjunction with EPA's review of the Work Plan for Additional Characterization of Areas 1 and 2 submitted to EPA by the Respondents on July 7, 2015. Cotter also seeks Bridgeton's concurrence and cooperation with this Work Plan, as set forth in EPA's June 12, 2015 approval of Cotter's additional sampling request.

The objective of the investigation set forth in this Work Plan is to provide site-specific focused information to further characterize the RIM in Areas 1 and 2 of OU-1. Specifically, this Work Plan will emphasize collection of data to aid in the following objectives:

1) Improved understanding of the chemical and radiological compositions of the RIM, which heretofore has been assumed to consist solely of the Leached Barium Sulfate Residue (LBSR) material;

2) Quantitation as to the leachability of radionuclides and the Resource Conservation and Recovery Act (RCRA) alkaline earth metal barium (which is the dominant (by weight) constituent of the LBSR when RIM samples of any origin(s) are subjected to the Toxicity Characteristic Leaching Procedure (TCLP)); and

3) Improved understanding of distribution and concentrations of RIM within areas of previously identified RIM.

These specific data objectives are further described within the denoted subsections below. As requested by EPA, the more detailed assessment in furtherance of these objectives will be the subject of a separate deliverable; however, the field data and sample results for the sampling will be provided with the upcoming Area 1/Area 2 deliverable.

Improved Understanding of the Chemical and Radiological Compositions of Radiologically Impacted Material (RIM)

The prior borehole-related sampling, and its associated emphasis on a very limited body of radionuclides, has led to the assumption that all RIM is LBSR. Analysis of the ratios of the radionuclide-related data (the method used for the earlier radionuclide analysis) is limited in its ability to specifically identify the origin(s) of the radiological materials. By comparison, Cotter's proposed analyte list (below), consisting of pertinent inorganic constituents established to be present in potentially additional

radiologic materials, will help determine the presence of radiological materials with chemical compositions diagnostically different from the LBSR. These proposed inorganic analytes consist of Target Analyte List (TAL) metals, with a particular focus on:

- Barium
- Calcium
- Magnesium
- Scandium
- Niobium
- Tantalum

As well as anions including:

- Carbonate
- Sulfate
- Fluoride

A suite of radionuclides, including total and isotopic Uranium and Thorium and their pertinent decay products, will also be measured, along with soil pH.[1]

From these data, an improved assessment of the chemical composition of RIM can be completed that may help identify the presence of any non-LBSR material. The identification and evaluation of any non-LBSR material is important in further assessing the human health and environmental impacts, if any, that could be caused by these non-LBSR radiologic materials, as well as serving to better characterize the RIM more generally for inclusion in the administrative record supporting EPA's remedy selection process.

Constituent Mobility As Measured by the Toxicity Characteristic Leaching Procedure (TCLP)

The LBSR is distinctive, insofar as it has been subjected to three prior forms of leaching targeted to specifically remove the maximum amount of uranium possible, while leaving the barium sulfate matrix of the LBSR intact and without significant dissolution of other non-uranium radionuclides. (Harrington and Ruehle, 1959).

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[1] These analytes are also included in the Phase ID Work Plan.

Compared to non-LBSR landfill materials, LBSR material should possess exceptional retention of both radionuclides and barium, the dominant inorganic constituent of the LBSR matrix and a RCRA alkaline earth metal. To aid in the assessment of the stability of the LBSR, samples documented to contain the requisite dominant barium and sulfate matrix and the co-associated radionuclides will be subjected to aggressive sampling using TCLP. The measured activities and concentrations of the respective radionuclides and barium will help provide quantified input that can be used in the hydrologic fate and transport models, and to improve the risk assessment regarding this specific form of RIM. Materials having other chemical and radiological compositions will also be subjected to the TCLP so as to help assess their retention of radionuclides.

Improved understanding of distribution of RIM within areas of previously identified RIM

To properly assess the efficacy of a partial excavation alternative, it is essential to understand the short-range behavior of RIM, based on borehole data. While geostatistical-based approaches, including kriging, can offer useful insights, such an approach is also limited by the need for identification of a mathematical relationship of a given sample (or samples) to a nearby area or material volume, which may not be available in a landfill environment due to random placement of various materials. Assessment of the presence or absence of short-range relationships between samples requires samples to be collected within a small distance, which is one of the purposes of this proposal. Positioning of these samples very close to historic samples will help document the relationship, if any, between these two sample sets.

