UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 7
11201 Renner Boulevard
Lenexa, Kansas 66219

Mr. Paul V. Rosasco
Project Coordinator
Engineering Management Support, Inc.
25923 Gateway Drive
Golden, Colorado 80401

Dear Mr. Rosasco:

On January 31, 2023, Parsons submitted the Design Investigation Evaluation Report (DIER) for the West Lake Landfill OU-1 on behalf of the West Lake Operable Unit 1 Respondents as required to fulfill Section 3.6(c) of the July 2022 Remedial Design Modified Statement of Work (SOW).

The U.S. Environmental Protection Agency has completed its review and identified deficiencies in the report that must be addressed prior to approval. The report includes a substantial amount of data that is well-organized and summarized in an understandable manner. The information presented in this report is critical to the design of the remedy going forward, including the extent of radiologically impacted material (RIM) greater than 7.9 pCi/g and the corresponding OU-1 engineered cover extent. While the EPA did identify deficiencies in the report related to these boundaries, the EPA expects any changes related to these comments to result in only minor adjustments to these boundaries, typically no greater than the spacing between design investigation borings. In addition, with few exceptions, the EPA agrees that the report currently demonstrates sufficient data has been collected to complete the design of the remedy and that these exceptions can be addressed as part of confirmation sampling.

Please revise this document in accordance with the enclosed comments. Section 5.6(b) of the SOW requires that the report be revised and re-submitted within 30 days of receipt of this letter. EPA is willing to discuss a reasonable extension of time to accommodate other prioritized work. Please feel free to contact me with any questions or concerns by phone at (913) 551-7416 or by email at mahler.tom@epa.gov.

Sincerely,

CHRISTINE JUMP

Digitally signed by CHRISTINE JUMP
Date: 2023.06.22 14:30:37 -05'00'

for Tom Mahler
Remedial Project Manager
Remediation Branch
Superfund and Emergency Management Division

Enclosure:
cc: Ryan Seabaugh, Missouri Department of Natural Resources

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Comments on 1/31/23 Design Investigation Evaluation Report

1. **General Comment.** The Design Investigation Evaluation Report (DIER) discusses and presents figures depicting the boundaries of Operable Unit 1 of the West Lake Landfill including Area 1 and Area 2. The EPA notes that Design Investigation Objective 1 listed in the OU-1 Design Investigation Work Plan states, "*The extent of waste and RIM associated with OU-1 Area 1 and 2 will be sufficiently delineated to confirm the OU-1/OU-2 boundaries.*" The objective goes on to state that this will be addressed through the installation of perimeter borings. Design Investigation Objective 3 also states "*Further characterize RIM between 7.9 pCi/g and 52.9 pCi/g to identify the extent of RIM greater than 7.9 pCi/g for the purposes of confirming the OU-1 boundary and designing and specifying the extent of the Uranium Mill Tailings Radiation Control Act (UMTRCA) cap.*" The results of the sampling from the perimeter borings and associated step out borings which were found to contain waste, or Radiologically Impacted Material (RIM), greater than 7.9 pCi/g indicate that portions of the prior OU-1 boundary (and by extension the Area 1 and Area 2 boundaries) were not confirmed and so OU-1 must be expanded. To prevent confusion and to ensure the new OU-1 boundaries can be established based on the data and evaluations presented the DIER, the report must clearly identify the *prior* OU-1 boundary rather than indicate it is the final, delineated OU-1 boundary. For example, Figure 1.3 depicts OU-1 Area 1 and OU-1 Area 2 in yellow and the corresponding map legend labels these areas as "OU1 Area Boundary." Similarly, Figure 2.1 depicts these prior Area 1 and Area 2 boundaries with the label "OU-1 Boundary." The DIER must be revised to identify these prior boundaries as such (for example, the boundary could be labeled "2018 OU-1 Boundary" or "Pre-DI OU-1 Boundary" or "OU-1 Boundary per the 2018 Record of Decision Amendment (RODA)").

2. **Section 2.0, General Comment.** The EPA agrees as stated in the introductory paragraph to Section 2 that a concise summary of the conceptual site model (CSM) as it was known before the Design Investigation that focuses on elements important to understanding the data gaps that needed to be resolved and the corresponding design investigation objectives is useful. However, Section 2.1 does not achieve that goal and includes substantial additional information that is not relevant to understanding the data gaps that the Design Investigation was intended to resolve. The EPA is providing additional, specific, comments in section 2.1 below.

   Ultimately, the DIER must demonstrate that sufficient data has been collected to resolve those data gaps and complete the design of the remedy. Critical to these efforts is precisely estimating the extent of RIM. Because some of the data gaps defined in the RODA based upon uncertainties in the OU-1 CSM relate to the extent of RIM, those elements of the CSM must be included in this section. Lastly, a brief summary of the changes to the CSM informed by the various phases of the design investigation must be added to Section 2 or Section 6 to support the demonstration that adequate data has been collected to define the boundary of OU-1 and OU-2 based on having a precise estimate of the extent of RIM.

3. **Section 2.1, footnote 1.** The EPA acknowledges that the CSM developed for the RODA based on the information presented in the Remedial Investigation Addendum (RIA) did not include

significant evaluation of the Inactive Sanitary Landfill (ISL) and Closed Demolition Landfill (CDL) as data was not available to show whether RIM was present in those areas. However, the CSM presented in the OU-1 RIA does include some information related to the CDL and the ISL that is pertinent to understanding the uncertainty in the OU-1 and OU-2 boundary known at the time the 2018 RODA was issued. For example, Section 10.4.2 of the OU-1 RIA states on page 270, "*The southern boundary of Area 2 is coincident with the northern boundary of the Inactive Sanitary Landfill. Review of historical aerial photographs indicates that activities associated with the quarry operations and landfill did occur contemporaneously across the boundary between these two areas; however, portions of the Inactive Sanitary Landfill located near but not adjacent with Area 2 (e.g., MDNR Area 3 on Figure 3-8) were being used for waste disposal at the same time that Areas 1 and 2 were being used.*" This paragraph goes on to discuss similar information regarding the CDL and that elevated levels of radioactivity were not detected in these areas during a 1977 aerial gamma survey which occurred several years after RIM was known to have been brought to the Site. This CSM information is directly pertinent to understanding how the boundary of OU-1 and OU-2 was previously estimated and the associated uncertainty with this boundary. At a minimum, the summary of the CSM developed for the RODA must include discussion of CDL and ISL information relevant to establishing the OU-1 and OU-2 boundary, confirmation of which was established as the first design investigation objective. Remove this footnote or revise it to be consistent with other edits made to Section 2.1 in response to this comment.

4. **Section 2.1, general comment.** As stated in the comment to Section 2.0 above, Section 2.1 includes information that is not relevant to understanding the data gaps that needed to be resolved for the design of the remedy. For example, it's not clear how the numerous descriptions of the number of investigations and time frames over which the site has been studied, the number of borings collected prior to the design investigation, the number of samples/analyses performed on material from these borings, and the previously estimated total landfill waste volumes in Area 1 and Area 2 inform these data gaps. In addition, there are multiple elements of the CSM developed for the RODA that directly relate to the Design Investigation data objectives and associated data gaps that are not discussed. In addition to the discussion of aspects of the CDL and ISL discussed in the previous comment for footnote 1, information must also be added related to the previously defined Area 1 and Area 2 boundaries (See section 10.4.2 of the RIA), RIM occurrences on the Buffer Zone and Lot 2A2 (See section 10.4.3 of the RIA), and sediment in the drainage ways around the Site (See section 10.5.2 of RIA). Revise Section 2.1 by removing information that either isn't part of the CSM or isn't relevant to understanding the design investigation objectives and associated data gaps. Also include additional CSM elements and details that are relevant to understanding the design investigation objectives and associated data gaps.

5. **Section 2.1, page 2-1, fourth paragraph.** This paragraphs states, "*RIM was initially found in two areas at the Site…*" It's not clear in the context of the DIER what is meant by "*initially*" in this sentence. Revise for clarity.

6. **Section 2.1, page 2-2, first paragraph.** Replace the words "*field equipment*" in the last sentence with "*field survey methods*".

7. **Section 2.1, page 2-3, third, fourth, and fifth paragraphs.** These paragraphs must be updated to include additional CSM information and description of the associated data gaps based on information available in the OU-1 RIA and RODA as discussed in the general comment to Section 2.1 above.

8. **Section 2.2, page 2-4, third bullet.** There appears to be a typo in this bullet, e.g., "*Areas 1 and) accomplish to protect…*" Revise as necessary.

9. **Section 3.1, page 3-2, third paragraph and Section 3.4.2, page 3-7, first paragraph in the section.** Both paragraphs discuss actions taken as a result of high or persistent methane gas above the lower explosive limit (LEL) threshold during drilling activities. This pertains specifically to A1-PB-103 and A1-PB-104-A where the termination depth was affected because of methane. However, the DIER provides no other discussion of methane occurrences and/or the related health and safety monitoring that occurred throughout the drilling program. The EPA acknowledges that section 3.3.1.1 of the Design Investigation Workplan (DIWP) states additional data on current landfill gas and radon gas emissions are not currently anticipated to be needed to advance the design. However, the prevalence of methane occurrences is important for considering the need for gas management during remedial action. It is also useful for considering the accuracy of modeled landfill gas production being incorporated into the design of the OU-1 engineer cover system. As a reminder, the remedial action objectives specified in the 2018 RODA include, "*Limit inhalation and external radiation exposure from contaminated media (including waste material, fill, leachate, and gas emissions) located on or emanating from OU-1 to within the acceptable risk range*" and "*Control and treat landfill gas from OU-1 including radon in accordance with standards identified in the ARARs*"

   The EPA notes that the draft DIER table of contents provided to the EPA from Parsons on July 1st, 2022, indicates OU-2 Gas Monitoring Well Data would be a section included in a Landfill Perimeter Assessment Appendix along with radionuclide data, solid waste data, limit of waste for the final cover, and identification of areas outside of the final cover for removal and consolidation. It appears that all these items were included in the DIER except for the Gas Monitoring Well Data and any related discussion.

   Add a discussion in the DIER of the following items: (1) Methane and landfill gas encountered during the design investigation drilling operations as part of the health and safety monitoring, (2) landfill gas screening performed by Enterprise Risk Management (ERM) in certain OU-1 perimeter borings on the north side of Area 1, and (3) sub-slab methane readings detected underneath the landfill entrance building also north of Area 1. Discussion for item 1 should include information about locations where DI field activities were modified to accommodate landfill gas, such as minor or significant delays to drilling or downhole logging to allow off-gassing. The data for items 2 and 3 are available in the OU-3 2021 annual report. Discuss whether this information confirms prior assumptions about the prevalence of landfill gas based on the age of the waste in Areas 1 and 2. Because RIM was found in portions of the ISL and CDL which contain wastes that were disposed of several years after 1973, these discussions

should also include methane and landfill gas encountered during the design investigation drilling operations in those areas as well.

10. **Section 3.4, page 3-5. Third paragraph in the section.** This paragraph states 3-inch Schedule 40 PVC casing was inserted into the open borehole in accordance with 10 CSR 23-4.060 in preparation for downhole gamma logging. Given that these state regulations relate to monitoring well construction rather than gamma logging, revise the statement to clarify the applicability. For example, "*Once the target drill depth was reached at each respected boring, 3-inch Schedule 40 PVC casing meeting the riser material requirement of 10 CSR 23-4.060 (1) was inserted into the open boring hole in preparation for downhole gamma logging.*"

11. **Section 3.4, pages 3-5 and 3-6, paragraph that spans the page.** There appear to be errors in the citations to the state regulations related to the abandonment of monitoring holes. These citations should be identified as 10 CSR 23-4.060(9) and 10 CSR 23-4.080(2) for grout specification and placement, respectively. Revise the text with the correct citations. In addition, replace the word "*guidelines*" with "*requirements*".

12. **Section 3.4.1, page 3-6, last paragraph in the section.** This paragraph states that collection of composite municipal solid waste (MSW) samples for geotechnical analysis was discontinued after notification from the laboratory that it could not run geotechnical analysis on the MSW due to the composition of the submitted materials. The EPA notes that the Section 3.3 of the DIWP states, "*Geotechnical data will also be collected from borings installed within waste to further characterize the waste in terms of implementing the remedy (e.g., waste stockpiling, sloping/benching, excavation design).*" The DIER must explain either in Section 5.5 and/or 6.3 why these data are not necessary to finalize design elements related to waste stockpiling, sloping/benching, and excavation design.

13. **Section 3.4.1.1, page 3-6, last paragraph.** Add the following sentence to the beginning of this paragraph which is similar to the first sentence of section 3.4.1.2, "The southern portions of the previously estimated Area 1 and 2 boundaries are contiguous with other landfills. As a result, these portions of the Area 1 and 2 boundaries are defined by the absence of RIM greater than 7.9 pCi/g." In addition, this paragraph references the "*OU-1 Boundary*" three times. As stated, this could lead to confusion given that this section is summarizing step-out borings that were collected due to RIM being found in perimeter borings which did not confirm the OU-1 and OU-2 boundary. Revise this paragraph by replacing these sentences with a summary similar to Section 2.2.2.2 of the Field Sampling Plan which states, "*Step-out borings within the waste mass will be installed using sonic drilling methods with an offset distance of approximately 50 feet, as measured perpendicular to the currently understood OU-1 boundary.*" Replace "*currently understood*" with "*previously estimated*".

14. **Section 3.4.1.1, page 3-7, Area 1 paragraph.** This paragraph states that step-out boring A1-PB-118-A was blind drilled to 55 feet bgs (20-feet above the estimated 1975 surface elevation) before a core was collected for sampling. However, the corresponding boring log shows that blind drilling ceased at 49-ft below "*As Built Ground Surface*" which corresponds to an elevation of 464.58-feet. A1-PB-118-A was adequately sampled, and gamma logged in accordance with

Attachment A3-2 in Field Sampling Plan Addendum 3; however, the text and the boring log appear to be inconsistent. Revise for accuracy.

15. **Section 3.4.1.1, page 3-7, Area 2 paragraph.** EPA acknowledges that this paragraph explains certain perimeter borings that were found to have RIM but did not result in collection of a step-out boring because other nearby borings were sufficient to delineate the extent of RIM. However, the paragraph should also acknowledge that RIM was found in several of the step-out borings including three of the four step-out borings in the CDL (A2-PB-157-A, A2-PB-142-A, and A1-PB-134-A) and three of the five step-out borings in the ISL (A2-PB-151-A, A2-PB-149-A, and A2-PB-148-A). The results from the samples collected in these step-out borings indicate that RIM extends south beyond the previously estimated boundary of Area 2. EPA notes that additional step-out borings to the south were not required because an alternative approach to investigating the RIM in the ISL and CDL was established in FSP Addendum 4. Revise this paragraph by including additional explanation of the results of the step-out borings and acknowledge the alternative approach to investigation in these areas established in FSP Addendum 4. In addition, provide a reference to other relevant sections of the DIER that describe how this alternative approach was established and/or provide additional details, e.g., Section 3.8.1. Lastly, replace the word "*eastern*" in the first sentence of this paragraph with "*southern*".

16. **Section 3.4.2, page 3.7, last paragraph.** Similar to Section 3.4, there appears to be an error in the citation to the state regulations related to the abandonment of monitoring holes. This citation should be identified as 10 CSR 23-4.080(2). Revise the text with the correct citation. In addition, replace the word "*guidelines*" with "*requirements*".

17. **Section 3.4.2.1, page 3-8 and table 3.3.** Discussion was left out of this section that perimeter boring samples were not collected along the portion of the previously estimated Area 1 boundary adjacent to the transfer station. In addition, there appears to be an error in table 3.3 with regard to A1-PB-067. Table 3.3 lists this boring as having a waste start depth and waste end depth of "*None*" yet the boring log in appendix B-1 lists landfill waste in the 6 to 8-ft core, the 10 to12-ft core, the 12 to 14-ft core, and the 14 to 16-ft core. Check the boring log and revise the table for accuracy. In addition, two acknowledgements must be added to this section. First, include a statement that boring samples were not collected along the portion of the Area 1 boundary adjacent to the Transfer Station and, as a result, no sampling data is available to delineate the extent of MSW or RIM in that area or to evaluate whether either is present underneath that structure. Second, add statements that acknowledge that while RIM was not observed in A1-PB-067, MSW is present with a thickness greater than 2-ft in the perimeter boring located on the concrete/asphalt apron North of the Transfer Station, but additional step-out borings were not collected to delineate the extent of MSW in this Area.

18. **Section 3.4.2.1, page 3-8, Area 1 paragraph.** The first sentence of this paragraph states that step-out borings were drilled over the course of seven mobilizations, however the parenthetical only lists six dates. Revise the sentence by resolving or explaining the discrepancy. In addition, the third sentence states a total of 31 step-out borings were drilled during these mobilizations. However, the next two sentences state, "*Six of the 31 step-out borings were drilled to delineate*

MSW. The remaining 27 borings were drilled to delineate RIM greater than 7.9 pCi/g", indicating a total of 33 step-out borings. Revise the paragraph to resolve or explain the discrepancy.

