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

FEB 0 5 2018

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

Re: January 26, 2018, Final Feasibility Study, West Lake Landfill, Operable Unit-1

Dear Mr. Rosasco:

The U.S. Environmental Protection Agency has reviewed the Final Feasibility Study, or FFS, submitted by the Respondents on January 26, 2018. The enclosure contains modifications and an addendum to the FFS. The EPA hereby approves the Final Feasibility Study with modification per the enclosure, in accordance with the Remedial Investigation/Feasibility Study Administrative Settlement Agreement and Order on Consent, or RI/FS ASAOC, Docket No. VII-93-F-0005, and the May 6, 2016, Abbreviated Work Plan for Remedial Investigation Addendum and Final Feasibility Study.

Sincerely,

Christine Jump
Remedial Project Manager
Site Remediation Branch
Superfund Division

Enclosures

cc: Mr. Ryan Seabaugh, MDNR

Printed on Recycled Paper

Modifications to the January 26, 2018 Final Feasibility Study

1. Revised Applicable or Relevant and Appropriate Requirements Tables

As previously discussed, EPA has completed the final revisions to Tables 3-1, 3-2, and 3-3. Specifically, these revisions include: (1) changes to the ARARs tables to ensure consistency with the revised text in Section 3 of the FFS; (2) consolidation of the state ARARs tables for ease of reference and including certain ARARs previously identified by MDNR; (3) addition of details where appropriate to describe the regulatory provisions, statutes, and/or guidance documents identified as ARARs or TBCs; (4) deleting editorial language; and (5) movement of all TBCs to a separate table. Further, EPA moved the floodplain management details from Table 3-2 to the TBC portion of the tables and moved the solid waste requirements to the state-portion of Table 3-2. Lastly, in Table 3-3 EPA added specific language related to 10 C.F.R. Part 61, 40 C.F.R. Part 264 Subpart N, 10 C.F.R. Part 40, 19 C.S.R. § 20-10.050, and 19 C.S.R. § 20-10.090 as relevant and appropriate requirements. EPA's revised Tables 3-1, 3-2, and 3-3 are enclosed with this letter.

2. "Unrestricted Use" Terminology:

The EPA previously identified inconsistencies and incorrect statements in the FFS regarding use of the term "unrestricted use" and establishing specific cleanup levels as being suitable for unrestricted use at OU-1. The EPA discussed this issue with Respondents during conference calls on Monday, January 22, 2018, and Tuesday, January 23, 2018. Following those calls, on January 23, 2018, the EPA sent Respondents an email message with an attachment that provided examples of preliminary draft language related to the specific instances in the text of the FFS that referenced "unrestricted use."

The evaluations performed in the Remedial Investigation Addendum (RIA), the Baseline Risk Assessment (BRA), and the Final Feasibility Study (FFS) do not provide information sufficient to conclude that a cleanup level equal to the definition of RIM would allow for unrestricted (i.e., residential) use of the Site relative to radionuclide occurrences. The EPA acknowledges that such an evaluation was described previously on page 8 of the approved Work Plan for Supplemental Feasibility Study (SFS) (EMSI, June 4, 2010). That evaluation was based on the original baseline risk assessment (Auxier, April 24, 2000) in which risk to the maximally exposed future receptor (1,000 years of Ra-226 ingrowth) was estimated at $2x10^{-4}$. However, since that time Respondents have updated the BRA, fully accounting for ingrowth of Ra-226 (approximately 9,000 years), which indicates the estimated risk to the same maximally exposed individual would increase to $5.1x10^{-2}$ or approximately two orders of magnitude greater than the estimate from the previous BRA. Therefore, the site-specific risk evaluation provided in the approved SFS Work Plan is no longer valid to support the conclusion that a cleanup level equal to the definition of RIM would result in Areas 1 and 2 being safe for "unrestricted" (i.e., residential) use of the Site relative to radionuclide occurrences.

As stated above, Respondents have not provided documentation to support references to the definition of RIM as an unrestricted (i.e., residential) use cleanup level for the Site or that excavation of all RIM would be sufficient to allow for unrestricted (i.e., residential) use of the Site with respect to radionuclides. Respondents appear to recognize this in Section 2.2.3, page 28, footnote 6 of the January 26, 2018, Final FFS, which states, "As noted in Section 2.1.4, above, use of the Site for residential purposes is inconsistent with the presence of municipal solid wastes within a landfill, regardless of the presence (or absence) of radionuclides within those wastes." The EPA is clarifying that the FFS should have consistently stated throughout the document that the Full Excavation of RIM alternatives would

leave Area 1 and Area 2 in a condition that would not require additional engineering and institutional controls due to their radiological content beyond what is required for their anticipated future use as a solid waste landfill.

In addition, there are conflicting statements in the FFS with regards to the potential cleanup of the Buffer Zone and Lot 2A2 portions of the Site. Some statements indicate this portion of the Site will be cleaned up consistent with the definition of RIM while other statements indicate that RIM will be removed to unrestricted use levels. Other statements such as the last paragraph in section 6.2.2.3.1 on page 279 indicate that "residual risks posed by the remaining radionuclide-impacted soil on these properties, if any, should be indistinguishable from variations in background levels." Consistent with the remedial action objective for Lot 2A2 provided in Section 3 of the FFS, soils must be remediated to the extent necessary to allow for unrestricted land use (i.e., residential use). The EPA will set cleanup levels in the Record of Decision (ROD) amendment consistent with ARARs that are demonstrated to be protective, and consistent with the EPA guidance and evaluation of risks. The EPA is clarifying that the FFS should have consistently stated throughout the document that for all of the alternatives "[r]adioactive soils will be excavated from any portions of the Buffer Zone not utilized to construct an engineered cover on Area 2 as well as from Lot 2A2 to the extent necessary to allow for unrestricted land use."

Addendum to the January 26, 2018 Final Feasibility Study

1. Uncertainty Related to Deeper Occurrences of RIM in Area 2:

As discussed in Section 10 of the RIA, there remains some uncertainty with the limited set of soil borings that indicate deeper occurrences of Radiologically Impacted Material (RIM), particularly in Area 2. As an example, elevated downhole gamma readings were detected during field work associated with the original Remedial Investigation (RI), near the bottom of borings WL-210 and WL-235; however, soil samples were not collected from these intervals at that time to confirm these field readings with analytical testing. The RI discusses RIM from an interval near the surface of WL-210 being knocked into or falling into the bottom of the borehole. The bottom of the WL-210 boring was cleaned out with the drill rig auger and another down-hole gamma scan was performed. The repeated scan did not identify elevated gamma levels near the base of this boring however a sample collected a few feet above this interval did exceed the definition of RIM (combined thorium at approximately 19 pCi/g).

To better understand the potential impact of these deep borings on the cost estimates provided in the FFS, the EPA has completed an exercise to approximate the costs associated with these deeper occurrences of RIM for these two borings (WL-210 and WL-235) and two other nearby borings (AC-24 and AC-25) in Area 2 and to determine the proportion of those costs compared to the cost of Full Excavation of RIM from Areas 1 and 2.

First, the EPA utilized volume estimates provided by Respondents associated with the deeper occurrences of RIM for these four borings to estimate their portion of the total excavation volume. The table below provides these volume estimates:

Comparison of Volume of Materials Associated with Deep RIM (WL-210/AC-24 and WL-235/AC-25) to Volume of Full Excavation of RIM (Criteria 7.9 pCi/g)					
	Unit	RIM	Vertical Overburden	Excavation Setback	Total
WL-210/AC-24[1]	bank cubic yards	2,820	28,010	60,780	91,610
WL-235/AC-25[2]	bank cubic yards	950	13,300	14,758	29,008
Total	bank cubic yards	3,800	41,300	75,500	120,600
Area 2 Total	bank cubic yards	251,000	376,000	334,000	961,000
Proportions	%	1.5%	11.0%	22.6%	12.5%

[1]The volume estimate for the deeper RIM associated with WL-210/AC-24 is not contiguous with RIM estimated in Area 2 associated with WL-235/AC-25 or any other borings.
[2]The volume estimate for the deeper RIM associated with WL-235/AC-25 is contiguous with RIM estimated to be present in Area 2 associated with AC-23.

Next, the EPA utilized the volume estimates in the table above to develop a preliminary cost estimate associated with excavation of this deeper RIM in a manner consistent with the FFS cost estimates calculated for the Full Excavation of RIM. An estimate for the portion of transportation and disposal costs associated with the deeper occurrences of RIM related to WL-210 and WL-235 is provided below:

Comparison of Deep RIM Transportation and Disposal Costs to Similar Costs for Full Excavation of RIM at 7.9 pCi/g		
	Unit	2018 FFS
Total Deep RIM Volume (from table above)	bank cubic yards	3,800
Assumed Swell Factor[1]	%	150%
Daily Cover Factor[2]	%	110%
Total Excavated Deep RIM Volume	loose cubic yards	6,270
Transportation and Disposal Cost Rate[3]	$/ loose cubic yards	262
Total Transportation and Disposal Costs of Deep RIM	$	1,642,740
Total Transportation and Disposal Costs of all RIM[4]	$	135,000,000
Proportion of Estimated Cost	%	1.2%

[1]The swell factor for general refuse is from Section K-9.1 of Appendix K in the FFS
[2]The daily cover factor was taken from the Construction Assumptions for Excavation Alternatives table in Section K-9.3 of Appendix K in the FFS.
[3]The transportation and disposal cost rate was taken from the RIM Loading Rate Assumptions table in Section K-9.3 of Appendix K of the FFS.
[4]Total Transportation and Disposal Costs Cost of all RIM was taken from page 1 of 22 of Section K-4 of Appendix K of the FFS.

The EPA identified other potential costs associated with excavation of this deeper RIM and the associated overburden and setback required to access this RIM. These costs include construction costs, radiological survey costs, health and safety related costs, and other miscellaneous costs as presented and summarized in Appendix K-4 of the FFS. The EPA has created a series of summary tables presented below to illustrate an estimate of these costs. The table below presents the proportion of the total waste excavation (RIM and Non-RIM wastes) associated with this deeper RIM in Area 2 using the volumes provided by Respondents and estimates provided in the FFS:

Comparison of Deep RIM Waste Excavation Volume to the Waste Excavation Volume Estimated for the Full Excavation of RIM with Off-site Disposal, Adjusted for Other Excavation Factors Such as Fluff and Required Cover		
	Unit	Final FFS
Total Deep RIM and Associated Overburden/Setback Volume (from table above)	bank cubic yards	120,600
Assumed Swell Factor[1]	%	150%
Daily Cover Factor[2]	%	110%
Total Excavated Deep RIM and Associated Overburden/Setback Volume	loose cubic yards	198,990
Waste Excavation Volume (Area 1 and Area 2)[3]	bank cubic yards	1,821,000
Total "Loose" Excavated Waste Excavation Volume (Area 1 and Area 2)[4]	loose cubic yards	3,004,650
Estimated Proportion of Waste Excavation Volume Associated with Deep RIM	%	6.6%

[1]The swell factor for general refuse is from section K-9.1 of Appendix K in the FFS
[2]The daily cover factor was taken from the Construction Assumptions for Excavation Alternatives table in section k-9.3 of Appendix K in the FFS.

[3]Waste Excavation Volume taken from the Full Excavation of RIM with Off-Site Disposal column of Table ES-1 in the FFS.
[4]Excavation Waste Excavation Volume was calculated using the same swell factor and daily cover factor presented in this table.

As mentioned above, the portion of the waste excavation volume associated with this deeper RIM will impact the construction costs, the radiological survey costs, the health and safety support costs, and other miscellaneous costs estimated for the Full Excavation of RIM with Off-Site Disposal alternative. The EPA has utilized the proportion of volume from the table above to support estimates of these associated cost impacts. The EPA acknowledges that some of the individual general non-specific costs provided in Appendix K for this alternative would not be impacted if this deeper RIM were not included. Therefore, these costs may overestimate the actual cost associated with the excavation of this deep RIM.

Partial Capital Costs		
Construction Cost – Full Excavation Off-site Disposal[1]	$	186,700,000
Rad Survey/H&S Cost - Full Excavation Off-site Disposal[1]	$	55,201,000
Partial Construction and Rad Survey/H&S cost[2]	$	16,020,462
Associated Loaded Costs (17%)[3]	$	18,743,940
Partial Contingency Costs		
Scope (Construction) 55%[4]	$	10,309,167
Scope (Transportation/Disposal) 15%[4]	$	246,411
Bid 20%[4]	$	4,077,336
Impact on Total Capital Cost		
Total Cost of Deep RIM[5]	$	35,019,594
Total Full Excavation Cost[6]	$	695,000,000
Proportion of Estimated Cost	%	5.0%

[1]The Construction Cost and Rad Survey/H&S Cost values were taken from page 1 of 22 of section K-4 of Appendix K of the FFS.
[2] The partial construction and rad survey/H&S cost are calculated using the Estimated Proportion of Waste Excavation Volume Associated with Deep RIM provided in the table above.
[3]The Associated Loaded Costs (17%) is the sum of the percentages for Project Management (5%), Engineering Design (6%), and Construction Management (6%) costs provided on page 1 of 22 of section K-4 of Appendix K of the FFS.
[4]The Scope and Bid costs percentages were taken from page 1 of 22 of Section K-4 of Appendix K of the FFS.
[5]The Total Cost of Deep RIM is the sum of the Total Transportation and Disposal Costs of Deep RIM from the table above and the Associated Loaded Costs and Partial Contingency Costs from this table.
[6]The Total Full Excavation Cost was taken from page 1 of 22 of Section K-4 of Appendix K of the FFS.

The percentage of the overall cost associated with excavation and disposal of the deep RIM is 5%. Based on the estimates and information provided above, although uncertainty remains for some of the

deeper occurrences of RIM, costs for the deep RIM excavation and disposal are estimated to only be approximately 5% of the overall costs for the Full Excavation of RIM alternative. Therefore, inclusion of the deep RIM in the FFS volume and cost estimates is appropriate for a feasibility study comparison.

2. Total Excavated RIM Activity Estimates for each Alternative Presented in the FFS:

During review of the August 25, 2017, draft of the FFS by the EPA and its partner agencies, the MDNR suggested that additional metrics, such as radioactivity or "activity" removed, may be relevant with respect to evaluating the various partial and full excavation of RIM alternatives. The EPA agreed with this suggestion and subsequently developed draft estimates of total activity removed for each of these alternatives. The EPA discussed this issue with Respondents during conference calls held on Monday, January 22, 2018, and Tuesday, January 23, 2018. The EPA provided draft estimates of the calculated activities associated with excavated RIM to Respondents on January 22, 2018 via email. Understandably, Respondents did not have sufficient time to include activity estimates for excavated RIM in the FFS submitted on January 26, 2018.

The EPA acknowledges that Respondents have spent considerable effort developing estimates for the volume of RIM that would be excavated as a result of each remedy. These estimates are fundamentally necessary to estimate costs, develop preliminary schedules, and appropriately estimate the level of effort necessary to perform each of the remedy alternatives. The EPA has determined that in addition to RIM volume removed, activity removed would be relevant for evaluating the long-term effectiveness of each of the remedy alternatives.

As discussed in the updated BRA, Ra-226 accounts for approximately 96% of the risk to the future maximally exposed individual at the Site (assuming 1,000 years' ingrowth). Thorium-230 present at the Site in concentrations greater than Ra-226 causes ingrowth which will cause the risks posed by the RIM at the Site to increase for nearly 9,000 years. Estimating the activity of Ra-226 and Th-230 that would be removed from Area 1 and Area 2 as a result of each of the remedy alternatives provides a metric that directly relates to the threat posed by the radioactive materials at the Site and the potential for this threat to be reduced.

The activity estimates for excavated RIM are an important factor for consideration as a part of the comparative analysis of the various remedial alternatives. The following is a description of how these activity estimates were developed and a table summarizing the activity estimates for the remedial alternatives involving removal of RIM.

Leached barium sulfate residues (LBSR) were generated at the Mallinckrodt Chemical Company, stored at the St. Louis Airport site, and then moved to Latty Avenue before finally being brought to the West Lake Landfill in 1973. The EPA's 2008 ROD provides an estimated mass concentration of approximately 3 milligrams of Ra-226 per ton of LBSR. In addition, the Basis for Development of an Exposure Matrix for the Mallinckrodt Chemical Company St. Louis Downtown Site and the St. Louis Airport Site (ORAUT-TKBS-0005, 6-14-2007) also provides estimates of the mass concentration of Ra-226 for LBSR (4E-09 g Ra-226/g residue on page 42 and 124). Using this information, the EPA estimated a range of Ra-226 activities associated with the residues brought to West Lake Landfill in 1973.

Estimate of Radium-226 Activity Associated with LBSR				
Weight Residue (ton)	Mass Residue (g)	Mass Concentration (g Ra-226/ g residue)	Mass Ra-226 (g)	Activity Ra-226 (Ci)
8700	7.89E+09	4.00E-09	31.6	31.6
8700	7.89E+09	3.31E-09	26.1	26.1

Reportedly, 8,700 tons of LBSR were mixed with 39,000 tons of soil from the Latty Avenue Site. As discussed in section 6.6.1 of the final RIA, these Latty Avenue Site soils consisted of: (i) on-site stockpiled soil; (ii) surface soils from unimpacted areas south of the former residue piles; and (iii) surface soils scraped from the areas formerly occupied by residue piles. These other residue piles included Belgian Congo Raffinate Cake, Colorado Concentrate Raffinate Cake, un-leached Barium Sulfate Residue, Leached Barium Sulfate Residue, and C-Liner Slag. Most of these materials included various concentrations of Ra-226, Th-230, and Uranium-238. It is therefore likely that some of this soil may have been impacted with radionuclides from the other residue piles that were previously located at the Latty Avenue Site, since that site required further remediation after the LBSR was removed. Thus, the estimates in the table above potentially underestimate the total activity of Ra-226 that was brought to the West Lake Site.

The EPA utilized the information provided in the Estimated Three-Dimensional Extent of Radiologically Impacted Material Report dated December 22, 2017 (Geostat Report) to support estimates of the total activity of excavated RIM and the proportion of this activity that would be potentially removed with each of the evaluated remedial alternatives. The EPA has utilized the volume estimates provided in Table 7-3 of the Geostat report and the mean concentration estimates for Radium-226 and Thorium-230 provided in the various tables in Section 9. The EPA acknowledges that the datasets that represent Ra-226 and Th-230 for most of the alternatives do not follow a normal distribution and may be bimodal. Therefore, some uncertainty exists as to whether the mean concentration provides an accurate estimate of the central tendency of the concentrations of Ra-226 and Th-230. As discussed in the February 2, 2018, the EPA approval letter for the Geostat Report, unquantifiable uncertainty exists with respect to the volume estimates. However, the EPA compared the total estimated Ra-226 activity associated with the Full Excavation of RIM with Off-site Disposal remedy from the table below (77 Ci) to estimated activity in the table above (26 Ci – 31 Ci) and finds the geostatistical based estimates to be reasonable. Therefore, the EPA considers the estimates of Ra-226 and Th-230 activity associated with the various remedial alternatives as presented in the table below to be preliminary but sufficient for use in a feasibility study.

Excavated RIM Activity Estimates

			Volume Removed[1]	Mean Concentration[2]		Density	Activity Removed		Activity Removed
			yd3	Ra-226 (pCi/g)	Th-230 (pCi/g)	g/m3	Ra-226 (Ci)	Th-230 (Ci)	(%)
Full Excavation RIM (≥7.9pCi/g) Table 9-5[2]		Area 1	58,700	315.2	4451	1.40E+06	20	280	25.7
		Area 2	251,000	213.1	3016	1.40E+06	57	810	74.3
		Total	309,700	528.3	7,467	1.40E+06	77	1090	100
Excavation of RIM ≥1,000 pCi/g Table 9-10[2]		Area 1	7690	1375	19531	1.40E+06	11	161	14.7
		Area 2	31000	1129	15941	1.40E+06	37	529	48.5
		Total	38,690	2,504	35,472	1.40E+06	49	690	63.3
Excavation of RIM ≥52.9 pCi/g down to 16 ft Table 9-7[2]		Area 1	10200	557.4	7623	1.40E+06	6	83	7.7
		Area 2	73700	554.8	8276	1.40E+06	44	653	59.7
		Total	83,900	1,112	15,899	1.40E+06	50	736	67.3
Risk Base Excavation (≥7.9pCi/g) down to 2.2ft	During Regrading Table 9-3[2]	Area 1	1330	97.4	1333	1.40E+06	0.1	1.9	0.2
		Area 2	5580	126.6	1788	1.40E+06	0.8	10.7	1.0
	Before Cover Install Table 9-4[2]	Area 1	862	11.56	745.8	1.40E+06	0.0	0.7	0.1
		Area 2	7800	1.611	18.74	1.40E+06	0.0	0.2	0.0
		Total	15,572	237	3,886	1.40E+06	0.9	13.4	1.2
Full Excavation of RIM (≥7.9pCi/g) with On-Site Disposal Table 9-5[2]		Area 1	0	315.2	4451	1.40E+06	0	0	0
		Area 2	0	213.1	3016	1.40E+06	0	0	0
		Total	0	528.3	7467	1.40E+06	0	0	0

[1]Volumes provided in table 7-3 from the December 22, 2017 3D Extent of RIM Report

[2]Mean concentrations of Radium-226 and Thorium-230 provided in the tables from Section 9 of the December 22, 2017 3D Extent of RIM Report

3. **Appendix E, Supplemental Radon Flux Evaluation:**

- The EPA requested in its comments that the PRPs model a range of operating parameters and site conditions including flare emission rates, landfill gas removal efficiencies, radius of influence for the modeled gas well(s), and ingrowth of Ra-226 from Th-230 decay. Varying known or reasonably anticipated operating conditions would provide a more robust evaluation of the potential impacts of a SSE if one were to occur at OU-1. The PRPs did not fully address these comments and did not provide the requested analyses; however, generally worst-case assumptions were used in the modeling submitted.

- The EPA requested that the PRPs use the more general acronym "SSE" instead of "SSR" in regard to the subsurface heating event in the South Quarry of the Bridgeton Landfill but this item was not fully addressed in the FFS. The nature of the subsurface heating event in the South Quarry is not known with complete certainty and may have varied natures depending on depths, time periods and other related factors. Section 4.2.2.3.4 and Appendix N-2 of the revised FFS provide clarifying information. For clarity, the EPA has defined an SSR consistent with the following language from the North Quarry ASAOC (Docket No. 07-2016-0005), "subsurface, exothermic, self-sustaining chemical reaction."

- Mechanisms related to and/or evaluations of potential particulate impacts from a subsurface heating event were not provided in the revised Appendix E. The EPA notes that discussion was added to Section 6.2.2.3.4 of the FFS that includes the results of an evaluation presented in the March 28, 2016, Final Particulate Emission Analysis From Area South of Proposed Isolation Barrier; however, that document is not sufficient to evaluate the potential for particulate releases resulting from a SSE because it does not consider all RIM in Area 1. The PRPs informed the EPA that they would not have sufficient time to evaluate the potential for particulate releases or additional leachate generation due to a hypothetical SSE if they were to meet the required submittal date. Therefore, the EPA has provided an additional qualitative analysis of the potential for an SSE to cause particulates to be released from all of OU-1. This evaluation, titled Evaluation of Possible Impacts of a Potential Subsurface Soldering Event on the RIM Releases for Operable Unit 1 at the West Lake Landfill, dated February 2, 2018, is enclosed.