To satisfy the above data objectives, this Work Plan proposes that seven (7) additional borings be drilled as shown in attached Figures 1 and 2, consisting of 3 borings in Area 1 (WL-102, WL106, and WL-114) and 4 borings in Area 2 (WL-209, WL-210, WL-234, and WL-235). These locations have been precisely placed to assess the presence of previously detected RIM and to then comprehensively assess its chemical and radiological composition, and/or to help provide improved insight as to the internal distribution of RIM within the general outline of the extrapolated presence of RIM at the Site. To allow for direct comparison, these proposed additional samples will be collected per the same protocols used for the Phase 1D investigation (as discussed below).

The review and analysis of the proposed additional borehole data will assist with the determination of the composition and internal distribution of RIM, which, as noted, is

currently presumed to consist solely of LBSR that was shipped and disposed at the West Lake Landfill within a limited period of time in 1973.

Field Investigation and Sample Collection and Analyses

It is anticipated that all of the work will be performed in general accordance with the procedures set forth in the 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 approved by EPA on May 5, 2015 (as amended to address EPA's comments on May 23, 2015) and associated documents (e.g., Health and Safety Plans) used for the prior Phase 1 investigations, including the radionuclides and chemical analytes noted above. As with previous investigations, sonic drilling techniques will be utilized for boring installation and down-hole gamma scanning will be used to confirm sampling intervals. As with the most recent field activities, the use of GCPT to install preliminary borings is not necessary. Samples will be collected at the 7 borehole locations in Area and Area 2 noted on Figures 1 and 2 (specifically, WL-102, WL-106, and WL-114 in Area 1, and WL-209, WL-210, WL-234, and WL-235 in Area 2). The borings will be advanced to depths matching previous depth intervals that exhibited elevated downhole gamma readings to obtain RIM material for subsequent laboratory analysis. Based on the results of the downhole logging of the sonic boreholes, and visual and geologic logging and gamma scans of the core samples, one soil sample per sonic boring will be collected for submittal to offsite analytical laboratories for TAL metals analyses (plus Carbonate, Sulfate, and Fluoride analyses) and TCLP analyses.

Reporting and Schedule

The field data and sample results from this testing will be presented in the upcoming Area 1/Area 2 deliverable, as directed by EPA in its approval of Cotter's May 18 request (see June 12, 2015 email from Alyse Stoy). Reporting will be conducted in a manner and format consistent with the Phase 1D Work Plan. As directed by EPA, any additional analysis and interpretation of these sampling results will need to be submitted to EPA in a separate deliverable. (See June 12, 2015 email from Alyse Stoy)

Upon approval of this Work Plan and access agreement, the proposed work can begin pending the availability of both field staff and equipment at the time of approval. Since the equipment will be mobilized in connection with the additional

Area 1/Area 2 investigation work, prompt approval would facilitate the timely completion of this work as part of the same mobilization effort. We anticipate that this additional work should take no more than two weeks (if performed as part of the Area 1/Area 2 mobilization) in the field, plus lab turnaround and analysis time.

Project Team

As outlined previously, the proposed work will be performed for Cotter by Paul Rosasco of EMSI (including any subcontractors that EMSI may retain), the Respondents' Project Coordinator responsible for overseeing the implementation of the AOC, with assistance by ARCADIS staff.

References

Harrington, C. D., and Ruehle, A. E. (editors), 1959, Uranium Production Technology, D. Van Nostrand Company, Inc. New York, New York.

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,

ARCADIS U.S., Inc.

Craig Divine, PhD
Vice President, Principal Hydrogeologist

Attachments:
Figure 1: Cotter Proposed Borings Area 1
Figure 2: Cotter Proposed Borings Area 2

Copies:
Alyse Stoy - EPA
Dale Guariglia – Bryan Cave HRO
John McGahren – Morgan Lewis
Steven Miller – U. S. Department of Energy
Philip Dupré – U.S. Department of Justice
Tiffany Drake – Missouri Dept. of Natural Resources
Paul Rosasco - EMSI