19. **Section 3.5, page 3-9, first paragraph in the section.** The first sentence of this paragraph states that "*borings were drilled to further characterize radiological impacts within the boundaries of Areas 1 and 2.*" This sentence is overly broad and does not reasonably summarize Design Investigation Objective (DIO) #2, #3, and Geostatistical Modeling Objectives (GSMO) #1, #2, and #3 for which the section is titled. DIO #2 and GSMO #1, #2, and #3 all specifically relate to the design of the excavation which focuses primarily on concentrations of RIM greater than 52.9 pCi/g and only within 20 feet of the 2005 ground surface. While DIO #3 relates to characterizing RIM between 7.9 pCi/g and 52.9 pCi/g for the purposes of confirming the OU-1 boundary and designing and specifying the extent of the UMTRCA cap, the borings discussed in this section are limited in that the target depth was no greater than 20 feet. Therefore, these borings can be used to extend the OU-1 boundary and extent of the UMTRCA cap if RIM greater than 7.9 pCi/g is observed. However, the absence of RIM in these interior borings cannot be used to confirm or retract the OU-1 boundary and extent of the UMTRCA cap unless the boring happened to extend into alluvial materials below all the landfill waste. Revise this paragraph by including an acknowledgment that the primary purpose of the interior borings was to improve the geostatistical model and support the design of the excavation. Further, that interior borings can also be used to inform the OU-1 boundary and the extent of the engineered cover if RIM and MSW are observed in these borings but generally cannot be used to confirm OU-1 boundaries or limit the extent of the engineered cover given these borings are not required to extend through the entire waste mass and into the alluvial materials below the waste.

20. **Section 3.5, page 3-9, second paragraph in the section.** Similar to comments above regarding state regulations for monitoring well construction, a revision is needed to clarify the applicability of these regulations to downhole gamma logging. For example, "*Once the target drill depth was reached, 3-inch Schedule 40 PVC casing meeting the riser material requirement of 10 CSR 23-4.060 (1) was inserted into the open borehole in preparation for downhole gamma logging.*"

21. **Section 3.5.1, page 3-10, last paragraph and bullets at the end of the section.** The paragraph states that composite samples collected from three borings were resampled in one-foot intervals to allow for further definition of the activity and the extent of RIM greater than 52.9 pCi/g. However, the bullets below list four borings. In general, there appear to be multiple discrepancies related to boring names, sample intervals and sample numbers in this section that need to be resolved and revised in the text. For example, the depth of the composite sample listed for A2-PB-143-A is 15-20 feet, but according to the boring log, the composite results for this depth (1.62 pCi/g combined radium and 1.95 pCi/g combined thorium) do not appear to need re-sampling. However, the composite results for the 0-5 feet depth interval in this boring (1.72 pCi/g combined radium and 44.6 pCi/g combined thorium) do indicate additional sampling is justified. Data in Table 5.3 of this report indicates that 5 one-foot samples were collected from the 0-5' interval, but none of them exceeded the initial composite results. In another example, only one sampling interval (15 to 20-feet) is listed in the bullets for boring A2-PB-156; however, the 10-15 foot interval and the 15 to 20 foot interval have similar results, potentially justifying

resampling in 1-foot intervals (the A2-PB-156 10 to 15-foot composite sample results are 3.01 pCi/g combined radium and 34.1 pCi/g combined thorium and the 15 to 20-foot composite results are 2.93 pCi/g combined radium and 32 pCi/g combined thorium). According to Table 5-3, both intervals appear to have one additional grab sample collected at 13.5 to 14-feet and 19.5-20 feet respectively rather than in one-foot intervals as indicated in the text even though the boring log indicates 100% recovery for both. In addition, there are no borings named A2-PB-154 and A2-PB-154-A. The EPA assumes that these are meant to reference ISL-EA-154 and ISL-EA-154-A. Similar to A2-PB-156, the 5 to10-ft composite result for ISL-EA-154 is 4.34 pCi/g combined radium and 58.0 pCi/g combined thorium. However, only one additional grab sample was collected from the 7 to 7.5-ft interval which had a result of 4.78 pCi/g combined radium and 110 pCi/g combined thorium even though recovery was over 90%. This also appears to be the case for ISL-EA-154-A for the 15 to 20-ft interval although recovery for this interval was only approximately 70%. Review the text, logs, and data for accuracy. Revise the text by making sure it correctly describes the sampling that was performed for these efforts. In addition, update the bullets so that they reflect the correct boring names and depth intervals from which the supplemental grab sampling occurred.

22. **Section 3.5.2, page 3-10, general comment.** The EPA acknowledges that the intent of this section appears to be to summarize additional borings and sampling to support DIO #9 related to disposal facility waste acceptance criteria and field sampling plan (FSP) Variance Request 4. However, no standalone section specifically summarizing borings and samples that were collected for this objective was included in Section 3. As a result, there is no discussion of the planned non-radiological sampling and analyses related to this design objective. The EPA acknowledges that the details of this sampling and analysis are included in Appendix I and a summary of the evaluation of the results is included in Section 5.7. Regardless, expand this section by briefly discussing the requirement to analyze samples for non-radiological constituents related to DIO #9 and include a discussion of the locations and rationale for the locations for these samples. Alternatively, create separate section summarizing this information as has been done for other design investigation objectives.

23. **Section 3.5.2, page 3-10, third paragraph in the section.** Consider whether the terminology "*in situ blending*" included in the last sentence of this paragraph should be revised to be consistent with the terminology "*concentration averaging*" described Appendix I. Revise as necessary by using the terminology that most accurately describes the excavation process that is being evaluated for the 90% RD.

24. **Section 3.5.2, page 3-11, first full paragraph.** The last sentence of this paragraph states that composite samples were collected following FSP Section 2.4.3.5 for the additional waste borings and samples described in FSP Variance Request 4. However, that does not appear to be correct as both the originally planned and additional waste acceptance borings and samples were discrete samples collected from a six-inch depth interval. Revise as necessary.

25. **Section 3.8, page 3-12, first paragraph in the section.** Modify the second sentence by replacing the words "*better define RIM distribution in those areas*" with "*to determine whether RIM was present in those areas*".

26. **Section 3.9.3, page 3-16, general comment.** Include in this section the specific FSP addendums that required the step-out borings in the Buffer Zone and Lot 2A2 being described in this section.

27. **Section 3.10, page 3-17, third paragraph.** This paragraph states that boring locations FCC-SED-01, FCC-SED-02, and AC-SED-11-A are located adjacent to the Earth City Flood Control Channel which could erroneously be interpreted as being on the bank of the water body rather than within it. The EPA understands that these sediment samples were collected within the Earth City Flood Control Channel from areas underwater and/or beyond the drainage culvert that directs stormwater from Lot 2A1/2A2 and the Buffer Zone to the flood control channel. Revise the paragraph so that it is clear that sediment samples were collected from within the flood control channel along the estimated stormwater flow path downgradient of Lot 2A1/2A2. It may be helpful to specifically state the depth of the water to the mudline at the time of sampling.

28. **Section 3.12.2, page 3-21, first paragraph.** This paragraph states that observations of potential putrescible waste during sample processing were documented on boring logs. Clarify in this section how these observations were documented to support review of the boring logs for this information.

29. **Section 3.16.2, page 3-25, second paragraph.** The paragraph states, as required by Section 2.9 of the FSP, that the limit of the geotextile overlying the consolidated soil/waste investigation-derived wastes (IDW) was surveyed by the field team using the GPS surveying methods to approximately identify the location and elevation of the final IDW surface. However, Section 2.9 of the FSP also states these data will be recorded and presented in the DIER. Add this data to the DIER and reference it in this section or add a figure depicting the location within the NCC area within Area 2 where this IDW was consolidated and covered.

30. **Section 3.16.3, page 3-25, general comment.** The EPA acknowledges, as approved in the FSP, that soil and landfill waste cores will be archived through the design investigation and finalization of the design, in case additional samples are required; and further, that the soil archives will be disposed of during implementation of the RA and in accordance with criteria in the OU-1 RODA. However, this future RA disposal was not approved in the FSP for incidental wastes such as used PPE, disposable sampling materials, used PVC pipe, and materials used during decontamination activities and/or sampling of equipment for removal radiological contamination. The EPA notes that the FSP states Incidental IDW that meets the criteria would be disposed of as solid waste and Incidental IDW that does not meet the criteria would be disposed of at an appropriate off-site disposal facility. There is no need for any additional sampling of these materials to support the design of the remedy and so it should be disposed of within 30 days of the EPA approval of the DIER as stated in the first sentence of this paragraph and in Section 2.9 of the FSP. As a reminder, Section 3.11 of the Remedial Design Statement of Work in the third amendment to the administrative settlement agreement and order on consent (Docket No: VII-93-F-005) contains requirements for off-site shipments that must also be complied with.

31. **Section 4.1.1, page 4-2, first paragraph.** This paragraph states that 1.5% of the sample data were qualified during data validation as estimates "J" or "UJ" based upon precision and accuracy outliers. Clarify in this section or in an appropriate section within Appendix H whether "J" and "UJ" flagged data were treated as detects or non-detects in any presented analysis of this data.

32. **Section 4.1.1, page 4-2, second paragraph.** This paragraph discusses a small set of samples that were analyzed after the holding time limits had been exceeded. The EPA agrees in general that exceeding these holding times will not affect the analytical results for radionuclides with large half-lives like U-234 included as an example. In addition, the EPA agrees decay products from these long-lived radionuclides will be in secular equilibrium with decay products that have relatively short half-lives. An example of this would be Protactinium-234 which has a half-life of 1.17 minutes and so can be assumed to be in secular equilibrium with Th-234 at the time the sample was collected and similarly when it was analyzed regardless of whether the holding time was exceeded. However, secular equilibrium at the time of sampling cannot be assumed at this site for all radionuclides in the decay chain. Lead-210 for instance may not be in secular equilibrium with Radium-226 and Lead-210 has a half-life about 22.3 years. Based on the listed holding times, the EPA also agrees there would not be any issue with the Lead-210 analysis. However, the time between sample collection and analysis should be compared to the half-life of the radionuclide of interest, some of which may not be in secular equilibrium at the time of sampling with the parent radionuclide. Revise the paragraph to include these considerations.

33. **Section 4.2.2, general comment.** This section states data that were generated by GEL Laboratories were considered 100% complete (i.e., usable) from an analytical perspective. It's not clear what is meant by "*from an analytical perspective*" in this sentence. Regardless, this statement is misleading as the next paragraph states that a small subset of data was not useable for answering the principal study questions designated in the Quality Assurance Project Plan (QAPP). The EPA is not aware of any other uses of the data in the context of the DIER other than what is specified in the related QAPP. As an example, Section 4.1.2 discusses composite sampling results which failed the duplicate variability criteria and required the collection of 1-ft samples which were then used to make determinations regarding the presence or absence of RIM. Section 4.2.1.1 also discusses samples that did not meet the $1/10^{th}$ the action level measurement performance criteria specified in the QAPP. Revise this section and potentially other portions of Section 4 with regard to the completeness criteria to acknowledge the relatively small amount of lab data that did not meet the corresponding QAPP criteria. In addition, the EPA is aware that some samples were reanalyzed by the laboratory either at the request of Parsons because of relatively low method detection limits or by the laboratory itself. A discussion should be added to this section listing samples and/or lab reports that were reanalyzed so that documentation exists to appropriately excluded the original analyses.

34. **Section 5.1, page 5-1, first paragraph.** This paragraph states that perimeter borings were drilled to delineate the extent of MSW and/or RIM along the perimeters of OU-1 Areas 1 and 2. The paragraph also states, six borings were drilled south of the estimated Area 2 boundary within the ISL and CDL at the request of USEPA to confirm the boundary between OU-1 and OU-2. The EPA notes that the perimeter borings placed immediately adjacent to the southern portion of the

estimated Area 2 boundary were also collected to confirm the boundary between OU-1 and OU-2 as stated in the DIER. Revise the text accordingly.

35. **Section 5.1, page 5-1, second paragraph.** This paragraph states that the extent of MSW was not estimated for the southern extent of Area 1 along the North Quarry of Bridgeton Landfill or the southern extent along the Area 2 boundary with the CDL and ISL because OU-2 has its own remedy and remedial process to address solid waste. This explanation is misleading and should be removed. It implies all the waste south of the previously estimated Area 2 boundary is subject to the OU-2 remedy when design investigation data show that RIM is present in solid wastes south of this previously estimated boundary and the OU-1 and OU-2 boundary will be revised accordingly. The EPA notes that the extent of MSW along the southern portions of Areas 1 and 2 cannot be estimated because these areas are coincident with other landfill cells that also contain solid waste. As a result, the southern portions of these two areas are defined by the presence of RIM. Revise the text accordingly.

36. **Section 5.1.1.1, page 5-2, general comment.** The EPA generally agrees that it is reasonable to estimate the MSW boundary halfway between the presence of MSW in Design Investigation perimeter borings or step-out borings and the absence of MSW in subsequent Design Investigation Step-out borings. This is acceptable because, for the most part, perimeter borings and step-out borings were closely spaced so the amount of uncertainty between those borings is relatively small. However, greater uncertainty exists for some portions of the proposed MSW boundary and will need either additional explanation and lines of evidence to support the MSW boundary, or additional shallow MSW borings that could be collected during confirmation sampling. The EPA also notes that portions of the proposed Area 1 MSW boundary are inconsistent with the approximate edge of refuse depicted in Figures 5-9 and 5-10 from the RIA without any new data or borings to inform this change. This is in part why additional explanation is needed to justify the proposed MSW boundary. Additional specific feedback is provided below on MSW boundary areas that will need additional justification.

    a. It's not clear how the outer extent of MSW was established between A1-PB-115/A1-PB-115-A and A1-PB-116. The text states that the boundary was established halfway between borings with and without MSW. However, there is no boring without MSW beyond A1-PB-115-C.
    b. Between stations A1-450 and A1-1350, the text states the MSW boundary was generally placed at the current toe of the landfill slope. It's not clear what is meant by "*current*" nor is it clear how this was identified. In several instances, it appears that the proposed MSW boundary was pulled inward and inside the Area 1 fence, such as in the general area around A1-PB-111 without sufficient justification. It's also not clear how the proposed MSW boundary was established in the general area around A1-PB-105 and A1-PB-066-R2.
    c. Between stations A1-1350 and approximately A1-1650, two separate boundary estimates are depicted in figure 5.1A. The EPA notes that the difference between the "*Estimated Extent of MSW*" and "*Estimated Extent of Potential MSW*" is unclear. There should only be one line representing the "*Estimated Extent of MSW*". The "estimated extent of potential MSW" line should be deleted and the "*Estimated Extent of MSW*" line should be

redrawn based on the existing data. The respondents only collected one perimeter boring, Boring A1-PB-067, on the pad north of the transfer station and west of the previously estimated Area 1 boundary and it contained MSW greater than 2-ft thick. This invalidates the current location of the "*Estimated Extent of MSW*" boundary on Figure 5.1A depicted between these stations and no additional data was collected to bound MSW west of A1-PB-067. If the current location of the "estimated extent of potential MSW" is converted to the "*Estimated Extent of MSW*", additional explanation is needed to justify how that line was established and why it doesn't extend further to the west coincident with the eastern side of the ISL.

d. Between stations A1-1650 and A1-1950, additional explanation and lines of evidence are needed to justify placement of the MSW boundary in a straight line that follows the eastern side of the Transfer Station rather than like what was done in other locations such as placing it halfway between borings with and without MSW. The EPA acknowledges that the paragraph after the bullets states this was selected based on Site topography and the distance between the presence of MSW in parent borings and its absence in step-out borings. This sentence doesn't include enough information to evaluate how this portion of the MSW boundary was established.

37. Section 5.1.1.1, page 5-2, last paragraph. This paragraph states "*current activities at the Transfer Station prevented step-out borings from being drilled further to the west in the apron area.*" Based on EPA's observations of the transfer station while borings were being drilled on Sundays, including boring A1-PB-067, this statement does not appear to be accurate and should be removed. EPA encouraged the respondents to drill additional borings in this area to delineate the MSW but did not require it because the apron and adjacent road currently provide a cover over any MSW that may be present. However, because no additional data was collected, MSW must be assumed to be present underneath these covers.

38. Section 5.1.1.2, page 5-3, general comment. The EPA agrees that the outermost boundary of RIM depicted between station A1-0 starting at boring A1-PB-116 and station A1-1350 ending at boring A1-PB-066-R2 reasonably represent the data. The EPA also agrees that the secondary deposition areas of RIM in proximity to the A1-PB-114 series, the A1-PB-111 series, and borings A1-PB-107 through A1-PB-106 must be sampled to confirm the 7.9 pCi/g RIM boundary as stated in the text of Section 5.1.1.3. The EPA notes that this confirmation sampling could be conducted prior to the excavation of these materials as has been proposed for the rest of the site, with the possible exception of the A1-PB-114 area due to complications with the high voltage power lines and proximity to St. Charles Rock Road. Additional specific feedback on the 7.9 pCi/g RIM boundary around Area 1 is provided below.

a. It's not clear how the boundary between the "*Estimated Extent of RIM greater > 7.9 pCi/g*" and the "*Estimated Extent of Secondary Deposition RIM > 7.9 pCi/g*" was established. Further, it's not clear how or whether this inner boundary will be used to inform design of OU-1. In any case, the RODA requires the OU-1 cover to extend over all RIM whether present in soils or MSW. The EPA further acknowledges that this cover extent can be reduced if all RIM and, if present, MSW is excavated and confirmed through sampling from the areas depicted as "secondary depositional".

b. The step-out boring for A1-PB-104 is A1-PB-104-A_PZ-112 and is located approximately 80 feet away from the original boring. Some additional discussion is needed to explain how the extent of RIM greater than 7.9 pCi/g was established in this area between A1-PB-066-R2 and A1-PB-067. In addition, please add a label to A1-PB-104-A_PZ-112 to figure 5.1C since it is an Area 1 step-out boring.

c. Additional explanation is needed to explain how the extent of RIM greater than 7.9 pCi/g was estimated between A1-PB-067 and A1-PB-101. This explanation must include why the estimated extent of RIM has been located outside of A1-PB-103, A1-PB-102, and A1-PB-101 even though those borings did not contain RIM. In addition, the distance between A1-PB-102 and A1-PB-103 is approximately 250 feet which the EPA notes is greater than the maximum distance between perimeter borings of 200 feet, except where historical borings and data were present as described in the first paragraph of Section 3.4. The explanation for the RIM extent in this area must also include discussion of the results of the borings closest to the boundary collected prior to the Design Investigation, e.g., 01-2, 1C-2RAGP and 1C-6. Ultimately, no sampling data exists to bound the extent of RIM on this portion of the east side of Area 1 between A1-PB-102 and A1-PB-103, therefore, the EPA will require RIM testing of the materials underneath the transfer station and apron area between these borings should either ever be removed or resurfaced.

d. **(1)** With the exception of A1-PB-117, A1-SB-076, A1-SB-164, the entire extent of RIM between station A1-1800 and A1-3089 is defined by borings collected prior to the design investigation. In addition, neither A1-SB-078 or A1-SB-164 were perimeter borings and so neither were required to characterize the entire thickness of waste down to the alluvium below. In addition, A1-SB-164 had 50% recovery or less for the 0 to 4-ft, 4 to 8 -ft, and 16 to 20-ft cores and no recover for the 12 to 16-ft core. As a result, these borings do not provide sufficient information to delineate the extent of RIM greater than 7.9 pCi/g. In all other areas of the site, "PB" borings were specifically proposed to evaluate the accuracy of the existing boundaries and it is unclear why this protocol was not followed for the southern boundary of Area 1.

