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

FEB 0 7 2020

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

Re: November 12, 2019 Draft Final Remedial Investigation and Feasibility Study Work Plan, West Lake Landfill, Operable Unit 3

Dear Mr. Rosasco:

The U.S. Environmental Protection Agency has reviewed the November 12, 2019, Draft Final Remedial Investigation and Feasibility Study, or RI/FS, Work Plan, West Lake Landfill, Operable Unit, or OU-3. This document was prepared and submitted by Trihydro Corporation on behalf of the West Lake Landfill OU-3 Respondents, Cotter Corporation (N.S.L.), Bridgeton Landfill, LLC, and the U.S. Department of Energy, to support the remedial investigation of groundwater for the West Lake Landfill Site, in Bridgeton, Missouri. The EPA has coordinated its review of this document with the Missouri Department of Natural Resources and the U.S. Geological Survey. The EPA is disapproving the document.

Enclosed are the EPA's comments on the referenced work plan. The EPA recommends, in consideration of the enclosed technical comments and particularly those regarding the Quality Assurance Project Plan (Volume 2B), that the EPA and Respondents meet to discuss the enclosed comments prior to submittal of the revised work plan.

The Respondents shall submit a revised RI/FS Work Plan for OU-3 that incorporates responses to the EPA's comments and requested changes within 45 days of receipt of this letter, pursuant to paragraph 52.b of the Remedial Investigation/Feasibility Study Administrative Settlement Agreement and Order on Consent, (CERCLA-07-2018-0259).

Please contact me to set up a meeting regarding the EPA's comments. You may contact me either by phone at (913) 551-7910 or by e-mail at schwartz.jamie@epa.gov.

Sincerely,

for Jamie Schwartz
Remedial Project Manager
Site Remediation Branch
Superfund and Emergency Management Division

Enclosure

cc: Mr. Ryan Seabaugh, MDNR

Comments to the November 12, 2019, Draft Final OU-3 Remedial Investigation/Feasibility Study Work Plan, Site Wide Groundwater (Operable Unit 03), West Lake Landfill Site, Bridgeton, Missouri.

A. General Comments on Proposed Monitoring Well Network

The Remedial Investigation/Feasibility Study (RI/FS) Work Plan and associated planning documents are generally unclear regarding how the findings of the monitoring well network adequacy evaluation will be communicated to the Agencies and incorporated into determining actual new well placements. These documents require revision to provide clear and consistent procedures detailing how the RI is envisioned to proceed as data is collected and more information becomes available. Specifically, more details are required regarding step-out and step-in protocols for additional well placements beyond the currently proposed locations and additional data collection from the proposed and existing well network. Revise the work plan to clearly establish the points at which the monitoring well network will be evaluated, and how findings and proposed revisions will be communicated to the EPA for approval.

The work plan requires revision to clearly communicate contaminant decision-making or action levels with regard to further actions involving the "Phase 2" work elements, "addendums", step-ins/outs or other procedural triggers. If some of the details are not currently available, the work plan needs to acknowledge this limitation and discuss plans to address these unknowns as a part of conducting the overall RI process.

B. General Comment on the use of Alternate Contamination Levels (ACLs) at CERCLA sites

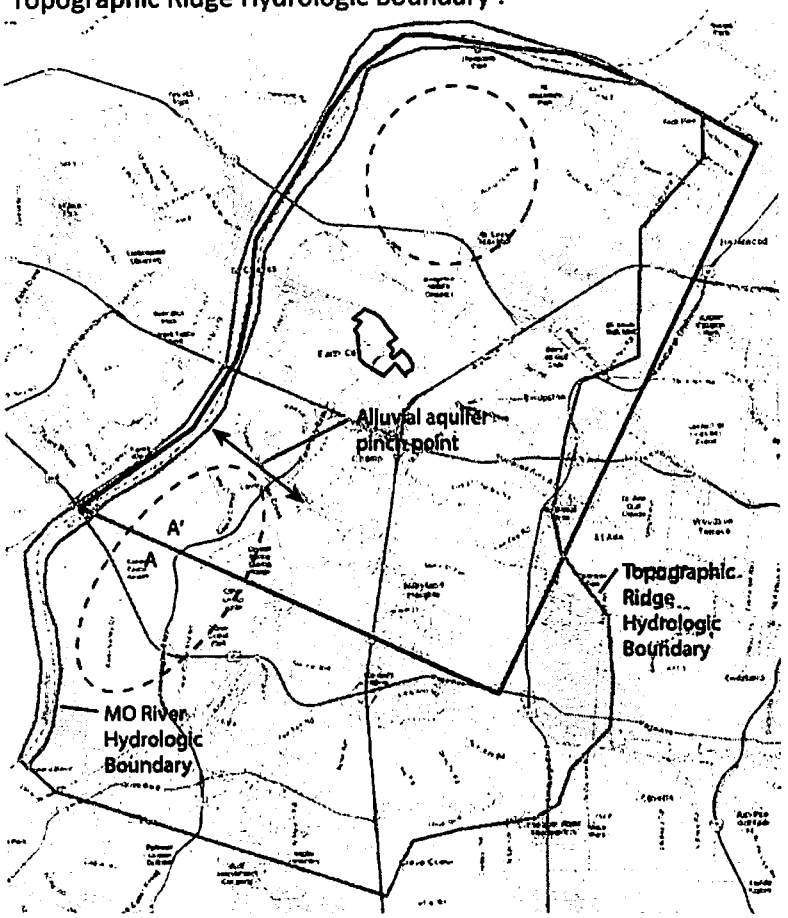
ACLs are discussed in several sections of the Work Plan and Quality Assurance Project Plan. The use of ACLs does not appear appropriate as discussed in this submittal because the EPA does not generally clean up below natural background levels (EPA, 1997). CERCLA section 121 provides authority to use ACLs under certain circumstances. OSWER Directive 9200.4-39, dated July 2005, reiterates the statutory requirements and provides several factors to consider in evaluating whether use of ACLs at a CERCLA site may be appropriate under site-specific circumstances. At this point in time, the EPA cannot comment on whether the use of ACLs could be appropriate at this site. Globally check and delete the discussion of ACLs from the entire RI/FS work plan other than as described in the OSWER Directive 9200.4-39 memorandum.

C. General Comment on Groundwater Modeling:

Neither the proposed new monitoring wells or the existing monitoring wells are sufficiently spatially distributed within the model domain to allow for confidence in the model calibration, particularly further away from the site. Because of the relatively small area of calibration points currently defined in the work plan, even relatively small errors in model fit at and near the site would likely translate to much larger errors and larger predictive uncertainty at the terminus of predicted alluvial flow paths associated with the site. Revise the work plan to include additional water-level measurement points in the areas as shown on Figure A (see the dashed oval areas on Figure A, below) to allow for proper model calibration across the model domain. Water-level data must include measurements collected in these areas throughout the duration of the RI in both new and existing wells.

Revise the proposed location for the model domain boundary in the Work Plan and Figure 3-16 to intersect with a natural flow boundary. The proposed upstream (southerly) model domain boundary (figure A; at label A-A') is not located at a natural flow boundary. Head information is required on

both sides of this boundary (measured concurrently through time) to adequately define the transient flux across the model boundary. The proposed new alluvial monitoring wells are located over 2 miles downstream of this apparent boundary location and will not be adequate for defining transient conditions at this boundary. Additionally, there is an area where the lateral extent of the alluvial aquiver narrows (see Figure A item labeled *'pinch point'*) that is anticipated to have an effect on the hydraulic gradient in this area. To simplify this boundary condition and lessen potential impacts of inadequately defining the flux and head distribution across this boundary, revise the model boundary by moving it further south-southwest to the Missouri River (orange line; see Figure A). Further, the proposed upland model domain boundary (to the southeast) is not defined at a natural flow boundary. Revise Figure 3-16 to move this domain boundary to the natural flow boundary at the topographic high on the ridge to the southeast. See Figure A (below) labeled 'Topographic Ridge Hydrologic Boundary'.



Model boundary extended to nearby hydrologic boundaries

Model boundary proposed in work plan

Area of alluvium in the model domain where additional water-level data are needed for proper calibration of groundwater model

Figure A Topographic Ridge Hydrologic Boundary - Approximate location of currently defined model domain boundary, revised location of model domain boundary at natural flow boundaries, and location of needed additional model water-level calibration points.

Work Plan Specific Comments

1. **Work Plan, Section 1.1 Page 1-2.** This section states, *"Routine groundwater monitoring for the North and South Quarries of the Bridgeton Landfill is ongoing and is under MDNR oversight."* Details of the Missouri Department of Natural Resources' (MDNR's) monitoring program were not provided in the Work Plan, and the OU-1 and OU-2 monitoring programs are in development. Revise the work plan to clarify that groundwater data and any related data such as bore logs, matrix samples, etc. that are collected under the MDNR's or the EPA's oversight (including data collected from sampling locations or for analyte parameters not specified in this work plan) will also be considered and included in the data set for this RI.
2. **Work Plan, Section 2.2 Page 2-3.** Revise *"The landfill became permitted for use as a sanitary landfill in 1952"* to state *"The landfill was authorized by the county to accept sanitary waste in 1952."* Because sanitary landfills were not subject to state permitting prior to 1974 (see Section 2.2.1), the use of the term "permitted" here may be misconstrued without additional clarification.
3. **Work Plan Section 2.2.2, Page 2-5.** This section states, *"Pursuant to a Materials Management Plan (EMSI 2006) approved by MDNR, inert fill material (e.g., clean materials as defined in 10 CSR 80-2.010(11), such as uncontaminated soil, concrete, asphaltic concrete, brick, or inert solids) was placed over portions of Area 1 between 2006 and 2008."* This statement has been found and commented on in prior remedial documents submitted by the responsible parties, however, as we have commented before, the EPA was unable to confirm that placement of inert materials was executed "pursuant" to the Materials Management Plan. Evidence exists that the state communicated concerns regarding whether the work being performed was executed in accordance with the MDNR plan. Replace the word *"pursuant"* with *"during implementation of"* when referencing activity related to the Materials Management Plan throughout the document.
4. **Work Plan, Section 2.2.1 Page 2-4.** This section states: *"MDNR Areas 1, 2, 5, and 6 were subsequently permitted for waste disposal. MDNR Areas 2 and 4, which included the majority of OU-1 Area 1 and the majority of OU-1 Area 2, were not permitted and were therefore closed in 1974."* Revise to state, *"MDNR Areas 1, 3, 5, and 6 were subsequently permitted for waste disposal."*
5. **Work Plan, Section 2.2.2 Page 2-5.** The Response to prior EPA comment 9 (September 11, 2019), notes that *"additional information regarding the below ground stormwater drain located along St. Charles Rock Road is not currently available."* Revise Section 2.2.2 to include this statement and to clarify whether any additional information will be gathered under the RI.
6. **Work Plan Section 2.2.3 Page 2-6.** This section discusses the West Lake Landfill Radiological Area 2, and states: *"No information has been located as to the purpose or use of this building or why it was removed; however, the time of the presence of the building corresponds to the period of time when material stockpiles are visible on the surface of Area 2, and therefore its use may have been related to activities being conducted by the West Lake Quarry, which were terminated in 1988."* The purpose of the building and why it was removed may be inferred from information available in site files. The purpose of the building can be found in a letter dated June 30, 1982 from Reitz & Jens, Inc. to the MDNR's Waste Management Program stating *"A paving contractor operation on the north side of the site has now been terminated. The building and remaining equipment will be removed, clearing up the delay and final grading in this north area which was*

present a year ago." Further, a 1989 report cited in Section 2.4.2 of this draft work plan, states, *"Radon gas had been observed to accumulate to an unacceptable level in the Butler-type building on site. This building has since been removed."* Revise the narrative to accurately reflect available information related to the purpose of the building and the previous identification of radon gas accumulation in the building.

7. **Work Plan Section 2.2.4 Page 2-7.** This section discusses the Inactive Sanitary Landfill and Closed Demolition Landfill and states: *"The OU-1 RI Addendum (RIA) concluded there was no indication of industrial wastes within the Inactive Sanitary Landfill based on sampling results (EMSI 2018a)."* Revise this statement to state, "According to the OU-1 RI Addendum, no industrial waste was identified in the samples collected from the Inactive Sanitary Landfill."
8. **Work Plan Section 2.4.2, Page 2-14**: States, *"However, it also identified that there was a long-term potential for the RIM to pose a health problem without the proper construction of a soil cap."* The text of Section 5 of the 1989 UMC report states: *"The radioactive material as it presently exists does not pose an immediate health hazard for individuals living or working in the area of the landfill. However, there is a long-term potential for the radioactive material to pose a health problem."* Delete *"without the proper construction of a soil cap."*
9. **Work Plan Section 2.4.2. Page 2-14.** This section discusses the 1989 Site Characterization and remedial action concepts. The following conclusions from the cited report are relevant to OU-3 and should be included in the narrative of this section. *"On the basis of radiological surveillance conducted by RMC, UMC, and ORAU, the following areas of concern have been identified: Radon gas had been observed to accumulate to an unacceptable level in the Butler-type building on site. This building has since been removed;" and "Some degree of radiological contamination has been found in the wells that monitor the perimeter."* Revise this section to include these two conclusions in the narrative summary.
10. **Work Plan Section 2.4.15, Page 2-22.** Revise the last sentence of the 3rd paragraph to include the acronym *"MCL"* after *"USEPA"* in the last sentence.
11. **Work Plan Section 2.4.15, Page 2-22, 3rd paragraph.** Delete the last sentence of the 3rd paragraph beginning with, *"Average combined dissolved..."* because the only bedrock wells at the site are in the eastern part of the site near the North and South Quarry areas. The U.S. Geological Survey (USGS) report did not make this generalized statement.
12. **Work Plan Section 2.4.18 Page 2-24.** This section discusses the 2018 OU-1 Updated Baseline Risk Assessment, and states, *"The OU-1 BRA concluded there were no current unacceptable risks to on-property or off-property human or ecological receptors."* Revise this section to add more detail to the statement describing the pathways that were not previously evaluated, and that current institutional and engineering controls were relied upon to make determinations regarding incomplete exposure pathways for the site's "baseline" conditions.
13. **Work Plan, Sections 3.1.2.2 Page 3-4, 3.1.5.1 Page 3-16, and 6.2.1.3 Page 6-4.** Define and distinguish the difference between the terms "base flow" and "underflow" as they apply to groundwater flow and surface water interaction.
14. **Work Plan, Sections 3.1.2.2 Page 3-4.** Revise Section 3.1.2.2 to reference Appendix N, which now includes the USGS map of the predevelopment potentiometric surface of the Springfield Plateau Aquifer (Imes, 1990).
15. **Work Plan Section 3.1.4. Page 3-13. 2nd paragraph.** Revise this paragraph to cite a credible source for the data presented or use the published USGS data for this location (St. Charles, MO). As presented, the data are not consistent with USGS discharge data. As examples:

- The USGS does not have discharge data available for download at St. Charles beginning in 1984, as is stated here, but from April 2000 to present.
- Daily mean discharge since 2000 at St. Charles was 90,100 cubic feet per section (with a range of 42,090 to 505,000 cfs), not 75,000 cfs as stated in this section.
- The May-June average daily flow is about 142,200 cfs, considerably less than the 300,000 cfs stated in this section.

Data for the USGS gage further upstream at Hermann, Missouri could be used as an approximation for flow statistics at St. Charles; however, a check of data from that location does not match the values stated in the text either. See the following for more information: https://waterdata.usgs.gov/nwis/wys_rpt?dv_ts_ids=75947&wys_water_yr=2018&site_no=06935965&agency_cd=USGS&adr_water_years=2006%2C2007%2C2008%2C2009%2C2010%2C2011%2C2012%2C2013%2C2014%2C2015%2C2016%2C2017%2C2018&referred_module= .