- Revised Appendix E did not directly evaluate the potential for increased leachate generation and subsequent impacts from a subsurface heating event; however, additional discussion of leachate was added to Section 6.2.2.3.4 of the revised draft FFS. This discussion indicated that the existing on-site leachate pre-treatment plant currently has sufficient capacity to treat a potential increase in leachate volume due to a subsurface heating event, however, the discussion does not sufficiently evaluate the potential impacts associated with the increased leachate generation, such as potential changes in geochemistry and the potential to impact groundwater. In addition to addressing the potential for an SSE to cause particulates to be released, the enclosure titled Evaluation of Possible Impacts of a Potential Subsurface Soldering Event on the RIM Releases for Operable Unit 1 at the West Lake Landfill, dated February 2, 2018, addresses leachate impacts associated with a hypothetical SSE.

4. Appendix F – Calculations of Required Cover Thicknesses :

Radon flux estimates are utilized to estimate the risks from radon and its decay products provided in Appendix H. The EPA generally agrees that the assumptions made for the radon flux and air modeling, but uncertainties remain related to the selection of key input parameters, including porosity and moisture levels which are projected to change as the solid wastes in Area 1 and Area 2 age for the next 1,000 years. The conceptual cap designs and related porosity and moisture content parameter assumptions are provided in Appendix F. Some of these values have relied upon recommendations from HELP model guidance document (http://mag.ncep.noaa.gov/help/ModelGuidanceParams.php) while others utilized site specific testing results. Materials such as clay, fill, and bio-intrusion layers were assigned porosity values from a range of values found in the HELP guidance documents. Changes to either or both the moisture content or porosity parameters can result in significant changes in the modeled radon flux indicating the modeled approach is sensitive with respect to these parameters. Appendix F acknowledges that these two factors can impact the modeling; however, a discussion of uncertainty with respect to these parameters was not included in this appendix. The EPA previously provided technical comments to the respondents that Appendix F should evaluate this uncertainty by including radon flux modeling for a range of possible porosity and moisture content values; however, the EPA determined the related radon flux estimates provided in appendix F sufficient for FFS level comparisons.

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement	Preliminary Determination	Remarks
40 C.F.R. § 192, Subpart A Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, Standards for the Control of Residual Radioactive Material from Inactive Uranium Processing Sites 40 C.F.R. § 192.02(a), (b)	Radon-222 in air	The annual average release rate of radon-222 to the atmosphere applied over the entire surface of a disposal site should not exceed 20 pCi/m2-s, and the annual average concentration of radon-222 in air at or above any location outside the disposal site should not be increased by more than 0.5 pCi/L. 40 C.F.R. 192.02(b). Protection standards also include the requirement that the control of the radioactive materials be designed to be effective for up to 1,000 years, as far as reasonably achievable, but at a minimum, 200 years. 40 C.F.R. 192.02(a).	Not applicable but potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. These regulations are applicable to uncontrolled areas, whereas the current and future uses of Areas 1 and 2 are restricted. As these regulations address radon emissions, which is a concern for OU-1, they are considered potentially relevant and appropriate to the modified ROD-selected remedy, UMTRCA capping alternative, and the partial excavation alternatives.
40 C.F.R. Part 192, Subpart C Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, Implementation 40 C.F.R. § 192.21(c)	Radium, Uranium, and trace metals in soil	40 C.F.R. § 192.21(c) comes into play when the estimated cost of remedial action to satisfy § 192.12(a) at a "vicinity" site (described under section 101(6)(B) of the Act) is unreasaonably high relative to the long-term benefits, and the residual radioactive materials do not pose a clear present or future hazard. The likelihood that buildings will be erected or that people will spend long periods of time at such a "vicinity" site should be considered in evaluating this hazard. Remedial action will generally not be necessary where residual radioactive materials have been placed semi-permanently in a location where site-specific factors limit their hazard and from which they are costly or difficult to remove, or where only minor quantities of residual radioactive materials are involved. Examples are residual	Not applicable but potentially relevant and appropriate	40 C.F.R. Part 192, Subparts A and B, would not be applicable. Given that Subpart C purports to guide the implementation of Subparts A and B where applied to a site, Subpart C is inapplicable as well. However, given that Subparts A and B may be relevant and potentially appropriate, the implementation standards of Subpart C may have bearing on any remedy that considers or is based off of the standards in Subparts A and B. In particular, this could apply if inaccessible RIM is identified during the course of the Remedial Design (particularly on "vicinity" properties).
40 C.F.R. Part 192 Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, Subpart D, Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as amended Subpart E, Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as amended 40 C.F.R. § 192.32 40 C.F.R. § 192.41	Radiation in any media	Processing operations during and prior to the end of the closure period at a facility managing uranium and thorium by-product materials should be conducted in a manner that provides reasonable assurance that the annual dose equiva- lent does not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public as a result of exposures to the planned discharge of radioactive material to the general environment (excluding radon-222, radon-220, and their decay products). Subpart E applies the standards of 40 C.F.R. § 192 Subpart D to thorium byproduct materials, save for the provisions of § 192.32(a)(4) (setting forth monitoring standards following placement of permanent radon barrier).	Not applicable but potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. The radiologically impacted materials at the Site are a small fraction of an overall matrix of municipal solid waste, debris and fill materials. Therefore, the waste materials at the Site are not similar to uranium mill tailings. As alpha and gamma radiation is a potential exposure route for OU-1, these regaulations are considered to be potentially relevant and appropriate. However, these subparts may be relevant and appropriate to the extent that they identify performance standards for disposal areas, specifically mandating that a design must be effective for 1,000 years, to the extent reasaonably achievable, and, in any case, 200 years, and limit releases of radon-222 into the atmosphere from disposal areas exceeding an average release rate of 20 pCi/(m2-sec).

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement	Preliminary Determination	Remarks
10 C.F.R. Part 20, Subpart C NRC Standards for Protection Against Ionizing Radiation, Maximum Permissible Exposure Limits 10 C.F.R. § 20.1201(a)	Radiation in any media	For persons inside a controlled area, the maximum permissible whole-body dose due to all external sources of radiation within a controlled area is limited to 5 rems/year or the sum of the deep-dose equivalent and the committed dose equivalent to any indvidual organ or tissue other than the lens of the eye being equal to 50 rems. The annual limits to the lens of the eye , to the skin of the whole body, and the skin of the extremities are a lends dose equivalent of 15 rems and a shallow-dose equivalent of 50 rem to the skin of the whole body or to the skin of any extremity.	Potentially relevant and appropriate	Because the site is not licensed by NRC, these requirements are not applicable. As these regulations address sources of ionizing radiation, they are potentially relevant and appropriate as they provide standards for protection from radiation for workers inside Areas 1 and 2 during any remedial actions that may be undertaken.
10 C.F.R. Part 20, Subpart D NRC Standards for Protection Against Ionizing Radiation, Maximum Permissible Exposure Limit 10 C.F.R. 20.1301(a) 10 C.F.R. Part 20, Subparts F, H, and J NRC Standards for Protection Against Ionizing Radiation	Radiation in any media	For persons outside a controlled area, the maximum permis-sible whole-body dose due to sources in or migrating from the controlled area is limited to 0.002 rem in any 1 hour, and 0.1 rem in any one hour. (Notes: A controlled area is an area that requires control of access, occupancy, and working conditions for radiation protection purposes; 0.5 rem = 500 mrem.) These Subparts also require protective measures such as monitoring for individual exposures, respiratory protection, and caution signs.	Potentially relevant and appropriate	Because the site is not licensed by NRC, these requirements are not applicable. As these regulations address sources of ionizing radiation, they are potentially relevant and appropriate of workers and the public outside of Areas 1 and 2 during any remedial actions that may be taken. (Note: 10 C.F.R. § 20.1301 was the only section from 10 C.F.R. Part 20 specifically listed as an "Other Potential Federal ARARs for Consideration".)
10 C.F.R. Part 40, Appendix A, Criterion 6(6) Criteria for Disposal of Wastes from Processing Source Material	Uranium processing waste material (radon, radium, thorium, etc.) in soil	Criterion 6(6) addresses the lack of remediation standards for residual radionuclides, other than radium in soil, for decomissioning of lands and structures (excluding radon) at uranium recovery facilities. Criterion 6(6) uses the existing soil radium standard (5 pCi/g surface and 15 pCi/g subsurface) to derive a dose criterion (benchmark approach) for cleaning up byproduct material, and for cleanup of surface activity on structures to be released for unrestricted use.	Not applicable. Potentially relevant and appropriate for non-radium radionuclides.	Because this Site is not licensed in conjunction with uranium and thorium milling, nor is it a site where milling operations generated byproduct material, these requirements are not applicable. To the extent the cleanup standards in 40 C.F.R. 192.12(a) are potentially relevant and appropriate for OU-1, Criterion 6(6), including Table 3, may be potentially relevant and appropriate for purposes of deriving surface soil cleanup goals for non-radium radionuclides.

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement	Preliminary Determination	Remarks
40 C.F.R. Part 61, Subpart H National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities 40 C.F.R. § 61.90-97 40 C.F.R. § 61.90-92	Radionuclides other than radon-222 and radon-220 in air	"Emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent to 10 mrem/yr." 40 C.F.R. § 61.92. Applies to any DOE facility that emits any radionuclide other than radon-222 and radon-220 into the air, except any disposal facility subject to 40 C.F.R. Part 191, Subpart B or 40 C.F.R. Part 192. "Facility" is defined as "all buildings, structures and operations on one contiguous site." 40 C.F.R. § 61.91(b).	Not applicable, but potentially relevant and appropriate for portions of the Site that are "facilities" and not subject to 40 C.F.R. Part 192	Because the West Lake Landfill OU-1 Site is not a Department of Energy owned or operated facility, these standards are not applicable. As these regulations address standards for airborne effluents containing radionuclides, they are potentially relevant and appropriate to any buildings, structures or operations on OU-1 if 40 C.F.R. Part 192 does not otherwise apply.
40 C.F.R. Part 61 Subpart I (codified at 40 C.F.R. § 61.100- 61.109) National Emission Standards for Radionuclide Emissions from Federal Facilities other than Nuclear Regulatory Commission Licensees and not Covered by Subpart H 40 C.F.R. 61.102(a)	Radionuclides in air	"Emissions of radionuclides, including iodine, to the ambient air from a facility regulated under this subpart shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr." 40 C.F.R. § 61.102(a). "Emissions of iodine to the ambient air from a facility regulated under this subpart shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 3 mrem/yr." 40 C.F.R. § 61.102(a). The provisions of this subpart apply to facilities owned or operated by any Federal agency other than the Department of Energy and not licensed by the Nuclear Regulatory Commission, except that this subpart does not apply to disposal at facilities regulated under 40 C.F.R. Part 191, Subpart B, or to any uranium mill tailings pile after it has been disposed of under 40 C.F.R. Part 192, or to low energy accelerators. [61 FR 68981, Dec. 30, 1996]	Not applicable, but potentially relevant and appropriate for portions of the Site that are "facilities" and not subject to 40 C.F.R. Part 192	Because the West Lake Landfill OU-1 Site is not owned or operated by any federal agency, these standards are not applicable. As these regulations address standards for airborne effluents containing radionuclides, they are potentially relevant and appropriate to any buildings, structures or operations on OU-1 if 40 C.F.R. Part 192 does not otherwise apply.
40 C.F.R. Part 61, Subpart T National Emissions Standards for Hazardous Air Pollutants, National Emissions Standards for Radon Emissions from disposal of Uranium Mill Tailings 40 C.F.R. § 61.222(a)	Radon-222 in air	Radon-222 emissions to ambient air from uranium mill tailings piles that are no longer operational should not exceed 20 pCi/(m2-sec) (1.9 pCi/(ft2-sec)) of radon-222. 40 C.F.R. § 61.222(a).	Potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated uranium mill tailings site, so this requirement would not be applicable; however it could be considered relevant and appropriate because a portion of the waste materials at the Site do emit radon. 40 C.F.R. § 61.222(a)'s limit of 20 pCi/(m2-sec) (1.9 pCi/(ft2-sec)) of radon-222 may be potentially relevant and appropriate to the capping and partial excavation alternatives.
Toxic Substances Control Act 15 U.S.C. § 2661 15 U.S.C. § 2664 15 U.S.C. § 2643(h) 15 U.S.C. § 2605(e)	Radon, PCBs, and asbestos in waste	This provision of TSCA concerns indoor radon health risks, mandating that EPA publish a guide about radon health risks and to perform studies of radon levels in schools and federal buildings. “The national long-term goal of the United States with respect to radon levels in buildings is that the air within buildings in the United States should be as free of radon as the ambient air outside of buildings.” 15 U.S.C. § 2661. “The Administrator of the Environmental Protection Agency shall develop model	Not applicable nor relevant and appropriate	This statute offers no definable standards for the control of radon exposure or contamination at the West Lake Landfill. Further, the West Lake Landfill is neither a school nor does it contain federal buildings. Therefore, these provisions are neither applicable nor are they relevant and appropriate. PCBs, if encountered, will be addressed under 40 C.F.R. Part 761 (see Action specific ARARs). Asbestos, if encountered, will be addressed under the asbestos NESHAP (40 C.F.R. Part 61) and Missouri state regulations.
40 C.F.R. Part 192, Subpart A Health and Environmental Protection Standards for	Radium, uranium, and trace metals in groundwater Radium-226 (Radium-228) in soil	Maximum constituent concentration: Combined Ra-226 and Ra-228 5 pCi/L Combined U-234 and U-238 30 pCi/L Gross alpha (excluding radon & uranium) 15 pCi/L	Not applicable, but potentially relevant and appropriate for all of OU-1, except for the areas covered by an engineered	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. As potential leaching of radionuclides and trace metals from the radiologically impacted materials at the Site is a possible issue of concern, these standards are potentially relevant and appropriate to the ROD-

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement	Preliminary Determination	Remarks
Uranium and Thorium Mill Tailings, Standards for the Control of Residual Radioactive Material from Inactive Uranium Processing Sites 40 C.F.R. Appendix Table 1 to Subpart A of Part 192, Maximum Concentration of Constituents for Groundwater Protection		Arsenic 0.05 mg/L Barium 1.0 mg/L Cadmium 0.01 mg/L Chromium 0.05 mg/L Lead 0.05 mg/L Mercury 0.002 mg/L Selenium 0.01 mg/L Silver 0.05 mg/L Nitrate (as N) 10 mg/L Molybdenum 0.1 mg/L Residual concentrations of radium-226 in soil at a designated uranium processing	cap compliant with standards in UMTRCA Subpart A.	selected remedy and the partial excavation alternatives. The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore this requirement would not be applicable. The EPA has determined that the residual radioactive materials considered in 40 C.F.R. § 192.12 are similar to RIM present in OU-1. EPA has concluded that the cleanup standards in 40 C.F.R. § 192.12 are relevant and appropriate for all of OU-1, except for the areas covered by an engineered cap compliant with standards in UMTRCA Subpart A.
Missouri Water Quality Standards, 10 C.S.R. § 20-7.031(5)	Groundwater	Water contaminants shall not cause or contribute to an exceedance of the following Inorganics (mg/L) Fluoride 4 Nitrate 10 Trace metals (ug/L) Antimony 6 Arsenic 50 Barium 2000 Beryllium 4 Boron 2000 Cadmium 5 Chromium III 100 Cobalt 1000 Copper 1300 Iron 300 Lead 15 Manganese 50 Mercury 2 Nickel 100 Selenium 50 Silver 50 Thallium 2 Zinc 5000 Organics (ug/L) Acrolein 320 Bis-2-chloroisopropyl ether 1400 2, chlorophenol 0.1 2,4-dichlorophenol 93 2,4-dinitrophenol 70 2,4-dimethylphenol 540 2,4,5-trichlorophenol 2600 2,4,6-trichlorophenol 2 2-methyl-4,6-dinitrophenol 13 Ethylbenzene 700	Potentially relevant and appropriate	These standards are only applicable to public drinking water systems; however, these standards may potentially be relevent and appropriate standards for groundwater.

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement		Preliminary Determination	Remarks
		Hexachlorocyclopentadiene	50		
		Isophorone	36		
		Nitrobenzene	17		
		Phenol	300		
		Dichloropropene	87		
		Para(1,4)-dichlorobenzene	75		
		Other Dichlorobenzenes	600		
		1,2,4-trichlorobenzene	70		
		1,2,4,5-tetrachlorobenzene	2.3		
		Pentachlorobenzene	3.5		
		1,1,1-trichloroethane	200		
		1,1,2-trichloroethane	0.04		
		2,4-dinitrotoluene	0.04		
		1,2-diphenylhydrazine	0.04		
		di (2-ethylhexyl) adipate	400		
		Pesticides (ug/L)			
		2,4-D	70		
		2,4,5-TP	50		
		Alachlor	2		
		Atrazine	3		
		Carbofuran	40		
		Dalapon	200		
		Dibromochloropropane	0.2		
		Dinoseb	7		
		Diquat	20		
		Endothall	100		
		Ethylene dibromide	0.05		
		Oxamyl (vydate)	200		
		Picloram	500		
		Simazine	4		
		Glyphosate	700		
		Bioaccumulatie Anthropogenic Toxics (ug/L)			
		PCBs	0.000045		
		DDT	0.00059		
		DDE	0.00059		
		DDD	0.00083		
		Endrin	2		
		Endrin aldehyde	0.75		
		Aldrin	0.00013		
		Dieldrin	0.00014		
		Heptachlor	0.4		
		Heptachlor epoxide	0.2		
		Methoxychlor	40		
		Toxaphene	3		
		Lindane (gamma-BHC)	0.2		

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement		Preliminary Determination	Remarks
		Alpha,beta,delta-BHC	0.0022		
		Chlordane	2		
		Benzidine	0.00012		
		2,3,7,8-TCDD (dioxin)	0.000000013		
		Pentachlorophenol	1		
		Anthropogenic Carcinogens (ug/L)			
		Acrylonitrile	0.058		
		Hexachlorobenzene	1		
		Bis (2-chloroethyl) ether	0.03		
		Bis (chloromethyl) ether	0.00013		
		Hexachloroethane	1.9		
		3,3'-dichlorobenzidine	0.04		
		Hexachlorobutadiene	0.456		
		n-nitrosodimethylamine	0.0007		
		Volatile Organic Compounds (ug/L)			
		Chlorobenzene	100		
		Carbon Tetrachloride	5		
		Trihalomethanes	80		
		Bromoform	4.3		
		Chlorodibromomethane	0.41		
		Dichlorobromomethane	0.56		
		Chloroform	5.7		
		Methyl Bromide	48		
		Methyl Chloride	5		
		Methylene Chloride	4.7		
		1,2-dichloroethane	5		
		1,1,2,2-tetrachloroethane	0.17		
		1,1-dichloroethylene	7		
		1,2-trans-dichloroethylene	100		
		1,2-cis-dichloroethylene	70		
		Trichloroethylene	5		
		Tetrachloroethylene	0.8		
		Benzene	5		
		Toluene	1000		
		Xylenes (total)	10000		
		Vinyl chloride	2		
		Styrene	100		
		1,2-dichloropropane	0.52		
		Polynuclear Aromatic Hydrocarbons (ug/L)			
		Anthracene	9600		
		Fluoranthene	300		
		Fluorene	1300		
		Pyrene	960		
		Benzo(a)pyrene	0.2		
		Other polynuclear aromatic hydroca	0.0044		

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement		Preliminary Determination	Remarks
		Acenaphthene	1200		
		Phthalate Esters (ug/L)			
		Bis(2-ethylhexyl) phthalate	6		
		Butylbenzyl phthalate	3000		
		Diethyl phthalate	23000		
		Dimethyl phthalate	313000		
		Di-n-butyl phthalate	2700		
		Health Advisory Levels (ug/L)			
		Ametryn	60		
		Baygon	3		
		Bentazon	20		
		Bis-2-chloroisopropyl ether	300		
		Bromacil	90		
		Bromochloromethane	90		
		Bromomethane	10		
		Butylate	350		
		Carbaryl	700		
		Carboxin	700		
		Chloramben	100		
		o-chlorotoluene	100		
		p-chlorotoluene	100		
		Chlorpyrifos	20		
		DCPA (dacthal)	4000		
		Diazinon	0.6		
		Dicamba	200		
		Diisopropyl methylphosphonate	600		
		Dimethyl methylphosphonate	100		
		1,3-dinitrobenzene	1		
		Diphenamid	200		
		Diphenylamine	200		
		Disulfoton	0.3		
		1,4-dithiane	80		
		Diuron	10		
		Fenamiphos	2		
		Fluometron	90		
		Fluorotrichloromethane	2000		
		Fonofos	10		
		Hexazinone	200		
		Malathion	200		
		Maleic hydrazide	4000		
		MCPA	10		
		Methyl parathion	2		
		Metolachlor	70		
		Metribuzin	100		
		Naphthalene	20		

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement	Preliminary Determination	Remarks
		Nitroguanidine 700 p-nitrophenol 60 Paraquat 30 Pronamide 50 Propachlor 90 Propazine 10 Propham 100 2,4,5-T 70 Tebuthiuron 500 Terbacil 90 Terbufos 0.9 1,1,1,2-Tetrachloroethane 70 1,2,3-trichloropropane 40 Trifluralin 5 Trinitroglycerol 5 Trinitrotoluene 2		
Missouri Public Drinking Water Program, Contaminant Levels and Monitoring 10 C.S.R. § 60-4	Inorganics, Synthetic Organic Compounds, Radionuclides, Secondary Contaminants, and Volatile Organic Compounds	Maximum contaminant levels for public water systems. Maximum Contaminant Levels Inorganics Antimony 0.006 mg/L Arsenic 0.01 mg/L Asbestos 7×10^6 fibers/L Barium 2 mg/L Beryllium 0.004 mg/L Cadmium 0.005 mg/L Chromium 0.1 mg/L Cyanide 0.2 mg/L Fluoride 4.0 mg/L Mercury 0.002 mg/L Nitrate (as N) 10 mg/L Nitrite (as N) 1 mg/L Total Nitrate + Nitrite (as N) 10 mg/L Selenium 0.05 mg/L Thallium 0.002 mg/L Synthetic Organic Compounds Alachlor 0.002 mg/L Atrazine 0.003 mg/L Benzo(a)pyrene 0.0002 mg/L Carbonfugran 0.04 mg/L Chlordane 0.002 mg/L Dalapon 0.2 mg/L Di(2-ethylhexyl) adipate 0.4 mg/L Dibromochloropropane (DBCP) 0.0002 mg/L Di(2-ethylhexyl) phthalate 0.006 mg/L Dinoseb 0.007 mg/L	Not applicable. Potentially relevant and appropriate	These standards apply to public water systems and therefore are not applicable to the West Lake Landfill OU-1 Site. As these standards provide for maximum concentrations in drinking water and the alluvial aquifer could be used for drinking water, these standards are potentially relevant and appropriate for groundwater at the Site.