(2) In addition, several of the borings being used to define the extent of RIM between these stations are from the original remedial investigation ("MH" borings). The EPA acknowledges that a boring in the vicinity of WL-119 was redrilled using a sonic rig as part of the Phase 1-C work which did extend through the entire waste mass and into alluvium. However, the borehole summary sheet indicates most of the core runs were ten feet in length and several had 5 feet or less recovery. Further, the borehole summary sheet identifies a top and bottom interval of RIM based on a fairly well-defined downhole gamma peak of about 2 to 3 times the baseline for this borehole from 31.5 to 33 feet which corresponds to one of the intervals of no recover. In any case, the boring logs for these pre-DI borings should be reviewed, especially the original "MH" RI borings, to confirm whether they were drilled through the entire waste mass into the alluvium and whether sufficient data is available to define the extent of RIM since these borings were not collected consistent with Design Investigation perimeter borings which may have resulted in less recovery and fewer samples.

(3) Lastly, the spacing between the WL-119 borings, WL-109D-MH, and WL-108-MH exceeds 200 feet and all of these borings are historical borings so it's not clear whether there is sufficient additional information to support defining the extent of RIM with spacing that exceeds the 200-foot maximum discussed in Section 3.4. In addition, boring 8-1 is located only about 50 feet from the estimated extent of RIM line in which RIM was found despite having poor recovery in the waste portion of the boring between 0 feet and 20 feet below ground surface. The EPA acknowledges that expanding the estimated extent of RIM to other more closely spaced borings would increase the portion of the Site that must be managed as part of OU-1 and that overlaps with the Bridgeton Landfill. The EPA suggests considering collecting borings during confirmation sampling at the base of the North Quarry slope in this area to confirm the RIM doesn't extend underneath the above grade portion of Bridgeton Landfill in this area.

39. Section 5.1.1.3, page 5-3, general comment. In the second paragraph of this section, A1-PB-114-A is listed twice in the list of borings with RIM greater than 7.9 pCi/g. Revise as necessary. In addition, the sentence at the bottom of the page states, "*The extent of MSW and RIM has been delineated around the perimeter of Area 1, except in areas of borings A1-PB-103, A1-PB-067, and A1-PB-114-I, as discussed above.*" Additional description is necessary to understand more specifically what portions of the extent of MSW and/or RIM around Area 1 have not been delineated. Revise this in consideration of the EPA's other comments on Sections 5.1, 5.1.1.1, and 5.1.1.2.

40. Section 5.1.2.1, page 5-3, general comment. The EPA generally agrees that the estimated MSW boundary is reasonably estimated from the design investigation data in this area. Specific feedback on text that needs some additional clarification is provided below.

a. Additional description must be added to the first and last bullet of this section to explain why it is not possible to define the extent of MSW along these station IDs. In general, the language should be consistent with the last bullet of Section 5.1.1.1 for the southern portion of Area 1. For example, "*The MSW boundary cannot be estimated from Station A2-0 through Station A2-900 because CDL wastes are in this area and extend to the south. The presence of MSW is not a factor in determining the final cover extent in this area.*" and "*The MSW boundary cannot be estimated from Station A2-4200 through Station A2-5152 because ISL wastes are in this area and extend to the south. The presence of MSW is not a factor in determining the final cover extent in this area.*" In addition, any references to the previously estimated Area 2 boundary in these bullets must include the "*previously estimated*" description.

b. The second bullet states that the estimated MSW extent has been shifted towards the borings without MSW due to the steepness of the slope from Station A2-900 through Station A2-1200. Clarify how the slope steepness informs the likely extent of MSW. For example, clarify if the extent of MSW in these areas is based on a slope change/leveling out indicating a potential toe of the landfill.

c. The third and fourth bullets estimate the extent of MSW in part based on the 444-foot amsl topographic contour and the 452-foot amsl topographic contour. However, no explanation is provided in the text or Table 5.1a as to why these topographic contours inform the likely extent of MSW. Provide additional explanation.

d. Some additional information is needed with regard to how the toe of the landfill was estimated between stations A2-1500 and approximately A2-1800 (between borings A2-TH-126 and A2-PB-136 and the northernmost corner of Area 2) in the fifth bullet. In addition, it's not clear what is meant by, "*the boundary is placed between borings with MSW and the current toe of the landfill slope*" as stated in the fifth bullet. This could be interpreted to mean that the MSW boundary has been established on the landfill slope or even at the top of the landfill slope closer to borings which contained MSW. Consider whether a more accurate statement would be, "*the boundary is placed between the current toe of the landfill slope and borings without MSW*". This appears to be an accurate description for the portion of the MSW boundary in the vicinity of perimeter borings A2-PB-129 through A2-PB-136.

e. It's not clear what is meant by "*the historical survey of the rock buttress layer*" in the sixth bullet. For example, clarify if this is referencing a survey of the toe of the landfill slope prior to construction of the rock buttress or something else. If this survey has previously been depicted on a figure, include a reference to that report and/or figure.

41. Section 5.1.2.2, pages 5-4 and 5-5, general comment. In several instances it appears that the estimated extent of RIM has been defined based on either "SB" borings or "TH" borings. However, these borings were not drilled and sampled consistent with perimeter borings. As stated in comments for Section 5.1.1.2 for Area 1, in most cases these borings do not provide sufficient information to delineate the extent of RIM greater than 7.9 pCi/g. For example, core materials were recovered from A2-SB-044 near station A2-1200 only down to about 13.5-feet. In addition, recovery was only 25% for the 4 to 8-ft interval, 60% for the 8 to12-ft interval, and 40% for the 12 to 16-ft interval. Lastly, the combined thorium result for the 4 to 8-ft interval was 6.69 pCi/g. At a minimum, additional explanation is needed to justify use of the SB and/or TH borings for estimating the extent of RIM greater than 7.9 pCi/g. Borings which do not extend through the entire waste mass and into alluvium are unlikely to be accepted by the EPA for this purpose. Additional specific feedback is provided below.

a. Add the words "*previously estimated*" before "*Area 2*" in the first bullet on page 5-4. In addition, the reference to Section 5.2.3 should apparently be Section 5.1.3. Revise as appropriate.

b. The second and third bullets on page 5-4 and the first bullet on page 5-5 all have the exact same language to describe how the RIM boundary is delineated. However, portions of each of these three sets of station IDs utilize "*SB*" and "*TH*" borings to establish this boundary. Without additional support justifying these borings for use as perimeter borings, the EPA does not approve of these portions of the estimated extent of RIM. The

EPA notes that the proposed OU-1 cover depicted in figures 6.2 and 6.5 appears to extend beyond all the borings regardless.

c. As mentioned in comments on the previous section, clarify what is meant by the "*historical survey of the rock buttress layer*" in the second bullet on page 5-5. It's also not clear why two portions of the primary estimated extent of RIM greater than 7.9 pCi/g appear to extend beyond the estimated extent of MSW depicted in figure 5.1B. This includes the portion of the boundary near A2-PB-126 and WL-234-CT. The EPA notes that the proposed OU-1 cover depicted in figures 6.2 and 6.5 does not extend over these borings. The text should clarify if the intent is to excavate and sample these areas during remedial activities to confirm the 7.9 pCi/g RIM boundary like what is specified for the secondary depositional boundaries.

d. **(1)** In part, the extent of RIM from Station IDs A2-3750 to A2-4200 is defined by A2-SPW-003. While this boring is neither an "*SB*" or "*TH*", it also was not drilled and sampled consistent with perimeter borings nor did it extend through the entire waste mass. In addition, this boring had limited recovery from the 0 to 4-ft, 8 to 12-ft, and 16 to 20-ft intervals and had no recovery from the 12 to 16-ft interval.

(2) The distance between A2-SPW-003 and WL-236-MH is about 200-feet, which is stated generally to be the maximum spacing between perimeter borings. However, located about 25-feet from the estimated RIM extent and directly in between these borings is A2-SB-077 which has RIM. RIM was also found about 100-feet south of WL-236-MH in A2-SB-080. Review of the borehole summary sheet for WL-236-MH included in Appendix L of the RIA does not indicate that this boring was extended through the entire waste mass and into the alluvium below potentially due to auger refusal at 37-ft below ground surface. In addition, only two samples were taken from this boring.

(3) Because of these uncertainties and because these borings were not drilled and sampled like perimeter borings, the EPA does not approve of this portion of the estimated extent of RIM. Again, the EPA notes that the proposed OU-1 cover depicted in figure 6.2 and 6.5 appears to extend beyond these borings.

e. Add the words "*previously estimated*" before "*Area 2*" in the fourth bullet on page 5-5. The reference to Section 5.1.4 should apparently be Section 5.1.5. Revise as appropriate. In addition, further explanation is needed to support the establishment of the RIM boundary between stations A2-4800 and A2-4950. A2-SB-009 appears to have been one of the borings without RIM used to define this boundary. In addition to being an "SB" boring rather than a perimeter boring, RIM was found in several nearby borings located to the north (A2-SB-130), west (A2-TH-091), and south (AC-26A and A2-TH-092). Again, because of these uncertainties, the EPA cannot approve of this portion of the estimated extent of RIM without additional justification. Unlike other areas, the proposed OU-1 cover depicted on figures 6.2 and 6.5 does not extend beyond these borings.

42. Section 5.1.2.3, page 5-5, general comment. An additional bullet is needed in this section to describe how the estimated extent of secondary deposition RIM greater than 7.9 pCi/g was established between A2-TH-092 and A2-PB-162 unless the primary extent of RIM is moved out to include this area in response to comments provided on the previous section.

43. Section 5.1.2.3, page 5-5, first bullet. Additional explanation is needed to justify that WL-244-MH "*is delineated by borings with combined thorium or radium less than 7.9 pCi/g*". Include a summary description of the most likely mechanism for this deposition similar to what is stated in the second and third bullets. It's not clear how the estimated extent of secondary depositional RIM greater than 7.9 pCi/g was established in this area given that Figure 5.1D only shows WL-246-MH and A2-PB-166 beyond the boundary. The text should specify whether any sediment sampling was considered when estimating this boundary. Revise for clarity.

44. Section 5.1.2.3, page 5-5, second bullet. Some additional description of which borings with combined thorium and radium less than 7.9 pCi/g were used to delineate the secondary depositional boundary is necessary. For example, either add to Figure 5.1D or specify in the text which borings south of AA02S, AA03S, AA04S and S10 were used to form the southern portion of this boundary.

45. Section 5.1.2.3, page 5-5, third bullet. It appears the reference to Section 5.1.2.1 in this bullet and in the short paragraph that follows should instead be Section 5.1.3. Revise as appropriate.

46. Section 5.1.4, page 5-6, first paragraph. This paragraphs states two borings south of the estimated Area 2 boundary and within the CDL were initially drilled to confirm that the outer boundary of RIM occurrences is sufficiently defined to support the RD. The EPA notes that these borings were required as stated in Enclosure A of the EPA's July 13th, 2022 letter to confirm the boundary between OU-1 and OU-2. Revise the text accordingly.

47. Section 5.1.4.1, page 5-6, general comment. For consistency with the bullets defining the extent of RIM in Area 2, an additional bullet should be added to this section to describe stations CDL-2850 to CDL-3688. For example, "*RIM above 7.9 pCi/g was encountered in the initial borings in the north side of the CDL and several of the original perimeter borings and their step-outs from station CDL-2850 through CDL-3688, along the previously estimated Area 2 boundary with the CDL. The RIM greater than 7.9 pCi/g extends through these stations to the southeast.*"

48. Section 5.1.4.1, page 5-6, first bullet. The EPA notes that because A2-SB-169 was drilled and sampled as a hybrid boring it is reasonable to utilize for the purposes of establishing the extent of RIM between stations CDL-0 and CDL-1200. However, CD-EA-199-D was not drilled and sampled as a hybrid boring and did not extend through the entire waste mass. This boring was only drilled to 20 feet as a step-out for CD-EA-199-C to support bounding shallow RIM greater than 52.9 pCi/g north of both CD-EA-199-C and CD-EA-200-C. In addition, recovery was only 25% for 4 to 8-ft and 8 to 12-ft intervals and 37% for the 16 to 20-ft interval for an overall recover rate of 58%. Lastly, a downhole gamma log was not performed for this boring which was standard procedure for perimeter borings in waste and the other borings collected from the CDL

for similar purposes. Because of these uncertainties and the fact that this boring was not drilled for the purpose of defining the extent RIM greater than 7.9 pCi/g nor sampled in a similar manor, the EPA cannot approve an extent of RIM defined by CD-EA-199-D.

49. **Section 5.1.4.1, page 5-6, second bullet.** The EPA acknowledges that estimating the extent of RIM greater than 7.9 pCi/g based in part on analysis of historical aerial photography is reasonable between stations CDL-1200 and CDL-1350. However, the purpose of investigation work specified in FSP Addendum 4 and FSP Addendum 6 was in part to confirm with sampling the RIM extent estimated from evaluation of historical aerial photography and other relevant evidence. This included collecting step-outs for borings with combined thorium and combined radium greater than 7.9 pCi/g. Step-out borings were not collected from CD-EA-199-E to bound the extent of RIM to the northwest between A2-SB-165-I, A2-PB-162, and CD-EA-198-R or to bound the extent of RIM to the southwest between A2-SB-165-G and CD-EA-208-A. In general, it appears that the extent of RIM greater than 7.9 pCi/g has been estimated nearly all the way to those borings. In any case, either during confirmation sampling or after excavation of the secondary depositional RIM areas adjacent to the ISL, sampling must be conducted to confirm the extent of RIM to the northwest of CD-EA-199-E between it and A2-PB-162 otherwise the OU-1 cover will need to be extended to the nearest borings without RIM in this area. In addition, some confirmation sampling is needed to the southwest of CD-EA-199-E between A2-SB-165-G and CD-EA-208-C.

50. **Section 5.1.4.1, page 5-6, third and fourth bullets.** The step-out boring collected to bound the extent of RIM greater than 7.9 pCi/g from CD-EA-190-A and CD-EA-191 was CD-EA-191-A, yet the estimated extent of RIM boundary has been established very close to CD-EA-191 and nearly 70 feet away from CD-EA-191-A. It's also not clear how the site entrance road, as determined from the 1973 aerial photo, provides a reasonable boundary for the extent of RIM, especially given that one of the mechanisms of secondary depositional RIM being considered in this report is vehicles moving from areas of the Site with RIM to other areas of the Site. In addition, this particular portion of the CDL was disturbed after 1973 in part for road improvements and parking areas around the present-day entrance road and in part to construct the stormwater drainage infrastructure between the storage area on the CDL and the entrance road. Therefore, confirmation sampling will be needed to confirm the extent of RIM between CD-EA-190-A, CD-EA-191, and CD-EA-191-A or the extent of RIM must be extended to CD-EA-191-A.

51. **Section 5.1.5, page 5-7, first paragraph.** This paragraphs states four borings located south of the estimated Area 2 boundary and within the ISL were initially drilled to confirm that the outer boundary of RIM occurrences is sufficiently defined to support the RD. As stated in the comment for Section 5.1.4, these borings were required as stated in Enclosure A of the EPA's July 13th, 2020, letter to confirm the boundary between OU-1 and OU-2. Revise the text accordingly.

52. **Section 5.1.5.1, page 5-7, second bullet.** Given that the distance between ISL-EA-181-B and ISL-EA-180 is greater than 250 feet and ISL-EA-181 from which RIM was found is located only about 50 feet from the estimated RIM greater than 7.9 pCi/g boundary that connects these two

borings, uncertainty exists with regard to the extent of RIM southeast and east of ISL-EA-181. Either a confirmation boring is needed between ISL-EA-180 and ISL-EA-181-B or the extent of RIM boundary needs to be expanded by forming a right triangle directly south of ISL-EA-180 and east of ISL-EA-181-B.