16. **Work Plan Section 3.1.4. Page 3-14.** The last sentence in the last paragraph states, *"Precipitation directly affects the Missouri River stage, infiltration, and localized recharge due to runoff from bluffs."* It is unreasonable to expect that local precipitation at the site or at the St. Louis Airport has a measurable immediate effect on stage of the Missouri River. Revise this sentence to indicate that local precipitation will have minimal effect on the Missouri River but is an important factor for the water levels in alluvium and surface water bodies in the immediate area.
17. **Work Plan Section 3.1.5.1, Page 3-16, 3rd paragraph, 1st sentence.** This sentence states, *"Recharge to the Missouri River Alluvial aquifer occurs by upward movement of groundwater from underlying bedrock near the margins of the alluvial floodplain..."* Upwelling of groundwater from underlying bedrock is not limited to just the margins of the alluvial floodplain but occurs throughout the alluvial valley. Revise this statement to indicate that the upwelling discussed in this section is not limited to the margins but occurs throughout all areas of the alluvial valley.
18. **Work Plan Section 3.1.5.7.1 Page 3-28.** This section discusses quarry dewatering and states, *"While transport of leachate through solution channels in the limestone is also possible, quarry operators maintained the limestone is intact. Evidence of karst (solution) activity was limited on quarry walls with minor widening of joints and bedding planes near the bedrock surface (NRC 1989)."* This statement appears to contradict the mapped voids and collapse zones shown in the cross-sections in the Physical Characterization Technical Memorandum (Golder, 1996), and it should not be relied upon without additional lines of evidence for purposes of developing the conceptual site model (CSM) or determining the need for monitoring well locations. Revise this section to better describe the fracture and dissolution features mapped and logged in the Golder report, and to discuss how bedrock dissolution and/or widening of cracks can affect the current understanding of the conceptual site model.
19. **Work Plan Section 3.1.5.7.2. Page 3-24.** This section states, *"The current monthly amount of leachate generated during 2018 ranged from 1.8 to 3.3 million gallons (approximately 60,000 to 110,000 gpd)."* Revise this section to cite the data source(s) and explain the origin of the leachate in relation to the leachate collection system (i.e. what portions of the leachate collection system are currently operational.) the EPA made this comment on the prior draft Work Plan and it was not addressed.
20. **Work Plan Section 3.1.6.1 Page 3-26.** The Nature and Extent of Radiologically Impacted Material (RIM) section states, *"RIM is irregularly interspersed within the overall larger matrix of MSW; not*

found in a thin, continuous layer as the NRC assumed." Revise this section to be consistent with the language of the OU-1 Remedial Investigation Addendum (RIA) which generally stated that the RIM at the Site is irregularly interspersed within the overall larger matrix of Municipal Solid Waste (MSW). The distribution of the RIM within the landfilled areas has been impacted by both natural and anthropogenic processes, such as the initial placement and the subsequent 40-plus years of decomposition, consolidation and differential settlement of the MSW over time. Consequently, the RIM is not present as a laterally continuous layer but is now interspersed within separate areas and intervals of MSW such that RIM cannot be easily distinguished from the surrounding MSW, landfill cover, and native soil matrix within which it is found.

21. **Work Plan Section 3.1.7.1 Page 3-27.** This section states, *"The RIA identified wells in proximity to the site – none of which are used for domestic consumption or community supplies."* Delete this sentence. The RIA for OU-1 did not conduct or describe performance of a comprehensive evaluation of groundwater use or water supply wells located in the area. For this RI, the performance of a well survey is required that will be conducted within the designated area including reviews of water billing records, surveys by mail, and visual assessments/drive-arounds to document potential receptors to impacted groundwater located in the area of the site.
22. **Work Plan Section 3.1.7.2 Page 3-28.** The 1st sentence states, *"Potential exposure routes include ingestion of groundwater, sediment, or surface water containing COPCs."* Revise this sentence to also include the potential exposure routes of dermal contact and inhalation, as follows: *Potential exposure routes include the inhalation of vapors associated with, and/or dermal contact with, and/or the ingestion of, groundwater, sediment, or surface water containing COPCs.*
23. **Work Plan Section 3.1.7.2 Page 3-28.** The entire second paragraph of this section does not appear specifically germane to the sub-section's topic. Revise this section to delete the 2nd paragraph and replace with the following statement: *"A baseline human health risk assessment work plan will be developed and submitted to provide details and discussion of identified site-specific receptors and associated exposure routes that will be evaluated per CERCLA."*
24. **Work Plan Section 3.3.2 Page 3-29.** This section discusses institutional controls and states: *"Institutional controls provide limited action consisting of maintaining the existing perimeter site fencing/warning signs, regular maintenance, deed restrictions, deed notices, covenants, groundwater use restrictions, site activity use limitations, groundwater monitoring, and five-year reviews."* The statement describes both institutional and engineering controls, and the review should not be limited to what currently exists at the site. Revise this section to include a more generic description of institutional and engineering controls, as specific controls should be developed during the FS.
25. **Work Plan, Section 4.2 Page 4-2.** In this section a "work plan rationale" is identified that is apparently separate from the "RI/FS rationale," and the reason for this distinction is unclear. As presented, the work plan rationale seems to only attempt to address the nine data gaps as identified in the 2019 OU-3 Administrative Settlement Agreement and Order on Consent (ASOC) Statement of Work (SOW). While addressing these data gaps is critical to the overall RI/FS process, the work plan should be structured to not only to fill the identified data gaps, but also to meet the specific and overarching objectives of any CERCLA RI/FS. Revise the work plan so that efforts to fill data gaps inform the process but do not replace or limit the overall CERCLA RI/FS process.

26. **Work Plan, Section 4.2.1 Page 4-2.** This section indicates that the inventory of currently installed wells will inform the need for repair and replacement of these wells. Well construction, well survey data, and any identified need for repairs to existing wells may also indicate an impact to the quality of the historical groundwater data or representativeness of samples collected from these wells. Revise the work plan to indicate how this will be evaluated and documented in the Well Inventory Report and project database.
27. **Work Plan Section 4.2.4 Page 4-5, FSP Section 1.3.4 Page 1-9, and Quality Assurance Project Plan (QAPP) Section 3.7.1 Page 3-27.** These sections state, *"Nearby off-site sources may be contributing to groundwater quality within the study area, including leaking underground storage tank sites and the Champ Landfill."* Delete discussions or references to specific off-site businesses or other potential sources that may or may not be impacting groundwater quality from the Work Plan, such as Champ Landfill. Further, current data collected during the RI is envisioned to inform the investigation in relation to background groundwater quality within the study area.
28. **Work Plan, Section 4.2.4 Page 4-5 and FSP, Section 1.3.4 Page 1-9.** Work Plan Section 4.2.4 and FSP Section 1.3.4 discuss the approach to determine background concentrations of Radium-226, Radium-228 and geochemical conditions, but the text does not discuss an approach to determine background concentrations of other contaminants of potential concern (COPCs). Revise these sections to present an approach for determining background concentrations for all COPCs.
29. **Work Plan, Sections 4.2.8 Page 4-8 and 5.4.17 Page 5-24; FSP Section 1.3.8 Page 1-12 and 1-13; and QAPP Section 3.11 Page 3-55 to 3-60.** Section 4.2.8 indicates that on-site indoor air quality will be assessed through testing of occupied, enclosed on-site structures for radon, methane, and volatile organic chemicals (VOCs). Additional detail is provided in Work Plan Section 5.4.17, and this information is reiterated in FSP Section 1.3.8 and QAPP Section 3.11. Revise the work plan and associated FSP content to address the following:
    a. Per EPA guidance (2015), multiple lines of evidence are necessary to evaluate whether the vapor intrusion pathway is complete and poses a potential risk to human health. The absence of contaminants of potential concern in indoor air may support the case that the vapor intrusion pathway between vapor-forming chemicals in the subsurface and building receptors is incomplete. However, the presence of contaminants of potential concern in indoor air may indicate contamination by any number of subsurface, indoor, or outdoor sources. Sub-slab soil gas samples, outdoor ambient air samples, and building surveys/ chemical inventories are needed to distinguish between surface and subsurface sources of indoor air contamination and to evaluate modes of vapor entry into buildings.
    b. Because vapor analytical results are inherently variable, and Superfund site actions should be based on an estimate of the reasonable maximum exposure expected to occur under both current and future land-use conditions (EPA, 1989), EPA Region 7 makes vapor intrusion risk management decisions based on the maximum concentration of each vapor-forming chemical detected in a data set representative of the exposure scenario. In Region 7, a representative data set typically includes at least one year of four quarterly samples to assess seasonal (temporal) variability and the appropriate number of samples needed to assess spatial variability depends on building use(s), size, and configuration.

c. Although occupied structures are prioritized for the first round of vapor intrusion sampling, both current and reasonably likely future risks need to be considered in order to demonstrate that a site does not present an unacceptable risk to human health and the environment (EPA 1991). Evaluation of future risks due to inhalation exposure may also be based on groundwater or soil gas sample data.

d. Beyond the indoor air analytes proposed in these sections and QAPP Table 2-3c, other site COPCs are to be considered a vapor intrusion concern if:
   - Volatility is indicated by 1) a vapor pressure greater than 1 millimeter of mercury (mm Hg), or 2) a Henry's law constant (ratio of a chemical's vapor pressure in air to its solubility in water) greater than 10^{-5} atmosphere-meter cubed per mole ($atm \cdot m^3/mol$).
   - Toxicity is indicated by 1) the vapor concentration of the pure component exceeding the indoor air target risk level, when the subsurface vapor source is in soil, or 2) the saturated vapor concentration exceeding the target indoor air risk level, when the subsurface vapor source is in groundwater (EPA, 2015).

30. **Work Plan Section 5.0 Page 5-1.** This section is titled "Site Characterization" and on page 5-1 states: *"The following tasks have been initiated and/or will be completed to address the data gaps outlined in Section 4.0 and meet the objectives of the RI/FS process:"* Revise to add the following bullets related to risk assessment: (1) assessment of whether information related to current and potential receptors is sufficient to determine if exposure pathways identified in the OU-1 RIA are fully complete, and (2) completion of a detailed well survey and any additional data gathering needed to complete the human health and ecological risk assessments for OU-3.

31. **Work Plan, Section 5.3.3 Page 5-7 and 5-8.** Section 5.3.3 indicates that the MW-400, 401, 402, and 403 series wells are proposed, in part, because the following wells are anticipated to be abandoned during OU-1 remedy implementation: D-6, S-8, D-13, I-62, I-65, I-66, and D-83. However, during the December 17, 2019, meeting among OU-3 Respondents and Stakeholders, the Respondents indicated that well removals would include D-3, I-4, S-5, D-6, S-10, I-11, D-12, D-13, I-62, and D-83. Well S-8 was anticipated to remain in place. Revise the work plan to update the anticipated wells to be abandoned and areas of surface disturbance. The EPA acknowledges that these items will be further addressed during the well inventory and that Section 5.3.6 (p. 5-11) states, *"Additional wells may be added if OU-1 activities result in the need for well replacement."* However, a current understanding of these items facilitates effective planning and implementation of an expanded monitoring program.

32. **Work Plan, Section 5.3.3 Page 5-5 to 5-8, Tables 5-2 and 5-3, and Figures 5-2 and 5-5.** Revise the referenced text, tables, figures, and associated portions of the FSP and QAPP to address data gaps consistent with the following comments on the proposed on-site and near-site monitoring well locations. Planning and installing proposed wells must consider other site work, including proposed remedial work conducted at the other OUs. Further, if any of the proposed wells are intended to act as a "replacement well" for existing wells that are anticipated to be destroyed by remedial activities at other OUs, that must also be stated and included in the work plan.

    a) Add "SS and "SD" depth wells located near the S-82/I-9/D-93 cluster for data gaps 2, 3, 5, 6, 7, 9.
    b) To help with potential bias and clarity of the potentiometric surface, add two new well clusters within the interior of the site. A hydrogeologic divide has been

reported to exist in the unconsolidated materials, but very little historical data for bedrock wells has been provided to help demonstrate this divide. Revise to add one cluster from "AS" through "SD" depths near the entrance gate of Area 2; and further revise to add another well cluster in the general location of LR-103 on the inactive sanitary landfill for data gaps 2, 3, 6, 7, 9.

c) To help with potential bias and clarity of the potentiometric surface, add an "SD" depth monitoring well in the vicinity of the PZ-113 series for data gaps 2, 3, 6, 7, 9.

d) At minimum, MO-3- "SS" and "SD" wells should be added to the monitoring network, and addition of other state wells is recommended (MO-1-SS/SD, MO-2-SD). Bore logs and other information are available if needed. These monitoring wells were installed to be comparable to the same depths below ground surface as the existing "SS" and "SD" monitoring wells located on-site. Alternatively, should the Respondents determine that the use of the MO wells is not preferred, add one "SS" and one "SD" wells in the vicinity of PZ-204 and add one "SS" and one "SD" well north/northwest of PZ-301-SS for data gaps 2, 3, 5, 6, 7, 8, 9.

e) Add an "SD" depth monitoring well in the vicinity of PZ-107-SS and PZ-205 series wells to help define the potentiometric surface between Bridgeton Landfill and the Inactive Sanitary Landfill for data gaps 2, 3, 6, 7, 9.

33. **Work Plan Section 5.3.3, Page 5-6.** Top of page, it is stated, *"Additional detections of combined total Radium-226 and Radium-228 and the Radium-228/Radium-226 ratios are variable in these wells across the site."* This is not clear as worded. Revise the sentence as follows, *"Additional detections of combined total Radium-226 and Radium-228 and the Radium-228/Radium-226 ratios are variable in* other *wells across the site."*

34. **Work Plan, Section 5.3.4 Pages 5-8 to 5-9, Tables 5-2 and 5-3, and Figures 5-3 and 5-5.** Off-site wells are proposed for multiple purposes, including determining the nature and extent of site-related groundwater impacts. However, the proposed well locations are broadly spaced and sufficiently distant from the site such that they are not expected to detect contaminants, either because the limited number of wells do not intersect what is currently a poorly-defined flow path or because the contaminants would be expected to have attenuated by the time the groundwater reaches the wells. At a minimum, the following additional monitoring points are required to support determination of the nature and extent of site-related groundwater impacts. Revise the referenced text, tables, figures, and associated portions of the FSP and QAPP to address the following comments on the proposed on-site and near-site monitoring well locations:

    a. Additional monitoring points (AS through SD) are required in the vicinity of S-53 for data gaps 3, 5, 6, 9. The EPA acknowledges that well S-53 is screened from 423.698-420.698 feet (ft) above mean sea level (amsl) (the AS interval); however, well S-53 is in a topographically low area that may be problematic. Consider this in determining whether an additional AS well is needed near the former leachate lagoon.

    b. Additional monitoring points are required in the vicinity and south of the former leachate lagoon to address data gaps 3, 5, 6, 9.

    c. Additional monitoring points (AS through AD) are required in the vicinity of the southern boundary of the Buffer Zone/Lot 2A2 to address data gaps 2, 5, 6, 9. Avoid locating these new wells too close to the existing S-82/I-9/D-93 cluster.

35. **Work Plan, Section 5.3.4 Pages 5-8 to 5-9.** As discussed in the December 17, 2019, meeting among OU-3 Respondents and the EPA, the implications of a scenario in which there are no or

only very low contaminant detections in the 500-series wells are unclear in the work plan. Because site COPCs have been detected at the perimeter of the site, the nature and extent of the impact(s) between the site boundary and the currently proposed 500-series wells must be determined during the RI. Revise this section to include step-out/step-in protocols for additional well placements beyond the currently proposed 500 series locations. Also state that the annual Hydrogeological/Groundwater Characterization Reports will provide an evaluation of the need for additional well sampling and/or new well installations based upon these protocols, a review of the site investigation and monitoring data.

36. **Work Plan Sections 5.3.4 and 5.3.5 Pages. 5-8 to 5-10, Tables 5-2 and 5-3, and Figures 5-3, 5-4, and 5-5.** An additional purpose of the 500- and 600-series wells is to support groundwater modeling efforts. As proposed, the 500- and 600-series wells do not have enough spatial distribution to support model calibration. Because alluvial flow paths from the site may terminate in the river and alluvium north and northeast of the site, propose to redistribute or add additional 500-series wells further north of the site. See also General Comment 3. Revise the referenced text, tables, figures, and associated portions of the FSP and QAPP to include these wells.

37. **Work Plan, Section 5.3.5 Page 5-9 to 5-10, Tables 5-2 and 5-3, and Figures 5-4 and 5-5.**
    a. In general, the intent of the background wells proposed in Section 5.3.5 is poorly defined. The Work Plan is unclear regarding whether or how data from the background monitoring wells will distinguish natural background levels (e.g., from the aquifer matrix) from anthropogenic background levels (e.g., from other nearby sites such as landfills, spills, cleanup sites, leaking underground storage Tanks, and RCRA generators, or resulting from the redox and other impacts that such sites may impart on aquifer materials). Revise the work plan to clarify the intent of the proposed 600 series wells (e.g., natural background, anthropogenic background, regional gradients, model calibration). If the wells are intended to provide data to support multiple studies, indicate this in the Work Plan, and provide the rationale to support the use of these wells for the intended purposes.
    b. The purpose of the MW-600 and MW-601 well clusters is unclear. The text of the Work Plan indicates these wells will be used to establish regional groundwater flow; however, Table 5-2 indicates they will be used to establish background conditions. Revise the text and table for consistency and clarity. If these well clusters are intended to represent or support background determinations, note that the current proposed location of MW-600 is likely too close to Champ Landfill, despite its liner, to be considered natural background and must be relocated. More appropriate locations to evaluate natural background include the undeveloped area west of the currently proposed MW-600 location and south of the currently proposed MW-601 location, at the upstream end of the Site's alluvial aquifer, or in the relatively undeveloped alluvial area immediately upstream of the Site's alluvial aquifer that includes Catfish Island and Bonhomme Island.
    c. As proposed, the background well network would appear to provide a limited data set that would not be representative and thus would not capture the range of background values within the alluvial and bedrock aquifers or support the calculation of statistically defensible background levels. Additional proposed background monitoring locations and data are required. Minimally, an SS/SD well cluster is needed south of a line between

the 602 and 603 wells to address data gaps 2, 3, 4, 5, 6, and 9. Revise the referenced text, tables, figures, and associated portions of the FSP and QAPP to address these comments.