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement		Preliminary Determination	Remarks
		Diquat	0.02 mg/L		
		Endothall	0.1 mg/L		
		Endrin	0.002 mg/L		
		2,4-D	0.07 mg/L		
		Ethylene dibromide (EDB)	0.00005 mg/L		
		Glyphosoate	0.7 mg/L		
		Heptachlor	0.0004 mg/L		
		Heptachlor Epoxide	0.0002 mg/L		
		Hexachlorobenzene	0.001 mg/L		
		Hexachlorocyclopentadiene	0.05 mg/L		
		Lindane	0.0002 mg/L		
		Methoxychlor	0.04 mg/L		
		Oxamyl (Vydate)	0.2 mg/L		
		Picloram	0.5 mg/L		
		Polychlorinated biphenyls (PCBs)	0.0005 mg/L		
		Pentachlorophenol	0.001 mg/L		
		Simazine	0.004 mg/L		
		Toxaphene	0.003 mg/L		
		2,3,7,8-TCDD (Dioxin)	0.00000003 mg/L		
		2,4,5-TP (Silvex)	0.05 mg/L		
		Radionuclides			
		Combined Ra_{226} and Ra_{228}	5 pCi/L		
		Gross alpha (excluding radon & urn	15 pCi/L		
		Uranium	30 ug/L		
		Secondary Contaminants			
		Aluminum	0.05 - 0.2 mg/L		
		Chloride	250 mg/L		
		Copper	1.0 mg/L		
		Fluoride	2.0 mg/L		
		Iron	0.3 mg/L		
		Manganese	0.05 mg/L		
		Silver	0.1 mg/L		
		Sulfate	250 mg/L		
		Total Dissolved Solid (TDS)	500 mg/L		
		Zinc	5 mg/L		
		Volatile Organic Compounds			
		Benzene	0.005 mg/L		
		Carbon tetrachloride	0.005 mg/L		
		1,2-dichloroethane	0.005 mg/L		
		1,1-dichloroethylene	0.007 mg/L		
		para-dichlorobenzene	0.075 mg/L		
		1,1,1-trichloroethane	0.2 mg/L		
		Trichloroethylene	0.005 mg/L		
		Vinyl chloride	0.002 mg/L		
		cis-1,2-dichloroethylene	0.07 mg/L		

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement			Preliminary Determination	Remarks
		Dichloromethane	0.005 mg/L			
		1,2-dichloropropane	0.005 mg/L			
		Ethylbenzene	0.7 mg/L			
		Monodichlorobenzene	0.1 mg/L			
		o-dichlorobenzene	0.6 mg/L			
		Styrene	0.1 mg/L			
		Tetrachloroethylene	0.005 mg/L			
		Toluene	1 mg/L			
		1,2,4-Trichlorobenzene	0.07 mg/L			
		1,1,2-Trichloroethane	0.005 mg/L			
		trans-1,2-dischloroethylene	0.1 mg/L			
		Xylenes (total)	10 mg/L			
40 C.F.R. Part 141 National Primary Drinking Water Regulations 40 C.F.R. § 141.50 40 C.F.R. § 141.51 40 C.F.R. § 141.52 40 C.F.R. § 141.53 40 C.F.R. § 141.54 40 C.F.R. § 141.55	Various chemicals in water	Establishes standards including maximum contaminant levels (MCLs) and			Potentially relevant and appropriate	These standards are only applicable to public drinking water systems; however, MCLs and non-zero MCLGs may potentially be relevent and appropriate standards for groundwater.
		Contaminant	MCLG (mg/L)	MCL (mg/L)		
		Trace metals				
		Antimony	0.006	0.006		
		Asbestos	7×10^6 fibers/liter	7 mfl		
		Barium	2	2		
		Beryllium	0.004	0.004		
		Cadmium	0.005	0.005		
		Chromium (total)	0.1	0.1		
		Copper	1.3	1.3		
		Cyanide	0.2	0.2		
		Fluoride	4	4		
		Lead	0.015	zero		
		Mercury (inorganic)	0.002	0.002		
		Nitrate (as N)	10	10		
		Nitrite (as N)	1	1		
		Selenium	0.05	0.05		
		Thallium	0.0005	0.002		
		Organic Chemicals				
		Alachlor	zero	0.002		
		Atrazine	0.003	0.003		
		Benzene	zero	0.005		
		Benzo(a)pyrene (PAHs)	zero	0.0002		
		Carbofuran	0.04	0.04		
		Carbon tetrachloride	zero	0.005		
		Chlordane	zero	0.002		
		Chlorobenzene	0.1	0.1		
		2,4-D	0.07	0.07		
		Dalapon	0.2	0.2		
		1,2-Dibromo-3-chloropropane	zero	0.0002		
		o-Dichlorobenzene	0.6	0.6		
		p-Dichlorobenzene	0.075	0.075		
		1,2-Dichloroethane	zero	0.005		

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement			Preliminary Determination	Remarks
		1,1-Dichloroethylene	0.007	0.007		
		cis-1,2-Dichloroethene	0.07	0.07		
		trans-1,2-Dichloroethene	0.1	0.1		
		Dichloromethane	zero	0.005		
		1,2-Dichloropropane	zero	0.005		
		Di(2-ethylhexyl) adipate	0.4	0.4		
		Di(2-ethylhexyl) phthalate	zero	0.006		
		Dinoseb	0.007	0.007		
		Dioxin (2,3,7,8-TCDD)	zero	0.00000003		
		Diquat	0.02	0.02		
		Endothall	0.1	0.1		
		Endrin	0.002	0.002		
		Ethylbenzene	0.7	0.7		
		Ethylene dibromide	zero	0.00005		
		Glyphosate	0.7	0.7		
		Heptachlor	zero	0.0004		
		Heptachlor epoxide	zero	0.0002		
		Hexachlorobenzene	zero	0.001		
		Hexachlorocyclopentadiene	0.05	0.05		
		Lindane	0.0002	0.0002		
		Methoxychlor	0.04	0.04		
		Oxamyl (Vydate)	0.2	0.2		
		PCBs	zero	0.0005		
		Pentachlorophenol	zero	0.001		
		Picloram	0.5	0.5		
		Simazine	0.004	0.004		
		Styrene	0.1	0.1		
		Tetrachloroethylene	zero	0.005		
		Toluene	1	1		
		Toxaphene	zero	0.003		
		2,4,5-TP (Silvex)	0.05	0.05		
		1,2,4-Trichlorobenzene	0.07	0.07		
		1,1,1-Trichloroethane	0.2	0.2		
		1,1,2-Trichloroethane	0.003	0.005		
		Trichloroethylene	zero	0.005		
		Vinyl chloride	zero	0.002		
		Xylenes (total)	10	10		
		Radionuclides (picocuries per liter [pCi/L])				
		Alpha particles	zero	15		
		Beta particles and photon emitters (millirems per year)	zero	4		
		Radium-226 and Radium-228 (combined)		5		
		Uranium (ug/L)	zero	30		
10 C.F.R.. Part 20 Appendix B	Specific radionuclides (see table) in air	The concentrations above natural background of radionuclides in air outside a Effluent Concentration Limit (uCi/mL)			Potentially relevant and appropriate	Because the site is not licensed by NRC, these requirements are not applicable. These requirements would be potentially relevant and

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Citation	Chemical & Medium	Requirement			Preliminary Determination	Remarks
NRC Standards for Protection Against Ionizing Radiation, Annual Limits on Intake (ALIs) Derived Air Concentrations (DACs) Effluent Concentrations (Tables 1 and 2)		Isotope	Air	Water		appropriate to protection of the public during implementation of any remedial action. Specifically, these regulations potentially may require perimeter monitoring to be undertaken during any activities that may expose or disturb the radiologically- impacted materials at the Site.
		Actinium-227	1×10^{-15}	5×10^{-9}		
		Lead-210	6×10^{-13}	1×10^{-8}		
		Protactinium-231	8×10^{-15}	6×10^{-9}		
		Radium-226	9×10^{-13}	6×10^{-8}		
		Radium-228	2×10^{-12}	6×10^{-8}		
		Radon-222	1×10^{-8}	NA		
		Thorium-230	3×10^{-14}	1×10^{-7}		
		Thorium-232	6×10^{-15}	3×10^{-8}		
		Uranium-234	5×10^{-14}	3×10^{-7}		
		Uranium-235	6×10^{-14}	3×10^{-7}		
		Uranium-238	6×10^{-14}	3×10^{-7}		
		NA = not applicable because radon-222 is a gas.				

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Chemical	Maximum Concentration Allowed	Medium	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
All chemicals, compounds or substances listed under CERCLA	Any release that exceeds the Reportable Quantity (RQ) listed under CERCLA	Any	CERCLA reporting requirements are incorporated by reference in MO state law and regulations. Any release in the excess of the RQ must be reported and cleaned up in accordance with state law and regulations	RSMo Sections 260.500-550; 10 C.S.R. 24-2.010; 10 C.S.R. 24-3.010 (1) The Department of Natural Resources is authorized under sections 260.500-260.550, RSMo to administer the state's Hazardous Substance Emergency Response Office 10 C.S.R. 24-2.010 Definitions10 C.S.R. 24-3.010 Notification Procedures for Hazardous Substance Emergencies and for Emergency Notification of Releases of Hazardous Substances and Extremely Hazardous Substances	Any chemicals that exceed the RQ would be Relevant and Appropriate under CERCLA, if excavated soil contained free liquids. Hazardous waste, if encountered will not be placed back in the landfill.
Petroleum (including but not limited to gasoline or diesel fuels)	Any release that exceeds the state RQ of 50 gallons	Any	MO state law and regulations require that any release of petroleum in excess of the RQ must be reported and cleaned up in accordance with state law and regulations	RSMo Sections 260.500-550; 10 C.S.R. 24-2.010; 10 C.S.R. 24-3.010	Notification requirements are not substantive ARARs. Petroleum is excluded under CERCLA unless mixed with other CERCLA wastes. Petroleum compounds that exceed the RQ would be Relevant and Appropriate if dripping soils were excavated.
Toxic Substances	Water contaminants shall not cause an exceedance of criteria in Tables A and B to be exceeded; Concentrations of these substances in bottom sediments or waters shall not harm benthic	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(B)(1) The specific criteria shall apply to waters contained in Tables G and H of this rule and the Missouri Use Designation Dataset. (B) Toxic Substances. 1. Water contaminants shall not cause the criteria in Tables A and B to be exceeded. Concentrations of these substances in bottom sediments or waters shall not harm benthic organisms and shall not accumulate through the food	These standards are potentially applicable to discharges to waters of the state.

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Chemical	Maximum Concentration Allowed	Medium	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
	organism and shall not accumulate through the food chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded.			chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded. More stringent criteria may be imposed if there is evidence of additive or synergistic effects.	
Toxic Substances	Analysis methods for metals are specified.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(B)(2) (5) Specific Criteria. (B) Toxic Substances. 2. For compliance with this rule, metals shall be analyzed by the following methods: A. Aquatic life protection and human health protection—fish consumption. (I) Mercury—total recoverable metals. (II) All other metals—dissolved metals; B. Drinking water supply—total recoverable metals; and C all other beneficial uses – total recoverable metals.	These standards are potentially applicable to discharges to waters of the state.
Toxic Substances	Other toxic substances for which sufficient toxicity data are not available may not be released to waters of the state until safe levels are demonstrated through studies.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(B)(3) Other potentially toxic substances for which sufficient toxicity data are not available may not be released to waters of the state until safe levels are demonstrated through adequate bioassay studies	If contaminated media treatment generated free liquids that are discharged to a surface water body, these standards are potentially applicable.
pH	Shall not cause pH to be outside the range of 6.5 - 9.0 standard units.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(E) Water contaminants shall not cause pH to be outside of the range of 6.5 to 9.0 standard pH units.	If contaminated media treatment generated free liquids that are discharged to a surface water body, these standards are potentially applicable.

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Chemical	Maximum Concentration Allowed	Medium	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Taste- and Odor-Producing Substances	Shall not interfere with beneficial uses.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(F) Taste- and Odor-Producing Substances Taste- and odor-producing substances shall be limited to concentrations in the streams or lakes that will not interfere with beneficial uses of the water. For those streams and lakes designated for drinking water supply use, the taste- and odor-producing substances shall be limited to concentrations that will not interfere with the production of potable water by reasonable water treatment processes.	These standards are potentially applicable to discharges to waters of the state.
Turbidity and Color	Shall not cause or contribute substantial visual contrast with natural appearance or interfere with beneficial uses.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(G) Turbidity and Color. Water contaminants shall not cause or contribute to turbidity or color that will cause substantial visible contrast with the natural appearance of the stream or lake or interfere with beneficial uses.	If turbidity and color are elevated in any potential discharge, these standards are potentially applicable.
Solids	Shall not cause or contribute to excess of a level that will interfere with beneficial uses.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(H) Solids. Water contaminants shall not cause or contribute to solids in excess of a level that will interfere with beneficial uses. The stream or lake bottom shall be free of materials which will adversely alter the composition of the benthos, interfere with the spawning of fish or development of their eggs, or adversely change the physical or chemical nature of the bottom.	If elevated TSS is present in any potential discharge, these standards are potentially applicable.
Radioactive Materials	Shall conform to state and federal limits for drinking water supply.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(I); cross-reference 10 C.S.R. 60-4.060 Radioactive Materials. All streams and lakes shall conform to state and federal limits for radionuclides established for drinking water supply.	As these standards provide for maximum concentrations in drinking water and the alluvial aquifer could be used for drinking water outside of the West Lake Landfill boundaries, these standards are potentially applicable.
Dissolved Oxygen	Shall not cause levels lower than described in Table A or Table K.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 2-7.031(5)(J) Dissolved Oxygen. Water contaminants shall not cause the dissolved oxygen to be lower than the levels described in Table A or Table K—Site-Specific Criteria.	If DO is not within the acceptable range in any potential discharge, these standards are potentially applicable.

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Chemical	Maximum Concentration Allowed	Medium	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Total Dissolved Gases	Operation of impoundments shall not to exceed 110% of the saturation value for gases at the existing atmospheric and hydrostatic pressures.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(K) Total Dissolved Gases. Operation of impoundments shall not cause the total dissolved gas concentrations to exceed one hundred ten percent (110%) of the saturation value for gases at the existing atmospheric and hydrostatic pressures.	If dissolved gases are present in any potential discharge, these standards are potentially applicable.
Sulfates and Chlorides	Shall not cause or contribute to levels in excess of Table A from 2009 version of the Missouri Water Quality Standards.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(L), 10 C.S.R. 20-7.031 Table A (2009)	If sulfides and chlorides are elevated in any potential discharge, these standards are potentially applicable.
Carcinogenic Substances	Shall not exceed concentrations in water which correspond to the 10^{-6} cancer risk rate, at average fish and water consumption amounts. Federal limits for drinking water supply shall supersede criteria developed in this manner.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(M) Sulfate and Chloride Limit for Protection of Aquatic Life. Water contaminants shall not cause sulfate or chloride criteria to exceed the levels described in Table A. Carcinogenic Substances. Carcinogenic substances shall not exceed concentration in water which correspond to the 10-6 cancer risk rate. This risk rate equates to one (1) additional cancer case in a population of one (1) million with lifetime exposure. Derivation of this concentration assumes average water and fish consumption amounts. Assumptions are two (2) liters of water and six and one-half (6.5) grams of fish consumed per day. Federally established final maximum contaminant levels for drinking water supply shall supersede drinking water supply criteria developed in this manner.	If carcinogenic substances are elevated in any potential discharge, these standards are potentially applicable.
All Pollutants	Sample collection shall be performed per Standard Methods, 40 CFR 136, for the examination of water and wastewater or other procedures approved by EPA and the Department.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(0) All methods of sample collection, preservation, and analysis used in applying criteria in these standards shall be in accord with those prescribed in the latest edition of Standard Methods for the Examination of Water and Wastewater or other procedures approved by the Environmental Protection Agency and the Missouri Department of Natural Resources.	These standards are potentially applicable to sample collection and analysis of discharges to waters of the state.

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Chemical	Maximum Concentration Allowed	Medium	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Whole Effluent Toxicity (WET)	Chronic WET tests performed at the percent effluent at the edge of the missing zone shall not be toxic to the more sensitive of at least two representative, diverse species. Pollutant attenuation will be considered.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031(5)(Q) WET Chronic Tests. Chronic WET tests performed at the percent effluent at the edge of the mixing zone shall not be toxic to the more sensitive of at least two (2) representative, diverse species. Pollutant attenuation processes such as volatilization and biodegradation which may occur within the allowable mixing zone will be considered in interpreting results.	If WET is elevated in any potential discharge, these standards are potentially applicable.
Biocriteria	Receiving waters shall not be significantly different than reference waters.	Water	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-7.031 (5)(R) Biocriteria. The biological integrity of waters, as measured by lists or numeric indices of benthic invertebrates, fish, algae, or other appropriate biological indicators, shall not be significantly different from reference waters. Waters targeted for numeric biological criteria assessment must be contained within the Missouri Use Designation Dataset and shall be compared to reference waters of similar size, scale within the stream network, habitat type, and aquatic ecoregion type. Reference water locations for some aquatic habitat types are listed in Table I.	If biocriteria are met in any potential discharge, these standards are potentially applicable.
Water Quality	Appendix 1 Appendix 2	Water	Continue to monitor	10 C.S.R. 80-3.010(11)B.4 10 C.S.R. 80-3.010 Appendix 1 10 C.S.R. 80-3.010 Appendix 2 Groundwater Monitoring. (A) Requirements. The owner/operator of a sanitary landfill shall implement a groundwater monitoring program capable of determining the sanitary landfill's impact on the quality of groundwater underlying the sanitary landfill. (B) Satisfactory Compliance-Design	Not applicable to CERCLA sites, but may be relevant and appropriate if water is required to be monitored.
Water Quality	TMDLs	Water	Continue to monitor	TMDL for Missouri Load Missouri's Water Quality Standards, 10 C.S.R. 20-7.031, Table A, under Persistent, Bioaccumulative, Man-made Toxics.Satisfactory Compliance-Design	Not applicable to CERCLA sites, but may be relevant and appropriate if water is required to be monitored.
Odor		Air	Protect air quality	10 C.S.R. 10-6.165	

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Chemical	Maximum Concentration Allowed	Medium	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
	May not cause, permit, or allow the emission of odor greater than 7:1 for two separate trials not less than 15 minutes apart within the period of one hour outside of property boundary			Restriction of Emission of Odors	Not applicable to CERCLA sites, but may be relevant and appropriate if odor is present in the air, if waste is excavated.
Air particulates	Particulate matter (dust) seen leaving the property or observed on surfaces beyond the property of origin are a violation of Missouri regulations.	Air	Protect air quality	10 C.S.R. 10-6.170 Restriction of Particulate Matter to the Ambient Air Beyond the Premises of Origin	Not applicable to CERCLA sites, but may be relevant and appropriate if PM is present in the air if waste is excavated or dust is generated during cover construction of soil layers under the capping scenario.
Asbestos	Registration, Abatement, Notification, Inspection, Demolition and performance requirements	Air	Health and Safety	10 C.S.R. 10-6.241 Registration, Notification and Performance Requirements	As stated in the FFS, “no definitive information exists from the RI investigations regarding the presence of RACM in Areas 1 and 2.” Not applicable to CERCLA sites, but may be relevant and appropriate if friable asbestos is encountered.
Asbestos	Certification, Accreditations and Business Exemption Requirements	Air	Health and Safety	10 C.S.R. 10-6.250 Asbestos Projects—Certification, Accreditation and Business Exemption Requirements Note that in the entry for 19 C.S.R. 20-10.099, there is a reference to another reg that is incorrectly called out as 10 C.S.R., should be 19 C.S.R.	As stated in the FFS, “no definitive information exists from the RI investigations regarding the presence of RACM in Areas 1 and 2.” Not applicable to CERCLA sites, but may be relevant and appropriate if friable asbestos is encountered.
Radiation	Specified in regulation	Air	Protection against ionizing radiation	19 C.S.R. 20-10 Title 19—DEPARTMENT OF HEALTH AND SENIOR SERVICES Division 20—Division of Environmental Health and Epidemiology Chapter 10—Protection Against Ionizing Radiation	Potentially applicable for the excavation scenarios with offsite disposal.
Air pollutants	Air quality standards, definitions, sampling and reference methods and air pollution control regulations for the entire State of Missouri	Air	Protection against air pollutants	10 C.S.R. 10-6 Related: 643.010-643.620 RSMo Department of Natural Resources Division 10—Air Conservation Commission Chapter 6—Air Quality Standards, Definitions, Sampling and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri	Potentially applicable during the remedy implementation.

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Chemical	Maximum Concentration Allowed	Medium	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Water pollutants	Safe Drinking Water Law and specified regulatory contaminant limits	Water	Drinking water protection	640.100-640.140 RSMo Drinking water regulations	Not applicable to CERCLA sites since these pertain to drinking water, but may be relevant and appropriate if water pollutants are present in any water discharged or to groundwater.
Regulated quantities of hazardous waste	None	Any	Hazardous waste excluded from landfill	10 C.S.R. 80-3.010(3)(A)1 Solid waste excluded	Hazardous waste, if encountered will not be placed back in the landfill. These requirements are potentially applicable if excavated hazardous waste is disposed of in a solid waste landfill in the State of Missouri.
Other excluded waste	None	Any	If excavated, needs to be removed	10 C.S.R. 80-3.010(3)(A)2.H.I.3-13 Solid waste excluded H. Low-level radioactive waste as defined in section 260.700, RSMo as radioactive waste that is not classified as high-level radioactive waste and that is class A, B, or C low-level radioactive waste as defined in 10 CFR 61.55, as that section existed on January 26, 1983. Low-level radioactive waste or waste does not include any such radioactive waste that is owned or generated by the United States Department of Energy; by the United States Navy as a result of the decommissioning of its vessels, or as a result of any research, development, testing or production of any atomic weapon; and I. Any greater-than-class-C radioactive waste; 3. Explosives; 4. Regulated quantities of polychlorinated biphenyls (PCBs); 5. Bulk liquids; 6. Highly flammable or volatile substances; 7. Septic tank pumpings; 8. Major appliances; 9. Waste oil; 10. Lead-acid batteries; 11. Waste tires as provided by 10 CSR 80-8.020; 12. Yard waste; and 13. Infectious waste as provided by 10 CSR 80-7.010.	These requirements are potentially applicable to landfills in operation after 10-9-91 if these excluded wastes are excavated and disposed of in a solid waste landfill in the State of Missouri.

Table 3-1: Preliminary Identification of Potential Chemical-Specific ARARs

Chemical	Maximum Concentration Allowed	Medium	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Tires		Any	If excavated, needs to be removed	10 C.S.R. 80-8.020 Solid waste excluded	These requirements are potentially applicable to landfills in operation after 10-9-91 if these excluded wastes are excavated and disposed of in a solid waste landfill in the State of Missouri.
Radioactive materials	Defined in regulation	Any	Radioactive waste excluded from landfill	10 C.S.R. 80-3.010(3)(A)2 Solid waste excluded	These requirements are potentially applicable to landfills in operation after 10-9-91 if these excluded wastes are excavated and disposed of in a solid waste landfill in the State of Missouri. While the design, operation, closure, monitoring, and post-closure care of the new engineered cell would need to comply with certain Missouri solid waste regulations, these requirements would be met through achievement of more stringent requirements associated with the UMTRCA, NRC and RCRA Subtitle C regulations that have been identified as ARARs for the on-site disposal cell.

3-1 OSWER Directives and Other Guidance Documents Identified as TBCs

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
OSWER Directive 9285.6-20 ("Radiation Risk Assessment at CERCLA Sites: Q&A")	Radon	Air	Specifies an ARAR protectiveness criteria evaluation recommendation of 12 mrem/yr in place of the 15 mrem/yr value previously specified in Directive 9200.4-18.	Potential TBC	As this is only guidance, it is not an ARAR; however, this guidance would be a TBC for purposes of demonstrating compliance with UMTRCA where UMTRCA is identified as an ARAR for indoor radon exposure. This guidance provides pCi/l concentration levels to show compliance with the UMTRCA working-level indoor air levels.
OSWER 9200.4-18 ("Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination" (EPA, 1997a))	Radioactive Contamination at CERCLA sites		Provide guidance on use of the UMTRCA standards as CERCLA cleanup levels. Cleanup of radionuclides is governed by the risk range for all carcinogens established in the NCP when ARARs are not available or are not sufficiently protective. Where ARARs are not available or are not sufficiently protective EPA generally sets site-specific remediation levels for: (1) carcinogens at a level that represents an exceedance of upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6}; and, (2) non-carcinogens such that the cumulative risks from exposure will not result in adverse effects to human populations (including sensitive sub-populations) that may be exposed during a lifetime or part of a lifetime, incorporating an adequate margin of safety. If a dose assessment is conducted at the site, then a 15 millirem per year (mrem/yr) effective dose equivalent should generally be the maximum dose limit for humans. This equates to approximately 3 X 10^-4 increased lifetime risk of cancer and is consistent with levels generally considered protective in other governmental actions.	Potential TBC	As this is only guidance, it is not an ARAR. EPA has defined the full excavation of RIM alternatives to mean attainment of the risk-based radiological clean levels specified in OSWER directives 9200.4-25 and 9200.4-18. These criteria are based on the UMTRCA standards (40 CFR Part 192 Subpart B) for cleanup of so-called 'vicinity property' (as opposed to the actual waste disposal units.) The UMTRCA standards at 40 C.F.R. Part 192 Subpart B are potentially relevant and appropriate for all of OU-1, except for the areas covered by an engineered cap compliant with standards in UMTRCA Subpart A.