53. **Section 5.1.5.1, page 5-7, fourth bullet.** This bullet states that the small portions of the estimated extent of RIM greater than 7.9 pCi/g between station ISL-2150 and station ISL-2250 is defined by the MDNR Area #3 permit boundary. It's difficult to determine which portion of the extent of RIM near these station ID's is defined by this permit boundary because that boundary was not included on Figure 5.1F. However, based on a review of Figure L-1 and comparison to Figure 5.1F, it does not appear that the estimated extent of RIM greater than 7.9 pCi/g between station ISL-2150 and station ISL-2250 is based on the MDNR Area #3 permit boundary as stated in the text. Rather, it appears that this permit boundary might have been used to define the estimated extent of RIM greater than 7.9 pCi/g between stations ISL-1800 and ISL-2150. Review this permit boundary and consider adding it to Figure 5.1F if it will be used to define the estimated extent of RIM. Revise the bullet as necessary for accuracy.

54. **Section 5.1.5.1, page 5-7, fifth bullet.** This bullet states that the RIM boundary has been established at the "*current toe of the landfill slope*" between stations ISL-2250 and ISL-2650. It's difficult to determine how the "*current toe of the landfill slope*" was established based on Figure 5.1F. The EPA acknowledges that the estimated extent of secondary depositional RIM extends beyond this RIM boundary in this same area. However, the EPA notes that the primary RIM boundary goes back and forth across the previously estimated boundary for the Inactive Sanitary Landfill also depicted on Figure 5.1F. In addition, the EPA notes that both boundaries are different from the inactive landfill boundary depicted on Figure 3.8 of the DIER. This indicates that there is some uncertainty regarding the extent MSW along this portion of the ISL. Given the overall size and the potential to need to excavate relatively newer MSW from the ISL in this area to address the RIM, confirmation boring samples should be collected in this area to delineate the extent of MSW. It's not clear why the former edge of the Area 2 entrance road shown in the September 1973 aerial photograph (Figure L-8 and L-8E in Appendix L) is not being used to establish the potential primary boundary of RIM between these stations.

55. **Section 5.1.5.2, page 5-8, second bullet.** This bullet states that the secondary depositional RIM boundary is delineated by borings with maximum results of thorium or radium less than 7.9 pCi/g. The EPA notes that two step-out borings, A2-SB-165-G and A2-SB-165-J, contain RIM but no step-out borings were collected. The EPA acknowledges that in the case of A2-SB-165-G, the secondary depositional boundary of RIM was extended out to be contiguous with the RIM boundary for the ISL. This was not done for A2-SB-165-J and so the EPA agrees that the outer extent must be sampled to confirm that all the RIM greater than 7.9 pCi/g has either been removed or will remain in place beneath the landfill cover as stated in the paragraph below the bullet. In any case, revise the bullet by noting the two exceptions described in this comment.

56. **Section 5.2, page 5-8, section title.** The title of this section is "*Characterization of RIM Greater Than 52.9 pCi/g Within the Top 16 feet (DIO #2)*". The EPA notes that DIO #2 states, "*Locations with RIM >52.9 pCi/g will be further characterized to design an optimized excavation that meets*

the RODA requirements." DIO #2 does not include the "*within the top 16 feet*" limit in this section title. Regardless, Table 5.1e and Figures 5.1G, 5.1H, and 5.1I which support the text in this section all include the following in their titles, "*Less Than 20 Feet Below DI Datum*". The EPA recommends the title of Section 5.2 be revised to avoid confusion and for consistency with the related tables and figures.

57. Section 5.2.1, page 5-8, general comment. The last sentence of this section states, "*To avoid conflict with the result of the geostatistical model and the resultant estimate of the extent of RIM greater than 52.9 pCi/g in Area 1 and 2, refer to the draft Technical Memorandum on the Extent of RIM Greater than 52.9 pCi/g dated December 2022.*" The EPA notes that this memo and the corresponding model estimate the extent of RIM greater than 52.9 pCi/g within several of the areas discussed in Section 5.2.2, Section 5.2.3, and Section 5.2.5 including around ISL-EA-154, A2-SB-165-B-R, and the entirety of the Buffer Zone and Lot 2A2/2A1. In addition, this memo and the corresponding model identify two locations that are in the vicinity of the areas described in these sections but not discussed or depicted on the corresponding figures. This includes RIM greater than 52.9 pCi/g around surface sample AA02S on the north side of Lot 2A2 near the toe of the Area 2 landfill slope and around A2-PB-145 near the northwest corner of the CDL and previously estimated Area 2 boundary. Because all these occurrences of RIM greater than 52.9 pCi/g are being estimated from the geostatistical model and were presented in extent of RIM memo, they are not required to be included in the DIER in accordance with paragraph 3.6(c)(7) of the revised RD SOW dated July 18th, 2022. The EPA agrees conflicts should be avoided between these two documents and recommends the estimates of the extent of this RIM greater than 52.9 pCi/g for areas which are already being modeled be removed from the revised DIER.

58. Section 5.2.2, page 5-9, first and second full paragraphs. The first sentence of the first paragraph states that the extent of RIM greater than 52.9 pCi/g for the Area 2 entrance road is shown on Figure 5.1F. It appears the intended reference is Figure 5.1I. Review and revise as necessary. In addition, the EPA agrees that there is sufficient data around A2-SB-165-B-R to estimate the extent of RIM greater than 52.9 pCi/g in this area. However, as stated in the previous comment, the EPA suggests removing the specific extent estimates from the revised DIER to avoid conflicts with the modeling estimates and limiting the discussion in this section to an acknowledgement that RIM greater than 52.9 pCi/g was found in A2-SB-165-B-R which was drilled in the Area 2 entrance road. Finally, the last sentence of the second paragraph states the isolated pocket of RIM greater than 52.9 pCi/g at A2-SB-165-B-R is anticipated to be excavated for off-site disposal and the outer extent sampled as part of remedial activities. The boring log for A2-SB-165-B-R identifies RIM with combined thorium at 72.2 pCi/g from 0.5 to 1-ft below DI Datum with 0.9-ft of inert fill on top of the 0 DI datum depth. The EPA notes that because the RIM greater than 52.9 pCi/g is within 8 feet of the 2005 ground surface, the RODA requires this RIM to be excavated and shipped to an off-site disposal facility. In addition, this area would also be subject to confirmation sampling per the related requirements in the RODA.

59. Section 5.2.3, page 5-9, first paragraph in the section. This paragraph states, "*Pursuant to FSP Addendum 8, 39 step-out borings were subsequently drilled to achieve horizontal and vertical delineation of RIM detections greater than 52.9 pCi/g in the remaining DUs (BZ1, BZ2, BZ3, 2A2-1, 2A2-8, and 2A1-1).*" The EPA notes that FSP Addendum 8 does not contain any

discussion of the intent to delineate occurrences of RIM greater than 52.9 pCi/g in the Buffer Zone or Lot 2A2. Rather it states, "*Addendum 8 has been prepared to collect additional samples below previously collected sample locations that may represent material above background.*" Revise the sentence in the DIER for accuracy. In addition, the decision unit IDs in the text are not consistent with the IDs used in Figure 5.4. The EPA recommends these IDs be made consistent between the text and the figures.

60. **Section 5.2.3, page 5-9, second paragraph and associated bullets.** The second sentence of this paragraph states that three isolated pockets of RIM greater than 52.9 pCi/g were detected in the Buffer Zone and Lot 2A2. However, Figure 5.1G shows four areas with RIM greater than 52.9 pCi/g within 20 feet below DI datum which appear to correspond to the four bullets below the paragraph. Revise for accuracy. The EPA also notes that surface sample AA02S located inside the current Area 2 fence between the fence and the toe of the slope of Area 2 also has RIM greater than 52.9 pCi/g. Some of the nearest clean borings are on Lot 2A2. The EPA suggests this occurrence of RIM greater than 52.9 pCi/g also be acknowledged in this section. Regardless, this occurrence must be acknowledged somewhere in Section 5.2.

61. **Section 5.2.3, page 5-9, last paragraph in the section.** The last sentence of this paragraph states, "*A plan for this excavation will be provided in a separate document.*" It's unclear what is meant by this statement as the plan for all the excavations are expected in either the Revised Excavation Plan or the 90% RD. Given that this section is discussing occurrences of RIM greater than 52.9 pCi/g less than 20 feet below DI datum, at a minimum the EPA expects this portion of the excavation of the Buffer Zone and Lot 2A2 to be included in the Revised Excavation Plan. Revise the sentence by specifying which design deliverable will include the plans for excavating RIM greater than 52.9 pCi/g in the buffer zone and Lot 2A2/2A1.

62. **Section 5.2.4.1, page 5-10, bullets at the top of the page.** The DIER does not include sufficient information to justify the estimated extent of RIM greater than 52.9 pCi/g at depth less than 20 feet below DI Datum summarized in these bullets, described in table 5.1e, and depicted on figure 5.1H. The description of the site features used to support this estimate between station CDL-900 and station CDL-1650 in the first bullet of the text have been applied to the estimate between CDL-1650 and CDL-1800 in Table 5.1e. Revise the text by resolving this inconsistency. In addition, it's unclear how site features identified in September of 1973 in figure L-8C from Appendix L provide a reasonable limit to assume as the outer extent of the RIM greater than 52.9 pCi/g in this area, especially since the estimated extent in almost all cases is immediately adjacent to the boring that has RIM greater than 52.9 pCi/g. Further, the EPA acknowledges that CD-EA-199-B is bounded by borings with less than 52.9 pCi/g (CD-EA-199-R, CD-EA-199-A, and CD-199-E); however, no boring exists between CD-EA-199-B and CD-EA-199-C. Therefore, additional justification is needed with regard to the outer extent of RIM greater than 52.9 pCi/g in this area. This should include how the boundary was established between CD-EA-199-B and the three borings listed above, as well as, why there is a large gap between the two RIM boundaries associated with CD-EA-199 and CD-EA-199-C.

63. **Section 5.2.5.1, page 5-10, first bullet.** The DIER does not include sufficient information to justify the estimated extent of RIM greater than 52.9 pCi/g at depth less than 20 feet below DI

Datum around ISL-EA-173. The description in Table 5.1e states that the extent follows the site road leading to the asphalt plant. However, Figure 5.1I depicts this as a circle centered around ISL-EA-173 and so it's not clear that the description in the table matches the figure. Nearly identical sized circles are shown on this figure around borings ISL-EA-154 and A2-SB-165-B-R even though distance to the clean borings that surround each of the three areas differ significantly. For example, the circle around A2-SB-165-B-R extends beyond borings that have RIM less than 7.9 pCi/g. In addition, Figure 5.1I doesn't show the three borings listed in Table 5.1e that were used to develop the estimated extent of RIM greater than 52.9 pCi/g around ISL-EA-173 (ISL-EA-184, ISL-EA-185, and ISL-EA-204). Revise the text, table, and figure to provide clarity and additional justification for the estimation of this boundary.

64. **Section 5.2.5.1, page 5-10, second bullet.** As stated in previous comments, the RIM greater than 52.9 pCi/g in the vicinity of ISL-EA-154 was estimated via the geostatistical model and presented in the Extent of RIM Tech memo. To avoid conflicts, the EPA suggests this bullet and the corresponding estimated extent be removed from the DIER and replaced by an acknowledgement that RIM greater than 52.9 pCi/g at depths less than 20 feet below DI Datum was identified at this boring.

65. **Section 5.3, page 5-11, paragraph after the bullets.** The EPA has provided several comments to Appendix H including recommendations on how to control the type 1 false positive error. Revise this paragraph as necessary to be consistent with changes made to Appendix H in response to the EPA comments. The EPA also notes, as discussed in comments to Appendix H, that it's currently unclear whether sufficient data has been collected at depths below 1-ft for all DUs to determine the depth of potential impacts and/or to design the excavation. Ultimately, if some additional data is necessary, it could be collected as part of the confirmation sampling in these areas either before or during excavation.

66. **Section 5.4.1, page 12, fourth paragraph.** Include in the discussion of the results of SEDIMENT 2016-03-16A, the closest samples collected around the stormwater conveyance piping and evaluate the potential for impacted sediments to be present inside this piping between these samples and the Earth City Flood Control Pond.

67. **Section 5.4.3, page 5-13, first paragraph.** The EPA acknowledges that the probing results may indicate a potential maximum depth of radiologically impacted sediments; however, the nature of the difference between hard and soft sediments has never been defined and the significant variability of the sediment probing depths suggests that there may be rocks or debris causing refusal at some locations. Therefore, some uncertainty remains with regard to whether the maximum probe depth is consistent with the depth of the soft sediment. In addition, no analytical data exists to demonstrate that the impacted sediments are within the estimated depth of soft sediments. Given that the highest concentration of radionuclide impacts in multiple sediment locations was found at the lowest depth and those depths are in some cases very close to the estimated soft sediment depth, some additional confirmation samples will be necessary to provide evidence that the radiological impacts do not extend below the estimated soft sediment depth. This can be done either before the remedial action if a safe and effective sampling technology can be deployed to this area or during the remedial action. The EPA notes that the

water level in this surface water body typically is at its lowest during the winter months and is usually significantly lower than when the probing and sediment sampling was conducted for the DI.

68. **Section 5.5, page 5-14, last paragraph in the section.** This paragraph states that moisture content reported along with radionuclide results will be used to augment the geotechnical sampling to provide a comprehensive dataset for evaluated moisture conditions in the tested materials. The EPA notes that samples collected from cores drilled via the sonic rig may not have moisture content representative of conditions in the landfill because water is used to cool the drill during operations and to help remove the core from the core barrel. In addition, while cores are wrapped in plastic and stored in closed containers, it's possible moisture conditions in the cores could change, especially over extended time frames and in higher temperatures. The EPA notes that some cores were sampled multiple times resulting in the core material being opened and closed on different dates. The EPA also notes that Section 4 of the DIER discusses that some radiochemical analyses were performed even beyond the standard 180 day holding times. The EPA agrees that the radiological analyses were not impacted by those extended holding times but is uncertain whether a moisture content analysis would be. These issues must be considered before utilizing this data in subsequent design deliverables.

69. **Section 5.7, 5-15, general comment.** Either in this section or Appendix I, include some discussion of the location of the samples that were analyzed for polychlorinated biphenyls (PCBs) and Resource Conservation and Recovery Act (RCRA) characteristics and how those sampling locations were selected. Clarify if these analyses were performed on samples collected from an area representative of RIM material that will potentially be excavated and shipped to an off-site disposal facility and whether any samples were biased towards areas that may be more likely to contain RCRA or TSCA waste.

    In addition, further description of concentration averaging should be summarized in this section. For example, it seems that this process is meant to describe that normal excavation and loading of the RIM during the remedial action using typical construction equipment will result in individual containers and/or shipments with average concentrations that do not exceed the Waste Control Specialists (WCS) waste acceptance criteria (WAC). This should be further discussed and expanded upon in Appendix I by including some description of either the estimated volume or thickness of RIM intervals that may exceed the WCS WAC to support the conclusion that this process is considered to be a practical and viable approach to manage this RIM.

70. **Section 6.1, page 6-1, third paragraph. (1)** Additional demonstration is needed in the DIER to support the outermost potential limit of the excavations and/or estimated extent of RIM greater than 52.9 pCi/g at depth less than 20 feet below DI Datum depicted on Figure 5.1h. See comments provided on Section 5.2.4.1 for more detail about what is needed. Ultimately, this excavation boundary will be subject to confirmation sampling consistent with the other excavation boundaries. **(2)** In addition, this paragraph states that a model using Thiessen polygons is recommended to define the excavation boundary in this area. This may be acceptable but some justification or reason why this approach is being recommended must be added to this section. **(3)** Lastly, the EPA generally expects the other areas of RIM greater than 52.9 pCi/g at

depth less than 20 feet below the DI Datum in the CD and ISL to be defined based on the geostatistical model as presented in the Extent of RIM Tech Memo except for the area around ISL-EA-173. The EPA acknowledges that the depth of RIM in that boring and its potentially isolated nature may not require any formal modeling. However, consideration of multiple lines of evidence will be necessary to demonstrate that this is an isolated pocket and in particular that RIM greater than 52.9 pCi/g is not present at depths less than 8 feet below DI Datum in the immediate vicinity to the south and east as the surface elevation decrease down the slope of the landfill. A description of the lines of evidence should be added to the DIER and the formal evaluation presented in the Revised Excavation Plan.

71. **Section 6.2, page 6-1, first paragraph in the section.** The last sentence of this paragraph states that the extent of the OU-1 final cover presented in the DIER is limited to the anticipated boundary extent only, and does not address the composition of the cover, which will be addressed in subsequent submittals. Clarify how the composition of the cover could impact this boundary and whether those impacts are likely to increase or decrease the final cover boundary, if known.

72. **Section 6.2, page 6-1, second paragraph in the section.** This paragraph states that MSW with a thickness greater than 2 feet and RIM (>7.9 pCi/g) that is shown to be outside the proposed Area 1 cover boundary on Figure 6.1 will be excavated and consolidated within the final cover limit during the remedial action. This is clear with regard to the east side of Area 1 adjacent to St. Charles Rock Road and the north side of Area 1 adjacent to the landfill entrance road. However, clarification is needed with regard to the estimated extent of MSW shown outside the cover boundary on the west side of Area 1 adjacent and south of the transfer station. In addition, the EPA understands that the RIM underneath the ethylene vinyl alcohol (EVOH) cover shown to extend beyond the proposed cover boundary near the southern corner of Area 1 will not be excavated. Lastly, the portion of the south side of Area 1 that is north of Bridgeton landfill near and east of the Area 1 south entrance gate appears to have no cover proposed. The EPA also provided some comments about whether the corresponding estimated extent of RIM greater than 7.9 pCi/g is reasonably supported in this area. Regardless, a landfill cover is still needed to address the solid wastes in this area. Revise the text in this paragraph as needed for accuracy and provide additional clarification about the areas discussed in this comment.