38. **Work Plan Section 5.4.6. Pages 5-16 and 5-17.** This section and associated bulleted items, while not incorrect, are potentially misleading and appear to assume that chemical equilibrium and kinetics are slower processes, such that the surface area and mass become more important factors to evaluate. As an example, iron oxides are known to exist in Missouri River alluvial sediments, yet ferric iron and hydrogen sulfide are still detectable in water samples collected in proximity to the sediments. While the iron oxides may be considered "unstable," they have not been completely "dissolved." The opposite can be true when iron disulfide (pyrite) is present without sulfate-reducing conditions in the water. Revise this section, and as appropriate the associated bullets, to acknowledge the complexity of aquifer geo-chemistry and the limitations of redox indicator compounds like iron and sulfides.
39. **Work Plan Section 5.4.7 Page 5-17.** Borehole geophysical logging can also be used on existing wells to help determine the integrity of below ground components, such as well screens and riser pipes, in addition to other parameters for measuring hydrogeologic properties. Revise this section to indicate what proposed logging techniques will be used for determining and documenting well integrity.
40. **Work Plan Section 5.4.9 Page 5-18.** The Work Plan states that for alluvial wells, *"A 0.008-inch screen and 40/60 silica sand pack are proposed to reduce the chance for elevated quantities of suspended solids entering the well."* Earlier in the Work Plan it is stated that the deeper alluvial material is likely to be gravel. The proposed size of the filter pack seems small in comparison to the conditions expected in the deeper alluvium. The proposed fine screen and filter pack could potentially affect the proposed hydraulic test results because presumably the well will have a much lower conductivity than the course sand-gravel lower alluvium. Revise the work plan to propose a more appropriate filter pack for the deeper alluvium.
41. **Work Plan Section 5.4.14 Page 5-20.** This paragraph indicates leachate indicators and stable isotopes will be included in the groundwater monitoring program, as specified in the SOW. However, Section 5.4.14.3, page 5-22, states, *"If following collection of groundwater data, stable isotopes are required to answer a specific question to characterize the aquifer, groundwater samples will be collected from select locations to support that study."* Revise to state that the leachate indicators tritium, anions and stable isotopes will be collected from all on-site and near site groundwater and leachate sampling locations.
42. **Work Plan Section 5.4.14. Page 5-20:** The groundwater monitoring program as described in this section continues to be limited and does not comply with the requirements of the ASAOC. All OU-1 and OU-2 contaminants of concern will be monitored to sufficiently characterize contaminants and assess risk. The RI must be capable of determining the nature and extent of groundwater contamination. To achieve this objective the RI must address locations and formation intervals that are not currently characterized sufficiently for the complete suite of COPCs. Revise this section to include monitoring for all COPCs to determine the nature and extent of groundwater contamination and assess risk to human health and the environment.
43. **Work Plan Section 5.4.14.3 Page 5-22.** The Monitoring Well Sampling section states, *"Although only detected in select locations if at all, these will all be collected and analyzed during the first*

site-wide OU-3 monitoring event to evaluate the nature and extent of impacts." Replace the sentence with *"All COPCs will be analyzed to evaluate the nature and extent of impacts."*

44. **Work Plan Section 5.4.14.3 Page 5-22.** The Monitoring Well Sampling section states, *"This list will be reevaluated and shortened as appropriate (based on detected parameters) after the first monitoring event."* Replace the sentence with *"This list will be evaluated throughout the investigation and may be modified based on results and with approval from the EPA."*
45. **Work Plan Section 5.4.14.3 Page 5-22.** The 4th paragraph indicates that during the first site-wide groundwater sampling event, samples will be collected and analyzed for, *"COPCs: metals, general parameters, radionuclides, VOCs, SVOCs, PCBs, pesticides, and TPH."* Revise to include anions as well as stable isotopes and tritium, which are leachate indicators.
46. **Work Plan Section 5.4.15 Page 5-23.** The following comments regarding staff gages were discussed during the December 17, 2019, meeting. Revise this section as follows:
    a. Remove any redundant gages proposed in interconnected, free flowing (i.e., not gated) surface water bodies within the Earth City flood control system.
    b. Include an additional staff gage on Creve Coeur Lake. This lake is located on the current model domain southern boundary (see Work Plan Figure 3-16) and will be included in the model domain boundary once it is moved to natural flow boundaries (see general model comment).
47. **Work Plan Section 5.4.16 Page 5-23.** The 2nd paragraph states, *"Leachate sampling will include the same analytical suite as noted above for groundwater."* The list must include the full 1st round list as stated in Section 5.4.14.3 and include anions, stable isotopes and tritium for the north and south quarry leachate samples. Revise to include this information.
48. **Work Plan Section 5.4.16 Page 5-23.** The EPA notes that leachate monitoring has historically been performed for portions of the Inactive Sanitary Landfill. Revise this section to describe what, if any, modifications will occur with leachate infrastructure located in areas other than the Former Active (Bridgeton) Landfill, including the Inactive Sanitary Landfill.
49. **Work Plan Section 5.4.16 Page 5-23.** The last sentence of the section states, *"Pumping information will be used to populate the groundwater flow model and complete a water balance for the site."* Revise this section to detail the types of information to be included in the "water balance" study.
50. **Work Plan Section 5.4.17 Page 5-24.** The On-Site Vapor Intrusion Assessment section states, *"Commercial/industrial land use will be assumed for the onsite indoor air evaluation due to existing deed restrictions on the site."* The baseline risk assessment is intended to determine the need for institutional and engineering controls on site by evaluating baseline conditions, not conditions that assume existing controls remain in place. Revise this section assuming baseline conditions without consideration of controls.
51. **Work Plan Section 5.4.17 Page 5-24.** The On-Site Vapor Intrusion Assessment section states, *"Results from the initial groundwater sampling dataset proposed above will be used to evaluate the need for off-site vapor testing, which may include passive soil gas vapor sampling, installation of soil gas vapor wells, soil gas vapor sampling, sub-slab vapor sampling, indoor air quality sampling, and/or installation of mitigation systems."* Revise section to delete *"...initial groundwater sampling dataset proposed above..."* and replace with *"investigation"*.
52. **Work Plan Section 5.4.19 Page 5-26.** This section was revised to state, *"The collection and management of geospatial data will be defined in a geospatial data QAPP in accordance with USEPA guidance (USEPA 2003)."* Preparation of a geospatial data QAPP is not listed in the

schedule of deliverables (Section 10.3 and Figure 10-2), however the QAPP submitted with this Work Plan includes procedures for geospatial data management, assessment, and reporting. Revise Section 5.4.19 to reference the submitted QAPP or include a geospatial data QAPP in the schedule of deliverables.

53. **Work Plan Section 5.6. Page 5-28.** Revise the statement, *"An assessment will be performed to determine the potential for completion of vapor intrusion pathways in on-Site or off-Site occupied structures."* to replace the word *"or"* with the word *"and"*.
54. **Work Plan Section 6.1.4.2 Page 6-2.** Revise to clearly indicate that all field data from groundwater sampling events, such as the water levels and final recorded field measurements (i.e., temperature, specific conductivity, dissolved oxygen, turbidity) will also be included as a part of the electronic record.
55. **Work Plan Section 6.2.1 Page 6-3.** Revise the section to state that the Groundwater Modeling Work Plan (GWMP) must also include the temporal domain (both calibration and prediction) and a description of the method of determining parameter sensitivity.
56. **Work Plan, Sections 6.2.1 Page 6-3 and 6.2.1.1 Page 6-4.** The modeling objectives listed in the first paragraph of Section 6.2.1 are not consistent with those bulleted in Section 6.2.1.1. Revise these two sections for consistency.
57. **Work Plan Section 6.2.1.4 Page 6-5.** The following statement, *"However, data collection and evaluation may also determine that certain processes are not relevant to COPC transport. Therefore, the Groundwater Modeling Work Plan will provide a determination on which processes are appropriate be included in transport simulation"*, may indicate that a determination of outcomes without proper consideration, verification and EPA approval. Revise the statement to clarify that the evaluation to determine whether certain processes are relevant or not will only be made following consultation with the EPA.
58. **Work Plan Section 6.2.1.5 Page 6-5.** The section states that the model will be calibrated to "current" conditions. A steady-state groundwater model should be based on pre-development conditions with no pumping stresses to allow the model to mathematically come to equilibrium within the model boundary prior to introducing transient stresses (such as changing river stage, recharge, surface-water stage, pumping, etc.). Calibration of the model must include head and flow measurements throughout the simulation period, and not be based upon the "current conditions". However, current measurements will inform the model regarding how groundwater and surface water interact with each other relative to the current state of the river, pumping, and precipitation affects. All historical water-level and stage measurements are to be used as calibration points, along with "current" data/measurements. Revise this section to clarify that the model will be allowed to reach equilibrium at steady state prior to calibrating with or determining "current" conditions.
59. **Work Plan Section 6.2.1.5 Page 6-5.** The Anticipated Calibration Goals section states: *"Is the conceptual model of the system under investigation reasonable?"* Objectives generally should strive for documented and measurable goals to determine "reasonableness" and minimize the use of "appearances" and vague statements. Revise this section to state that the pending groundwater modeling work plan will provide more detailed and quantifiable objectives which will include subjective parameters used to make determinations.

60. **Work Plan Section 6.2.2, Page 6-3.** Data must be compared to the EPA's most current regional screening levels (RSLs), for screening purposes in the human health risk assessment (EPA, 2019a). Revise this section to include this step in the process, consistent with the EPA guidance.
61. **Work Plan Section 6.2.4 Page 6-7.** Revise the following statement, *"Examples of potential figures and diagrams used to convey information include but are not limited to: potentiometric surface figures, hydrogeologic cross-sections, isopach diagrams, Stiff diagrams, Piper diagrams, modified Stiff diagrams, and 3-D site visualizations"* deleting *"potential"* and replacing *"used"* with *"that will be created and updated"*.
62. **Work Plan Section 7.0 Page 7-1.** Revise the first paragraph to state that the risk evaluation will also include a qualitative assessment of potential bioaccumulative and synergistic effects for the potential contaminants of concern.
63. **Work Plan Section 7.0, Page 7-1, Paragraph 1.** The baseline risk assessment requires an evaluation of current risk as well as an evaluation of a reasonable maximum potential future risk posed by contaminants at the Site. Therefore, revise the first paragraph of this section by stating that the results will be used to determine if site-related contaminants have migrated or may migrate in the future beyond Site boundaries at concentrations above risk-based screening levels.
64. **Work Plan Section 7.0, Page 7-1, Sentence 2.** Revise this section to include a discussion generally describing how background is anticipated to be incorporated into the baseline risk assessment.
65. **Work Plan Section 7.1.1., Page 7-1.** Revise the first sentence in this section to delete *"...along with consideration of background concentrations..."*
66. **Work Plan Section 7.1.2 Page 7-2.** Revise this section to include surface water runoff in the evaluation of potentially affected surface water bodies. The following statement in the section appears to prematurely limit the transport and exposure routes for the CSM and baseline risk assessment and must be modified: *"Potential ecological risk is predicated on the confirmation of a connection between groundwater and surface water bodies within or in close proximity to the site and the conveyance of site-related constituents to those water bodies."*
67. **Work Plan Section 7.1.2 Page 7-2.** The Exposure Assessment section states: *"The OU-3 Phase II Work Plan would identify potentially complete exposure pathways (i.e. surface water bodies), potential receptors (both aquatic and terrestrial), and potential media (water and sediment) that would need to be compared to freshwater and sediment screening criteria to determine whether a screening level risk assessment is necessary."* This statement does not commit to conducting a screening level ecological risk assessment. The ASAOC SOW requires that the baseline risk assessment include an ecological risk assessment that addresses the following:
    - Definition of objectives;
    - Characterization of site and potential receptors;
    - Selection of chemicals, species and end points for risk evaluation;
    - Exposure assessment;
    - Toxicity assessment;
    - Risk characterization; and
    - Limitations/uncertainties.

    Revise this section to include details regarding an ecological risk assessment sufficient to meet requirements of the SOW.

68. **Work Plan Section 7.2.3 Page 7-5.** Revise the sentence *"An updated CSM will be presented in this section of the RI Report. Site characteristics will include geology, hydrogeology, geochemistry, meteorology, ecology, demographics, land use, and a reuse assessment"* to also include *"groundwater use in the area based on results of the well survey"*.
69. **Work Plan, Section 9.1 Page 9-1.** It is indicated that repair or replacement of unsuitable, damaged or inoperative wells will occur following the EPA's approval of the final Well Inventory Report. However, according to the schedule, the first round of quarterly groundwater sampling will be completed prior to finalization of the Well Inventory Report. Revise the Work Plan and schedule to address this conflict.
70. **Work Plan, Section 9.1 Page 9-1.** Revise the work plan to clearly establish the points at which the monitoring network will be evaluated, and how findings and proposed revisions will be communicated to the EPA. It is unlikely that sufficient RI data will be collected prior to the planned submission of the Well Inventory Summary Report to support determinations regarding the need for further well sampling efforts. Thus, off-site water supply wells, located near the Site or downgradient (to the west and/or north, between the Site and the Missouri River) must be identified before the Well Inventory Summary Report is completed. Revise this section to include identification of water supply wells, including any previously sampled off-site wells located in the general area of the Site or downgradient of the Site (north and west to the Missouri River), to occur prior to the release of the Well Inventory Summary Report.
71. **Work Plan Section 9.2, Page 9-1.** Revise this section to specify that potentiometric surface and flow figures will be included in the monthly report following a quarterly sampling event and further compiled in each year's annual report.
72. **Work Plan Section 10.3, Page 10-2.** Revise Section 10.3 to provide a summary of the efforts associated with the inventory of potable and production water wells as discussed in Section 3.1.7.1. The project schedule must include schedules for these activities.
73. **Work Plan Section 10.3, Page 10-2 and Figure 10-2**: Revise this section to add a summary level discussion of the proposed Phase II work, including explaining when and how this work will be initiated and how or if it will interact with the initial Phase 1 work elements/"addendum" sampling. Further, as needed, add the specific Phase II work elements to Figure 10-2.
74. **Work Plan, Section 10.3 Page 10-2 and Figure 10-2.** Revise the milestone schedules in Section 10.3 and Figure 10-2 for consistency, completeness and accuracy. Specific examples include:
    a. Section 10.3 does not include the Baseline Risk Assessment Work Plan identified in Response to Comment F, Section 7.0, and Figure 10-2.
    b. Section 10.3 does not include the annual Hydrogeological/Groundwater Characterization Reports identified in Figure 10-2.
    c. Section 10.3 indicates Winter 2020 for the Addendum to the RI Work Plan, while Figure 10-2 indicates June 2021.
    d. Section 10.3 indicates Summer 2021 for the Groundwater Modeling Work Plan, while Figure 10-2 indicates December 2021.
    e. Section 10.3 indicates Fall 2022 for the Groundwater Modeling Report, while Figure 10-2 indicates April 2023.
75. **Work Plan, Section 10.3 Page 10-2 and Figure 10-2.** Remove the 2019 Hydrogeological/ Groundwater Characterization Report from the schedule, as was agreed upon during the meeting held December 17, 2019.