3-1 OSWER Directives and Other Guidance Documents Identified as TBCs

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
OSWER No. 9200.4-23 ("Clarification of the Role of Applicable, or Relevant and Appropriate Requirements in Establishing Preliminary Remediation Goals under CERCLA")	Various	Various	This directive clarifies the relationship between 1) the requirement to protect human health and the environment, and 2) the requirement to attain, or waive if justified based on site-specific circumstances, ARARs. Specifically, this directive clarifies that EPA may establish preliminary remediation goals at levels that are more protective than required by ARARs.	Potential TBC	As this is only guidance, it is not an ARAR. This guidance may be a TBC.
EPA Memo "Considering a Noncancer Oral Reference Dose for Uranium for Superfund Human Health Risk Assessments" (Dated December 1, 2016)	Soluble uranium	Various	This memorandum provides information and recommendations about an oral reference dose (RfD) for non-radiological toxicity of soluble uranium. This memorandum recommends the use of the ATSDR intermediate MRL for soluble uranium <u>without</u> further adjustment, in lieu of the RfD currently published in IRIS, for assessment of chronic exposures also. Specifically, evaluation of the non- carcinogenic risks posed by uranium should use a toxicity value of 0.0002 mg/kg-day.	Potential TBC	As this is only guidance, it is not an ARAR. This guidance may be a TBC if soluble uranium is identified as a COPC.
OSWER 4283.1-14 ("Use of Uranium Drinking Water Standards under 40 CFR 141 and 40 CFR 192 as Remediation Goals for Groundwater at CERCLA Sites")	Radionuclides	Ground-water	OSWER Directive 9283.1-14 addresses the use of uranium drinking water standards for groundwater remediation at CERCLA sites. This directive specifies that both the uranium MCL (40 CFR 141) and the UMTRCA standards (40 CFR 192) are potentially relevant and appropriate. This directive also provides guidance on the groundwater point of compliance standard in 40 C.F.R. 192.02(c)(4) relative to the CERCLA approach for conducting groundwater responses.	Potential TBC	As this is only guidance, it is not an ARAR. This guidance may be a TBC, insofar as it specifies certain standards as ARARs.

3-1 OSWER Directives and Other Guidance Documents Identified as TBCs

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments, OSWER 530-SW-89-047 (July 1989)	Hazardous Wastes	Hazardous Waste Landfills	Provides design guidance on final cover systems for hazardous waste landfills and surface impoundments. Addresses multilayer cover design to provide long-term protection from infiltration of precipitation.	Potential TBC	As this is only guidance, it is not an ARAR. While RCRA Subtitle C regulations are neither applicable nor relevant and appropriate to West Lake Landfill OU-1 for alternatives that include an engineered cap that is compliant with UMTRCA 40 C.F.R. 192 Subpart A, EPA guidance on the design of landfill covers for RCRA and CERCLA sites may provide information useful for the design of a final cover system. Therefore, this guidance may be a TBC for all alternatives except the full excavation with off-site disposal alternative.
(Draft) Technical Guidance for RCRA/CERCLA Final Covers, EPA OSWER 540-R-04-007 (April 2004)	Hazardous Wastes and MSW	Hazardous Waste and MSW Landfills	Provides design information regarding cover systems for municipal solid waste (MSW) and hazardous waste (HW) landfills being remediated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA) Corrective Action, and sites regulated under the RCRA. Specifically, this guidance recommends and describes a multi-layer cover system that includes a two-component low permeability layer with a hydraulic conductivity no greater than 1 x 10-7 cm/sec.		While RCRA Subtitle C regulations are neither applicable nor relevant and appropriate to West Lake Landfill OU-1 for alternatives that include an engineered cap that is compliant with UMTRCA 40 C.F.R. 192 Subpart A, EPA guidance on the design of landfill covers for RCRA and CERCLA sites provides specific information that is useful for the design of a final cover system that will result in compliance with the UMTRCA performance standards. Because proper design and construction of a final cover is key to long-term protection from infiltration of precipitation, these criteria will be incorporated into the design of the

3-1 OSWER Directives and Other Guidance Documents Identified as TBCs

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
			This guidance includes updated information related to development of design criteria, use and types of geosynthetics such as geosynthetic clay liners, alternative materials and designs, performance monitoring, maintenance of cover systems, and other issues.		engineered landfill cover system. Therefore, this guidance may be a TBC for all alternatives except the full excavation with off-site disposal alternative.
OSWER Directive 9200.4-35P ("Remediation Goals for Radioactively Contaminated CERCLA Sites Using the Benchmark Dose Cleanup Criteria in 10 CFR Part 40 Appendix A, I, Criterion 6(6)")	Uranium processing waste material (Radon, radium, thorium, etc.)	Soil	Clarifies the relationship between the UMTRCA soil standards under 40 CFR 192 and the NRC radium benchmark approach under the 10 CFR 40 Appendix A, I, Criterion 6(6) in setting remediation goals in soil and structures. OSWER Directive 9200.4-35P explains that "The Criterion 6(6) rule is a supplement to the radium standards of 40 CFR Part 192, to address other site-related radionuclides. Therefore, when the 5 pCi/g and 15 pCi/g standards under EPA's UMTRCA rule are not RARs for either radium-226 and/or radium-228, the Criterion 6(6) rule is generally not appropriate … Even if EPA's UMTRCA soil standards were used as TBCs, we recommend that the Criterion 6(6) rule's benchmark dose should not be used as a TBC."	Potential TBC	As this is only guidance, it is not an ARAR. This guidance may be a TBC, insofar as it clarifies the relationship between the UMTRCA soil standards under 40 CFR 192 and the NRC radium benchmark approach under the 10 CFR 40 Appendix A, I, Criterion 6(6) in setting remediation goals in soil and structures, and further clarifies when Criterion 6(6) should be applied.
OSWER Directive No. 9200.4-25 ("Use of Soil Cleanup Criteria in 40 C.F.R. Part 192 as Remediation Goals for CERCLA Sites" (EPA, 1998)	Radium-226 Radium-228 Thorium-230 Throium-228	Soil	Clarifies EPA's position on the use of the soil cleanup criteria in 40 C.F.R. Part 192 at CERCLA sites with radioactive contamination. In particular it clarifies the intent of 40 C.F.R. Part 192 in setting remediation levels for subsurface soil. Also, Thorium-230 and Thorium-232 should be cleaned up to the same concentrations as their radium progeny (5 and 15 pCi/g).	Potential TBC	As this is only guidance, it is not an ARAR. As 40 C.F.R. 192 is considered to be potentially relevant and appropriate for the radiologically-impacted soil on OU-1 (other than areas covered by an engineered cap compliant with UMTRCA standards in Subpart A), this guidance would be a TBC.

3-1 OSWER Directives and Other Guidance Documents Identified as TBCs

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
			Radium 226 +228 5 pCi/g plus background Thorium 230 +232 5 pCi/g plus background		
FAA Record of Decision (1998) FAA Memorandum of Understanding (2003)			The FAA ROD includes requirements relative to proximity of the proposed Lambert Airport new runway to the existing Bridgeton Sanitary Landfill. The FAA MOU, entered into between the FAA, EPA and other agencies, addresses aircraft-wildlife strikes.	Potential TBC	The FAA ROD and FAA MOU are not legally binding and are not ARARs. They do, however, represent TBC criteria relative to the potential remedial actions that involve excavation at the Site.
FAA Advisory Circular AC 150/5200-34A (2006)			FAA Advisory Circular AC 150/5200-34A, "Construction or Establishment of Landfills Near Public Airports," contains guidance on complying with federal statutory requirements regarding the construction or establishment of a new municipal solid waste landfill near public airports. This advisory requires a minimum separation distances of six statute miles between a new MSWLF and a public airport as measured from the closest point of the airport property boundary to the closest point of the MSWLF property boundary.	Potential TBC	This requirement would be a TBC relative to the potential remedial actions that involve excavation at the Site.
FAA Advisory Circular AC 150/5200-33B (2007)			FAA Advisory Circular AC 150/5200-33B, "Hazardous Wildlife Attractants On or Near Airports," provides guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports. This circular recommends against locating a MSWLF within certain separation distances: 1. Airports serving piston-powered aircraft – 5,000 feet	Potential TBC	This requirement would be a TBC relative to the potential remedial actions that involve excavation at the Site.

3-1 OSWER Directives and Other Guidance Documents Identified as TBCs

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
			2. Airports serving turbine-powered (jet) aircraft – 10,000 feet 3. Protection of approach, departure and circling airspace – 5 statute miles		
Executive Order 11988 40 CFR 6.302(b) and App. A			Federal agencies should avoid, to the maximum extent possible, any adverse impacts associated with direct and indirect development of a floodplain. 40 C.F.R. Part 6 describes EPA's policy on implementing Executive Orders 11988 (Floodplain Management). The procedures substantively require that EPA conduct its activities to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupation or modification of floodplains.	Potential TBC	This requirement may be a TBC for any remedial action for the Buffer Zone/Crossroad Property. Mitigative measures would be taken to minimize any adverse impacts.
Governor's Executive Order 82-19			Potential effects of actions taken in a floodplain should be evaluated to avoid adverse impacts.	Potential TBC	This requirement may be a TBC for any remedial action for the Buffer Zone/Crossroad Property. Mitigative measures would be taken to minimize any adverse impacts.

3-1 OSWER Directives and Other Guidance Documents Identified as TBCs

Citation	Chemical	Medium	Requirement	Preliminary Determination	Remarks
Closure and Post-Closure Plan Laidlaw Waste Systems (Bridgeton), Inc. Sanitary Landfill, December 1996, Revised September 1997, Revised April 1998, Revised April 2016			Sets out closure and post-closure procedures for the West Lake Landfill, in particular, the final cover, grading and vegetation plan.	Potential TBC	Sets out the procedures to be used at the Landfill to comply with the MDNR Solid Waste Regulations. This document should be considered in the design and construction of any cover system or drainage improvements that may be constructed for Areas 1 and 2 or if additional waste materials are placed in these areas as part of a remedial action. This document will also need to be considered if any regrading and/or landfill cover improvements are implemented for Areas 1 or 2.

Table 3-2: Preliminary Identification of Potential Location-Specific ARARs

Location Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Landfills, land application sites, open dumps that have received hazardous or industrial wastes.	Establishes regulatory basis and substantive requirements for storm water discharges.	To ensure existing or proposed discharges are in compliance.	10 C.S.R 20-6.200 Storm Water Regulations	Potentially applicable. Substantive requirements are potentially applicable for control of storm water runoff during and after remedy construction.
Landfills, land application sites, open dumps that have received hazardous or industrial wastes.	Establishes regulatory basis and substantive requirements for site selection, planning and zoning.	To ensure that new landfills are sited properly.	10 C.S.R 80-2.015, 10 C.S.R 80-2.020(2)(A)2.E, and 10 C.S.R 80-3.010(4)(A) Landfill Regulations	Potentially applicable. Substantive requirements are potentially applicable for control of storm water runoff during and after remedy construction.
Fee Fee Creek Watershed	Effluent Limitations for Metropolitan No-Discharge Streams. Discharge is prohibited except as specifically permitted under the Water Quality Standards 10 C.S.R 20-7031(7).	To ensure existing or proposed discharges are in compliance.	10 C.S.R 20-7.015(5) (A) Discharge to metropolitan no-discharge streams is prohibited, except as specifically permitted under the Water Quality Standards 10 C.S.R 20-7.031 and noncontaminated storm water flows.	These standards are potentially applicable if water pollutants are present in any water discharge.
Waters of the State of Missouri	Protection of designated uses.	To ensure existing or proposed discharges are in compliance.	10 C.S.R 20-7.031(2)(A)-(C) (2) Designation of Uses. (A) Rebuttable presumption. (B) Presumed Uses. All waters described in subsection (2)(A) shall also be assigned Livestock and wildlife protection and Irrigation designated uses, as defined in this rule. (C) Other Uses	These standards are potentially applicable if water pollutants are present in any water discharge.
Waters of the State of Missouri	Waters of the state are subject to applicable Anti-Degradation Tiers 1 & 2.	To ensure existing or proposed discharges are in compliance.	10 C.S.R 20-7.031(3) The antidegradation policy shall provide three (3) levels of protection.	These standards are potentially applicable if water pollutants are present in any water discharge.
Waters of the State of Missouri	General criteria are applicable to all waters of the state at all times, including mixing zones.	To ensure existing or proposed discharges are in compliance.	10 C.S.R 20-7.031(4) The following water quality criteria shall be applicable to all waters of the state at all times including mixing zones.	These standards are potentially applicable if water pollutants are present in any water discharge.

Table 3-2: Preliminary Identification of Potential Location-Specific ARARs

Location Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Mixing Zones	Where mixing zones are applicable, they will be based on 7Q10 low flow.	To ensure existing or proposed discharges are in compliance.	10 C.S.R 20-7.031(5)(A) Specific Criteria. The specific criteria shall apply to waters contained in Tables G and H of this rule and the Missouri Use Designation Dataset. Protection of drinking water supply is limited to surface waters designated for raw drinking water supply and aquifers. Protection of whole body contact recreation is limited to waters designated for that use. (A) The maximum chronic toxicity criteria in Tables A and B shall apply to waters designated for the indicated uses given in the Missouri Use Designation Dataset and Tables G and H.	These standards are potentially applicable if water pollutants are present in any water discharge. The immediate receiving stream is not classified for mixing zone to apply.
Surface of Landfills	Runoff Control	Minimize infiltration and erosion	10 C.S.R 80-3.010(8)(B)(1)(F) and (8)(C) Design and Operation (8) Water Quality. (B) Satisfactory Compliance-Design. F. Provisions for surface water runoff control to minimize infiltration and erosion of cover.	These requirements are not applicable as they only apply to landfills in operation after 10-9-91. Substantive portions of 10 C.S.R 80-3.010(8)(B)(1)(F) and 10 C.S.R 80-3.010(8)(C) are potentially Relevant and Appropriate under Action Specific. Runoff control to minimize infiltration and erosion is standard practice. Regarding (8)(C), while not operations, minimization of surface water contact with waste and surface water diversion from open waste if waste is exposed during remedy implementation should be performed.
Surface of Landfills	Siting - Integrity of structural components and landfill operational characteristics	Location specific prohibitions of landfills	10 C.S.R 80-3.010(4)(B)3.A 10 C.S.R 80-3.010(4)(B)4,6,7,8, 10 C.S.R 80-3.010(5)(B)1(4)(B)(3) (4)(B)(2) landfills located in one hundred (100)-year floodplains shall demonstrate to the department that the sanitary landfill will not restrict the flow of the one hundred (100)-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to public health or the environment. (4)(B)(3) A sanitary landfill shall not be located in wetlands.	Potentially applicable for the on site cell alternative. These requirements would be relevant and appropriate to regrading of Areas 1 and 2 after removal of radiologically-impacted material under the full and partial excavation alternatives.

Table 3-2: Preliminary Identification of Potential Location-Specific ARARs

Location Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
			(4)(B)(4) Sanitary landfills located in the seismic impact zone shall not be located within two hundred feet (200') of a fault that has had displacement in Holocene time. (4)(B)(6) Sanitary landfill's design ensures that the integrity of the structural components of the sanitary landfill will not be disrupted. (4)(B)(7)(D)(IV) The area extent and depth of soil suitable for landfill construction shall be determined. Variations in soil depth shall be clearly described. (4)(B)(8) If the base of the landfill liner will be in contact with groundwater, the applicant shall demonstrate to the department's satisfaction that the groundwater will not adversely impact the liner. (5)(B)(1) maintenance of a one hundred foot (100')- buffer zone between the outer edge of the landfill liner and any property line(s) or any right-of-way(s) of adjoining road(s) when the property line(s) is inside the right-of-way(s) to provide room for assessment and/or remedial actions.	
Landfill	Vector Control	Exposed waste	10 C.S.R 80-3.010(15) Vectors. (A) Requirements. Conditions shall be maintained that are unfavorable for the harboring, feeding and breeding of vectors.	These requirements would be relevant and appropriate to regrading of Areas 1 and 2 after removal of radiologically-impacted material under the modified ROD selected remedy, and for excavation and regrading activities for the full and partial excavation alternatives. Potentially applicable for the on site cell alternative.
Landfill	Aesthetics	Exposed waste	10 C.S.R 80-3.010(16) Aesthetics. (A) Requirement. The sanitary landfill shall be designed and operated at all times in an aesthetically acceptable manner. (B) Satisfactory Compliance	These requirements would be relevant and appropriate to regrading of Areas 1 and 2 after removal of radiologically-impacted material under the modified ROD selected remedy, and for excavation and regrading activities for the full and partial excavation

Table 3-2: Preliminary Identification of Potential Location-Specific ARARs

Location Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
				alternatives. Potentially applicable for the on site cell alternative
All work areas	Safety	Designed, constructed to address airport safety and protect health and safety of personnel.	10 C.S.R 80-3.010(4)(B) 1.A and 1.B., 10 C.S.R 80-3.010(19) (4)(B)(1)(A) Requires new or existing municipal solid waste landfills or lateral expansions that are located within 10,000 feet of any airport runway end used by turbojet aircraft to demonstrate that the units are designed and operated so that the municipal solid waste landfill unit does not pose a bird hazard to aircraft. (4)(B)(1)(B) Owners/operators proposing to site new sanitary landfills and horizontal expansions of existing sanitary landfills within a five (5)-mile radius of any airport runway end used by turbojet aircraft or piston-type aircraft shall notify the affected airport and the Federal Aviation Administration (FAA). (19) Safety. (A) Requirement. The sanitary landfill shall be designed, constructed and operated in a manner so as to protect the health and safety of personnel and others associated with and affected by the operation. The design, construction and operation of the sanitary landfill shall minimize environmental hazards and shall conform to applicable ambient air quality and source control regulations.	These requirements would be relevant and appropriate to regrading of Areas 1 and 2 after removal of radiologically-impacted material under the modified ROD selected remedy, and for excavation and regrading activities for the full and partial excavation alternatives. Potentially applicable for the on site cell alternative if located within 10,000 feet of the Lambert airport runway.
Landfill	Air Quality		10 C.S.R 80-3.010(13) The design, construction and operation of the sanitary landfill shall minimize environmental hazards and shall conform to applicable ambient air quality and source control regulations.	These requirements would be relevant and appropriate to excavation and grading activities in Areas 1 and 2.

Table 3-2: Preliminary Identification of Potential Location-Specific ARARs

Location Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Side slope of landfill and disturbed areas	QA/QC	Part of landfill cover	10 C.S.R 80-3.010(6)(A) Requirement. The construction, operation and closure of the sanitary landfill shall include quality assurance and quality control measures to ensure compliance with approved plans and all applicable federal, state and local requirements. The permittee shall be responsible for ensuring that the quality assurance/quality control supervision is conducted by a qualified professional. (B) Satisfactory Compliance - Design	These requirements are not applicable as they only apply to landfills in operation after 10-9-91; however, substantive portions as related to closure/final cover and to ensure compliance with ARARs are potentially Relevant and Appropriate under Action Specific. The design and associated QA/QC requirements will be detailed in CERCLA documents and approved as part of the CERCLA process.
Landfill	Cover	Minimize fire hazard, infiltration, odors, blowing litter, gas venting, vectors, discourage scavenging, appearance	10 C.S.R 80-3.010(17)(A): Requirement. Cover shall be applied to minimize fire hazards, infiltration of precipitation, odors and blowing litter; control gas venting and vectors; discourage scavenging; (B) Satisfactory Compliance Design. The owner/operator shall prepare a written closure plan that describes the steps necessary to close all sanitary landfill phases at any point during the active life of the sanitary landfill in accordance with the requirements of 10 C.S.R 80-2.030(4)(A). In addition, includes specifications for the final cover requirements.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.
Landfill	Compaction	If existing cap is disturbed	10 C.S.R 80-3.010(18)(A) Requirement. In order to conserve sanitary landfill site capacity, thereby preserving land resources and to minimize moisture infiltration and settlement, solid waste and cover shall be compacted to the smallest practicable volume. (B) Satisfactory Compliance Design. (C) Satisfactory Compliance Operations.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.

Table 3-2: Preliminary Identification of Potential Location-Specific ARARs

Location Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Landfill	Local Planning and Zoning	Approval from local authorities	10 C.S.R 80-2.020(2)(A)2.E (1) General Requirements. (A) Any disposal or processing of solid waste shall comply with the permitting requirements of this rule unless specifically exempted under section (9) of this rule. (B) All solid waste disposal areas and solid waste processing facilities shall be located, designed and operated in conformity with the rules in 10 C.S.R 80, as authorized by section 260.225.1(3), RSMo	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action. The design and associated QA/QC requirements will be detailed in CERCLA documents and approved as part of the CERCLA process. No permit is required for on-site CERCLA activities. Appropriate coordination with local officials will be conducted.
Landfill	Site Selection	Geologic, hydrologic and soil conditions	10 C.S.R 80-3.010(4)(A) In order to conserve sanitary landfill site capacity, thereby preserving land resources and to minimize moisture infiltration and settlement, solid waste and cover shall be compacted to the smallest practicable volume.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.
Landfill	Site characteristics	Design criteria for new landfills	10 C.S.R 80-3.010(5)(B)1, (5)(B)3, and (5)(B)4.A (5)(B)1 maintenance of a one hundred foot (100')- buffer zone between the outer edge of the landfill liner and any property line(s) or any right-of-way(s) of adjoining road(s) when the property line(s) is inside the right-of-way(s) to provide room for assessment and/or remedial actions. (5)(B)3 Owners/operators of sanitary landfills shall demonstrate how adverse geologic and hydrologic conditions may be altered or compensated for via surface water drainage diversion, underdrains, sumps, and other structural components. (5)(B)4A Settlement and bearing capacity analysis shall be performed on the in-place foundation material beneath the disposal area. The effect of foundation material settlement on the air and leachate collection system shall be evaluated.	Potentially applicable for the on site cell alternative.