73. **Section 6.2, page 6-2, first full paragraph.** The EPA agrees as stated in this paragraph that the OU-2 ROD establishes a remedy for the MSW in OU-2. The EPA notes however that the design of the cover in these areas may require the boundary to be modified for "*constructability reasons*" consistent with what was described for the proposed cover for Area 2 on the previous page. The EPA expects the greatest likelihood for this to occur is near very steep slopes like the west side of the ISL. The EPA also expects those areas to be fully evaluated with regard to the design of the OU-1 cover system and addressed in the 90% RD.

74. **Section 6.2, page 6-2, third and fourth full paragraphs.** Figure 6.4 identifies a significant area of RIM greater than 7.9 pCi/g beyond the cover on the east and southeast sides of the ISL. The EPA has some concerns that due to the uncertainty in the extent of MSW in this area, excavation and relocation of the RIM and secondary deposition RIM beyond the cover extent could result in

the excavation of a significant volume of MSW. The EPA acknowledges Parsons' opinion that additional data collection is not required for the evaluation of the extent of the final cover in Area 1, Area 2, the CDL, or the ISL. However, the level of effort required to excavate and relocate the RIM is this area must be further evaluated and presented in the 90% RD. This evaluation must also consider the potential to encounter MSW during the excavation. Lastly, the EPA encourages the respondents to consider whether additional data collection to better characterize the extent of MSW and support the final design of the OU-1 cover in this area is warranted. The EPA notes this work could be conducted with the proposed pre-excavation confirmation sampling.

75. Section 6.3.1, page 6-2, general comment. The EPA has provided comments on Appendix H below that relate to some of the concerns with the statistical testing performed on the background reference area and Buffer Zone/Lot 2A2 decision unit data. Revise this paragraph as necessary to be consistent with changes made to Appendix H in response to those comments. The EPA also agrees that the additional sampling needed to define the depth of excavations in the Buffer Zone and Lot 2A2 could be performed in conjunction with the OU-1 confirmation sampling. The EPA expects the confirmation sampling plan will at least address the RIM greater than 52.9 pCi/g at depth less than 20 feet below DI Datum in these areas.

76. Section 6.3.2, page 6-3, second paragraph. As stated in comments to Section 5.4, some additional sampling is necessary to demonstrate if it is reasonable to assume the estimated depth of soft sediments based on the probing investigation encompasses the lowest possible depth of RIM in this water body and to address the related uncertainty. This sampling can either be done as confirmation sampling during the remedial action or as pre-excavation confirmation sampling. Revise the text to acknowledge this additional sampling will be performed.

77. Table 1.1. To improve awareness of the various phases of the design investigation and how those phases related to the design investigation objectives, add the related addendums and variance requests to the solution column of this table where appropriate. For example, the solution for objective 6 includes the following, "*recollection of a subset of historical sediment samples and collection of step out samples as part of Addendum 7.*" Objective 1 should include that additional borings and step-out borings as part of FSP addendums 1, 4, and 6 were collected to delineate the extent of RIM south of the previously estimated Area 2 boundary, additional borings installed around the other portions of previously estimated Area 2 boundary per FSP Addendum 2, and additional step-out borings installed around the previously estimated Area 1 boundary per FSP Addendum 3. Objective 2 should include additional borings based on preliminary RIM modeling and prior Design Investigation data per FSP Addendums 5 and 6. Objective 5 should include additional deeper sampling and step-out borings per FSP Addendum 8. Lastly, Objective 9 should include additional analyses and sampling to further characterize the RIM, particularly around high concentrations that may potentially be excavated per FSP Variance Request 4 and Addendum 6.

78. Table 1.2. Add a statement regarding FSP Variance Request 5 to GSMO 1 to acknowledge the additional gamma scanning conducted during the DI to support rescaling of gamma measurements collected at different times with a variety of detection equipment.

79. **Table 3.1.** For completeness, add an additional note to the table that acknowledges FSP Variance Request 4 and Variance Request 5 along with a short description of each requested variance.

80. **Figure 3.3.** It appears the symbol for A1-SPW-001 is covering the A1-SB-070 boring and A1-SPW-002 may be covering A1-SB-060. Revise the figure so that both boring types can be seen and add labels for A1-SB-060 and A1-SB-070, e.g., consider prioritizing the smaller additional boring's and interior boring's symbology to show on top of the large standpipe well symbology.

81. **Table 5.1c.** The "Area" column on the right shows that all but the last row of the table relates to Area 1. However, the last two rows to the right of the Area 1 designation contain borings in Area 2, the Buffer Zone, and Lot 2A2/2A1. In addition, the description of the borings that correspond to station ID A2-2400-A2-2750 seems to be referring to A2-PB-129 rather than A1-PB-129 (as stated), which doesn't exist. Revise the table as necessary for accuracy.

82. **Tables 5.1d and 5.1e, General comment.** It's not clear why both tables exist or how specific information was selected for inclusion in one versus the other. For example, the first five rows of Table 5.1d relate to the extent of RIM greater than 52.9 pCi/g in the Buffer Zone/Lot 2A2 and the road that leads into the Area 2 entrance gate between the ISL and CDL. All the RIM greater than 52.9 pCi/g in these areas is at depths less than 20 feet below the DI Datum. Similarly, the first row of Table 5.1e also relates to RIM greater than 52.9 pCi/g in this same road. In addition, unlike the titles of both tables, neither table describes the entire boundary of RIM greater than 52.9 pCi/g whether without any depth limit or less than 20 feet below DI Datum. For example, there is additional RIM greater than 52.9 pCi/g at depths greater than 20 feet below DI Datum in portions of Area 1 and Area 2 not included in table 5.1d. Regardless, characterization of RIM greater than 52.9 pCi/g at depths greater than 20 feet below DI datum is not necessary to design the remedy and as a result there is no related design investigation objective in the DIWP. Because of this, the data available to estimate the extent of RIM greater than 52.9 pCi/g described in Table 5.1d for the ISL and CDL were not collected for this purpose and so the corresponding estimations are highly uncertain but again, not necessary to complete the design. Further, the DIER text does not appear to discuss any of this information nor is there any figures depicting these RIM extents. Therefore, move the first five rows of Table 5.1d to Table 5.1e and change the title of Table5.1e to be representative of the specific RIM extents that are being described, e.g., 52.9 pCi/g boundary, less than 20 feet below DI datum, not included in the geostatistical model. The EPA notes that several of these 52.9 pCi/g RIM boundaries were included in the geostatistical model so consideration should be given to removing those rows from Table 5.1e as well. Lastly, remove the rest of Table 5.1d as it doesn't appear to be needed for the OU-1 design nor is it discussed further in the DIER.

83. **Figure 5.1B.** Add A2-PB-131 to this figure so it's clear where the extent of MSW in the vicinity was estimated relative to this perimeter boring.

84. **Figure 5.1E.** Add step-out borings CD-EA-191-A to this figure.

Appendix B-1

85. **Appendix B-1, General Comment.** Add a disclaimer to the beginning of Appendix B-1 acknowledging that the depth of a small number of core gamma and sampling results have been adjusted to align with downhole gamma results in accordance with Attachment 4 to the December 2022, Estimate of Extent of Radiologically Impacted Material Greater than 52.9 pCi/g Technical Memorandum. In addition, include Table 1 from Attachment 4 with the disclaimer so that there is a reference in the DIER that identifies the minor adjustments that were made to these specific borings.

86. **CD-EA-192 Boring Log.** The sample results for the 5- to 6-ft interval from CD-EA-192 appears to be listed twice. It appears that the second listing of this result should be replaced with CD-EA-192-6-7-N. Revise for accuracy.

Appendix E

87. **Appendix E, General Comment.** The EPA acknowledges that attaching all the individual lab reports from the design investigation to the DIER would result in a voluminous document with several thousand additional pages. As a result, it is acceptable to the EPA for the document to include a summary list of all the lab reports from which data is evaluated in the DIER. However, the lab reports that were provided to the EPA throughout the DIER were generally not level 4 lab reports. In addition, many lab reports have the words "PRELIMINARY-UNVALIDATED" stamped on top of most of the pages. The EPA requests that the respondents make available to the EPA all the final versions of the lab reports listed in Appendix E in a useable format for our records.

Appendix H

88. **Appendix H, General Comment.** The EPA acknowledges that the approach to the statistical analysis presented in Appendix H for the eleven radionuclides results in an unreasonably high false discovery rate. However, methods exist to help control the false discovery rate which are discussed below. In addition, the EPA does not agree with limiting the statistical analysis to only Ra-226, Ra-228, Th-230, and Th-232 for evaluating whether soils are impacted, and remediation is necessary in accordance with requirements in the 2018 RODA for OU-1.

    The EPA agrees that consideration of multiple lines of evidence is appropriate with regard to concluding whether impacts above background are present in decision units (DUs) on the Buffer Zone and Lot 2A2. These lines of evidence should include but are not limited to information related to the RIM located within the landfill portion of the Site, such as, the prevalence of Thorium-230 and Radium-226 compared to other radionuclide contaminants of concern and that more than 95% of the total risk evaluated in the baseline risk assessment is accounted for from these radionuclides and their respective decay products. The EPA also expects the data quality to be considered, in particular, with respect to radionuclides such as Uranium-235 that exists naturally at very low concentrations.

    To control the high false discovery rates, the EPA recommends adjusting the significance level for multiple comparisons in order to control the family-wise error rate. An example is

Bonferroni's adjustment which divides the family-wise significance level (typically 0.05) by the number of comparisons to obtain the significance level for individual tests. In any case, the intention of the statistical tests performed are to evaluate whether the central tendency of a DU is indistinguishable from background. If the statistical test indicates that the DU's sample dataset is not indistinguishable from background, there is some evidence that the soils are impacted by contamination from the landfill. However, false positives can occur even if controlled through a method like what is described above. Therefore, each statistically significant result should be carefully evaluated along with the other lines of evidence. The determination that one out of the eleven radionuclides has a mean or median value that is statistically greater than background may not be sufficient to conclude that the decision unit has above background impacts such that remediation is necessary. However, the EPA expects that decision units with means or medians statistically greater than background for either Thorium-230 or Radium-226 would generally require some excavation.

With regard to aggregate sampling, the EPA notes that the use of this data was not defined in the DIWP and associated QAPP. Rather, the PRPs proposed to collect this data in Field Sampling Plan Addendum 8 "*to assess concentrations of radionuclides in natural borrow materials that may be used in Lot 2A2/Buffer Zone and other areas of the Site.*" Addendum 8 did not discuss that the PRPs intended to use this data for statistical evaluations in comparison to background and consideration should be given as to whether the aggregate data is statistically comparable to the background reference unit data. Because the aggregate samples were collected as composites rather than discrete samples and did not incorporate randomness, a finding of significant statistical difference should be viewed as questionable or of limited utility.

Regardless, the potential existence of radionuclide statistically significant differences between soil and a limestone aggregate product do not inform the reasonableness of the statistical tests required in the Design Investigation QAPP. Section 3.2.4.2 of the DIWP states, "*Background measurements generally comprise a range of values, particularly for mineral elements that are naturally occurring…In order to select a statistically valid background concentration range, four proposed referenced units with characteristics similar to those in the Buffer Zone and Lot 2A2 have been chosen.*" The EPA acknowledges that the soil in the background reference units and decision units on the Buffer Zone and Lot 2A2 may be made up of some proportion of limestone minerals, however, the aggregate product itself is dissimilar from these soils in many ways and therefore could have a distinctly different naturally occurring range of radionuclides.

89. Section 1.0, page 1, general comment. This paragraph states, "*It is suspected that historical rainfall, surficial runoff, and erosion of Area 2 slopes may have resulted in impacts to surface soils in these parcels.*" For clarity, expand the paragraph by including relevant information from section 3.2.4 and 3.2.4.1 from the DIWP. For example, page 3-13 in Section 3.2.4 of the DIWP states, "*Previous investigations of the site and surrounding parcels have demonstrated radionuclide impacts to surface soils of the Buffer Zone and Lot 2A2, likely as a result of historical erosion of Area 2 slopes.*" Some of the CSM information for the Buffer Zone and Lot 2A2 is also reasonably summarized in the first two paragraphs of Section 3.9 of the body of the DIER and could be included here to address this comment. In any case, the paragraph should also explain that because these soils were known to have been disturbed and subsequently

covered after the previous investigations were completed, this data can no longer be relied upon to determine whether impacts remain in the underlying soils of this portion of the Site and/or whether impacts are constrained to the 6 inches of soil directly underlying gravel and asphalt covers. Section 3.2.4.1 from the DIWP explains why the depth of sampling in Lot 2A2 and the Buffer Zone included both 0-6 inches and 6-12 inches. This information is pertinent to understanding the CSM, provides rationale for the approach to sampling and supports the evaluation of the results.

90. Section 3.1, page 3, general comment. As discussed in the general comment to Appendix H, the EPA acknowledges that the statistical testing performed for and presented in Appendix H results in a high false discovery rate. Revise this section by incorporating a multiple comparisons procedure like what is discussed above and in other comments below into the statistical analysis and summarize that procedure here. Revisions are also necessary regarding the discussion of background reference units (BRUs) and aggregate data comparisons.

91. Section 3.3, page 4, second bullet. This bullet states, "*random start systematic data collection was used for sampling, except in areas where step-outs were required.*" However, the sampling method utilized for BRUs was a simple random sampling rather than having a systematic approach. Revise the bullet to acknowledge this difference. In addition, provide in Appendix H the rationale for utilizing two different sampling protocols for background reference units and decision units, e.g., systematic sampling within the decision units improves the spatial coverage of the sampling and decreases the likelihood of missing potential hotspots, whereas background reference units are expected to have a relatively uniform distribution of radionuclide concentrations that are spatially independent within the BRU.

92. Section 3.3, page 4, third bullet. The bullet states, "*Removal of outliers from the dataset was only considered if data were not of acceptable quality or <u>significantly impacted the distribution of a BRU</u>.*" (Underlined for emphasis) This statement does not appear to be consistent with QAPP Worksheet 37, step 4, item 3, which states, "*Only remove outliers and re-test statistical distribution if further evaluation determines the data are not of acceptable quality.*" Outliers appear to have been removed from the background datasets but not from the site DUs for the analyses presented in Appendix H. In accordance with the Design Investigation QAPP, sample results should not be immediately removed just because they were identified as outliers, but instead investigated for data quality. For example, if some outliers had particularly large laboratory error reported, were flagged for possible inaccuracy, or otherwise suspect, they may be considered for removal. This process should be repeated not only for the background dataset but also for the site DUs for consistency and defensibility. Ensure that outliers are addressed in a manner consistent with the QAPP and revise this bullet accordingly.

93. Section 3.4.1, page 4, first paragraph in the section. This paragraph states, "*In addition, the rows containing the radionuclides of concern for the Site (i.e., Ra-226, Ra-228, Th-230, and Th-232) are shaded.*" It's unclear what is meant by "*radionuclides of concern for the Site*" in this sentence. Section 7.1.1 of the 2018 Record of Decision Amendment (RODA) identified all the radionuclides in the uranium, actinium, and thorium series as contaminants of concern. In addition, Section 7.1.1 also identifies Th-230, Ra-226 and their associated decay products as the

primary contaminants of concern because they accounted for more than 95% of the total risk to the target receptors. The EPA acknowledges that the RODA states on Page 1 that the radium, thorium, and uranium isotopes used to define radioactively impacted materials (RIM) are the primary radionuclides of concern for the Site. These radionuclides include Ra-226, Ra-228, Th-230, Th-232, U-234, U-235, and U-238. Include a definition of radionuclides of concern for the Site in Appendix H and ensure that it is consistent with the RODA.

The EPA also notes that many samples were analyzed for these radionuclides prior to the 2018 RODA for OU-1. Evaluation of these samples is presented in the RIA and Final Feasibility Study. The EPA believes this information may also be useful to consider as part of the multiple lines of evidence approach to determine whether impacts above background are present in DUs on the Buffer Zone and Lot 2A2. In the case of uranium isotopes, the RIA evaluated the prevalence of uranium in comparison to thorium and radium. These evaluations concluded that in nearly all cases where samples exceeded the definition of RIM for Uranium, those samples also had exceedances for either combined radium or combined thorium. Ultimately, statistical testing must be conducted for all the radionuclides identified in the DI QAPP, however, the prevalence of certain radionuclides compared to others determined from data collected from the landfill portion of the Site can be used as part of the multiple lines of evidence approach to determine which DUs are impacted.

94. Section 3.4.1, page 4, first paragraph in the section. This paragraph states, "*Although there were no indications that the outliers were not of acceptable data quality, they were removed from the BRU datasets to be conservative because, in many cases, they significantly affected the results of the statistical analysis.*" This appears to be inconsistent with the third bullet in Section 3.3 which states that removal of outliers was only considered if data were not of acceptable quality or significantly impacted the distribution of a BRU. In any case, both statements are inconsistent with the Design Investigation QAPP. Ensure that outliers are addressed in a manner consistent with QAPP and revise this paragraph accordingly.