76. **Work Plan, Table 3-6.** Table 3-6 has been revised to include the constituents on the Title 10 Missouri Code of State Regulations Section 80.3010 Appendices I, II, III, and IV lists as potential chemical applicable or relevant and appropriate requirements (ARARs). Considering site use and permitting, revise the table and associated Section 3 text to clarify how these ARARs affect monitoring program analytes.
77. **Work Plan, Table 5-1.** Well I-65 is listed twice. Verify whether the second entry should be I-66 or another well and revise the table accordingly. Revise the table to specify whether the total depth measurements are gauged or as-constructed.
78. **Work Plan, Table 5-4.** Table 5-4 includes monitoring well cluster MW-605, but this well is not included elsewhere in the Work Plan or in the figures. Revise the text, tables, and figures as necessary to resolve this discrepancy.
79. **Work Plan, Figures.** Revise all map-view figures to include the former leachate lagoon within the OU-3 site boundary.
80. **Work Plan, Appendix D.**
    a. Some historical boring logs indicate drilling through landfilled material. Response to prior comment 142 from the EPA's comment letter dated September 11, 2019 states: "*The Work Plan, Sampling and Analysis Plan, and Health and Safety Plan will be revised to define "HHT" and address how to drill through potential landfill material safely, if encountered.*" However, the stated revisions to these three plans do not appear to have been made. Revise as indicated.
    b. Response to prior comment 143 from the EPA's comment letter dated September 11, 2019, indicates that the text and tables will be revised to acknowledge when boring logs or well construction diagrams are not available for specific locations. Such acknowledgement does not appear to have been made. Revise as indicated.
81. **Work Plan, Appendix M.** Appendix M has not been revised to "*describe the conversion process (e.g., difference, error) used*" to convert water level elevations to NAVD88, as indicated in the response to prior general comment D from the EPA's comment letter dated September 11, 2019. However, this information is provided in Section 3.1.5.3. For clarity, revise the table in Appendix M to indicate those measuring point elevations where a conversion has been conducted.

FSP Specific Comments

82. **FSP, Section 1.2 Page 1-4.** Review the following underlined measurements and revise as appropriate: "*The South Quarry Pit was excavated to a maximum depth of 240 feet below ground surface (ft bgs) and had a bottom elevation of approximately 240 ft above mean sea level (msl) (H&A 2005; Golder 1996).*"
83. **FSP, Section 1.3.1 Page 1-7.** This section indicates that area wells will be identified using "*publicly available databases.*" However, QAPP Section 3.4.4.2 notes that online well records are available only for wells drilled after 1987. Revise to clarify that the MDNR will be contacted directly to obtain available records for older wells, and that utility records will be reviewed for buildings absent water connections.
84. **FSP Section 1.3.4 Page 1-9.** The last sentence of the first paragraph states, "*Nearby off-site sources may be contributing to groundwater quality within the study area, including leaking underground storage tank sites and the Champ Landfill.*" Delete discussions or references to

specific off-site businesses or other potential sources that may or may not be impacting groundwater quality from the Work Plan, such as Champ Landfill. Further, current data collected during the RI is envisioned to inform the investigation in relation to background groundwater quality within the study area.

85. **FSP Section 1.3.6 Page 1-10 through 1-12.**
    a. Revise this section to define what is meant by the term *"redox measurements"* mentioned in the first bullet on page 1-10.
    b. Revise the section to include field measurement of routine stabilization and geochemical parameters including oxidation reduction potential (ORP), dissolved oxygen, ferrous-ferric iron (field test), sulfide (field test for hydrogen sulfide (H2S)).
    c. Revise this section to include the remaining redox couples or pairs, as stated in the QAPP (N species, Fe species, Mn, Cr III, Cr VI), which will be determined through analysis of water samples.
    d. The USGS has developed a spreadsheet tool for determining redox states in groundwater that is applicable to large data sets such as will be obtained during this RI. https://pubs.usgs.gov/of/2009/1004/ Revise the FSP and QAPP to state that this tool (or a comparable tool) will be utilized to support this RI.
86. **FSP Section 1.3.7, Page 1-11, 3rd paragraph.** Revise this one sentence paragraph from *"Leachate concentrations will be evaluated"* to *"Leachate effects will be evaluated"*.
87. **FSP Section 1.3.7, Page 1-12, Last bullet.** The text within the parentheses in the first sentence mentions "leachate parameters." This term is mentioned twice in the QAPP but not used in the Work Plan. All of these plans must be reviewed and revised for consistency. Revise all of these plans to clearly state what the "leachate parameters" are. These should be included in tables in the FSP and QAPP or identified in the existing tables in the QAPP. In the tables, indicate whether the parameter is measured in the field or the laboratory and the frequency measured.
88. **FSP Section 1.3.7 Page 1-12.** Iodide, bromide, tritium, and stable isotopes must be added to the list of leachate parameters.
89. **FSP, Section 1.3.8 Page 3-12 and 3-13.** Comments #29, 50 and 51 above on Work Plan Sections 4.2.8 and 5.4.17 also apply to this section of the FSP.
90. **FSP, Sections 3.5 Pages 3-12 and 3.6.2 Page 3-19.** The FSP states, *"Bedrock aquifer matrix samples will be collected every 10 feet within vertical intervals with detectable radiation levels based on the Scaler/Ratemeter/Datalogger with the NaI probe and the alpha/beta probes (if present). Secondary criteria for the sample selection will be zones with the highest hydraulic conductivity based on geophysical logging results and any zones with elevated PID readings."* Whether a bedrock aquifer matrix sample will be collected every 10 feet if no radiation is detected is unclear. Additionally, two secondary criteria are proposed, and which will govern if photoionization detector (PID) readings are elevated is unclear, as is the level of PID reading that constitutes "elevated". Revise these sections to clarify the process for selecting bedrock aquifer matrix samples.
91. **FSP, Section 3.6.1. Pages 3-19.** In this section it is implied that sequential extraction analysis samples will be held and selected for analysis based on the results of total and isotopic radiological testing. However, the number of samples to be selected for analysis is unclear. The last paragraph of Section 3.6.1 notes four samples at one point, and three samples at another. Moreover, Table 2-6c of the FSP indicates the same number of sequential extraction analyses as

any other samples for alluvial aquifer matrix analyses. Revise Section 3.6.1 to clarify the process for sequential extraction sampling and analysis and if necessary, correct the number of associated samples in Table 2-6c.

92. **FSP, Section 3.9.1 Pages 3-25 to 3-28 and Figures 3-6a and 3-6b.** Section 3.9.1. proposes a 40/60 silica sand filter pack, an 0008-inch screen slot, and an anticipated screen length of 20 feet for monitoring wells installed in bedrock and alluvium.
    a) For wells installed in unconsolidated material, ASTM International (2010) specifies that the primary filter pack grain size distribution and well screen openings must be fine enough to retain the formation, but coarse enough to allow for unrestricted movement of groundwater into and through the monitoring well. This must also allow for representative sample collection and aquifer testing. Ultimately, the filter pack and corresponding screen slot size should be determined based on the grain size distribution of the formation encountered, as determined by sieve analysis (ASTM, 2010). Revise Section 3.9.1 to specify that the ASTM standard practice will be followed. The boring logs of previously installed monitoring wells may be used to predict the anticipated filter pack grain size distribution(s) to be installed within the study area. For wells installed in bedrock, revise Section 3.9.1 to clarify the basis for filter pack and screen use.
    b) EPA guidelines (2002) indicate that well screens greater than 10 feet long should not be used for low flow purging and sampling. Potential issues posed by longer screens include drawing water from multiple water-bearing zones or across a plume gradient, diluting impacts from discrete zones of contamination (e.g., fracture flow), and decreasing the comparability of analytical results among sampling events if the pump depth varies within the well screen interval. Revise Section 3.9.1 to indicate that well screen lengths will be limited to 10 feet, with the screened interval focused on the anticipated zone of impact as determine during hydraulic profile tool (HPT) efforts or core logging or based on previously obtained data. If the driver for a longer screen length is the volume of water needed for sampling, a larger diameter well should be considered.
93. **FSP, Section 3.14.2 Page 3-34 and 3-35.** Section 3.14.2 states, *"Equilibrium is achieved when parameters exhibit variation equal to or less than the above-reference USEPA criteria for stabilization for a minimum of three consecutive field parameter readings."* The text clarifies that the three consecutive readings should not be trending but fails to identify how the independence of the three readings will be determined. Revise section for consistency with the EPA guidelines (2002) cited, which indicate that measurements will be made at each one-half well volume removed.
94. **FSP Section 3.14.3 Page 3-37.** Revise the section to specify whether ferrous/total iron field testing is to be done on filtered or unfiltered samples. If this test is being conducted to help assess groundwater redox, then the tests must be done on filtered samples using the same filter as that used for the dissolved inorganic constituents. Revise this section to include a summary discussion of the filtering step for total iron field testing using the same filter as the dissolved inorganic constituents.
95. **FSP, Section 3.14.3 Pages 3-35 to 3-38.** Revise to clarify that samples collected for RAD7 Radon Groundwater Screening and Hach kit field analysis of ferrous and ferric iron concentrations will not be field filtered prior to testing.

96. **FSP, Section 3.16.1 Page 3-39.** Revise this statement; *"The site's proposed groundwater monitoring well network will be routinely evaluated for indications that sediment is accumulating inside the well"* from *"will be routinely evaluated"* to *"will be evaluated at least annually."*
97. **FSP, Table 2-2.** The vapor analytes on Table 2-2 are limited to radon, methane, and VOCs. As noted above, other site COPCs are to be considered a vapor intrusion concern if:
    a) Volatility is indicated by 1) a vapor pressure greater than 1 millimeter of mercury (mm Hg), or 2) a Henry's law constant (ratio of a chemical's vapor pressure in air to its solubility in water) greater than 10^{-5} atmosphere-meter cubed per mole ($atm \cdot m^3/mol$).
    b) Toxicity is indicated by 1) the vapor concentration of the pure component exceeding the indoor air target risk level, when the subsurface vapor source is in soil, or 2) the saturated vapor concentration exceeding the target indoor air risk level, when the subsurface vapor source is in groundwater (EPA, 2015).

    Revise Table 2-2 accordingly.
98. **FSP, Table 2-6e.** Revise the footnote from "up-gradient of the site" to "up-wind of the site."
99. **FSP, Table 3-1.** On Table 3-1, the RAD7 is listed as field equipment for indoor air sampling but not for groundwater or leachate sampling. In general, no field equipment is proposed for leachate sampling. Revise Table 3-1 to include all necessary field equipment.

FSP Appendices

100. **FSP Appendix A-7.** The water quality meter calibration form has a fixed value of 4.49 milli-Siemens/centimeter, or mS/cm, for specific conductivity. Calibration using a standard of 4,490 micro-Siemens/centimeter, or µS/cm, MAY be adequate for leachate affected wells, but this standard is NOT adequate for specific conductivity values expected for unaffected alluvial and bedrock wells. The standard value used must approximate the anticipated values that will likely be encountered in the field. If the 4,490 µS/cm standard is used, then additional check standards of 500 or 1,000 µS/cm also must be run each day, and those value recorded, to ensure meter response is linear. Revise the water quality meter calibration form to include additional check standards of 500 and 1000 µS/cm.

    The EPA has had experience with the stated brand of field meter listed in the appendix and has noted previously that specific conductance readings are not linear across the range of expected values from this site. Three-point calibration for pH must be conducted because pH values vary across the site. In addition, given the one-hour potential wait time for auto calibration, as described in the user manual, it is expected that manual calibration will be done as the factory default span ranges are not acceptable for collection of field parameters to be used in the site-specific geochemical assessments. Revise the calibration log with space for recording information for all calibration checks with the additional pH buffer solutions, including sufficient space for recording calibration solution lot or serial number and expiration date.

    Field meters that do not measure dissolved oxygen (DO) optically are vulnerable to contamination from constituents such as hydrogen sulfide. Field probes are generally not considered accurate for DO measurements of 0.5 mg/L or less, which is critical for assessing redox conditions at this site. Colorimetric test kits, such as those available from Chemtrics or

HACH, are capable of testing lower levels of DO. Revise this section to include the use of colorimetric testing under appropriated conditions for DO measurements.

101. **FSP Appendix H-1 "Field Measurement of Residual Radiation SOP" (Trihydro), 7.0 Procedures.** Add a reference to NUREG 1556, vol 11 regarding Broad Scope Licenses, Table L-2 for acceptable surface radioactive contamination limits.
102. **FSP Appendix L2 – Low Flow Bladder SOP Section 3.3.** Revise to indicate the type of compressors to be used and how VOC contamination will be prevented if the compressor is gasoline powered.
103. **FSP Appendix L2 – Low Flow Bladder SOP Section 3.4.** Revise the text to describe how the effects of tubing leaks, aeriation of groundwater within the well, and down-well low-flow pump apparatus will be assessed and mitigated. Low-flow methods and powered compressors can be problematic for assessments of redox as ANY leaks can result in the oxygenation of water downhole. It is recommended that consideration be given to the use of nitrogen tanks when sampling for redox-sensitive constituents.
104. **FSP Appendix L2 - Low Flow Bladder SOP 1, Page 5, Bullet 4a.** Field readings are planned to be measured at 2-10 minutes intervals with no rationale provided for this proposed time interval. This interval should be a function of the pump and tubing volume and the well. If the pump is not set opposite the actual yielding interval in the well, a 2-minute interval may not allow for adequate purging and collection of representative samples. Revise this bullet to a more conservative interval of 4 to 10 minutes, or an interval that is to be based upon the pump and tubing volume in each well.
105. **FSP Appendix L2 - Low Flow Bladder SOP, Page 5, bullets 4b and 4c.** Bullet 4b states stabilization criteria of 0.1 for pH, 3% of stabilization criteria and 0.3 mg/L for DO; but bullet 7e on page 4 states the field meter is only calibrated to within 10 percent. The proposed 10 percent value is not acceptable for calibration, especially if the criteria in bullet 4b are used. Also, bullet 5 indicates continued purging until readings are within 10 percent. The information in these bullets is contradictory and confusing. Revise this standard operating procedure (SOP) as follows:
    a. Address the inadequate calibration criteria specified in bullet 7e on page 4. More typical criteria are within 0.1 pH units and a 3-point calibration; within 2 or 3 % for specific conductance with check standard bracketing the range of field values; within 0.1 mg/L DO; and within 0.2 degrees when compared to a National Bureau of Standards (Nbs) traceable thermometer.
    b. Resolve the conflict between bullets 4b and 5 by removing bullet 5.
106. **FSP Appendix O, Section 1.0, 3rd sentence** Revise "personal" to "personnel."
107. **FSP Appendix O, Sections 3.1 and 3.2** The described decontamination guidance is specific to the Ohio EPA and EPA Region 4. The EPA Region 7 Equipment Decontamination SOP, EPA Environmental Response Team SOP #2006, provides more extensive, analyte-specific decontamination procedures (e.g., various solvent rinses). Revise to reference the EPA Region 7 SOP. Modify the equipment decontamination SOP for consistency with the EPA Region 7 SOP or remove and replace it with the EPA Region 7 SOP.

Quality Assurance Project Plan (QAPP) Comments

General Comments on the QAPP

108. **General QAPP Comment.** Additional improvement of QAPP Section 3.0, Data Quality Objectives, remains necessary to clearly document appropriate RI/FS study questions, clarify study objectives, identify data collection needs, specify performance or acceptance criteria, and define tolerable levels of decision error as the basis for establishing the quality and quantity of data needed to support decisions (EPA QA/G-4). The current organization of the QAPP makes it is difficult for the EPA to discern which Principal Study Question is being addressed in subsequent QAPP sections. Because revision of the Step 2 Principal Study Question(s) will result in subsequent revisions of the remaining steps, the EPA is not able to provide comprehensive comments on Steps 3 through 7 of the data quality objectives (DQOs) process and will likely have additional input once these steps are appropriately addressed with the required inputs. Further, because this submittal is the second draft of the QAPP, the EPA recommends that the Respondents and the EPA meet to efficiently develop acceptable DQOs for the next revision of the QAPP.

    An overarching issue within Section 3.0 of the QAPP is the lack of connection between the Studies, the specific Principal Study Questions within those Studies, and the subsequent steps in the DQO process. Identification of appropriate Principal Study Questions (Step 2) is critical. Some of the proposed Principal Study Questions are not focused enough to be carried through the full DQO process. Other proposed Principal Study Questions overlap each other, and in some cases additional Principal Study Questions are needed to fully address identified data gaps or otherwise meet objectives of a CERCLA RI/FS and the 2019 ASAOC. Following are two primary examples of these issues.

    a. The QAPP is organized into nine Studies based on the data gaps identified in the 2019 ASAOC. While addressing data gaps is critical to the RI, the QAPP should be structured to answer questions that support broader attainment of RI/FS objectives. The following potential issues are the result of using the data gaps rather than the RI/FS process to drive the development of DQOs.
        i. Information that is needed to address RI/FS objectives but that is not defined as a data gap is shoehorned into the nine data gap Studies, making it difficult for estimation or decision Principal Study Questions to be clearly defined and carried through the DQO process in a supportive way. For example, groundwater, indoor air, and ecological receptors are identified as relevant to multiple Studies, but the carry-through to mitigation decision-making is unclear because the Principal Study Question(s) are not fully or clearly defined.
        ii. The Principal Study Questions risk becoming the equivalent of data inputs. For example, the Principal Study Questions under data gap Study #2 are essentially a list of potential aquifer properties to be determined. This must be carefully considered because the data obtained in addressing a data gap may be used to inform multiple RI/FS objectives with differing performance criteria, again making it difficult to carry the Principal Study Questions through the DQO process in a supportive way.

b. The Principal Study Questions are not appropriately defined and have not been carried through the DQO process. Per EPA QA/G-4, the manner in which Principal Study Questions are framed and carried through the DQO process will differ based on the intended use of the data collected, that is, "whether the study is qualitative or descriptive in nature, will support the quantitative estimation of some unknown parameter, or will provide information for supporting decision-making."

   i. The foreword to EPA QA/G-4 indicates the DQO process is the Agency's recommended planning process when environmental data are used to derive an estimate of contamination (estimation studies) or select between two alternatives (decision studies). As such, qualitative studies that are not decision problems do not need to go through the full DQO process. These qualitative studies can occur in the work plan and be removed from the QAPP.

   ii. The study question may support decision-making (a choice between multiple alternatives) or estimation (evaluating the magnitude of an environmental parameter or characteristic).