Table 3-2: Preliminary Identification of Potential Location-Specific ARARs

Additional Potential Location-Specific ARARs and TBC Criteria

Citation	Location	Requirement	Preliminary Determination	Remarks
Archeological and Historic Preservation Act (54 USC 312508; PL 113-287; 128 Stat. 3256)	Land	Data recovery and preservation activities should be conducted if prehistoric, historical, and archaeological data might be destroyed as a result of a federal, federally assisted, or federally licensed activity or program.	Potentially applicable	No destruction of such data is expected to result from remedial action. The Site has been considerably disturbed by past human activities and is therefore not expected to contain any such data. However, if these data were affected, *e.g.*, at any potential off-site borrow area, the requirement would be applicable.
Endangered Species Act, as amended (16 USC 1531-1544; 50 C.F.R. Part 17)	Any	Federal agencies should ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify any critical habitat.	Potentially applicable	No critical habitat has been identified in the affected area, and no adverse impacts to threatened or endangered species are expected to result from any remedial action. However, if such species were affected, the requirement would be applicable. An assessment of the potential for occurrences of threatened or endangered species was performed during the RI. No federal listed or proposed threatened and endangered species or their habitats were identified at or in the vicinity of the Site.
Missouri Wildlife Code (1989) (RSMo. 252.240; 3 CSR 10-4.111), Endangered Species	Any	Endangered species, i.e., those designated by the U.S. Department of the Interior and the Missouri Department of Conservation as threatened or endangered (see1978 Code, RSMo. 252.040), should not be pursued, taken, possessed, or killed.	Potentially applicable	No critical habitat has been identified in the affected area, and no adverse impacts to threatened or endangered species are expected to result from any remedial action. However, if such species were affected, the requirement would be applicable.
Clean Water Act, 33 U.S.C. § 1251, et seq. and associated regulations Clean Water Act (33 USC 1344); Disposal Sites Specifications (40 C.F.R. 230), Dredged or Fill Material Discharges (Section 404 Program); Definitions, Exempt Activities Not Requiring	Wetland	Regulates the discharge of pollutants into the waters of the United States. Dredge or fill material is not to be discharged into a wetland (as defined by the U.S. Army Corps of Engineers) without a permit.	Potentially applicable	This requirement could be applicable to any off-site borrow area if the location selected contains any wetlands or if the borrow activities could indirectly impact wetlands. No wetlands have been identified on-site. Effluent limitations under 33 U.S.C. § 1311 (Subpart C) are effectively covered by the Missouri state equivalents.

Table 3-2: Preliminary Identification of Potential Location-Specific ARARs

Citation	Location	Requirement	Preliminary Determination	Remarks
Permits (40 C.F.R. 232); State Program Regulations (40 C.F.R. 233); General Regulatory Policies (33 C.F.R. 320); Nationwide Permits (33 C.F.R. 330)				
Farmland Protection Policy Act (7 USC 4201 et seq.) Farmland Protection [7 C.F.R. 658; 40 C.F.R. 6.302(c)]	Farmland (prime, unique, or of state and local importance)	Federal agencies should take steps to ensure that federal actions do not cause U.S. farmland to be irreversibly converted to nonagricultural uses in cases in which other national interests do not override the importance of the protection of farmland or otherwise outweigh the benefits of maintaining farmland resources. Criteria developed by the U.S. Soil Conservation Service are to be used to identify and take into account the adverse effects of federal programs on farmland preservation. Federal agencies should consider alternative actions that could lessen adverse effects and should ensure that programs are compatible with state and local government and private programs and policies to protect farmland.	Potentially applicable	This requirement would be applicable for any potential soil borrow area off-site. Mitigative measures and restoration activities would also be conducted at any off-site borrow area, as appropriate, to minimize any adverse impacts to farmland.

Table 3-2: Preliminary Identification of Potential Location-Specific ARARs

Citation	Location	Requirement	Preliminary Determination	Remarks
Missouri Guidance for Conducting and Reporting Detailed Geologic and Hydrogeologic Investigations at a Proposed Solid-Waste Disposal Area 10 C.S.R. 80-2.015 Appendix 1	Landfill site selection	Provides general procedures for characterization of potential solid waste landfill sites	Potentially applicable	Potentially applicable for the on-site disposal cell alternative.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 C.F.R. 192), Subpart A, Standards for the Control of Residual Radioactive Materials from Inactive Uranium Processing Sites 40 C.F.R. 192.02	Radioactive waste disposal		Control of residual radioactive materials at designated uranium processing or depository sites should be designed to be effective for at least 200 years and up to 1,000 years, to the extent reasonably achievable. In addition, the control should be designed such that releases of radon-222 from the residual radioactive material would not exceed an average rate of 20 pCi/m2-s or increase the annual average concentration in air outside the disposal site by more than 0.5 pCi/L. Because this standard applies to design, monitoring after disposal is not required to demonstrate compliance	Not applicable but potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site; therefore, this requirement would not be applicable. These regulations are applicable to uncontrolled areas, whereas the current and future uses of Areas 1 and 2 are restricted. As OU-1 does contain radiologically-impacted materials, these requirements may potentially be relevant. Since the wastes do contain radium and thorium the longevity standard is potentially relevant and appropriate. As the radiologically-impacted materials do emit radon, the radon standard is potentially relevant and appropriate. For the cap in place and partial excavation alternatives, radiologically-impacted materials will remain past the post-closure period for a solid waste landfill and longevity considerations should be factored into the cover design.
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings (40 C.F.R. 192), Subpart D, Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the U.S. Atomic Energy Act of 1954, as amended. 40 C.F.R. 192.32	Radioactive waste disposal		Disposal areas for uranium and thorium by-product materials should be designed to be effective for at least 200 years and up to 1,000 years, to the extent reasonably achievable. In addition, the control should be designed so that releases of radon-222 and radon-220 from these materials (*i.e.*, excluding the cover) would not exceed an average of 20 pCi/m2-s. The standard applies to design, so monitoring for radon after installation of an appropriately designed cover is not required. (This requirement does not apply to any portion of the Site that contains residual surface and subsurface concentrations of radium-226 and radium-228 at or below those identified in Subpart B which was described under potential chemical-specific ARARs and TBCs.)	Not applicable but potentially relevant and appropriate	The West Lake Landfill OU-1 Site is not a designated Title I uranium mill tailings site. Therefore, this requirement would not be applicable. These regulations are applicable to uncontrolled areas whereas the current and future uses of Areas 1 and 2 are restricted. As OU-1 does contain radiologically impacted materials, these requirements may potentially be relevant. The wastes contain radium. and thorium, therefore the longevity standard is potentially relevant and appropriate. As the radiologically impacted materials will remain on-site beyond the 30-year post-closure period for a solid waste landfill, the 200/1000 year period, this standard is considered to be potentially relevant and appropriate.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Resource Conservation and Recovery Act (RCRA) Subtitle C (40 C.F.R. 240 et seq.)	Hazardous waste management		Establishes standards for identification of and treatment, storage and disposal of hazardous wastes including hazardous wastes disposed in landfills. Standards for Identification of hazardous wastes (40 C.F.R. 261) Standards for Generators of hazardous wastes (40 C.F.R. 262) Standards for Transporters of hazardous wastes (40 C.F.R. 263) Use and Management of Containers (40 C.F.R. 264 Subpart I) Land Disposal Restrictions (40 C.F.R. 264 Subpart N) Staging Piles (40 C.F.R. 264.554) Specifically, must determine if solid waste is a hazardous waste using the following method: • Should first determine if waste is excluded from regulation under 40 C.F.R. 261.4; and • Must then determine if waste is listed as a hazardous waste under subpart D 40 C.F.R. part 261 or whether the waste is (characteristic waste) identified in subpart C of 40 C.F.R. part 261 by either: (1) Testing the waste according to the methods set forth in subpart C of 40 C.F.R. part 261, or according to an equivalent method approved by the Administrator under 40 C.F.R. §260.21; or (2) Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used. A generator may accumulate hazardous waste at the facility provided that	Possibly applicable in the event that hazardous wastes or materials that potentially could be hazardous wastes are encountered during remedy implementation	The radiologically-impacted materials in Areas 1 and 2 do not meet the criteria for classification as hazardous wastes; however, other waste materials in Areas 1 or 2 may meet these criteria and as such these requirements may be applicable.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
			(accumulation of RCRA hazardous waste on site as defined in 40 C.F.R. §260.10): • waste is placed in containers that comply with 40 C.F.R. 265.171–173; and • the date upon which accumulation begins is clearly marked and visible for inspection on each container; • container is marked with the words "hazardous waste"; or • container may be marked with other words that identify the contents if accumulation of 55 gal. or less of RCRA hazardous waste or one quart of acutely hazardous waste listed in §261.33(e) at or near any point of generation.		
Resource Conservation and Recovery Act (RCRA) Subtitle C 40 C.F.R. 264.301	Hazardous waste landfill design		Establishes standards for landfill design and operating requirements. 40 C.F.R. 264.301(a)(1) and (a)(2) describe the requirements for liner systems and leachate collection and removal systems. 40 C.F.R. 264.301(c)(2) though (c)(5) provides additional specific requirements for liner systems and leachate collection and removal system above and between such liners.	Potentially relevant and appropriate for the full excavation, on site disposal cell alternative	The radiologically-impacted materials in Areas 1 and 2 do not meet the criteria for classification as hazardous wastes; however, other waste materials in Areas 1 or 2 may meet these criteria and as such these requirements may be applicable. The RCRA Subtitle C and Missouri hazardous waste management regulations would apply to the design, construction, operation and closure of a new on-site engineered disposal cell in the event that hazardous wastes would be disposed in this cell. However, the evaluations of the remedial alternatives presented in the FFS are predicated on the presumption that any hazardous or mixed waste that may be encountered during implementation of any of the remedial alternatives would be transported offsite for treatment and/or disposal. Therefore, the hazardous waste regulations related to design, operation, closure or post-closure of a hazardous waste landfill are not expected to be applicable to any of the remedial alternatives being evaluated in this FFS. Although not applicable, the design criteria for a hazardous waste landfill, in particular those related to liner and cover system design and construction requirements, could be relevant and appropriate to the design of a new engineered on-site disposal cell

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
					included in the Full Excavation of RIM with On-Site Disposal Alternative.
Solid Waste Disposal Act, as amended (42 USC 6901 et seq.); Criteria for Municipal Solid Waste Landfills (40 C.F.R. 258), Subpart F, Closure and Post-Closure Care	Solid waste disposal		Criteria for closure of a landfill unit and post-closure care requirements are specified. Cover system design requirements at closure include (1) an infiltration layer constructed of a minimum of 18 in. of earthen material with a permeability less than or equal to the permeability of the bottom liner system or no greater than 1 x 10-5 cm/s, whichever is less, and (2) an erosion protection layer of earthen material capable of supporting native plant growth; or equivalents approved by the director of an approved state program. Post-closure care requires maintenance of the integrity of the final cover system, the leachate collection system, ground-water monitoring, and gas monitoring for a period of 10 years or as necessary to protect human health and the environment. Management of the leachate may be terminated if the owner/operator demonstrates that leachate no longer poses a threat to human health and the environment	Neither applicable nor relevant and appropriate	Neither applicable nor relevant and appropriate as solid waste landfills in Missouri are regulated by the Missouri solid waste regulations.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 C.S.R. 20-10.090), Disposal of Radioactive Wastes	Radioactive waste disposal		Radioactive waste material should not be disposed of by dumping or burial in soil, except at sites approved by and registered with the Missouri Department of Health; a permit should be obtained for holding and preparation of such material prior to disposal; and no releases to air or water should cause exposure of any person above the limits specified in 10-C.S.R. 20-10.040.	Potentially applicable to the full and partial excavation with off-site disposal alternatives	Certain of these requirements would be potentially applicable if one of the alternatives involving off-site disposal were to be implemented
Missouri Radiation Regulations; Protection Against Ionizing Radiation (19 C.S.R. 20-10.070), Storage of Radioactive Materials 19 C.S.R. 20-10.050(1) and (3) 19 C.S.R. 20-10.090	Radioactive waste Storage Personnel monitoring and radiation surveys Control of radioactive contamination		Radioactive materials should be stored in a manner that will not result in the exposure of any person, during routine access to a controlled area, in excess of the limits identified in 19 C.S.R. 20-10.040 (see related discussion for contaminant- specific requirements); a facility used to store materials that may emit radioactive gases or airborne particulate matter should be vented to ensure that the concentration of such substances in air does not constitute a radiation hazard; and provisions should be made to minimize hazards to emergency workers in the event of a fire, earthquake, flood, or windstorm.	Potentially applicable	These requirements would be applicable to the temporary storage of radiologically-impacted soils that might be generated during any remedial action.
Missouri Solid Waste Rules (10 C.S.R. 80), Chapter 4, Demolition Landfills, 4.010(17), Cover	Solid waste disposal		The landfill should be covered to minimize fire hazard, infiltration of precipitation, odors and blowing litter; control gas venting and vectors; discourage scavenging; and provide a pleasing appearance. Final slope of the top shall be a minimum of 5%. No slopes shall ever exceed 33 1/3 % and slopes shall not exceed 25% without a detailed slope stability analysis. The final cover should be at least 1 ft of compacted clay with a permeability of 1 x 10^{-5} cm/sec or less	Only applicable if Areas 1 or 2 are re-opened to accept additional solid wastes. Potentially relevant and appropriate for design of the final cover.	These requirements are applicable to landfills in operation after 10-9-91. These requirements would be applicable to regrading of Areas 1 and 2 after removal of radiologically-impacted material under the full and partial excavation alternatives. These regulations would also be applicable to the final slopes and cover design for Areas 1 and 2 under the ROD-selected remedy, full excavation, and partial excavation alternatives except that the slopes would be a minimum of 2% (see discussion in text).

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
			overlain by 2 ft of soil capable of supporting vegetative growth.		
Noise Control Act, as Amended; Noise Pollution and Abatement Act (42 USC 4901 et seq)	Construction activities		The public should be protected from noises that jeopardize human health or welfare.	Potentially applicable	These requirements would be applicable to any remedial action.
CERCLA Offsite Rule 40 C.F.R. 300.440	Off-site disposal		Wastes can only be disposed at offsite facilities operating in compliance with applicable regulations as verified by EPA.	Applicable to off-site disposal	These requirements would be applicable to the "complete rad removal" and partial excavation with off-site disposal alternatives.
DOT and NRC regulations for shipment of radioactive materials 49 C.F.R. Parts 171-180 and 10 C.F.R. Part 71	Off-site disposal		Specifies requirements for shipment of radioactive materials including hazard communications, labeling, manifests, security, emergency response, and planning.	Applicable to off-site disposal	These requirements would be applicable to the "complete rad removal" and partial excavation with off-site disposal alternatives.
Offsite disposal Waste Acceptance Criteria	Off-site disposal		Lists the types of materials and activity levels of waste materials that can be accepted by off-site disposal facilities.	Applicable to off-site disposal	These requirements would be applicable to the "complete rad removal" and partial excavation with off-site disposal alternatives.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
National Emissions Standards for Hazardous Air Pollutants - Asbestos 40 C.F.R. Part 61 40 C.F.R 61.150 40 C.F.R. § 61.154(j)	Asbestos management	Waste	Requirements for management of regulated asbestos containing materials (RACM). 40 C.F.R. 61.150(a) requires that there be no visible emissions to the outside air during collection, processing, packaging, or transporting of any asbestos containing waste material. 40 C.F.R. 61.150(b)(1) and (2) requires that all asbestos-containing waste material shall be deposited as soon as is practical by the waste generator at a waste disposal site operated in accordance with the provisions of § 61.154, or an EPA-approved site that converts RACM and asbestos-containing waste material into non asbestos (asbestos-free) material according to the provisions of § 61.155.	Potentially applicable if RACM are encountered during remedy implementation	Standards for demolition and renovation may be applicable in the event that RACM is encountered during remedy implementation. Notice requirements may become applicable in the event that it is determined that RACM is located within the relevant portions of the Site and that the remedy may involve the excavation or disturbance of said RACM.
National Ambient Air Quality Standards, 40 C.F.R. 50 40 C.F.R. §§ 50.3-50.19	Radionuclides Radon and Particulates	Air	Air quality standards	Potentially applicable	Potential standards for air emissions during remedy implementation. It should be noted that these primary and secondary standards reference the following: sulfur dioxide, PM10 (particulate matter), PM2.5 (particulate matter), Carbon Monoxide, Ozone, Oxides of Nitrogen, and Lead. They do not directly address radioactive materials, but may be relevant to the extent that there may be a need to control airbone particulates during the implementation of the ultimate remedy selected for the Site.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
PCB Spill Cleanup Policy 40 C.F.R. 761 Subparts D, G, N, O, P, R and S	PCB cleanup and management	Soil or waste	Requirements for cleanup of PCB wastes. In particular Subpart D regulates storage and disposal of PCB wastes and establishes requirements for handling, storage, and disposal of PCB-containing materials, including PCB remediation wastes, and sets performance standards for disposal technologies for materials/wastes with concentrations in excess of 50 milligrams per kilogram (mg/kg). Establishes decontamination standards for PCB contaminated debris. If additional testing identifies wastes at concentrations of 50 mg/kg PCBS, TSCA regulations may be applicable for managing excavated material for off-site disposal and listed here: 40 C.F.R. 761.1(b)(5), 40 C.F.R. 761.3, 40 C.F.R. 761.50(a) and (b)3, 40 C.F.R. 761.61(a)(5) and (b), 40 C.F.R. 761.65(c)(9)(i)-(iii), and 40 C.F.R. 761(c).	Potentially applicable if PCBs are encountered during remedy implementation	Sets out procedures for cleanup of PCB wastes.
Missouri Storm Water Regulations 10 C.S.R. 20-6.200		Stormwater	Requirements for control of stormwater runoff	Potentially applicable	Substantive requirements are potentially applicable for control of storm water runoff during and after remedy construction.
De Minimis Emissions Levels 10 C.S.R. 10-6.020(3)(A)	PM-10 Non-methane organic compounds (NMOC)		Air quality standards	Potentially applicable	Potential standards for air emissions during remedy implementation.
Sampling Methods for Air Pollution Sources 10 C.S.R. 10-6.030		Air	Stack emissions sampling procedures	Potentially applicable	Potentially applicable if a landfill gas flare is constructed and operated as part of the remedy.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
Controlling Emissions During Episodes of High Air Pollution Potential 10 C.S.R. 10-6.130		Air	Requirements for controlling emissions during air pollution events	Potentially applicable	Potentially could require shut down of remedy implementation construction operations during a purple or maroon air quality event.
Restriction of Particulate Matter to the Ambient Air Beyond the Premises of Origin 10 C.S.R.-6.170	Particulate Matter	Air	Requirements for controlling emissions	Potentially applicable	Potentially applicable to the control of fugitive dust emissions during remedy construction activities.
40 C.F.R. Part 122 (EPA Administered Permit Program - The National Pollutant Discharge Elimination System), Subpart C (Permit Conditions) 40 C.F.R. 122.26(b)(14)(v)	Various pollutants	Water/ Stormwater	The regulatory provisions contained in this part implement National Pollutant Discharge Elimination System (NPDES) Program under sections 318, 402, and 405 of the Clean Water Act (CWA) (Public Law 92-500, as amended, 33 U.S.C. 1251 *et seq.*) Stormwater permits are required for any landfill, land application sites and open dumps that receive or have received industrial waste, and said stormwaters impact waters of the United States. 40 C.F.R. 122.26(b)(14)(v). Certain conditions are applicable to permits and permit holders regulated pursuant to 40 C.F.R. 122.26, including compliance with the effluent standard under Section 307a of the Clean Water Act for toxic pollutants and with standard for sewage sludge.	Potentially applicable	At this time, it is uncertain whether stormwaters draining from the Site impact Waters of the United States. In any event, Missouri has an approved state program/delegated water program under 40 C.F.R. Part 123.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
40 C.F.R. Part 131 (Water Quality Standards) 40 C.F.R. § 131.36	Sets forth requirements and procedures for developing, reviewing, revising and approving water quality standards by the States as authorized by the Clean Water Act	Groundwater	40 C.F.R. Part 131 describes the requirements and procedures for developing, reviewing, revising, and approving water quality standards by the States as authorized by section 303(c) of the Clean Water Act. 40 C.F.R. Part 131 does not lay out specific standards to be applied, but rather serves as a framework by which States must develop water quality standards for water bodies, including uses that may be made of such bodies, and standards to promote the safety of water as used. It also provides for the process by which EPA reviews, revises and approves of water quality standards developed by States.	Not applicable, but potentially relevant to groundwater	It does not appear that these standards are applicable to Missouri. It should be noted that Missouri has adopted Water Quality Standards under 10 C.S.R. 20-7.031(5), which regulate concentrations of inorganics, trace metals, organics, pesticides, man-made volatiles, PAHs, phthalates and other chemicals.
42 U.S.C. 10171, Part D (Financial Arrangement for Low-Level Radioactive Waste Site Closure			This statute permits the Commission to establish by rule, regulation or order, that an adequate bond, surety or other financial arrangement be provided by a licensee to permit the completion of all requirements established by the Commission for the decontamination, decommissioning, site closure, and reclamation of sites, structures or equipment used in conjunction with such low-level radioactive waste.	Not applicable nor potentially relevant and appropriate	This statute does not contain any standard, requirement, criteria, or limitation that would apply directly to the Site but instead is a mechanism for NRC to require financial assurance for cleanup of NRC permitted facilities. Financial assurance is an administrative requirement and not a substantive requirement. Any financial assurance that may be required would be established by the Order or Consent Decree governing the remedial action.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
10 C.F.R. 61 Subpart D (NRC Low-Level Waste Regulations - Technical Requirements for Land Disposal Facilities) 10 C.F.R. 61.50(7) (Disposal site suitability requirements for land disposal) 10 C.F.R. 61.5(2) (Disposal site suitability requirements for land disposal)	Land/Environment/Disposal Cell		These regulations establish the procedures, criteria, and terms and conditions upon which the Commission issues licenses for land disposal of radioactive waste containing byproduct, source and special nuclear material. Subpart D describes the requirements for disposal site suitability, disposal site design, disposal site operation and closure, and environmental monitoring and waste classification. 61.50(7) provides that the disposal site must provide sufficient depth to the water table that groundwater intrusion, perennial or otherwise, into the waste will not occur. In no case will waste disposal be permitted in the zone of fluctuation of the water table. 61.52(2) provides that wastes designated as Class C pursuant to § 61.55, must be disposed of so that the top of the waste is a minimum of 5 meters below the top surface of the cover or must be disposed of with intruder barriers that are designed to protect against an inadvertent intrusion for a least 500 years.	Potentially relevant and appropriate.	The portions of the 10 C.F.R. Part 61 referenced here are not applicable, but may be potentially relevant to the design and operation/performance of a new on-site disposal cell. Because these regulations were not developed for waste materials such as residual radioactive materials which are regulated under 40 C.F.R. 192 and 10 C.F.R. 40 Appendix A, typically NRC's low level waste regulations would not be relevant and appropriate for sites with materials similar to uranium byproduct material. Concentrations of Radium-226 and Thorium-230 exceed what is typical for uranium mill tailings (300 – 1000 pCi/g) and, therefore, portions of the 10 C.F.R. Part 61 are potentially appropriate for the design, operation, or closure of an on-site disposal cell.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Citation	Action	Medium	Requirement	Preliminary Determination	Remarks
10 C.F.R. 40 Appendix A (Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings of Wastes Produced by the Extraction or Concentration of Source Material From Ores Processed Primarily for Their Source Material Content) Criterion 1 (Siting Objectives), Criterion 3 (preference for placement below grade), Criterion 4 (selected site and design criteria), Criterion 6 (waste cover design and effectiveness)	Land/Disposal Cell/Environment		This appendix establishes technical, financial, ownership, and long-term site surveillance criteria relating to the siting, operation, decontamination, decommissioning, and reclamation of mills and tailings or waste systems and sites at which such mills and systems are located. These regulations are applicable to uranium or thorium milling and disposition of tailings or wastes resulting from such milling activities at sites licensed by the NRC. Criterion 4(c) provides that embankment and cover slopes must be relatively flat after final stabilization to minimize erosion potential and to provide conservative factors of safety assuring long-term stability. The broad objective should be to contour final slopes to grades which are as close as possible to those which would be provided if tailings were disposed of below grade; this could, for example, lead to slopes of about 10 horizontal to 1 vertical (10h:1v) or less steep. In general, slopes should not be steeper than about 5h:1v. Where steeper slopes are proposed, reasons why a slope less steep than 5h:1v would be impracticable should be provided, and compensating factors and conditions which make such slopes acceptable should be identified.	Not applicable, but potentially relevant or appropriate.	The portions of the 10 C.F.R. Part 40, Appendix A referenced here are not applicable, but may be potentially relevant to the design and operation/performance of a new on-site disposal cell. Many of the standards established by these regulations are essentially the same as those set forth in the UMTRCA standards (40 C.F.R. 192), and therefore, compliance with the UMTRCA standards should result in compliance with these standards. However, criterion 4(c) provides a specific requirement for slopes relative to the design of a disposal cell and therefore is considered appropriated for the design of the on-site disposal cell.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Action Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Statements, Acts	Unlawful acts prohibited; false statements and negligent acts prohibited, penalties, exceptions	To ensure existing or proposed discharges are in compliance.	Missouri Clean Water Law, Missouri Revised statute Chapter 644, 641.076 644.006. This subchapter shall be known and may be cited as the "Missouri Clean Water Law". Unlawful acts prohibited--false statements and negligent acts prohibited--penalties--exception. 644.076. 1	Substantive elements of these chapters may be Relevant and Appropriate if implementing a remedial action that includes a discharge to water.
Disturbance of landfilled wastes	Cannot remove/disrupt/excavate from a discontinued landfill without receiving prior approval from the Department.	Disturbed existing landfill	10 C.S.R. 80-2.030(3) and 260.210.1 (2) RSMo. 80-2.030 Solid Waste Disposal Area Closure, Post-Closure Care and Corrective Action Plans and Procedures with Associated Financial Assurance Requirements. (3) No person may excavate, disrupt or remove any deposited material from any active or discontinued solid waste disposal area without having received prior approval from the department	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.
Removal of waste from sanitary landfill	Screening and removal of unapproved wastes	Disturbed existing landfill	10 C.S.R. 80-3.010(3)(B)2 Missouri Code of State Regulations > TITLE 10- DEPARTMENT OF NATURAL RESOURCES >DIVISION 80- SOLID WASTE MANAGEMENT > CHAPTER 3- SANITARY LANDFILL 80-3.010 Design and Operation (1) General Provisions	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.
Encountering whole waste tires	None allowed in landfill	If dug up, needs to be removed.	10 C.S.R. 80-3.010(3)(A)11 Waste tires as provided by 10 C.S.R. 80-8.020	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Action Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Sanitary Landfill construction	One hundred foot buffer zone	Provide room for assessment of remedial actions	10 C.S.R. 80-3.010(5)(B)1 Plans submitted as part of an application for a construction permit after the effective date of this rule shall provide for the maintenance of a one hundred foot (100')-buffer zone between the outer edge of the landfill liner and any property line(s) or any right-of-way(s) of adjoining road(s) when the property line(s) is inside the right-of-way(s) to provide room for assessment and/or remedial actions.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option.
Sanitary Landfill construction	Water quality; Detailed Site Investigation, projected use of water resources and groundwater elevation.	Protection of the state and local waterways	10 C.S.R. 80-3.010(8)(B)1.A -10 C.S.R. 80-3.010(8)(B)1.C 1. Plans shall include: A. A report on the detailed geologic and hydrologic investigation of the site as required by 10 CSR 80-2.015. B. Current and projected use of water resources in the potential zone of influence of the sanitary landfill; C. Groundwater elevation and proposed separation between the lowest point of the lowest cell and the predicted maximum water table elevation.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option.
Sanitary Landfill construction	Leachate collection system	Collect and remove leachate from landfill	10 C.S.R. 80-3.010(9)(A) leachate collection system shall be designed, constructed, maintained and operated to collect and remove leachate from the sanitary landfill.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option.
Sanitary Landfill construction	Less than one foot of leachate on liner	Prevent collapse under pressures	10 C.S.R. 80-3.010(9)(B)1.E Design and operate systems to maintain less than one foot (1') depth of leachate over the disposal area liner.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option.
Landfill	Soil classifications, permeability and parameters	Minimize migration of leachate from site	10 C.S.R. 80-3.010(10)(B)2.A – 2(E) Provides design standards for a composite liner.	Substantive elements of these chapters may be Applicable if