95. Section 3.4.1, page 5 and Section 3.4.2, page 5, general comment. The text in this section describes a process to evaluate the data from the BRU that included testing whether there was a significant difference between each individual BRU and the combined BRU. This is inherently flawed. An alternative defensible process would be to test each BRU against each other before combining. Testing using this process was performed by the EPA's statistical support contractor, Neptune, for all analytes with adequate detects using ANOVA and Tukey's multiple comparisons procedure. This testing shows that BRU-1 is consistently statistically different from the other three BRUs for many of the eleven analytes. For the subsurface state, BRU-1 is different from all other reference units for Ra-226, Ra-228, and Th-232 even after adjusting for false discovery rate (refer to the comment on section 3.1 above), and marginally different from the other three reference units for Th-230, Th-228, U-233/234 and U-238. There is also strong evidence that BRU 1 is different from the other reference units in surface soils for Ra-226 and Ra-228, and marginal evidence that BRU-1 is different from other reference units in surface soils for Th-232, Th-228, U-233/234, and U-238. Because BRU-1 appears to have a distinct population of concentrations for many of the radionuclides evaluated, additional evaluation is needed in Appendix H to determine whether the soils in BRU-1 are suitable to represent

background soil for the Buffer Zone and Lot 2A2. This evaluation should include a comparison of the boring and photologs for these samples to what was anticipated as described in section 3.2.4.2 of the DIWP for this BRU.

96. Section 3.4.2, page 6, first paragraph. This paragraph states, "*Based on the above statistical comparison of the individual BRUs to the overall combined BRUs, all the BRUs except BRU-1 should be rejected.*" It's not clear what is meant by "*rejected*" in this statement. In addition, the fact that the statistical analysis shows significant differences in naturally occurring radionuclide concentrations aligns with what was expected based on the underlying geology in the St. Louis Area and the paragraph at the bottom of Page 5. In the previous comment, feedback is provided on the appropriateness of the statistical analysis conducted for BRUs in Appendix H. The EPA also acknowledges the high false discovery rate and has provided an alternative to control that in our comment on Section 3.1. The EPA agrees that a "*multiple lines of evidence approach*" to determine which decision units have radionuclide impacts above background is consistent with the DI QAPP. Number 8 in Step 4 of Worksheet #37 of the QAPP states, "*Given that multiple tests are performed, there will be a multiple lines of evidence evaluation to determine if action is required for a DU.*" This sentence and paragraph should be revised after additional statistical analysis has been performed in response to the comments for Sections 3.1 and 3.4.2 above.

97. Section 3.4.3, page 6, General Comment. This section discusses the results of statistical tests comparing BRUs to aggregate material from a local quarry. The EPA provided feedback in our comment on Section 3.1 on the limited utility of such a comparison given the nature of the sample collection and that this use of the aggregate data was not considered in the DI QAPP. The third paragraph of the section states, "*The statistical evaluation of aggregate samples, although not required by the QAPP, provides further support as to why the method described in the QAPP cannot be reliably used to determine if action is required for a DU.*" The EPA disagrees with this statement while also acknowledging that this type of statistical test is part of the multiple lines of evidence that will be considered to determine if action is required for a DU. Further, and as discussed in the comment for Section 3.1, it is not surprising that there are potentially statistical differences in naturally-occurring radionuclide concentrations between a limestone aggregate product and native soils surrounding the site given the potential for the underlying geology to affect the central tendency and variability of radionuclide concentrations. In any case, differences in central tendency values, higher or lower, for naturally occurring radionuclides between a limestone aggregate product and native soils do not inform the appropriateness or reliability of the statistical tests. The OU-1 RODA does not specify the central tendency concentrations of background radionuclides as excavation criteria. However, these concentrations can be compared to similarly calculated concentrations within DUs to provide a line of evidence regarding whether the DU has been impacted by RIM from the Site. The EPA acknowledges that a conceptual discussion of the aggregate sample results may be appropriate for Appendix H as it further informs the variability of naturally occurring radionuclide concentrations in the greater St. Louis area and the overall evaluation of background. Revise this paragraph after addressing this comment and similar feedback provided in EPA's comment for section 3.1.

98. Section 3.4.4, page 6, first paragraph in the section. This paragraph states, "*Outliers were identified but not removed from the DU datasets because the outliers may plausibly be impacts*

from the Site." The EPA agrees that sample results in the Buffer Zone and Lot 2A2 that are determined to be outliers may be the result of Site related impacts. However, the EPA notes that outliers should only be removed "*if further evaluation determined the data are not of acceptable quality*" as stated in Step 4 to Worksheet #37 of the DI QAPP. Appendix H must include a discussion of the data quality associated with any sample results which according to the relevant statistical tests are determined to be outliers. This discussion must conclude whether these outliers meet data quality requirements in the DI QAPP and whether the results are reasonable for use in evaluating potential impacts on decision units in the Buffer Zone and Lot 2A2.

99. Section 3.4.4, page 7, third full paragraph. This paragraph states that in most cases, outlier, distribution, and hypothesis testing were not completed for Ac-227 and Pa-231 because of the frequency of non-detects. Additional evaluations and discussion of these radionuclides is needed in Appendix H. First, clarification is needed as to whether this high number of non-detects occurred in DUs, BRUs, or both. If this is unique to DUs, then a comparison of the detection limits to the BRU central tendency concentrations should be included with a discussion of whether this provides evidence that concentrations appear to be lower in DUs. If a high percentage of non-detects occur in both data sets, then include an evaluation of whether the data available are adequate to evaluate whether above background impacts from these radionuclides are present in DUs. If the data are not sufficient, Appendix H should also include a discussion of how low concentrations of radionuclides in the U-235 decay chain are relative to those in the U-238 decay chain in typical background soil and the difficulty in determining their precise concentrations given the limits of the analytical methods. In addition, Appendix H must also include a discussion of the RIM from the site and the prevalence of Ac-227 and Pa-231. Ultimately, Appendix H must conclude whether sufficient lines of evidence exist to evaluate these radionuclides present on DUs and, if so, conclude whether there are any above background impacts.

This paragraph also states that hypothesis testing of Pb-210 results were confounded by variable detection limits and that quantile testing is not considered reliable because of a high percentage of non-detect results. Similar to Ac-227 and Pa-231, Appendix H must be revised to include a discussion of the data quality for Pb-210 including whether the quality criteria in the Design Investigation QAPP were met. The EPA notes that multiple analytical methods for Pb-210 analysis exist that can achieve a range of detection limits based on the sample media and other factors. Given the relationship between radon (which is a gas) and Pb-210, a radon decay product and a solid, Pb-210 can be out of secular equilibrium with Ra-226 and other radionuclides in the U-238 decay series. Ultimately, Appendix H must conclude whether sufficient lines of evidence exist to evaluate Pb-210 on each DU and, if so, conclude whether there are any above background impacts.

100. Section 3.4.4, page 7, second bullet. This bullet states that Th-230 "*is one of the four principal radionuclides of interest at the Site.*" The meaning of "*principal radionuclides of interest*" is unclear. The EPA notes that this terminology is slightly different from what is introduced in section 3.4.1, e.g., "*the radionuclides of concern for the Site (i.e., Ra-226, Ra-228, Th-230, and Th-232)*". Revise Appendix H by including information about how the "*four*

principal radionuclides of interest" were determined consistent with any revisions made in response to the related comment from Section 3.4.1 above.

101. **Section 3.4.4, page 7, fourth, tenth, and thirteenth bullet.** While each of these bullets conclude that a statistical evaluation of the data from the 0.5 to 1-ft interval should be conducted for DUs 2A2-1 through 2A2-7, this appears to be premised on whether impacts were observed in the upper six inches. Because the exact nature of the regrading on Lot 2A2 and Buffer Zone is uncertain and the potential depth of any radionuclide impacts are also uncertain, the statistical evaluation of the 0.5- to 1-ft interval must be conducted for all DUs regardless of whether specific impacts are observed in the six-inch interval above. However, results from the 0.5- to 1-ft interval may be used to determine whether deeper sampling is necessary as has been done in accordance with the DIWP and associated field sampling plan.

102. **Section 3.4.4, page 8, last bullet.** This bullet states that an evaluation of data below 1-ft is required to determine the total depth of excavation necessary and the criteria for defining the excavation will be presented either before or with the Revised Excavation Plan. It is acceptable to the EPA for the excavation limits for DUs in the Buffer Zone and Lot 2A2 to be presented in the Revised Excavation Plan. However, the approach to determining which DUs and at which depths have radionuclide impacts above background must be defined in the DIER so that a determination can be made about whether additional data are needed. Excavation criteria can ultimately be tested through confirmation sampling. Appendix H must at least be revised to conclude which DUs have above background impacts below 1-ft and which DUs need additional data to evaluate whether above background impacts are below 1-ft.

103. **Section 3.4.5, page 8, first paragraph in the section.** This paragraph states, "*Hypothesis testing for DUs 2A2-8 , 2A1-1, and BZ-1 through BZ-3 was not performed because RIM was already identified at these DUs at a depth greater than 1-ft.*" The EPA generally agrees with this approach, but Appendix H must still specify whether impacts, such as samples that exceed the definition of RIM, are present in the 0- to 0.5-ft and 0.5- to 1-ft intervals of each of these DUs.

104. **Section 3.4.5, page 8, fourth paragraph in the section.** This paragraph is similar to the third paragraph in Section 3.4.4 on page 7. Revise this paragraph to ensure consistency with any revisions to the third paragraph in Section 3.4.4 in response to the EPA's comment above.

105. **Section 3.4.5, bullets on page 8 and 9.** These bullets should be revised after completing a statistical evaluation adjusted for multiple comparisons as described in comments above. The EPA is also including with comments to Appendix H a summary of such an evaluation performed by the EPA's statistical contractor, Neptune.

106. **Section 3.4.6, page 9. General comment.** This section states that deeper sampling was conducted at select locations exhibiting "higher activities". The section does not discuss how the locations were selected nor how the corresponding data would be used to make decisions about whether soils deeper than 1-ft must be remediated to comply with the requirements in the RODA. The paragraph also states that where RIM (combined thorium or combined radium >7.9 pCi/g) was identified, its depth was delineated as part of FSP Addendum 8. However, deeper

samples were collected from some borings based on results which were less than the definition of RIM. Revise this section by including a summary description of how the results of the initial sampling in the Buffer Zone and Lot 2A2 were evaluated to determine where deeper sampling would be performed. In addition, complete the evaluation of all the available data from depths greater than 1-ft and present the conclusions from that evaluation in Appendix H. Lastly, Appendix H must specify whether any additional data is needed to evaluate whether impacts above background are present in soils at depths below 1-ft in each DU and, if so, when this data will be collected.

107. Section 3.4.7, page 9, last paragraph. This paragraph states, "*For 2A2-7, where a statistically significant difference was identified for U-235/236 only, the box plots did not show elevated outliers that may indicate action is required.*" It's not clear what is meant by "*elevated outliers*". Outliers should be identified in accordance with the statistical test in the QAPP but only removed if those results are not of acceptable data quality. Therefore, the box plots should include all outliers except those that are not of acceptable quality. It may be useful to identify or label results on box plots which were determined to be outliers. Revise the paragraph by clarifying what is meant by "*elevated outliers*" or replace with more precise terminology.

108. Section 3.4.7, page 10, paragraph at the top of the page. This paragraph states the box plot of the U-235 results from 2A2-7 appeared to be similar to the box plot of the U-235 results from the aggregate and that this comparison provides a line of evidence that no action is required. However, as stated in earlier comments to Appendix H, aggregate sampling was not conducted consistent with the sampling done in the BRUs and DUs and therefore statistical comparisons of this data are questionable and of limited utility. In addition, because there is no reason to expect that limestone aggregate would have statistically similar concentrations of naturally occurring radionuclides as background or site soils, such a comparison does not provide compelling evidence of whether action is needed.

109. Section 3.4.8, page 10, item 1.a and b. These items state that the presence of RIM, e.g. combined radium or combined thorium greater than 7.9 pCi/g in any DU would require remediation "*(i.e, excavation)*". It is acceptable to the EPA for all RIM greater than 7.9 pCi/g to be excavated from any DU on Lot 2A2 and the Buffer Zone, however, additional excavation may be required to ensure those DUs have been sufficiently remediated in accordance with requirements in the RODA. The EPA also notes that no description is included with regard to how the extent of RIM greater than 7.9 pCi/g will be determined both laterally and vertically from the data collected from the Lot 2A2 and Buffer Zone portions of the Site. This information must be specified either before or with the Revised Excavation Plan as stated in Section 3.4.4.

110. Section 3.4.8, page 10, item 1.d. This item states that the maximum depth of RIM was determined through additional data collection because "*this is the only defined value available for determining if action is required.*" This statement is misleading as one of the objectives of the Design Investigation is to collect sufficient samples of background soils to determine representative statistics of naturally occurring radionuclides. Further, the DI workplan and QAPP described statistical evaluations to be conducted with this data in a multiple lines of evidence approach to make determinations about whether remediation is necessary at the Buffer Zone and

Lot 2A2 which are presented here in this appendix. As stated in the comment above for Section 3.4.6, the definition of RIM was not the only criteria used to select borings in Lot 2A2 for sampling deeper than 1-ft. Revise this statement consistent with any changes made to section 3.4.6 in response to the EPA's comment above.

This item states that further data evaluation is required to determine if excavation below the depth of the RIM is required. It is acceptable for excavation criteria to be presented in the Revised Excavation Plan. Appendix H must include a complete evaluation of all the data currently available in Lot 2A2 and the Buffer Zone to determine whether sufficient data is available to evaluate impacts to soils at depths greater than 1-ft. Revise item 1.d. by specifying whether sufficient data below 1-ft has been collected and, if not, when, and how this data will be obtained.

111. Section 3.4.8, page 10, item 2, general comment. As stated in earlier comments, the EPA does not agree that the hypothesis testing should be limited only to Ra-226, Ra-228, Th-230, and Th-232 nor should the multiple lines of evidence approach presented in Section 3.4.8 replace a multiple comparison procedure. All the radionuclides identified in the QAPP which are also contaminants of concern listed in the RODA should be considered in the statistical evaluations. Item 2 must be revised after completing a revised statistical evaluation. If these statistical tests still result in identification of one or two analytes which based on the data are substantially less prevalent in the contamination from the landfill portions of the Site (not Th-230 or Ra-226), the data quality and confidence for these analytes must be carefully examined along with other lines of evidence including the results of the statistical tests to determine whether remediation in that DU is necessary.

112. Section 3.4.8, page 10, item 2.a.i. This item discusses comparisons of the Buffer Zone, Lot 2A2, and Lot 2A1 data to calculated 95% upper simultaneous limits or USLs. The EPA notes that in general, use of a background threshold value such as a USL for background comparisons is flawed because eventually enough samples will be collected such that at least one exceeds the threshold value even if the DU is identical to background. For example, if a 95/95 upper tolerance limit or UTL were to be used as a background threshold value, there is a 5% chance any one sample will exceed this threshold even if the site is equivalent to background. For Buffer Zone and Lot 2A2 where 14 samples were taken per DU, there is a 51% chance that at least one will exceed the estimate of the 95^{th} percentile for each analyte. USLs make even less conceptual sense. The USL in version 5.2 of the EPA's ProUCL software was originally a modification of Scheffe's method which allows for computation of upper confidence limits (UCLs) for multiple datasets (e.g., multiple analytes) while still maintaining adequate coverage for all datasets; In other words, a UCL computation which corrects for multiple comparisons and is intended for multivariate data. However, this procedure was modified for use on a univariate scale, which treats each individual observation in a dataset for a single analyte and site as a random variable with adequate coverage for each observation. This application to univariate data does not make sense in the context of Scheffe's method, and a statistical analysis incorporating a multiple comparison procedure is a better approach for the Buffer Zone, Lot 2A2, Lot 2A1, and background reference areas data set.

113. **Section 3.4.8, page 11, item 3.b.** The EPA has pointed out in previous comments that statistical comparisons between aggregate data and DU or BRU data are unreliable due to differences in sampling methodologies and that this use of the aggregate data was not considered in the DI QAPP. Nevertheless, item 3.a. states that statistically significant differences are expected between BRU soils and aggregate materials based on the expected variability of geology in the greater St. Louis area. Item 3.b. states that the statistical methods presented in the QAPP do not adequately consider the natural variability of the materials. However, the EPA notes that the test appropriately demonstrates that the two materials do in fact have different background populations of naturally occurring radionuclides. The fact that a statistical test comparing aggregate to background soils, while questionable, indicates that the two materials are different does not suggest that any action is required. In addition, the EPA does not agree that the statistical methods identified in the QAPP are mischaracterizing background soils or DUs. As stated in previous comments, the EPA agrees that the overall type I error rate for the statistical testing presented in Appendix H is high and could result in an unacceptable number of false positives. The EPA has also provided a method to control the type I error rate while still performing hypothesis testing comparing central tendency concentrations. To be clear, the RODA does not require, nor does the EPA expect that the central tendency concentrations for any radionuclide of concern will be used as excavation criteria. The EPA does expect the PRPs to propose an excavation for DUs that are impacted which will result in the soil that remains on the DU being indistinguishable from background. The EPA expects this will be achieved by excavating a portion of those DUs that are determined to be impacted from areas that generally correspond to the samples with higher concentrations. The EPA disagrees that the comparison of radionuclide central tendency concentrations between BRUs and DU should be limited to screening. However, the QAPP does discuss that determinations of which DUs are impacted should be based on multiple lines of evidence and central tendency concentration comparisons are only a part of that multiple lines of evidence approach.

114. **Section 3.4.8, page 11, second bullet.** This bullet states, "*Further data evaluation using a different approach is required to identify the depth of excavation in these areas.*" Evaluation of the available data from BRUs and DUs must be completed and presented in Appendix H. At a minimum, the evaluation of this data must demonstrate whether sufficient data has been collected to determine which DUs at any depth have above background impacts of radionuclides that are contaminants of concern for the Site. If additional data is needed, Appendix H must specify when and how this data will be collected. Revise these summary bullets by including the conclusions reached from a complete evaluation of the Buffer Zone, Lot 2A2, Lot-2A1, and BRU data.