      - Quantitative decision-making problems are typically framed as a statistical hypothesis test, with alternative actions identified as part of the Step 2 problem definition. Under Step 6, probability limits for false rejection and false acceptance decision errors may be specified.
      - With estimation problems, Step 2 includes a statement of the unknown environmental characteristics that will be estimated from the collected data. Alternative actions do not apply to estimation problems, but anticipated outcomes or important considerations for data collection may be indicated as part of the estimation statement. Step 6 is typically expressed in terms of acceptable uncertainty (e.g., width of an uncertainty band or interval) associated with a point estimate at a desired level of statistical confidence (EPA QA/G-4).

   Due to the complexity of this RI/FS, numerous Principal Study Questions are appropriate. However, they must be decision or estimation studies that are appropriately focused in Step 2 and then carried through the other DQO steps (e.g., decision rule/specification in Step 5, performance/acceptance criteria in Step 6). Thus, revision of the structure of Section 3 of the QAPP is necessary and revision of multiple Principal Study Questions is required, consistent with Chapter 2 of EPA 2006 "Guidance on Systematic Planning Using the Data Quality Objectives Process" (EPA QA/G-4).

109. **General QAPP Comment.** The QAPP is missing site-specific and study-specific data quality criteria (such as, the required method uncertainty, or u_{MR}, and the upper bound of the gray region, or UBGR) needed to determine whether the measurement data discussed in Section 3.13 are of adequate quantity and quality. Performance of data validation in accordance with the standards specified in Section 7 is only possible if these criteria are established. In particular, measurement quality objectives (MQOs), are required to perform data validation and otherwise ensure adequate data quality. These criteria need to be determined as described in EPA QA/G-5 and MARLAP and must be listed or referenced in the QAPP.

    Ultimately, according to the EPA guidance, MQOs must be established for each analyte on an individual DQO basis in consideration of associated principal study questions, action levels and

decision rules. The EPA notes that Tables 2-3a, 2-3b, and 2-3c list different state and federal guidelines for several of the COPCs and compare these guidelines to the method reporting and method detection limits provided by Pace, ALS, and MCL laboratories. However, it is not clear whether any of these guidelines are intended to be action levels or decision rules for any of the principal study questions. Similarly, these tables provide laboratory method reporting limits and/or detection limits, but it is not clear whether any of this information is intended to be used to develop MQOs or other measurement quality criteria. For example, in the DQO process, the UBGR is often set at the action level for the corresponding DQO. If that were to be the Respondents' intent for any of the DQOs described in this QAPP, this must be explicitly stated.

Further, the equations for the evaluation of radionuclide quality control (QC) samples (e.g., blanks, laboratory control sample) appear to be from the Multi-Agency Radiological Laboratory Analytical Protocols Manual, or MARLAP, but because of formatting or other issues, they are misrepresented in the QAPP. Revise the equations to be formatted correctly and consistent with the equations found in MARLAP. For example, see Section 3.13.1.2 For $\bar{x} <$ *UBGR*, the statistic looks generally correct, except the subscripts "1" and "2" aren't lowered. See the correct version of this formula below.

$\text{abs}(x_1 - x_2)$

or

$\text{abs}(x_1 - x_2)$

And, for $\bar{x} \geq$ UBGR, the equation for RPD needs to be retyped. If the absolute value bars are to be avoided for some reason, then present the formula as follows:

$$RPD = \frac{\text{abs}(x_1 - x_2)}{(x_1 + x_2)/2} \times 100\,\%$$

Or alternatively,

$$RPD = \frac{\text{abs}(x_1 - x_2)}{(x_1 + x_2)/2} \times 100\,\%$$

Further, in Section 3.13.2.2 the equation for Z needs to be corrected. The radical doesn't extend far enough, the exponent 2 isn't raised, and the subscript "MR" isn't lowered. See below for the correct version of this formula:

$$Z = \frac{SSR - SR - SA}{\varphi_{\text{MR}} \sqrt{SSR^2 + \max(SR, UBGR)^2}}$$

Or alternatively,

$$Z = \frac{SSR - SR - SA}{\varphi_{\text{MR}} \sqrt{SSR^2 + \max(SR, UBGR)^2}}$$

Presumably, in this formula the UBGR is the action level, in which case the symbol AL may be preferred instead of UBGR, for clarity.

110. **General QAPP Comment.** Multiple deficiencies have been identified with the Step 7 sampling designs. Apply Visual Sample Plan, ProUCL, or an equivalent software tool to move from Step 6 (limits on decision errors) to Step 7 (sampling and analysis plan) in a manner that is statistically defensible and optimized to balance the cost and effort of data collection with measurement performance to achieve DQOs. See also EPA QA/G-4 and EPA QA/G-9S.
    a. Basis for design: The sampling designs are presented without sufficient basis. A defensible sampling design must be based on (1) the study objectives and intended data use, (2) the outputs of DQO Steps 1 through 6, (3) background information on the problem, including knowledge of the CSM, contaminant distribution/fate/transport, and regulatory requirements, and (4) expected data variability and distribution based on similar studies or professional opinion. While items 1 through 3 are addressed to some degree in the QAPP, item 4 is largely absent.
    b. Design type: The type of sampling design is not specified in the context of the study objectives, intended data use, and DQO process. See EPA QA/G-5S.
    c. Sample representativeness: The lateral and vertical distribution of the sampling locations is not consistently or clearly tied to the intended use of the data to be collected, such that the representativeness of the proposed samples for their intended purpose can always be verified. Moreover, the lateral and vertical distribution of the sampling locations is not strongly tied to the conceptual site model, such that the density of lateral and vertical sampling locations can be demonstrated to correspond to the variability of lateral and vertical stratification in the subsurface. An example in which these considerations are especially important is the 600-series background locations, as elaborated in other comments.
    d. Number of samples: The minimum sample size depends on the estimated total variability of the data to be collected (see Basis for Design). The software tools listed previously support calculation of statistically defensible values.

Specific Comments to the QAPP

111. **QAPP, Title/Signature Page/Distribution Page.** Remove Ryan Seabaugh, MDNR, as a signatory. Remove Justin Barker, EPA, as a signatory and replace with Jamie Schwartz, EPA. Revise the cover page to add a new signature line for EPA Region 7 Quality Assurance Manager, Diane Harris.
112. **QAPP, Section 1.2, Page 1-4.** Under Study #2 – Aquifer Properties, the second to last sentence states, *"A pilot test using a hydraulic profiling tool is proposed to evaluate its potential to provide continuous hydraulic conductivity data."* For alignment with the Work Plan, revise to indicate what type of hydraulic profiling tool this section is referring to, and further revise to indicate the contingency plan if the pilot test fails to provide continuous hydraulic conductivity data.
113. **QAPP, Section 2.3, Page 2-5, last paragraph.** This section states that validation levels are specified in the RI/FS Work Plan, but it also states that validation levels for specific portions of the project will be included in the RI/FS Work Plan. These statements are not clear as to whether the specific validation tier for each data collection event has already been specified or will be specified in the future. In addition, use of the term "RI/FS Work Plan" in this context is vague as this could include any of the volumes associated with this document. Revise the

paragraph by clarifying the level of data validation that will be performed for each data collection event or provide a specific reference to where this information has been or will be included.

114. **QAPP, Section 2.5, Page 2-8, paragraph associated with bulleted item "3."** This bulleted item states *"MCL, Inc. is a specialty laboratory that will be performing analyses that are not able to be covered by Pace or ALS (large commercial laboratories). Due to the nature of these specialty analyses, the QA/QC procedures may slightly vary or be modified from the procedures discussed for other methods in the QAPP. These methods are described in greater detail in Section 5.1.2.2 and included in Appendix D as part of the laboratory SOPs."* Revise this paragraph to clarify that MCL, Inc. will follow the narrative provided in Section 5.1.2.2 and/or per the SOPs provided in Appendix D-7, and that any other specific quality assurance/quality control (QA/QC) procedures that are modified or developed for the work to be performed by MCL Inc. will be submitted to the EPA for review and approval prior to the modified or new procedure being implemented on site samples or used in support of project studies.
115. **QAPP, Section 3.0, Pages 3-1 to 3-66, and Table 3-1 (mislabeled as Table 4-1).** To eliminate redundancy and the potential for discrepancies, present the DQOs as either text or table, not both. If a table format is used, use a readily legible font and font size.
116. **QAPP, Section 3.0, Page 3-2.** Multiple references are made to Table 3-1, however, these references appear to be to Table 4-1 as there is no Table 3-1 included with the revised QAPP. Revise the reference or correct the table number as appropriate
117. **QAPP, Section 3.4.1, Page 3-4, and equivalent Data Gaps sections.** Under each Study, the subsection titled "Data Gaps" informs the goal of the study and the associated principal study questions. However, "Data Gaps" is incorrectly identified as Step 1.3 of the DQO process. The EPA DQO process does not include a process step titled "Data Gaps" (EPA QA/G-4), and the reference to Step 1.3 should be removed from the "Data Gaps" header.
118. **QAPP, Section 3.1, Page 3-2 and 3-3.** The problem definition provided in this section is limited and does not fully capture the nine studies and the scope of the 2019 ASAOC. Revise the Section 3.1 problem statement to state: *"Petroleum hydrocarbons, VOCs, trace metals, trace anions, and various radionuclides have been detected in groundwater at the site. The nature and extent of site-related impacts to groundwater, surface water, sediment, and indoor air are unknown. An improved understanding of the nature, extent, and source(s) of groundwater contamination at the site, and the mechanisms of contaminant migration, will be used to 1) assess the potential for site-related contamination to migrate beyond site boundaries into critical exposure pathways, 2) determine the attendant current and predicted future risks posed to human health and the environment, and 3) develop potential groundwater remedies as necessary."*
119. **QAPP, Section 3.2, Page 3-3.** Section 3.2 acknowledges the potential for impacts to surface water, sediments, and/or ecological receptors. However, the QAPP is unclear as to how the studies will assess that impact. Although ecological risks are noted under Study #1, they appear to be tied to water well use only. Impacts to ecological receptors are not discussed under Study #9, which addresses the interaction of groundwater with surface water bodies. Revise the QAPP to better indicate how the studies will support the assessment of ecological risk.
120. **QAPP, Section 3.3, Page 3-4.** Section 3.3 is intended to present the project budget, personnel, and schedule. No schedule is provided or referenced. Revise Section 3.3 to include the schedule or reference Table 3-1 (mislabeled as Table 4-1) of the QAPP or Section 10.3 of the Work Plan.

Additionally, revise the schedule information in the QAPP text and Table 3-1 (mislabeled as Table 4-1) to reflect comments on Work Plan Section 10.3.

121. **QAPP, Section 3.4, Pages 3-4 to 3-14.** The scope of Study #1 is broad, such that some aspects may be more appropriate to consider as part of other studies or moved to volume 1 of the Work Plan. In particular:
    a. Regarding evaluation of historical data under Study #1, data usability should be assessed when considering data to make decisions or estimates related to any of the other studies proposed for the RI and presented in this QAPP. As such, a separate data validation process and deliverable that does not consider these studies and their specific DQOs is not necessary and may not be useful. However, the QAPP remains unclear as to what level of data validation will be required for various data uses, and clarification is required. For example, Section 3.4.3.2 states, "The level of validation for older data without the Level IV QA/QC data package will be validated to the level possible based on the QA/QC data available for that particular data set." The EPA requires that the QAPP be utilized to evaluate the adequacy of data quality for all data, historical or new, that is proposed to be used to fill a data gap or answer a principal study question according to the specific requirements for that study as presented in this QAPP. Any historical data that does not meet these requirements cannot be used quantitatively to provide an estimate or to make a decision related to that DQO. The EPA notes that data quality for historical data may be adequate for some studies/DQOs but not for others. Historical data that does not meet the data quality criteria for any of the studies present in this QAPP may be considered qualitatively during the RI if justification is provided and approved by the EPA. Revise the QAPP to remove the evaluation of all historical data from Study #1, and to incorporate evaluation of relevant historical data as a component of studies where it is applicable. Revise the QAPP to include a clear process for determining whether such data would be rejected outright or if the data would meet DQOs for some purposes but not others (e.g., acceptable for qualitative purposes but not quantitative ones).
    b. Principal Study Question 2 under Study #1 evaluates the adequacy of the existing and proposed monitoring network. If the proposed adequacy evaluation is not a decision or estimate, revise the planning documents to move this study question from the QAPP to the Work Plan. Regardless, the QAPP will provide an indirect check on the adequacy evaluation because the field and analytical data used to support the evaluation will meet QAPP DQOs.
    c. Identification of groundwater receptors is addressed under Study #1 (Principal Study Question 9), but also under Study #5 (Principal Study Questions 3 and 4) and Study #8 (Principal Study Questions 1 and 2). Identification of human health and ecological receptors appears to be a qualitative/descriptive study component that belongs in the Work Plan rather than the QAPP. However, comparison of environmental data to levels protective of human and ecological receptors is a quantitative study component that belongs in the QAPP. Revise the planning documents to move studies that are not decisions or estimates from the QAPP to the Work Plan. In doing so, clarify when and how potential receptors will be identified and communicated to the EPA. Further, identify the process for evaluating, communicating, and implementing interim actions as necessary to protect potential receptors.

122. **QAPP, Section 3.4.2.1.** Study #1 Principal study questions, page 3-5, states: *"Are there drinking water wells within a 2-mile radius of the site that may be impacted by the site groundwater?"*

See the comment on QAPP Section 3.4 regarding human receptors, and revise QAPP Section 3.4.2.1 accordingly. Revise to clarify that in evaluating risk to human health, exposure to well water through direct contact, inhalation, and other ingestion routes must be considered in addition to drinking water. In addition, wells other than drinking water wells may need to be considered.

123. **QAPP, Section 3.4.2.2, Page 3-6.** Revise the alternative outcome bullets in Section 3.4.2.2 per the general and specific comments above, removing qualitative study content and clarifying the relationship between principal study questions, alternative actions, and decision rules. For example, note that alternative outcome 10 ("It is possible that the proposed turbidity threshold is not achievable.") is not clearly derived from any single study question or tied to any decision rule.

124. **QAPP, Section 3.4.2.3, Page 3-7, and equivalent Step 2.3 sections through 3.12.2.3.** Step 2.3 is titled "Decision Statements/What Needs Estimated and Key Assumptions." To prevent confusion with Step 7.2, titled "Key Assumptions," rename Step 2.3 "Decision Statements/Estimation Statements."

125. **QAPP, Section 3.4.2.3, Page 3-7, and Work Plan, Section 9.1, Page 9-1.** QAPP Section 3.4.2.3 and Work Plan Section 9.1 indicate that the Well Inventory Summary Report will discuss the adequacy of the existing data quality. As discussed in prior comments to this section, the Well Inventory Summary Report must determine the status and integrity of each well within the existing well network. It is outside the scope of this report to attempt to determine whether historical samples collected from these wells have produced data that is of sufficient quality for use in the RI. Rather, all the analytical data that is proposed to be used for making estimates or decisions in the RI must meet the requirements specified in this QAPP for the specific study the data is supporting. The EPA agrees that the condition of the wells in the network should be considered, in addition to any historical laboratory QA information and independent data validation documentation, when deciding whether it is appropriate to include historical data in any RI evaluation. As such, the Well Inventory Summary Report should note for each well any findings that may impact the representativeness of collected samples. Revise the QAPP and Work Plan to clarify the scope of the Well Inventory Summary Report and to specify that any well conditions impacting sample representativeness will be documented therein.