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Action Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
				implementing a remedial action to include an on-site cell option.
Sanitary Landfill construction	Groundwater monitoring program	Determine the impact of the landfill on the quality of groundwater	10 C.S.R. 80-3.010(11)(A) The owner/operator of a sanitary landfill shall implement a groundwater monitoring program capable of determining the sanitary landfill's impact on the quality of groundwater underlying the sanitary landfill.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.
Landfill	Liner System	Minimize migration of leachate from site	10 C.S.R. 80-3.010(10)(A) A liner shall be placed on all surfaces to minimize the migration of leachate from the sanitary landfill.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option.
Sanitary Landfill construction	Air quality controlled	Conform to ambient air standards	10 C.S.R. 80-3.010(13) The design, construction and operation of the sanitary landfill shall minimize environmental hazards and shall conform to applicable ambient air quality and source control regulations.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.
Sanitary Landfill construction	Gas generated shall be controlled	Protect the public's health and environment	10 C.S.R. 80-3.010(14)A Decomposition gases generated within the sanitary landfill shall be controlled on-site, as necessary, to avoid posing a hazard to the environment or to public health and the safety of occupants of adjacent property.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Action Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Sanitary Landfill construction	Decomposition of gas not allowed to migrate	Protect the public's health and environment	10 C.S.R. 80-3.010(14) (C)1 The gas monitoring specified in the plans shall be performed at gas monitoring wells. The monitoring program shall specify how buildings on the landfill property are to be monitored.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option.
Sanitary Landfill construction	Unfavorable conditions for vectors	Prevent harboring, feeding or breeding of vectors	10 C.S.R. 80-3.010(15)A Conditions shall be maintained that are unfavorable for the harboring, feeding and breeding of vectors.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.
Sanitary Landfill construction	Cover	Minimize fire hazards, vectors, infiltration of water, control gas, etc.	10 C.S.R. 80-3.010(17) Cover shall be applied to minimize fire hazards, infiltration of precipitation, odors and blowing litter; control gas venting and vectors; discourage scavenging.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.
Sanitary Landfill construction	Closure and post closure plans; Financial Assurance	Plans and maintenance of landfill when it closes	10 C.S.R. 80-3.010(20)(C) 1.I and J Describes the types of landfill records to be maintained.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option. EPA will typically require financial assurance in a Consent Decree to implement the remedy.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Action Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Release of Pollutants to Waters of the State	Unlawful to pollute waters of the state, reduce quality below water quality standards, violate pretreatment and toxic material control regulations, discharge radiological, chemical or biological gen or high-level radioactive wastes into waters of the state.	To protect water quality and ensure existing or proposed discharges do not degrade water quality beyond the bounds of the law.	644.051.1 It is unlawful for any person to cause pollution of any waters of the state or to place or cause or permit to be placed any water contaminant in a location where it is reasonably certain to cause pollution of any waters of the state.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.
Hazardous Waste landfill construction	Hazardous waste landfills constructed after October 31, 1980, shall have a leachate collection system. The rules and regulations of the commission shall treat and protect all aquifers to the same level of protection.	Statutory requirements for construction of hazardous waste landfills	260.395(17) RSMo All hazardous waste landfills constructed after October 31, 1980, shall have a leachate collection system. The rules and regulations of the commission shall treat and protect all aquifers to the same level of protection. The provisions of this subsection shall not apply to the disposal of tailings and slag resulting from mining, milling and primary smelting operations.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option for hazardous waste disposal.
Evaluation of Alternatives prior to Hazardous waste landfill construction	Before using a hazardous waste disposal facility permitted under sections 260.350 to 260.432, generators of hazardous waste must prove that they have investigated and reviewed alternatives to landfilling. The generator shall use, to the maximum extent feasible, the best demonstrated available technology for source reduction, recycling, treatment, stabilization, solidification or	Statutory requirements for construction of hazardous waste landfills	260.394 RSMo Disposal of untreated hazardous waste, prohibited, exceptions — alternative to landfilling, best demonstrated available technology. — 1. Nothing in this section shall apply to the storage or treatment of hazardous waste by a generator on-site or to the disposal on-site of smelter slag waste from the processing of materials into reclaimed metals if the smelter was in operation prior to August 13, 1988, nor preclude the transportation of hazardous waste out of state for treatment, storage or disposal. After August 13, 1988, no person shall dispose of untreated hazardous waste in a hazardous waste disposal facility permitted in the state of Missouri.	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option for hazardous waste disposal.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Action Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
	destruction,. In determining the best demonstrated available technology, the commission shall give consideration to the relative economic feasibility of the technology, including potential future costs of cleanup and environmental damage. Such technology shall render the hazardous waste sufficiently low in toxicity, reactivity and corrosivity as to present the least possible risk to human health and safety and to the environment in the event of a release from a hazardous waste disposal facility.		The provisions of this section shall not apply to abandoned or uncontrolled sites as listed under section 260.440, or sites listed in the national priority list pursuant to the federal Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (P.L. 96-510), as amended, unless otherwise determined by the department or required by the commission by rule.	
Construction of Earthen Basin	Ensure all engineering reports, plans, and specifications in accordance with state law for construction of earthen basins	To ensure existing or proposed discharges are in compliance.	10 C.S.R. 20-8.110 Reports, Plans, and Specifications	Administrative, but design elements will be included in CERCLA documents
Corrective Measures	Groundwater quality	Landfill location	10 C.S.R. 80-3.010(12)(C) Requirement related to the establishment and implementation of a corrective action groundwater monitoring program.	Not applicable to CERCLA sites, but may be relevant and appropriate if water pollutants are present in groundwater or any water discharge.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Action Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Structures on landfill	Not allowed without controls	Stability and gas	10 C.S.R. 80-3.010(4)(B)7.C(I) It is not recommended practice to construct major structures within the permitted area of a closed sanitary landfill. If major structures are to be built within the permitted area of a closed sanitary landfill, prior written approval from the department is required. A professional engineer shall approve their design and construction, including provision for protection against potential hazards of solid waste decomposition gases	Not applicable to CERCLA sites, but may be relevant and appropriate if structures are present or gas is generated at Areas 1 and 2 after removal of radiologically-impacted material under the full excavation and partial excavation alternatives.
Installation of observation or monitoring wells	Regulates drilling, construction, registration, and abandonment of monitoring wells in Missouri	Groundwater protection	10 C.S.R. 23-4 Monitoring Well Construction Code	Substantive portions of Division 23 may be relevant and appropriate if wells are constructed and/or abandoned as part of the remedy, but will mostly be administrative.
Practice of geology	Regulates practice	Health and safety	4 C.S.R. 145-1.010 Board of Geologist Registration	Substantive portions of 4 C.S.R. 145-1.010 may be relevant and appropriate if a PG stamp and seal on drawings are necessary as part of the remedy. Otherwise mostly administrative.
Abandonment of unused domestic supply wells	Regulates activity	Groundwater protection	10 C.S.R. 23-3.110 Plugging of Wells	Although abandonment of unused domestic supply wells are not envisioned in the ROD-selected remedy, could be Relevant and Appropriate if monitoring wells are required to be abandoned.
Pollution and vandalism	Relates to protection of caves (including sinkholes) and cave life	Groundwater protection	L. 1981 H.S.H.B. 1192, an Act This state law provides for protection of caves (including sinkholes) and cave life from vandalism and pollution.	The law may be applicable if site contains the presence of solution enlarged fractures during excavation. This act is an ARAR for all excavation scenarios.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Action Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Groundwater tracing	Registration and reporting of results to Missouri Geological Survey	Groundwater protection	L.1991 S.B.221, an Act RSMo 256.621 All persons engaged in groundwater or surface water tracing, for any purpose, shall register with the division. The registrant shall report in writing all proposed injections of tracers to the division prior to actual injection. Written and graphical documentation of traces shall be provided to the division within thirty days of completion of each trace. The division shall maintain records of all injections and traces reported and will provide this information to interested parties upon request at the cost of	If groundwater tracing is required, this might be considered and ARAR, but note that this activity is not envisioned in the ROD-selected or other remedy.
Open burning	Only untreated wood and lumber may be burned and a permit must be obtained	Air quality protection	10 C.S.R. 10-6.045 Open Burning Requirements	If open burning is required, this might be considered and ARAR, but note that this activity is not envisioned in the ROD-selected or other remedy.
Hazardous Waste Generation, storage, treatment, transportation and disposal	Follow all applicable state and federal hazardous waste laws and regulations	Health and safety	Hazardous Waste Management Law 260.350-260.1039 Hazardous Waste Regulations 10 C.S.R. 25-1 through 19 10 C.S.R. 25-19.010 Electronics Scrap Management	Substantive portions of Division 25 may be Relevant and Appropriate if hazardous waste is required to be managed under the selected remedial options.
Closure and Post-closure	Care and O&M	Long term protection	10 C.S.R. 80-2.030 Solid Waste Disposal Area Closure, Post-Closure Care and Corrective Action Plans and procedures with Associated Financial Assurance Requirement	Section 6.2.2.2.1 discusses that the “substantive MDNR landfill requirements for post-closure care and corrective action found in 10 C.S.R. 80-2.030 are also considered relevant and appropriate.

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Action Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
Closing sides of disturbed landfill	Obtain approval	Disturbed existing landfill	10 C.S.R. 80-2.030(1) To prevent a solid waste disposal area from being a blight on the land, a hazard to health and safety and air pollution problem or a source of pollution to any water course, the owner/operator of any solid waste disposal area shall obtain approval of the method of closure from the department prior to closure.	The substantive MDNR landfill requirements for post-closure care and corrective action found in 10 C.S.R. 80-2.030 are also considered relevant and appropriate.
Slope construction	Runoff without excessive erosion, stability	Cap protection	10 C.S.R. 80-3.010(17)(B)3,7,(C)3 Surface grades and side slopes needed to promote maximum runoff, without excessive erosion, to minimize infiltration. Final side slopes shall not exceed twenty-five percent (25%) unless it has been demonstrated in a detailed slope stability analysis approved by the department that the slopes can be constructed and maintained throughout the entire operational life and post-closure period of the landfill. (C)3. No active, intermediate or final slope shall exceed thirty-three and one-third percent (33 1/3%).	Substantive elements of these chapters may be Applicable if implementing a remedial action to include an on-site cell option and relevant and appropriate for all other alternatives except no action.
Precipitation on open side slopes	Treat as leachate	Contact with waste	10 C.S.R. 80-3.010(8)(C)(2) The quantity of water coming in contact with solid waste shall be minimized by the daily operational practices. Water which comes in contact with solid waste shall be managed as leachate in accordance with the approved plans.	May be Relevant and Appropriate during construction.
QA/QC of cover	Thickness and testing of each lift of soil	Prevent infiltration and promote vegetative growth	10 C.S.R. 80-3.010(6) Testing of each lift of the soil component of the final cover and landfill liner for field density and field moisture once per every ten thousand (10,000) square feet and providing relatively uniform coverage over the landfill surface.	May be Relevant and Appropriate during construction.
Corrective Action	Address contamination	Known contaminants	10 C.S.R. 80-3.010(12) Corrective Action	Not applicable to CERCLA sites, but may be relevant and appropriate if water pollutants are

Table 3-3: Preliminary Identification of Potential Action-Specific ARARs

Action Subject to Requirement	Requirement	Reason Why Requirement is an ARAR	Regulatory Citation	Discussion/Analysis
				present in groundwater or any water discharge.
Cover requirements	2 feet of clay, 1 foot vegetative soil, 1x10-5 permeability, if disturbed	Thickness	10 C.S.R. 80-3.010(17)(C)4 As each phase of the sanitary landfill is completed, a final cover system shall be installed at portions of A. Existing sanitary landfills without composite liners. This final cover shall consist of at least two feet (2') of compacted clay with a coefficient of permeability of 1 × 10-5 cm/sec or less and overlaid by at least one foot (1') of soil capable of sustaining vegetative growth; B. Sanitary landfills with composite liners. This final cover shall consist of component layers, in order from top to bottom, as follows: (I) Two feet (2') of soil capable of sustaining vegetative growth; (II) A drainage layer; (III) A geomembrane liner at least as thick as the geomembrane liner described in subparagraph (10)(B)1.G; (IV) One foot (1') of compacted clay with a coefficient of permeability of 1 × 10-5 cm/sec or less; and C. The geomembrane liner shall be in intimate contact with the underlying compacted clay. 5. The installation of the final cover systems.	Substantive elements of these chapters may be Applicable for the full excavation alternatives.

Prepared for:
U.S. Environmental Protection Agency
Region 7
11201 Renner Boulevard
Kansas City, Kansas 66219

Evaluation of Possible Impacts of a Potential Subsurface Smoldering Event on the RIM Releases For Operable Unit-1 at the West Lake Landfill

February 2, 2018

Prepared For
USEPA Region VII

EPA Contract No.: EP-S7-05-06
EPA Task Order No.: 137
BVSPC Project No.: 044811

Prepared by:
Black & Veatch Special Projects Corp.
6601 College Blvd.
Overland Park, Kansas 66211

Contents

1.0 Introduction 1
2.0 Potential for an SSE to Occur in OU-1 3
2.1 Potential for SSE from South Quarry to Expand to OU-1 3
2.1 Potential of an SSE Occurring in OU-1 3
3.0 Identification of Potential Impacts of an SSE on OU-1 5
4.0 Evaluation of Potential Impacts from Particulate Generation During an SSE 6
4.1 Particulate Generation 6
4.2 Particulate Generation from Cracks 6
4.2.1 Desiccation 6
4.2.2 Subsidence 8
4.3 Particulate Generation from Gas Collection Systems 8
4.4 Particulate Generation from the Installation of Additional Infrastructure 8
5.0 Evaluation of Potential Impacts from Leachate Generation During an SSE 9
5.1 Subsidence 9
5.1.1 Reduced Cap Drainage 9
5.1.2 Cap Degradation 9
5.2 Increased Concentration of Leachate 9
5.3 Increased Mass Permeability 10
5.4 Increased Leachate Volume Due to Water Condensing Out to Free Water 10
6.0 References 11

Figures

Figure 1 – West Lake Landfill Site Arrangement (Ref 1) 13
Figure 2 - Heat Extraction Barrier System Arrangement Bridgeton Landfill (Ref 4) 14
Figure 3 – Subsurface Smoldering Event Front at Bridgeton Landfill July August 2017 (Ref 4) 15
Figure 4 – Landfill Property Ownership (Ref 9) 16
Figure 5 - Vertical Temperature Profile through Subsurface Smoldering Event in South Quarry (Ref 7) 17
Figure 6 - Depth to RIM Material OU-1 Area 2 – West lake Landfill (Ref 2) 18
Figure 7 - Cross-section OU-1 (Area 1) and OU-2 (Ref 2) 19
Figure 8 - Surface Cracks from Subsidence Settlement at Bridgeton Landfill, OU-2 (Ref 7) 20

1.0 Introduction

The West Lake Landfill is a 200-acre, closed solid waste disposal facility consisting of demolition debris, industrial solid waste and municipal solid waste that operated from approximately the 1940s through 2004. Operable Unit -1 (OU-1) Areas 1 and 2 are two portions of this facility where radionuclide containing materials were mixed with soil to provide daily or intermediate cover over the waste deposited during operations of OU-1. Operable Unit -2 (OU-2), the remainder of the site are not impacted by placement of radiologically-impacted materials (RIM). The layout of the West Lake Landfill is provided in Figure 1 (Ref 1).

In December 2010, changes in the discharges from the gas extraction system, elevated temperatures, and increased carbon monoxide levels were identified in the South Quarry portion of OU-2 (Ref 1 and Ref 2) which is the Bridgeton Landfill consisting of the former active sanitary landfill "North Quarry Pit" and "South Quarry Pit" shown in Figure 1. Continued investigation identified the presence of an exothermic subsurface smoldering event (SSE) in the South Quarry portion of OU-2. Several measures have been implemented to monitor the progression of the SSE and to reduce the potential for expansion of the SSE into the North Quarry. Specific monitoring and SSE reduction measures have included (Ref 3 and Ref 4):

- Installation of a system of temperature monitoring probes (TMP) in the North and South Quarries.
- Installation of gas interceptor wells/heat extraction points (GIW).
- Installation of a heat extraction barrier system (HEB) and heat extraction wells (HEW) located at the neck between the North and South Quarries.
- Implementation of a monitoring program of the discharges from the gas extraction wells (GEWs), and the temperature readings from the TMPs, GIW, and HEB.
- Monitoring of the subsidence of the landfill surface in the area of the SSE.

As part of the Final Feasibility Study (FFS) (Ref 2), the Respondents to OU-1 have prepared and issued an evaluation of the potential for radon vapor release from an SSE (Appendix E of the FFS [Ref 5]). The United States Environmental Protection Agency (EPA) requested that Black & Veatch Special Projects Corp. (BVSPC) perform an evaluation to provide a qualitative evaluation of other considerations that may have potential impact on RIM releases as part of a future remedy (including the remedy's implementation) if an SSE were to occur at the West Lake Landfill OU-1, in particular EPA's comments (Ref 6) 3, 4, and 5 on Appendix E of the FFS (Ref 5). The evaluation requested by EPA includes a qualitative assessment of impacts from particulate and leachate that may be generated as a result of the SSE, in addition to any related impacts to the landfill that may not be pyrolytic in nature (i.e., increased pressures from gas and liquids, and differential settlement). The intent of this evaluation is to provide additional information on impacts from a potential SSE for consideration as part of the evaluation of Remedial Alternatives in the FFS.

The evaluation provided in this report addressed the following points:

1. Potential for an SSE to occur in OU-1:
   - Potential for the SSE from South Quarry to expand into OU-1.
   - Potential for an SSE to occur within OU-1.

2. Evaluation of potential impacts from particulate generation during an SSE including:
   - Particulate generation from cracks.
   - Particulate generation from gas collection systems.
   - Particulate generation from the installation of additional infrastructure [wells, monitoring points, other landfill penetrations].
   - Landfill release mechanisms from cracking due to:
     - Desiccation.
     - Subsidence.
     - Gas pressure/steam.
   - Impacts on releases from RIM.
3. Evaluation of potential impacts from leachate generation during an SSE including:
   - Subsidence.
     - Reduced cap drainage.
     - Cap degradation.
   - Increased concentration of leachate.
   - Increased mass permeability.
   - Increased leachate volume due to water condensing out to free water.
   - Impacts on releases from RIM.

2.0 Potential for an SSE to Occur in OU-1

2.1 Potential for SSE from South Quarry to Expand to OU-1

Bridgeton Landfill, LLC, is required to provide monthly reports on the readings from the HEB, TMP, and GIW to identify the progression of the SSE. The results of the monitoring are provided in the *Year 1 Heat Extraction Barrier Performance Report, Bridgeton Landfill, Bridgeton, St Louis, Missouri*, prepared for Bridgeton Landfill, LLC (Ref 4). Figure 2 provides a layout of the HEB and associated monitoring system.

The elevation of the surface of the SSE critical temperature of 220 degrees Fahrenheit (deg F), as shown in Figure 5, is above an elevation 450 feet, which would be above the refuse base of Areas 1 and 2 which is approximately 430 feet (Ref 2). Based on elevations alone, if the SSE progressed from the South Quarry into the North Quarry area at the same elevation, there is a potential that the SSE could directly continue into Area 1 of OU-1. However, the likely hood of an SSE progressing into Area 2 is more remote, due to the presence of the of native material located between the OU-1 Area 1 and the OU-2 closed demolition and inactive sanitary landfills (see Figure 4, area designated by West Lake Quarry and Material Company) [Ref 9].