115. **Section 3.4.8, page 11, third bullet and fourth bullets.** Revise these bullets after addressing the other comments provided for Appendix H. Ensure that the evaluation of the available data is completed and presented in the revised Appendix H. As stated in previous comments, the EPA disagrees with limiting the statistical testing to Ra-226, Ra-228, Th-230, and Th-232. However, the EPA acknowledges that determination of what DUs require remediation will be determined based on a multiple lines of evidence approach.

116. **Section 4.0, page 12.** The first sentence states, "*The data are sufficient in number and quality to support DIO #4, DIO #5, and PSQ-2*." It's not clear how this conclusion was reached given that multiple references are made in Appendix H to the need for additional statistical analysis and the potential need for additional sampling at depth. The EPA does not agree that the statistical methods established in the QAPP are only useful for screening. Revise this section after completing the statistical analysis described in other EPA comments along with any additional data evaluation described elsewhere in Appendix H. Appendix H must conclude which DUs and depth intervals require remediation unless sufficient data is not available to determine that in all cases. If additional data is needed, Appendix H must specify when and how this data will be collected. It is acceptable for excavation criteria and limits to be presented in the Revised Excavation Plan. However, sufficient data must be available or collected as part of confirmation sampling to demonstrate the soil that remains in each DU is consistent with background. Revise this section as necessary after completing this work.

117. **Additional statistical analysis from Neptune.** The EPA is providing additional information that may be useful to consider while addressing the comments provided on Appendix H. The EPA expects the respondents to complete their own analysis.

Neptune performed an independent analysis of the data to compare individual DUs to background, with a combined background dataset that includes all four RU's. Since no difference was found in the depth intervals, both were combined in the final background dataset to increase statistical power. Neptune implemented "Gilbert's toolbox", which includes a t-test for a difference in means, a Gehan test for a difference in medians, a slippage test for a difference in the upper tail, and a quantile test for a difference in the 0.8 quantile. For all tests, an alpha level was used based on Bonferroni's adjustment for the number of comparisons being made. Since comparisons are made for multiple analytes and DUs, the significance level used is 0.05/(number of analytes*number of DUs). Twelve DUs and eleven radionuclides were studied, in both surface and subsurface soils. The eleven radionuclides are Ra-226, Ra-228, Th-230, Th-232, Ac-227, Pa-231, Pb-210, Th-228, U-233/234, U-235/236, and U-238. No outliers were removed from either the BRU or DU datasets. The determination of whether the central tendency of each DU is greater than background is used to identify potential issues, with the quantile and slippage tests performed for potential supporting evidence. If the "Stat test" column in Tables H.7 and H.9 indicates "Gehan" or "WMW", the Gehan test was used since in the absence of non-detects it will be identical to the WMW. If the "Stat test" column in Tables H.7 and H.9 indicates "t-Test" or "t-Test (W-S)", the Welch-Satterthwaite t-Test was used and unequal variance was assumed for all analytes. This is because the sample size may not be large enough for adequate power for the test of equal variance.

a. DUs 2A1-1, 2A2-8 and BZ-1, BZ-2, and BZ-3 all appear to have at least one exceedance over 7.9 pCi/g for at least one radionuclide, for both surface and subsurface soils. 2A2-1 has an exceedance in surface soils only. These DUs were therefore removed from the DUs selected for background comparisons since remediation will occur regardless. There are 13 remaining DUs: 2A2-1 in subsurface soils, and 2A2-2, 2A2-3, 2A2-4, 2A2-5, 2A2-6, and 2A2-7 in both surface and subsurface soils.

b. The differences in our analysis compared with Table H.11 are shown in Table 1. 'Dropped' indicates the exceedance was not significant using a multiple comparison procedure (MCP).

DU	Depth	Principal Rad - Table H.11	Any Rad - Table H.11	Neptune MCP
2A2-2	Surface	Ra-228	Ra-228	Ra-228
2A2-3	Surface	Ra-228, Th-230	Th-228, U-233/234, U-238	Ra-228, Th-230, U-234/235, U-238
2A2-4	Surface	Ra-228, Th-230, Th-232 quantile only	Th-228, U-233/234, U-235/236, U-238	Th-230, U-233/234, U-235/236, U-238
2A2-5	Surface	Th-232	Th-228, U-233/234	**Dropped**
2A2-6	Surface			**Pa-231 but all NDs**
2A2-7	Surface			
2A2-1	Subsurface	Ra-228, Th-230	U-233/234, U-238	Th-230, U-234/235
2A2-2	Subsurface	Ra-228	Ra-228	**Dropped**
2A2-3	Subsurface			**Pa-231 but all NDs**
2A2-4	Subsurface	Ra-228, Th-230, Th-232	U-233/234, U-235/236, U-238	U-233/234, U-238
2A2-5	Subsurface	Ra-228	U-233/234 quantile only	U-233/234 quantile only
2A2-6	Subsurface			
2A2-7	Subsurface		U-235/236	**Dropped**

i. Table H.11 identifies no exceedances in 2A2-6 in both surface and subsurface soils, in 2A2-7 in surface soils, and in 2A2-3 in subsurface soils. Neptune's analysis is consistent. **In addition, Neptune's analysis identified no exceedances in 2A2-5 in both surface and subsurface soils and 2A2-2 in subsurface soils after adjusting for multiple comparisons.** Table H.11 identifies no exceedances for Ra-226, Ra-228, Th-230, or Th-232 in 2A2-7 subsurface soils but at least one exceedance for one of the other seven analytes. **This exceedance was no longer significant after adjusting for multiple comparisons.**

ii. Table H.11 shows some exceedances in 2A2-2 and 2A2-3 in surface soils. Neptune's analysis agrees with these exceedances even after adjusting for multiple comparisons. Table H.11 also shows exceedances in both surface and subsurface soils in 2A2-4 in Ra-228, Th-230, Th-232, U-233/234, U-235/236, and U-238. For surface soil, Th-230, U-233/234, U-235/236, and U-238 show significant exceedances after correcting for multiple comparisons. For subsurface

soils, only U-233/234 and U-238 show significant exceedances after adjusting for multiple comparisons.

118. **Tables H.5, H.8, H.10, and H.11.** The EPA expects these tables to be regenerated after completing a revised statistical evaluation and believes they will be useful to compare to the results of Neptune's analysis.

119. **Figures H.1 and H.11.** It would be useful to have a figure similar to these figures but that colors or outlines each decision unit depending on whether it's been found to be greater than background, and if so, which radionuclide is elevated.

120. **Figure H.3.** While in theory the workflow in Figure H.3 is reasonable, the sample sizes may not be high enough to identify violations of normality and equal variance assumptions. Neptune examined Q-Q plots of the analytes and DUs where normality was assumed, and found some that looked non-normal (e.g., 2A2-6 in subsurface soils for Th-232) but the conclusion using the Gehan test matched that of the t-test for all potential issues. Neptune also examined boxplots of the analytes and DUs where equal variance was assumed. Due to the difference in sample sizes between site and background, it is sometimes difficult to evaluate this assumption. Neptune recommends assuming unequal variance and using the Welch-Satterthwaite t-Test for all cases where normality can be assumed.

Appendix I

121. **General Comment.** Some additional information must be included in Appendix I in order for the EPA to evaluate the conclusion in Section 6.3.3 of the DIER which states, "*Additional data collection is not required in the remedial design for potential off-site disposal at WCS.*" Ultimately, Objective 9 from the DIWP states that data would be collected "*to characterize materials related to waste acceptance criteria of potential waste disposal facilities.*" (underlined for emphasis). While there is no specific requirement for the DIER to demonstrate whether sufficient data has been collected to meet the waste acceptance criteria (WAC) for Waste Control Specialists (WCS), the DIER must demonstrate that sufficient data has been collected to fully comply with WAC from at least one potential disposal facility. There currently appears to be some uncertainty about whether the RIM that will be excavated can all be disposed of in one of the two disposal cells operated by WCS. Sampling shows that some RIM that will be excavated exceeds the WAC for the Subtitle C disposal cell. In addition, the Compact Waste Disposal Facility, which is a licensed Low Level Waste facility, is not permitted to accept wastes that contain garbage, municipal solid waste, or putrescible waste. Regardless, Appendix I must include discussion of whether, based on the design investigation data, there is a disposal facility with waste acceptance criteria such that the RIM that will be excavated can be loaded and transported directly to the disposal facility without any additional handling or excavation requirements to comply with the WAC. The EPA must have documentation from the disposal facilities being evaluated that they will accept the data and excavation methods being proposed by the Respondents to comply with their WACs or that a facility has a WAC that can accept the RIM that will be excavated without special excavation procedures in order for the EPA to

determine whether the RIM Staging and Loading Building can be eliminated from the 90% Remedial Design.

In addition, Appendix I must include additional discussion on the data collection specified in Field Sampling Plan (FSP) Variance Request 4 and Addendum 6. For example, Section 1.0 of variance request 4 states, "*The waste disposal sites being considered in the Draft Loading, Transportation, and Disposal Plan (LTODP) (Parsons 2020) require radiological data beyond radium and thorium for documenting materials received under their permits.*" In addition, Section 1.1 states, "*Both Waste Control Specialists (WCS) and U.S. Ecology require submission of full laboratory data packages of the radiological parameters listed in FSP Section 2.4.5.1. for compliance with their permits. WCS requires these data for every 500 cubic yards of disposed material. Although U.S. Ecology does not have a specific testing frequency, a statistically significant dataset is required.*" Appendix I must include additional discussion of these disposal facility data requirements and how the data collected during the design investigation including per Variance Request 4 and Addendum 6 were intended to achieve these requirements. After those discussions and supporting presentation of the data, Appendix I must conclude whether sufficient data has been collected to meet those requirements. If additional data is needed, Appendix I must specify when and how that data will be collected.

Both FSP Variance Request 4 and Addendum 6 discuss that additional waste characterization data was to be collected "*to refine the thickness of the RIM layer potentially exceeding the WCS WAC*" (FSP Variance Request 4, section 1.1) and "*to better define the presence of materials that may exceed waste acceptance criteria of disposal site being considered for disposal*" (FSP Addendum 6, section 1.3.7). To accomplish these objectives, samples were collected from select borings with high gamma readings and/or based on prior sampling results from six inches above and below the high RIM layer. The results of this sampling should also be discussed in Appendix I, including how this data will be used to develop and refine excavation and loading procedures that will be presented in the Revised Loading, Transportation, and Off-Site Disposal Plan to be submitted with the 90% Remedial Design. Again, after those discussions and supporting presentation of the data, Appendix I must conclude whether sufficient data has been collected to fully develop those excavation procedures to receive acceptance from disposal facilities. This will also support EPA's evaluation of the proposal from the Respondents to eliminate the RIM staging and loading building.

122. Section 2.0, page 2, second paragraph. This paragraph discusses a recent permit modification for WCS that resulted in increases to their WAC. However, Appendix I does not appear to include the new limits. It would be helpful if the current limits were included in Section 2.1 and/or Section 3.0. At a minimum, Table I-6 should be revised by including a third column that lists the current activity limits for WCS.

123. Section 2.1, page 2, last paragraph in the section. The last sentence of this paragraph states, "*Concentration averaging can be used to manage materials with a SOF greater than one using materials with a SOF less than one to result in material with a SOF less than or equal to one.*" This description is not clear. The EPA acknowledges that this process relates to excavation procedures which will be finalized in the 90% RD and/or the revised Loading, Transportation,

and Off-site Disposal Plan. However, additional explanation is needed in Appendix I on this topic. The EPA expects that the data collection performed as part of FSP Variance Request 4 and Addendum 6 as discussed in the last paragraph to the general comment above were intended to support this process. Include at least one example of how the concentration averaging would be demonstrated, e.g., because the high concentrations of RIM that exceed the WAC are generally expected to be present in thin layers based on the design investigation data, excavation of the thin layer along with RIM greater than 52.9 pCi/g from above and below this layer is also expected to result in an average concentration that is below the current WAC. This comment also applies to the last sentence in Section 2.1.1 at the top of Page 3.

124. **Section 2.1.1, first paragraph.** This paragraph discusses that the data evaluated and discussed in Appendix I were "collected generally from anticipated excavation depths". However, Figures I-1 and I-2 have notes that state, "All borings shown represent locations where total Radium or Thorium activities exceed 52.9 pCi/g in samples collected from 0 to 20 feet below the 2005 ground surface." Please clarify in this section whether the data set consisting of 303 samples described in the remaining paragraphs of this section represents all borings with activities greater than 52.9 pCi/g from 0 to 20 feet below the 2005 ground surface. If the data set does not include all these samples, provide a justification.

125. **Section 2.2, pages 3 and 4, paragraph that spans the page.** This paragraph discusses various permitting requirements that apply to WCS facilities. It's not clear which specific disposal cells each of the permitting requirements listed apply to, e.g., the RCRA/TSCA (Subtitle C) Landfill, the Compact Waste Disposal Facility, or both. Revise the paragraph by clarifying which disposal cells these permitting requirements apply to.

126. **Section 2.2, page 4, last paragraph.** This paragraph states that the waste characterization samples were not analyzed for uranium but instead for the list of radionuclides in FSP Section 2.4.5.1. This is confusing as stated because the list of radionuclides from FSP Section 2.4.5.1 includes Uranium-238, Uranium-235, and Uranium-234. Revise for clarity.

Appendix K

127. **Appendix K, General Comment.** Appendix K concludes that leachate volumes with proposed excavation areas are currently expected to be limited in nature, based on the relatively thin zones of saturation and depths to water observed in the standpipe wells. However, given that leachate observations were conducted over irregular time frames, uncertainty remains with regard to the water depth data. In addition, Section 6.3.4 states that contact water requiring treatment is expected to be predominantly stormwater that comes in contact with waste and un-decontaminated equipment used during the remedial action. As a result, the volume of water requiring treatment will potentially be higher than what is estimated from observed water levels in the standpipe wells. The EPA expects the 90% Design report to provide detail on the calculation of the design flow and provide treatment and/or flow equalization capacity to address the potential for flow variability.

128. **Section 2.0, page 1, first paragraph and Table K-2.** According to Table K-2, observations in the standpipe wells were conducted in March, April, September, and October of 2021, as well as March, April, and June of 2022. Section 3.3.3 of the Design Investigation Workplan (DIWP) states, "*Leachate will be gauged monthly over the course of one year to assess seasonal fluctuation of liquid levels within proposed excavation areas which will, in combination with field testing, support estimation of leachate volumes within the proposed excavation.*" Section 2 must be revised to explain why monthly gauging was not conducted as specified in the DIWP and whether sufficient data exists to reasonably estimate leachate volumes that may be encountered within proposed excavation areas. The EPA notes that water depth observations presented in Table K-2 appear to indicate seasonal variability in some standpipe wells although it is difficult to evaluate given the limited and irregular time frames that observations were made.

129. **Section 3.2, page 5, table of waste and aquifer thicknesses.** The appendix does not appear to provide enough information for the EPA to verify the saturated thickness calculation presented in the far-right column of this table. In addition, it is unclear what the "penetration" column is meant to represent. For example, A2-SPW-004 is listed as "fully" in this column. The waste thickness is listed as 26 feet. However, the well depth is 23.98 feet according to the slug test field forms in attachment K-2. In addition, Appendix K states that all the wells extend to a depth of 20 feet below the 2005 ground surface. Clarify what is meant by "fully" in the penetration column and whether the well extends all the way through the waste.

130. **Section 3.3, page 7, second paragraph.** The first sentence of this paragraph references the 1976 Bouwer & Rice paper regarding the effective screen length. The same Bouwer and Rice paper states "*If the water level is rising in the perforated section of the well, allowance should be made for the porosity outside the well casing if the hydraulic conductivity of the gravel envelope or developed zone is much higher than that of the aquifer.*" Furthermore, the 1989 Bouwer paper says, "*If the water level rises in the screened or open section of the well with a gravel pack around it, the thickness and porosity of the gravel envelope should be taken into account when calculating the equivalent value of* r_c *for the rising water level.*" It's not clear how the variables in the table on Page 5 are being applied in the equation on Page 7 to calculate the hydraulic conductivity values on Page 6. Include clarification on if the sand envelope around the screens of the standpipe wells was accounted for when calculating K, or if this effect could be considered negligible and why.

131. **Section 4.4, pages 8 and 9.** This section states "*The leachate data, in combination with other potential sources, is being used to establish an influent design basis for a temporary construction contact water treatment system...*" It's not clear what is meant by "*other potential sources*". Include a list in this section of other potential sources that are being used to establish the influent design basis for the contact water treatment system.

132. **Table K-2 and attachment K-2.** The EPA is unable to verify the water depth below the 2005 ground surface presented in Table K-2. Discrepancies exist between the field notes and the Water Depth below the 2005 ground surface for standpipe well A1-SPW-002 presented in Table K-2. The difference in the depth to water from top of casing in the field notes and the depth to

water from 2005 ground surface as listed in Table K-2 should be constant as both the 2005 ground surface and top of casing are static. However, for standpipe well A1-SPW-002, the difference in the measurements recorded for March 19, 2021, and March 20, 2021, are not equal, implying that one or both static datums moved spontaneously without reason. Add additional information to the appendix indicating the estimated depth of the 2005 ground surface and how this was estimated. For example, consider adding the 2005 surface to the well completion diagram. In addition, add the length of casing above the concrete to the top of the casing.

Appendix L

133. **Section 2, page 1, second paragraph.** The dates listed in the second sentence refer to when the Missouri Department of Natural Resources (MoDNR) approved plans for two permits. Revise by including the actual permit issuance dates as well as the authorization dates for these permits.