126. **QAPP, Section 3.4.3.1, Page 3-7 and 3-8, and equivalent Step 3.1 sections through 3.12.3.1.** Step 3.1 presents the types and sources of information needed for each study. If the source of information is another RI/FS activity or study, revise this section to clearly reference the associated work plan, field sampling plan, or QAPP sections.

127. **QAPP, Section 3.4.3.1, Page 3-7.** Types and Sources of Information for Study #1 include: *"Missouri State well databases, Environmental Data Resources (EDR) database reports, and OU-1/OU-2 historical reports are available to identify potential wells (including drinking water wells) in the area. Water connection information may be available from the local water providers to identify parcels without tap water service."* As noted above, revise the planning documents to move qualitative/descriptive study questions and related inputs from QAPP to the Work Plan.

128. **QAPP, Section 3.4.3.2, Page 3-8.** It is unclear what is meant in the first sentence of this section by ..."*will be evaluated relative to the following resources:*" For example, the first bullet states, *"The Missouri State Well code will be used to establish criteria for the well inspection and for making decisions with respect to well repairs, well abandonment and well replacement."* It is

unclear which Missouri State Well code will be used, and how the integrity of the below ground components will be inspected and documented, such as using a downhole camera during the well inspections. Provide additional clarity on how these resources will be applied and demonstrations made. Additionally, as noted above, revise the planning documents so that resources associated with qualitative/descriptive study questions are moved from the QAPP to the Work Plan.

129. **QAPP, Section 3.4.3.3, Page 3-9.** Section 3.4.3.3 indicates that the well inventory will be "followed by a statistical test to evaluate if sufficient data are available in each zone ... and/or model layer." No additional discussion of the statistical test is provided. Revise the QAPP to indicate the specific statistical test(s) and performance criteria. Additionally, see the general and specific comments regarding evaluation of the monitoring well network. Revise the QAPP to clarify where and when this evaluation will be presented to the EPA, considering the schedule for well installations and model planning and implementation.
130. **QAPP, Section 3.4.4.1, Page 3-9.** This section uses the term "groundwater wells." Revise the section to use consistent terms with Section 3.4.2.2 or explain why different terms are used.
131. **QAPP, Section 3.4.4.2, Page 3-10.** Temporal and Spatial Boundaries, Study #1, states: *"The temporal boundary for the off-site well search will be limited to the date the MDNR well records began."* To the extent that potential human receptors are associated with the off-site well search, no temporal boundary should be placed on open or active groundwater wells. Revise this section to delete this statement or revise it for clarity. See also QAPP Comment 3.4 regarding human receptors.
132. **QAPP Section 3.4.4.2 Page 3-10.** Temporal and Spatial Boundaries (Step 4.2), The last sentence states, *"The vertical boundary of the well network is the base of the Keokuk Formation."* This appears to be an arbitrary limit placed on the scope of the investigation. Additionally, it's unknown how accurate this statement is since no existing or proposed monitoring well goes to the base of the Keokuk. Revise to state that unless results of the investigation indicate a need to step out further, the boundary of the well network is the base of the Keokuk Formation.
133. **QAPP, Section 3.4.4.3 Page 3-10.** Section 3.4.4.3 states, *"The presence of a dedicated pump may create an obstacle for collection of total depth readings. Total depth readings could skew turbidity readings if sediment at the base of the well is disturbed."* Neither of these conditions presents a constraint if the dedicated pump is removed prior to total depth measurement, but only after turbidity measurements and other monitoring and sampling activities have been conducted. Revise the FSP so that the proposed approach avoids this potential constraint on data collection.
134. **QAPP Section 3.4.5.2, Page 3-11.** This section states, *"...if historical data are not of sufficient quality to use as part of a groundwater model or risk assessment or site characterization, the data will be evaluated to determine if it requires qualification or rejection."* Revise for consistency with QAPP Comment 121a on QAPP Section 3.4.
135. **QAPP, Sections 3.4.6 Page 3-12, 3.5.6 Page 3-19, 3.6.6 Page 3-26, 3.7.6 Page 3-33, and 3.11.6 Page 3-60.** Various sections of the QAPP identify the following completeness objective: *"95% of the data will meet data quality objectives."* Because data quality objectives are presented in the QAPP as a 7-step process, the meaning of this statement in the context of these studies is unclear. Revise the QAPP to clarify the completeness objective. Expand the discussion by referencing the specific subsections within Section 3 (individual studies and/or data quality

metrics) that contain or will be used to identify performance or acceptance criteria related to groundwater data quality.

136. **QAPP Section 3.4.6, Page 3-12.** Section 3.4.6 states, *"The spatial distribution of the well network could be deemed adequate but additional wells may be necessary for the risk assessment, the groundwater model, or to completely characterize groundwater conditions."* Because the proposed study question is broadly defined (*"adequate for future groundwater monitoring in terms of horizontal and vertical distribution"*), the spatial distribution of the well network could only be considered adequate if it met the groundwater monitoring needs of the corresponding risk assessment, groundwater model, and groundwater condition characterization components of the RI. Delete this statement.
137. **QAPP Section 3.4.7.1, Page 3-12.** Sampling Design for Study #1, task 9, page 3-13, states: *"Determine if drinking water well testing or water replacement is warranted based on off-site groundwater well data, flow direction, drinking water well depth, and well use."* The scope of this task is poorly defined within the scope of Study #1 and the associated principal study questions. See Comment 121c, and revise QAPP Section 3.4.7.1 accordingly.
138. **QAPP Section 3.4.7.1, Page 3-13, Bullets.**
    a. Bullet 2 states that the determination if additional wells are needed will be made after the second quarterly round of data collection. However, Sections 5.4.14.3 and 5.4.16 of the Work Plan mention that not all constituents and some important leachate indicators (e.g., stable isotopes, tritium) will not be sampled initially but only if it is determined they are "needed." Determining the need for additional wells BEFORE collecting these additional leachate indicators is an inconsistency that also is observed in Work Plan Section 5.4. Revise the Work Plan and the QAPP, if applicable, to ensure multiple quarters of sampling for all COPCs and leachate indicators are performed before completing the adequacy evaluation of the monitoring well network.
    b. For Bullet 9, see comments on Work Plan Section 9.1 and revise the QAPP accordingly.
139. **QAPP, Section 3.4.7.2 Page 3-10. QAPP, Section 3.4.7.2 Page 3-10.** Assumption/bullet 7 under Section 3.4.7.2 states, *"Wells can be redeveloped successfully to reach 5 NTU during sampling and if 5 NTU cannot be achieved, the well will be redeveloped by removing 10 well casing volumes prior to sampling."* The removal of well casing volumes is generally not an acceptable method of well redevelopment; as the movement of formation water in only one direction, as when pumping from the well, does not produce the proper development effect. Generally surging is the most common method of well development, as surging involves forcefully moving water into and out of the well screen and is preferred to induce flow reversal and prevent particle bridging (EPA, 1992; ASTM 2013). Revise Section 3.4.7.2 to reference the Well Development SOP in Appendix L-1 of the RI/FS FSP.
140. **QAPP, Section 3.5 Page 3-14 to 3-21.** Move the discussion of the aquifer properties study to Volume 1 of the Work Plan, as discussed in General QAPP Comment 108(b)(i). the EPA's remaining specific comments to section 3.5 should be addressed in that new section. Ensure that specific references are made to the field sampling plan when presenting information regarding the various field measurements that will be made to support this study. Also, include a discussion of how any historical field measurements of aquifer properties will be considered and evaluated to support this study.
141. **QAPP, Section 3.5.3.1 Page 3-16.**

a. The types and sources of information provided do not appear to address Principal Study Question 2. Revise Section 3.5.3.1 to identify the types and sources of aquifer discharge rate information.
b. Both historical reports and newly collected data are identified as sources of water levels, hydraulic conductivity data, and aquifer properties. Revise to clarify when and how the historical information will be applied.

142. **QAPP Section 3.5.3.1 Page 3-16.** Bullet 1, precipitation records are not by themselves considered "aquifer recharge." Revise this bullet and include in the relevant sections how area precipitation data is used with other types of information in determining aquifer recharge estimates. Further, borehole flowmeter measurements as mentioned in the Work Plan are another source of information on flow in fractures and the relative transmissivity of the fractures, especially if such measurements are done under both ambient and stressed conditions. There is no mention of this technique in the documents. Revise the Work Plan to evaluate the use of vertical borehole flow measurements under both ambient and stressed conditions. Useful references to support this work include the following:
- Paillet, F.L., Hess, A.E., Cheng, C.H., and Hardin, E., 1987, Characterization of fracture permeability with high-resolution vertical flow measurements during borehole pumping: Ground Water, v. 25, no. 1, p. 28-40.
- Paillet, F.L., 1998, Flow modeling and permeability estimation using borehole flow logs in heterogeneous fractured formations: Water Resources Research, v. 34, no. 5, p. 997-1010.
- Paillet, F.L., 2000, A field technique for estimating aquifer parameters using flow log data: Ground Water, v. 38, no. 4, p. 510-521.
- Paillet, F.L., and Reese, R.S., 2000, Integrating borehole logs and aquifer tests in aquifer characterization: Ground Water, v. 38, no. 5, p. 713-725.
- Paillet, F.L., 2001, Hydraulic head applications of flow logs in the study of heterogeneous aquifers: Ground Water, v. 39, no. 5, p. 667-675.

143. **QAPP, Sections 3.5.3.2 Page 3-16, 3.5.5.2 Page 3-18, 3.5.7.1 Page 3-20, 3.6.3.2 Page 3-23, 3.6.5.2 Page 3-25, 3.7.3.2 Page 3-30, 3.8.3.2 Page 3-37, 3.9.3.2 Page 3-44, 3.10.3.2 Page 3-50, 3.12.3.2 Page 3-63, and 6.2.2 Page 6-7 to 6-8.** Evaluation and qualification of outliers is discussed in multiple sections of the QAPP, but no statistical test or procedure is identified for the identification of outliers. Revise the QAPP to clarify how outliers will be identified and their cause(s) determined. Useful guidance documents to support this work include the following:
- EPA. 2015. ProUCL Version 5.1 Technical Guide. EPA/600/R-07/041. October. https://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_tech-guide.pdf
- EPA. 2015. ProUCL Version 5.1 User Guide. EPA/600/R-07/041. October. https://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_user-guide.pdf
- EPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. EPA 530/R-09-007. March.

144. **QAPP, Section 3.5.3.3 Page 3-17.** Section 3.5.3.3 mentions laboratory methods for mineralogic analysis of the aquifer matrix samples, but mineralogy is not previously identified as a data gap or study question in Section 3.5. Revise Section 3.5 to clarify the need for mineralogic analysis earlier in the study description.

145. **QAPP, Section 3.5.7.1 Page 3-20.** Section 3.5.7.1 indicates that no slug tests will be conducted in previously tested existing wells, implying that historical slug test data will be solely relied upon at these locations. Revise the QAPP to state that 1) the Study #2 data evaluation process will be applied to the historical slug test data, and 2) if the historical slug test data do not meet data quality objectives, new slug tests will be conducted at these well locations.
146. **QAPP, Section 3.5.7.1 Page 3-20.** The sampling approach in Section 3.5.7.1 includes a number of steps to evaluate groundwater and surface water interaction. As groundwater and surface water interaction is the focus of Study #9, either move these steps to Study #9 or clarify the interdependencies between these two studies.
147. **QAPP, Section 3.6 Page 3-21 to 3-27.** Move the discussion of the regional and local hydraulic gradients study to Volume 1 of the Work Plan as discussed in General QAPP Comment 108(b)(i). Similar to comments on Section 3.5, ensure that specific references are made to the FSP when presenting information regarding the various field measurements that will be made to support this study. Also, include a discussion of how any historical field measurements of hydraulic gradients with be considered and evaluated to support this study.
148. **QAPP Section 3.7 Page 3-27 to 3-34.** Study #4 addresses background conditions; however, the intent of this study is unclear.
    - To meet the objectives of the 2019 ASAOC SOW, the RI/FS must distinguish background groundwater quality, not affected by previous or existing site activities, from on-site groundwater quality that may be affected by site-associated waste or activities. This requirement applies to all COPCs detected in background groundwater, whether naturally-occurring or man-made.
    - However, a distinction between natural background levels (e.g., from the aquifer matrix) and anthropogenic background levels (e.g., from other nearby sites such as landfills, spills, cleanup sites, Leaking Underground Storage Tanks, and Resource Conservation and Recovery Act generators, or resulting from the redox changes such sites impart on aquifer materials) is also necessary. Note that the EPA does not generally clean up below natural occurring/ambient levels (EPA, 1997). The EPA guidance further clarifies: "Background samples should be collected from nearby [upgradient] wells that are not expected to be influenced by the source of contamination or by other sites. If there are other sites or potential local sources of ground water contamination, additional background samples should be collected where possible to differentiate their contribution from that of the site under investigation" (EPA, 1995, 2018).

    Revise QAPP Section 3.7 to reflect these EPA expectations regarding the background study. Changes are anticipated to all aspects of the DQO process.
149. **QAPP Section 3.7.1, page 3-27, first paragraph:** The section states that background should be established due to the presence of elevated concentrations of naturally-occuring radionuclides and other COPCs in groundwater. Background must be established simply because some COPCs are naturally-occuring in groundwater. Further, no comparison value or discussion is provided to justify referring to the current unknown background groundwater concentrations as elevated. Delete the words "*of elevated concentrations*" from this sentence.
150. **QAPP Section 3.7.2.1 Page 3-28.** The background data gap appears to be overly focused on radium and radionuclide background concentrations. Revise this section to include the

contaminants of concern that will be identified through conducting the groundwater investigation.

151. **QAPP Section 3.7.2.1 Page 3-28.** Section 3.7.2.1 indicates that a principal study question under Study #4 is to determine if off-site sources are impacting groundwater within the study area. Revise the study DQOs to clarify how natural background levels (e.g., from the aquifer matrix) will be distinguished from anthropogenic background levels.
152. **QAPP Section 3.7.2.1, Page 3-28:** The following comments pertain to the Principal Study Questions proposed for Study #4:
    a. The distinction between the first two study questions is unclear since the radionuclide activity in groundwater near the site and off-site will, at a minimum, include the background level of radionuclide activity in groundwater off-site. Additionally, boundary conditions for "near the site" and "off-site" are not clearly defined here or in QAPP Section 3.7.4.2. See also the Comment 148 on QAPP Section 3.7. Revise the section by developing more specific principle study questions.
    b. Principal Study Questions 3, 4, and 5 seem to be outside the scope of the "Background Groundwater Conditions" study as they involve making comparisons of on-site data to background data or otherwise involve evaluating potential impacts to groundwater from the Site. Move these principal study question to Section 3.8, Study #5 – Occurrence and Extent of Groundwater Impacts.
    c. In place of Principal Study Questions 3 and 4, revise QAPP Section 3.7.2.1 to add the following principal study question: "What is the ratio of Ra228/Ra226 in groundwater at the representative background locations?" Maintaining this more limited principal study question in this section will ensure that consideration is given to the data quality criteria necessary for analysis of Ra228 and Ra226 to ensure the necessary level of accuracy and precision is achieved when comparing the ratio of these two analytes between background and other groundwater sampling locations to support Study #5.
    d. In place of Principal Study Question 5, revise QAPP Section 3.7.2.1 to provide a more precise principal study question related to potential anthropogenic impacts to groundwater conditions upgradient of the Site.
153. **QAPP Section 3.7.2.2, Page 3-28:** The first sentence assumes that the *"historical on-site groundwater quality data are not adequate to provide the necessary background groundwater quality data."* On-site groundwater quality data cannot be used to determine background groundwater quality data because of the potential for impacts from site-related COPCs. Revise the first sentence as follows, "The assumption for Study #4 – Background Groundwater Conditions is that historical background groundwater quality data are not adequate to determine representative background concentrations for naturally-occuring COPCs."
154. **QAPP Section 3.7.2.2, Page 3-28 and 3-29:** All bullets in this section except the last bullet describe alternate outcomes which are related to determining whether releases of COPCs from the Site are impacting groundwater, and thus, are more applicable to Study #5 – Occurrence and Extent of Groundwater Impacts than Study #4 – Background Groundwater Conditions. In addition, the last bullet is overly broad and vague, as the study area encompasses groundwater on-site, off-site and upgradient, and off-site and downgradient. Revise the section to present alternative outcomes related only to the objectives of Study #4 (see Comment 148 on QAPP Section 3.7) and the corresponding principal study questions as revised.