The monitoring of the SSE in the South Quarry has shown it has not progressed into the North Quarry. This is illustrated by Figure 3 which shows the progression of the interpreted SSE front, based on a temperature of 220 deg F and the extent of the subsidence above the SSE in the area of the neck between the North and South Quarries. Monitoring of the North Quarry TMPs also do not show a temperature rise indicative of an SSE. (Appendix C, Ref 4).

An evaluation of the performance and modeling of the HEB has been performed by P.J. Carey & Associates (Ref 4). The model compared the anticipated heat extraction to the actual heat extraction of the system and the temperatures anticipated in the neck between the North and South Quarries. Due to the variability in the conditions in the landfill mass, this modeling was calibrated to actual site performance. The model has been updated to adjust model predictions versus actual conditions measured in the field since operation began. Predications and heat flux are generally in conformance to site conditions.

Based on a combination of Site data and quantitative information, such as: temperature monitoring probe data collected at the Site, and HEB modelled results, it appears that the engineering controls installed in both the North and South Quarries of Bridgeton Landfill, such the ethyl vinyl alcohol (EVOH) cover and the HEB have operated as intended and the SSE has not moved into the North Quarry or subsequently into OU-1. However, continued operation of the HEB and continued monitoring of the Site will be required to verify the continued performance of the system.

2.1 Potential of an SSE Occurring in OU-1

The date of initiation of landfilling operation in OU-1 is uncertain. However, it is believed to have been initiated in the 1950s with some initial deposition of materials in the 1940s (Ref 2). Area 1 encompasses approximately 16.6 acres and Area 2 encompasses approximately 47.8 acres (Ref 2). Landfilling in these areas ceased in the 1970s. Figure 7 provides a cross-section through OU-2 (specifically the Bridgeton landfill) and Area 1 of OU-1.

Based on review of these figures, the landfill at OU-1 is 30-40 feet thick in OU-1 Area 2 and approximately 100 feet thick in OU-1 Area 1. This is considerably thinner than OU-2 which is over 250 feet in thickness and therefore providing additional insolation of the heat generated within the landfill and preventing dissipation of the heat generated from the chemical reactions. Landfilling operations in OU-2 started in 1984 and ceased in 2004. The landfill in OU-1 ceased in the mid-1970s. It is estimated that the SSE started in OU-2 around 2010, approximately 6 years after operations ceased. The landfill in OU-1 is also considerably older than OU-2 and has experienced over 40 years of decomposition since operations ceased in OU-1.

There have been no indications of an SSE event occurring in either Areas 1 or 2 of OU-1. Decomposition of the organics in these landfill areas has been occurring for over 40-50 years. Typically, the rate of decomposition increases initially and then decreases with the age of the landfill. Therefore, it would reasonably be expected that the reactions that would have increased temperatures in the landfill in OU-1 would not be as active at this point in these landfill's history. The limited thickness of these landfills in OU-1 would also tend to dissipate heat. Waste materials contained within both Areas 1 and 2 of OU-1 are also considered to be unsaturated or largely un-saturated, unlike much of Bridgeton Landfill, with limited ability to gain additional moisture that could accelerate decomposition and help to retain heat within the waste mass. The conceptual cap designs included in the proposed remedial alternatives for these landfill areas at OU-1 would further decrease the potential for moisture increases to these landfill areas.

Based on this information, there are no current indications of subsurface conditions or site-specific data that would make spontaneous pyrolysis (i.e., chemical heating development), of an SSE within the OU-1 areas likely. Continued monitoring will be required to verify the subsurface conditions at the Site.

3.0 Identification of Potential Impacts of an SSE on OU-1

Although as discussed in Section 2, the potential of the SSE from OU-2 expanding into OU-1 or the potential of an SSE spontaneously occurring in OU-1 are not anticipated, the potential impacts if an SSE did occur at OU-1 are identified in this section and discussed further in Sections 4 and 5.

The occurrence of an SSE in OU-1 would have several impacts on the landfill mass including:

- Increased temperatures in the landfill mass. This would induce changes in leachate and gas generation.
- Changes in landfill gas generation quantity and composition. This could cause increased gas generation from combustion of the landfill mass and phase change of the liquids entrained in the waste.
- Changes in the gas composition. The increased temperature and combustion of the landfill mass would increase the gas temperature, carbon dioxide, carbon monoxide, hydrogen, and potentially volatile organics.
- Releases of odors from increase gas generation, pressures, and changes in composition.
- Changes in leachate composition and quantity. Similar to the gas generation, the combustion of the landfill mass would change the chemistry of the leachate generation; thereby potentially increasing leachate quantity due to evaporation and re-condensation of entrained liquids. This may lead to impacts on the underlying ground water system.
- Consumption of the waste mass, primarily organic materials, in the landfill mass leading to subsidence. This might also impact perimeter slope stability.
- Damage to landfill infrastructure installed or to be installed. This would include wells, monitoring systems, and liners (e.g., caps or underlying cell liner systems).

If these potential impacts from an SSE did occur, they might impact the Site due to as the generation of particulates and additional leachate generation originating from the waste and RIM material located in OU-1. These potential impacts could also impact the effectiveness of potential remedial actions for OU-1 (identified in the FFS [Ref 2]). The discussion in Sections 4 and 5 provides a qualitative evaluation of the issues associated with these potential impacts of an SSE.

4.0 Evaluation of Potential Impacts from Particulate Generation During an SSE

4.1 Particulate Generation

Based upon the Conceptual Site Model presented in Section 10 of the *Remedial Investigation Addendum* (Ref 9), the RIM at the West Lake Landfill Site originated from leached barium sulfate residues mixed with soil at the Latty Avenue Site (Ref 9). This RIM material was reportedly staged at various on-site locations at the West Lake Landfill Site and used as daily, intermediate, and final cover (Ref 9). Based on the use of this material from the Latty Avenue Site, as cover for waste materials during landfill operations, it would be expected that it became intermixed with layers of landfill waste materials. The intermixing of the cover layers and the waste material would likely have increased due to subsequent landfill operations and consolidation and subsidence of the waste mass. As illustrated, based on detailed past investigations, the RIM has been found to be interspersed within separate areas and intervals of the municipal solid waste (MSW) (Ref 9). Therefore, the RIM cannot be easily distinguished from the surrounding MSW, landfill cover, and native soil matrix within the Areas 1 and 2 of OU-1 which it has been found (Ref 9).

The melting point of the RIM material is reported to be greater than 1,300 deg F to 1,580 deg F (Ref 1). The temperatures encountered in the SSE at the site or in the literature, range from 250 deg F to 450 deg F (Refs 1 and 7). These temperatures would not melt or combust the RIM or soil materials, and therefore, an increase in particulates directly from the RIM material is considered unlikely. The increase in temperature would not impact the RIM in Areas 1 and 2 with respect to radionuclides other than radon. The temperatures expected during an SSE would likely combust most of the organic materials (i.e., MSW) in the landfill, decreasing the overall mass, and potentially generating soot and dust particulates.

The temperature increase would also cause additional expansion of the gas volume. This increased volume would increase the gas pressures in the landfill. An additional volume increase would also be caused by the phase change of the moisture in the soil to vapor/steam. This could increase the velocity of gas movement within the landfill mass. These increased volumes and gas velocity have the capacity to increase particulate generation and the rate of particulate transport.

There is uncertainty regarding the affinity of radium to organic materials (Ref 13); therefore, there is an unknown potential for radium to attach to particulates generated from the environment of an SSE.

4.2 Particulate Generation from Cracks

4.2.1 Desiccation

Cracks can form in the landfill mass due to desiccation of the material because the liquids entrained in the material would be volatized resulting in increased void space in the landfill mass from:

- Removal from water in the landfill voids.
- Drying and shrinkage of the solids, in particular organics or plastic soil materials.

Cracking would increase the porosity of the mass allowing for higher gas permeability and more rapid movement of generated landfill gas through the landfill to a point of release. Cracks extending to the surface could provide a direct pathway for release of the generated landfill gas. The extent and size of the cracks is a complex development process and their formation would depend on the extent of heating (whether by direct thermal transfer through the mass or the rise of heated gas), types of materials, material strength, and confining pressures. Internal desiccation cracks that do not propagate to the surface would provide increased porosity within the landfill mass to allow faster movement of gas through the subsurface within the landfill mass.

The development of a crack to the surface of OU-1, if a cap remedy were implemented, could be alleviated based on the capping system used. For example, if the cap system consists of soil materials with the barrier system consisting of clays with no geomembranes, shrinkage of the clay materials due to desiccation could lead to a crack propagating to the surface. However, with the use of a geosynthetic clay liner (GCL) would allow for some re-healing of these cracks with application of water from precipitation. Natural soil materials would not be expected to re-heal.

A cap that includes a geomembrane would not be susceptible to desiccation cracking. However, exposure to excessive temperatures (i.e., greater than operating limitations) would degrade the liner materials causing failure of the geomembrane material. Typical high density polyethylene (HDPE) membranes have an operating limitation of 140 deg F and specialty HDPE geomembranes can operate up to 212 deg F. The potential for temperatures in excess of these material operating temperatures could be possible based on the range of SSE temperatures reported in OU-2 (see Figure 5). The magnitude of the temperature increase and type of geomembrane material selected would determine the potential for liner failure.

The increased porosity of the landfill materials and potential development of a crack to the surface would provide a potential pathway for increased particulate escape from the landfill. , Also, cap systems that have a rock bio-intrusion layer overlying the clay/geomembrane layers, makes identifying the extent of cap damage difficult. Cracks forming below the rock barrier might not be expressed at the surface. The rock layer would allow gas generated in the landfill below this layer to expand laterally, making the source or crack location harder to identify. However, the likelihood of particulates containing RIM travelling through the rock barrier and reaching the surface is considered to be remote.

A radon flux analysis in Appendix E of the FFS provided an analysis of the impacts on radon gas emissions from a crack from a RIM deposit at a depth of 20 feet (Ref 5). In contrast, Figure 6 (Ref 2) indicates a substantial portion of the RIM materials in Area 2 of OU-1 is within approximately 5 feet of the present landfill surface. In the absence of regular control measures, the portions of Areas 1 and 2 containing near-surface RIM would be expected to have a greater potential for radioactive particulate releases than those portions containing RIM buried at a deeper level. It would be expected, however, that the areas of near-surface RIM would be maintained regularly during routine maintenance of the cap including fugitive dust control measures. Therefore, the potential for emissions of particulates containing RIM from surface cracks is anticipated to be more heavily dependent on the level of maintenance of the surface (e.g., periodic dust control [watering] and minimization of exposed surfaces) than on the depth of the buried RIM.

4.2.2 Subsidence

An SSE reduces the volume of the landfill mass by reduction in the organic water content and consumption of landfill material. This reduction in waste volume would lead to consolidation of the material and settlement of the landfill mass. Based on the distribution of the landfill materials consumed by an SSE and the propagation of an SSE, differential settlement of the landfill would be anticipated. Figure 8 shows an example of a crack caused by subsidence at the Bridgeton Landfill. The effects would be similar to the pathway formed by a desiccation crack and could increase the extent of a crack caused by desiccation.

In addition to the potential for cracking caused by subsidence, the reduction in landfill volume would result in an increased generation of gas as the waste mass consolidates and would expel the excess gas in the landfill mass as the volume of the mass reduces. As mentioned previously, the bio-intrusion barrier might mask cracking due to this material being non-cohesive and not being able to support a crack. As cracks develop, additional pathways are present that could allow release of gases. However, although landfill gas and MSW particulates may be released, based on our professional judgement, the added likelihood of radioactive particulates reaching the surface is considered remote.

4.3 Particulate Generation from Gas Collection Systems

A gas collection system has a potential to provide a pathway for collection and removal of particles containing RIM from the landfill. If a GEW system is implemented in OU-1 as part of a remedial action as presented in the FFS (Ref 2) without removal of RIM material (all or partial), the wells could provide a direct pathway to the surface. If a GEW penetrates into RIM material and an SSE increases the gas velocity and volume, the GEW could provide a preferential path for radon to escape the landfill. This preferential pathway would therefore by-pass the protection of potential releases provided by the cap system. This impact could be mitigated by verifying a GEW installation does not penetrate into a RIM deposit.

Another potential impact of an SSE on the gas collection system is its impact on the well construction materials. If the well materials cannot withstand the increased temperatures, or become plugged due to combustion by-products or additional moisture, the effectiveness of a gas collection system would be reduced. Also, soot/tar-like materials could accumulate on Gas Collection and Control Systems (GCCS) components (flame arrestors, knock-out pots, demister pads, well pumps, and small diameter hoses and lines) (Ref 1). This could lead to uncontrolled landfill gas releases due to plugging of the gas system and result in similar odor problems that have occurred at OU-2.

4.4 Particulate Generation from the Installation of Additional Infrastructure

Installation of infrastructure during the implementation of a remedy has the potential to bring RIM material to the surface. Specific activities which could also expose RIM materials include construction of TMP, GEW, or other penetrations of the landfill mass as well as grading of the surface. The impacts to particulate generation would be proportional to the amount of RIM material brought to the surface and the effectiveness of dust control procedures. The implementation of appropriate dust control procedures to prevent dust generation and prompt encapsulation of all drilling derived materials and covering of exposed waste areas would reduce the potential for particulate material containing RIM.

5.0 Evaluation of Potential Impacts from Leachate Generation During an SSE

5.1 Subsidence

As previously discussed, an SSE would result in subsidence of the surface of the landfill due to desiccation of the landfill materials and consumption of the waste mass within the SSE. The resulting settlement could result in two impacts that would increase leachate production:

- Disruption of surface drainage patterns.
- Damage to the infiltration cap, increasing the permeability of the cap.

5.1.1 Reduced Cap Drainage

Settlement of a cap (such as the conceptual cap designs included with some of the remedial alternatives in the FFS [Ref 2]) could cause disruptions to surface drainage features. This could lead to decreased run-off from the cap or ponding of rainfall on the cap. The infiltration barriers included in the conceptual cap designs would reduce the potential impacts of reduced drainage off the cap. However, increased infiltration if present, would likely increase the amount of leachate generated and could increase the potential for groundwater impacts below the landfill site due to increased leachate generation. The magnitude of this impact would depend on the area of the subsidence, the reduced effectiveness of the surface drainage features, and potential cap damage.

5.1.2 Cap Degradation

As discussed previously, subsidence combined with desiccation and damage to the landfill cap materials caused by an SSE could allow cracks to form in the cap allowing increased infiltration into the landfill. Increased infiltration would likely increase the amount of leachate generated and could increase potential groundwater impacts below the landfill site due to increased leachate generation. The magnitude of this impact would depend on the area of the subsidence and the extent of cap damage. If a cap remedy such as those included in some of the remedial alternatives in the FFS (Ref 2) was implemented, the rock barrier proposed at the surface might make it difficult to identify the extent of cap damage. In addition, cracks forming below the rock barrier might not be expressed or be visible at the surface. The rock layer would likely allow infiltration from the surface to more easily spread laterally to any cracks that form below this layer which may not be detected by surface cap monitoring.

5.2 Increased Concentration of Leachate

An SSE would change the characteristics of the leachate generated from the waste due to the thermal decomposition of the waste in the SSE. An SSE's impact on the leachate would likely result in higher levels of biological oxygen demand (BOD), chemical oxygen demand (COD), volatile organic compounds, and dissolved metals (Refs 1 and 8). These concentration changes have required significant upgrades in the leachate management and treatment system for OU-2 to handle increased "strength" of the leachate.

Under normal oxidizing conditions, the radium contained in the RIM is primarily bound in a barium sulfate matrix which is insoluble in water. An SSE, however, would generate a reduction-oxidation (i.e.,

redox) reaction that would, geochemical variables notwithstanding, increase the solubility of radium in water, resulting in the potential for increased radium and/or radon levels in groundwater and leachate (Ref 12).

Uranium is soluble under oxidizing conditions but considered insoluble under reducing conditions; therefore, the presence of an SSE in OU-1 would not be likely to increase the concentration of uranium in the leachate. Thorium is insoluble under both oxidizing and reducing conditions so, like uranium, would tend to remain in the waste matrix in the event of an SSE.

The increased leachate "strength" would likely directly impact the underlying groundwater below OU-1. If a remedy were implemented that did not include a base liner or leachate collection system, the increased leachate "strength" would also likely directly impact the underlying groundwater below OU-1.

5.3 Increased Mass Permeability

If an SSE were to occur in OU-1, the waste mass permeability would likely initially increase because of the reduction in mass volume due to thermal decomposition of the primarily organic portion of the waste and moisture reduction and desiccation of areas of organic waste or soils outside of the SSE. Consolidation of the waste and subsidence would then reduce the mass permeability over time. The initial increased permeability would increase the rate in which infiltration or internally generated water would pass or move through the landfill mass. However, the changes due to increased mass permeability from infiltration would not significantly impact total leachate quantity.

5.4 Increased Leachate Volume Due to Water Condensing Out to Free Water

A potential SSE and the heat front developed surrounding an SSE would volatize the moisture contained/bound in the organic material. This steam would re-condense in the cooler zones of the landfill, thus increasing liquid generation in the landfill and the quantity of leachate exiting the landfill. The increased leachate flow, coupled with the increased leachate concentrations, would likely directly impact the groundwater beneath the landfill as discussed in Section 5.2.

6.0 References

1. *Evaluation of Possible SSE Impacts, Impacts of a Potential Subsurface Smoldering Event of the Record of Decision – Selected Remedy for Operable Unit-1 at the West Lake Landfill*, prepared for West Lake OU-1 Respondents Group by Engineering Management Support, Inc., January 14, 2014.
2. *Final Feasibility Study West Lake Landfill Operable Unit 1*, prepared for West Lake OU-1 Respondents Group by Engineering Management Support, Inc., Revised Draft August 25, 2017.
3. Bridgeton Landfill 2016 Q3 Infrastructure Update, prepared by Feezor Engineering, October 27, 2016.
4. *Year 1 Heat Extraction Barrier Performance Report, Bridgeton Landfill, Bridgeton, St Louis, Missouri*, prepared for Bridgeton Landfill, LLC, by P.J. Carey and Associates and Feezor Engineering, Inc., October 11, 2017.
5. Appendix E of FFS Report: *Draft Supplemental Radon Flux Analysis for the Final Feasibility Study, West Lake Landfill Operable Unit 1*, prepared for Bridgeton Landfill, LLC, by Auxier & Associates, Inc., August 14, 2017.
6. Comment Letter on Appendix E: Supplemental Radon Flux Evaluation, August 25, 2017 and Appendix F: Cover Thickness Calculations, August 25, 2017, letter to Paul Rosasco, Engineering Management Support, Inc., from Christine Jump, EPA Region 7, Remedial Project Manager, dated October 26, 2017.
7. *Webinar Bridgeton Sanitary Landfill*, Missouri Department of Natural Resources (MDNR), June 17, 2013.
8. *Operation, Maintenance, and Monitoring Plan, Vol 3, Leachate Management Systems*, prepared for Bridgeton Landfill, LLC, by Civil and Environmental Consultants, Inc., September 2013.
9. *Remedial Investigation Addendum West Lake Landfill Operable Unit 1*, prepared for West Lake OU-1 Respondents Group by Engineering Management Support, Inc., Revised Draft, November 28, 2017.
10. Final Particulate Emission Analysis from Area South of Proposed Isolation Barrier – West Lake Landfill Superfund Site, prepared for Bridgeton Landfill, LLC, by Auxier & Associates, Inc., March 2016.
11. Observations on the EMSI Report: Evaluation of Possible Impacts of a Potential Subsurface Smoldering Event on the Record of Decision –Selected Remedy for Operable Unit-1 at West Lake Landfill, dated January 14, 2014, EPA Office of Research and Development (ORD), National Risk Management Research Laboratory Engineering Technical Support Center, March 28, 2014.
12. *Modeling of Radium-226 Leaching from Barium-Radium Sulfate Sludges*, Waste Management, Volume 9, Issue 3, 1989, Peter M. Huck, et al., March 13, 1989.
13. *The Environmental Transport of Radium and Plutonium: A Review*, Brice Smith and Alexandra Amonette, Institute for Energy and Environmental Research, June 23, 2006.

FIGURES

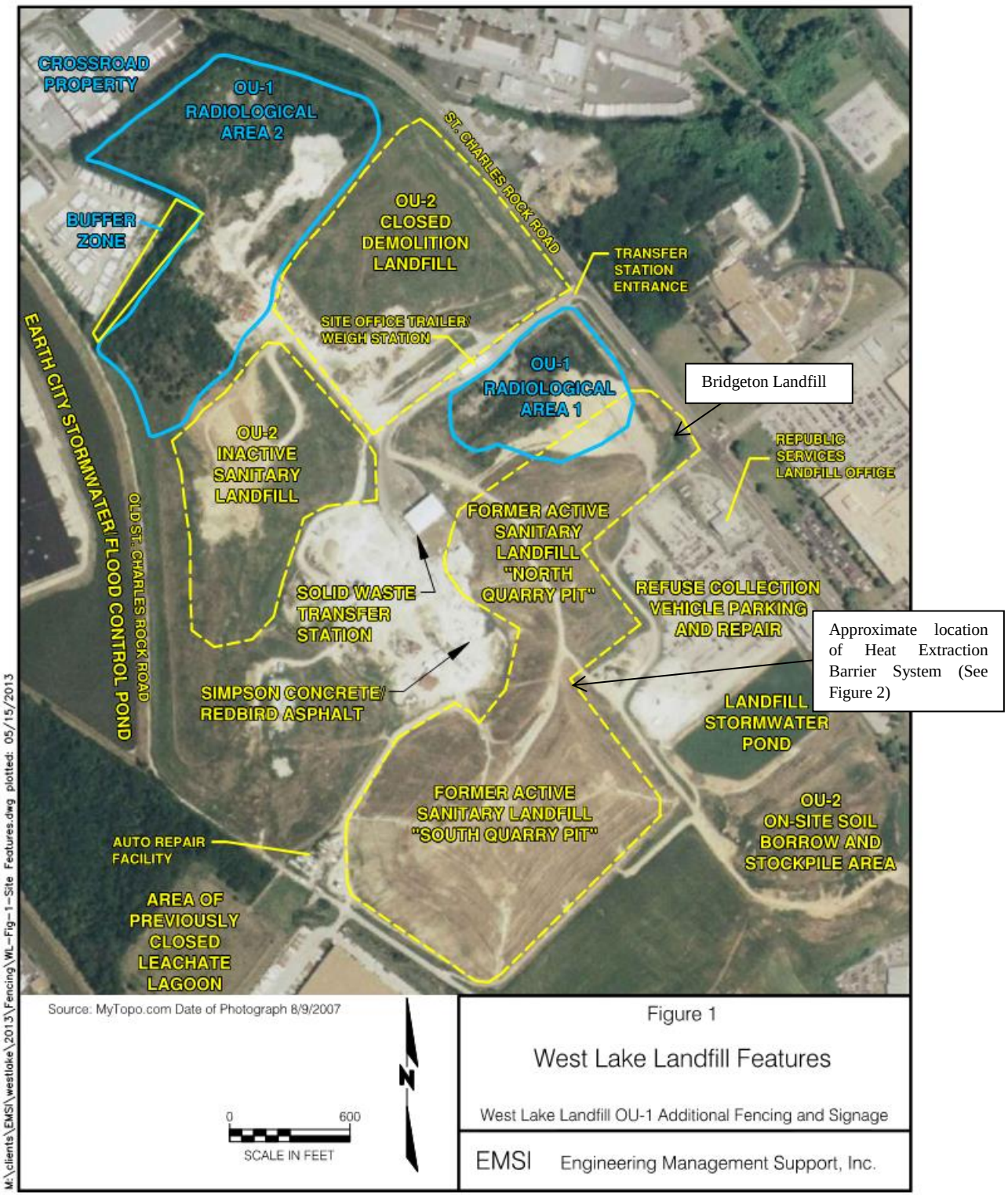


Figure 1 – West Lake Landfill Site Arrangement (Ref 1)