134. **Section 2, page 1, third paragraph.** This paragraph states that the Design Investigation performed from 2020 to 2022 was focused within and along the perimeter of OU-1 Areas 1 and 2. Given that most of the investigation work conducted in 2022, and some work even before 2022, was focused on finding the extent of RIM south of the previously estimated Area 2 boundary, add the word "*initially*" between the words "*investigations*" and "*focused*" in the second sentence.

135. **Section 2, pages 1 and 2, last paragraph that spans the page.** The summary in this section of the investigation work in the ISL and CDL that occurred during the Design Investigation does not include any mention of FSP Addendum 1. Include an acknowledgement of FSP Addendum 1 in this paragraph like what is discussed in Sections 3.8.1 and 5.1.4 of the DIER. In addition, this paragraph states that the results of the initial six borings located south of the estimated Area 2 boundary "*prompted a review of historical aerial photographs, construction of terrain models, and development of various isopachs of differences in elevation between two terrain model topographic surfaces…*" This statement is somewhat misleading as the locations of the initial six borings and the subsequent borings included as part of FSP Addendum 1 were based on review of historical aerial photographs. Revise the statement by replacing the word "*a*" in the quoted statement above with "*further in-depth*".

136. **Section 2, page 2, first full paragraph.** Include in this paragraph additional information related to the timeframe when leached barium sulfate residues (LBSR) were known to have been brought to the site and generally how the changes identified in the aerial imagery and associated products provide evidence for potentially locating RIM. The EPA notes this is summarized in the second paragraph of Section 3.8.1 of the DIER but should be included and expanded upon in this appendix.

137. **Section 2, page 2, second full paragraph.** The description of the rationale for the borings initially proposed in FSP Addendum 4 must be expanded to acknowledge that review of the aerial imagery and terrain models along with the results from the initial six boings and subsequent FSP Addendum 1 borings were used to establish an estimated potential extent of

RIM outside of which the borings in FSP Addendum 4 were primarily placed. This is important context because it explains that the focus of the investigation in these areas was on establishing the outer extent of RIM and provides a description of how this was accomplished.

138. **Section 2.2, page 3, last paragraph.** The EPA acknowledges that isopach comparisons with elevation changes of less than 10 feet may provide inaccurate conclusions about past cutting and filling activities which was also stated in FSP Addendum 4. However, the paragraph goes on to discuss that the comparison of visual disturbance in aerial photographs with topographic surface and isopachs still provide additional lines of evidence for defining horizontal limits of cuts and fills that is likely more accurate than the thicknesses estimated from the isopachs alone. In addition, FSP Addendum 4 included several isopach maps that show estimated elevation changes between 3-5 feet and 5-10 feet (See Figures A4-20, A4-21, A4-22, A4-24 [5-10 foot only], A4-25 [5-10 foot only], A4-27, A4-30, A4-34, A4-35, and A4-36 from FSP Addendum 4). Exclusion of this detail from the figures in Appendix L makes it appear as if there were fewer activities happening in these areas than the aerial photos suggest. In addition, RIM was identified in many of the areas that correspond to depth changes of less than 10 feet. Therefore, considering changes in surface elevation of less than 10 feet along with other lines of evidence is relevant for estimating the extent of historical landfilling activities and the potential extent of RIM. Additional text must be added to this section justifying excluding this information from Figures L-22 through L-26 or this information should be added to these figures.

139. **Section 3.1, section title.** The title of this section is inaccurate as the MoDNR permitting process did not actually authorize any disposal activities until August and October of 1974. In addition, there were landfill activities occurring before April of 1969, that were also prior to the MoDNR permitting process. Revise the title of the section by either specifying this as the timeframe prior to Leached Barium Sulfate Residues being brought to the Site or to simply refer to the time period being discussed in the section.

140. **Section 3.1, page 5, first paragraph.** The last sentence of this paragraph states that filling was not observed in the CDL or the southern portion of the ISL between May of 1971, and May of 1973. Clarify whether any cutting was observed in these areas during this time frame. In addition, clarify if this evaluation is only considering estimated filling greater than 10 feet and whether the analysis of the associated historical aerial photographs also support this conclusion.

141. **Section 3.3, Section Title.** Similar to Section 3.1, the title of this section is inaccurate as the State waste management authority started on December 21st, 1973; however, no authorization for disposal of new waste in the ISL and CDL was granted until August 27, 1974. Revise the title for accuracy. Because leached barium sulfate residue (LBSR) was still being brought to the site after September of 1973, the EPA suggests renaming this section similar to Section 3.4, e.g., "*Comparison between September 1973 and April 1975*".

142. **Section 4.1, general comment.** There is no discussion in this section with regard to the southern extent of RIM greater than 7.9 pCi/g depicted on Figure L-47. The EPA has provided additional comments on this estimated RIM extent for Section 5.1.1.2 and 6.2. The EPA notes

that no perimeter borings were proposed for the southern boundary of Area 1 between A1-PB-118-A and A1-PB-116. Other borings collected during the Design Investigation were limited in depth and were sampled differently from perimeter borings. Additional discussion of this RIM extent is not required in Appendix L unless the evaluated evidence is utilized to establish the southern extent of RIM in Area 1 in the revised DIER. Regardless, Figure L-47 will need to be updated consistent with any changes made to the estimated extent of RIM and other DIER figures in response to the EPA comments on Section 5.1.1.2 and 6.2.

143. **Section 4.2, page 9, first and second full paragraphs.** The use of the term "pit" in these paragraphs implies that materials placed in these areas would not have been moved after placement. However, some uncertainty still exists with regard to this interpretation. The EPA notes that the "northern pit" depicted on the terrain estimates on Figure L-17 could also be a low area with a trench trending south across the CDL. Further, the two areas with fill thicker than 10 feet on Figure L-24 could have been used as stockpiles for materials that were spread in other locations on the CDL.

144. **Section 4.2, page 9, second full paragraph.** This paragraph states that RIM was observed at depths consistent with the elevation of the waste/soil fill (between 435 and 445 feet amsl) and the estimated waste/soil fill thicknesses. As stated, it's not clear what this sentence is intending to convey. The EPA agrees that RIM was found in some borings at these elevations but RIM greater than 52.9 pCi/g was also found above these elevations in other borings. The last sentence of this paragraph states the extents of RIM greater 52.9 pCi/g and greater than 7.9 pCi/g in the former pits and trough align with the features mapped in the September 1973 aerial photograph, as illustrated in Figure L-41. The EPA notes that there are some exceptions to this conclusion including CD-EA-199-B and CD-EA-193. Revise the paragraph to clarify and to acknowledge borings with RIM greater than 52.9 pCi/g that are located outside of the former pits and trough.

145. **Section 4.2, page 9, fourth full paragraph.** This paragraph states that items identified with dates from early 1974 serve as marker above which no RIM greater than 7.9 pCi/g brought to the site in 1973 should be detected and then goes on to list all the assumptions that would have to be met for this conclusion to be accurate. As stated, this sentence is unclear especially since historical aerial photos provide evidence that many of those assumptions are not true including that regrading or other disturbance occurred after 1973 and that materials may have been stockpiled. Revise for clarity and expand the discussion to both RIM greater than 7.9 pCi/g and RIM greater than 52.9 pCi/g. As discussed elsewhere in Appendix L, it's potentially more likely that RIM greater than 52.9 pCi/g was not disturbed after placement, whereas relatively low concentrations of RIM may more likely be the result of spreading out after initial placement or regrading activities that occurred at a later date.

146. **Section 4.3.1, page 11, first full paragraph.**

(a) In the sentence that states, "*Two intervals of RIM were encountered at borings A2-SB-025, A2-SB-06, A2-SB-034, and AC-13…*", it appears that A2-SB-06 should be A2-SB-026. Revise for accuracy.

(b) The sentence that states, "*No waste was described in boring A2-SB-032, placed closest to the former pit…*" is inconsistent with the boring log in Appendix B-1. Landfill wastes were identified on the boring log at 16.5 feet and 17.5 feet below DI datum with no recovery below 18 feet. The sample at 15.5 to 16 feet have combined radium of 4,140 pCi/g and combined thorium at 12,000 pCi/g and white flecks were identified in this interval immediately overlying the identified landfill waste. Revise for accuracy.

(c) Add the words, "*and in many cases significantly above this concentration, i.e., greater than 1,000 pCi/g*." to the end of the sentence that begins with, "*The fill from this interval is described as a silt and clay containing white flecks/particles…*"

(d) The last two sentences of this paragraph are partially inaccurate and as a result misleading. The interval of RIM in A2-SB-040 identified in the boring log from 5.8 to 6.3 feet below DI datum has a combined thorium result of 69.3 pCi/g which exceeds 52.9 pCi/g and the interval of RIM from 9.2 to 9.7 feet below DI datum has a combined thorium result of 20.4 pCi/g which is less than 52.9 pCi/g. The EPA also notes that no samples were collected between these intervals and no specific evidence was discussed in the text to support the conclusion that these two samples represent two thin layers of RIM rather than one continuous thicker layer of RIM. Review of the boring logs from nearby borings including A2-SB-178, A2-TH-107, and A2-SB-136 appear to also indicate a singular thicker layer of RIM from a similar depth interval. Revise the sentences for accuracy and reevaluate the conclusion based on the available evidence and analytical data.

147. Section 4.3.1, page 11, last paragraph on the page. This paragraph states that two intervals of RIM are present in borings A2-SB-139, A2-SB-195, A2-SB-137, and A2-SB-022. This sentence does not appear to be accurate. For example, the boring log for A2-SB-022 has two samples with results above 7.9 pCi/g. One from the 8 to 12-ft core run and one from the 12 to 16-ft core run. However, no samples were collected between these two samples and recovery was poor for both core runs, e.g., 55% and 30% respectively. In addition, downhole gamma results begin to rise significantly above 10^4 CPM right around 9.5 to 10 feet below DI datum where the first sample was collected, plateau at around 10^5 CPM from 11 to 12.5 feet below DI datum, rise further to a peak of about 10^6 CPM at 14 feet DI datum, and finally fall back below 10^5 at about 16 feet below DI datum. All this suggests that RIM is most likely present in a single thicker layer. Regardless, this information certainly suggests there is significant uncertainty with regard to concluding that there are two separate layers of RIM in this boring. Uncertainties with A2-SB-137 include that all three samples from 4.8 to 5.3, 8.8 to 9.3, and 10.8 to 11.3 below DI datum exceed 7.9 pCi/g, although the EPA acknowledges that the concentration is lowest for the sample in the middle from 8.8 to 9.3-ft below DI datum. In addition, it appears that downhole gamma logging was not able to be conducted below 10 feet where the highest concentration of RIM was found and recovery was poor for the two runs below 10 feet, 33% and 43% respectively. For A2-SB-139, it's difficult to determine where RIM layers may be present based on the sampling results due to poor recovery for the 0 to 4-ft, 8 to 12-ft, 12 to16-ft, and 16 to 20 -ft core runs (all less than 50% and as low as 25%). However, the downhole gamma log indicates a significant peak at around 3.5-ft below DI datum, sampling below that depth at 6 to 6.5-ft did

not identify RIM, and then RIM was identified in lower samples from 9.3 to 9.8-ft and 12.5 to 13 -ft. This indicates a potential for two RIM layers with a lower concentration layer below 4-ft. Further, cross section C-C' depicted on Figure L-30 depicts one continuous layer of RIM for A2-SB-022 but shows A2-SB-137 as having two RIM layers. Re-evaluate these borings and revise the text for accuracy. In addition, ensure that the conclusions described in the text are consistent with the estimated depictions of RIM in the cross section.

148. **Section 4.3.2, page 12, general comment.** Referring to the North Surface Water Body as the Northwest Water Body could lead to confusion given that the Earth City Flood control pond is located the west and northwest of the Site. Revise the section title and related text by changing this to simply the North Water Body.

149. **Section 4.3.3, page 13, partial paragraph at the top of the page.** This paragraph states that between September 1973 and April 1977, the remainder of the drainage ditch was filled with 35 to 40 feet of fill/waste. However, Figures L-25 and L-26 indicated filling occurred east of the trench from 1973 to 1975 and the linear trench itself was primarily filled from April 1975 to April 1977. These timeframes are important as they indicate it is less likely that RIM would have been disposed of in the trench. Revise the paragraph by describing what is observed in Figure L-25 and L-26 separately.

150. **Section 4.3.4, page 15, last paragraph in the section.** It's not clear what is meant by "*thin*" in the first sentence of this paragraph. Revise by replacing the word "*thin*" with the range of thicknesses of RIM observed in the Buffer Zone.

151. **Section 4.4, general comment.** The EPA notes that the primary purpose of the design investigation work in the ISL was to locate the outer boundary of RIM greater than 7.9 pCi/g rather than to locate and characterize areas within the ISL that may contain higher concentrations of RIM at significant depth and/or to definitively determine where RIM may have been stockpiled. Therefore, the ability to infer the extent of RIM greater than 52.9 pCi/g at depth in the ISL is limited at best. Also see comments provided below in this section with respect to composite samples and comparisons of RIM concentrations between composite and discrete samples. Conclusions drawn in this section should acknowledge the limitations of the data based on the intent and design of the investigation and the concentration differences between composite samples collected in the ISL and CDL and grab samples collected throughout OU-1.

152. **Section 4.4, page 16, first full paragraph.** Add the words "*previously estimated*" between "*the*" and "*OU-1 Area 2 boundary*" in the first sentence of this paragraph.

153. **Section 4.4, page 16 and 17, paragraph that spans the page. (a)** This paragraph states, "*Samples collected from this material had corresponding analytical results greater than 52.9 pCi/g, similar to concentrations detected in local areas in the CDL and OU-1.*" Use of the term "*OU-1*" in this sentence is vague. Replace with a more specific reference to either Area 1, Area 2, or both. **(b)** The EPA notes that comparison of RIM concentrations in composite samples to RIM concentrations in 1-ft grab samples collected from the same interval often indicate that maximum RIM concentrations from the grab samples are significantly higher than the

concentration of in the composite. This fact should be acknowledged as an uncertainty with regard to the discussion in this paragraph. Therefore, direct comparisons of maximum concentrations of RIM in borings with only composite samples to maximum concentrations of RIM in borings with grab samples should generally be avoided. If such comparisons are made, this uncertainty must also be acknowledged.

154. Section 5.0, page 18, first full paragraph. This paragraph states, "*Areas 1 and 2 are believed to have some RIM near the surface, as well as at depth, because fill placements were nearing an end in those areas by May 1973 and the aerial photos and terrain models do not indicate substantial additional filling in these areas.*" This statement is misleading as it is known based on sampling and data that RIM is near the surface, as well as at depth, in Areas 1 and 2. Further, RIM in the southwest portion of Area 1 is at significant depth because substantial filling did occur in that area after the RIM was disposed of as stated at the end of this paragraph. The intent of this statement is not clear. Revise for accuracy and clarity.

155. Section 5.0, page 18, second full paragraph. This paragraph concludes that RIM greater than a couple of feet in thickness and more than an order of magnitude above 52.9 pCi/g are believed to be associated with staging areas and stockpiles that may have been the initiation points of spreading activities, whereas RIM generally less than 52.9 pCi/g is associated with outer edges of spread activities and secondary deposition. The EPA generally agrees with this characterization, but an additional uncertainty must be acknowledged in this paragraph. As discussed in comments to Section 4.4, composite samples have been demonstrated to generally report lower concentrations than discrete samples collected from the same interval and often significantly lower. In addition, because many of the composite samples collected in the ISL and CDL were from 5-ft intervals, the ability to define RIM layers within those 5-ft intervals to identify thicknesses of RIM that may be greater than or less than 2-ft is also limited. Further, any RIM greater than 52.9 pCi/g within 20-ft below the 2005 surface was sampled more frequently both in terms of the spacing between borings and the spacing between samples within those borings. As stated in other comments, locating and characterizing areas of RIM greater than 52.9 pCi/g at significant depth was not an objective of the design investigation. Therefore, these estimations need to be qualified by also acknowledging the related uncertainties. Expand this paragraph by acknowledging these uncertainties.

156. Figures, general comment. In the EPA's January 10th, 2-22 FSP Addendum 4 approval with conditions and modification letter, the EPA specifically required the Respondents to provide two additional isopach figures in the DIER report. These included developing isopach maps from the May 1973 to May 1974 aerial photos and from the May 1973 to April of 1975 aerial photos. This requirement was included because the Respondents failed to comply with the EPA comment 18.b. of the November 5, 2021, comment letter regarding the September 23, 2021, Draft FSP Addendum 4. These required figures were not provided in Appendix L or elsewhere in the DIER. Include these figures in the revised DIER.

Appendix M

157. **Appendix M, General Comment.** The EPA notes that while the Bird Hazard Monitoring and Mitigation Report concludes that there is no indication that the material present in Area 1, Area 2, the CDL or the ISL poses an attraction to wildlife, it also states there was little opportunity for bird and other wildlife to be attracted to the materials unearthed during drilling activities. Therefore, the EPA agrees as stated on page 1 of Appendix M that the related findings should be used to inform a final wildlife hazard monitoring and mitigation plan that will include procedures to address bird or other wildlife issues that may arise during the remedial action.

158. **Appendix M, page 11, fourth paragraph.** This paragraph states that it is unclear when the CDL and ISL stopped receiving waste. The potential age of the waste in the CDL and ISL is useful for informing several aspects of the remedial design for OU-1, including cover system design, excavation of shallow RIM greater than 52.9 pCi/g in the southwest corner of the CDL, and other items. Revise this paragraph by including a brief summary of available information related to when landfill operations ceased in the CDL and ISL. Available information includes the Waste Limits Investigation Summary Report by Aquaterra dated July of 2011, as well as various historical aerial photographs included in FSP Addendum 4 which were evaluated as part of the Design Investigation.