155. **QAPP Section 3.7.2.2 Page 3-28.** The first sentence in the first bullet does not make grammatical sense and is missing something. Revise bullet to correct this issue.
156. **QAPP Section 3.7.2.3, Page 3-29:** Revise Section 3.7.2.3 to present decision and estimation statements related to the objectives of Study #4 (see Comment 148 on QAPP Section 3.7) and the corresponding principal study questions and alternative actions as revised (see comments on QAPP Section 3.7.2 and its subsections). In particular:
    a. Revise the decision and estimation statements for consistency with the scope of Study #4. Move comparisons with on-site impacts to Study #5.
    b. Quantitative considerations are limited to radionuclide COPCs/radium isotopes. Revise this section to include representative background concentrations of all naturally-occurring COPCs. These will be necessary to determine the extent of site-related groundwater impacts (Study #5) and the need for groundwater remediation (above natural background levels). Further, the impact of upgradient anthropogenic sources on on-site COPC concentrations in groundwater will also need to be understood.
    c. Move discussion of qualitative/descriptive studies, such as identification of potential upgradient sources, to the Work Plan.
    d. Move discussion of information inputs to Section 3.7.3.1, Types and Sources of Information.
157. **QAPP Section 3.7.3, Pages 3-29 and 3-30:** Most of this section discusses information sources and comparison levels outside the scope of the background groundwater conditions study. In addition, the section is missing any specific performance criteria associated with estimating a representative background concentration for naturally occuring COPCs. Revise this section to include information sources and performance criteria related to the objectives of Study #4 (see Comment 148 on QAPP Section 3.7) and the corresponding principal study questions, alternative actions, and decision/estimation statements as revised (see comments on QAPP Section 3.7.2 and its subsections).
158. **QAPP, Section 3.7.3.2 Page 3-30, 3.7.5.2 Page 3-32, 3.8.3.2 Page 3-37, and 3.8.5.2 Page 3-39, and Tables 2-3a, 2-3b, and 2-3c.** Several sections of the QAPP indicate that analytical results will be compared to MCLs, if available, and RSLs, if no MCL exists, for screening purposes. The acceptability of laboratory reporting limits also is evaluated on this basis. For risk assessment purposes, all results should be screened against the current EPA RSL at the lower range of a cancer risk of 1E-06 or a non-cancer hazard index of 0.1. Revise the QAPP sections identified in this comment and QAPP Tables 2-3a, b, and c accordingly.
159. **QAPP Sections 3.7.4.1 and 3.7.4.2:** The target populations and boundaries described from the Background Groundwater Conditions study are overly broad and outside the scope of the study. Revise these sections by generally describing target areas that are likely to be representative of background concentration of naturally occuring COPCs and provide reasonable boundaries that are unlikely to be impacted by the Site but are still close enough to be representative of background conditions on Site.
160. **QAPP Section 3.7.4.2 Page 3-31.** Section 3.7.4.2 defines the temporal boundary based on the oldest data collected on site; the spatial boundary is based on the study boundary. Revise Section 3.7.4.2 to indicate additional temporal and spatial considerations that may serve as interim boundaries for the study. Such a spatial consideration may be lateral or vertical changes in stratigraphy. For example, natural background concentrations in alluvium may not be

representative of natural background concentrations in bedrock. A temporal consideration may be a change in sample collection or analytical methods.

161. **QAPP Section 3.7.5, Pages 3-32 and 3-33:** Most of the discussion in this section relates to evaluating whether there are impacts to groundwater from the Site and thus should be moved to Study #5 – *Occurrence and Extent of Groundwater Impacts*. Revise the section to include a discussion of quantitative approaches to determining representative background monitoring locations and estimating representative background concentrations of naturally-occuring COPCs.

162. **QAPP Section 3.7.5.2 Page 3-32.** This section states, *"A background radionuclide concentration will be established as an alternate concentration limit."* Delete this statement. The EPA does not generally clean up below natural background levels (EPA, 1997), thus the establishment of an ACL is not currently appropriate. (See the general comment on ACLs.) However, a natural background radionuclide concentration will need to be determined. Note that a single natural background concentration may not be representative of all aquifer units (EPA, 2009).

163. **QAPP Section 3.7.5.2 Page 3-32.** The 1st paragraph, 3rd sentence states: *"If down-gradient off-site radionuclide concentrations are lower than background radionuclide concentrations, no additional wells are necessary for delineation purposes."* As presented, this statement appears to be a proposed Decision Rule. The following comments are noted:

    a. This proposed decision rule is more applicable to Study #5 – Occurrence and Extent of Groundwater Impacts than Study #4 – Background Groundwater Conditions. Revise the QAPP to move it to the appropriate study.

    b. Issues with the content of the proposed decision rule include:

        - This approach assumes that a valid and representative background range or value is quickly/initially obtained.
        - The term "lower" in the statement is not specifically or statistically defined.
        - Variation in background values is anticipated but is not discussed.
        - Non-radiological COPCs are not discussed and additional analytes such as redox parameters and leachate indicators that require evaluation, in a similar manner, are not discussed.
        - The proposed decision rule appears to refer to the 500-series wells, but the population and boundary conditions are loosely defined.
        - This approach presumes that the initial placement of 500-series wells are along flows paths from the site and at a distance that impacts from the site should have reached them.
        - The absence of impacts at the proposed 500-series well locations does not, by itself, indicate if off-site impacts are or are not occurring or will or will not occur in the future.

    Overall, the 500-series wells are proposed at distances potentially beyond what would be estimated to be the travel time from the site using gradient and estimated hydraulic conductivity, or K values. If leachate indicators and site effects are not seen in the 500-series wells, then it can be said that site impacts were not found at these locations at that time; however, it does not mean that no off-site impacts exist or will exist in the future, given there are documented impacts near or at the site boundary.

    An alternative approach is to place 500-series wells closer to the site, and as the distance to the site boundary decreases, the potential for detecting site effects increases, especially

since detects have already been found near or at the site boundary. This is not optimal either as the progressive series of wells would likely need to be stepped outward from the site. However, the absence of site contamination and leachate indicators would be evidence, in concert with groundwater model results, to indicate the likelihood of the wells being in appropriate locations and thus provide data appropriate for making remedial decision.

Revise the QAPP to remove the decision rule, or else revise the decision rule to address the issues noted above. Clarify that, until the groundwater model is completed, the full evaluation cannot be completed, making it premature to base decisions on the initial sample data from the 500-series well locations as currently proposed. See also the related comments on Work Plan Section 5.3.4, Tables 5-2 and 5-3, and Figures 5-3 and 5-5.

164. **QAPP Section 3.7.6, Page 3-33, Second Paragraph in the Section:** This paragraph states that, *"Historical background data meeting Section 7.0 data quality requirements and new background data will be used to calculate a 95% Upper Prediction Limit and identify a background concentration(s) of COPCs."*
    a. Section 7 describes four separate tiers of data validation and does not specify what data quality requirements there are for historical background data. Therefore, revise the sentence as follows, *"Available historical background data and new background data determined to be of acceptable quality based on the criteria specified for this study will be used to estimate representative background concentrations of COPCs."* Revise the QAPP to establish specific data quality requirements for historical and new background data applied in support of Study #4.
    b. In addition, there is no further discussion or supporting information related to the appropriateness of the *"95% Upper Prediction Limit"* statistic for the intended purpose or its method of calculation. The proposed approach oversimplifies EPA's approach to establishing background concentrations in groundwater, and it is not clear what this value may represent or how it will be calculated. Revise the QAPP to reflect EPA guidance addressing basic statistical assumptions, appropriate tests, monitoring considerations, sample size, outliers, spatial variability, and other considerations in accordance with EPA guidance on calculating background levels, including:
        - EPA. 2015. ProUCL Version 5.1 Technical Guide. EPA/600/R-07/041. October. https://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_tech-guide.pdf
        - EPA. 2015. ProUCL Version 5.1 User Guide. EPA/600/R-07/041. October. https://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_user-guide.pdf
        - EPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. EPA 530/R-09-007. March.

165. **QAPP, Sections 3.7.6 Page 3-33, 3.8.6 Page 3-40, 3.9.6 Page 3-46, 3.10.6 Page 3-53, and 3.11.6 Page 3-60.**
    a. The performance or acceptance criteria specified for analytical data are unclear. Revise each of these sections by explicitly listing method quantitation goals sufficient to provide valid

estimates, or to reasonably make decisions, around the specified action level for each principal study question.

b. The text states: *"If a sample result is "Rejected", then the data are not adequate or useable."* Revise the QAPP to specify or reference the criteria for rejecting data.

c. The text states: *"Determination of if resampling will be necessary for the data that are critical in the final decision-making process."* Revise the QAPP to identify the data that are critical in the final decision-making process or to detail the process for making this determination.

166. **QAPP Section 3.7.7.1 Page 3-34, 1st bullet.** The text appears to indicate that background value(s) will be determined solely from data obtained from the new background wells (600-series) installed during this investigation. This amounts to nine sample points from three locations for the alluvial aquifer. This limited data set does not capture the range of background values within this aquifer. The additional new data must be used with the background data collected during previous site investigations and from other data sources compiled by the EPA, the MDNR, and the USGS. A comparison of newly installed monitoring well data with existing background data must be made. Additional bedrock well data, such as data from the PZ-212 cluster, and other related data must be included in this determination as well as any additional wells that can be sampled within the study area. The reference to statistical calculations again presumes that the new wells to be used are representative of the entire range of background values. Revise this section to state that data from the previous site investigations, other area wells, and from other data compiled by the EPA, the MDNR, and the USGS will be incorporated and compared as discussed in this comment.

167. **QAPP, Section 3.7.7.1 Page 3-34.** Revise the last bullet of Section 3.7.7.1 to clarify that background groundwater samples will be collected for the analytical suite identified in Section 3.8.7.1 and the leachate indicators identified in Section 3.10.7.1.

168. **QAPP Section 3.7.7.2 Page 3-34.** An important key assumption overlooked is that the *"background well"* locations used actually represent the range of constituent concentrations within the respective aquifers sampled. A continuing concern is that only three well cluster locations are planned to be used to assess background concentrations. Additional data should be used to supplement this dataset. Revise this section to include the use of additional alluvial aquifer data including data from existing alluvial wells located in the general site area. See prior comment to Section 3.7.7.1.

169. **QAPP Section 3.8.3.2 Page 3-37.** This section states, *"Background concentrations will be used as a basis for establishing alternate concentration limits as appropriate."* Delete this statement. EPA does not generally clean up below natural background levels (EPA, 1997), thus the establishment of ACLs is not appropriate at this time. (See the general comment on ACLs.) However, natural background radionuclide concentrations will need to be determined for comparisons to radionuclide concentrations in groundwater with site-related impacts. Note that a single natural background concentration may not be representative of all aquifer units (EPA, 2009).

170. **QAPP, Section 3.8.4.2 Page 3-38.** Section 3.8.4.2 states: *"The temporal boundary for the compilation of property information is the current ownership. The spatial boundary for the compilation of property information is the properties within 100 feet of the boundary of groundwater impacts."* The nature and purpose of these boundaries is somewhat unclear.

Clarify or revise the temporal boundary such that all known waste inputs and relevant modifications to the site property are considered in developing the CSM and list of COPCs, not just those that occurred during current ownership. Clarify or revise the spatial boundary to consider future risk and the modeled extent of groundwater impact over time.

171. **QAPP, Section 3.8.4.4 Page 3-38.** The basis provided for the proposed well spacing of 500 to 800 feet is *"approximately ¼ of the down-gradient length of the northern and western face of the site."* This basis is arbitrary and inadequate. Well spacing should be planned based on the ability of the wells to detect offsite migration of site COPCs, the number of wells installed, and the scale of decision-making. Revise the QAPP to provide a well-spacing supported by the CSM (for example, source size, aquifer properties, COPC properties) and hydrogeologic principles.
172. **QAPP, Section 3.8.5.2 Page 3-40.** Section 3.8.5.2 states, *"Properties located within 100 ft of groundwater impacts that could result in a potential for vapor intrusion (e.g. VOCs, radon, or methane) will be assessed for the potential for a complete vapor intrusion pathway."* Revise Section 3.8.5.2 to clarify that this 100-foot zone of inclusion would extend downgradient of the interpolated extent of groundwater contamination, not as a radius around an individual monitoring point. Also, clarify that the potential of preferential pathways (e.g., fracture zones, subsurface utility corridors) could extend this zone of inclusion (EPA, 2015). See also the comments on Work Plan, Sections 4.2.8 (p. 4-8) and 5.4.17 (p. 5-24), and FSP Section 1.3.8 (p. 1-12 and 1-13).
173. **QAPP Section 3.8.2.1 Page 3-35. 2nd Bullet.** Revise to remove the words *"(if any)"* from this bullet, as groundwater impacts have already been identified at the site (landfill leachate indicators in a number of onsite wells identified by the USGS Report.)
174. **QAPP Section 3.8.4.4 Page 3-38.** The text mentions specific distances from the site border and distance between wells (500-series), but no rationale is provided for why these specific distances were selected. Revise to explain the reasoning behind these selected distances, and why they *"should be adequate"* to sufficiently characterize the site area.
175. **QAPP Section 3.8.5.2 Page 3-39 to 3-40.**
    a. In the first bullet, the determination of impacts from the site is based on radionuclides and metals in background wells. Revise this bullet to clarify how potential anthropogenic background concentrations of other COPCs will be addressed.
    b. The first bullet also implies that sampling for other COPCs will be discontinued if they are not detected within the first round of sampling. This is inconsistent with the statement in Section 3.8.3.2 that "a minimum of two years of quarterly groundwater monitoring is needed to achieve a statistically viable data set," a statement that is especially true where contaminant concentrations may vary, as in the alluvial aquifer. Revise this bullet to ensure a more representative data set, consistent with QAPP Section 3.8.3.2 and Comment 44 on Work Plan Sections 5.4.14.3.
    c. Further, revise the first bullet to discuss the collection of leachate indicators, including tritium and the stable isotopes, consistent with Comments 41 and 45 on Work Plan Sections 5.4.14 and 5.4.14.3.
    d. The last bullet indicates vapor intrusion will be evaluated for all properties within 100-feet of a groundwater impact. Revise this bullet consistent with Comment 170 on QAPP Section 3.8.5.2.

176. **QAPP Section 3.8.6 Page 3-40, 2nd paragraph.** The statement that an error resulting from not sampling a location where groundwater impacts occur will be controlled by careful placement of monitoring wells, implementing quarterly groundwater monitoring and evaluating the rate of groundwater flow is erroneous. A quarterly groundwater monitoring program will not control this type of error. If the wells are not located "properly" (i.e., in a flow path), additional sampling at the same location will not affect or correct this error. This is one reason EPA recommended a screening campaign using direct-push technology. Results of a calibrated groundwater flow model must be included in this discussion because one utility of such a model is determining the placements of long-term monitoring wells. Revise this section to thoroughly describe how potential errors will be minimized, how any remaining uncertainty will be minimized or otherwise managed, and how the calibrated groundwater flow model will be used to assess monitoring well locations and the potential need for additional (or less) sampling points.
177. **QAPP Section 3.8.7.1 Page 3-41** Revise to delete *"(*may only be sampled once based on non-detect results from on-site wells)."*
178. **QAPP Section 3.8.7.1 Page 3-41.** Revise the sampling list to include all COPCs, including metal COPCs.
179. **QAPP Section 3.8.7.1 Page 3-41.** Revise the list of analytes to include anions, tritium and stable isotopes.
180. **QAPP, Section 3.8.7.1 Page 3-41.** Revise the following statement to clarify how potential future risks from the modeled future extent of groundwater contamination will be addressed. *"For off-site properties, obtain property information for parcels within 100 ft of the spatial extent of groundwater impacts (if present) and determine current use and potential future of groundwater from this area."*
181. **QAPP, Section 3.8.8.2 Page 3-36.** Revise item 4 as follows: *"Affected media could include groundwater, surface water, sediment, sediment pore water, and vapor/air."*
182. **QAPP Section 3.9.1 Page 3-42, 1st paragraph, 5th sentence.** The statement, *"The presence of available metals for sorption under certain pH levels and redox conditions can result in lower radionuclide concentrations in groundwater"* is not correct. Sorption is not onto "metals" because few pure metals exist in nature in significant amounts; rather, they exist as metal oxides or oxyhydroxides. Revise to correct this misstatement.
183. **QAPP Section 3.9.2.1 Page 3-42.**
    a. Bullet 1: Revise the study questions to further consider how the geochemical environment is expected to change as landfill influence changes.
    b. Bullet 2: Revise to explain what is meant by the term "transformation" in the context of radionuclides.
    c. Bullet 2: Revise to include onsite groundwater.
184. **QAPP Section 3.9.2.2 Page 3-42.**
    a. Bullet 2: The phrase *"composition of the geochemical environment"* is unclear. Revise to remove *"composition of."*
    b. Bullet 3: Revise to include a reference and/or additional narrative to explain why high organic materials are expected near surface water bodies in the shallow alluvium.
    c. Add a discussion of how organic matter degradation within the landfill waste matrix affects groundwater quality and geo-chemistry currently and in the future.
185. **QAPP Section 3.9.2.3 Page 3-43.**

a. Bullet 1: Revise the bullet to clearly explain how total metal concentrations will be used to assess redox. Refer to the USGS tool for assessing groundwater redox: https://pubs.usgs.gov/of/2009/1004/. The following parameters are useful for understanding redox: ORP, D.O., H2S, SO4, Fe+2 v. Fe3+, and Mn.
b. Bullet 2: Either revise the following statement to provide explanation or delete, *"sequential extraction can be used to asses dissolve phase concentrations of radionuclides in different geochemical environments."* This statement as written appears incorrect.