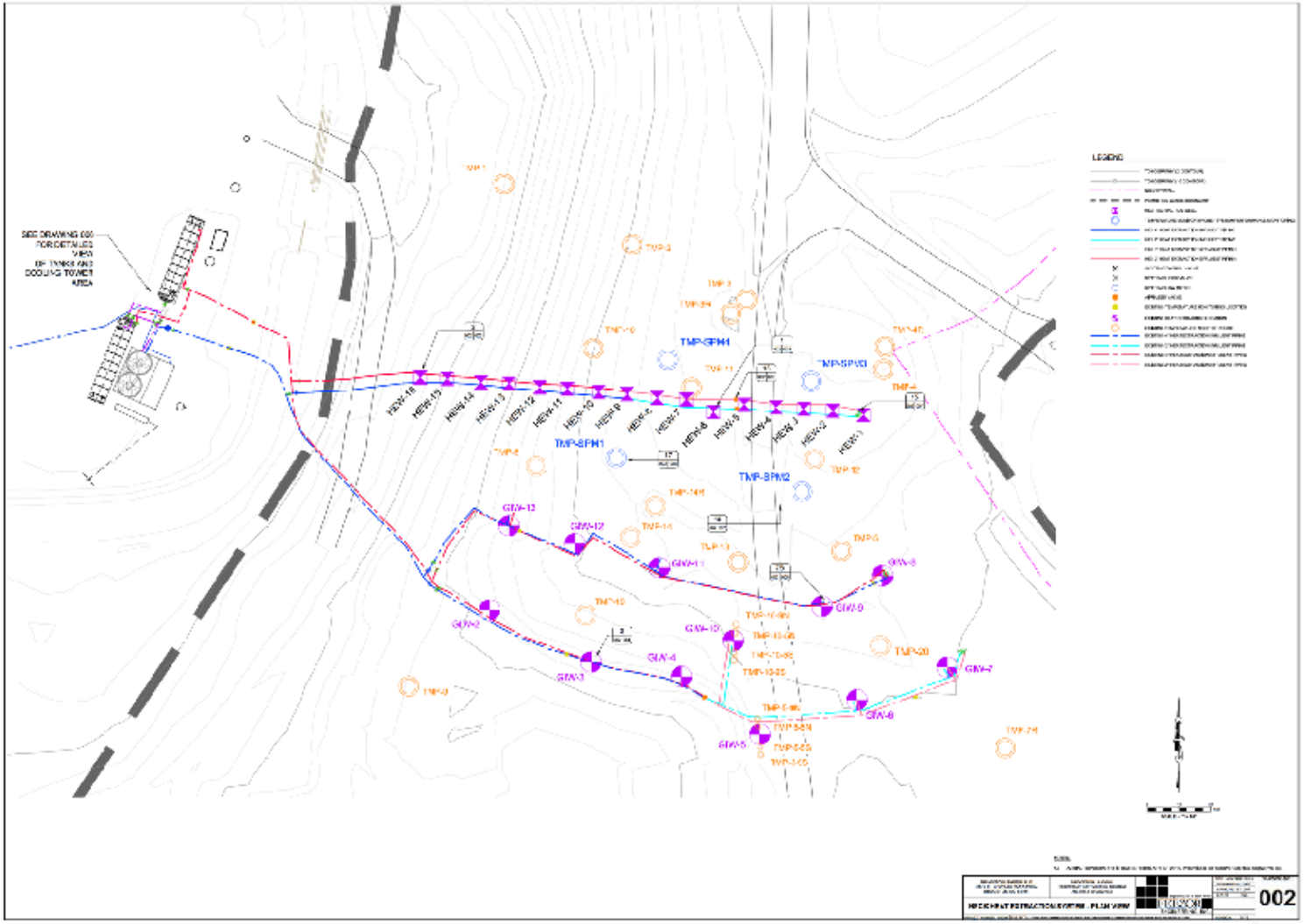


Figure 2 - Heat Extraction Barrier System Arrangement Bridgeton Landfill (Ref 4)

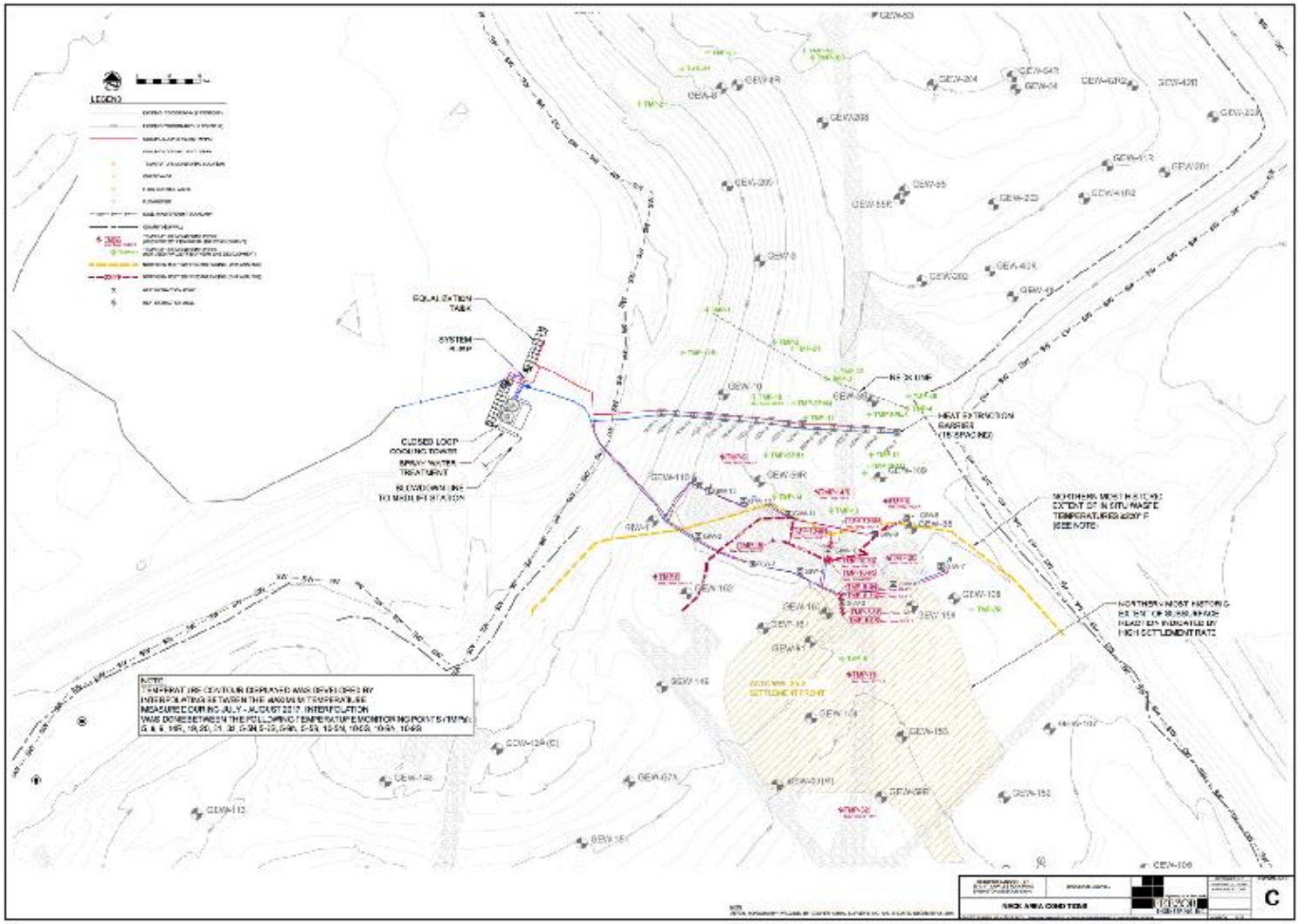


Figure 3 – Subsurface Smoldering Event Front at Bridgeton landfill July August 2017 (Ref 4)

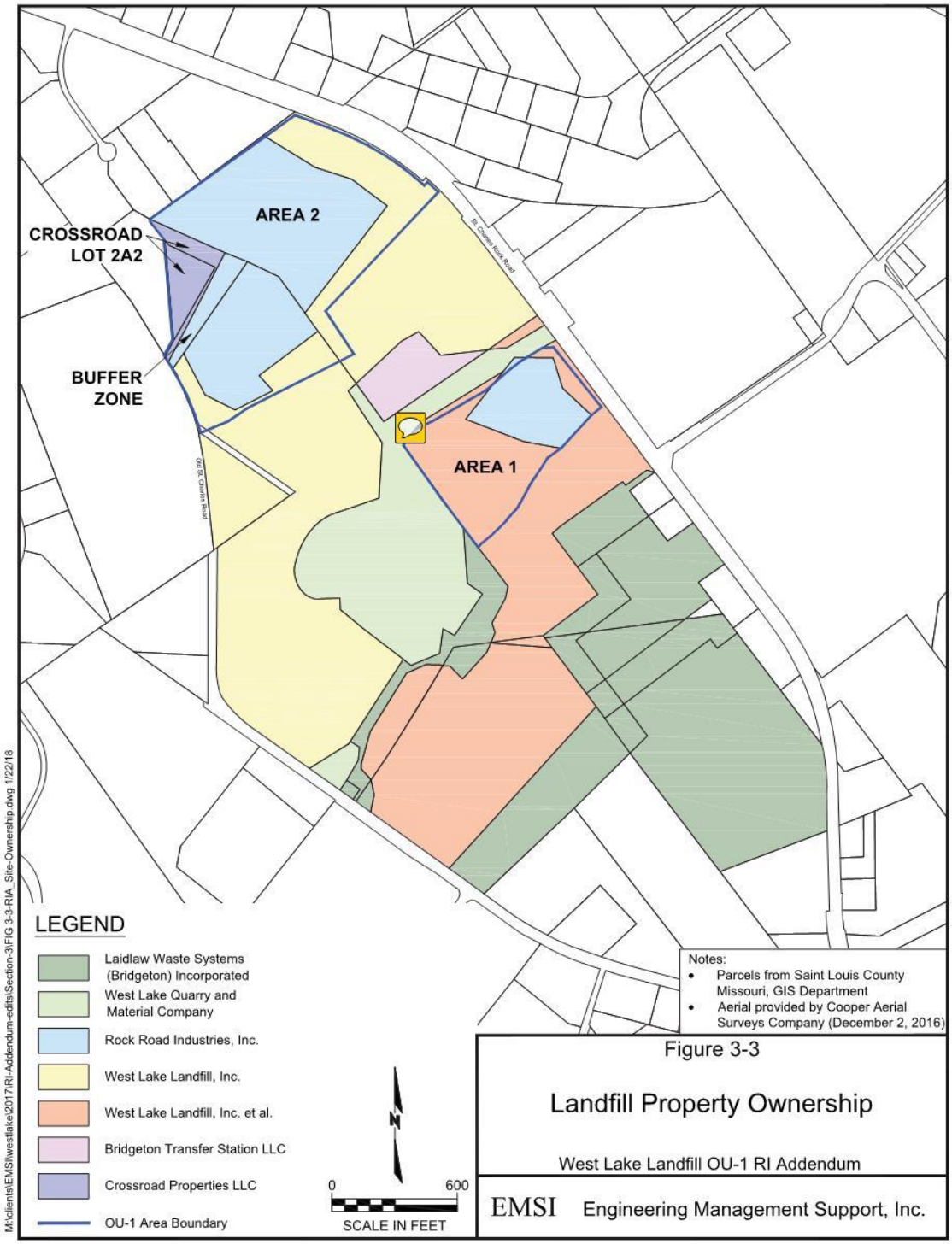


Figure 4 – Landfill Property Ownership (Ref 9)

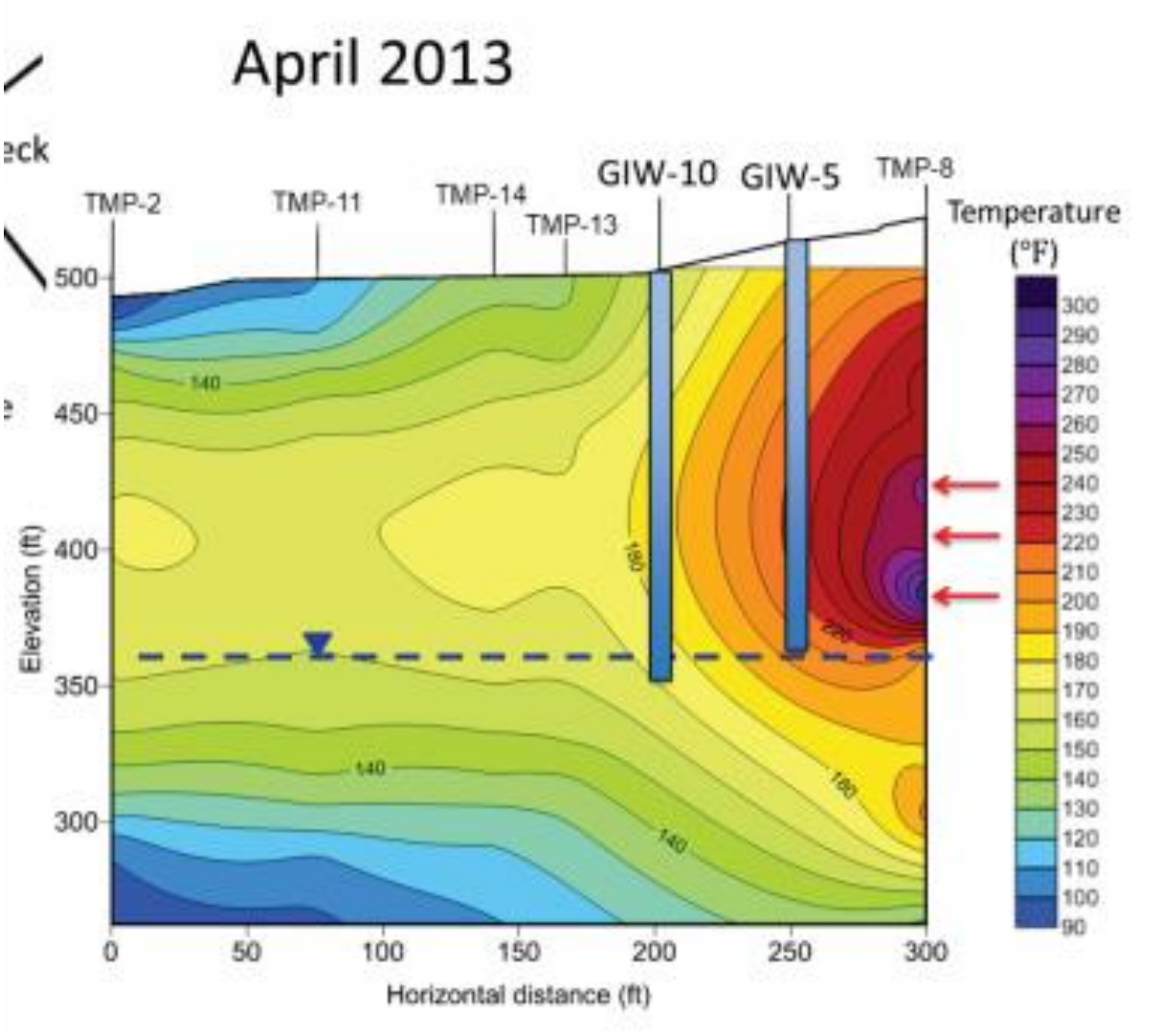
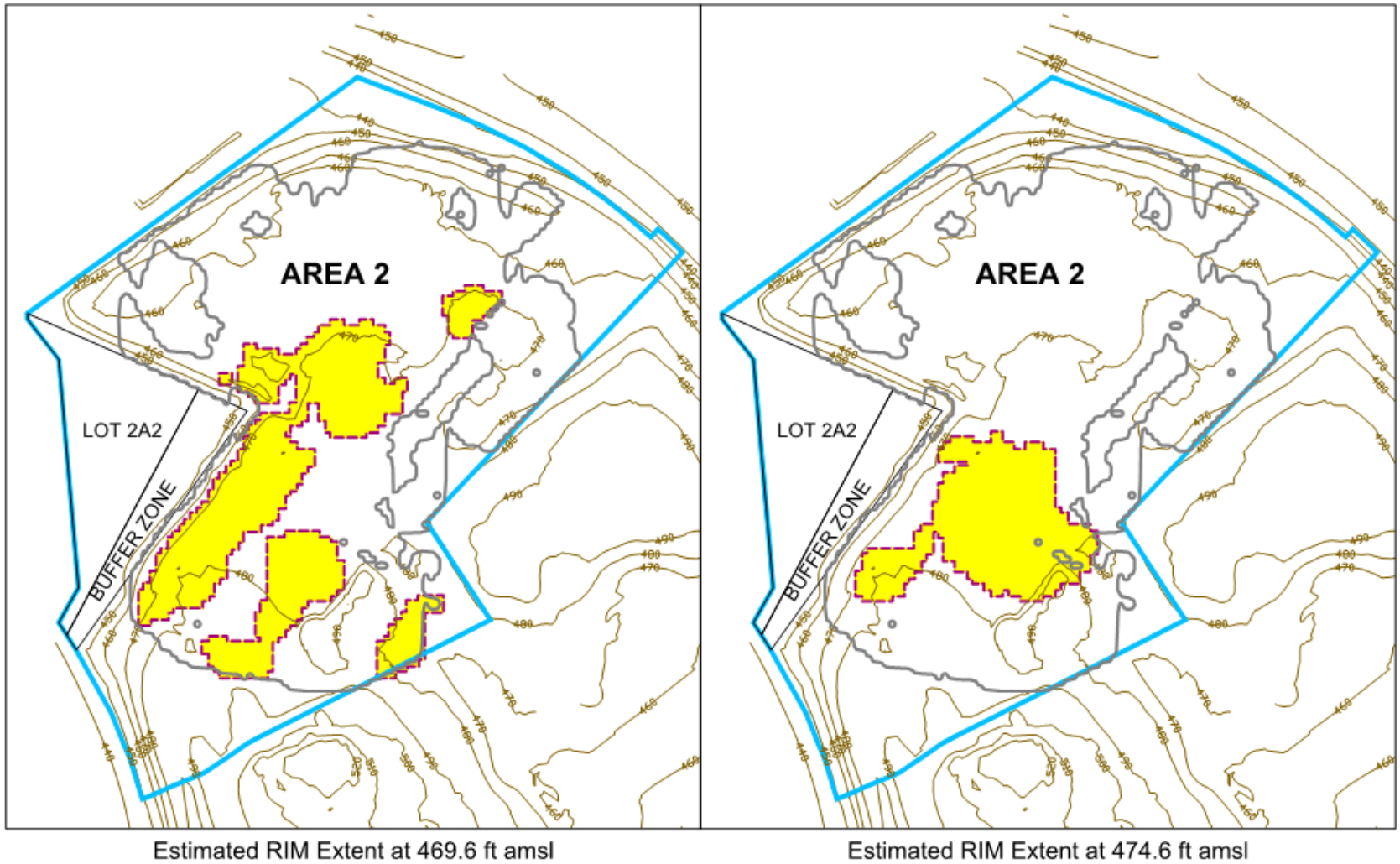


Figure 5 - Vertical Temperature Profile through Subsurface Smoldering Event in South Quarry (Ref 7)



Note: Contour lies are current ground topography lines. Extent of RIM shown is closest extent to ground surface.

Figure 6 - Depth to RIM Material OU-1 Area 2 – West lake Landfill (Ref 2)

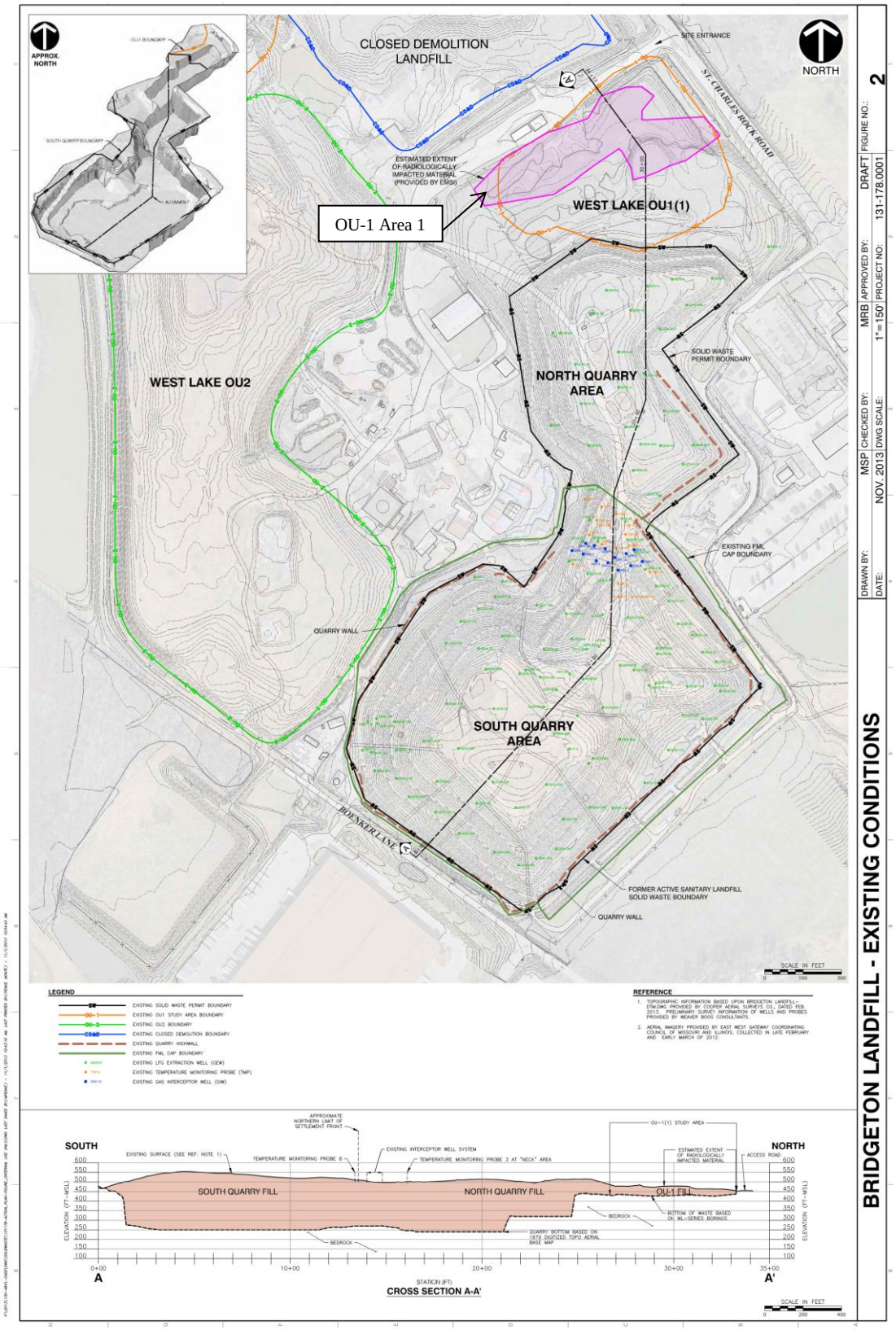


Figure 7 - Cross-section OU-1 (Area 1) and OU-2 (Ref 2)

Figure 8 - Surface Cracks from Subsidence Settlement at Bridgeton Landfill, OU-2 (Ref 7)