186. **QAPP, Section 3.9.3.2 Page 3-44.** Revise the section to state that the samples will be verified for *"completeness, correctness, and conformance/compliance"* of the data set against the methods and procedures established in the planning documents (EPA QA/G-8).
187. **QAPP Section 3.9.5.2 Page 3-46, Bullet 1.** Revise this bullet to specify which redox pairs will be evaluated.
188. **QAPP Section 3.9.7.1 Page 3-47.**
    a. Bullet 1: Revise this statement *"64 new wells are in 19 clusters and that data to determine the geochemical environment will be collected from the deepest borehole at each location"* to clarify that the alluvium will be characterized by alluvial samples and that bedrock will be characterized by bedrock samples.
    b. Bullets 1, 2, and 3: The first bullet refers to *"soil and bedrock"*; the second and third bullets refer to *"aquifer matrix."* Revise the bullets to explain these differences in terminology or use consistent terminology.
    c. Bullet 2: The list in Bullet 2 appears incomplete, mentioning only pH and organic carbon. Revise the analytical parameters list in the bullet and combine bullets to include all relevant analysis for aquifer matrix samples.
    d. Bullet 3: Revise to delete *"carbonate and cation+anion are redox species"* or explain how cation and CO^3 are "redox species".
    e. Bullets 3 and 4: Revise to include testing for ferric and ferrous iron in aquifer matrix and groundwater samples and explain how Fe will be determined in the samples. The FSP and Work Plan mention use of HACH tests for Fe2+ relative to total Fe (difference presumed to be Fe3+) in water samples, which is appropriate. Estimates of Fe2+ and Fe3+ may be made in the field using the method mentioned in the FSP.
    f. Bullet 5: Sequential extraction and analysis of samples for radionuclide isotopes are not sufficient to determine the "geochemical environment." Revise the bullet to include other relevant methods, such as mineralogy, Scanning Electron Microscope (SEM), Cation Exchange Capacity (CEC), organic carbon, etc. which are discussed elsewhere in the QAPP, WP, and FSP.
    g. In the last sentence in the section it is unclear whether up to 10 samples from each alluvial well and up to 14 samples from each bedrock well will be submitted for detailed solid-phase characterization or only 10 total alluvial samples and 14 bedrock samples will be taken. Revise to clarify and reference the associated summary table(s).
189. **QAPP Section 3.10.2.1 Page 3-48.** In addition to the questions listed for Principal Study Question 1 under Study #7, include the question, *"How will groundwater gradients be affected if leachate extraction is discontinued?"* Both scenarios need to be evaluated (i.e., with and without leachate pumping) in order to determine long-term groundwater remedial action requirements beyond permitting requirements for leachate control at Bridgeton Landfill.

190. **QAPP, Section 3.10.2.1 Page. 3-49.** In addition to Principal Study Question 5 ("Are dissolved landfill gasses ... present in groundwater and attributable to the site?"), revise Section 10.2.1 to consider whether dissolved gases are impacting the groundwater geochemistry (e.g., CO_2/pH) and affecting radionuclide concentrations.
191. **QAPP, Section 3.10.2.1 Page 3-49.** Methane may be present in groundwater as a dissolved landfill gas; it may also be a degradation product of chlorinated ethenes. Revise Section 3.10 to indicate how this distinction will be addressed, if necessary.
192. **QAPP, Sections 3.10.3.2 Page 3-51 and 3.10.7.1 Page 3-55.** Section 3.10.7.1 only correlates landfill gasses with distance from the site. Revise Section 3.10.7.1 to also include a discussion of the correlation between leachate parameters and radionuclide activity levels, consistent with Section 3.10.3.2.
193. **QAPP, Section 3.10.4.2 Page 3-51** Revise to clarify whether leachate indicators are present in groundwater data, potentially extending the temporal boundary.
194. **QAPP Section 3.10.7.1 Page 3-54.** All analytes listed in Table 2-2A, Section 3.10.7.1, and Section 3.8 should be analyzed in all groundwater and leachate sump samples. Revise the table and sections for completeness and consistency. For clarity, revise Sections 3.8 and 3.10 to reference the analytes for groundwater and leachate sump samples as provided in a single table (Table 2-2A). Further, revise the QAPP such that these individual analytes are identified in a single table or highlighted in the current set of 2-2X tables.
195. **QAPP, Section 3.11 Page 3-55 to 3-60.** Based upon the information provided in this section for proposed Study #8, too few lines of evidence would be collected to: (1) sufficiently evaluate potential Site-related radon exposure(s) via the vapor intrusion pathway, (2) complete a Baseline Risk Assessment, and (3) support risk management decisions under CERLCA. The comment covering Work Plan Sections 4.2.8 and 5.4.17, and FSP Section 1.3.8, applies to this item (Work Plan Comment 29). In addition, the contribution of naturally-occuring radon, including associated daughters, in indoor air and groundwater must be considered. Revise this section to address these comments and add additional lines of evidence to ensure the data collected will support the objectives of the RI and Baseline Risk Assessment.
196. **QAPP, Section 3.11 Page 3-55 to 3-60.** Potential ARAR 10 CSR 80-3.010 provides requirements for monitoring decomposition gases and methane, including soil gas monitoring at the property boundary. Revise the vapor intrusion DQOs to address this potential ARAR. Provide a soil gas sampling approach and concentration limits to support both 10 CSR 80-3.010 and human health risk assessment.
197. **QAPP, Section 3.11 Page 3-55 to 3-60.** Revise references to "*volatile*" compounds of interest to "*vapor-forming*" compounds of interest.
198. **QAPP, Section 3.11.2.3 Page 3-56.** Revise to clarify that the vapor intrusion study will include methane and vapor-forming COPCs in addition to radon.
199. **QAPP, Sections 3.11.2.3 Page 3-56, 3.11.4.1 Page 3-58, 3.11.5.2 Page 3-60.** Section 3.11.2.3 and subsequent subsections indicate that the extent of site-related groundwater impacts will define the radon study area. Because vapor may migrate beyond the extent of groundwater impacts, the extent of the inclusion zone for the vapor intrusion study must be expanded. Revise these sections to address this issue. Note that, although the EPA guidance typically recommends an initial 100-foot buffer for vapor intrusion evaluation, the guidance indicates that this distance is insufficient for sites with landfills, where landfill gases may be generated in sufficient quantities to induce advective transport in the vadose zone (EPA, 2015).

200. **QAPP, Section 3.11.3.1 Page 3-57 and 3.11.7.1 Page 3-61.** The second paragraph of Section 3.11.3.1 states: *"published data may also be used to supplement proposed background radon in groundwater data collection."* This is reiterated in Section 3.11.7.1. Revise both sections to specify which published data will be used and how they would be applied.
201. **QAPP, Section 3.11.3.2 Page 3-57.** The statement *"Methane levels will be compared to 10% of the lower explosive limit (LEL) since there is no MCL for methane"* is incorrect and inappropriate for safety purposes and continued exposure. The LEL for methane is 5% and the 8-hour threshold limit value established by the National Institute for Occupational Safety and Health is 1,000 parts per million. Revise this statement to include an appropriate comparison level.
202. **QAPP, Sections 3.11.3.2 Page 3-57, 3.11.3.3 Page 3-58, and 3.11.5.2 Page 3-60.** Section 3.11.3.2 states: *"The estimated indoor air concentration will be calculated using Henry's Law for radon and methane ..."* For reference, the target groundwater radon activity level is 2,500 pCi/L based on an attenuation factor of 0.001 and Henry's Law Constant of 1.6 (Kil et al. 2010). The specific process used to derive the target groundwater radon activity level is not presented, but noted:
    a. The EPA default attenuation factor of 0.001 was derived for VOCs (EPA, 2012a) and is not expected to be appropriate for radon because of the nature of its decay and transport. EPA studies (e.g., 2012b) have demonstrated differences in radon and VOC attenuation.
    b. The Henry's Law Constant referenced (Kil, 2010) does not appear to be consistent with the values derived in the study (2.641 at 20°C), and no temperature adjustment is indicated.

    Revise the overall approach to evaluating radon in indoor air (also refer to previous comments on this subject).
203. **QAPP, Section 3.11.5.2 Page 3-60.** The last paragraph of Section 3.11.5.2 discusses soil gas sampling, but Work Plan Section 5.4.17 implies that soil gas sampling will not be conducted until a future phase of investigation, if the need is indicated. See also Comments 29 and 196 regarding the need for multiple lines of evidence, including soil gas samples, to evaluate the vapor intrusion pathway. Revise throughout the QAPP and Work Plan for consistency.
204. **QAPP, Section 3.12 Page 3-62 to 3-66.** Move the discussion of the Groundwater and Surface Water Temporal and Spatial Variability study to Volume 1 of the RI Work Plan as discussed in the general comment above. Similar to the comment on Section 3.5, ensure that specific references are made to the FSP when presenting information regarding the various field measurements that will be made to support this study. Also, include a discussion of how historical field measurements of groundwater level and flow directions will be considered and evaluated to support this study.
205. **QAPP, Section 3.12.6 Page 3-65.**
    a. Delete the last sentence that specifies completeness objectives for leachate levels and leachate flow rates or clarify how they pertain to Study #9.
    b. Revise the section to specify the precision levels of equipment used to measure groundwater and surface water levels.
206. **QAPP, Section 3.13.3, Page 3-72.** Section 3.13.3 states: *"The laboratory completeness objective for this project, with respect to the data validation quality parameters established in the DQO is 95%."* Clarify this section consistent with the comment on QAPP Section 3.4.6 and similar sections.
207. **QAPP, Section 3.13.4, Page 3-72.** A general reference was included to Section 3.0 for information regarding data representativeness, which now states that overall data

representativeness is being accounted for in the sampling design program for each study. The EPA could not locate a discussion elsewhere within Section 3 that provides information on how sufficient data representativeness will be achieved for each study. Revise the QAPP by including a discussion of how data representativeness will be achieved for each study and provide a more specific reference to where this information can be found in the QAPP. (See also comment 110c.)

208. **QAPP, Section 4.** In the September 11, 2019, the EPA Comment Letter on the first draft of the OU-3 QAPP, EPA requested inclusion of or reference to site-specific information related to Data Quality Assessment. Although the Data Quality Assessment section (Section 4.0) of the second draft of the QAPP remains generic, it now includes a reference stating, *"...actual process for data evaluation is outlined in the RI/FS Work Plan and specified in the DQOs (Section 3.0)."* Adding this reference is an acceptable approach; however, as noted in the general and specific QAPP comments, the DQOs are inadequate as provided and would be insufficient to support a Data Quality Assessment following data collection. Where aspects of the generic Data Quality Assessment process will depend on the data collected (e.g., selection of the statistical method based on data distribution), revise Section 4.0 to clarify how these determinations will be made and communicated to the EPA. For more information on Data Quality Assessments, see EPA guidance on this topic at: https://www.epa.gov/sites/production/files/2015-06/documents/g9-final.pdf
209. **QAPP Section 5.1.2.1.1 Page 5-3, 2nd sentence.** Revise to add the HACH methods proposed for Fe2+ and Fe3+ testing per the FSP.
210. **QAPP Table 2-2A.** The EPA method 8081 for organochloride pesticides is proposed. These types of pesticides are generally not among the least water-soluble pesticides. While these may be analyzed for regulatory requirements, more water-soluble pesticides are a better indicator of landfill effects. The table has no indication of "leachate indicators" as is mentioned in the text, FSP, and Work Plan. These specific indicators must be identified in the tables for consistency. Revise the table to include tritium and stable isotopes of hydrogen and oxygen as leachate indicators and pesticides more suitable for this site.
211. **QAPP Tables 2-2X.** The tables as presented in the QAPP do not clearly identify the various types of leachate indicators as discussed in various sections. Revise the set of QAPP 2-2X table(s) to clearly indicate which analytes are "leachate indicators" or create a new table to provide this information. Also, see the related comment on Section 3.10.7.1, page 3-54.
212. **QAPP, Table 2-3c.** Although criteria for evaluating indoor air concentrations are not specified in the QAPP or Work Plan, QAPP Table 2-3c determines the acceptability of reporting limits for indoor air analyses by comparing the reporting limits to Occupational Safety and Health Administration Permissible Exposure Levels in addition to EPA Regional Screening Levels for industrial air. Note that:
    - EPA and OSHA have a distinct statutory responsibility to ensure the safety and health of America's workforce (EPA, 2015). OSHA regulates exposure to employees from chemicals used within the workplace; EPA has broad authority and distinct responsibilities to assess and, if warranted, mitigate vapor intrusion arising from a chemical release that causes subsurface contamination by hazardous, vapor-forming chemicals (EPA, 2015).
    - "OSHA recognizes that many of its permissible exposure limits are outdated and inadequate for ensuring protection of worker health" (OSHA, 2019).

Decisions pertaining to vapor intrusion from subsurface contamination will be based on the EPA guidance and levels as follows.

a. Except for trichloroethylene, indoor air removal management levels for indoor air are the most current EPA RSLs at a cancer risk of 1E-04 and a hazard quotient of 1. Sub-slab soil gas removal management levels are derived by applying a generic attenuation factor of 0.03 to the indoor air removal management levels. To assess potential for vapor intrusion, screening levels for groundwater and exterior soil gas are based on a cancer risk of 1E-05, a hazard quotient of 0.1, and a groundwater temperature of 20°C to address the uncertainty of using exterior soil gas and groundwater concentrations to estimate indoor air concentrations. The attenuation factor for groundwater is 0.001 (0.0005 for fine-grained soil) and the attenuation factor for soil gas remains 0.03.
b. To address human health risks from less-than-lifetime exposures, Region 7 has established the following removal management level for TCE in air: 6 $\mu g/m^3$ for an industrial/commercial scenario (8-hour), 2 $\mu g/m^3$ for a residential scenario (24-hour), or as calculated for another specific exposure duration (EPA, 2016). Associated soil gas and groundwater levels are calculated as above.

Revise the QAPP accordingly.

213. **QAPP Appendix B.** The first paragraph of Appendix B states, *"Radiochemical analyses will be validated as described in Appendix B, and in accordance with guidelines from Chapter 8 of the EPA MARLAP, document number EPA 402-B-04-001A (EPA 2004) and the American Nuclear Society Standard 41.5-2012 (ANS 2012)."* However, no other description is listed in Appendix B with respect to the validation procedures for radiochemical analyses. This paragraph also states, *"Where guidance tables are not included for specific analyses, then professional judgement is not required, and the referenced guidelines will be followed."* These two statements together allow for the inference that Appendix B intends to list and prescriptively follow the references listed for the validation of radiological data. Revise to state that is the case so that it is not necessary to make such an inference.

ANSI/ANS 41.5-2012 is a prescriptive *standard* while MARLAP is a multi-agency guidance document and is not prescriptive in nature. ASNI/ANS 41.5-2012 has a precise set of rules and conditions (normally written as shall statements) for the validation and application of validation qualifiers. However, in many critical instances ANSI/ANS 41.5-2012 relies on project/site specific measurement quality objectives (MQOs), which must be developed and then documented in this QAPP, for the application of data qualifiers to be used during data validation according to these standards. For example, the following regarding validation of LCS results is taken from ANSI/ANS-41.5- 2012 *"if the percent difference for the LCS was not within the QC acceptance limits as established in the MQOs, the data for all samples analyzed with the batch shall be qualified as estimated (J)."* In order to implement this portion of the standard, and other parts of the standards, the appropriate MQOs must be developed and documented in the QAPP prior to the generation of data. Ensure that that these MQOs are developed and explicitly stated in the QAPP and add a reference to the MQO's in Appendix B.

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EPA. 2018. "Frequently Asked Questions About the Development and Use of Background Concentrations at Superfund Sites: Part One, General Concepts." OLEM Directive 9200.2-141 A. March.